

ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 1

SCOPING PROCESS/COMMENTS

GRAND JUNCTION REGIONAL AIRPORT EA

AGENCY SCOPING NOTICES

Bureau of Land Management & Grand Junction Regional Airport Authority
to Host Agency Scoping Meeting for Proposed Land Transfer and Runway Project

The Bureau of Land Management (BLM) Grand Junction Field Office (GJFO), and the Grand Junction Regional Airport Authority (Airport) will host an agency scoping meeting on Tuesday, April 5, 2011, beginning at 2:00 p.m. at the Marriott Courtyard Hotel in Grand Junction. This meeting will solicit agency comments and concerns on a proposed transfer of public land from BLM to the Airport Authority and the relocation of Runway 11/29. (A public scoping meeting will be held the same day beginning at 6:00 p.m.).

Agency comments will assist with the required Environmental Assessment (EA) of the proposed actions in accordance with the National Environmental Policy Act (NEPA). The meeting will begin with a short presentation by the consultant team and will then be opened for questions and discussion following the presentation. The proposed project involves the following separate actions by the BLM and the Airport. The enclosed Notice of Intent and Notice of Realty Action provides additional information on the project.

BLM: The BLM is considering a request from the Airport to transfer title to 720 acres of public land for an airport improvement project described in the Airport actions below. The requested lands are located north and adjacent to airport property (see the enclosed maps). An EA is being prepared to assess the environmental effects of the proposed land transfer, as well as an amendment to the BLM GJFO 1987 Resource Management Plan (RMP) to identify the requested lands as suitable for disposal to the Airport.

Airport: The Airport Authority has requested the proposed land transfer as part of a plan to correct deficiencies in runway and taxiway gradients associated with the primary runway, Runway 11/29, and to eliminate intersecting runways to improve safety. The proposed land transfer would allow a new replacement primary runway to be built 650 feet north of the existing runway, making it possible for the Airport to stay open during construction. The project would also include the relocation of a portion of 27¼ Road, conversion of the existing Runway 11/29 to a taxiway, construction of various detention ponds, water quality ponds and culverts, installation/relocation of navigational aids, visual aids, and runway lighting, installation/relocation of taxiway lighting, construction of airport perimeter fencing, removal of existing sections of pavement no longer required and the relocation of the aircraft maintenance run-up area. See the enclosed Proposed Actions Map for details.

The BLM and the Airport will accept comments on the proposed actions through May 20, 2011. Agencies are also asked to comment on other values of the land considered for transfer including resource uses, management options and alternatives. Primary public use now includes a variety of recreational activities, one non-producing gas well and a power line right of way. The draft planning criteria is also available at the GJFO. *Comments can be sent to Robin Lacy, BLM GJFO, 2815 H Road, Grand Junction, CO 81506, or via email to Robin_Lacy@blm.gov.* Please note "Airport Land Transfer" in the subject line of emails. Please identify the specific action to which your comments pertain, i.e., BLM or Airport. *For more information contact BLM Visitors Information Services at 970 244-3000.*

GRAND JUNCTION REGIONAL AIRPORT

Notice of Intent to Amend the BLM Grand Junction Resource Management Plan, Prepare an Environmental Assessment, and Notice of Realty Action

SUMMARY: The Grand Junction, Colorado, Regional Airport Authority has requested the Bureau of Land Management (BLM) Grand Junction Field Office (GJFO) to consider the transfer of title to approximately 720 acres of public land for airport improvements, including relocation and construction of the main runway for the Grand Junction Regional Airport. Public Land Order No. 7027 (59 FR 3000 January 20, 1994) withdrew these lands from mining claim location in anticipation of a need for future airport expansion. The BLM consideration of the Airport's request initiates a BLM Notice of Intent (NOI) to initiate a public scoping process to amend the BLM GJFO 1987 Resource Management Plan (RMP) and prepare an Environmental Assessment (EA). The request also initiates a Notice of Realty Action (NORA), to assist the BLM in determining whether granting the requested title conveyance is consistent with the needs of the Department of the Interior, in accordance with 43 CFR 2641.2(a). An NOI/NORA for this project was published in the Federal Register on January 13, 2011. This notice initiates the public scoping process and concurrent opportunity for submission of public comments for the EA, RMP amendment and NORA.

DATES: Comments on this project, the NORA, or the proposed transfer of title to the Airport Authority may be submitted in writing until May 20th, 2011. A public scoping meeting will be held on Tuesday, April 5th, 2011, at 6:00 p.m. at the Marriott Courtyard Hotel in Grand Junction. The meeting will utilize an open house format with representatives from the BLM, the FAA, the Airport and the consulting team available to answer questions.

ADDRESSES: Written comments can be sent to Robin Lacy, BLM Grand Junction Field Office, 2815 H Road, Grand Junction, CO 81506, or via email to rlacy@blm.gov. Please note Airport Land Transfer in the subject line of the email. Comments, including names and addresses of respondents, will be available for public review at the BLM GJFO, during regular business hours 7:30 a.m. through 4:30 p.m. Monday-Friday except holidays. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

FOR FURTHER INFORMATION CONTACT: For further information and/or to have your name added to our mailing list contact Robin Lacy at (970) 244-3028. Project documents may be reviewed on the BLM GJFO Web site at *http://www.blm.gov/co/st/en/fo/gjfo*.

SUPPLEMENTARY INFORMATION: The purpose of the public scoping process is to identify those issues that should be considered in the EA and to initiate public participation in the planning process. BLM and Airport Authority personnel will be present at scoping meetings to explain the proposed action and other requirements for preparing the EA. Interested parties can request notification of any encumbrances or other claims relating to the land. Customary Federal Aviation Administration (FAA) conditions, in draft, that would be proposed to be included in a land patent from the United States to the Airport Authority will also be available for review. The public lands requested for title transfer are within the jurisdiction of the BLM GJFO adjacent to the Grand Junction Regional Airport in the North Desert and are described as follows:

Ute Principal Meridian
T. 1 N., R. 1 W.,
sec. 23, S½NE¼;
sec. 24, S½NE¼, N½SE¼ and SE¼SE¼;
T. 1 N., R. 1 E.,
sec. 19, lots 3 and 4, and E½SW¼;
sec. 29, SW¼NW¼;
sec. 30, lot 1, NE¼, and NE¼NW¼.

The areas described contain approximately 720 acres in Mesa County.
These are public lands administered by the BLM GJFO and do not include any private, State, tribal trust or Federal lands not administered by the BLM.

The EA will fulfill the needs and obligations set forth by the National Environmental Policy Act (NEPA) and associated Council of Environmental Quality Regulations (40 CFR Part 1500). The EA will also fulfill requirements of the Federal Land Policy and Management Act of 1976 (FLPMA: 43 U.S.C. 1701), Section 516 of the Airport and Airway Improvement Act of 1982 (49 U.S.C. 2215), airport grant regulations at 43 CFR Part 2640, applicable planning regulations at 43 CFR 1600, and BLM management policies.

The purpose of the proposed land title transfer from the United States to the Airport Authority is to fulfill the BLM's intent to make such lands available to the Airport Authority for a beneficial public use as described in the 1991 Memorandum of Understanding between the BLM and the Airport Authority. As authorized through the FLPMA, these lands will also be considered for title transfer to the Airport Authority in an amendment to the Grand Junction RMP. The BLM will determine whether or not to transfer title to the lands based on the EA, and the assessed environmental impacts of transferring title to the lands.

The purpose of the runway relocation is to comply with the FAA design standards by correcting deficiencies related to runway and taxiway gradients, and to eliminate intersecting runways at the airport. The need for the proposed runway relocation is to increase safety at the Grand Junction Regional Airport, which is one of the few commercial service airports in the State of Colorado that still has a geometric runway layout consisting of an intersecting crosswind runway. The runway intersection increases the potential for runway incursions, which are defined by the FAA as "any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft." Increasing runway safety has been made a high priority in recent years and the FAA has published guidance on improving runway safety through airfield configuration. Also, several design components of the runway at Grand Junction Regional Airport do not meet the FAA design standards, including the following:

-Runway 11/29 Transverse Gradient. Portions of the runway exceed the maximum recommended design standard of 1.5 percent.
-Runway 11/29 Longitudinal Gradient. A portion of the runway near the approach end of Runway 29 exceeds the maximum recommended design standard of 0.8 percent.
-Runway 11/29 Connecting Taxiway Gradient. A number of the connecting taxiways between Runway 11/29 and parallel Taxiway "A" exceed the maximum recommended design standard of 1.5 percent.
-Runway 11/29 and Runway 4/22 Runway Visibility Zone (RVZ). Numerous structures obstruct line of sight between runway mid-points.

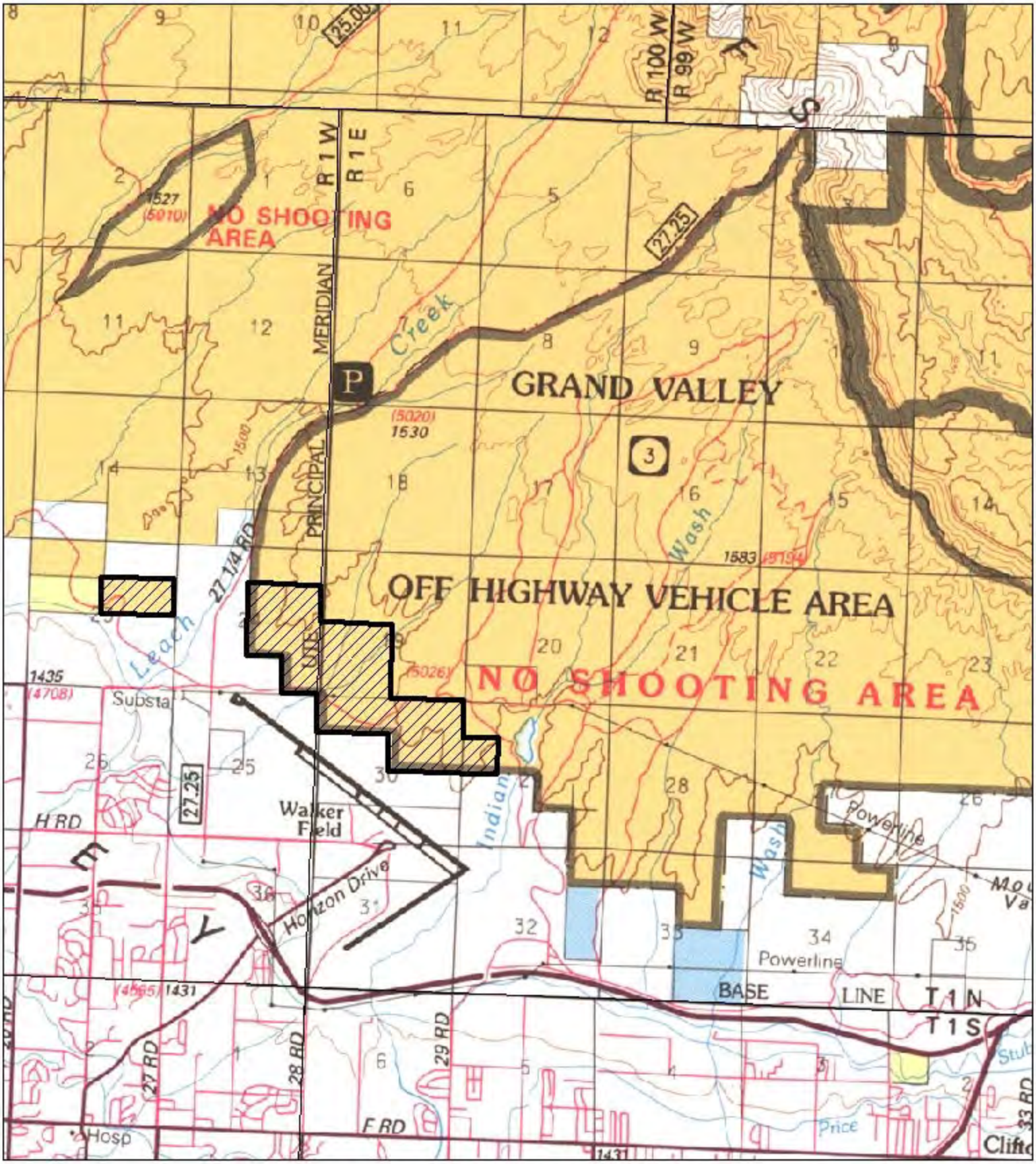
The BLM seeks resource information and data for other public land values [i.e., air quality, cultural and historic resources, fire and fuels, fisheries, forestry, lands and realty, non-energy minerals and geology, oil and gas (including coalbed methane), paleontology, rangeland management, recreation, soil, water, and

wildlife] in the BLM GJFO planning area. The purpose of this request is to assure that the planning effort has sufficient information and data to consider a reasonable range of resource uses, management options, and alternatives, for the public lands involved. BLM draft planning criteria is also available for review at the Grand Junction Field Office.

Proprietary data marked as confidential may be submitted in response to this call for coal, oil and gas, and other resource information. Please submit all proprietary information submissions to the address listed above. The BLM will treat submissions marked as "Confidential" in accordance with the laws and regulations governing the confidentiality of such information.

The BLM GJFO will work collaboratively with interested parties to identify the management actions and decisions that are best suited to local, regional, and national needs. Potential issues that have been identified to date include, but are not limited to the following general categories: wildlife (including birds); vegetation (including weeds and invasive plant species); threatened, endangered, and sensitive species; public access; visual concerns; cultural resources; tribal concerns; rangeland resources; geology and soils; hydrology; recreation resources; hazardous materials; air quality; noise; and socio-economics. The BLM has established a 45-day scoping period during which affected tribes, landowners, concerned citizens, special interest groups, local governments, and any other interested parties are invited to comment on the scope of the EA. Scoping will help the BLM identify the full range of issues that should be addressed in the EA.

AUTHORITY: Airport and Airway Improvement Act of September 3, 1982 (49 U.S.C. 4761, 49 U.S.C. 47101 *et seq.*), 43 CFR 2640.



Proposed Transfer of Public Lands to the Grand Junction Regional Airport Authority

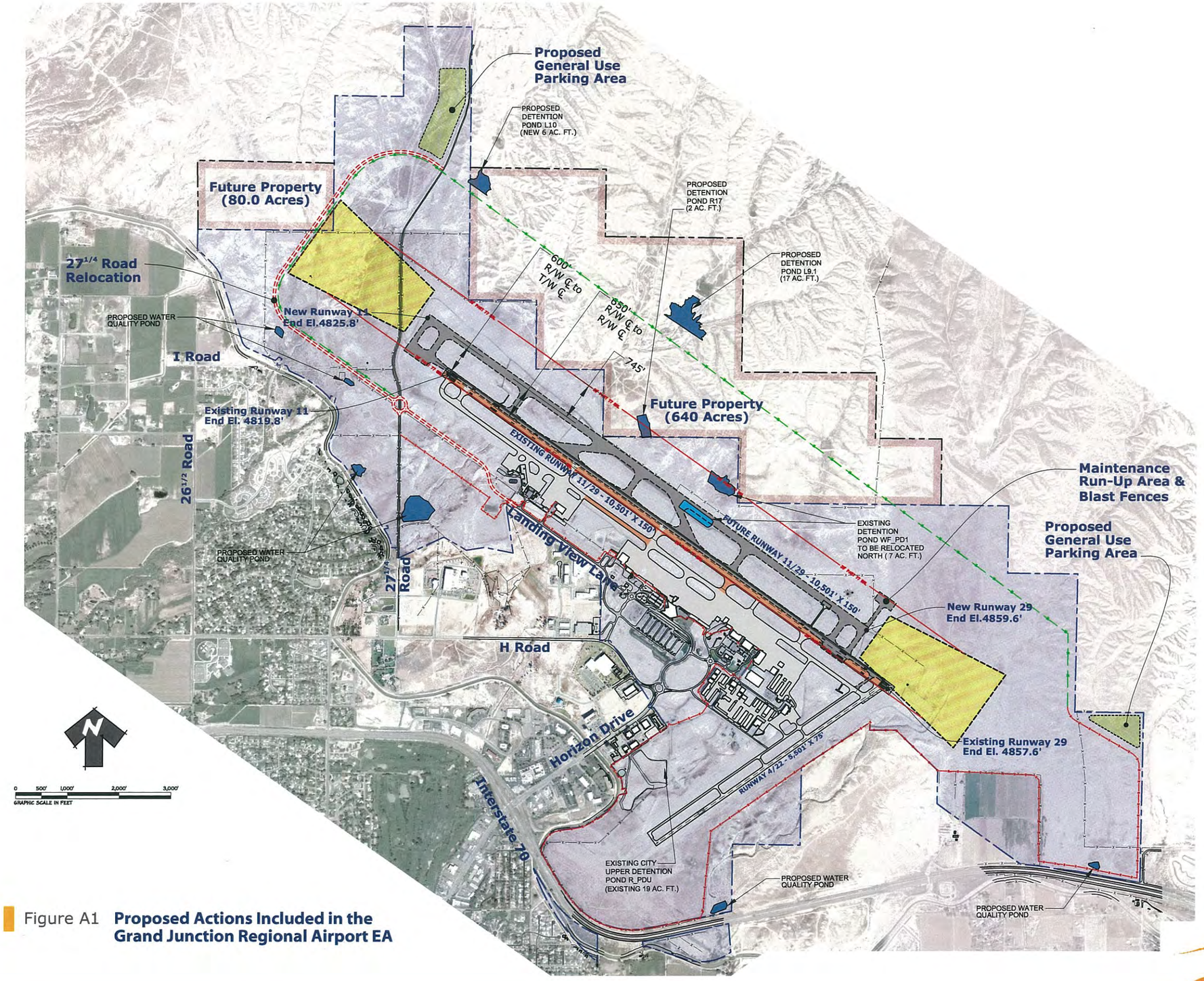
N

Proposed Transfer

BLM

Private

State



Legend

- Existing Airport Property
- Proposed Land Transfer from BLM
- Future Runway Protection Zone
- Proposed Road
- Existing Building on Airport Property
- Proposed Airfield Pavement
- Pavement to be Removed
- Existing Fencing
- Proposed Fencing

Figure A1 **Proposed Actions Included in the Grand Junction Regional Airport EA**

COPY OF SCOPING NOTICES EMAILED AND MAILED

First Name	Last Name	Other Name	Organization Name	Address	City	State	Postal Code	Email Address
Agency								
			City of Grand Junction	250 North 5th Street	Grand Junction	CO	81501	lauriek@gjcity.org
Dean	Riggs		Colorado Division of Wildlife	711 Independent Avenue	Grand Junction	CO	81505	dean.riggs@state.co.us
			Grand Junction NRCS Area Office	2738 Crossroads Blvd.	Grand Junction	CO	81506-3933	info@mrpbike.com
			Grand Mesa, Uncompahgre & Gunnison National Forest	2250 Highway 50	Delta	CO	81416	lmauch@fs.fed.us
John	Ballagh		Grand Valley Drainage District	PO Box 969	Grand Junction	CO	81502	gjddmgr@gvii.net
			Grand Valley Ranger District	2777 Crossroads Blvd, Unit 1	Grand Junction	CO	81506	cclementson@fs.fed.us
			Honorable Diana DeGette	600 Grant Street, Suite 202	Denver	CO	80203	
Joe	McBurney		Honorable John Salazar	225 N. 5th St., Ste 702	Grand Junction	CO	81501	joe.mcburney@mail.house.gov
			Honorable Laura Bradford	200 E. Colfax Ave.	Denver	CO	80203	laurabradford@gmail.com
			Honorable Steve King	200 E. Colfax Ave	Denver	CO	80203	steve.king.house@state.co.us
Richard Jr.	Jenks		Northern Ute Tribe	PO Box 190	Fort Duchesne	UT	84026	alannaj@utetribe.com
			Senator Josh Penry	200 E. Colfax Ave	Denver	CO	80203	joshpenry@gmail.com
Gaspar	Perricone		Senator Mark Udall	400 Rood Avenue, Suite 215	Grand Junction	CO	81501	gaspar_perricone@markudall.senate.gov
Trudy	Kareus		Senator Michael Bennet	225 N. 5th St., Ste 215	Grand Junction	CO	81501	trudy_kareus@bennet.senate.gov
			Southern Ute Indian Tribe	P.O. Box 737	Ignacio	CO	81137	sweb@southern-ute.nsn.us
Eric	Mende		5-2-1 Drainage Authority	PO Box 3389	Grand Junction	CO	81502	eric.mende@mesacounty.us
			Tribal Business Council	P.O. Box 190	Fort Duchesne	UT	84026	
			Tribal Historic Preservation Officer, Ute Mountain Ute Tribe	PO Box 468	Towoac	CO	81334	
		Colorado Service Office	US Army Corps of Engineers	1600 Broadway, Suite 1070	Denver	CO	80202	
Sue	Nall		US Army Corps of Engineers	400 Rood Avenue	Grand Junction	CO	81501	
Al	Pfister		US Fish and Wildlife Service	764 Horizon Drive, Bldg. B	Grand Junction	CO	81506-3946	
		Rocky Mountain Region	USDA Forest Service	740 Simms Street	Golden	CO	80401	
Gary	Hayes	Chairman	Ute Mountain Ute Tribe	PO Box 189	Towaoc	CO	81334	
			Ute Water Conservancy District	PO Box 460	Grand Junction	CO	81502	
Sonja	Chaves DeBaca		Selenium Task Force	114 Sandpiper Trail	Gunnison	CO	81230	
		Colorado State Office	Bureau of Land Management	2850 Youngfield Street	Lakewood	CO	80215-7076	
		Western CO Area Office	Bureau of Reclamation	2764 Compass Drive	Grand Junction	CO	81506-8744	
JT	Romatzki		Colorado Division of Wildlife	711 Independent Avenue	Grand Junction	CO	81505	
Keith	Fife		Mesa County Long Range Planning	PO Box 20000	Grand Junction	CO	81502	
			Mesa County Board of Commissioners	PO Box 20000	Grand Junction	CO	81502	
			NAGPRA Representative, Ute Tribe of the Uintah & Ouray Reservation	PO Box 190	Ft. Duchesne	UT	84026	
			NAGPRA Representative, Southern Ute Indian Tribe	PO Box 737	Ignacio	CO	81137	
Alan	Morganfield		Xcel Energy	1123 West 3rd Avenue	Denver	CO	80223-1351	

GRAND JUNCTION REGIONAL AIRPORT EA

AGENCY SCOPING RESPONSES

UTM 4/25/11

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
764 Horizon Drive, Building B
Grand Junction, Colorado 81506-3946

IN REPLY REFER TO:
ES/CO: BLM/GJFO/GJRegionalAirport
TAILS 65413-2011-CPA-0009

RECEIVED
BUREAU OF LAND MGMT.
GRAND JCT., CO
2011 APR 20 PM 5:01

April 21, 2011

Memorandum

To: Field Manager, Bureau of Land Management, Grand Junction Field Office, Grand Junction, Colorado

From: Western Colorado Supervisor, Fish and Wildlife Service, Ecological Services, Grand Junction, Colorado Allan R. Pfister

Subject: Comments on Proposed Land Transfer to Grand Junction Regional Airport Authority

The U.S. Fish and Wildlife Service (Service) received your March 21, 2011, request for comments regarding the proposed project near Grand Junction, Colorado. The proposed action includes transferring title to 720 acres of land administered by the Bureau of Land Management (BLM), Grand Junction Field Office (GJFO), to the Grand Junction Regional Airport Authority (Airport) for an airport improvement project. BLM is preparing an Environmental Assessment (EA) to assess the environmental effects of the proposed land transfer, as well as an amendment to the BLM GJFO Resource Management Plan to identify the requested lands as suitable for disposal to the Airport.

The Airport has requested the proposed land transfer as part of a plan to correct deficiencies in runway and taxiway gradients associated with the primary runway and to eliminate intersecting runways to improve safety. The proposed land transfer would allow a new replacement primary runway to be built 650 feet north of the existing runway, making it possible for the Airport to stay open during construction. Other project activities include relocation of portions of roads; construction of detention ponds, water quality ponds and culverts; installation/relocation of navigational aids, visual aids, and runway lighting; installation/relocation of taxiway lighting; construction of airport perimeter fencing; removal of existing sections of pavement no longer required; and relocation of the aircraft maintenance run-up area.

The Service's primary concern with any project is avoidance of impacts to threatened, endangered and candidate species, as well as species-at-risk and their habitats within the project area. To assist with planning, we provide the following list of federally listed threatened, endangered, and proposed species, and potential candidates for future listing that could be impacted by the proposed project.

Common Name	Scientific Name	Status
Yellow-billed cuckoo	*Coccyzus americanus*	C
Canada lynx	*Lynx canadensis*	T
Humpback chub*	*Gila cypha*	E
Colorado pikeminnow*	*Ptychocheilus lucius*	E
Bonytail chub*	*Gila elegans*	E
Razorback sucker*	*Xyrauchen texanus*	E
Greenback cutthroat trout #	*Oncorhynchus clarki stomias*	T
Colorado hookless cactus	*Sclerocactus glaucus*	T
DeBeque phacelia	*Phacelia submuitica*	P

T = federally listed threatened, E = federally listed endangered, C = federal candidate species, P = federally proposed as threatened

* Water depletions in the Upper Colorado River Basin may affect the species and/ or critical habitat in downstream reaches in other states.
# Recent genetic tests identified cutthroat population as GB lineage; therefore, consultation is an interim measure until genetic and taxonomic issues are resolved.

We compiled the list above from an inventory for Mesa County, Colorado, and therefore it may be that some or all of the species do not presently occupy or use the proposed project area, and/or that habitats for these species do not exist within the project area. We included the four federally-listed fishes on the list in the event that project actions cause water depletions to the Upper Colorado River Basin, or affect listed species and/or off-site habitat, including critical habitat, in downstream reaches.

Based on our records, cacti identified as *Sclerocactus parviflorus* (Devil's claw cactus) occur in the vicinity of the project area. Comparative deoxyribonucleic acid (DNA) sequences (Porter et al. 2000) infer common ancestry between *S. parviflorus* and *Sclerocactus glaucus* (Colorado hookless cactus) (*S. glaucus*), and introgression may occur between the two species. Consequently, there are uncertainties regarding the taxonomic distinction between these species, based on current morphological and genetic data. This issue is currently being researched by the Denver Botanic Gardens, and study results are forthcoming (DBG 2009). Also, the Service intends to collect *S. glaucus* samples from the project vicinity for further genetic testing. Please be aware that, depending on this and future research related to *Sclerocactus*, proposed and ongoing Federal activities may be subject to further review under the Endangered Species Act, possibly including reinitiation of Section 7 consultation. As with any proposal involving disposal or exchange of public lands which support threatened or endangered species, or their habitats, or other trust resources, the Service strongly recommends retaining lands in Federal ownership, or otherwise ensuring protection of those species through other means if lands cannot be retained.

Migratory birds, raptors and eagles: Please be apprised of the potential application of the Migratory Bird Treaty Act (MBTA) of 1918, as amended, 16 U.S.C. 703 et seq., and the Bald Eagle Protection Act (BEPA) of 1940, as amended, 16 U.S.C. 688 et seq., to your project. The MBTA does not require intent to be proven and does not allow for "take," except as permitted by regulations. Section 703 of the MBTA provides: "Unless and except as permitted by regulations

. . . it shall be unlawful at any time, by any means or in any manner, to... take, capture, kill, attempt to take, capture, or kill, possess . . . any migratory bird, any part, nest, or eggs of any such bird ... "

The BEPA prohibits knowingly taking, or taking with wanton disregard for the consequences of an activity, any bald or golden eagles or their body parts, nests, or eggs, which includes collection, molestation, disturbance, or killing activities.

One or more candidate species potentially occur within the project area. Federal candidates for official listing as threatened or endangered have no legal protection under the Endangered Species Act of 1973, as amended. However, it is within the spirit of the Act to consider project impacts to these species.

Based on the information provided, we would like to point out that it appears that Section 7 consultation may be appropriate in this case. The BLM must evaluate the effects of the action, including the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). In this case it would be the responsibility of the Bureau of Land Management, Grand Junction Field Office, to complete consultation with the Service on effects to listed species prior to granting the land transfer, if listed species or their habitat may be affected in or near the project area.

The Service looks forward to commenting further on this project. If the Service can be of further assistance, please contact Charlie Sharp (970) 243-2778, extension 18, or charles_sharp@fws.gov.

LITERATURE CITED

DBG. 2009. Proposal for funding submitted by the Denver Botanic Gardens and the University of Northern Colorado, "A genetic investigation of *Sclerocactus glaucus* (Colorado hookless cactus): Genetic diversity and taxonomic relations in western Colorado. Denver, Colorado. 8 pp.

Porter JM, MS Kinnery, and KD Heil. 2000. Relationships between *Sclerocactus* and *Toumeya* (Cactaceae) based on chloroplast trnL-trnF sequences. Haseltonia 7:8-23.

Forwarded by Ivan Capps/GJFO/CO/BLM/DOI on 02/28/2011 05:09 PM
> -----
> From> Julie_Sharp@nps.gov
>
> To> 02/25/2011 01:57 GJFO_mail@blm.gov
> cc> WASO_EQD_ExtRev@nps.gov,
> robert_f_stewart@ios.doi.gov
>
> Subject: EC-11/0008 -- Grand Junction RMP-- NO COMMENTS
>
>
> The National Park Service has reviewed the Notice of Intent to prepare
> an environmental assessment for the Grand Junction Resource Management
> Plan, and determined that no parks will be affected; therefore we have
> no comments.
>
> Thank you!
> Julie
>
> ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
> Julie Sharp
> Environmental Protection Assistant
> National Park Service - Intermountain Regional Office Denver, CO ph
> 303.987.6705
>
>
>

STATE OF COLORADO

John W. Hickenlooper, Governor
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE
AN EQUAL OPPORTUNITY EMPLOYER

Thomas E. Remington, Director
6060 Broadway
Denver, Colorado 80216
Telephone: (303) 297-1192
wildlife.state.co.us

RECEIVED
BUREAU OF LAND MGMT.
GRAND JCT., CO
2011 APR 23 PM 5: 52

For Wildlife-
For People

April 25, 2011

Bureau of Land Management
Attn: Robin Lacy
2815 H Road
Grand Junction, Co. 81506

Re: Bureau of Land Management & Grand Junction Regional Airport Authority Land Transfer and Runway Project.

Dear Ms. Lacy:

The Colorado Division of Wildlife (CDOW) received your March 24, 2011 request for Environmental Assessment comments regarding the proposed Bureau of Land Management and Grand Junction Regional Airport Authority Land Transfer and Runway Project. The proposed land transfer is approximately 720 acres located in Mesa County, Colorado, specifically within all or parts of T1N, R1W, S23 and S24; and all or parts of T1N, R1E, S19, S29, and S30 in Ute Principal Meridian.

The CDOW appreciates the opportunity to provide wildlife and habitat comments for this project. We have reviewed the information provided in the public notice and offer the following comments.

The proposed land transfer is located in the Colorado Division of Wildlife's Game Management Unit 30 which is overseen by District Wildlife Manager Albert Romero. Habitat on the land proposed for transfer is representative of the east-central edge of the Colorado Plateau in the upper sonorant life zone – a hot dry climate with uniquely adapted vegetation and allied wildlife. The species that CDOW identify in this correspondence are not common and occur within specific micro-habitats that are relatively limited.

The main species inhabiting the area is the white-tailed prairie dog, *Cynomys leucurus*. White-tailed prairie dogs are a state listed species of concern and have a S4 state ranking from the Colorado Natural Heritage Program. Several prairie dog colonies are located on the 720 acre property and several more colonies are in close proximity. The proposed site, the immediate area, and the extended area surrounding the proposed project make-up landscape scale habitat that is part of and supports a relatively intact prairie dog town and individual population area (prairie dog ecosystem) as identified in the CDOW *Grand Valley and Uncompahgre Valley Population Area Action Plan*, November 2009.

CDOW has located and mapped one western burrowing owl, *Athene cunicularia*, pair on the proposed transfer land; numerous others have been mapped in close proximity. Western burrowing owls are a state listed threatened species and have a G4, S4B ranking from the Colorado Natural Heritage Program. The specific location is not on the land proposed for transfer but close to it, and may, over time, be impacted by indirect impacts such as increased human activity and increased vehicle and construction traffic.

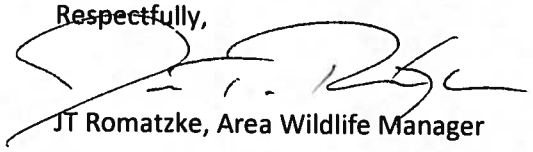
DEPARTMENT OF NATURAL RESOURCES, Mike King, Executive Director
WILDLIFE COMMISSION, Tim Glenn, Chair • Robert Streeter, Vice Chair • Mark Smith, Secretary
Members, David R. Brougham • Dorothea Farris • Allan Jones • Gaspar Perricone • John Singletary • Dean Wingfield
Ex Officio Members, Mike King and John Salazar

The CDOW recommends that Mesa County 27 ¼ Road remain permanently open to serve as access to the BLM lands at the base of the Bookcliffs in this area. It is also important to CDOW that the expansion of the runways and associated airport expansion have no adverse impact to the shooting range and its long term continuation. The shooting range is an important asset to the Grand Junction community; it is a significant point that the range remains open and active.

The CDOW appreciates the opportunity to comment on this project. The mission of the CDOW is to protect, preserve, enhance, and manage wildlife and their environment for the use, benefit and enjoyment of the people of Colorado and its visitors. One of the ways we achieve this mission is to comment on land use proposals such as the request we received from you.

Please do not hesitate to contact me at 970-255-6178 if you have any questions or would like clarification on any of our concerns.

Respectfully,



JT Romatzke, Area Wildlife Manager

cc. Dean Riggs, NW Assistant Regional Manager
Dan Neubaum, Terrestrial Conservation Biologist
Stephanie Duckett, Terrestrial Biologist
Albert Romero, District Wildlife Manager
file.

MESA COUNTY

DEPARTMENT OF PUBLIC WORKS
Administration - Building - Engineering - Transportation
Planning - Solid Waste Management - Traffic

750 Main Street • P.O. Box 20,000 • Grand Junction, Colorado 81502-5022
Ph (970) 244-1765 Fax (970) 255-7171

19 May 2011

Ms. Robin Lacy
Bureau of Land Management, Grand Junction Field Office
2815 H Road
Grand Junction, CO 81506

RE: Airport Transfer Scoping Comments

Dear Ms. Lacy:

Thank you for the opportunity to comment on issues that will be considered in an environmental assessment (EA) for the Proposed Land Transfer and Runway Project in Mesa County, Colorado for the Grand Junction Regional Airport Authority. We appreciate the cooperative relationship Mesa County has with BLM and our opportunity to coordinate with the BLM on NEPA projects. Additionally our Memorandum of Understanding (MOU) with the BLM (MOU # CO-076-97-001) provides a good framework for this relationship.

We understand the proposal generally as follows:
The proposed land transfer of approximately 720 acres to the Airport would allow replacement of runway 11/29, the primary runway, to be built 650 feet north of the existing runway - eliminating intersection runways. Other project activities include realigning portions of 27 ¼ Road; construction of detention ponds, water quality ponds and culverts; installation/relocation of navigational aids, visual aids, and runway lighting taxiway lighting; construction of airport perimeter fencing; removal of existing sections of pavement no longer required; and relocation of the aircraft maintenance run-up area.

We offer the following comments for consideration in the EA process:

Mesa County supports the intent of the proposed land transfer to allow the Grand Junction Regional Airport Authority to relocate runway 11/29 and correct deficiencies in the primary runway. We understand the vital role the airport serves in our local economy and a safer more efficient airport is in the greater interest of the community as a whole. In fact, the Grand Junction/Mesa County Comprehensive Plan identifies these lands and more as "Airport" for future expansion and operations.

Transportation Planning and Access
Transportation planning for the future is of utmost importance to the success of the Regional Airport. If planned and coordinated properly a new interchange on Interstate 70 near 29 Road should one day provide excellent access to the airport and areas to the east including Clifton. The City/County Comprehensive Plan identifies the area near the future interchange as Mixed Use Business Park with

extensive areas planned for Industrial, Commercial, and Commercial/Industrial eastward toward Clifton. The recently adopted Regional Comprehensive Transportation Plan for Mesa County includes a 29 Road Interchange and an enhanced Clifton Interchange connected by a future major east-west transportation corridor to service this planned industrial/commercial district.

Mesa County and the City of Grand Junction have tentative plans to pursue the 1601 environmental planning process for a 29 Road interchange in the year 2016 with potential construction in 2017 - 2018. Justification of this significant investment includes supporting the airport and its future. The Regional Comprehensive Transportation Plan's conceptual road corridor tunneling under the cross-wind, north-south runway to the terminal area appears to be cost prohibitive and potential disallowed by TSA and FAA regulations.

We suggest the airport reserve the ability to create a multi-modal transportation corridor north of and paralleling I-70 between the future 29 Road interchange and Horizon Court or the Horizon Drive/H Road roundabout for easy and efficient access to and from the airport and the future interchange. This corridor will require at least 100 feet of right-way in the area shown on the airport plan as an expanded Runway Protection Zone (RPZ) for the area immediately north of I-70. We are also concerned that the expanded (RPZ), as shown on the airport plans, encroaches Interstate 70 and may limit future expansion of I-70 to 6 lanes as our modeling indicates may be needed in the future.

Although the project is within the City of Grand Junction, we suggest the relocation of 27 ¼ Road include a sixty (60) feet wide right-of way to accommodate future road needs. We also concur with the Colorado Division of Wildlife's (CDOW) comments suggesting 27¼ Road remain open as recreational access to BLM lands and particularly the shooting range, a community asset as identified by CDOW.

Mesa County Road 29.65 was recently closed by the Airport Authority and rerouted to the east. Mesa County receives Highway Users Trust Funds for the maintenance of 29.65 Road which provides recreational access to BLM lands and is the maintenance route to the Indian Wash detention pond. We ask the Airport Authority to dedicate to Grand Junction or Mesa County a 60 feet wide right of-way for the relocated portion of the road across Airport Authority property. This route should also remain open to the public to access BLM lands.

Water Detention Ponds

The proposal includes construction of several detention ponds and water quality ponds. We suggest the EA and ultimate construction include consultation with the Colorado State Engineer's Office and the local 5-2-1 Drainage Authority for review of the design of these structures. It is also import to provide sufficient maintenance access for these structures, regardless of what entity will be responsible for maintenance.

The 29 Road and I-70B interchange location will not be known until after completion of the environmental assessment that is currently scheduled for 2016. However, the proposed airport detention basin in that vicinity is shown on the airport master plan in an area that has a high probability of becoming part of the interchange. In final planning for this detention basin please work with the Grand Junction City Engineer's office on locating the facility in an area that minimizes the need to reconstruct the basin in the near future.

Gas Well and Moulton Valley Unit Lease
The lands proposed for transfer to the Airport has an existing natural gas lease and one shut-in gas well held by Maralex Resources. The EA should address the status of this lease and the potential for further development of the resource in the area.

GV Power Line
The existing Grand Valley Power electrical transmission line on the subject lands needs to be considered in the EA and any potential impact on the Airport's expansion plans.

Other
We understand the Colorado Division of Wildlife and the U. S. Fish and Wildlife Service have provided comments on potential impacts to wildlife and plant habitat. We support their comments and encourage the BLM to analyze potential impacts and any mitigation measures found necessary in the EA.

The proposal is located within the Grand Valley airshed and will be required to meet all Colorado air quality requirements. The State Air Quality Control Commission should be included in the review and permitting of the project.

Applicable Goals and Policies from the *Mesa County Master Plan:*

Chapter 4
Conservation and Environment (CE)
CE Goal 1: To protect, conserve and efficiently manage the county's public lands.
Policies:

CE1.1 Coordinate land use planning with public land and resource management agencies.

CE Goal 2: To conserve sustainable ecosystems.
Policies:

CE2.1 New development shall conserve and protect native wildlife and vegetation habitat, water, open lands, vistas, minerals, etc. Development will not diminish these systems.

CE Goal 3: To preserve public access to public lands.
Policies:

CE3.1 Require the dedication of access easements across private property to public land for public access in coordination with the appropriate land or resource management agencies.

Open Lands and Trails (OLT)
OLT Goal 1: To protect important open lands within Mesa County.

OLT Goal 2: Protect important wildlife habitats.

OLT Goal 4: To identify and protect existing and future major trail linkages and intersections in the County.

Policies:

OLT4.1 Continue to communicate regularly with all public entities in Mesa County responsible for open space, parks, and trails through an established, formal system to plan, protect, acquire and manage lands under their jurisdictions.

Community Services/Facilities & Intergovernmental Coordination (CS)

CS Goal 1: To maximize the efficient use of public resources.

Policies:

CS1.2 Maintain a five to ten year capital facilities/improvements program which establishes priorities for constructing necessary facilities consistent with the Mesa County Master Plan.

CS1.3 New community facility locations should be reserved in accordance with planned areas of growth. Priorities for constructing these facilities will be established through a capital facilities/improvements plan before development is approved.

CS Goal 4: To maximize the capability of the County, its municipalities, and other government agencies to make collaborative land use decisions in areas of mutual concern and/or influence.

Policies:

CS4.2 Mesa County and its 5 municipalities will jointly prepare and adopt plans for the future development of the municipalities' respective areas of influence as defined in the Revised Colorado Statutes.

CS4.3 Mesa County will enter intergovernmental agreements and memoranda of understanding with municipal, federal and state agencies to address coordination of many efforts.

Chapter 5 - Grand Junction/Mesa County Comprehensive Plan

Goal 9: Develop a well-balanced transportation system that supports automobile, local transit, pedestrian, bicycle, air, and freight movement while protecting air, water and natural resources.

Policies:

A. The City and County will work with the Mesa County Regional Transportation Planning Office (RTPO) on maintaining and updating the Regional Transportation Plan, which includes planning for all modes of transportation.

C. The Regional Transportation Plan will be used as a basis for development review and to help prioritize capital improvement programming. The City and County will maintain Capital
Improvement Plans (CIPs) which prioritize road and alley improvements based on needs for traffic flow, safety enhancements, maintenance and linkages.

Goal 11: Public facilities and services for our citizens will be a priority in planning for growth.
Policy:

A. The City and County will plan for the locations and construct new public facilities to serve the public health, safety and welfare, and to meet the needs of existing and future growth.

Goal 12: Being a regional provider of goods and services the City and County will sustain, develop and enhance a healthy, diverse economy.
Policies:

A. Through the Comprehensive Plan's policies the City and County will improve as a regional center of commerce, culture and tourism.

B. The City and County will provide appropriate commercial and industrial development opportunities.

Thank you again for the opportunity to comment. We look forward to coordinating and reviewing the draft EA. If you have any questions or would like any documents relevant to these comments, please do not hesitate to contact us.

Sincerely,

Peter Baier
Public Works Director

cc: County Commissioners Janet Rowland, Steve Acquafresca and Craig Meis
Rex Tippets, Grand Junction Regional Airport Authority
Tom Papin, Acting County Administrator
Tom Kenyon, Mayor, City of Grand Junction
Laurie Kadrich, Grand Junction City Manager
Tim Moore, Director, Department of Public Works and Planning
Ken Simms, Mesa County Regional Transportation Planning Office
File

CITY OF Grand Junction COLORADO

PUBLIC WORKS & PLANNING

May 20, 2011

Ms. Robin Lacy
Bureau of Land Management
Grand Junction Field Office
2815 H Road
Grand Junction, Colorado 81506

RE: Airport Transfer Scoping Comments

Dear Ms. Lacy:

We thank you for the opportunity to comment on issues that will be considered in an environmental assessment (EA) for the Proposed Land Transfer and Runway Project in Mesa County, Colorado for the Grand Junction Regional Airport Authority. We appreciate the cooperative relationship the City of Grand Junction has wit BLM and our opportunity to coordinate with the BLM on NEPA projects.

The City of grand Junction supports the intent of the proposed land transfer to allow the Grand Junction Regional Airport Authority to relocate runway 11/29 and correct deficiencies in the primary runway. We understand the vital role the airport serves in our local economy and a safer more efficient airport is in the greater interest of the community as a whole. The Grand Junction Comprehensive Plan identifies these lands and more as "Airport" for future expansion and operations.

Transportation Comments

Transportation planning for the future is of utmost importance to the success of the Regional Airport. If planned and coordinated properly a new interchange on Interstate 70 near 29 Road should one day provide excellent access to the airport and areas to the east including Clifton. The City/County Comprehensive Plan identifies the area near the future interchange as Mixed Use Business Park with extensive areas planned for Industrial, Commercial, and Commercial/Industrial eastward toward Clifton. The recently adopted 2035 Regional Transportation Plan for Mesa County includes a 29 Road Interchange and an enhanced Clifton Interchange connected by a future major east-west transportation corridor to service this planned industrial/commercial district. The adopted Grand Valley Circulation Plan shows an extension of H Road heading east around or across airport property and continuing north of the interstate with access to the future 29 Road interchange and points east to I-70 exit 37.

Mesa County and the City of Grand Junction have tentative plans to pursue the 1601 environmental planning process for a 29 Road interchange in the year 2016 with potential construction in 2017-2018. Justification of this significant investment includes supporting the airport and its future. The 2035 Regional Transportation Plan's conceptual road corridor tunneling under the cross- wind, north-south runway to the terminal area appears to be cost prohibitive and potentially disallowed by TSA and FAA regulations.

We suggest the airport reserve the ability to create a multi-modal transportation corridor north of and paralleling 1-70 between the future 29 Road interchange and Horizon Court or the Horizon Drive/H Road roundabout for easy and efficient access to and from the airport and the future interchange. This corridor will require at least 100 feet of right-way in the area shown on the airport plan as an expanded Runway Protection Zone (RPZ) for the area immediately north of 1-70. We are also concerned that the expanded (RPZ), as shown on the airport plans, encroaches Interstate 70 and may limit future expansion of 1-70 to 6 lanes as our modeling indicates may be needed in the future.

Because the project is within the City of Grand Junction, we ask that the relocation of 27 ¼ Road include a sixty (60) feet wide right-of-way to accommodate future road needs. We also concur with Mesa County and the Colorado Division of Wildlife's (CDOW) comments suggesting 27 ¼ Road remain open as recreational access to BLM lands and particularly the shooting range, a community asset as identified by these agencies.

Mesa County Road 29.65 was recently closed by the Airport Authority and rerouted to the east. It provides recreational access to BLM lands and is the maintenance route to the Indian Wash detention pond. We concur with Mesa County that the Airport Authority dedicate to the City of Grand Junction, since the area is within the city limits, a 60 feet wide right of-way for the relocated portion of the road across Airport Authority property. This route should also remain open to the public to access BLM lands.

Detention Facilities Comments

The proposal includes construction of several detention ponds and water quality ponds. We suggest the EA and ultimate construction include consultation with the Colorado State Engineer's Office and the local 5-2-1 Drainage Authority for review of the design of these structures. It is also import to provide sufficient maintenance access for these structures, regardless of what entity will be responsible for maintenance.

The 29 Road and I-70 interchange location will not be known until after completion

of the environmental assessment that is currently scheduled for 2016. However, the proposed airport detention basin in that vicinity is shown on the airport master plan in an area that has a high probability of becoming part of the interchange. In final planning for this detention basin we ask that you work with our City Engineer's office on locating the facility in an area that minimizes the need to reconstruct the basin in the near future.

Grand Junction Comprehensive Plan Comments

One of the six guiding principles of the Grand Junction Comprehensive Plan adopted in 2010 is to balance our transportation needs including air, transit, freight, auto, bike and pedestrian. Goals and Policies of the Comprehensive Plan include various goals and policies that support the airport and its continued growth and development as well as support for all modes of transportation in our community.

Goal 9: Develop a well-balanced transportation system that supports automobile, local transit, pedestrian, bicycle, air, and freight movement while protecting air, water and natural resources.

Policies:

A. The City and County will work with the Mesa County Regional Transportation Planning Office (RTPO) on maintaining and updating the Regional Transportation Plan, which includes planning for all modes of transportation.

C. The Regional Transportation Plan will be used as a basis for development review and to help prioritize capital improvement programming. The City and County will maintain Capital Improvement Plans (CIPs) which prioritize road and alley improvements based on needs for traffic flow, safety enhancements, maintenance and linkages.

Goal 11: Public facilities and services for our citizens will be a priority in planning for growth.

Policy:

A. The City and County will plan for the locations and construct new public facilities to serve the public health, safety and welfare, and to meet the needs of existing and future growth.

Goal 12: Being a regional provider of goods and services the City and County will sustain, develop and enhance a healthy, diverse economy.

Policies:

A. Through the Comprehensive Plan's policies the City and County will improve as a regional center of commerce, culture and tourism.

B. The City and County will provide appropriate commercial and industrial development opportunities.

Thank you for this opportunity to comment. We look forward to coordinating and reviewing the draft Environmental Assessment. If you have any questions please do not hesitate to contact us.

Respectfully,

Tim Moore
Public Works and Planning Director

cc: City Council
Laurie Kadrich, Grand Junction City Manager
Rex Tippets, Grand Junction Regional Airport Authority
Mesa County Commissioners
Tom Papin, Acting County Administrator
Pete Baier, Director, Department of Public Works, Mesa County
Ken Simms, Mesa County Regional Transportation Planning Office
File

GRAND JUNCTION REGIONAL AIRPORT EA

BLM NOTICE OF INTENT AND PUBLIC SCOPING MEETING ADVERTISEMENT

purposes. This action opens the lands to the operation of the public land laws. The lands have been and will remain open to mining and mineral leasing.

DATES: *Effective Date:* February 14, 2011.

FOR FURTHER INFORMATION CONTACT: Laura Bingham, Bureau of Land Management, Idaho State Office, 1387 South Vinnell Way, Boise, Idaho 83709, 208–373–3866.

SUPPLEMENTARY INFORMATION: Copies of the expired orders describing the lands involved are available at the Bureau of Land Management Idaho State Office (address above). All of the lands have been and will remain open to mining and mineral leasing.

1. The withdrawal established by the Secretarial Order of May 17, 1918, and Public Land Order No. 3398, (29 FR 6686 (May 22, 1964)), as modified by Public Land Order No. 6436 (48 FR 33711 (July 25, 1983)), which withdrew 60,744.74 acres public lands from the operation of the public land laws for a period of 20 years for stock driveway purposes, expired on July 24, 2003.

2. The withdrawal established by the Secretarial Order of July 17, 1918, as modified by Public Land Order No. 6518 (49 FR 5924 (February 16, 1984)), which withdrew 1,280.68 acres public lands from the operation of the public land laws for a period of 20 years for stock driveway purposes, expired on March 16, 2004.

3. In accordance with 43 CFR 2091.6, at 8:30 a.m. on February 14, 2011, the lands withdrawn by the orders listed in Paragraphs 1 and 2 above will be opened to the operation of the public land laws generally, subject to valid existing rights, the provisions of existing withdrawals, other segregations of record, and the requirements of applicable law. All valid applications received at or prior to 8:30 a.m. on February 14, 2011, shall be considered as simultaneously filed at that time.

Those received thereafter shall be considered in the order of filing.

Authority: 43 CFR 2091.6.

Jerry L. Taylor,

Chief, Branch of Lands, Minerals and Water Rights, Resource Services Division.

[FR Doc. 2011–608 Filed 1–12–11; 8:45 am]

BILLING CODE 4310–GG–P

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[LLCONO3000.L1610000.DSO000]

Notice of Intent To Amend the Grand Junction Resource Management Plan, Prepare an Environmental Assessment, and Notice of Realty Action, Colorado

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice of Intent and Notice of Realty Action.

SUMMARY: The Grand Junction, Colorado, Regional Airport Authority has requested the Bureau of Land Management (BLM) Grand Junction Field Office (GJFO) to consider the transfer of title to approximately 720 acres of public land for airport improvements, including relocation and construction of the main runway for the Grand Junction Regional Airport. Public Land Order No. 7027 (59 FR 3000 January 20, 1994) withdrew these lands from mining claim location in anticipation of a need for future airport expansion. The BLM's consideration of the Grand Junction Regional Airport Authority's (Airport Authority) request initiates a BLM Notice of Intent to initiate a public scoping process to amend the BLM GJFO 1987 Resource Management Plan (RMP) and prepare an Environmental Analysis (EA). The request also initiates a Notice of Realty Action (NORA) to assist the BLM in determining whether granting the requested title conveyance is consistent with the needs of the Department of the Interior. This notice initiates the public scoping process and concurrent opportunity for submission of public comments for the EA, RMP Amendment, and NORA.

DATES: Comments on this project, the NORA, or the proposed transfer of title to the Airport Authority may be submitted in writing until February 28, 2011. The date(s) and location(s) of scoping meetings will be announced at least 15 days in advance through local media, newspapers and the BLM Web site at: *http://www.blm.gov/co/st/en/fo/gjfo.html.* In order to be included in the EA, all comments must be received prior to the close of the scoping period or 45 days after the last public meeting, whichever is later.

ADDRESSES: Written comments should be sent to the Grand Junction Field Office, Bureau of Land Management, 2815 H. Road, Grand Junction, Colorado 81506, or via fax at (970) 244–3083. E-mail comments may be sent to *GJFO_mail@blm.gov.* Comments, including names and addresses of respondents, will be available for public review at the BLM GJFO, during regular business hours 7:30 a.m. through 4:30 p.m., Monday–Friday, except holidays.

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment–including your personal identifying information–may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

FOR FURTHER INFORMATION CONTACT: For further information and/or to have your name added to our mailing list contact Robin Lacy, Project Manager, telephone (970) 244–3028. Project documents may be reviewed on the BLM GJFO Web site at *http://www.blm.gov/co/st/en/fo/gjfo.*

SUPPLEMENTARY INFORMATION: The purpose of the public scoping process is to identify those issues that should be considered in the EA and to initiate public participation in the planning process. BLM and Airport Authority personnel will be present at scoping meetings to explain the proposed action and other requirements for preparing the EA. Interested parties can request notification of any encumbrances or other claims relating to the land. Customary Federal Aviation Administration (FAA) conditions, in draft, that are proposed to be included in a land patent from the United States to the Airport Authority will also be available for review. The public lands requested for title transfer are within the jurisdiction of the BLM GJFO adjacent to the Grand Junction Regional Airport in the North Desert and are described as follows:

Ute Principal Meridian

T. 1 N., R. 1 W.,
Sec. 23, S½NE¼;
Sec. 24, S½NE¼, N½SE¼, and SE¼SE¼;
T. 1 N., R. 1 E.,
Sec. 19, lots 3 and 4, and E½SW¼;
Sec. 29, SW¼NW¼;
Sec. 30, lot 1, NE¼, and NE¼NW¼.

The areas described contain approximately 720 acres in Mesa County.

These are public lands administered by the BLM GJFO and do not include any private, State, tribal trust or Federal lands not administered by the BLM, the lands proposed for the title transfer to the Airport Authority are currently withdrawn from the United States mining laws by Public Land Order No.

7027 (59 FR 3000 (1994)), and are not intended for further segregation.

The EA will fulfill the needs and obligations set forth by the National Environmental Policy Act and associated Council of Environmental Quality Regulations (40 CFR 1500). The EA will also fulfill requirements of the Federal Land Policy and Management Act of 1976 (FLPMA), 43 U.S.C. 1701, Section 516 of the Airport and Airway Improvement Act of 1982 (49 U.S.C. 2215), Airport Grant regulations at 43 CFR 2640, applicable planning regulations at 43 CFR 1600, and BLM management policies.

The purpose of the proposed land title transfer from the United States to the Airport Authority is to fulfill the BLM's intent to make such lands available to the Airport Authority for a beneficial public use as described in the 1991 Memorandum of Understanding between the BLM and the Airport Authority. As authorized through the FLPMA, these lands will also be considered for title transfer to the Airport Authority in an amendment to the Grand Junction RMP. The BLM will determine whether or not to transfer title to the lands based on the EA, and the assessed environmental impacts of transferring title to the lands.

The purpose of the runway relocation is to comply with the FAA design standards by correcting deficiencies related to runway and taxiway gradients and to eliminate intersecting runways at the airport. The need for the proposed runway relocation is to increase safety at the Grand Junction Regional Airport, which is one of the few commercial service airports in the State of Colorado that still has a geometric runway layout consisting of an intersecting crosswind runway. The runway intersection increases the potential for runway incursions, which are defined by the FAA as "any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft." Increasing runway safety has been made a high priority in recent years and the FAA has published guidance on improving runway safety through airfield configuration. Also, several design components of the runway at Grand Junction Regional Airport do not meet the FAA design standards, including the following:

Runway 11/29 Transverse Gradient. Portions of the runway exceed the maximum recommended design standard of 1.5 percent;

Runway 11/29 Longitudinal Gradient. A portion of the runway near the approach end of Runway 29 exceeds the maximum recommended design standard of 0.8 percent;

Runway 11/29 Connecting Taxiway Gradient. A number of the connecting taxiways between Runway 11/29 and parallel Taxiway "A" exceed the maximum recommended design standard of 1.5 percent; and

Runway 11/29 and Runway 4/22 Runway Visibility Zone (RVZ). Numerous structures obstruct line of sight between runway mid-points.

The BLM seeks resource information and data for other public land values [*i.e.,* air quality, cultural and historic resources, fire and fuels, fisheries, forestry, lands and realty, non-energy minerals and geology, oil and gas (including coalbed methane), paleontology, rangeland management, recreation, soil, water, and wildlife] in the BLM GJFO planning area. The purpose of this request is to assure that the planning effort has sufficient information to consider a reasonable range of resource uses, management options, and alternatives for the public lands involved.

Proprietary data marked as confidential may be submitted in response to this call for coal, oil and gas, and other resource information. Please submit all proprietary information submissions to the address listed above. The BLM will treat submissions marked as "Confidential" in accordance with the laws and regulations governing the confidentiality of such information.

The BLM GJFO will work collaboratively with interested parties to identify the management actions and decisions that are best suited to local, regional, and national needs. Potential issues that have been identified to date include, but are not limited to the following general categories: Wildlife (including birds); vegetation (including weeds and invasive plant species); threatened, endangered, and sensitive species; public access; visual concerns; cultural resources; tribal concerns; rangeland resources; geology and soils; hydrology; recreation resources; hazardous materials; air quality; noise; and socio-economics. The BLM has established a 45-day scoping period during which affected tribes, landowners, concerned citizens, special interest groups, local governments, and any other interested parties are invited to comment on the scope of the EA. Scoping will help the BLM identify the full range of issues that should be addressed in the EA.

Authority: Airport and Airway Improvement Act of September 3, 1982 (49 U.S.C. 4761, 49 U.S.C. 47101 *et seq.,* 3 CFR 2640 *et seq.*).

Helen M. Hankins,

State Director.

[FR Doc. 2011–556 Filed 1–12–11; 8:45 am]

BILLING CODE 4310–JB–P

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[LLMTC0400.L14300000.EU0000;SDM101126]

Notice of Realty Action: Direct Sale of Public Land in Lawrence County, SD

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice of Realty Action.

SUMMARY: The Bureau of Land Management (BLM), South Dakota Field Office, proposes to sell a parcel of public land consisting of 0.03 acres in Lawrence County, South Dakota, to Keith Sauls for the appraised fair market value of $183.

DATES: Comments regarding the proposed sale must be received by the BLM on or before February 28, 2011.

ADDRESSES: Written comments concerning the proposed sale should be sent to the Field Manager, BLM, South Dakota Field Office, 310 Roundup Street, Belle Fourche, South Dakota 57717.

FOR FURTHER INFORMATION CONTACT: Charles Berdan, Realty Specialist, BLM, South Dakota Field Office, 310 Roundup Street, Belle Fourche, South Dakota 57717 or phone (605) 892–7000.

SUPPLEMENTARY INFORMATION: The following described public land is being proposed for direct sale to Keith Sauls in accordance with Sections 203 and 209 of the Federal Land Policy and Management Act of 1976 (FLPMA), as amended (43 U.S.C. 1713 and 1719);

Black Hills Meridian

T. 5 N., R. 3 E.,
Sec. 26, Lot 16.

The area described contains 0.03 acres, more or less, in Lawrence County.

The BLM proposes to sell this land to Keith Sauls for the appraised fair market value of $183. The public land is identified as suitable for disposal in the BLM's 1986 South Dakota Resource Area Management Plan, as amended, and is not needed for any other Federal purpose.

The public land proposed for sale consists of a tiny lot on which a corner of a home was built. The BLM is proposing a direct sale to the homeowner, in accordance with 43 CFR

Bureau of Land Management and Grand Junction Regional Airport Authority
to Host Public Scoping Meeting for Proposed Land Transfer and Runway Project

The Bureau of Land Management (BLM) Grand Junction Field Office (GJFO), and the Grand Junction Regional Airport Authority (Airport) will host a public scoping meeting on Tuesday, April 5, 2011, with an open house beginning at 6:00 p.m., followed by a short presentation beginning at 7:00 p.m., at the Marriott Courtyard Hotel in Grand Junction. This meeting will solicit public comments and concerns on a proposed transfer of public land from the BLM to the Airport Authority and the relocation of Runway 11/29.

Public comment will assist with the required Environmental Assessment (EA) of the proposed actions in accordance with the National Environmental Policy Act (NEPA). The meeting will offer an open house format for the first hour with representatives from the BLM, the FAA, the Airport and the consulting team available to answer questions. The open house portion of the meeting will then be followed by a short presentation by the consultant team. The proposed project involves the following separate actions by the BLM and the Airport. The enclosed Notice of Intent and Notice of Realty Action provides additional information on the project.

BLM: The BLM is considering a request from the Airport to transfer title to 720 acres of public land for an airport improvement project described in the Airport actions below. The requested lands are located north and adjacent to airport property (see the enclosed maps). An EA is being prepared to assess the environmental effects of the proposed land transfer as well as an amendment to the BLM GJFO 1987 Resource Management Plan (RMP) to identify the requested lands as suitable for disposal to the Airport.

Airport: The Airport Authority has requested the proposed land transfer as part of a plan to correct deficiencies in runway and taxiway gradients associated with the primary runway, Runway 11/29, and to eliminate intersecting runways to improve safety. The proposed land transfer would allow a new replacement primary runway to be built 650 feet north of the existing runway, making it possible for the Airport to stay open during construction. The project would also include the relocation of a portion of 27¼ Road, conversion of the existing Runway 11/29 to a taxiway, construction of various detention ponds, water quality ponds and culverts, installation/relocation of navigational aids, visual aids, and runway lighting, installation/relocation of taxiway lighting, construction of airport perimeter fencing, removal of existing sections of pavement no longer required and the relocation of the aircraft maintenance run-up area. See the enclosed Proposed Actions Map for details.

The BLM and the Airport will accept comments on the proposed actions through May 20, 2011. The public is also asked to comment on other values of the land considered for transfer including resource uses, management options and alternatives. Primary public use now includes a variety of recreational activities, one non-producing gas well and a power line right of way. The draft planning criteria is also available at the GJFO. Comments can be sent to Robin Lacy, BLM GJFO, 2815 H Road, Grand Junction, CO 81506, or via email to Robin_Lacy@blm.gov. Please note "Airport Land Transfer" in the subject line of emails. Please identify the specific action to which your comments pertain, i.e., BLM or Airport. For more information contact BLM Visitors Information Services at 970 244-3000.

GRAND JUNCTION
REGIONAL AIRPORT

Notice of Intent to Amend the BLM Grand Junction Resource Management Plan, Prepare an Environmental Assessment, and Notice of Realty Action

SUMMARY: The Grand Junction, Colorado, Regional Airport Authority has requested the Bureau of Land Management (BLM) Grand Junction Field Office (GJFO) to consider the transfer of title to approximately 720 acres of public land for airport improvements, including relocation and construction of the main runway for the Grand Junction Regional Airport. Public Land Order No. 7027 (59 FR 3000 January 20, 1994) withdrew these lands from mining claim location in anticipation of a need for future airport expansion. The BLM consideration of the Airport's request initiates a BLM Notice of Intent (NOI) to initiate a public scoping process to amend the BLM GJFO 1987 Resource Management Plan (RMP) and prepare an Environmental Assessment (EA). The request also initiates a Notice of Realty Action (NORA), to assist the BLM in determining whether granting the requested title conveyance is consistent with the needs of the Department of the Interior, in accordance with 43 CFR 2641.2(a). An NOI/NORA for this project was published in the Federal Register on January 13, 2011. This notice initiates the public scoping process and concurrent opportunity for submission of public comments for the EA, RMP amendment and NORA.

DATES: Comments on this project, the NORA, or the proposed transfer of title to the Airport Authority may be submitted in writing until May 20th, 2011. A public scoping meeting will be held on Tuesday, April 5th, 2011, at 6:00 p.m. at the Marriott Courtyard Hotel in Grand Junction. The meeting will utilize an open house format with representatives from the BLM, the FAA, the Airport and the consulting team available to answer questions.

ADDRESSES: Written comments can be sent to Robin Lacy, BLM Grand Junction Field Office, 2815 H Road, Grand Junction, CO 81506, or via email to rlacy@blm.gov. Please note Airport Land Transfer in the subject line of the email. Comments, including names and addresses of respondents, will be available for public review at the BLM GJFO, during regular business hours 7:30 a.m. through 4:30 p.m. Monday-Friday except holidays. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

FOR FURTHER INFORMATION CONTACT: For further information and/or to have your name added to our mailing list contact Robin Lacy at (970) 244-3028. Project documents may be reviewed on the BLM GJFO Web site at *http://www.blm.gov/co/st/en/fo/gjfo*.

SUPPLEMENTARY INFORMATION: The purpose of the public scoping process is to identify those issues that should be considered in the EA and to initiate public participation in the planning process. BLM and Airport Authority personnel will be present at scoping meetings to explain the proposed action and other requirements for preparing the EA. Interested parties can request notification of any encumbrances or other claims relating to the land. Customary Federal Aviation Administration (FAA) conditions, in draft, that would be proposed to be included in a land patent from the United States to the Airport Authority will also be available for review. The public lands requested for title transfer are within the jurisdiction of the BLM GJFO adjacent to the Grand Junction Regional Airport in the North Desert and are described as follows:

Ute Principal Meridian
T. 1 N., R. 1 W.,
sec. 23, S½NE¼;
sec. 24, S½NE¼, N½SE¼ and SE¼SE¼;
T. 1 N., R. 1 E.,
sec. 19, lots 3 and 4, and E½SW¼;
sec. 29, SW¼NW¼;
sec. 30, lot 1, NE¼, and NE¼NW¼.

The areas described contain approximately 720 acres in Mesa County.
These are public lands administered by the BLM GJFO and do not include any private, State, tribal trust or Federal lands not administered by the BLM.

The EA will fulfill the needs and obligations set forth by the National Environmental Policy Act (NEPA) and associated Council of Environmental Quality Regulations (40 CFR Part 1500). The EA will also fulfill requirements of the Federal Land Policy and Management Act of 1976 (FLPMA: 43 U.S.C. 1701), Section 516 of the Airport and Airway Improvement Act of 1982 (49 U.S.C. 2215), airport grant regulations at 43 CFR Part 2640, applicable planning regulations at 43 CFR 1600, and BLM management policies.

The purpose of the proposed land title transfer from the United States to the Airport Authority is to fulfill the BLM's intent to make such lands available to the Airport Authority for a beneficial public use as described in the 1991 Memorandum of Understanding between the BLM and the Airport Authority. As authorized through the FLPMA, these lands will also be considered for title transfer to the Airport Authority in an amendment to the Grand Junction RMP. The BLM will determine whether or not to transfer title to the lands based on the EA, and the assessed environmental impacts of transferring title to the lands.

The purpose of the runway relocation is to comply with the FAA design standards by correcting deficiencies related to runway and taxiway gradients, and to eliminate intersecting runways at the airport. The need for the proposed runway relocation is to increase safety at the Grand Junction Regional Airport, which is one of the few commercial service airports in the State of Colorado that still has a geometric runway layout consisting of an intersecting crosswind runway. The runway intersection increases the potential for runway incursions, which are defined by the FAA as "any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft." Increasing runway safety has been made a high priority in recent years and the FAA has published guidance on improving runway safety through airfield configuration. Also, several design components of the runway at Grand Junction Regional Airport do not meet the FAA design standards, including the following:

-Runway 11/29 Transverse Gradient. Portions of the runway exceed the maximum recommended design standard of 1.5 percent.
-Runway 11/29 Longitudinal Gradient. A portion of the runway near the approach end of Runway 29 exceeds the maximum recommended design standard of 0.8 percent.
-Runway 11/29 Connecting Taxiway Gradient. A number of the connecting taxiways between Runway 11/29 and parallel Taxiway "A" exceed the maximum recommended design standard of 1.5 percent.
-Runway 11/29 and Runway 4/22 Runway Visibility Zone (RVZ). Numerous structures obstruct line of sight between runway mid-points.

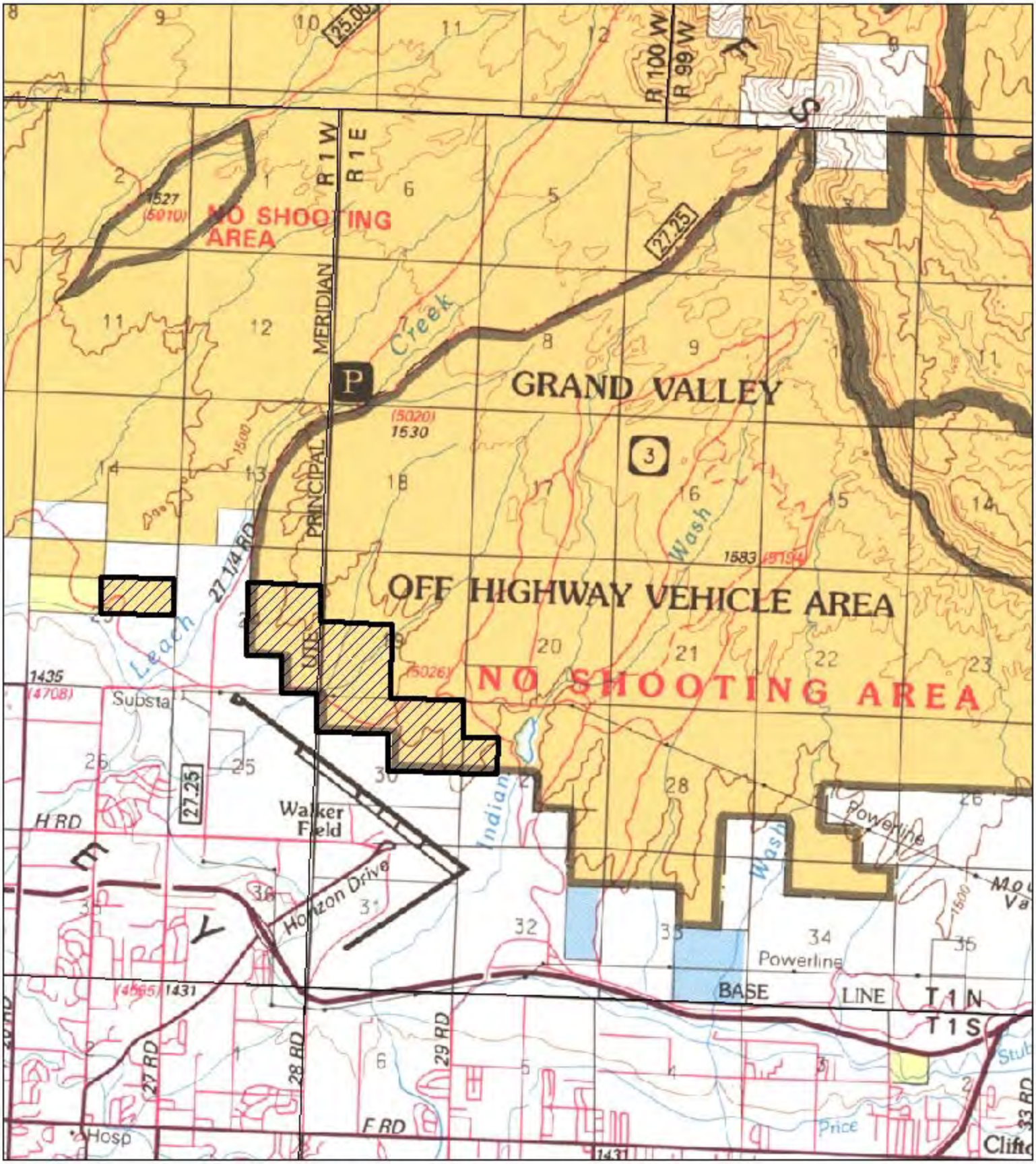
The BLM seeks resource information and data for other public land values [i.e., air quality, cultural and historic resources, fire and fuels, fisheries, forestry, lands and realty, non-energy minerals and geology, oil and gas (including coalbed methane), paleontology, rangeland management, recreation, soil, water, and

wildlife] in the BLM GJFO planning area. The purpose of this request is to assure that the planning effort has sufficient information and data to consider a reasonable range of resource uses, management options, and alternatives, for the public lands involved. BLM draft planning criteria is also available for review at the Grand Junction Field Office.

Proprietary data marked as confidential may be submitted in response to this call for coal, oil and gas, and other resource information. Please submit all proprietary information submissions to the address listed above. The BLM will treat submissions marked as "Confidential" in accordance with the laws and regulations governing the confidentiality of such information.

The BLM GJFO will work collaboratively with interested parties to identify the management actions and decisions that are best suited to local, regional, and national needs. Potential issues that have been identified to date include, but are not limited to the following general categories: wildlife (including birds); vegetation (including weeds and invasive plant species); threatened, endangered, and sensitive species; public access; visual concerns; cultural resources; tribal concerns; rangeland resources; geology and soils; hydrology; recreation resources; hazardous materials; air quality; noise; and socio-economics. The BLM has established a 45-day scoping period during which affected tribes, landowners, concerned citizens, special interest groups, local governments, and any other interested parties are invited to comment on the scope of the EA. Scoping will help the BLM identify the full range of issues that should be addressed in the EA.

AUTHORITY: Airport and Airway Improvement Act of September 3, 1982 (49 U.S.C. 4761, 49 U.S.C. 47101 *et seq.*), 43 CFR 2640.



Proposed Transfer of Public Lands to the Grand Junction Regional Airport Authority

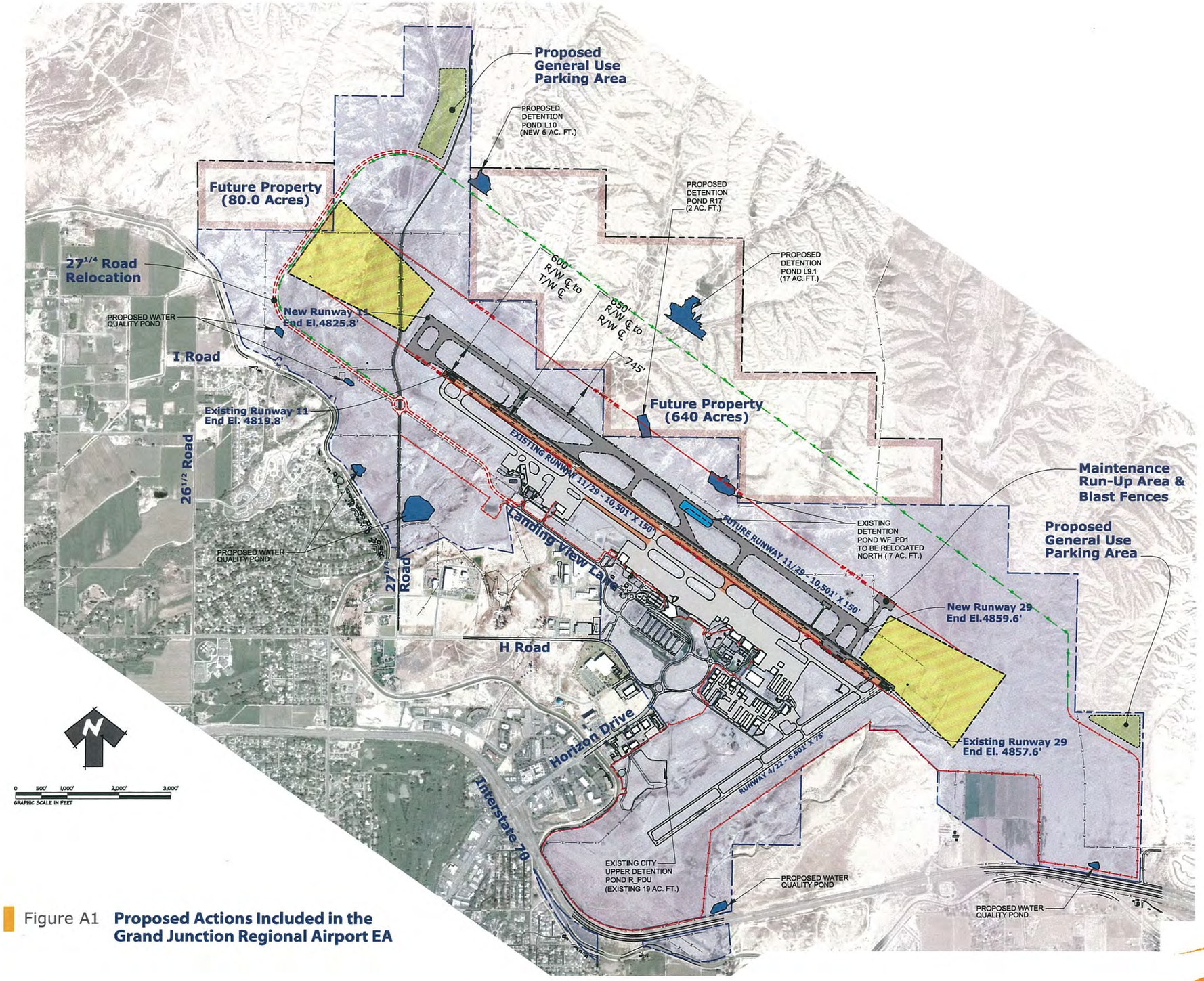
N

Proposed Transfer

BLM

Private

State



Legend

- Existing Airport Property
- Proposed Land Transfer from BLM
- Future Runway Protection Zone
- Proposed Road
- Existing Building on Airport Property
- Proposed Airfield Pavement
- Pavement to be Removed
- Existing Fencing
- Proposed Fencing

Figure A1 **Proposed Actions Included in the Grand Junction Regional Airport EA**

State PROOF OF PUBLICATION

(see attached)

STATE OF COLORADO

County of (Mesa)

Terry Laubhan

Being duly sworn, says that I am Legal Secretary of The Daily Sentinel, a daily newspaper, published and duly printed in The County of Mesa, State of Colorado; that said newspaper has a general circulation in said County and has been continuously and uninterruptedly published therein, during a period of at least fifty-two consecutive weeks next prior to the first publication of the annexed notice; that said newspaper is a newspaper within the meaning of the act of the general Assembly of the State of Colorado, entitled "An Act to regulate the printing of legal notices and advertisements," and amendments thereto; that the notice of which the annexed is a printed copy taken from said newspaper, was published in said newspaper, and in the regular and entire issue of every number thereof once a week for 1 successive week;
that said notice was so published in said newspaper proper and not in any supplement thereof, and that first publication of said notice as aforesaid, was on the 20th day of March, 2011,
and the last, on the 20th day of March, 2011.
Copies of each number of said paper in which said notice and/or list was published were delivered by carriers or transmitted by mail to each of the subscribers of said newspaper, The Daily Sentinel, according to the accustomed mode of business in this office.

Subscribed and sworn to before me, this 28TH day of April, 2011

Robin M. Gavegan

ROBIN M GAVEGAN
NOTARY PUBLIC
STATE OF COLORADO

My Commission Expires 04/14/2012

Notice of Intent to Amend the BLM Grand Junction Resource Management Plan, Prepare an Environmental Assessment, and Notice of Realty Action

SUMMARY: The Grand Junction, Colorado, Regional Airport Authority has requested the Bureau of Land Management (BLM) Grand Junction Field Office (GJFO) to consider the transfer of title to approximately 720 acres of public land for airport improvements, including relocation and construction of the main runway for the Grand Junction Regional Airport. Public Land Order No. 7027 (59 FR 3000 January 20, 1994) withdrew these lands from mining claim location in anticipation of a need for future airport expansion. The BLM consideration of the Airport's request initiates a BLM Notice of Intent (NOI) to initiate a public scoping process to amend the BLM GJFO 1987 Resource Management Plan (RMP) and prepare an Environmental Assessment (EA). The request also initiates a Notice of Realty Action (NORA), to assist the BLM in determining whether granting the requested title conveyance is consistent with the needs of the Department of the Interior, in accordance with 43 CFR 2641.2(a). An NOI/NORA for this project was published in the Federal Register on January 13, 2011. This notice initiates the public scoping process and concurrent opportunity for submission of public comments for the EA, RMP amendment and NORA.

DATES: Comments on this project, the NORA, or the proposed transfer of title to the Airport Authority may be submitted in writing until May 20th, 2011. A public scoping meeting will be held on Tuesday, April 5th, 2011, at 6:00 p.m. at the Marriott Courtyard Hotel in Grand Junction. The meeting will utilize an open house format with representatives from the BLM, the FAA, the Airport and the consulting team available to answer questions.

ADDRESSES: Written comments can be sent to Robin Lacy, BLM Grand Junction Field Office, 2815 H Road, Grand Junction, CO 81506, or via email to rlacy@blm.gov. Please note Airport Land Transfer in the subject line of the email. Comments, including names and addresses of respondents, will be available for public review at the BLM GJFO, during regular business hours 7:30 a.m. through 4:30 p.m. Monday-Friday except holidays. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment-including your personal identifying information-may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

FOR FURTHER INFORMATION CONTACT: For further information and/or to have your name added to our mailing list contact Robin Lacy at (970) 244-3028. Project documents may be reviewed on the BLM GJFO Web site at http://www.blm.gov/co/st/en/fo/gjfo.

SUPPLEMENTARY INFORMATION: The purpose of the public scoping process is to identify those issues that should be considered in the EA and to initiate public participation in the planning process. BLM and Airport Authority personnel will be present at scoping meetings to explain the proposed action and other requirements for preparing the EA. Interested parties can request notification of any encumbrances or other claims relating to the land. Customary Federal Aviation Administration (FAA) conditions, in draft, that would be proposed to be included in a land patent from the United States to the Airport Authority will also be available for review. The public lands requested for title transfer are within the jurisdiction of the BLM GJFO adjacent to the Grand Junction Regional Airport in the North Desert and are described as follows:

Ute Principal Meridian
T. 1 N., R. 1 W.,
sec. 23, S1/2NE 1/4
sec. 24, S1/2 NE1/4 N1/2 SE 1/4 and SE 1/4 SE1/4
T. 1 N., R. 1 E.,
sec. 19, lots 3 and 4, and E 1/2 SW 1/4
sec. 29, SW 1/4 NW 1/4
sec. 30, lot 1, NE¼, and NE 1/4 NW 1/4

The areas described contain approximately 720 acres in Mesa County.

These are public lands administered by the BLM GJFO and do not include any private, State, tribal trust or Federal lands not administered by the BLM.

The EA will fulfill the needs and obligations set forth by the National Environmental Policy Act (NEPA) and associated Council of Environmental Quality Regulations (40 CFR Part 1500). The EA will also fulfill requirements of the Federal Land Policy and Management Act of 1976 (FLPMA: 43 U.S.C. 1701), Section 516 of the Airport and Airway Improvement Act of 1982 (49 U.S.C. 2215), airport grant regulations at 43 CFR Part 2640, applicable planning regulations at 43 CFR 1600, and BLM management policies.

The purpose of the proposed land title transfer from the United States to the Airport Authority is to fulfill the BLM's intent to make such lands available to the Airport Authority for a beneficial public use as described in the 1991 Memorandum of Understanding between the BLM and the Airport Authority. As authorized through the FLPMA, these lands will also be considered for title transfer to the Airport Authority in an amendment to the Grand Junction RMP. The BLM will determine whether or not to transfer title to the lands based on the EA, and the assessed environmental impacts of transferring title to the lands.

The purpose of the runway relocation is to comply with the FAA design standards by correcting deficiencies related to runway and taxiway gradients, and to eliminate intersecting runways at the airport. The need for the proposed runway relocation is to increase safety at the Grand Junction Regional Airport, which is one of the few commercial service airports in the State of Colorado that still has a geometric runway layout consisting of an intersecting crosswind runway. The runway intersection increases the potential for runway incursions, which are defined by the FAA as "any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft." Increasing runway safety has been made a high priority in recent years and the FAA has published guidance on improving runway safety through airfield configuration. Also, several design components of the runway at Grand Junction Regional Airport do not meet the FAA design standards, including the following:

-Runway 11/29 Transverse Gradient. Portions of the runway exceed the maximum recommended design standard of 1.5 percent.

-Runway 11/29 Longitudinal Gradient. A portion of the runway near the approach end of Runway 29 exceeds the maximum recommended design standard of 0.8 percent.

-Runway 11/29 Connecting Taxiway Gradient. A number of the connecting taxiways between Runway 11/29 and parallel Taxiway "A" exceed the maximum recommended design standard of 1.5 percent.

-Runway 11/29 and Runway 4/22 Runway Visibility Zone (RVZ). Numerous structures obstruct line of sight between runway mid-points.

The BLM seeks resource information and data for other public land values [i.e., air quality, cultural and historic resources, fire and fuels, fisheries, forestry, lands and realty, non-energy minerals and geology, oil and gas (including coalbed methane), paleontology, rangeland management, recreation, soil, water, and wildlife] in the BLM GJFO planning area. The purpose of this request is to assure that the planning effort has sufficient information and data to consider a reasonable range of resource uses, management options, and alternatives, for the public lands involved. BLM draft planning criteria is also available for review at the Grand Junction Field Office.

Proprietary data marked as confidential may be submitted in response to this call for coal, oil and gas, and other resource information. Please submit all proprietary information submissions to the address listed above. The BLM will treat submissions marked as "Confidential" in accordance with the laws and regulations governing the confidentiality of such information.

The BLM GJFO will work collaboratively with interested parties to identify the management actions and decisions that are best suited to local, regional, and national needs. Potential issues that have been identified to date include, but are not limited to the following general categories: wildlife (including birds); vegetation (including weeds and invasive plant species); threatened, endangered, and sensitive species; public access; visual concerns; cultural resources; tribal concerns; rangeland resources; geology and soils; hydrology; recreation resources; hazardous materials; air quality; noise; and socio-economics. The BLM has established a 45-day scoping period during which affected tribes, landowners, concerned citizens, special interest groups, local governments, and any other interested parties are invited to comment on the scope of the EA. Scoping will help the BLM identify the full range of issues that should be addressed in the EA.

AUTHORITY: Airport and Airway Improvement Act of September 3, 1982 (49 U.S.C. 4761, 49 U.S.C. 47101 et seq.), 43 CFR 2640.

Published: March 20, 2011.

GRAND JUNCTION REGIONAL AIRPORT EA

SCOPING PRESENTATION

Barnard Dunkelberg Company

Environmental Assessment /RMP Amendment for Proposed Land Transfer and Runway Project

Scoping Meeting, April 5, 2011



ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION

REGIONAL AIRPORT

Agenda

- Introduction
- Scoping Process
- Environmental Assessment (EA) Process
- RMP Amendment Process
- Scoping Comments
- Next Steps

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Introduction to Project Contacts

Project Sponsor

- *Grand Junction Regional Airport*
  - Rex Tippetts, Director of Aviation
  - Amy Jordan, Deputy Director: Administration

Federal Agencies

- *Bureau of Land Management (BLM)*
  - Catherine Robertson, Field Manager
  - Robin Lacy, Realty Specialist
- *Federal Aviation Administration (FAA)*
  - Hans Anker, Environmental Specialist

Introduction to Project Contacts, cont.

Project Consultant Team

- *Barnard Dunkelberg & Company, Prime Consultant*
  - Ryk Dunkelberg, Project Manager
  - Ryan Hayes, Project Coordinator
  - Kate Andrus, Environmental Planner
- *BioEnvirons*
  - Biological and Wetlands Consulting
- *Tatanka Historical Associates*
  - Historical and Cultural Resource Consulting
- *Synergy Consultants*
  - NEPA Consistency/Quality Control

What Is Scoping?

- **An Early and Open Process of Determining the Issues to be Addressed in the Environmental Assessment process**
- **Identifying Issues Related to the Proposed Actions**
- **Important Part of the EA Process that Includes:**
  - *Public*
  - *Interested Agencies*
  - *Tribes*
  - *Airport Users and Recreational Users of BLM Land*
- **Process helps Identify Available Technical Information**
- **Includes Meetings, as well as the Submittal of Comments, Concerns and Questions**

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Purpose of Scoping

Receive Input from Interested and Potentially Affected Parties to:

- *Identify Issues and Concerns to be Analyzed in the EA*
- *Identify and Eliminate Issues that are Not Significant*
- *Identify Alternatives to the proposed action*
- *Scoping is NOT required by FAA for EA's but is recommended*
  - Scoping helps identify issues early on in the process
  - Scoping helps to get the public involved early in the process
- *Scoping IS required by the BLM for the amendment to the Grand Junction Field Office's Resource Management Plan (RMP), and for land transfer to the Airport*
  - 45 day comment period on issues and planning criteria, starts tomorrow

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Dual Scoping Process – Airport and BLM

✈ Airport Scoping Process – Obtain Public Comments For:

- *Environmental Assessment: Resources and Concerns*
  - ❖ In Accordance with NEPA and FAA Environmental Orders 1050.1E and 5050.4B

✈ BLM Scoping Process – Obtain Public Comments For:

- *Environmental Assessment: Resources and Concerns*
  - ❖ In Accordance with NEPA and BLM NEPA Handbook H-1790-1
- *Notice of Realty Action (NORA)*
  - ❖ Meets the requirements of 43 CFR 2641.2(a)
- *Resource Management Plan Amendment (Land Transfer)*
  - ❖ Meets the requirements of the Federal Land Policy and Management Act (FLPMA) and Section 516 of the Airport and Airway Improvement Act.

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Scoping Process

- **Step 1: Airport Sponsor Identifies the Project**
- **Step 2: Agency and Public Scoping Meeting (April 5, 2011)**
- **Step 3: Scoping Comment Period Ends (May 20, 2011)**
- **Step 4: Scoping Comments are Reviewed and Evaluated**
- **Step 5: Comments are Considered within the EA**
- **Step 6: Proceed with EA Analysis and Documentation and RMP Amendment Process**
  - *Meet the Needs of Both FAA and BLM NEPA Processes*

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Purpose of an EA

- **NEPA Requires the analysis of Environmental Effects for Federal Actions**
- **EA is a "Concise Document" that takes a "Hard Look" at Expected Environmental Effects of a Proposed Project**
- **Responsible Federal Officials use the EA to meet NEPA requirements**
  - *If no significant impacts are found, both the FAA and BLM will issue separate Findings of No Significant Impact (FONSIs).*
- **Discloses Alternatives and Mitigation Measures for Potential Impacts**
- **Allows Well-Informed Decisions to be Made**

RMP Amendment and Land Transfer

- **The Resource Management Plan amendment would allow for transfer of these lands out of federal ownership**
  - *Requires scoping/comment period on issues and planning criteria, starts tomorrow*
  - *Draft RMP Amendment and EA/FONSI - 30 day public comment period*
  - *Proposed RMP Amendment/EA/FONSI – 30 day protest period and governors consistency review*
  - *Decision Record/RMP Amendment - Public Notification*
  - *Department of Justice Review of Conveyance Document*
  - *Upon DOJ Approval, Transfer the land to airport*

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Proposed Actions

Proposed Actions

- *Land transfer of approximately 720 acres of BLM land (640 acres in a parcel immediately north of the Airport and 80 acres northwest of the Airport).*
- *Relocation of Runway 11/29.*

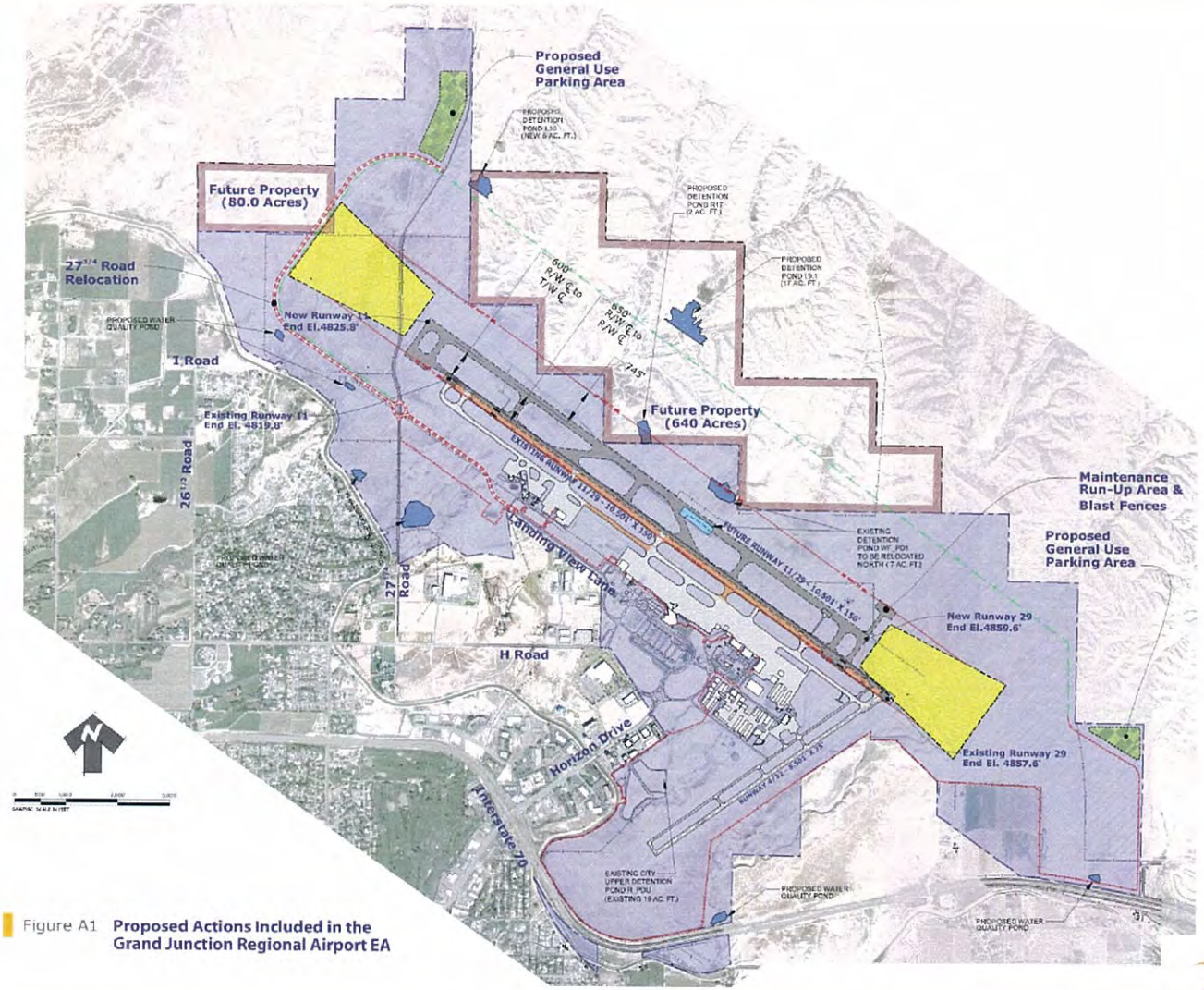
Connected Actions

Connected Actions

- *Conversion of the existing Runway 11/29 into a parallel taxiway and construction of associated connector taxiways.*
- *Relocation of 27 ¼ Road outside the relocated Runway Protection Zone (RPZ)*
- *Construction of various detention ponds, water quality ponds, and culverts to accommodate changes in drainage patterns*
- *Installation/relocation of Runway 11/29 NAVAIDS, visual aids, and runway lighting.*
- *Installation/relocation of taxiway lighting.*
- *Construction of airport perimeter fencing.*
- *Removal of any existing runway and taxiway pavement sections not required*
- *Relocation of the existing aircraft maintenance run-up area and installation of blast fences.*

Proposed Actions

Barnard Dunkelberg Company



Legend

- Existing Airport Property
- Proposed Land Transfer from BLM
- Future Runway Protection Zone
- Proposed Road
- Existing Building on Airport Property
- Proposed Airfield Pavement
- Pavement to be Removed
- Existing Fencing
- Proposed Fencing

Figure A1 **Proposed Actions Included in the Grand Junction Regional Airport EA**

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION REGIONAL AIRPORT

Purpose and Need for Runway Project

- **To Increase Safety at the Airport**
- **Meet FAA Design Standards for Existing Deficiencies**
  - *Runway 11/29 Transverse Gradient. Portions of the runway exceed the maximum recommended design standard of 1.5 percent.*
  - *Runway 11/29 Longitudinal Gradient. A portion of the runway near the approach end of Runway 29 exceeds the maximum recommended design standard of 0.8 percent.*
  - *Runway 11/29 Connecting Taxiway Gradient. A number of the connecting taxiways between Runway 11/29 and parallel Taxiway "A" exceed the maximum recommended design standard of 1.5 percent.*
  - *Runway 11/29 and Runway 4/22 Runway Visibility Zone (RVZ). Numerous structures obstruct line of sight between runway mid-points.*

Purpose and Need for the Proposed Land Transfer

- To meet the need of correcting non-standard FAA design criteria, the Airport proposed to acquire land from BLM to relocate Runway 11/29. The purpose of the proposed land transfer is to provide the Airport Sponsor with lands necessary for airport purposes.
- The BLM will decide whether or not to amend its land use plan & transfer the land based on the environmental analysis included in the EA and the decision will be based on the environmental impacts of transferring the land.

Alternatives to Be Considered

- **No Action Alternative: Required under NEPA**
- **Potential Alternatives Could Include:**
  - *Use of Alternative Airports*
  - *Use of other Modes of Transportation*
  - *Additional Airport Development Alternatives*
  - *Change in Transfer Parcel Configuration*
- **A reasonable range of Alternatives that meet the purpose and need will be Carried Forward into the EA**

Environmental Consequences to be Considered

The Following Categories will be Evaluated According to FAA Order 1050.1E:

- *Air Quality*
- *Coastal Resources*
- *Compatible Land Use*
- *Construction Impacts*
- *Department of Transportation Act: Section 4(f)*
- *Farmlands*
- *Fish, Wildlife and Plants*
- *Floodplains*
- *Hazardous Materials, Pollution Prevention, and Solid Waste*
- *Historical, Architectural, Archaeological and Cultural Resources*
- *Light Emissions and Visual Impacts*
- *Natural Resources and Energy Supply*
- *Noise*
- *Secondary (Induced) Impacts*
- *Socioeconomic Impacts, Environmental Justice, and Children's Environmental Health and Safety*
- *Water Quality*
- *Wetlands*
- *Wild and Scenic Rivers*

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Surveys: Fish, Wildlife and Plants

Completed Fish, Wildlife and Plant Surveys

- *Full Survey of the Site in Summer of 2010*
- *Some BLM sensitive species located on the site*

Coordination with:

- *U.S. Fish and Wildlife Service (USFWS)*
- *Bureau of Land Management (BLM)*
- *Colorado Natural Heritage Program (CNHP)*

Surveys: Historical, Architectural and Archaeological

Completed Historical, Architectural and Archaeological Surveys

- *Complete survey of the Area of Potential Effect in Summer and Fall of 2010*
- *Preliminary reports still being prepared*

Coordination with:

- *State Historic Preservation Officer (SHPO)*

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Surveys: Wetlands and Waters of the U.S.

- **Completed Wetland Survey and Delineation**
  - *Complete survey of the Area of Potential Effect in Summer of 2010*
- **Coordination with:**
  - *U.S. Army Corps of Engineers*
- **Survey Results**
  - *Two named ephemeral drainages*
  - *11 unnamed ephemeral drainages*
  - *Preliminary determination as "jurisdictional water features"*

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Comments…We Want Your Input

- **Oral Comments are Noted During Meetings**
- **Written Comments, Questions and Concerns are Accepted**
  - *At Meetings*
  - *Via Mail – Send To:*
    - Robin Lacy, BLM Grand Junction Field Office
      2815 H Road
      Grand Junction, CO 81506
  - *Via Email – Send To:*
    - rlacy@blm.gov
- **Please Submit Scoping Comments by May 20, 2011**

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Next Steps

- Consider All Scoping Comments – After May 20,2011
- Finalize EA/RMP Amendment Scope of Services
- Begin Developing Detailed Alternatives
- Collect Additional Information
- Prepare Draft EA
- Make Draft EA Available for Public Review and Comment
- Publish Notice of Availability of Draft EA and Opportunity for Public Hearing
- Incorporate Comments into Final EA and RMP Amendment

Thank You!

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

GRAND JUNCTION REGIONAL AIRPORT EA

AGECNY SCOPING MEETING SIGN-IN SHEETS

Sign-In

Agency Scoping Meeting—April 5, 2011.

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

NAME	ADDRESS	TELEPHONE NUMBER	EMAIL ADDRESS
Collin Ewing	2815 H Rd	244-3027	cewing@blm.gov
AL MORGANFIELD (PSCo)	3 W. DRY CK. CIR LITTLETON Co. 80120	303-233-5700	AMORGANFIELD@CONETRIBEENERGY.COM
Scott Thompson	344 Horizon Ct #110	970 2414722	Sthompson@vccwest.com
KEVIN WILLIAMS	722 23 Rd	970 2502249	@VDD@GVII.NET
Craig Sparks	5705 S. Telluride Ct. Aurora 80015	303-870-9050	SKCCraig@comcast.NET
Catherine Roberts	[illegible]		
JASON VIRZI / JVIATION	900 S. BROADWAY, STE 350, DENVER	303-524-3025	JASON.VIRZI@JVIATION.COM
Bridget Clayton	2815 H Rd Grand Junction	970 244 3021	bclayton@blm.gov
Amy Jordan	2828 Walker Field Dr Ste 301 GJ	970 · 244 · 9100	ajordan@gjairport.com
Eddie Storer	" " " " " "	970 · 244 9100	estorer@gjairport.com
Janell Barrilleaux	ANM Regional Office	303-342-1261	janell.barrilleaux@faa.gov
Scott Brownlee	5126 Front Range Parkway Watkins CO	3-261-4418	Scott.brownlee@dot.State.co.us

Thank You!

Barnard Dunkelberg Company

Sign-In

Agency Scoping Meeting—April 5, 2011.

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

NAME	ADDRESS	TELEPHONE NUMBER	EMAIL ADDRESS
Robin Lacy	2815 H Rd. GJ CO 81506	970 244-3028	RLacy@blm.gov
Bob Hartman	" " " "	244-3041	bhartman@blm.gov
Hans Anker	FAA Denver ADO	303-342-1265	Hans.Anker@FAA.gov
Alan Schroeder	BOR, Grand Jct. CO 81506	970-248-0692	aschroeder@usbr.gov

Thank You!

Barnard Dunkelberg Company

GRAND JUNCTION REGIONAL AIRPORT EA

PUBLIC SCOPING MEETING SIGN-IN SHEETS

Sign-In

Public Scoping Meeting—April 5, 2011.

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

NAME	ADDRESS	TELEPHONE NUMBER	EMAIL ADDRESS
Dean Gilbert	2286 Vista Rio Ct.	970-245-1850	
Steve Lauderson	381 Cascade Dr. Cl	970-433-0420	glauderson1@bresnan.net
Scott Brownlee	CDOT- Aeronautics	3-261-4418	Scott.Brownlee@dot.state.co.us
Gary Schroen	GJRAA	2488540	GSCHROEN@GJAIRPORT.com
Kathie Lucas	GJRAA		Klucas@GJAIRPORT.COM
Edward J Behr	926 26 Rd		edbgj@msn.com
Dana Brewer		2168449	
Bruce Waterbaugh	6309 City Rd 8K, Meeker	970-878-5129	cjslashcowreanwildblue.org.
Janell Barrilleaux	FAA ANM Renton	303-342-1261	janell.barrilleaux@faa.gov
Tom LaCroix	GJRAA	245-4601	Tlacroix@qwestoffice.net
LES CRAWFORD	3235 LAKESIDE	773-0610	LESCRAWFORD99@GMAIL.COM
Sam Sasuras	2680 Capra Way 81506	275-2265	ssasuras@6mail.com

Thank You!

Barnard Dunkelberg Company

Sign-In

Public Scoping Meeting—April 5, 2011.

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

NAME	ADDRESS	TELEPHONE NUMBER	EMAIL ADDRESS
RYAN HAYES - BDC	1743 WAZEE ST DENVER	303-825-8844	RYAN@BDJ-C.COM
Denny Granum	854 La Rd		denny@monumenthomesgj.com
Doug Simons	653 Round Hill Dr. GJ	9702617430	Doug@enstrom.com
Collin Ewing	BLM	244-3027	cewing@fws.gov
Hans Anker	FAA	303 342 1265	Hans.Anker@faa.gov
[illegible]	GJRA	970-248-8595	[illegible]@gjairport.com
Bill Pitts	2626 H Rd GJ	970-242-7342	BBRPITTS@BRENNAN.NET
Robin Lacy	2815 H Rd GJ	970-244-3028	RLACY@blm.gov
JASON VIRA	JVIATION	303-524-3025	JASON.VIRA@JVIATION.COM
Jim Trott	Jviation	303-574-3040	jim.trott@jviation.com
Tony Tamara Crist			t_crist@hotmail.com
Jim Graves			

Thank You!

Barnard Dunkelberg Company

GRAND JUNCTION REGIONAL AIRPORT EA

SCOPING COMMENTS

Begin forwarded message:

From: rlacy@blm.gov
Date: January 18, 2011 12:02:22 PM MST
To: cewing@blm.gov, Ryan@bd-c.com, ajordan@gjairport.com
Subject: Fw: PUBLIC COMMENT ON FEDERAL REGISTER FW: needs eis not sloppy cheap ea GRAND JUNCTION RMP 729 ACRES DESTROYED

----- Forwarded by Robin Lacy/GJFO/CO/BLM/DOI on 01/18/2011 11:57 AM -----

"INFO PEWTRUSTS.ORG" <usacitizen1@live.com>
01/13/2011 10:51 AM

To: <gtfo_mail@blm.gov>, <robin_lacy@blm.gov>, <americanvoices@mail.house.gov>, <comments@whitehouse.gov>, <rush.holt@mail.house.gov>, <sf.nancy@mail.house.gov>
cc: <info@njcaan.org>
Subject: PUBLIC COMMENT ON FEDERAL REGISTER FW: needs eis not sloppy cheap ea GRAND JUNCTION RMP 729 ACRES DESTROYED

THE PUBLIC OWNS THIS LAND AND DOES NOT WANT TO USE IT FOR AN AIRPORT. THE PUBLIC SAVED THIS LAND AS OPEN SPACE. LET AN AIRPORT BUY THE LAND IT NEEDS. DENVER HAS A HUGE NEW AIRPORT AND THERE IS NEED FOR THIS GROWTH IN GRAND JUNCTIONS. AIRPORT IS A PROFIT CENTER AND NEEDS TO BUY LAND FROM PRIVATE OWNERS NOT TURN OPEN SPACE INTO CONCRETE HELL. NATIONAL TAXPAYERS OPPOSE THIS CHANGE OF THIS LAND INTO AIRPORT LAND.

AN EA IS NOT ACCEPTABLE AS IT IS A SLOPPY, CHEAP EXCUSE FOR A REAL ENVIRONMENTAL ANALYSIS. AN EIS IS REQUIRED UNDER NEPA AND THAT IS WHAT HAS TO BE PERFORMED. THIS GROUP SEEMS TO BE TRYIN GTO CHEAP THROUGH THIS SITE. THE IMPORTANT THING HERE ISNT THE NEEDS OF THE DOI - WHERE DO THEY GET OFF. THE NEEDS OF THE PEOPLE ARE WHAT COUNT. THE PEOPLE OF COURSE ROUTINELY GET DISRESPECTED AT THE BUREAU OF LAND MANAGEMENT WHICH IS FULL OF BRIBE TAKERS WHO PARTY WITH OIL PROFITEERS, AND TAKE BRIBES FROM THEM. THE VENAL VICIOUIS BLM IS ALSO ENGAGED IN KILLING EVERY WILD HORSE ON THE RANGE SO THEY CAN TURN

THE LAND OVER TO THE FAVOLRITE CATTLE RANCHERS - DO THEY BRIBE THEM TOO? WHO IS INVESTIGATING - SOMEBODY SHOULD. THERE SHOULD HAVE BEEN NO MOU BETWEEN THIS AIRPORT AND THE BLM WITHOUT PUBILC NOTICE AND SUCH IS UNLAWFUL. CROSSWIND RUNWAYS ARE USED ALL OVER THIS COUNTRY, EVEN IN CONGESTED NEW JERSEY. THAT IS NOT A BONA FIDE FOR THIS INCURSION OF THIS AIRPORT. AIR QUALITY, NOISE QUALITY, QUALITY OF LIFE VANISHES WITH PLANS LIKE THIS. THERE IS NOTHING TO PREVENT A HELICOPTER RUNNING TEN FEET OVER YOUR HOUSE. JET FUEL IS EXTREMELY TOXIC . GASOLINE IS TOXIC. THE SNOW REMOVAL TOXIC CHEMICALS ARE ALSO TOXIC AND WOULD BE REQUIRED TO HAVE HEAVY USE AT THIS AIRPORTG. ALL WILDLIFE AND BIRDS ARE MURDERED WHEN A BIG AIRPORT COMES IN. THEY KILL AND KILL AND KILL ALL SPECIES - DEER, BIRDS OF ALL KINDS. THE TOXIC EFFECTS ON THE ENVIRONMENT ARE HORRENDOUS. WHO WOULD WANT TO DRINK WATER FROM A NEARBY AIRPORT? THE NOSIE IS HORRIFIC WITH ALL DAY AND ALL NIGHT AIRPLANES TAKING OFF AND LANDING. AND THEY BRING IN PASSENGERS AND THE PEOPLE LIVING THERE DONT EVEN KNOW WHO IS BROUGHT IN. YOU HAVE PASSENGERS SKULKING AROUND IN THE NIGHT TIME. THIS LAND SHOULD NOT BE MISMANAGED AND TAKEN FOR THIS AIRPORT EXPANSION. POLEASE MAKE SURE I AM ON A CONTINUING LIST FOR PAPER COPIES OF ANY NEW ATTEMPTS TO HAVE THIS LAND MISMANAGED LIKE THIS. JEAN PUBLIC ADDRESS IF REQUIRED.

[Federal Register Volume 76, Number 9 (Thursday, January 13, 2011)]
[Notices]
[Pages 2412-2413]
From the Federal Register Online via the Government Printing Office [
www.gpo.gov]
[FR Doc No: 2011-556]

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[LLCONO3000.L1610000.DSO000]

Notice of Intent To Amend the Grand Junction Resource Management Plan, Prepare an Environmental Assessment, and Notice of Realty Action, Colorado

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice of Intent and Notice of Realty Action.

SUMMARY: The Grand Junction, Colorado, Regional Airport Authority has requested the Bureau of Land Management (BLM) Grand Junction Field Office (GJFO) to consider the transfer of title to approximately 720 acres of public land for airport improvements, including relocation and construction of the main runway for the Grand Junction Regional Airport. Public Land Order No. 7027 (59 FR 3000 January 20, 1994) withdrew these lands from mining claim location in anticipation of a need for future airport expansion. The BLM's consideration of the Grand Junction Regional Airport Authority's (Airport Authority) request initiates a BLM Notice of Intent to initiate a public scoping process to amend the BLM GJFO 1987 Resource Management Plan (RMP) and prepare an Environmental Analysis (EA). The request also initiates a Notice of Realty Action (NORA) to assist the BLM in determining whether granting the requested title conveyance is consistent with the needs of the Department of the Interior. This notice initiates the public scoping process and concurrent opportunity for submission of public comments for the EA, RMP Amendment, and NORA.

DATES: Comments on this project, the NORA, or the proposed transfer of title to the Airport Authority may be submitted in writing until February 28, 2011. The date(s) and location(s) of scoping meetings will be announced at least 15 days in advance through local media, newspapers and the BLM Web site at: http://www.blm.gov/co/st/en/fo/gjfo.html. In order to be included in the EA, all comments must be received prior to the close of the scoping period or 45 days after the last public meeting, whichever is later.

ADDRESSES: Written comments should be sent to the Grand Junction Field Office, Bureau of Land Management, 2815 H. Road, Grand Junction, Colorado 81506, or via fax at (970) 244-3083. E-mail comments may be sent to GJFO_mail@blm.gov. Comments, including names and addresses of respondents, will be available for public review at the BLM GJFO, during regular business hours 7:30 a.m. through 4:30 p.m., Monday-Friday, except holidays.

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment-including your personal identifying information-may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

FOR FURTHER INFORMATION CONTACT: For further information and/or to have

your name added to our mailing list contact Robin Lacy, Project Manager, telephone (970) 244-3028. Project documents may be reviewed on the BLM GJFO Web site at http://www.blm.gov/co/st/en/fo/gjfo.

SUPPLEMENTARY INFORMATION: The purpose of the public scoping process is to identify those issues that should be considered in the EA and to initiate public participation in the planning process. BLM and Airport Authority personnel will be present at scoping meetings to explain the proposed action and other requirements for preparing the EA. Interested parties can request notification of any encumbrances or other claims relating to the land. Customary Federal Aviation Administration (FAA) conditions, in draft, that are proposed to be included in a land patent from the United States to the Airport Authority will also be available for review. The public lands requested for title transfer are within the jurisdiction of the BLM GJFO adjacent to the Grand Junction Regional Airport in the North Desert and are described as follows:

Ute Principal Meridian

T. 1 N., R. 1 W.,
Sec. 23, S\1/2\NE\1/4\;
Sec. 24, S\1/2\NE\1/4\, N\1/2\SE\1/4\, and SE\1/4\SE\1/4\;
T. 1 N., R. 1 E.,
Sec. 19, lots 3 and 4, and E\1/2\SW\1/4\;
Sec. 29, SW\1/4\NW\1/4\;
Sec. 30, lot 1, NE\1/4\, and NE\1/4\NW\1/4\.

The areas described contain approximately 720 acres in Mesa County.

These are public lands administered by the BLM GJFO and do not include any private, State, tribal trust or Federal lands not administered by the BLM, the lands proposed for the title transfer to the Airport Authority are currently withdrawn from the United States mining laws by Public Land Order No.

[[Page 2413]]

7027 (59 FR 3000 (1994)), and are not intended for further segregation.

The EA will fulfill the needs and obligations set forth by the National Environmental Policy Act and associated Council of Environmental Quality Regulations (40 CFR 1500). The EA will also fulfill requirements of the Federal Land Policy and Management Act of 1976 (FLPMA), 43 U.S.C. 1701, Section 516 of the Airport and Airway Improvement Act of 1982 (49 U.S.C. 2215), Airport Grant regulations at 43 CFR 2640, applicable planning regulations at 43 CFR 1600, and BLM management policies.

The purpose of the proposed land title transfer from the United

States to the Airport Authority is to fulfill the BLM's intent to make such lands available to the Airport Authority for a beneficial public use as described in the 1991 Memorandum of Understanding between the BLM and the Airport Authority. As authorized through the FLPMA, these lands will also be considered for title transfer to the Airport Authority in an amendment to the Grand Junction RMP. The BLM will determine whether or not to transfer title to the lands based on the EA, and the assessed environmental impacts of transferring title to the lands.

The purpose of the runway relocation is to comply with the FAA design standards by correcting deficiencies related to runway and taxiway gradients and to eliminate intersecting runways at the airport. The need for the proposed runway relocation is to increase safety at the Grand Junction Regional Airport, which is one of the few commercial service airports in the State of Colorado that still has a geometric runway layout consisting of an intersecting crosswind runway. The runway intersection increases the potential for runway incursions, which are defined by the FAA as ``any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft." Increasing runway safety has been made a high priority in recent years and the FAA has published guidance on improving runway safety through airfield configuration. Also, several design components of the runway at Grand Junction Regional Airport do not meet the FAA design standards, including the following:

Runway 11/29 Transverse Gradient. Portions of the runway exceed the maximum recommended design standard of 1.5 percent;

Runway 11/29 Longitudinal Gradient. A portion of the runway near the approach end of Runway 29 exceeds the maximum recommended design standard of 0.8 percent;

Runway 11/29 Connecting Taxiway Gradient. A number of the connecting taxiways between Runway 11/29 and parallel Taxiway ``A" exceed the maximum recommended design standard of 1.5 percent; and

Runway 11/29 and Runway 4/22 Runway Visibility Zone (RVZ). Numerous structures obstruct line of sight between runway mid-points.

The BLM seeks resource information and data for other public land values [i.e., air quality, cultural and historic resources, fire and fuels, fisheries, forestry, lands and realty, non-energy minerals and geology, oil and gas (including coalbed methane), paleontology, rangeland management, recreation, soil, water, and wildlife] in the BLM GJFO planning area. The purpose of this request is to assure that the planning effort has sufficient information to consider a reasonable range of resource uses, management options, and alternatives for the

public lands involved.

Proprietary data marked as confidential may be submitted in response to this call for coal, oil and gas, and other resource information. Please submit all proprietary information submissions to the address listed above. The BLM will treat submissions marked as ``Confidential'' in accordance with the laws and regulations governing the confidentiality of such information.

The BLM GJFO will work collaboratively with interested parties to identify the management actions and decisions that are best suited to local, regional, and national needs. Potential issues that have been identified to date include, but are not limited to the following general categories: Wildlife (including birds); vegetation (including weeds and invasive plant species); threatened, endangered, and sensitive species; public access; visual concerns; cultural resources; tribal concerns; rangeland resources; geology and soils; hydrology; recreation resources; hazardous materials; air quality; noise; and socio-economics. The BLM has established a 45-day scoping period during which affected tribes, landowners, concerned citizens, special interest groups, local governments, and any other interested parties are invited to comment on the scope of the EA. Scoping will help the BLM identify the full range of issues that should be addressed in the EA.

Authority: Airport and Airway Improvement Act of September 3, 1982 (49 U.S.C. 4761, 49 U.S.C. 47101 et seq., 3 CFR 2640 et seq.).

Helen M. Hankins,
State Director.
[FR Doc. 2011-556 Filed 1-12-11; 8:45 am]
BILLING CODE 4310-JB-P

April 6, 2011

David Kiel
2688 G ½ Road
Grand Junction, CO 81506
(970) 241-8152

BLM Grand Junction Field Office
c/o Robin Lacy
2815 H Road
Grand Junction, CO 81506

RECEIVED
BUREAU OF LAND MGMT.
GRAND JCT., CO
2011 APR -7 PM 2:01

RE: Airport Land Transfer

Dear BLM:

It is all about **ACCESS** !!!!!!

I understand the wants and needs of the Grand Junction Regional Airport and I do not have an objection to the BLM providing the Airport the land for needed safety and expansion to the north of the runways. What I do object to is limiting **ACCESS** to BLM land, which is highly used by the public.

The four objects to the plan are based on **ACCESS** to the east and west boundaries of the Airport.

Objection 1:

The moving of 27 ¼ Road to the west makes sense. What does not make sense is the "Proposed General Use Parking Area" along 27 ¼ Road. Instead of having the parking area on Airport owned land, (which the Airport could deny access) exchange the land owned by the Airport for the land they want north of the runways. See land circled in red on the attached map. This land exchange would guarantee parking in a flat area with BLM control and will guarantee **ACCESS** in the area for the future.

The Airport's intent was made clear last year when the Airport posted signs on 27 ¼ Road threatening to deny access to the land owned by the Airport right where the proposed parking lot is located. Save our **ACCESS** from Airport control.

Objection 2:

With the Airport fencing in the southeast corner of their property, they have eliminated the only large flat parking area near I70. Again, it is all about **ACCESS**.

I would suggest a land exchange for the lots owned by the Airport to the far east for the property the Airport wants to the north of the runways. These lots are highlighted in blue on the attached Mesa County Assessor's map. This land swap would allow uninterrupted access to BLM land from the I70 Frontage Road. It would be in BLM control, instead of having the 'Proposed General Use Parking Area' located on Airport owned land. It is all about future **ACCESS**.

Objection 3:

Based on the enclosed proposed map, the shifting of 27 ¼ Road includes the placement of a 'round-about' at the intersection of 27 ¼ Road and Landing View Lane. The people who use the desert routinely pull trailers, campers and large RVs. A round about is a very poor design for these types of vehicles and the connection of Landing View Lane to 27 ¼ Road will increase Airport traffic on 27 ¼ Road and for the local residences. The round-about will reduce **ACCESS.**

Objection 4:

The Daily Sentinel April 5th article indicates the Airport is seeking 26,000 acres to the north of the airport. I highly object to that proposal and will do everything in my power to stop it from happening. I also object to the statement "Airport officials are worried about fireworks that are set off in the area and wayward bullets from target practice that occurs there." If they have such concerns they should pay for security to patrol the area not by taking over all or our public lands.

There is no reason for the airport not to exchange land needed for access to public lands. They are asking us to give up land owned by all; they should be willing to consider the needs of the public. It is not a one-way street. I would challenge you to do the right thing for the public and secure permanent **ACCESS** to our valuable OHV lands both to the east and west ends of the Airport.

Thank you,

Dave Kiel

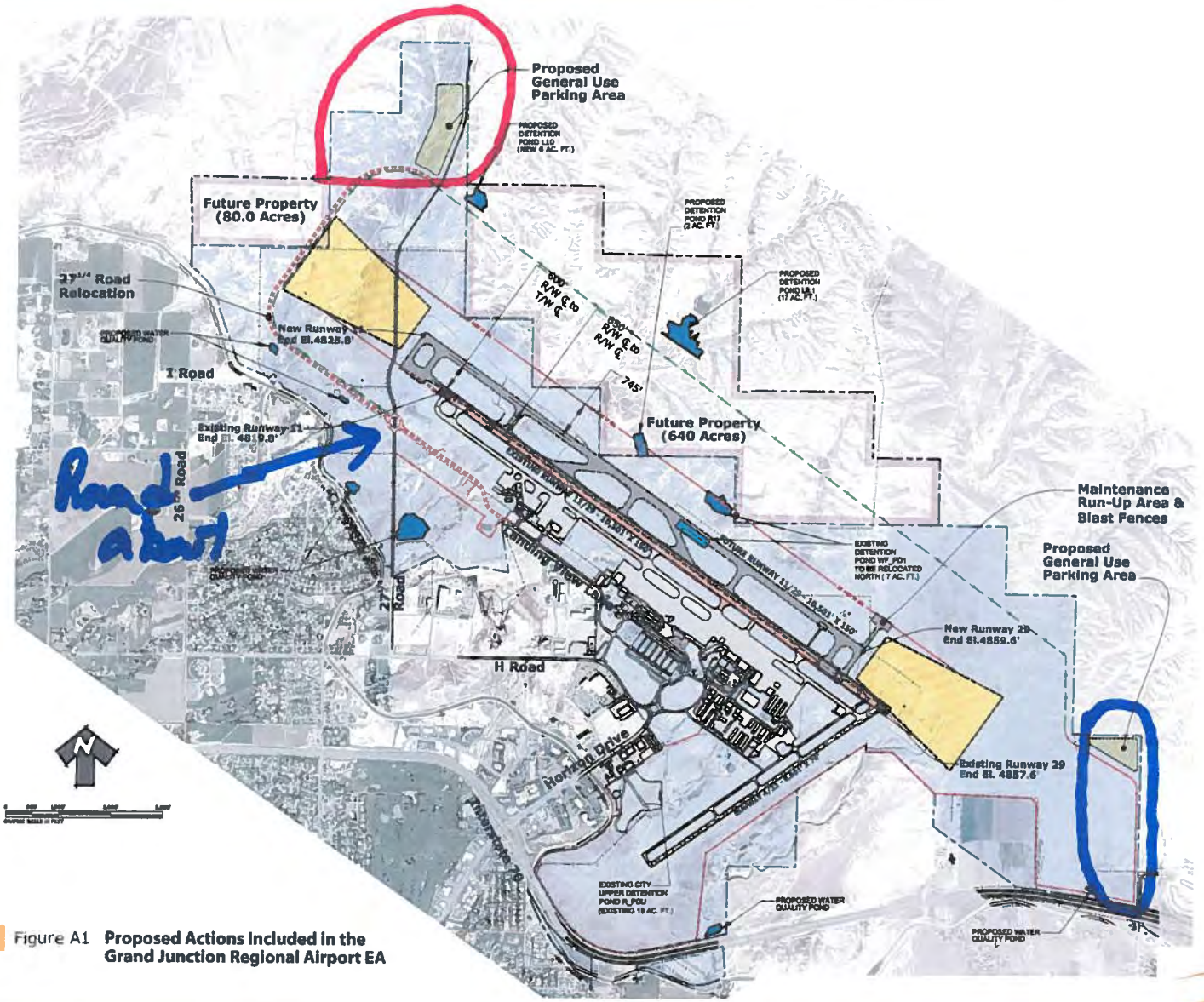
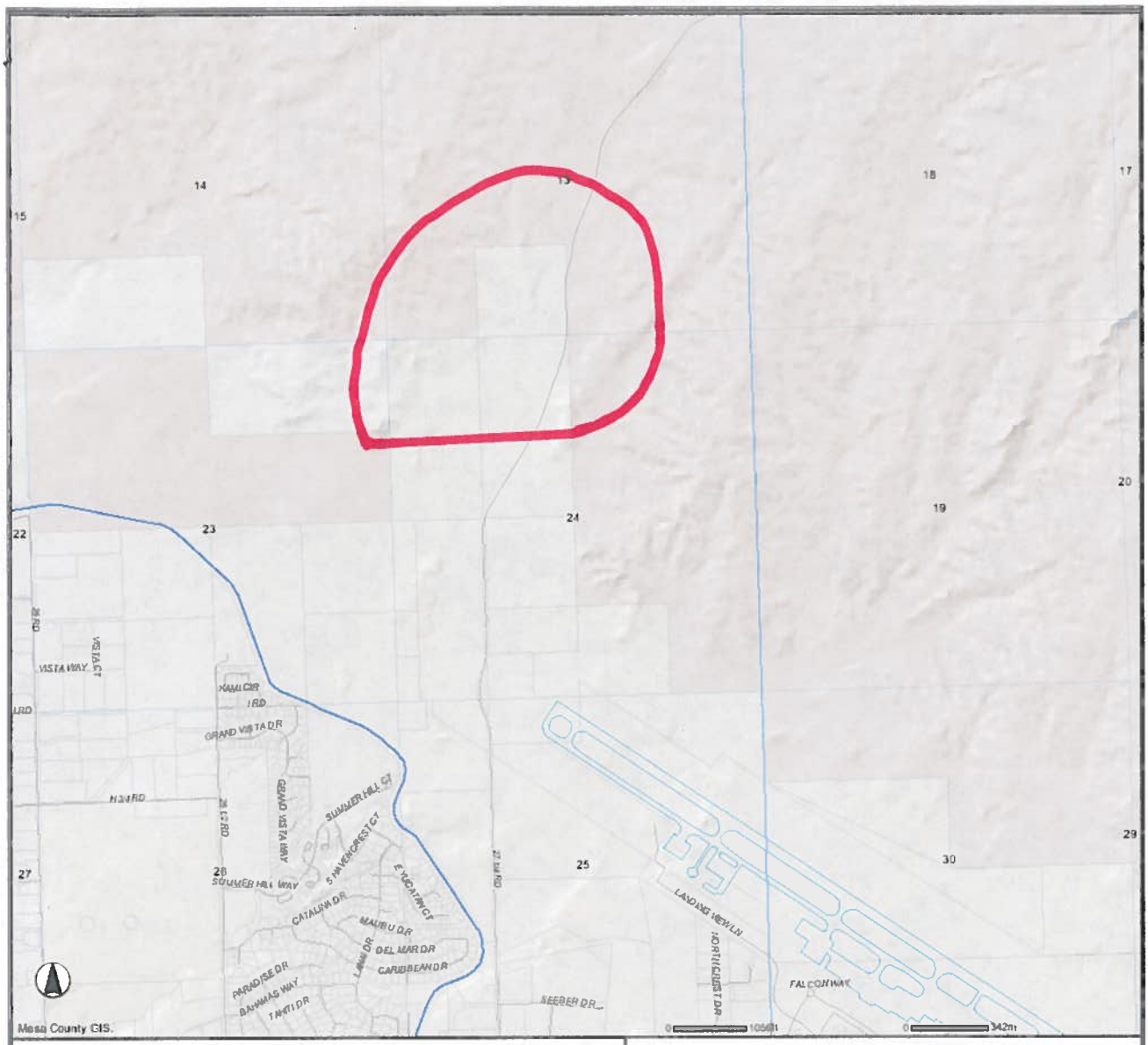


Figure A1 **Proposed Actions Included in the Grand Junction Regional Airport EA**

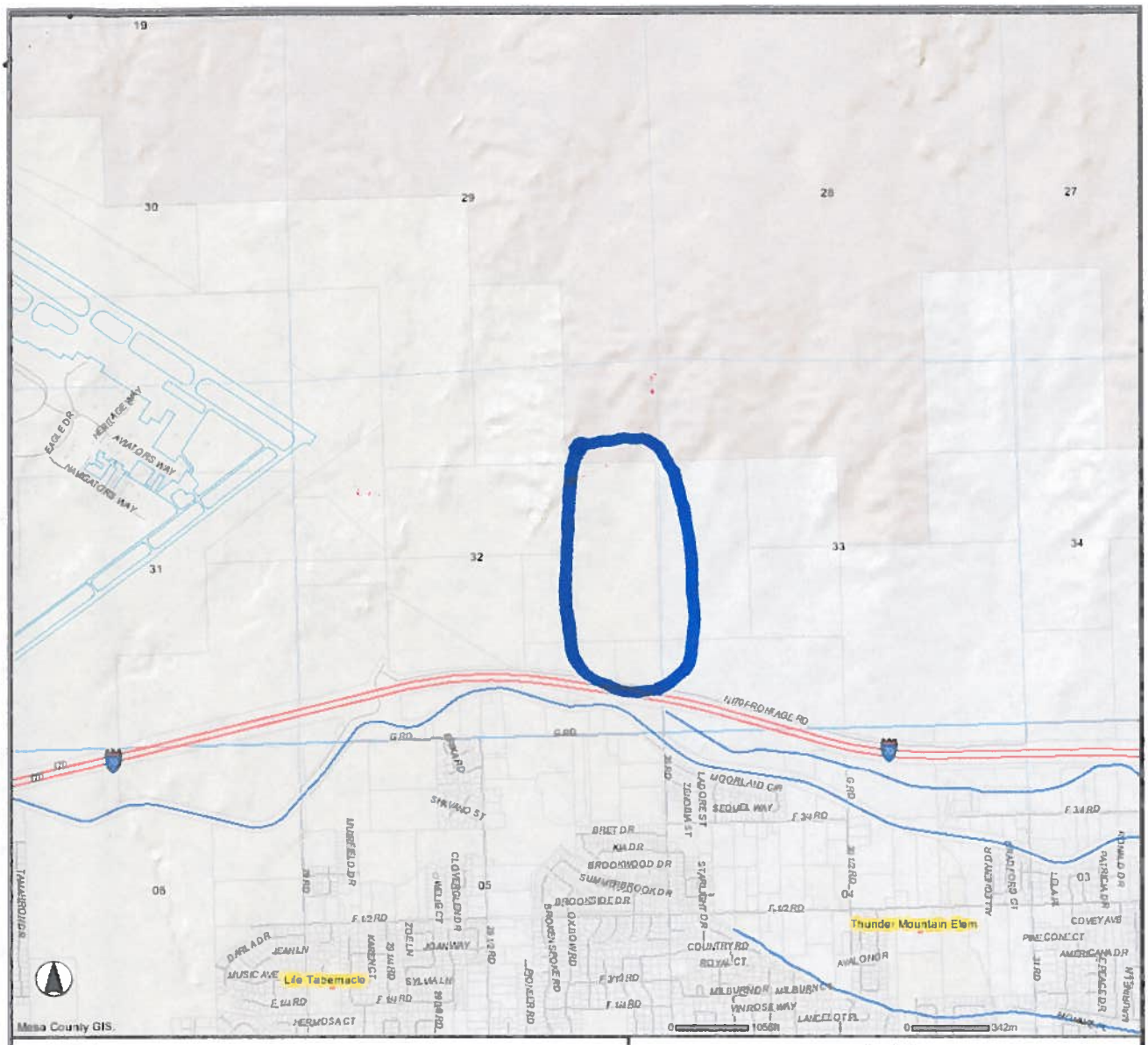


Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest



Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest



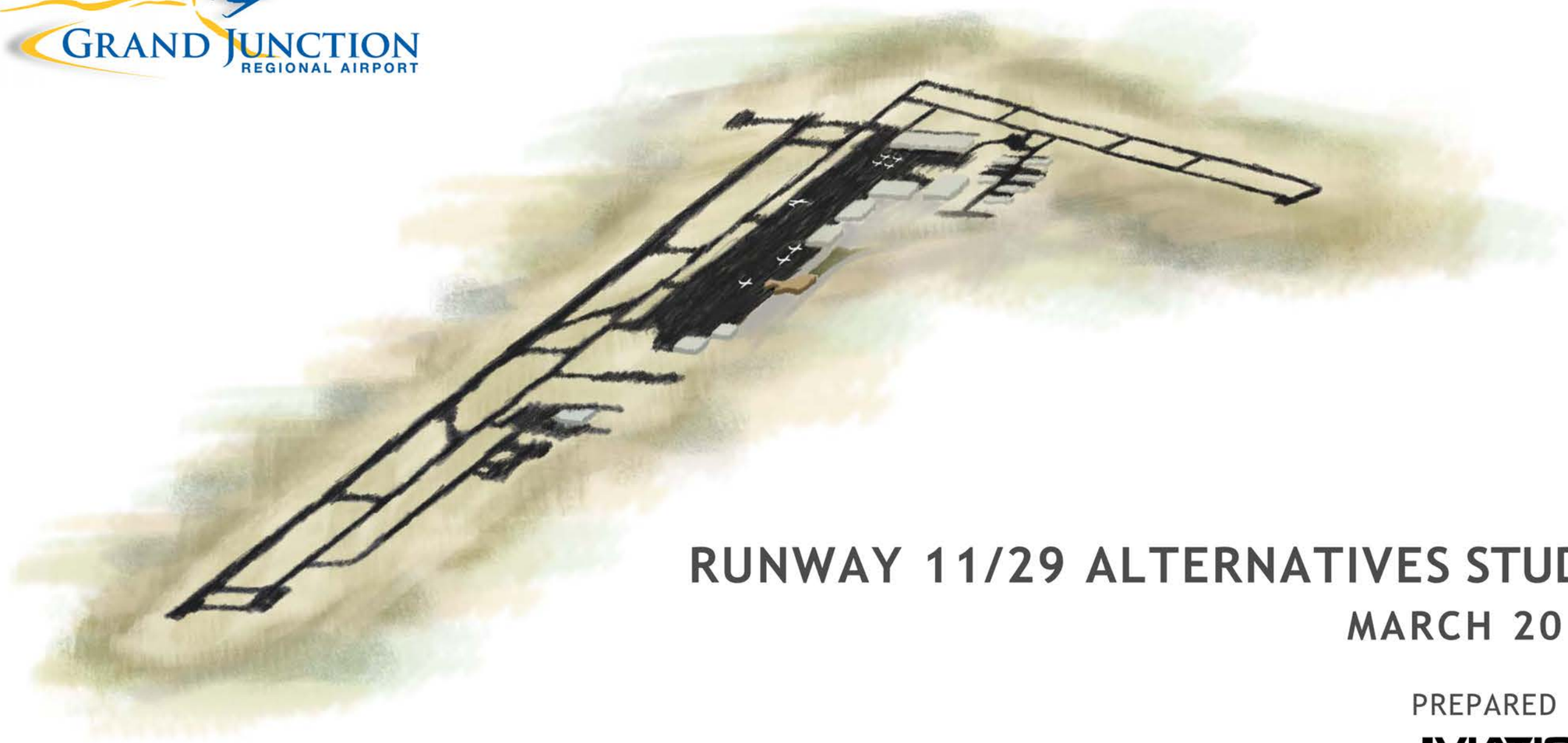
ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 2

RUNWAY 11/29 ALTERNATIVES STUDY

GRAND JUNCTION
REGIONAL AIRPORT



RUNWAY 11/29 ALTERNATIVES STUDY

MARCH 2011

PREPARED BY:

JVIATION®

900 S. BROADWAY, SUITE 350 | DENVER, CO 80209 | P. 303.524.3030 | F. 303.524.3031 | JVIATION.COM

Contents

I-Executive Summary 1
1. Introduction 2
1-1 Purpose 2
1-2 Operational Usage at Airport and Economic Impact 2
1-3 Airport Reference Code 2
1-4 Current Condition of Runway 11/29 2
1-5 Non-Standard Conditions 2
1-5.1 Longitudinal Runway Grades 2
1-5.2 Transverse Runway Grades 3
1-5.3 Runway Visibility Zone (RVZ) 3
1-5.4 Runway Crown 3
1-6 Airport Hot Spots 4
2. Runway 11/29 Alternatives 5
2-1 Alternative 1 – Reconstruct Runway 11/29 with a 1,800 Foot Extension to Runway 11 5
2-1.1 Design Options 5
2-1.2 Construction Impacts to Airport Operations 5
2-1.3 Estimated Construction Costs 10
2-1.4 Economic Impacts to Airport and Local Economy 10
2-1.5 Project Funding 10
2-2 Alternative 2 – Reconstruct Runway 11/29 with a 1,800 Foot Extension to Runway 11 and Runway 4/22 Upgrade 11
2-2.1 Design Considerations 11
2-2.2 Improvements to Runway 4/22 11
2-2.3 Reconstruction of Runway 11/29 14
2-2.4 Estimated Construction Costs 14
2-2.5 Economic Impacts to Airport and Local Economy 15
2-2.6 Project Funding 15
2-3 Alternative 3 - Construct Runway 11/29 at 650 Foot Offset of Existing Runway 11/29 Centerline 16
2-3.1 Construction Impacts to Airport Operations 16
2-3.2 Terminal Area and Apron Expansion 16
2-3.3 Improved Runway Efficiency 16
2-3.4 Estimated Construction Costs 16
2-3.5 Economic Impacts to Airport and Local Economy 16
2-3.6 Project Funding 16
2-4 Alternative 4 - 50 Foot Widening of Runway 11/29 20
2-4.1 Runway 11/29 Improvements 20
2-4.2 Pavement Life 20
2-4.3 Economic Impacts to Airport and Local Economy 20
2-4.4 Estimated Construction Costs 20
2.5 Alternative 5 – Overlay of Runway 11/29 21
2-5.1 Runway 11/29 Improvements 21
2-5.2 Pavement Life 21
2-5.3 Economic Impacts to Airport and Local Economy 21
2-5.4 Estimated Construction Costs 21
3. Conclusion 22
3-1 Alternative Rankings 22
3-1.1 Correction of Non-Standard Conditions 22
3-1.2 Construction Costs 22
3-1.3 Economic Costs 22
3-1.4 Funding Potential 22
3-1.5 Total Score 22

Figures

Figure 1.1: Runway 29 Profile 2
Figure 1.2: Runway 11/29 Cross Section at Connector Taxiway 3
Figure 1.3: Existing Runway Visibility Zone (RVZ) 3
Figure 1.4: Center Crown 3
Figure 1.5: Offset Crown 4
Figure 1.6: Airport Hot Spots 4
Figure 1.7: Airport Diagram 4
Figure 2.1: Runway 11/29 Extension Profile 5
Figure 2.2: Alternative 1 Project Schedule 6
Figure 2.3: Alternative 1 Phase 1 7
Figure 2.4: Alternative 1 Phase 2 8
Figure 2.5: Alternative 1 Phase 3 9
Figure 2.6: Transitional Layout 10
Figure 2.7: Runway 4/22 Profile 11
Figure 2.8: Alternative 2, Phase 1 12
Figure 2.9: Alternative 2, Phase 2 13
Figure 2.10: Runway 22 Safety Area Section 14
Figure 2.11: Runway 22 Threshold Section 14
Figure 2.12: Runway 4 Threshold Section 14
Figure 2.13: Future Development 17
Figure 2.14: Alternative 3, Phase 1 18
Figure 2.15: Alternative 3, Phase 2 19
Figure 2.16: Alternative 4 Section 20
Figure 2.17: Alternative 5 Section 21

Tables

Table I.1 Alternatives Summary 1
Table 2.1: Alternative 1: Construction Cost Estimate 10
Table 2.2: Alternative 2: Upgrade Runway 4/22 Construction Cost Estimate 15
Table 2.3: Alternative 2: Reconstruct Runway 11/29 With a 1,800' Extension Construction Cost Estimate 15
Table 2.4: Alternative 3: Construction Cost Estimate 16
Table 3.1: Alternative Rankings 22

I-Executive Summary

The Grand Junction Regional Airport is a Part 139 certified towered airport that plays a vital role in the economy of the City of Grand Junction and the local communities. The airport contains two runways. The primary runway is Runway 11/29 which is 10,501 feet in length and meets ARC D-IV criteria. The secondary runway is Runway 4/22 which is 5,501 feet in length and meets ARC B-II criteria. As the airport's only runway with an instrument approach, Runway 11/29 is used for the far majority of the airport's 80,000 annual operations. Aircraft of all types operate at the airport, including six airlines, air cargo services, and a wide spectrum of jet and turbo propeller general aviation aircraft. The airlines primarily use regional jets such as the Canadair Regional Jet (CRJ) or the Embraer 145 (ER4). Air cargo services at the airport are provided by Federal Express who have daily operations using Boeing 727 and 757 aircraft.

Runway 11/29 contains non-standard conditions that affect the runway's level of safety. These non-standard conditions have been accepted by the FAA and are documented under the FAA Airspace Case Numbers (FAA AC#) stated below.

- Runway 11/29 longitudinal grades in excess of 0.8% (FAA AC# 94-DEN-161-NRA)
- Runway 11/29 transverse grades in excess of 1.5% (FAA AC# 94-DEN-161-NRA and 2008-ANM289-NRA)
- Connector taxiway longitudinal grades in excess of 1.5% (FAA AC# 94-DEN-161-NRA and 2005-ANM-318-NRA)
- Runway 11/29 Runway 4/22 Visibility Zone (FAA AC# 02-DEN-044-NRA)

Existing Runway 11/29 pavements are nearing the end of their useful life. The underlying pavements date back to the 1950s and 1960s. The most recent construction on Runway 11/29 was completed in 2009. The intent of that project was to get another 10 years of useful life from the runway by replacing the top two inches of pavement with new asphalt. This would allow time for the FAA and the Airport Authority to develop a plan to completely rebuild the runway in order to correct the non-standard conditions and replace the aging pavements.

This paper analyzes five alternatives for fixing the pavements and non-standard conditions of Runway 11/29. These five alternatives are as follows:

- **Alternative 1** – Reconstruct Runway 11/29 with a 1,800 foot Extension to Runway 11
- **Alternative 2** – Reconstruct Runway 11/29 with a 1,800 foot Extension to Runway 11 and Runway 4/22 Upgrade
- **Alternative 3** – Construct Runway 11/29 at 650 Foot Offset of Existing Runway 11/29 Centerline
- **Alternative 4** – 50 foot widening of Runway 11/29
- **Alternative 5** – Overlay of Runway 11/29

Descriptions and detailed discussion for these five alternatives are contained in Section 2 of this report. With the exception of Alternative 3, all of the alternatives will either reconstruct or rehabilitate Runway 11/29 in its current location. Alternative 3 will shift the runway 650 feet to the northeast.

Each alternative was analyzed with respect to the following four categories:

- Estimated cost of construction
- Economic impact to the airport and local communities
- Correction of non-standards conditions
- Potential for securing project funding

A summary of the five alternatives is presented in Table I-1: Alternatives Summary.

Based on the analysis performed, Alternative 3 is the preferred alternative since it ranked best in three of the four categories. While the estimated construction cost for Alternative 1 is less than the costs for Alternative 3, its economic loss to the airport and local communities due to a six month closure of the airport's primary runway could far outweigh the additional construction costs of Alternative 3. Additionally, the ability to secure funding for Alternative 1 is highly unlikely since the project would be required to be funded over a 2-3 year period, whereas funding for Alternative 3 could be spread out over a more reasonable 10-15 year period. With respect to Alternative 2, Alternative 3 is superior in all four categories since it has lower construction costs, less economic impact, corrects all non-standard conditions, and better funding potential. Alternatives 4 and 5 ranked last out of all the alternatives, due to their shortened useful pavement life, their inability to correct all non-standard conditions, and their economic impact during construction.

TABLE I.1: ALTERNATIVES SUMMARY

ALTERNATE	ESTIMATED CONSTRUCTION COST	ECONOMIC IMPACT	NON-STANDARD CONDITIONS	FIXED	FUNDING POTENTIAL
Alternate 1 - Reconstruct Runway 11/29 with a 1,800 Foot Extension to Runway 11	$62,468,840.00	6 month closure of primary runway resulting in hundreds of millions of dollars of economic loss to airport and local communities.	1)Runway 11/29 Longitudinal Grades	☑	Low - Accelerated construction schedule required to minimize airport operations. Securing $62 million of funding over 2-3 years is unlikely.
			2)Runway 11/29 Transverse Grades	☑	
			3)Non-Standard Runway Visibility Zone	☑	
			4)Correction of Runway Offset Crown	☑	
			5)Connector Taxiway Longitudinal Grades	☐	
Alternate 2 - Reconstruct Runway 11/29 with a 1,800 Foot Extension to Runway 11 and Runway 4/22 Upgrade	$102,296,860.00	6 month restricted commercial use due to shortened (7,000 feet) runway length.	1)Runway 11/29 Longitudinal Grades	☑	Low - Accelerated construction schedule required to minimize airport operations. Securing $102 million of funding over 2-3 years is unlikely.
			2)Runway 11/29 Transverse Grades	☑	
			3)Non-Standard Runway Visibility Zone	☑	
			4)Correction of Runway Offset Crown	☑	
			5)Connector Taxiway Longitudinal Grades	☐	
Alternate 3 - Construct Runway 11/29 at 650 Foot Offset of Existing Runway 11/29 Centerline	$91,974,160.00	None - airport will maintain normal operations during construction.	1)Runway 11/29 Longitudinal Grades	☑	High - Project can be spread out over many years since construction will not affect airport operations. Securing $92 million over 10-15 years is feasible.
			2)Runway 11/29 Transverse Grades	☑	
			3)Non-Standard Runway Visibility Zone	☑	
			4)Correction of Runway Offset Crown	☑	
			5)Connector Taxiway Longitudinal Grades	☑	
Alternate 4 - 50 Foot Widening of Runway 11/29	Construction costs not determined since alternative was considered not viable due to limited pavement life.	6 month closure of primary runway resulting in hundreds of millions of dollars of economic loss to airport and local communities.	1)Runway 11/29 Longitudinal Grades	☐	Funding potential was not analyzed since alternative was considered not viable due to limited pavement life.
			2)Runway 11/29 Transverse Grades	☑	
			3)Non-Standard Runway Visibility Zone	☐	
			4)Correction of Runway Offset Crown	☑	
			5)Connector Taxiway Longitudinal Grades	☐	
Alternate 5 - Overlay of Runway 11/29	Construction costs not determined since alternative was considered not viable due to limited pavement life.	6 month closure of primary runway resulting in hundreds of millions of dollars of economic loss to airport and local communities.	1)Runway 11/29 Longitudinal Grades	☐	Funding potential was not analyzed since alternative was considered not viable due to limited pavement life.
			2)Runway 11/29 Transverse Grades	☑	
			3)Non-Standard Runway Visibility Zone	☐	
			4)Correction of Runway Offset Crown	☑	
			5)Connector Taxiway Longitudinal Grades	☐	

Note: Shaded cells received the best ranking for that category

1. Introduction

1-1 Purpose

The primary intent of this paper is to document the analytical process undertaken in evaluating solutions to provide for a 30 year pavement life for Runway 11/29 at the Grand Junction Regional Airport that meet all FAA design standards. Presently Runway 11/29 has an estimated pavement life of eight to ten years and contains non-standard FAA design conditions that require FAA approved modification to standards.

The analysis presented in this report was performed in the fall of 2008 as a result of meetings held between the Federal Aviation Administration (FAA), the airport, and the airport's engineering consultants regarding the future of Runway 11/29. During this time, the airport was moving forward with the design of the 2009 Runway 11/29 rehabilitation project (AIP-35). The intent of this project was to replace the top two inches of the existing asphalt pavement with a two inch overlay. This would extend the life of the runway by approximately 10 years, and in turn, would buy the FAA and the airport enough time to develop a plan for replacing the runway's aging underlying pavements while correcting non-standard conditions. The FAA, along with the airport and their consultants, developed and analyzed multiple alternatives for correcting and rehabilitating Runway 11/29. The findings from these alternatives are summarized in this report.

The FAA has established standards for runways to ensure safe aircraft operations. These standards are contained in Advisor Circulars (AC) published by the FAA and are used in the design of runway projects.

The principal Advisory Circular utilized in the geometric and vertical design of a runway is AC 150/5300-13, Airport Design (AC 5300-13). This circular provides all essential FAA criteria for runways and taxiways including: separation minimums, longitudinal and transverse grade requirements, grade break limitations, pavement widths, and safety area and object free area requirements. With airport operational safety residing at the top of the FAA's priority list, they are insistent that runways adhere to the standards contained in this document.

1-2 Operational Usage at Airport and Economic Impact

The Grand Junction Regional Airport is centrally located near the western border of Colorado along Interstate I-70 and provides non-stop commercial service flights to Denver, Salt Lake City, Las Vegas, Los Angeles, Phoenix, Houston, and Dallas/Fort Worth. Six commercial airlines (United, US Airways, Delta, American, Continental, and Allegiant Air) provide either daily or weekly service to these destinations. In addition to the scheduled commercial service, the airport serves extensive corporate jet traffic, charter services, general aviation traffic, and air cargo operations. With a maximum runway length of 10,501 feet, the airport is in a select group of airports within the region that can service air carrier jet operations.

The airport provides passenger and air cargo service for much of Western Colorado and Eastern Utah. Federal Express operations at the airport provide air cargo services for the City of Grand Junction as well as many of the surrounding communities. The airport provides a vital role in the stability and future growth of the local economy. The 2008 Colorado Airports Economic Impact Study, prepared by the Colorado Department of Transportation, Aeronautics Division (CDOT), determined that the airport's annual economic output was in excess of $600,000,000.

1-3 Airport Reference Code

The FAA uses a coding system for runways that relate actual aircraft operations to FAA design criteria. Each runway at an airport is designed in accordance with the Airport Reference Code (ARC) standards as described in the AC 5300-13.

Runway 11/29 is 10,501 feet in length, 150 feet wide with 25 foot paved shoulders, and is classified as a ARC D-IV runway. The "D" component for Runway 11/29 represents the approach speed associated with commercial regional jet aircraft (e.g., the Canadair CRJ-200) while the "IV" component is for the dimensional aspects associated with a Boeing B-757. Both of these aircraft operate routinely at the airport and are the most demanding aircraft at the airport for each ARC component. Based on 2007 USDOT data, CRJs have approximately 4,500 commercial operations per year while B-757s have approximately 630 operations per year. The runway is constructed of asphalt and has a design strength of 260,000 pounds for dual tandem gear aircraft which is representative of a Boeing B-757.

Runway 4/22 is classified as a ARC B-II and is sized to handle smaller jets and turbo propeller aircraft such as the Cessna Citation 550. The runway is 5,501 feet in length and 75 feet wide with a design strength of 26,000 pounds for dual wheel aircraft.

1-4 Current Condition of Runway 11/29

The pavements that comprise Runway 11/29 are essentially a hodgepodge of overlays on top of the runway's original asphalt pavement that was constructed in 1958. Rehabilitation projects were completed in 1966, 1983, 1995, 1996, and the latest completed in 2009 when the top 2-inches of the entire runway was rotomilled and overlayed with a nominal 2-inches of asphalt pavement. While the surface of the runway appears to be in good shape, the underlying pavements and aggregate bases are at the end of their useful life. With these underlying pavements ranging from 40-50 years in age, it was understood by the FAA and airport staff that the 2009 project was simply a "band-aid" to extend the life of the runway for approximately 10 years. This would buy enough time so that funding could be arranged to completely reconstruct the runway to replace the aging pavements as well as correct non-standard conditions. Therefore, a newly constructed or reconstructed runway would be planned to open around the year 2019.

1-5 Non-Standard Conditions

The primary runway at the Grand Junction Regional Airport is Runway 11/29. It does not meet all of the FAA standards as set forth in the AC 5300-13. In its current condition, the runway is considered non-standard and operates at a reduced level of safety. The areas of the runway that are non-standard are:

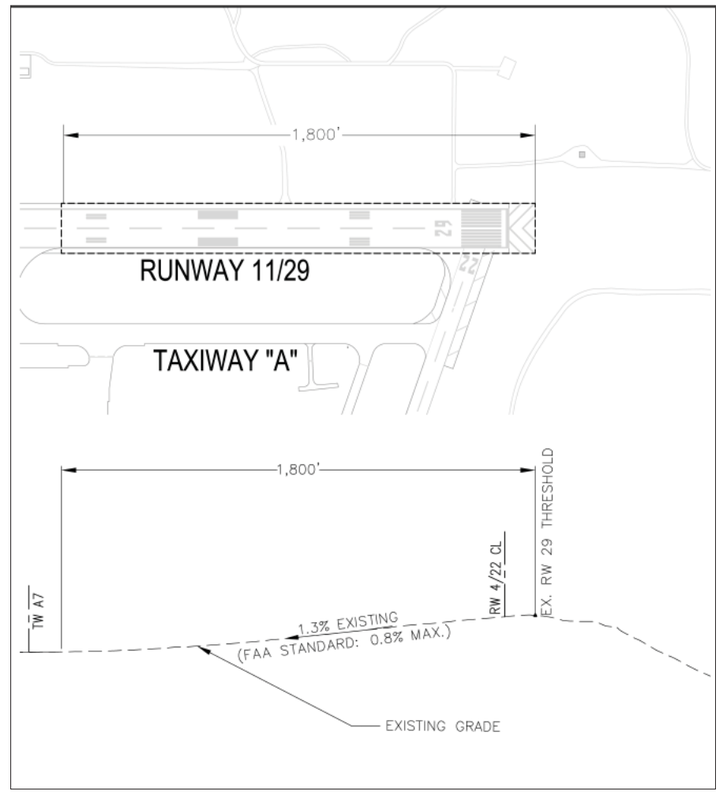
- Longitudinal Runway Grades
- Transverse Runway Grades
- Runway Visibility Zone (RVZ)
- Runway Crown

These non-standard conditions are discussed in more detail below.

1-5.1 Longitudinal Runway Grades

The FAA allows for the maximum longitudinal grades (parallel to the runway centerline) in the end quarters of the runway to be 0.8%. This is to allow for easier rollouts during departures as well as shorter touchdowns during landings. The existing longitudinal slope in the Runway 29 end quarter is in excess of 1.3% (See Figure 1.1: Runway 29 Profile). This modification is documented

Figure 1.1: Runway 29 Profile

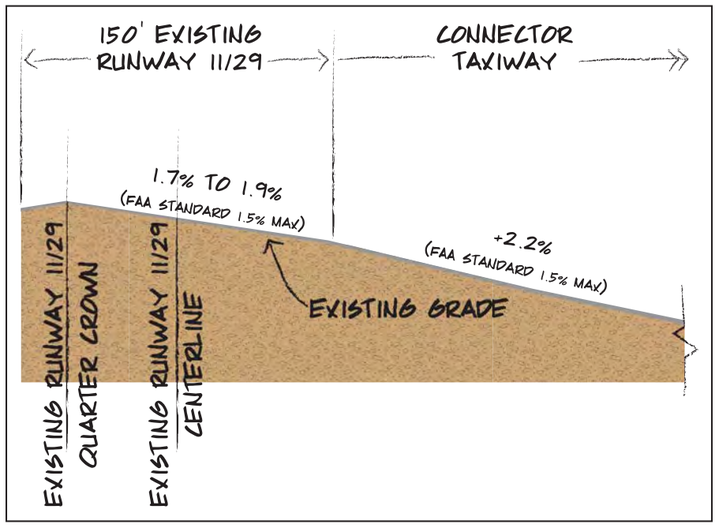


under FAA Airspace Case No. 94-DEN-161-NRA, dated March 22, 1995. For aircraft taking off to the east, this additional grade requires the aircraft to work harder since they have to accelerate upward at a steeper grade. For aircraft landing from the west, this steeper grade requires them to chase the falling runway grade, thus causing them to touchdown further down the runway. This leaves less runway length for the aircraft to decelerate, and increases the time the aircraft is occupying the runway.

1-5.2 Transverse Runway Grades

The existing transverse grades (perpendicular to the runway centerline) are also out of FAA criteria as specified in the AC 5300-13. For approach Category "D" runways, the circular allows for a maximum transverse grade of 1.5% at any point across the runway. The existing transverse grades for Runway 11/29 are in excess of this limit and reach as high as 1.9% (See Figure 1.2 Runway 11/29 Cross Section at Connector Taxiway). This modification is documented under FAA Airspace Case No. 94-DEN-161-NRA, dated March 22, 1995. The effect this has on aircraft operating at high speeds is to pull aircraft from the center of the runway towards the runway edge. In addition, the increased angle of the runway can affect the weight distribution of larger planes as fuel that is carried in the wings can be shifted due to the increased angle.

Figure 1.2: Runway 11/29 Cross Section at Connector Taxiway



1-5.3 Runway Visibility Zone (RVZ)

Another non-conforming design standard present at the airport is the Runway Visibility Zone (RVZ) for Runway 11/29 and Runway 4/22. This standard is described in Section 503b "Line of Sight Standards-Between Intersecting Runways" of the AC 5300-13. The RVZ is determined by connecting an imaginary line between the midpoints of the intersecting runways, as shown in

Figure 1.3: Existing Runway Visibility Zone (RVZ)

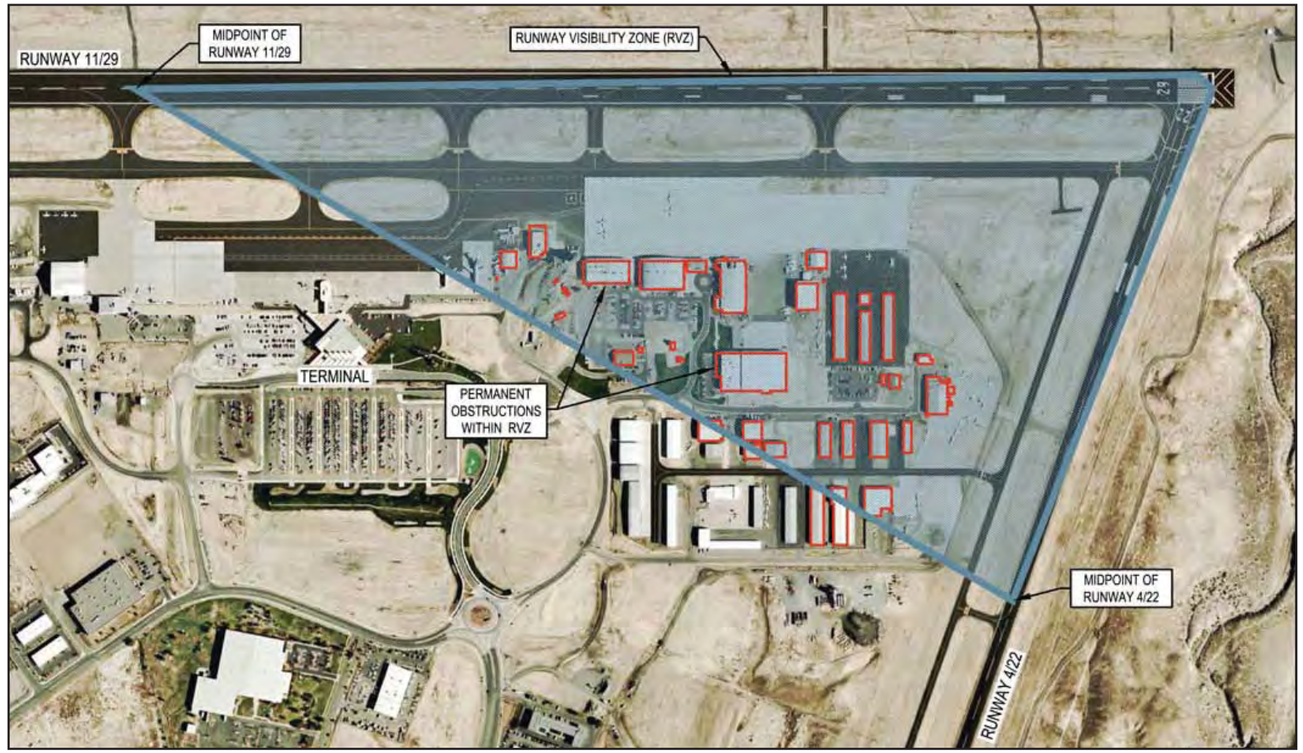


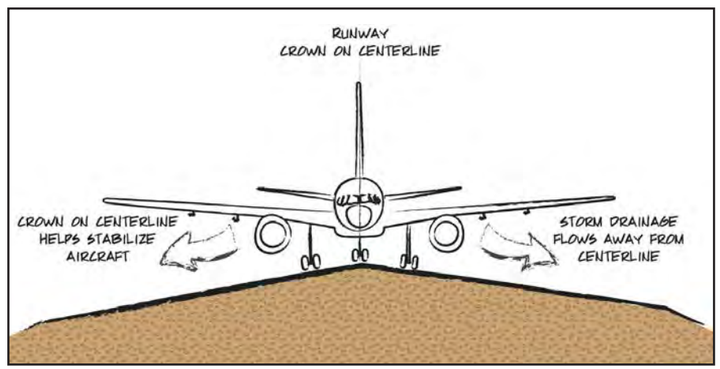
Figure 1.3. The purpose of the RVZ is to ensure that aircraft operating on intersecting runways have an adequate view of the other runway during takeoffs and landings to avoid possible aircraft collisions. All possible obstructions, including terrain and structures, that fall within the RVZ should be removed to allow for unobstructed visual site between the runways.

The existing layout of airport buildings and the runway system does not allow for an unobstructed RVZ (See Figure 1.3: Runway Visibility Zone). The hangars and aircraft support facilities located to the southwest of the Runway 11/29 and Runway 4/22 intersection fall within the RVZ for the runways. For this reason, Runway 4/22 can only be open for operations when the Air Traffic Control Tower (ATCT) is open between the hours of 6:00 A.M. and 10:00 P.M. This modification is documented under FAA Airspace Case No. 02-DEN-044-NRA, dated March of 2002.

1-5.4 Runway Crown

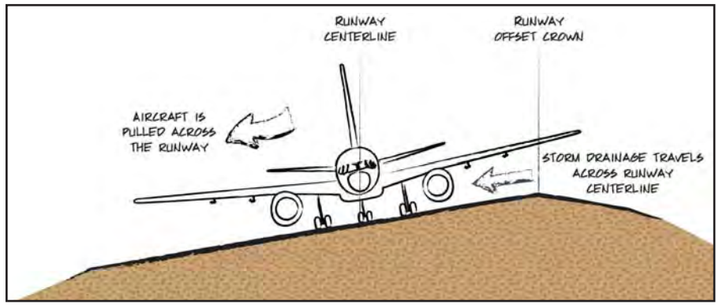
Finally, the last and perhaps most problematic non-standard condition is the location of the runway's crown. Typical runways have the crown at the centerline to promote aircraft stability while operating on the runway (See Figure 1.4: Center Crown). The central location of the crown allows an aircraft's main

Figure 1.4: Center Crown



landing gear to be on both sides of the crown, which will naturally help keep the aircraft centered on the runway. Currently, the crown on Runway 11/29 is located 50 feet to the northeast of runway centerline (See Figure 1.5: Offset Crown). This location causes aircraft that land along centerline to be drawn across the runway, since the runway transversely falls in this direction and all the landing gear are on the same side of the crown line. This requires pilots to work harder to maintain directional control and stay on centerline during takeoff and landing operations.

Figure 1.5: Offset Crown



Keeping the central portion of the runway well drained during storm events is crucial to maintaining safe runway operations. The preferred way to achieve this is to construct runways with a center crown. This will allow for the most efficient drainage of the runway surface by limiting the distance surface water must travel to exit the runway pavement. It will also help keep the center portion of the runway dry during storms, which is important since this is the area of the runway that is primarily used by landing and departing aircraft.

In contrast to this, the existing offset crown forces water to drain back across the runway centerline during storm events. This impacts runway safety as landing and departing aircraft operate on the central portion of the runway that has water draining across it from the offset crown. This additional moisture can potentially lead to hydroplaning and general loss of traction for aircraft operating on the runway. During winter months, this can also lead to icing of the center portion of the runway, since the water from the melting snow has further to travel to exit the runway and must travel across the runway centerline.

1-6 Airport Hot Spots

In July of 2009, the FAA Northwest Mountain Region Runway Safety Office (RSO) conducted an airport runway assessment at the Grand Junction Regional Airport. For this assessment, a Runway Safety Action Team (RSAT) was assembled and consisted of members from the FAA Air Traffic Control and the Grand Junction Regional Airport. The RSAT team noted potential "Hot Spots" at the intersection of the two runways and at the intersection of Taxiway A and Runway 4/22 (See Figure 1.6: Airport Hot Spots). The intersection of the two runways and the close proximity of Taxiway A to the intersection point could cause unauthorized access to Runway 29 from Runway 22. The tower has reported that when pilots are directed to taxi to Runway 29 via Taxiway A and Runway 22, and to hold short at Runway 22 and at Runway 29, they sometimes fail to hold short for Runway 29 and enter the runway without clearance. This is due to the confusing layout of this area. To help notify pilots of this potentially dangerous area, the RSAT updated the Airport Diagram to identify this hot spot area (See Figure 1.7: Airport Diagram).

Figure 1.6: Airport Hot Spots

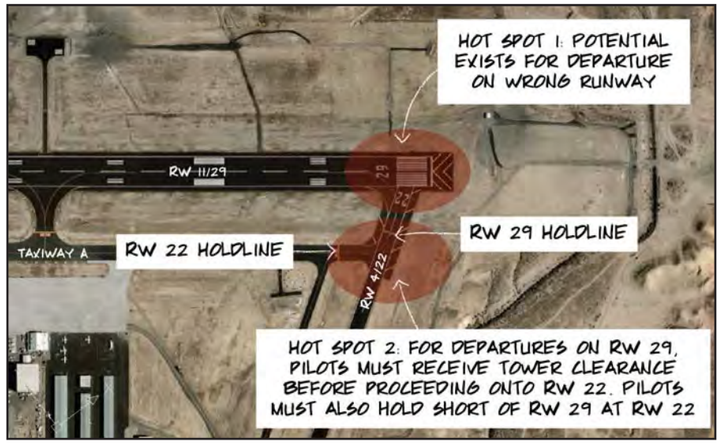
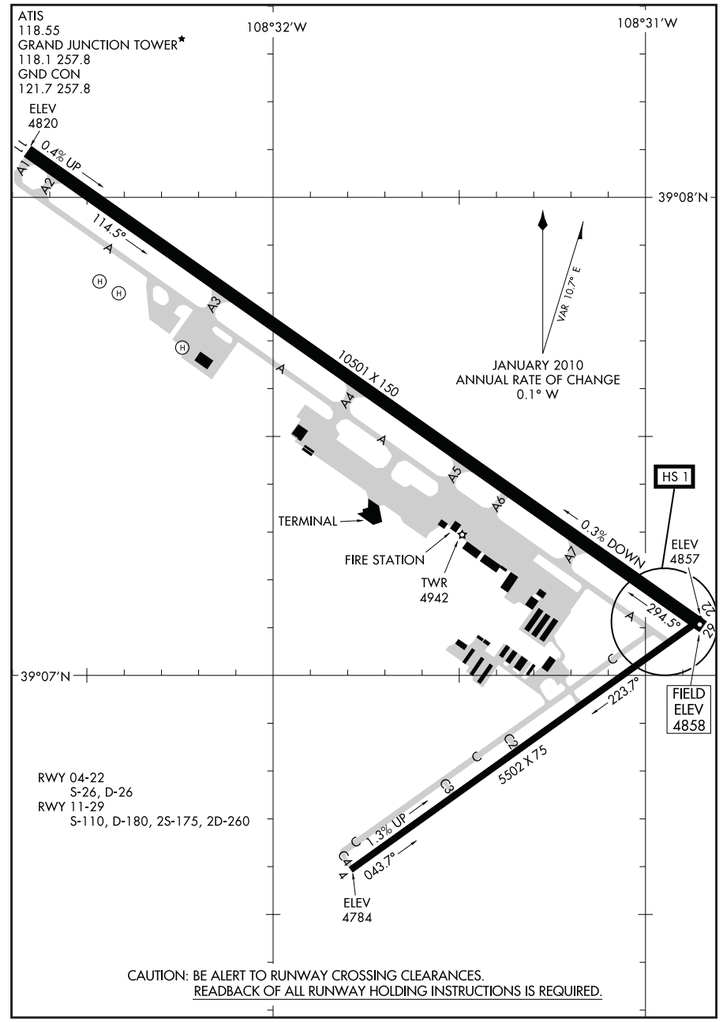


Figure 1.7: Airport Diagram



2. Runway 11/29 Alternatives

Runway 11/29 will require significant reconstruction in approximately eight years. When the non-standard conditions of the runway are considered in tandem with the remaining useful life of the runway's aging pavements, it becomes apparent that an opportunity will soon exist to correct the non-standard problems that have been plaguing the runway for many years. When this reconstruction becomes necessary, the FAA will only provide Airport Improvement Programs (AIP) funds if the runway is reconstructed to meet all applicable FAA standards contained in the AC 5300-13. In anticipation of this, development of this analysis has been completed to determine the best means to achieve this at the lowest capital cost while minimizing the impacts to the airport users and the economy of the City of Grand Junction and surrounding areas.

Section 2 of this report evaluates five possible alternatives available to improve Runway 11/29. Each alternative is evaluated on the basis of four categories which include; estimated construction costs, economic impacts, correction of non-standard conditions, and the potential for securing funding. The first two alternatives will consist of reconstructing Runway 11/29 in its current location with a 1,800 foot extension to Runway 11. The third alternative will construct a new runway to the northeast at a 650 foot offset of the existing runway centerline. The last two options would correct some of the existing non-standard conditions by either overlaying the existing pavements, or by shifting the runway centerline and adding additional pavement to the northeast edge of the runway.

2-1 Alternative 1 – Reconstruct Runway 11/29 with a 1,800 Foot Extension to Runway 11

The first alternative consists of reconstructing the runway in its current location and extending the runway to the northwest by 1,800 feet (See Figure 2.1: Runway 11/29 Extension Profile) in order to remove the southeastern most 1,800 feet of existing runway which is currently non-standard (See Figure 1.1: Runway 29 Profile). This alternative would involve removing the existing runway pavements and lighting system in their entirety, and rebuilding with all new material. In addition, approximately 2 million cubic yards of embankment would be required to construct the 1,800 foot extension.

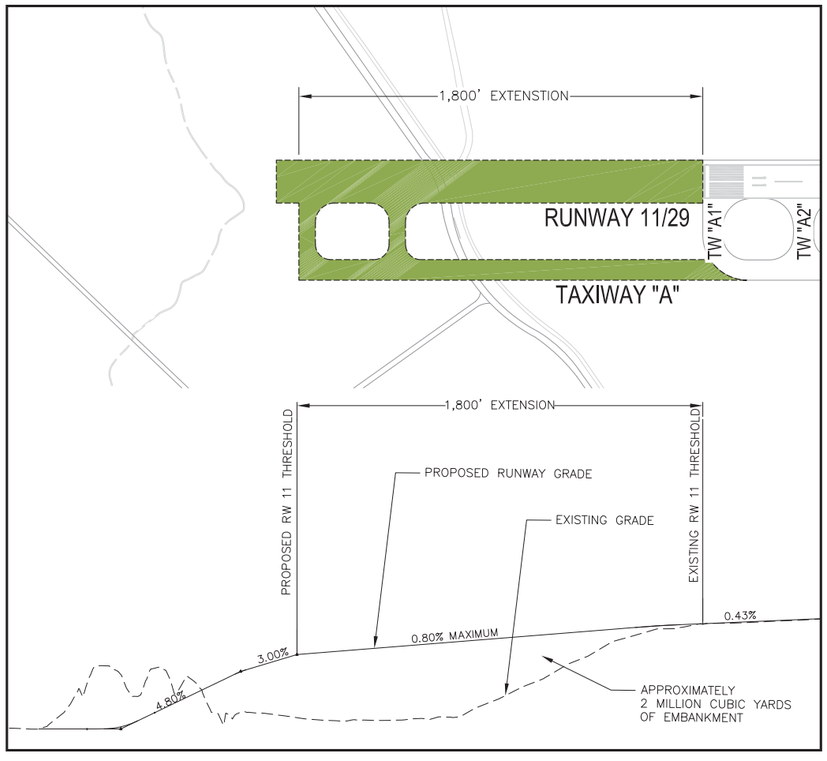
This alternative would correct all of the non-standard transverse grades, eliminate the offset crown, correct the issue with longitudinal grades at the runway's end quarter, and eliminate the intersecting runway condition that creates the non-standard RVZ and airport "Hot Spots". However, this alternative would not correct the non-standard conditions associated with the connector taxiways.

2-1.1 Design Options

This section discusses the design options that were considered to correct the longitudinal grade in the Runway 29 end quarter. As mentioned in Section 1, the Runway 29 end quarter has a maximum longitudinal grade of 1.3%. The FAA standard maximum for the end quarters of a Category D runway is 0.8% (See Figure 1.1: Runway 29 Profile). Bringing this area of the runway into conformance can be achieved three separate ways. The first would be to lower the Runway 29 end by approximately 2 feet. The layout of the runways at the Grand Junction Regional Airport is such that Runway 11/29 and Runway 4/22 intersect at the Runway 29 and Runway 22 ends. Thus, lowering Runway 29 by 2 feet would also lower Runway 22 by 2 feet, and therefore, require reconstruction of a portion of Runway 4/22 as well.

The second way to correct the longitudinal grade in the Runway 29 end quarter would be to hold the current elevation at the Runway 29/Runway 22 intersection, and extend a -0.8% maximum grade down the runway until the existing surface is intersected just west of Taxiway A7. This would require the runway in the vicinity of Taxiway A7 to be raised by approximately 3-4 inches, requiring an asphalt overlay of Taxiway A7. Currently, the longitudinal grades of Taxiway A7 are in excess of 2.2% which exceed the maximum allowable grade of 1.5% for connector taxiways. Raising the runway at the Taxiway A7 intersection would further increase its longitudinal grade and take it further out of criteria.

Figure 2.1: Runway 11/29 Extension Profile



The third way to correct the longitudinal grade would be to move the Runway 29 threshold to the northwest past the point where the grades no longer exceed 0.8%. This would require the threshold to be moved 1,800 feet, thus reducing the overall runway length by 1,800 feet. To make up for this loss of runway length, the Runway 11 end would need to be extended by 1,800 feet to the northwest. As mentioned above, the extension of Runway 11 would require approximately 2 million cubic yards of embankment.

While all three methods described would fix the longitudinal grade at the end quarter of Runway 29, only the third option would fix the problem with the RVZ and the hot spots. By shifting the runway to the northeast by 1,800 feet, the non-standard portion of the runway that currently exceeds 0.8% could be abandoned and re-graded to meet safety area criteria. This would eliminate the intersecting runway condition and thus would remove the line of sight requirement between the two runways. Separating the two thresholds will enhance safety at the airport by preventing the chance of aircraft incidents within the intersecting runways. Since this option is the only one capable of eliminating the non-standard RVZ and the hot spots, it was the only option analyzed for Alternative 1.

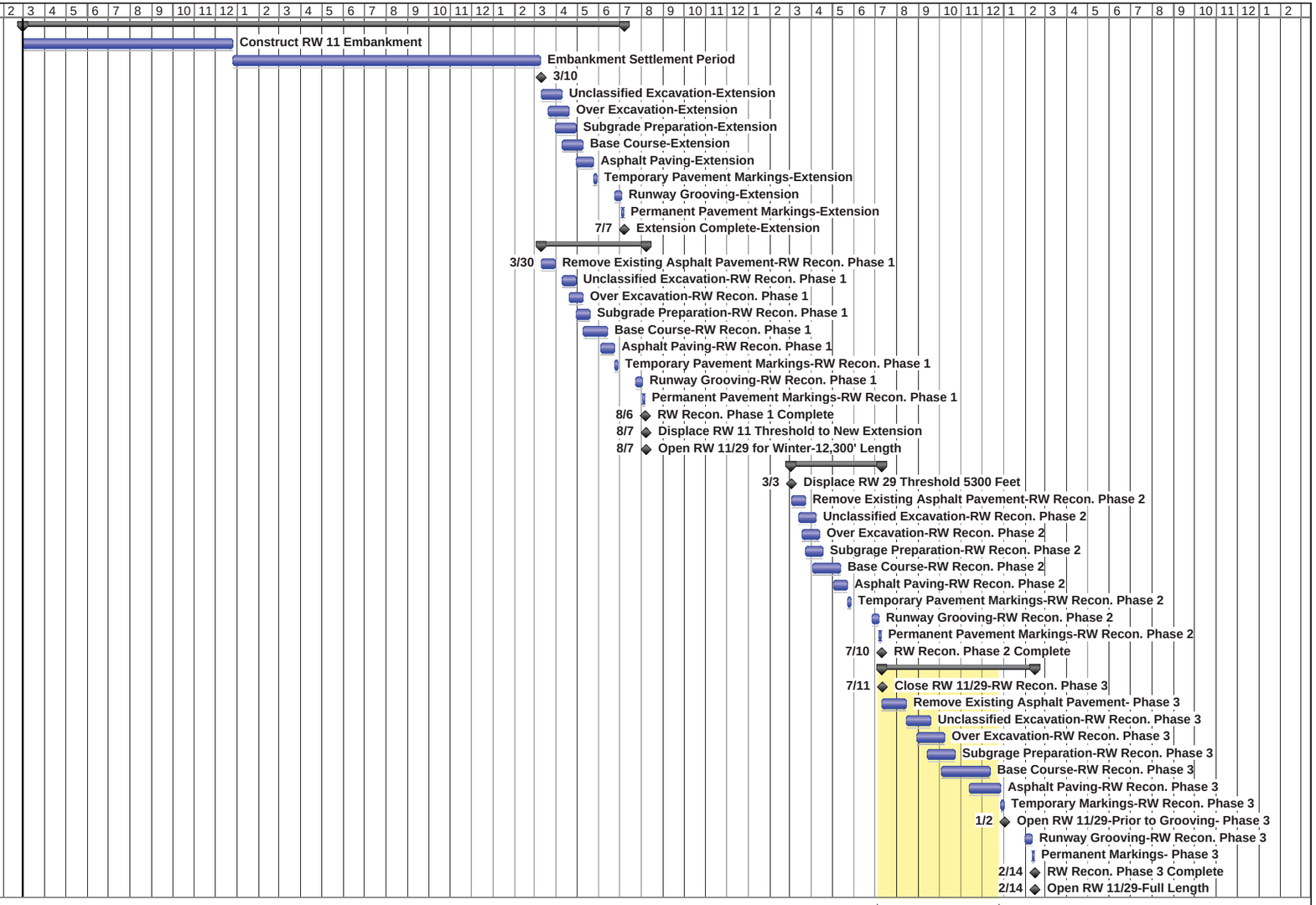
2-1.2 Construction Impacts to Airport Operations

Construction of this alternative would require two partial closures of Runway 11/29. In addition, a full closure of the airport's primary runway, lasting approximately 6 months, would be required, thus shutting down all commercial and air carrier service operations at the airport. A conceptual construction schedule was prepared in an effort to determine the overall impact to the airport for this alternative (See Figure 2.2 Project Schedule). This schedule was based on completing the project in three consecutive phases (Phases 1-3). The limits of Phases 1 and 2 were established to maintain at least 7,000 feet of available runway for restricted commercial and air cargo operations at all times during construction of these phases (See Figures 2.3 and 2.4).

Prior to the start of Phase 1, the 2 million cubic yards of required embankment will be allowed to consolidate over a two year period (See Figure 2.2: Alternative 1 Project Schedule). In order to construct Phase 1, the Runway 11 threshold would be displaced in the vicinity of Taxiway A3. This would allow for a work area of 3,800 feet, and leave 7,500 feet of runway to remain open for air operations with a 1,000 foot extended safety area (See Figure 2.3: Alternative 1, Phase 1). Work during this phase would consist of constructing the pavement section and lighting system for the runway and taxiway extensions. The portion of the existing runway between Station 85+00 and Station 105+50 would be completely reconstructed. The existing pavement section and lighting/guidance system would be removed and reconstructed with new materials. As a result of the reconstruction, the existing offset crown and non-standard transverse grades would be corrected. The crown would be positioned at the runway centerline and the transverse grades would be corrected to

Figure 2.2: Alternative 1 Project Schedule

ID	Task Name	Duration
	Text1: Extension	**860 days**
1	Construct RW 11 Embankment	300 days
2	Embankment Settlement Period	440 days
3	Displace RW 11 Threshold 3000 Feet	1 day
4	Unclassified Excavation-Extension	30 days
5	Over Excavation-Extension	30 days
6	Subgrade Preparation-Extension	30 days
7	Base Course-Extension	30 days
8	Asphalt Paving-Extension	25 days
9	Temporary Pavement Markings-Extension	5 days
10	Runway Grooving-Extension	10 days
11	Permanent Pavement Markings-Extension	3 days
12	Extension Complete-Extension	1 day
	Text1: Phase 1	**150 days**
13	Remove Existing Asphalt Pavement-RW Recon. Phase 1	20 days
14	Unclassified Excavation-RW Recon. Phase 1	20 days
15	Over Excavation-RW Recon. Phase 1	20 days
16	Subgrade Preparation-RW Recon. Phase 1	20 days
17	Base Course-RW Recon. Phase 1	35 days
18	Asphalt Paving-RW Recon. Phase 1	20 days
19	Temporary Pavement Markings-RW Recon. Phase 1	5 days
20	Runway Grooving-RW Recon. Phase 1	10 days
21	Permanent Pavement Markings-RW Recon. Phase 1	3 days
22	RW Recon. Phase 1 Complete	1 day
23	Displace RW 11 Threshold to New Extension	1 day
24	Open RW 11/29 for Winter-12,300' Length	1 day
	Text1: Phase 2	**130 days**
25	Displace RW 29 Threshold 5300 Feet	1 day
26	Remove Existing Asphalt Pavement-RW Recon. Phase 2	20 days
27	Unclassified Excavation-RW Recon. Phase 2	25 days
28	Over Excavation-RW Recon. Phase 2	25 days
29	Subgrade Preparation-RW Recon. Phase 2	25 days
30	Base Course-RW Recon. Phase 2	40 days
31	Asphalt Paving-RW Recon. Phase 2	20 days
32	Temporary Pavement Markings-RW Recon. Phase 2	5 days
33	Runway Grooving-RW Recon. Phase 2	10 days
34	Permanent Pavement Markings-RW Recon. Phase 2	3 days
35	RW Recon. Phase 2 Complete	1 day
	Text1: Phase 3	**219 days**
36	Close RW 11/29-RW Recon. Phase 3	1 day
37	Remove Existing Asphalt Pavement- Phase 3	35 days
38	Unclassified Excavation-RW Recon. Phase 3	35 days
39	Over Excavation-RW Recon. Phase 3	40 days
40	Subgrage Preparation-RW Recon. Phase 3	40 days
41	Base Course-RW Recon. Phase 3	70 days
42	Asphalt Paving-RW Recon. Phase 3	45 days
43	Temporary Markings-RW Recon. Phase 3	5 days
48	Open RW 11/29-Prior to Grooving- Phase 3	1 day
44	Runway Grooving-RW Recon. Phase 3	10 days
45	Permanent Markings- Phase 3	3 days
46	RW Recon. Phase 3 Complete	1 day
47	Open RW 11/29-Full Length	1 day



Project: RW Reconstruction w 1800 fo
Date: Mon 2/28/11

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Figure 2.3: Alternative 1 Phase 1

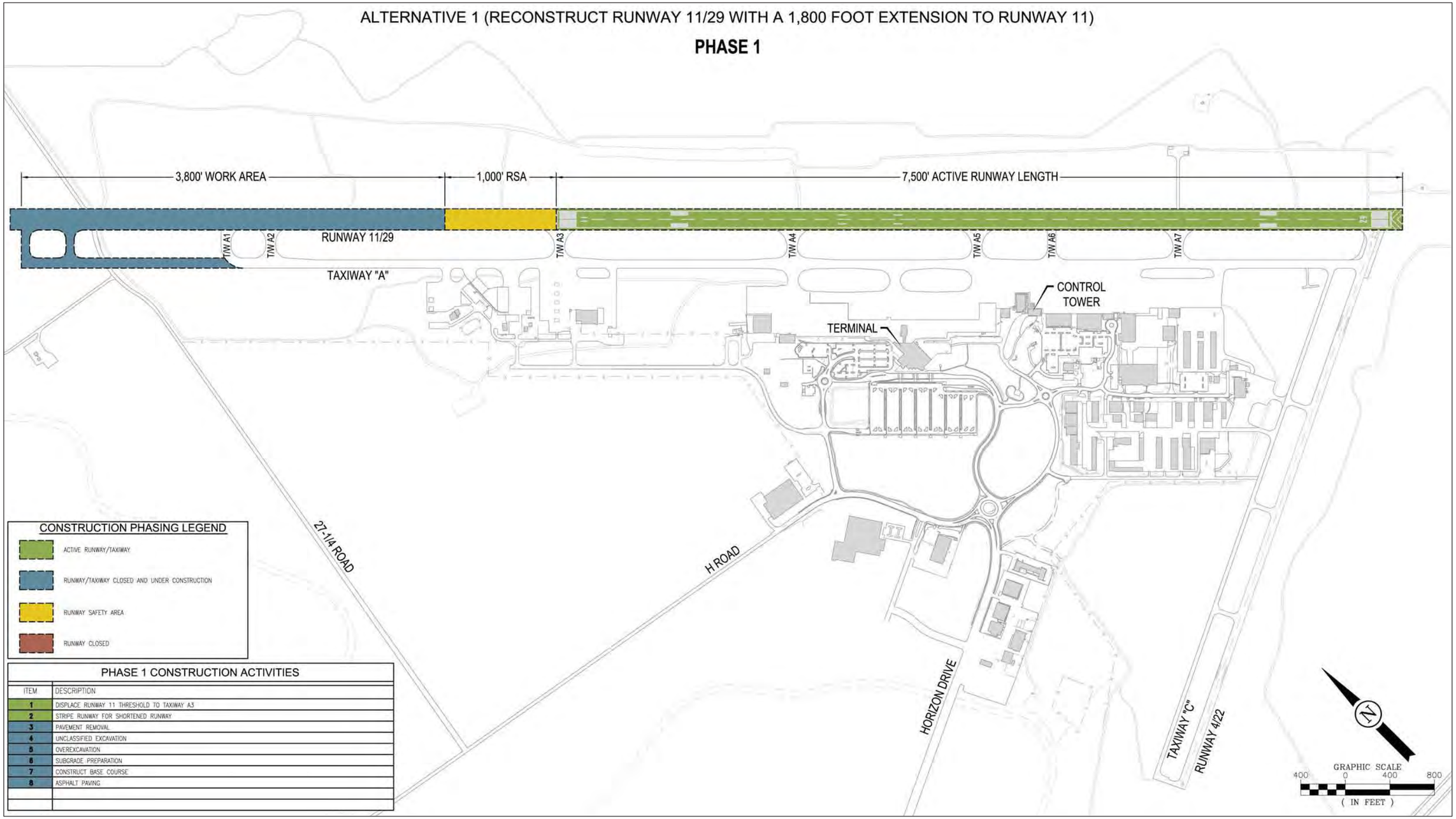


Figure 2.4: Alternative 1 Phase 2

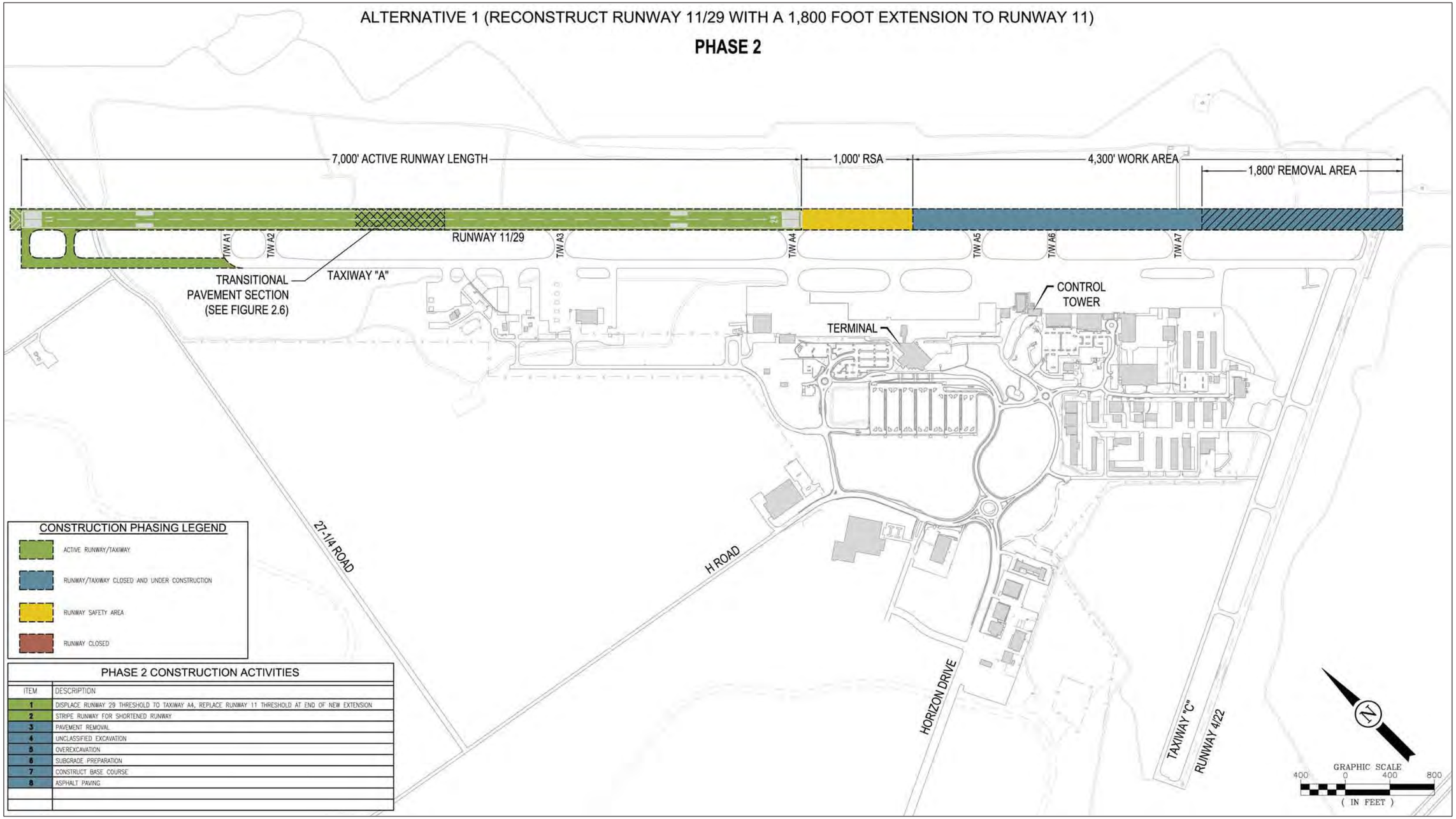
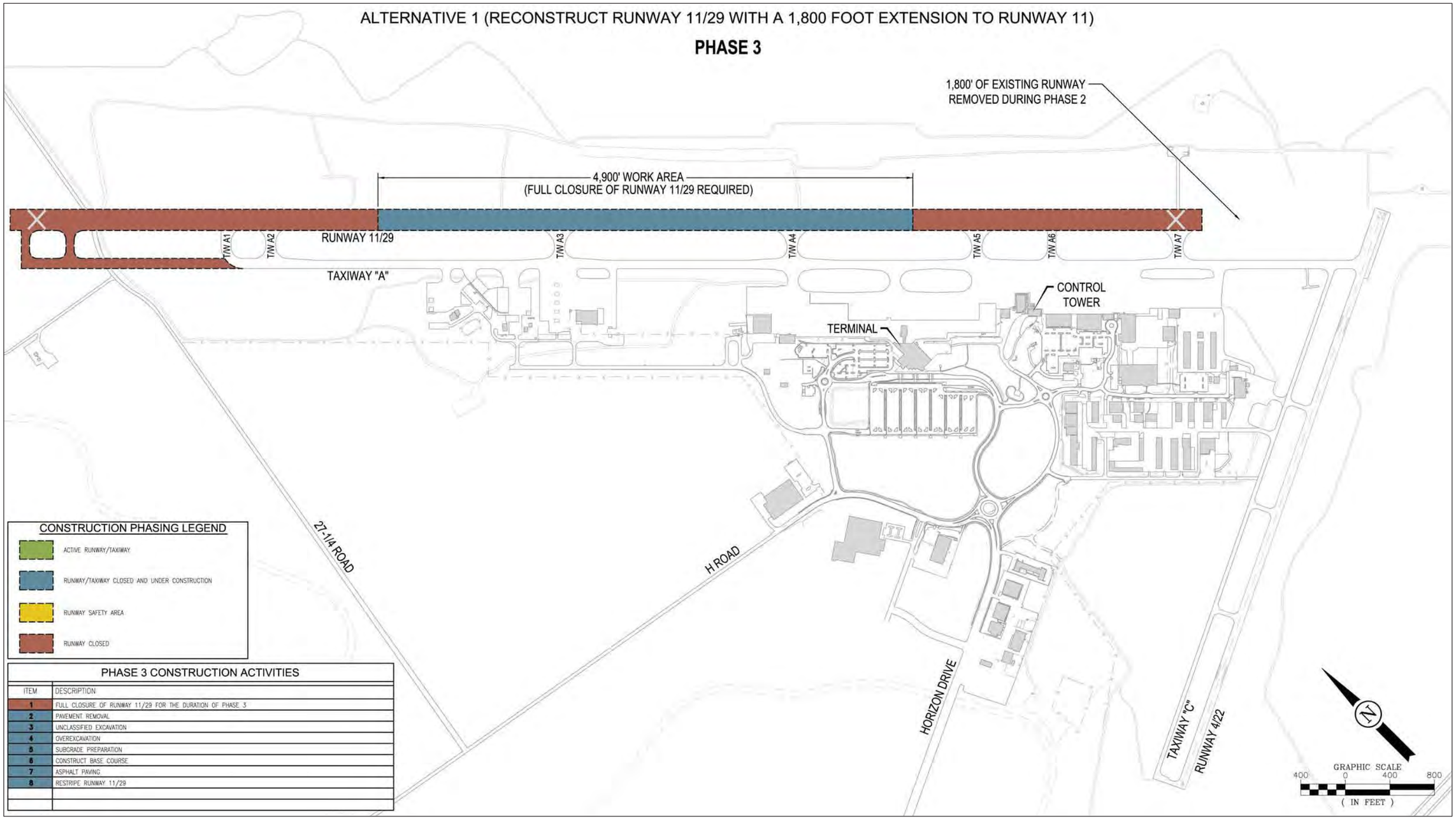


Figure 2.5: Alternative 1 Phase 3



meet FAA standards.

Once Phase 1 is completed, the Runway 11 threshold can be moved to the newly constructed extension, and the Runway 29 threshold can be displaced to Taxiway A4. This will open the northwest portion of the runway to aircraft operations, while closing the southeastern portion for Phase 2 construction. Phase 2 would have a work area of 4,300 feet in length, and leave 7,000 feet of runway open with a 1,000 foot extended safety area (See Figure 2.4: Alternative 1, Phase 2).

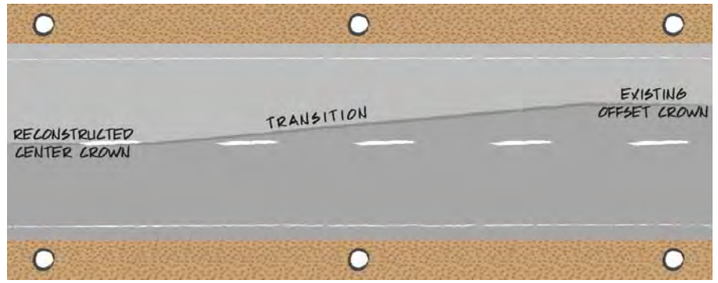
As a result of phasing the project to keep the runway open during construction, transitional pavements will be required on operational runway pavements during Phase 2. These transitional pavements will be located between Station 85+50 and Station 93+50 (See Figure 2.4: Alternate 1, Phase 2) and will be required to transition the centerline crown constructed under Phase 1 to the existing runway's offset crown (See Figure 2.6: Transitional Layout). This transition will make for an unusual runway dynamic as the runway will transition from a standard centerline crown to a non-standard offset crown. From a stability standpoint, an aircraft rolling along a center crowned pavement, will typically have its nose gear on the crown, with a main landing gear on each side of the crown (See Figure 1.4: Center Crown). This situation will generally keep the plane on centerline as the opposing downward sloping pavements acting on the main landing gear will offset each other and keep the aircraft centered on the runway. On the contrary, an aircraft that travels along a transverse runway (offset crown condition), will have all wheels on the same side of the crown and will push the aircraft towards the runway's edge, since the offsetting forces that apply for the center crown are not present (See Figure 1.5: Offset Crown).

Therefore, a pilot operating an aircraft rolling through this transitional section will be required to adjust directional control of the plane as it transitions from a stabilizing center crown section to an unstabilizing transverse runway section that naturally drags the aircraft across the runway. This could potentially cause safety concerns for unsuspecting pilots who are unaware of the changing runway conditions. Allowance for this temporary condition would require FAA approval as it would impact the runway's level of safety.

Work during this phase would include removing the existing pavements and lighting/guidance system and reconstructing with new materials. The area of Runway 11/29 between Runway 4/22 and Taxiway A7 will not be reconstructed, but will be graded as an extended safety area. By doing so, the non-standard RVZ and longitudinal grade in the end quarter will be eliminated. Similar to Phase 1, reconstructing the runway in the Phase 2 work area will also correct the offset crown and the transverse grades. The crown would be positioned at the runway centerline and the transverse grades would be constructed to FAA standards.

The final phase (Phase 3) will require the shutdown of the entire runway as the center 4,900 feet of the runway will be reconstructed (See Figure 2.5: Alternate 1 Phase 3). Since Runway 11/29 is the only runway at the airport with enough length and width to handle the existing commercial service and air cargo aircraft that currently operates at the airport, the air carriers will have no choice but to cease all services during this phase. Based on the conceptual construction schedule shown in Figure 2.2: Alternative 1 Project Schedule, Phase 3 construction will

Figure 2.6: Transitional Layout



take approximately 5 to 6 months to complete. Therefore, the airport, the City of Grand Junction, and surrounding areas, will be without commercial air carrier and air cargo services for half a year.

2-1.3 Estimated Construction Costs

As a part of this analysis, estimated construction and engineering costs for Alternative 1 were prepared. The total costs for this alternative is approximately $62 million (See Table 2.1: Alternative 1: Construction Cost Estimate).

2-1.4 Economic Impacts to Airport and Local Economy

While the value of the economic loss to the airport and the City of Grand Junction and surrounding areas, as a result of the shutdown to commercial air carrier and air cargo services during Phase 3 is beyond the scope of this study, it must be stressed that according to the 2008 Colorado Airports Economic Impact Study as prepared by CDOT, the airport's economic impact is in excess of $600,000,000 per year. This is evidence of the vital role the airport has in the economic stability of the City of Grand Junction and surrounding areas.

Businesses operating at the airport will, in particular, suffer economic loss from an extended shutdown of the primary runway. The commercial airlines and air cargo businesses at the airport will be forced to suspend services, or relocate to another airport. This will cause economic loss to the Fixed Base Operator (FBO) who provides fuel and other services to these businesses. It has been estimated by the FBO that, if the primary runway is closed for a prolonged period, they would be forced to layoff approximately 400 employees. Additionally, if the airlines are required to relocate, potential does exist that they would not return to the airport as they will have arranged for new service at another airport. This potential loss would impact the airport, local airport services, and the local community much longer than the 6 month shutdown period.

Therefore, it can only be assessed that a six month shutdown of commercial and air cargo service at the airport would have a severe economic impact to the airport, the city, and the surrounding areas. When the airport's annual economic impact of $600,000,000 is prorated monthly, the impact equates to approximately $50,000,000 per month. For a 6 month shutdown to commercial service, the total loss of revenue to the local economy could easily be in the hundreds of millions of dollars.

2-1.5 Project Funding

With the costs for design and construction of this alternative estimated in the $62 million range, planning for funding is an essential consideration that must be analyzed. Since approximately 95 percent of the project's cost will be provided by the FAA, the project's anticipated construction period must be compared to the FAA's funding program. The planned phasing and runway closure period inherent within this alternative requires an aggressive construction schedule in order to limit the impacts to the airport and the local economy during construction. As a result, the FAA would not be able to spread the required funding out over numerous years of construction, but would be required to fund the entire project over a 2 to 3 year period. This would prove very difficult and highly unlikely as numerous airports in the region will be competing for the same FAA funding.

TABLE 2.1:
ALTERNATIVE 1: CONSTRUCTION COST ESTIMATE

ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100	Mobilization (Est. 8%)	EA	1	$3,734,800.00	$3,734,800.00
P-140	Asphalt Pavement Removal (Complete)	SY	240,230	$8.00	$1,921,840.00
P-152	Embankment In Place	CY	1,920,230	$5.00	$9,601,150.00
P-152	Overexcavation/ Subgrade Preparation	CY	114,000	$25.00	$2,850,000.00
P-310	Crushed Aggregate Base Course/Stabilization Fabric	CY	118,530	$44.00	$5,215,320.00
P-401	Asphalt Pavement Course (Including Binder/ Aggregate/Tack)	TON	189,260	$119.00	$22,521,940.00
P-603	Asphalt Surface Treatment (Grooving/Striping)	SY	207,750	$2.60	$540,150.00
D-701	Drainage Improvements (Storm Pipe/Underdrains/ Structures)	LS	1	$2,000,000.00	$2,000,000.00
T-901	Seeding & Erosion Control/ Topsoil Placement	AC	55	$6,000.00	$330,000.00
L-108	Electrical Upgrades	LS	1	$1,421,500.00	$1,421,500.00
L-125	Instrumentation Upgrades (REIL/MALSR/Localizer/ Glideslope)	LS	1	$282,000.00	$282,000.00
				SUBTOTAL	**$50,418,700.00**
				Contingency (5%)	$52,939,640.00
				Design Engineering (Est.)	$4,235,200.00
				Construction Management (Est.)	$5,294,000.00
				GRAND TOTAL	**$62,468,840.00**

Note: All unit prices are in 2011 dollars

2-2 Alternative 2 – Reconstruct Runway 11/29 with a 1,800 Foot Extension to Runway 11 and Runway 4/22 Upgrade

Much like the first alternative, Alternative 2 will also reconstruct Runway 11/29 in its current location and extend the runway to the northwest by 1,800 feet in order to remove the southeastern most 1,800 feet of existing runway that is currently non-standard. This would involve removing the existing runway pavements and lighting system in their entirety, and rebuilding with all new materials. In addition, approximately 2 million cubic yards of embankment would be required to construct the 1,800 foot extension.

This alternative would correct all of the non-standard transverse grades, eliminate the offset crown, correct the issue with longitudinal grade at the Runway 29 end quarter, and eliminate the intersecting runway condition that creates the non-standard RVZ and airport "Hot Spots". However, this alternative would not correct the non-standard conditions associated with the connector taxiways.

The primary difference between this alternative and Alternative 1 is the reduced operational and economic impact this alternative will have on the airport and the local economy due to the ability to maintain continual commercial air carrier and air cargo services during construction. This will be achieved by upgrading Runway 4/22 to an ARC C-III runway and extending the runway by 1,500 feet prior to reconstructing Runway 11/29. While the airlines and air cargo services will continue to operate under this alternative, operations will be restricted due to the shortened runway length. This will require them to either use smaller aircraft, or weight restrict existing aircraft so they can operate on the shortened runway. Both of these options will have economic impacts to the service providers.

2-2.1 Design Considerations

The three design options discussed in Section 2-1.1 for Alternative 1 regarding the non-standard longitudinal grades in the runway end quarter and the non-standard RVZ, also apply to this alternative. Thus, the best option is to extend Runway 11/29 to the northwest by 1,800 feet in order to remove the southeastern-most 1,800 feet of runway that currently contains non-standard longitudinal grades and a non-standard RVZ. In addition, the runway will be completely reconstructed in order to correct the existing offset crown as well as non-standard transverse slopes.

Unlike Alternative 1, which phased construction by use of displaced thresholds, reduced runway lengths, and a 6 month shutdown of commercial air carrier and air cargo operations, Alternative 2 will upgrade Runway 4/22 to accommodate commercial traffic prior to reconstructing Runway 11/29. This will prevent the need to suspend commercial air carrier and air cargo services during Alternative 2 construction, and will allow for the complete closure of Runway 11/29 during reconstruction.

2-2.2 Improvements to Runway 4/22

To accommodate restricted air carrier and air cargo service during the reconstruction of Runway 11/29, the first phase of construction for Alternative 2 will be to upgrade Runway 4/22 to ARC C-III standards and extend the runway by 1,500 feet. Currently the runway is 5,501 feet in length and is constructed to ARC B-II standards. The current pavement strength of the runway is for 26,000 pound single/dual wheel gear loading. Adding 1,500 feet to the runway will bring the overall length to 7,000 feet, which is enough for the current air carriers and air cargo companies to continue to operate at a restricted level while Runway 11/29 is closed.

In addition to extending the runway, Runway 4/22 and the parallel Taxiway C system will also require significant upgrades to bring the runway to ARC C-III standards. These upgrades include:

- Increase the width of the runway from 75 feet to 100 feet
- Increase the width of the Runway Safety Area (RSA) from 150 feet to 500 feet
- Increase the length of the Extended Runway Safety Area from 300 feet to 1,000 feet
- Increase the runway/parallel taxiway separation distance from 240 feet to 400 feet
- Increase the taxiway widths from 35 feet to 50 feet
- Restrict the longitudinal grades within the runway end quarters to a maximum of 0.8%
- Strengthen the pavement sections to accommodate heavier aircraft

As shown in Figure 2.7: RW 4/22 Profile, correcting the longitudinal grades at the runway end quarters will dramatically change the profile of the runway. The Runway 4 threshold will be required to be raised by approximately 9 feet and the Runway 22 threshold will need to be lowered by 3-5 feet. This dramatic change in profile will render the existing runway pavements unusable, thus requiring Runway 4/22 to be reconstructed. The new profile, increased RSA, and increased runway/taxiway separation distance will require approximately 1 million cubic yards of embankment to construct (See Figure 2.7: RW 4/22 Profile). Figures 2.10, 2.11, and 2.12 are examples of cross sections for the Runway 4/22 upgrade at the proposed runway thresholds and in the Runway 22 extended safety area.

In order to complete the improvements to the Runway 22 end, there will be a period of time when the Runway 29 threshold will have to be displaced by 1,000 feet to accommodate construction. Analysis of the time required for this displacement has not been performed since its potential impact to airport operations would be minimal considering aircraft will still have over 9,000 feet of useable runway during this time.

To assess the environmental impacts of the extension to Runway 22, an environmental assessment will likely be required for this alternative. This process would take approximately 3 years to complete and would add additional costs to the project. One aspect of the environmental assessment that would be analyzed would be the noise impacts created by the lengthened runway. The increased runway length would allow for commercial jet operations, which would significantly increase the level of noise along the runway's approaches and departures. The approach to Runway 4 travels directly over residential communities. This change in aircraft operational type would significantly increase noise levels and would directly impact the existing communities.

Another aspect of this alternative that should be discussed is with regards to upgrading Taxiway C to a 400 foot separation from Runway 4/22. The taxiway currently sets at a 240 foot offset from the Runway 4/22 centerline. At this location, the taxiway currently contains areas of non-visibility from the tower. This is evidenced by the recent closure of connector Taxiway C1 due to a tower non-visibility area on Taxiway C at this intersection. Relocating Taxiway C to the 400 foot separation would further worsen the problems of non-visibility areas, as it would require the taxiway to move closer to the existing buildings west of Runway 4/22. Aircraft taxiing on Taxiway C would be blocked by the buildings between the taxiway and the control tower.

2-2.3 Reconstruction of Runway 11/29

Figure 2.7: Runway 4/22 Profile

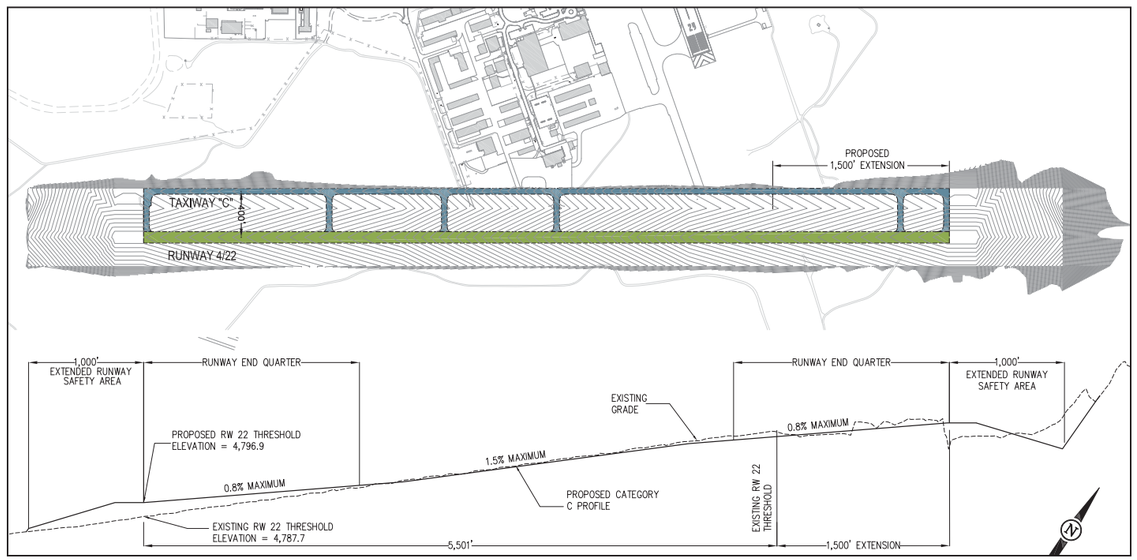


Figure 2.8: Alternative 2, Phase 1

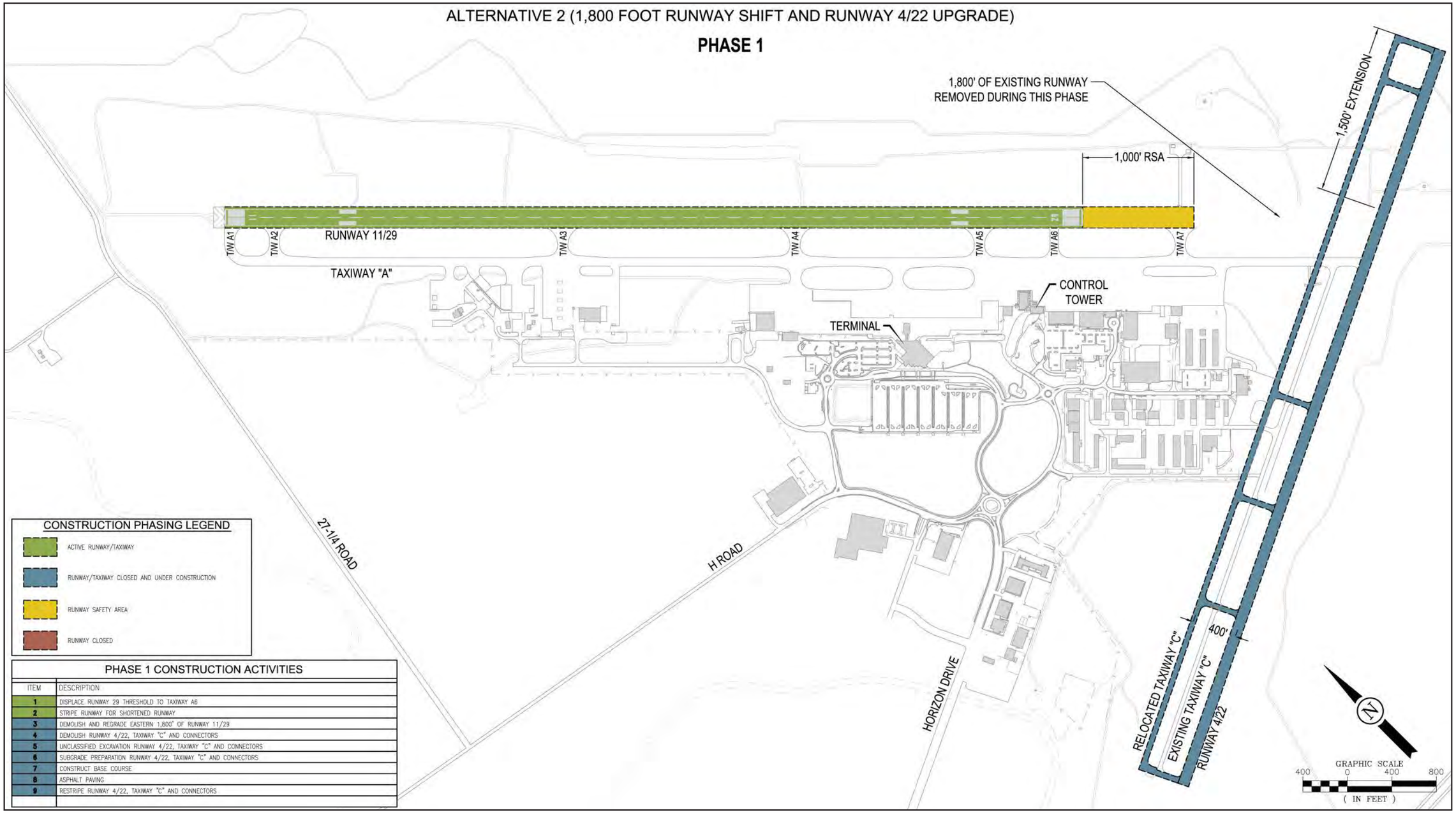


Figure 2.9: Alternative 2, Phase 2

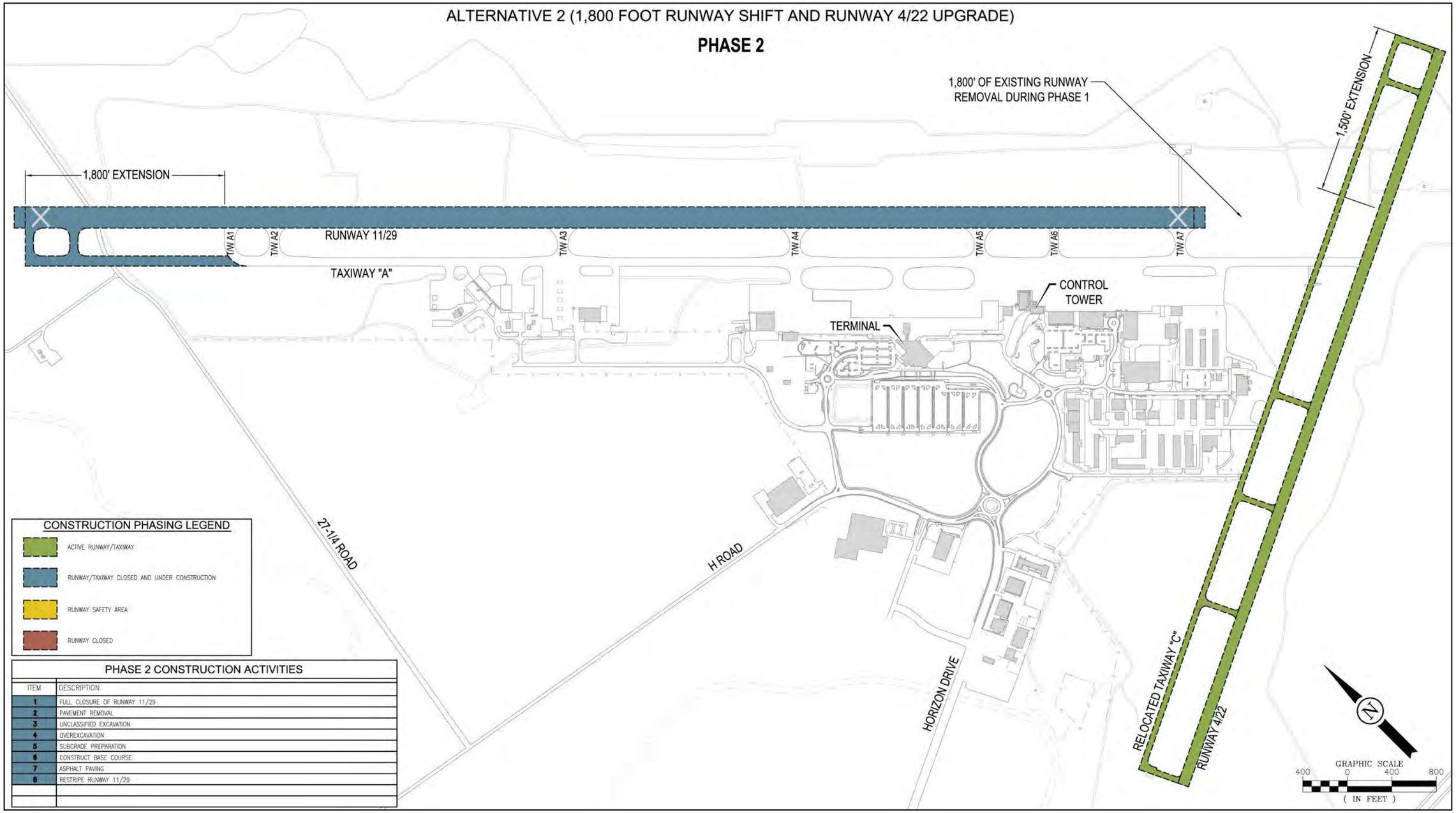


Figure 2.10: Runway 22 Safety Area Section

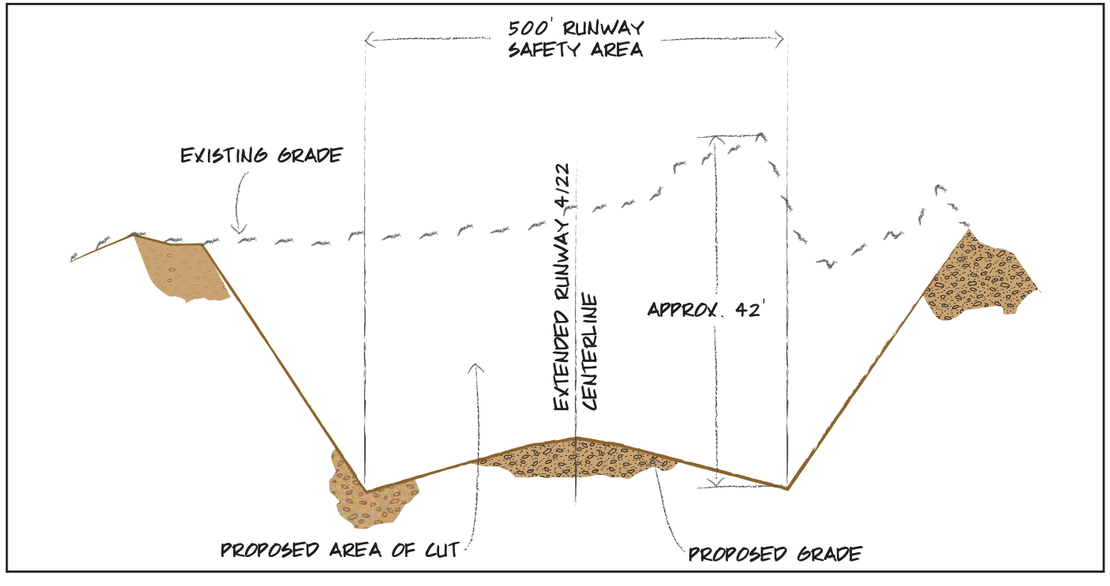
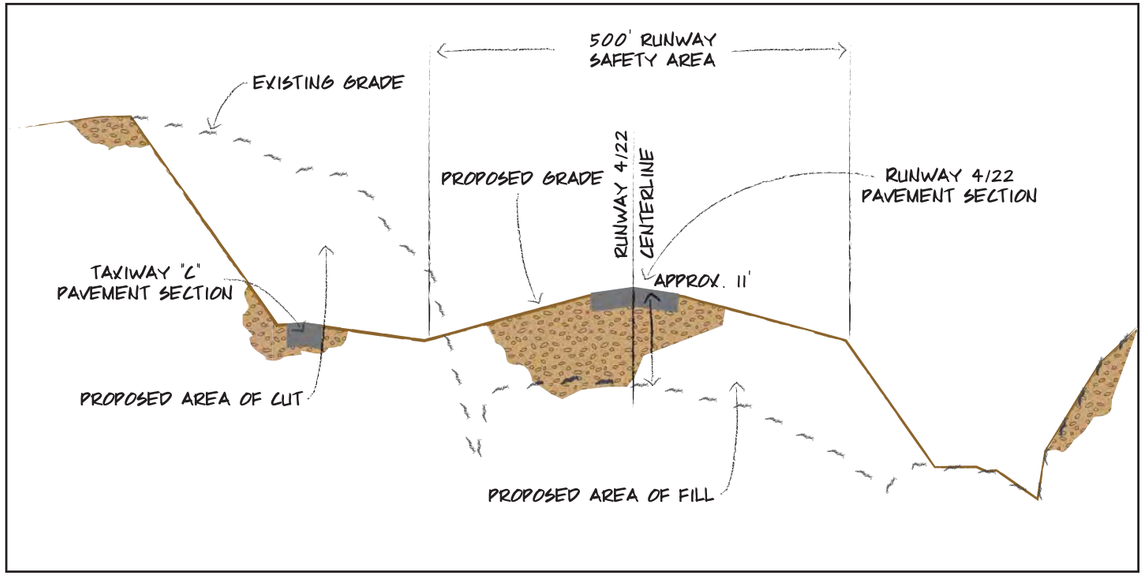


Figure 2.11: Runway 22 Threshold Section



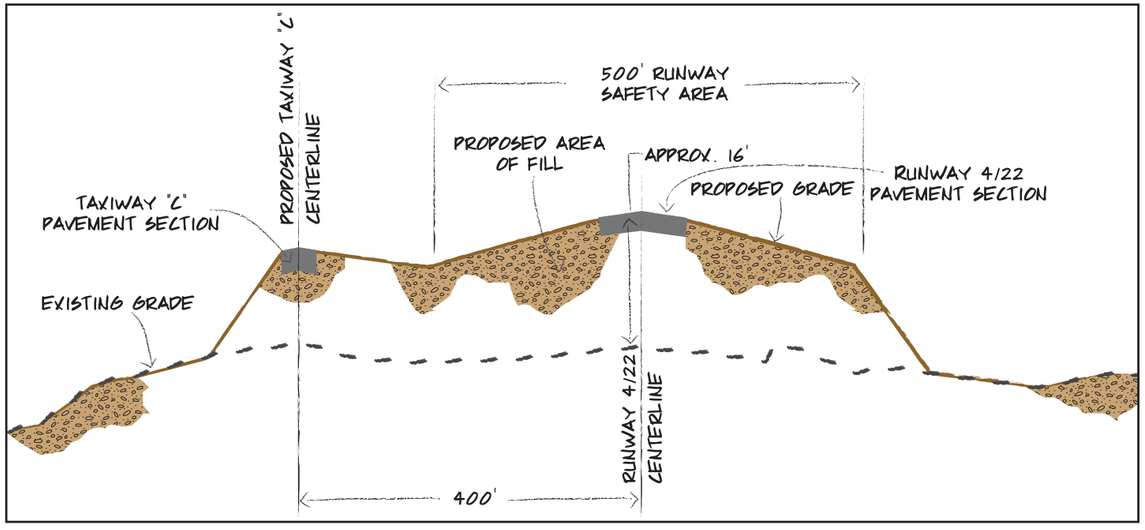
Once the upgrades to Runway 4/22 are complete, air carrier and air cargo services can now operate from Runway 4/22 at restricted levels. This will allow for all of Runway 11/29 to be closed for the entire time the runway is being reconstructed. Unlike Alternative 1, the contractor will have full access to the runway to complete the project. As a result, phasing, temporary thresholds, and transitional pavements will not be required, since the airport will still support restricted air carrier and air cargo operations from Runway 4/22 while Runway 11/29 is being reconstructed.

Similar to Alternative 1, Runway 11/29 will be reconstructed to correct all non-standard conditions. The runway will be shifted by 1,800 feet to the northwest, requiring approximately 2 million cubic yards of embankment. In addition, the existing offset crown, non-standard transverse grades, and RVZ will be brought to standards. The crown would be positioned at the runway centerline and the transverse grades would be corrected to meet FAA standards.

2-2.4 Estimated Construction Costs

The estimated construction cost for this alternative is comprised of the individual costs for both the upgrades to Runway 4/22 and reconstruction of Runway 11/29. The estimated costs to upgrade Runway 4/22 and Taxiway C to ARC C-III standards and to extend the runway by 1,500 feet is approximately $40 million (See Table 2.2: Alternative 2: Construction Cost Estimate). Like Alternative 1, the total cost to reconstruct Runway 11/29 is approximately $62 million (See Table 2.3: Alternative 2: Construction Cost Estimate). Combined, this alternative will cost approximately $102 million to complete.

Figure 2.12: Runway 4 Threshold Section



2-2.5 Economic Impacts to Airport and Local Economy

While the total construction cost for this alternative is approximately 75% more than Alternative 1, the economic loss to the airport and the local community will be significantly less as the airport will not suffer from an extended suspension to commercial air carrier and air cargo services. Based on the airport's annual economic impact of $600,000,000 as determined by CDOT, the economic loss of an extended shutdown may well exceed the costs to upgrade Runway 4/22. When the annual economic impact is prorated monthly, the impact equates to approximately $50,000,000 per month. For a 6 month shutdown to commercial service, the total loss of revenue to the local economy could easily be hundreds of millions of dollars.

2-2.6 Project Funding

Much like the first alternative, once this project is started, the need to complete it in a timely manner is essential. Therefore, the required funding schedule for this alternative will be accelerated similar to Alternative 1.

With the costs for design and construction of this alternative estimated in the $102 million range, planning for funding is an essential consideration that must be analyzed. Since approximately 95 percent of the project's cost will be provided by the FAA, the project's estimated construction period must be compared to the FAA's funding program. While the airport will be able to sustain commercial service at all times during the project, they will still be required to operate at a restricted level due to the shorter runway length of 7,000 feet. While the economic impact to the community will be significantly smaller than in the first alternative, economic loss will still exist. Considering this, an aggressive construction schedule will be required. As a result, the FAA would not be able to spread the required funding out over numerous years of construction, but would be required to fund the entire project over a 2 to 3 year period. Considering the difficulty the first alternative would have securing its funding, this alternative is even more unlikely since the overall FAA funding amount is almost doubled.

An additional barrier to obtaining the funds required for this alternative is the large cost to improve Runway 4/22, which is the airport's secondary runway. With many airports within the region competing for the same discretionary money, funding for a secondary runway is typically a lower priority with the FAA. When considering the large amount of discretionary money required to upgrade Runway 4/22, the likeliness of securing this funding significantly decreases.

TABLE 2.2:
ALTERNATIVE 2: UPGRADE RUNWAY 4/22 CONSTRUCTION COST ESTIMATE

ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100	Mobilization (Est. 8%)	LS	1	$2,381,200.00	$2,381,200.00
P-140	Asphalt Pavement Removal (Complete)	SY	76,455	$8.00	$611,640.00
P-152	Unclassified Excavation	CY	1,078,430	$8.00	$8,627,440.00
P-152	Overexcavation/Subgrade Preparation	CY	75,000	$25.00	$1,875,000.00
P-310	Crushed Aggregate Base Course/Stabilization Fabric/ Shouldering Material	CY	60,200	$46.00	$2,769,200.00
P-401	Asphalt Pavement Course (Including Binder/ Aggregate/Tack)	TON	94,215	$119.00	$11,211,585.00
P-603	Asphalt Surface Treatment (Grooving/Striping)	SY	167,660	$2.60	$435,916.00
D-701	Drainage Improvements (Storm Pipe/Underdrains/ Structures)	LS	1	$1,300,000.00	$1,300,000.00
T-901	Seeding & Erosion Control/ Topsoil Placement	AC	120	$6,000.00	$720,000.00
L-108	Electrical Upgrades	EA	1	$2,213,270.00	$2,213,270.00
				SUBTOTAL	**$32,145,251.00**
				Contingency (5%)	$33,752,520.00
				Design Engineering (Est.)	$2,700,200.00
				Construction Management (Est.)	$3,375,300.00
				GRAND TOTAL	**$39,828,020.00**

Note: All unit prices are in 2011 dollars

TABLE 2.3:
ALTERNATIVE 2: RECONSTRUCT RUNWAY 11/29 WITH A 1,800' EXTENSION CONSTRUCTION COST ESTIMATE

ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100	Mobilization (Est. 8%)	EA	1	$3,734,800.00	$3,734,800.00
P-140	Asphalt Pavement Removal (Complete)	SY	240,230	$8.00	$1,921,840.00
P-152	Embankment In Place	CY	1,920,230	$5.00	$9,601,150.00
P-152	Overexcavation/Subgrade Preparation	CY	114,000	$25.00	$2,850,000.00
P-310	Crushed Aggregate Base Course/Stabilization Fabric	CY	118,530	$44.00	$5,215,320.00
P-401	Asphalt Pavement Course (Including Binder/ Aggregate/Tack)	TON	189,260	$119.00	$22,521,940.00
P-603	Asphalt Surface Treatment (Grooving/Striping)	SY	207,750	$2.60	$540,150.00
D-701	Drainage Improvements (Storm Pipe/Underdrains/ Structures)	LS	1	$2,000,000.00	$2,000,000.00
T-901	Seeding & Erosion Control/Topsoil Placement	AC	55	$6,000.00	$330,000.00
L-108	Electrical Upgrades	LS	1	$1,421,500.00	$1,421,500.00
L-125	Instrumentation Upgrades (REIL/MALSR/Localizer/ Glideslope)	LS	1	$282,000.00	$282,000.00
				SUBTOTAL	**$50,418,700.00**
				Contingency (5%)	$52,939,640.00
				Design Engineering (Est.)	$4,235,200.00
				Construction Management (Est.)	$5,294,000.00
				TOTAL	**$62,468,840.00**
				Reconstruct Runway 11/29	$62,468,840.00
				Upgrade Runway 4/22	$39,828,020.00
				GRAND TOTAL	**$102,296,860.00**

Note: All unit prices are in 2011 dollars

2-3 Alternative 3 - Construct Runway 11/29 at 650 Foot Offset of Existing Runway 11/29 Centerline

Unlike the first two alternatives, Alternative 3 will not reconstruct Runway 11/29 in its current location, but will construct a new runway 650 feet to the northeast of the existing runway centerline (See Figure 2.14: Alternative 3, Phase 1). Upon the completion of the new runway, the existing Runway 11/29 will become the new runway's parallel taxiway. The new Taxiway A centerline will be shifted 50 feet to the northeast so that it will reside at the existing offset crown of the runway. This will leave 600 feet of separation between the runway and taxiway which will allow for the construction of high speed connector taxiways. The final taxiway width will be 75 feet, so 12.5 feet of pavement will be added to the northeast side of the new taxiway while 87.5 feet of existing pavement will be removed from the southwest side.

Construction of the new runway will require approximately 6 million cubic yards of excavation to meet all AC 5300-13 standards and remove all Part 77 terrain penetrations. Approximately 2 million cubic yards of this material can be used as embankment on the project, but the remaining 4 million yards will need to be disposed of or used for embankment on other areas of the airport. A good portion of this 4 million cubic yards of excess material can be used by other future airport development projects (See Figure 2.13: Future Development). One area that can use a portion of this material is along the western limits of Taxiway A, adjacent to connector Taxiways A1 and A2. This area is the only portion along Taxiway A that remains undeveloped. It is prime for aviation development as it will provide direct access to the runway. Development of this area will require approximately 1.5 million cubic yards of fill material to raise the grades up to the Taxiway A elevations. Another area planned for development is the area west of Taxiway C at Taxiways C2 and C3. This area is planned for general aviation development and will require approximately 400,000 cubic yards of fill. Another area requiring a large amount of fill material is east of Runway 4/22. The airport would like to develop this area for additional general aviation use. To bring this area up to the existing grades of Runway 4/22, approximately 1.5 million cubic yards of fill would be required. With all the areas on the airport that would need large volumes of fill material for development, this alternative can provide the material at no additional cost. If required to procure this material for each area independently, costs could reach into the $15 - $20 million dollar range.

The new runway and connector taxiways will meet all FAA design standards for longitudinal and transverse grades, and the crown will be constructed at the runway's centerline. Since the new runway will not intersect with Runway 4/22, a RVZ will not exist, therefore eliminating its operational restrictions when the Control Tower is closed. This will also eliminate the "Hot Spots" that exist at the current runway intersection.

2-3.1 Construction Impacts to Airport Operations

One significant advantage of Alternative 3 is that the new runway can be constructed while the airport continues to operate under normal conditions. Since the new runway will be constructed in a new location, the existing runway can remain open to normal operations while the new runway is being constructed. This will eliminate the need for periods of displaced thresholds, reduced runway lengths, economic loss from the suspension of commercial air carrier and air cargo services, and the large cost to upgrade Runway 4/22.

While some disruptions to operations will still exist during the construction of the connector taxiways near the existing runway, these disruptions should be minimal and can be reduced by working at night.

2-3.2 Terminal Area and Apron Expansion

One additional benefit this alternative has when compared to the others is that it creates space for additional apron area when the existing Taxiway A is relocated 450 feet to the northeast to the existing Runway 11/29 offset crown. Currently, the airport has no additional room to expand its apron in front of the Terminal Building and FBO as they are restrained by the current location of Taxiway A. With Taxiway A being shifted 450 feet to the northeast, additional space for expanding the apron becomes available.

This is especially important near the existing Terminal Building as the airport is planning to construct a new Terminal in the near future and needs additional apron adjacent to the new facility. In addition, the airport is a weather alternate for nearby airports experiencing inclement weather, and added apron would be highly valued.

2-3.3 Improved Runway Efficiency

As mentioned above, this alternative would construct a new runway at a 600 foot separation to the new parallel Taxiway A to allow for the construction of high speed connector taxiways. This is a significant advantage over the other alternatives that maintain a 400 foot runway to taxiway separation and does not allow for high speed geometry. The benefit of high speed connector taxiways is greater operating efficiency of Runway 11/29. High speed connector taxiways will allow aircraft landing on the runway to exit the runway at higher speeds and therefore in less time.

2-3.4 Estimated Construction Costs

The cost for this alternative is comprised solely of the design and construction of the new runway at the 650 foot offset. Since the airport will continue to operate during construction, no economic loss to the airport and surrounding area from the suspension of commercial air carrier and cargo services will be realized. Also, construction costs to upgrade the airport's secondary Runway 4/22 will not be required.

The cost for this alternative is estimated at approximately $92 million (See Table 2.4: Alternative 3: Construction Cost Estimate). This includes costs for engineering, construction, and contract administration. From a standpoint of construction costs, this alternative ranks behind Alternative 1, with a construction cost of $62 million, but ahead of Alternative 2, which has a construction cost of $102 million. When you add the first alternative's potential economic loss to the construction cost, the total cost (construction and economic loss) of Alternative 1 will likely far exceed the construction costs of Alternative 3.

2-3.5 Economic Impacts to Airport and Local Economy

Since the new runway under this alternative will be located 650 feet to the northeast of the existing runway, construction can be completed while Runway 11/29 remains open. This will allow for normal air carrier and air cargo operations during construction and therefore eliminate any economic loss to the airport and local economy. Minor disturbances to operations will be required when the connector taxiways are being constructed within the Runway 11/29 safety area, but the effect this will have on economic revenue will be minimized by completing this work at night. Therefore, the economic impacts of this alternative are considered negligible.

2-3.6 Project Funding

Unlike the first two alternatives, Alternative 3 can be constructed at a slower pace. Since the airport will not be required to operate at a decreased operational level due to shortened runways or commercial service shutdowns, construction of the runway can follow a schedule that works in concert with available funding. Since the FAA will not have to obligate large amounts of discretionary funds

TABLE 2.4:
ALTERNATIVE 3: CONSTRUCTION COST ESTIMATE

ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100	Mobilization (Est. 8%)	EA	1	$6,748,500.00	$6,748,500.00
P-152	Unclassified Excavation	CY	6,100,000	$3.50	$21,350,000.00
P-152	Subgrade Preparation	SY	372,400	$2.00	$744,800.00
P-310	Crushed Aggregate Base Course/Stabilization Fabric	CY	166,000	$44.00	$7,304,000.00
P-401	Asphalt Pavement Course (Including Binder/Aggregate/ Tack)	TON	265,150	$119.00	$31,552,850.00
P-603	Asphalt Surface Treatment (Grooving/Striping)	SY	243,000	$2.60	$631,800.00
D-701	Drainage Improvements (Storm Pipe/Underdrains/ Structures)	LS	1	$1,500,000.00	$1,500,000.00
T-901	Seeding & Erosion Control/ Topsoil Placement	AC	230	$6,000.00	$1,380,000.00
L-108	Electircal Upgrades	LS	1	$2,741,375.00	$2,741,375.00
L-125	Instrumentation Upgrades (REIL/MALSR/Localizer/ Glideslope)	LS	1	$279,300.00	$279,300.00
				SUBTOTAL	**$74,232,625.00**
			Contingency (5%)		$77,944,260.00
			Design Engineering (Est.)		$6,235,500.00
			Construction Management (Est.)		$7,794,400.00
				GRAND TOTAL	**$91,974,160.00**

Note: All unit prices are in 2011 dollars

to a single airport for 2 to 3 consecutive years, the likelihood of securing funds for this alternative are more realistic. This flexibility to work with funding schedules makes this alternative much more attractive when compared to the first two alternatives that require accelerated funding.

Figure 2.13: Future Development



Figure 2.14: Alternative 3, Phase 1

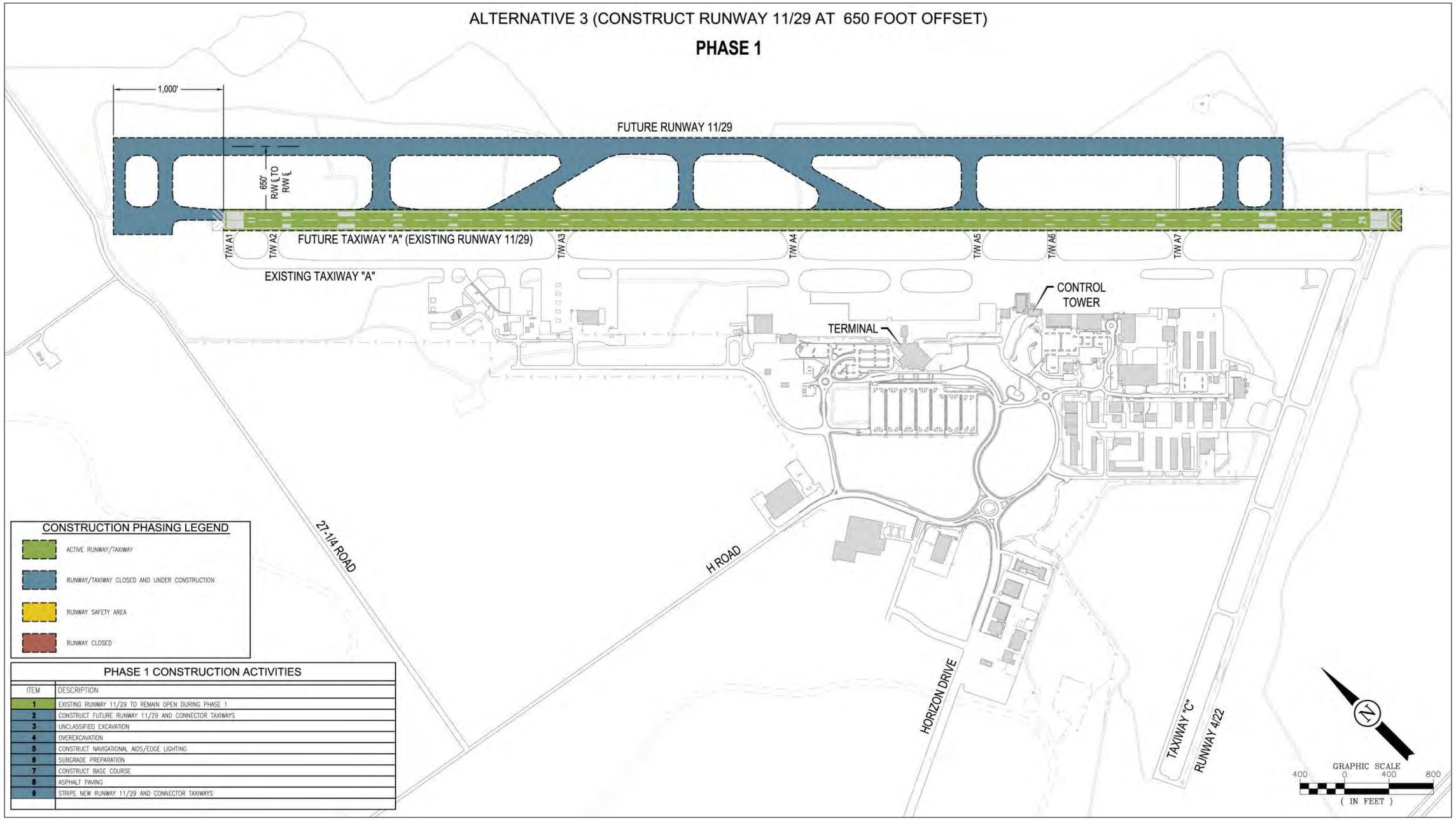
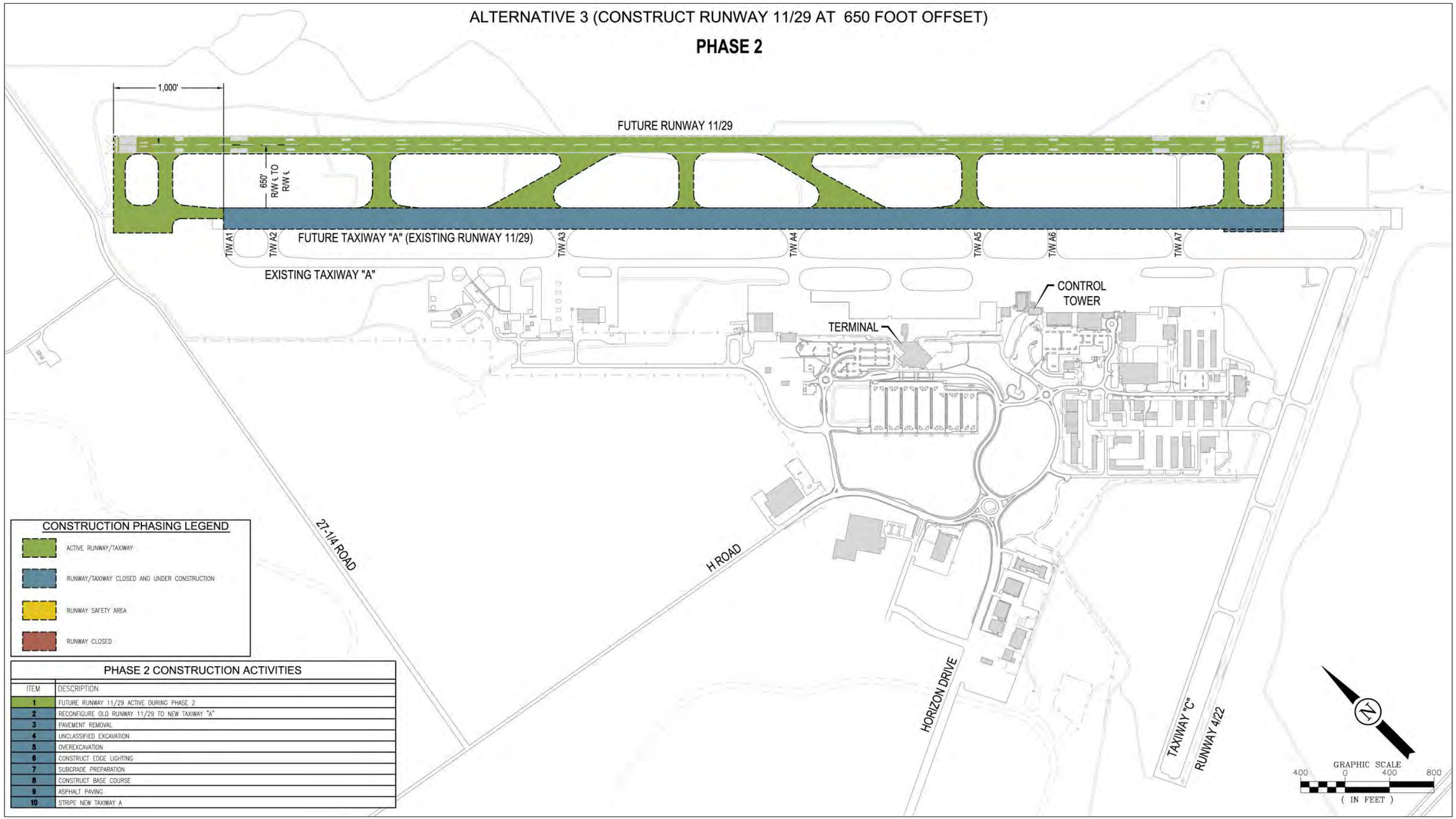


Figure 2.15: Alternative 3, Phase 2



2-4 Alternative 4 - 50 Foot Widening of Runway 11/29

This alternative is the first of two alternatives discussed (Alternative 4 and 5) that will use all, or a portion of, the existing Runway 11/29 pavements to correct some of the current non-standard conditions. This differs significantly from the first three alternatives which constructed the runway using all new materials. The primary goal of this alternative is to correct the offset crown as discussed in Section 1 of this report. The excessive longitudinal and transverse grades and the non-standard RVZ will not be corrected with this option.

2-4.1 Runway 11/29 Improvements

As mentioned in the previous section, the intent of this alternative is to correct the offset crown that currently exists on the runway. As seen in Figure 2.16: Alternative 4 Section, this will be accomplished by shifting the runway centerline to the northeast by 50 feet so that it falls on the runway's existing offset crown. The shift in runway centerline will change the runway's coordinates, thus requiring updating all relevant FAA and aviation publications.

To account for the centerline shift, the runway would need to be widened by 50 feet on the northeast side, and 50 feet of pavement from the southwestern edge would need to be removed. The existing runway lights, guidance signs, runway distant remaining (RDR) signs, localizer, glide slope, and the medium intensity approach lighting system (MALS) would also need to be relocated to the new runway alignment. In addition, the transitions at the connector taxiways would need to be reconstructed to tie to the new runway edges.

2-4.2 Pavement Life

As mentioned in Section 1-4 of this report, the existing pavements of the runway upon completion of the 2009 rehabilitation project were considered to have only 10 years of remaining useful life left. At the time of this study, only 8 years of remaining useful life remain. Since this alternative will build off of the existing pavements, the useful life of this alternative will only be 8 years as well. When compared to the 30+ year life spans of the first three alternatives, this alternative would only provide a short term fix for the airport and therefore, is not considered a viable option.

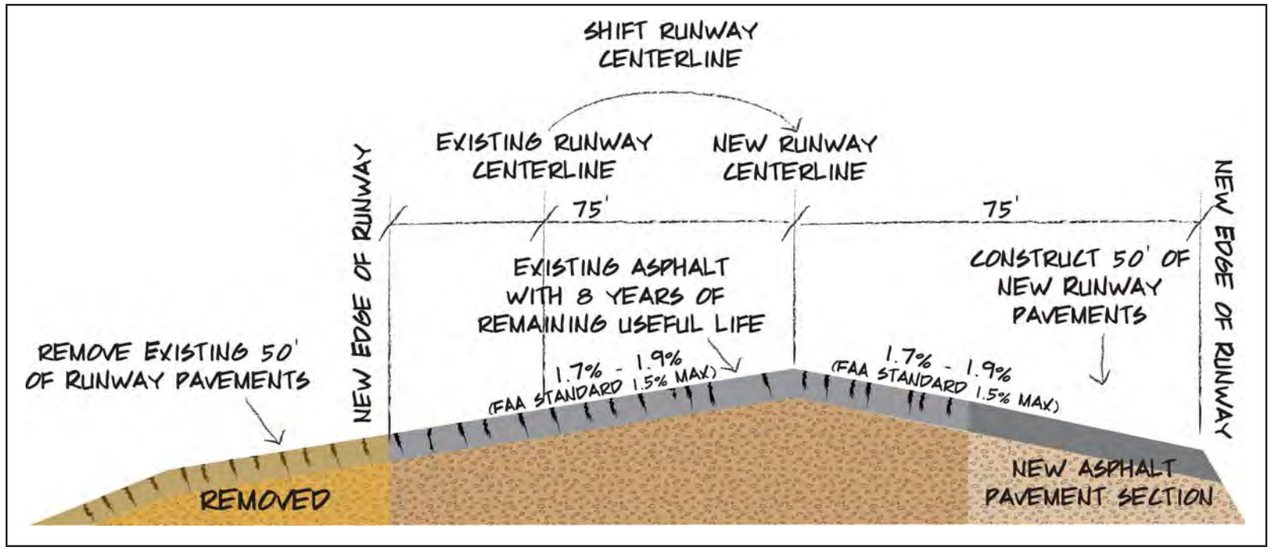
2-4.3 Economic Impacts to Airport and Local Economy

Since this alternative would alter the runway in its existing location, the runway would have to remain closed during construction and would not be able to be phased since the runway's centerline is being shifted 50 feet to the northeast. As a result, the airport would not be able to accommodate commercial air carrier and cargo services during construction, causing significant economic loss to the airport and the local community.

2-4.4 Estimated Construction Costs

A detailed construction cost estimate was not completed for this alternative since it is not considered a viable alternative. This is based on the shortened useful life of the runway under this alternative, the fact that it will not correct all non-standard conditions, and due to the economic loss the airport and the community would suffer during construction.

Figure 2.16: Alternative 4 Section



2.5 Alternative 5 – Overlay of Runway 11/29

The last alternative analyzed for this report would be to overlay the runway in order to correct the runway's existing offset crown. Similar to the fourth alternative, this alternative would not fix the non-standard conditions associated with the longitudinal and transverse grades, or the RVZ.

2-5.1 Runway 11/29 Improvements

This alternative would also build on the existing runway pavements as in the fourth alternative. The offset crown would be corrected by overlaying the runway as shown in Figure 2.17: Alternative 5 Section. Doing so would add significantly to the pavement depth and raise the southeastern edge of the runway by 1.5 feet. This would require the runway lights on this side to be raised and the safety areas to be re-graded. In addition, the connector taxiways would also need to be overlaid due to the elevation change. Many of the existing longitudinal grades of the connectors already exceed the maximum grade as specified in the AC 5300-13 and raising the runway's edge as required by this alternative would only worsen these conditions.

2-5.2 Pavement Life

Just like in the previous alternative, the useful life of this alternative would only be 8 years as it builds upon the existing runway's pavements. When compared to the 30+ year life spans of the first three alternatives, this alternative would only provide a short term fix for the airport and therefore, is not considered a viable option.

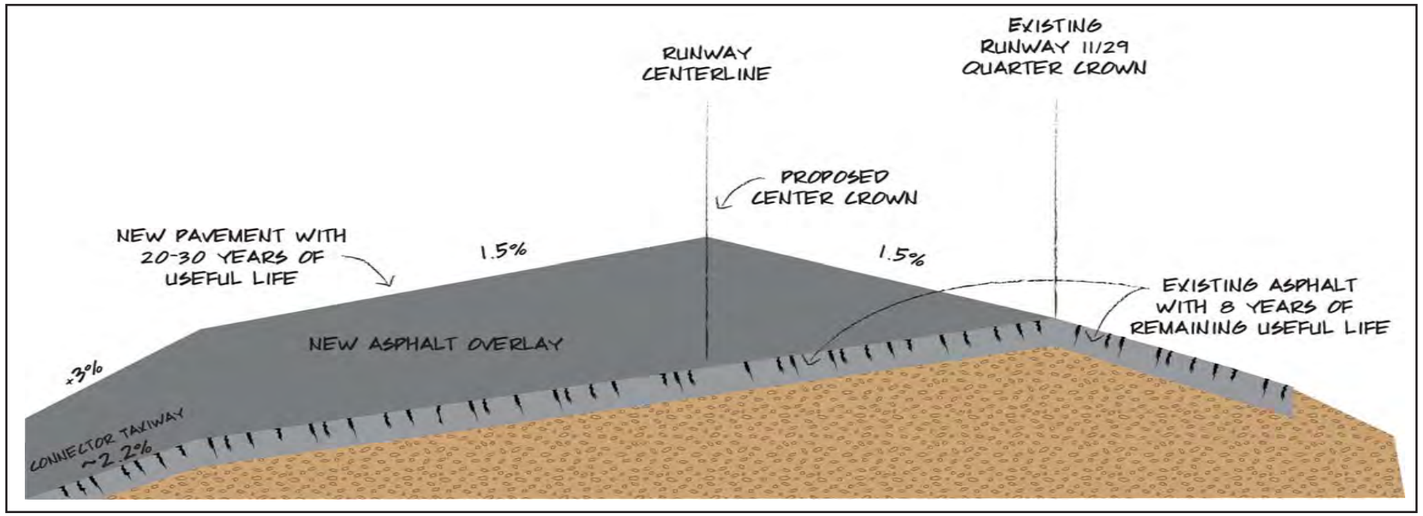
2-5.3 Economic Impacts to Airport and Local Economy

Since this alternative would alter the runway in its existing location, the runway would have to remain closed during construction and would not be able to be phased. As a result, the airport would not be able to accommodate commercial air carrier and cargo services during construction, causing significant economic loss to the airport and the local community.

2-5.4 Estimated Construction Costs

A detailed construction cost estimate was not completed for this alternative since it is not considered a viable alternative. This is based on the shortened useful life of the runway under this alternative, the fact that it will not correct all non-standard conditions, and due to the economic loss the airport and the community would suffer during construction.

Figure 2.17: Alternative 5 Section



3. Conclusion

3-1 Alternative Rankings

Based on the discussions contained in Section 2, each alternative was evaluated based on four categories. These four categories are: estimated construction costs, economic impacts, correction of non-standard conditions, and funding potential. Because Alternatives 4 and 5 were not considered viable options due to the minimal useful life of the pavements when compared to the other three alternatives, they are not included in the evaluation.

Each alternative was ranked from 1 to 3 for each category with 1 being the best alternative and three being the worst. These rankings are summarized as follows:

TABLE 3.1: ALTERNATIVE RANKINGS

ALTERNATIVE	CORRECTION OF NON STANDARD CONDITIONS	CONSTRUCTION COSTS	ECONOMIC COSTS	FUNDING POTENTIAL	TOTAL SCORE
1. Reconstruct RW 11/29 with 1,800' Shift	2	1	3	2	8
2. Reconstruct RW 11/29 with 1,800' Shift and RW 4/22 Upgrades	2	3	2	3	10
3. Construct RW 11/29 at 650' Offset	1	3	1	1	6
Note: Alternative with the lowest total score is the preferred Alternative with this ranking system.					

3-1.1 Correction of Non-Standard Conditions

All three alternatives are capable of correcting all of the non-standard conditions that exist on the runway, but only the third alternative will be able to correct the non-standard longitudinal grades on the connector taxiways. For this reason, the third alternative received the highest ranking for this category, while the other two alternatives tied for the second rank.

3-1.2 Construction Costs

When the construction costs of all three alternatives are compared, Alternative 1 ranks first with an estimated cost of construction of $62 million. Since the estimated costs for Alternatives 2 and 3 are essentially the same ($102 million and $92 million respectively), they both tie for the third rank.

3-1.3 Economic Costs

The economic cost of each alternative is based on the loss of revenue to the airport and the local economy due to the suspension of air carrier and cargo operations while Runway 11/29 is closed. Since Alternative 1 will require a 6 month suspension to air carrier and air cargo services, it receives a ranking of 3. Alternative 2 will still require the airlines to operate on a shortened runway during construction. This will cause the airlines to operate with smaller aircraft, thus causing them loss of revenue. For this reason, Alternative 2 received a ranking of 2. Alternative 3 received a ranking of 1 since air carrier and air cargo operations can continue unimpeded during construction.

3-1.4 Funding Potential

Due to the ability to spread the project out over a longer period of time, the third alternative has the best likelihood of receiving the funding required, and therefore receives the highest rank. Both the first and second alternatives will require funding over a 2 to 3 year period which will be difficult for reasons discussed in Section 2. Since Alternative 1 has a lower construction cost compared to Alternative 2, Alternative 1 receives the second rank and Alternative 2 receives the last.

3-1.5 Total Score

A total score for each alternative is calculated by adding up its rank in all four categories. The alternative that has the lowest total score is the preferred alternative. Alternative 1 has a total score of 8. Its primary negatives were the large economic cost the airport and local community would suffer from the 6 month long suspension of commercial service and the funding difficulties due to the accelerated construction schedule requirements. Alternative 2 had the worst total score of 10, primarily due to its high construction costs, the difficulty of securing funding due to the accelerated schedule, and the need to upgrade the secondary runway. Alternative 3 had a total score of 6 and is the preferred alternative. While its construction costs are greater than Alternative 1, it does not have the economic loss that Alternative 1 has, is able to correct all non-standard conditions better than Alternatives 1 and 2, and has the most potential to securing funding.



ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 3

1991 MEMORANDUM OF UNDERSTANDING

MEMORANDUM OF UNDERSTANDING

between
Walker Field, Colorado, Public Airport Authority
and
U.S. Department of the Interior,
Bureau of Land Management, Grand Junction District Office

This Memorandum of Understanding (MOU) is entered into this 18th day of July ___ 1991, by and between the Walker Field, Colorado, Public Airport Authority, hereinafter referred to as the "Airport Authority," and the U.S. Department of the Interior, Bureau of Land Management, Grand Junction District Office, hereinafter called the "BLM", for the management of public lands adjacent to the Walker Field Airport.

I. PURPOSE

The purpose of this MOU is to recognize the Airport Authority's need to acquire public lands in their long term expansion plans, and to acknowledge BLM's intent to make such lands available to the Airport Authority when needed. The subject lands, lying adjacent to and immediately north of the Airport, comprise approximately 2,163.46 acres and are described as follows:

Ute Meridian

T. 1 N., R. 1 E., Sec. 19: Lots 1-4, E½W½, SE¼;
Sec. 20: S½SW¼;
Sec. 29: N½, N½SE¼, SE¼SE¼;
Sec. 30: Lot 1, NE¼, NE¼NW¼;
Sec. 32: NE¼NE¼.

T. 1 N., R. 1 W., Sec. 13: N½SW¼, SW¼SW¼, S½SE¼;
Sec. 14: SE¼;
Sec. 23: NE¼, N½NW¼;
Sec. 24: NE¼, N½SE¼, SE¼SE¼.

II. AUTHORITY

A. BLM is authorized to enter into this MOU pursuant to its powers under the following statutory provisions:

1. The Federal Land Policy and Management Act of 1976, 43 U.S.C. 1700 et seq., in general, and Section 307(a), 43 U.S.C. 1737(a), in particular, which provides, as here pertinent, that "... subject to the provisions of applicable law, the Secretary may enter into contracts and cooperative agreements

involving the management, protection, development, and sale of public lands";

2. The National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq.; and

3. Section 516 of the Airport and Airway Improvement Act of 1982, 49 U.S.C. 2215, which sets forth procedures for the issuance of conveyance documents for lands under the jurisdiction of the Department of the Interior to public agencies for use as airports and airways.

B. Airport Authority

The Airport Authority is the owner and operator of the Walker Field Airport, located in Grand Junction, Colorado. The Airport Authority is authorized to enter into this MOU pursuant to its powers under its governing statute, the Colorado Public Airport Authority law, set forth at Colorado Revised Statutes, 41-3-101 et seq., in general, and 41-3-106(d), in particular, which empowers the Airport Authority, as here pertinent, "to enter into contracts and agreements affecting the affairs of the Authority, including, but not limited to, contracts with the United States...."

III. PROCEDURE

A. The Airport Authority agrees to the following:

1. Pending conveyance of the subject lands to the Airport Authority, the Airport Authority shall inform BLM, from time to time, of any significant changes in the Airport Master Plan, or in the Mesa County Plans and Policies for the Airport, relative to present or future Airport operations or Airport expansion needs.

2. The Airport Authority may request that the FAA apply to the BLM for conveyance of such portions, or all, of the subject lands, and any other public lands, that may be required to accommodate future Airport operations or expansion plans, at any time the Airport Authority believes such a conveyance would be appropriate. The BLM shall review said conveyance request or requests in accordance with the terms, conditions, and requirements of Section 516 of the Airport and Airway Improvement Act of 1982, 40 U.S.C. 2215.

B. The BLM agrees to the following:

1. The BLM will retain the subject lands until needed for expansion by the Airport Authority.

2. The BLM will consider the long term expansion needs of the Airport Authority when considering land use authorizations on the subject lands.

3. BLM shall immediately notify the Airport Authority of any proposed or requested future uses of the subject lands, that potentially could be inconsistent with present or future Airport operations or expansion plans, in order to provide the Airport Authority an opportunity to set forth its position and concerns on said proposals, prior to BLM's determining whether or not said proposed uses should be authorized, and, if authorized, the conditions and constraints under which said proposed uses will be authorized.

4. The BLM will not authorize any land uses determined to be inconsistent with present or future Airport operations or expansion plans. Without limiting the foregoing, BLM specifically agrees as follows:

(a) With respect to oil and gas leases:

(i) To the extent permitted by law, BLM will neither permit nor authorize any drilling, construction, or other operations of any kind or nature whatsoever, under any oil and gas leases presently encumbering the subject lands, that would be inconsistent with the Airport's present or future operations or long term expansion plans (or, if BLM cannot lawfully prohibit said inconsistent operations altogether, then BLM shall only permit or authorize such operations that are as minimally inconsistent as possible with present or future Airport operations or long term expansion plans);

(ii) BLM will not initiate any future oil and gas leasing on the subject lands; and

(iii) Should a third party request a future oil and gas lease on the subject lands, or should a third party request a reissuance of a present lease following the expiration or lapse thereof, BLM will not authorize, as part of said new lease, any activities that would be inconsistent with present or future Airport operations or expansion plans.

(b) BLM shall neither authorize nor permit any future rights-of-way for utility lines, pipelines, or other utility-related facilities of any kind or nature whatsoever, that would be inconsistent with present or future Airport operations or the Airport's long term expansion plans.

(c) With respect to mining claims:

(i) BLM shall process, as expeditiously and inexpensively as possible, the presently pending application from the Federal Aviation Administration to withdraw the subject BLM lands from entry under the mining laws;

(ii) To the extent permitted by law, BLM shall neither authorize nor permit any drilling, construction, or other mining operations of any kind or nature whatsoever, under any present or future mining claims, that would be inconsistent with present or future Airport operations or long term Airport expansion needs (and, if the BLM cannot lawfully prohibit said inconsistent operations altogether, then, to the extent permitted by law, BLM shall only permit such mining operations that are as minimally inconsistent with present or future Airport operations or expansion plans as possible). Should it be necessary to examine the mining claims for validity purposes, in order to determine whether the requested mining activity should be authorized, then the Airport Authority shall be responsible for the costs and expenses of the validity examination; and

(iii) If a present or future mining claim lapses as a result of the claimant's failure to timely file any necessary annual affidavits of assessment work, the BLM shall timely forward the written "Locke" notice to the claimant confirming that his mining claim has lapsed.

5. Subject to paragraph B 4, above, the BLM will keep the subject lands open to public uses as described in the Grand Junction Resource Area, Resource Management Plan (RMP), until such time as the subject lands are conveyed to the Airport Authority.

6. The BLM will issue written notices within thirty days of the effective date of this MOU, to all present livestock grazing permittees, advising them that the described lands may be removed from their grazing allotment at any time following two years from the date of said notice, to accommodate the Airport's future operations or expansion plans.

7. The BLM shall advise, in writing, all future livestock grazing permittees involved with the subject lands, of the Airport's future expansion plans. At the time a new permit is issued, it will be stipulated that the described lands may be removed from grazing use at any time, to accommodate the Airport's future operations or expansion plans.

8. BLM agrees that the next time BLM revises or amends the RMP, relative to lands involving or affecting the subject BLM lands, BLM shall include, as one of the proposed RMP amendments, the question as to whether the subject BLM lands should be reclassified as being suitable for disposal to the Airport Authority for Airport purposes. If BLM thereafter determines that the subject BLM lands should be reclassified as being suitable for disposal to the Airport Authority for Airport purposes, BLM shall amend the RMP to reflect said reclassification. BLM shall be responsible for all costs associated with said amendment review and reclassification process, provided that the review is made in conjunction with another proposed RMP amendment or revision affecting the subject BLM lands. Nothing herein shall preclude the Airport Authority from requesting that BLM consider reclassifying the subject BLM lands as being suitable for disposal to the Airport Authority for Airport purposes, prior to the time BLM would be required to engage in such review under this paragraph; provided, however, in such event, the Airport Authority shall bear the costs of such review and reclassification process.

9. The BLM shall apply the remaining balance of the Airport Authority's previous deposit, toward the costs that will be incurred in connection with the BLM's processing of the pending FAA application that the subject lands be withdrawn from location and entry under the mining laws. Notwithstanding the foregoing, the Airport Authority may, at any time, request that the BLM refund the remaining balance of said monies to the Airport Authority, minus the Airport Authority's share of costs incurred in processing the FAA Withdrawal Application, during the interim period following the execution of this MOU and prior to the Airport Authority's refund request. In such event, the BLM shall honor the Airport Authority's refund request, and may thereafter insist upon the Airport Authority posting an acceptable deposit of funds consistent with applicable BLM regulations, before the BLM further processes the pending FAA Withdrawal Application, or any further request or application the Airport Authority might submit regarding the subject lands.

C. Both parties agree to the following:

This MOU sets forth the complete and entire understanding of the parties, relative to the conveyance of the subject BLM lands to the Airport Authority, and the manner by which the lands shall be retained by the BLM pending said conveyance. No oral or written agreements, promises, representations, or understandings that may have been previously made between the parties shall be deemed to remain in force or effect, if said prior agreements, promises, representations, or understandings are not set forth herein.

IV. EXPIRATION

This MOU will continue in effect until such time as the subject lands are conveyed to the Airport Authority or a determination is made in a future revision or amendment of the Grand Junction Resource Management Plan that it would not be suitable to set aside the subject lands for disposal to the Airport Authority for Airport purposes. At such time as either of these conditions are met, this MOU shall be deemed to automatically expire.

V. AMENDMENT

This MOU may not be modified, except by a written modification, executed by both parties hereto.

VI. CANCELLATION

This MOU may be terminated by the mutual agreement of the parties hereto, prior to meeting the Expiration conditions in IV above, but said termination shall only be deemed effective if it is set forth in writing, executed by both parties hereto.

VII. SIGNATURE AUTHORIZATIONS

A. Attached to this MOU as Exhibit "A" is a Resolution adopted by the Airport Authority Board of Commissioners, authorizing the Airport Authority Chairperson of the Board to execute this MOU on behalf of the Airport Authority.

B. Mr. Bruce Conrad, the undersigned District Manager of the BLM, warrants and represents that he has been delegated the authority to execute this MOU on behalf of the BLM, and that this MOU will be binding upon the BLM, following its execution by him.

Done and entered into on the date first above written.

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT

Bruce Conrad, District Manager

H. Robert Moore, State Director

WALKER FIELD, COLORADO, PUBLIC AIRPORT AUTHORITY

John M. Leane, Chairperson

Jeffrey T. Wendland, Airport Manager



ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 4

SOIL RESOURCE REPORT

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Mesa County Area, Colorado



October 25, 2011

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....7
Soil Map.....8
Legend.....9
Map Unit Legend.....10
Map Unit Descriptions.....10
Mesa County Area, Colorado.....13
68—Killpack-Badlands-Persayo complex, 3 to 25 percent slopes, saline...13
74—Turley-Sagrlite-Fruitland complex, 0 to 3 percent slopes.....15
75—Uffens fine sandy loam, 1 to 6 percent slopes.....17
Av—Avalon sandy loam, gravelly substratum, 2 to 5 percent slopes.....18
AvC—Avalon loam, gravelly substratum, 5 to 25 percent slopes.....19
Bc—Sagers silty clay loam, 0 to 2 percent slopes.....20
BcW—Cojam loam, 0 to 2 percent slopes.....21
Bd—Sagers silty clay loam, 2 to 5 percent slopes.....22
BkD—Blackston very gravelly loam, 5 to 25 percent slopes.....23
Bl—Blackston gravelly loam, 2 to 5 percent slopes.....24
Cc—Persayo silty clay loam, 5 to 12 percent slopes.....25
Ce—Persayo silty clay loam, 2 to 5 percent slopes.....26
Fe—Fruita clay loam, 0 to 2 percent slopes.....27
Ff—Fruita clay loam, 2 to 5 percent slopes.....28
Fg—Fruitvale clay loam, 0 to 2 percent slopes.....29
Fh—Fruitvale clay loam, 2 to 5 percent slopes.....30
Fr—Fruitland fine sandy loam, 2 to 5 percent slopes.....31
Hj—Killpack silty clay, 2 to 5 percent slopes.....31
Hk—Killpack silty clay, 0 to 2 percent slopes.....32
Re—Sagrlite loam, 0 to 2 percent slopes.....33
Rp—Persayo silty clay loam, 12 to 40 percent slopes.....34
Rs—Ustifluvents, 0 to 2 percent slopes.....35
Tr—Turley clay loam, 0 to 2 percent slopes.....36
Soil Information for All Uses.....38
Suitabilities and Limitations for Use.....38
Land Classifications.....38
Farmland Classification (GJT Soil Survey).....38
References.....43

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

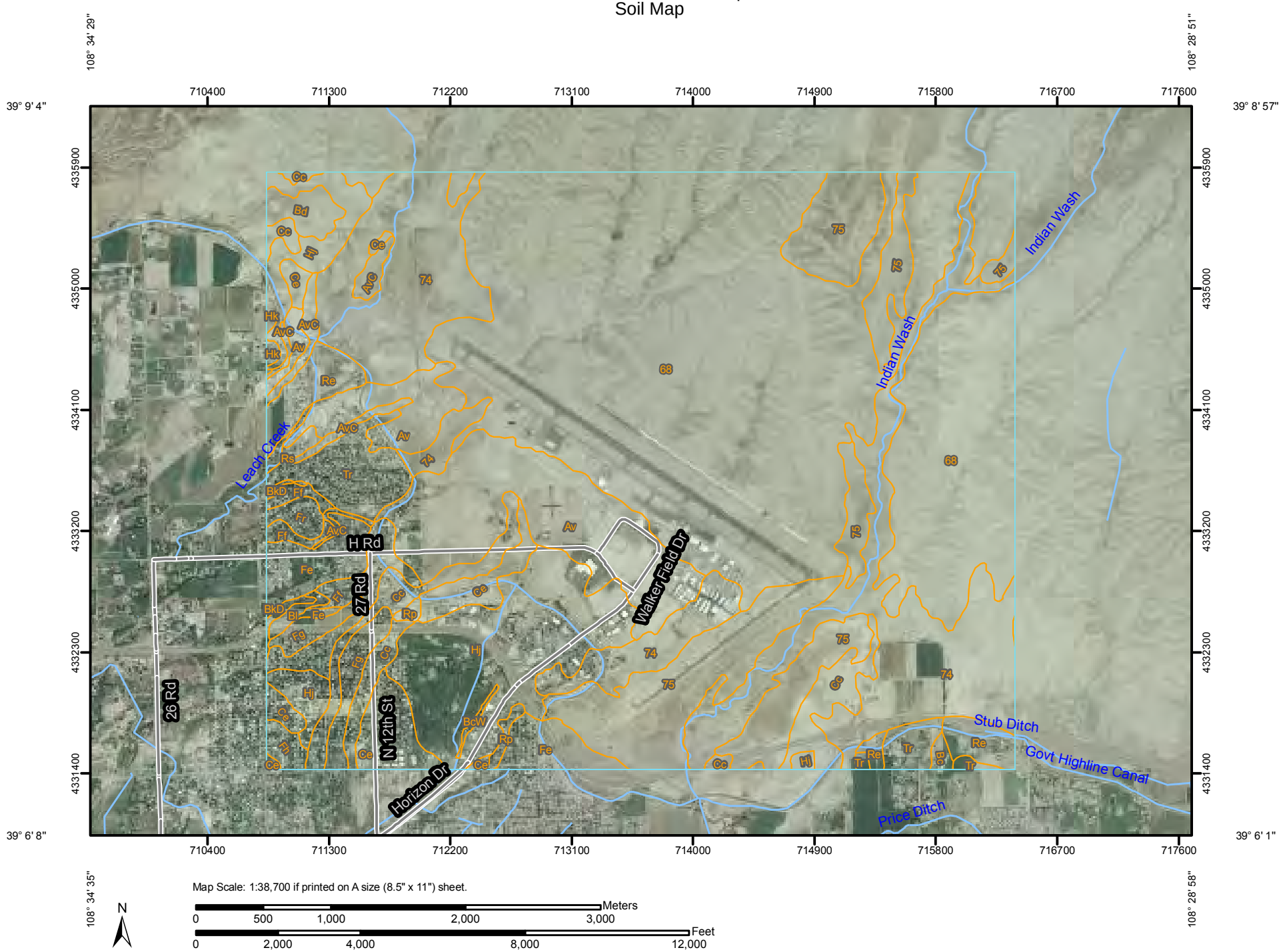
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:38,700 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

Date(s) aerial images were photographed: 8/24/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Mesa County Area, Colorado (CO680)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
68	Killpack-Badlands-Persayo complex, 3 to 25 percent slopes, saline	2,486.1	40.9%
74	Turley-Sagrlite-Fruitland complex, 0 to 3 percent slopes	933.1	15.3%
75	Uffens fine sandy loam, 1 to 6 percent slopes	569.3	9.4%
Av	Avalon sandy loam, gravelly substratum, 2 to 5 percent slopes	495.5	8.1%
AvC	Avalon loam, gravelly substratum, 5 to 25 percent slopes	57.1	0.9%
Bc	Sagers silty clay loam, 0 to 2 percent slopes	7.9	0.1%
BcW	Cojam loam, 0 to 2 percent slopes	4.2	0.1%
Bd	Sagers silty clay loam, 2 to 5 percent slopes	37.1	0.6%
BkD	Blackston very gravelly loam, 5 to 25 percent slopes	9.1	0.1%
Bl	Blackston gravelly loam, 2 to 5 percent slopes	10.6	0.2%
Cc	Persayo silty clay loam, 5 to 12 percent slopes	194.2	3.2%
Ce	Persayo silty clay loam, 2 to 5 percent slopes	151.1	2.5%
Fe	Fruita clay loam, 0 to 2 percent slopes	139.1	2.3%
Ff	Fruita clay loam, 2 to 5 percent slopes	97.3	1.6%
Fg	Fruitvale clay loam, 0 to 2 percent slopes	70.0	1.2%
Fh	Fruitvale clay loam, 2 to 5 percent slopes	19.7	0.3%
Fr	Fruitland fine sandy loam, 2 to 5 percent slopes	21.5	0.4%
Hj	Killpack silty clay, 2 to 5 percent slopes	494.7	8.1%
Hk	Killpack silty clay, 0 to 2 percent slopes	6.0	0.1%
Re	Sagrlite loam, 0 to 2 percent slopes	107.5	1.8%
Rp	Persayo silty clay loam, 12 to 40 percent slopes	14.9	0.2%
Rs	Ustifluvents, 0 to 2 percent slopes	6.5	0.1%
Tr	Turley clay loam, 0 to 2 percent slopes	150.9	2.5%
Totals for Area of Interest		**6,083.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic

class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical

or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Mesa County Area, Colorado

68—Killpack-Badlands-Persayo complex, 3 to 25 percent slopes, saline

Map Unit Setting

Elevation: 4,700 to 5,200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Killpack and similar soils: 35 percent
Badland: 30 percent
Persayo and similar soils: 25 percent

Description of Killpack

Setting

Landform: Knolls
Landform position (two-dimensional): Shoulder
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Residuum weathered from clayey shale

Properties and qualities

Slope: 3 to 25 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to strongly saline (1.0 to 25.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Moderate (about 6.3 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Ecological site: Clayey Saltdesert (R034XY403CO)

Typical profile

0 to 3 inches: Parachannery silty clay loam
3 to 12 inches: Parachannery silty clay loam
12 to 26 inches: Parachannery silty clay loam
26 to 36 inches: Extremely parachannery silty clay loam
36 to 40 inches: Weathered bedrock

Description of Badland

Setting

Landform: Hills, erosion remnants
Down-slope shape: Convex
Across-slope shape: Linear

Properties and qualities

Slope: 3 to 25 percent
Depth to restrictive feature: 0 to 4 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 4 percent
Maximum salinity: Very slightly saline to moderately saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability (nonirrigated): 8s

Typical profile

0 to 2 inches: Silty clay loam
2 to 12 inches: Weathered bedrock

Description of Persayo

Setting

Landform: Knolls
Landform position (two-dimensional): Shoulder
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Residuum weathered from clayey shale

Properties and qualities

Slope: 3 to 25 percent
Depth to restrictive feature: 4 to 10 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Nonsaline to moderately saline (2.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Very low (about 0.7 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Ecological site: Clayey Saltdesert (R034XY403CO)

Typical profile

0 to 2 inches: Silty clay loam
2 to 4 inches: Silty clay loam
4 to 8 inches: Weathered bedrock

74—Turley-Sagrlite-Fruitland complex, 0 to 3 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Turley and similar soils: 30 percent
Sagrlite and similar soils: 30 percent
Fruitland and similar soils: 25 percent

Description of Sagrlite

Setting

Landform: Alluvial fans, valley floors
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water capacity: High (about 9.4 inches)

Interpretive groups

Land capability (nonirrigated): 7c
Ecological site: Saltdesert Overflow (R034XY407CO)

Typical profile

0 to 13 inches: Silt loam
13 to 60 inches: Silt loam

Description of Turley

Setting

Landform: Alluvial fans, valley floors
Down-slope shape: Linear

Across-slope shape: Linear, concave
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 4 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 10.6 inches)

Interpretive groups

Land capability (nonirrigated): 7c
Ecological site: Saltdesert Overflow (R034XY407CO)

Typical profile

0 to 10 inches: Clay loam
10 to 20 inches: Fine sandy loam
20 to 30 inches: Clay loam
30 to 60 inches: Stratified loam to silty clay loam

Description of Fruitland

Setting

Landform: Alluvial fans, valley floors
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Moderate (about 7.6 inches)

Interpretive groups

Land capability (nonirrigated): 7c
Ecological site: Saltdesert Overflow (R034XY407CO)

Typical profile

0 to 8 inches: Fine sandy loam
8 to 30 inches: Stratified gravelly sandy loam to fine sandy loam
30 to 60 inches: Sandy loam, fine sandy loam

75—Uffens fine sandy loam, 1 to 6 percent slopes

Map Unit Setting

Elevation: 5,000 to 5,500 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 120 to 150 days

Map Unit Composition

Uffens and similar soils: 85 percent

Description of Uffens

Setting

Landform: Terraces, pediments
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Very slightly saline to moderately saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 60.0
Available water capacity: Moderate (about 7.6 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Ecological site: Loamy Saltdesert (R034XY401CO)

Typical profile

0 to 3 inches: Fine sandy loam
3 to 10 inches: Loam
10 to 28 inches: Clay loam
28 to 52 inches: Sandy clay loam
52 to 65 inches: Cobbly sandy clay loam

Av—Avalon sandy loam, gravelly substratum, 2 to 5 percent slopes

Map Unit Setting

Elevation: 4,600 to 4,800 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Avalon, gravelly substratum, and similar soils: 90 percent

Description of Avalon, Gravelly Substratum

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Alluvium and/or slope alluvium derived from sandstone and shale

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water capacity: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7c

Typical profile

0 to 3 inches: Sandy loam
3 to 17 inches: Loam
17 to 42 inches: Clay loam
42 to 60 inches: Gravelly loam

AvC—Avalon loam, gravelly substratum, 5 to 25 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Avalon, gravelly substratum, and similar soils: 80 percent

Description of Avalon, Gravelly Substratum

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Alluvium and/or slope alluvium derived from sandstone and shale

Properties and qualities

Slope: 5 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water capacity: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability (nonirrigated): 7c

Typical profile

0 to 3 inches: Sandy loam
3 to 17 inches: Loam
17 to 42 inches: Clay loam
42 to 60 inches: Gravelly loam

Bc—Sagers silty clay loam, 0 to 2 percent slopes

Map Unit Setting

Elevation: 4,500 to 5,900 feet
Mean annual precipitation: 5 to 8 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Sagers and similar soils: 90 percent

Description of Sagers

Setting

Landform: Alluvial fans, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium and slope alluvium derived from calcareous shale and sandstone

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Available water capacity: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability (nonirrigated): 7c

Typical profile

0 to 12 inches: Silty clay loam
12 to 25 inches: Silty clay loam
25 to 60 inches: Silty clay loam

BcW—Cojam loam, 0 to 2 percent slopes

Map Unit Setting

Elevation: 4,470 to 4,870 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Cojam and similar soils: 90 percent

Description of Cojam

Setting

Landform: Alluvial fans, drainageways
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): 7w
Land capability (nonirrigated): 7w

Typical profile

0 to 4 inches: Loam
4 to 12 inches: Silt loam
12 to 24 inches: Silty clay loam
24 to 35 inches: Silty clay loam
35 to 59 inches: Stratified sandy loam to silty clay loam

Bd—Sagers silty clay loam, 2 to 5 percent slopes

Map Unit Setting

Elevation: 4,500 to 5,900 feet
Mean annual precipitation: 5 to 8 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Sagers and similar soils: 90 percent

Description of Sagers

Setting

Landform: Alluvial fans, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium and slope alluvium derived from calcareous shale and sandstone

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Available water capacity: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7c

Typical profile

0 to 12 inches: Silty clay loam
12 to 25 inches: Silty clay loam
25 to 60 inches: Silty clay loam

BkD—Blackston very gravelly loam, 5 to 25 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Blackston and similar soils: 90 percent

Description of Blackston

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Eolian deposits over alluvium derived from sandstone and shale; eolian sands over alluvium derived from sandstone and shale

Properties and qualities

Slope: 5 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 35 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability (nonirrigated): 7c

Typical profile

0 to 3 inches: Very gravelly loam
3 to 7 inches: Gravelly clay loam
7 to 15 inches: Very gravelly sandy clay loam
15 to 35 inches: Extremely gravelly sandy loam
35 to 60 inches: Extremely gravelly sand

Bl—Blackston gravelly loam, 2 to 5 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Blackston and similar soils: 90 percent

Description of Blackston

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits over alluvium derived from sandstone and shale

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 35 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7c

Typical profile

0 to 3 inches: Gravelly loam
3 to 7 inches: Gravelly clay loam
7 to 15 inches: Very gravelly sandy clay loam
15 to 35 inches: Extremely gravelly sandy loam
35 to 60 inches: Extremely gravelly sand

Cc—Persayo silty clay loam, 5 to 12 percent slopes

Map Unit Setting

Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Persayo and similar soils: 90 percent

Description of Persayo

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Residuum weathered from calcareous shale

Properties and qualities

Slope: 5 to 12 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Very low (about 2.5 inches)

Interpretive groups

Land capability (nonirrigated): 7c
Ecological site: Silty Saltdesert (R034XY410CO)

Typical profile

0 to 4 inches: Silty clay loam
4 to 15 inches: Silty clay loam
15 to 19 inches: Weathered bedrock

Ce—Persayo silty clay loam, 2 to 5 percent slopes

Map Unit Setting

Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Persayo and similar soils: 90 percent

Description of Persayo

Setting

Landform: Hillsides
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Residuum weathered from calcareous shale

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 6s
Land capability (nonirrigated): 7c

Typical profile

0 to 4 inches: Silty clay loam
4 to 15 inches: Silty clay loam
15 to 19 inches: Weathered bedrock

Fe—Fruita clay loam, 0 to 2 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Fruita and similar soils: 90 percent

Description of Fruita

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from shale over alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 50 percent
Maximum salinity: Very slightly saline to moderately saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water capacity: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability (nonirrigated): 7c

Typical profile

0 to 2 inches: Clay loam
2 to 6 inches: Clay loam
6 to 16 inches: Clay loam
16 to 22 inches: Clay loam
22 to 32 inches: Loam
32 to 60 inches: Gypsiferous sandy loam

Ff—Fruita clay loam, 2 to 5 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Fruita and similar soils: 90 percent

Description of Fruita

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from shale over alluvium derived from sandstone and shale

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 50 percent
Maximum salinity: Very slightly saline to moderately saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water capacity: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7c

Typical profile

0 to 2 inches: Clay loam
2 to 6 inches: Clay loam
6 to 16 inches: Clay loam
16 to 22 inches: Clay loam
22 to 32 inches: Loam
32 to 60 inches: Gypsiferous sandy loam

Fg—Fruitvale clay loam, 0 to 2 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Fruitvale and similar soils: 80 percent

Description of Fruitvale

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from sandstone and shale over residuum weathered from clayey shale

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Very slightly saline to slightly saline (4.0 to 8.0 mmhos/cm)
Available water capacity: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 7c

Typical profile

0 to 4 inches: Clay loam
4 to 8 inches: Clay loam
8 to 12 inches: Clay loam
12 to 20 inches: Silty clay loam
20 to 24 inches: Silty clay loam
24 to 47 inches: Silty clay loam
47 to 60 inches: Silty clay

Fh—Fruitvale clay loam, 2 to 5 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Fruitvale and similar soils: 80 percent

Description of Fruitvale

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Slope alluvium derived from sandstone and shale over residuum weathered from clayey shale

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Very slightly saline to slightly saline (4.0 to 8.0 mmhos/cm)
Available water capacity: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7c

Typical profile

0 to 4 inches: Clay loam
4 to 8 inches: Clay loam
8 to 12 inches: Clay loam
12 to 20 inches: Silty clay loam
20 to 24 inches: Silty clay loam
24 to 47 inches: Silty clay loam
47 to 60 inches: Silty clay

Fr—Fruitland fine sandy loam, 2 to 5 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Fruitland and similar soils: 90 percent

Description of Fruitland

Setting

Landform: Fan terraces
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Sandy eolian deposits over alluvium derived from sandstone and shale

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7c

Typical profile

0 to 16 inches: Fine sandy loam
16 to 40 inches: Fine sandy loam
40 to 60 inches: Very fine sandy loam

Hj—Killpack silty clay, 2 to 5 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 150 to 190 days

Map Unit Composition
Killpack and similar soils: 85 percent

Description of Killpack

Setting
Landform: Hills
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from clayey shale

Properties and qualities
Slope: 2 to 5 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 15 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 7.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 4.7 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7c

Typical profile
0 to 6 inches: Silty clay
6 to 17 inches: Silty clay
17 to 21 inches: Silty clay
21 to 24 inches: Silty clay
24 to 38 inches: Silty clay loam
38 to 60 inches: Weathered bedrock

Hk—Killpack silty clay, 0 to 2 percent slopes

Map Unit Setting
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition
Killpack and similar soils: 85 percent

Description of Killpack

Setting

Landform: Hills
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from clayey shale

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 15 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 7.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 7c

Typical profile

0 to 6 inches: Silty clay
6 to 17 inches: Silty clay
17 to 21 inches: Silty clay
21 to 24 inches: Silty clay
24 to 38 inches: Silty clay loam
38 to 60 inches: Weathered bedrock

Re—Sagrlite loam, 0 to 2 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Sagrlite and similar soils: 90 percent

Description of Sagrlite

Setting

Landform: Terraces, alluvial fans
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water capacity: High (about 9.4 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability (nonirrigated): 7c

Typical profile

0 to 13 inches: Loam
13 to 60 inches: Silt loam

Rp—Persayo silty clay loam, 12 to 40 percent slopes

Map Unit Setting

Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Persayo and similar soils: 70 percent

Description of Persayo

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Residuum weathered from clayey shale

Properties and qualities

Slope: 12 to 40 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Very low (about 2.5 inches)

Interpretive groups

Land capability (nonirrigated): 7c
Ecological site: Silty Saltdesert (R034XY410CO)

Typical profile

0 to 4 inches: Silty clay loam
4 to 15 inches: Silty clay loam
15 to 19 inches: Weathered bedrock

Rs—Ustifluvents, 0 to 2 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Ustifluvents and similar soils: 85 percent

Description of Ustifluvents

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Slightly saline to moderately saline (8.0 to 16.0 mmhos/cm)
Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability (nonirrigated): 7c
Ecological site: Saltdesert Overflow (R034XY407CO)

Typical profile

0 to 2 inches: Sandy loam
2 to 8 inches: Very fine sandy loam
8 to 22 inches: Stratified loamy sand to sandy clay loam
22 to 60 inches: Very gravelly sandy loam

Tr—Turley clay loam, 0 to 2 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Turley and similar soils: 90 percent

Description of Turley

Setting

Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 4 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability (nonirrigated): 7c

Typical profile

0 to 10 inches: Clay loam
10 to 20 inches: Fine sandy loam
20 to 30 inches: Clay loam
30 to 60 inches: Stratified loam to silty clay loam

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

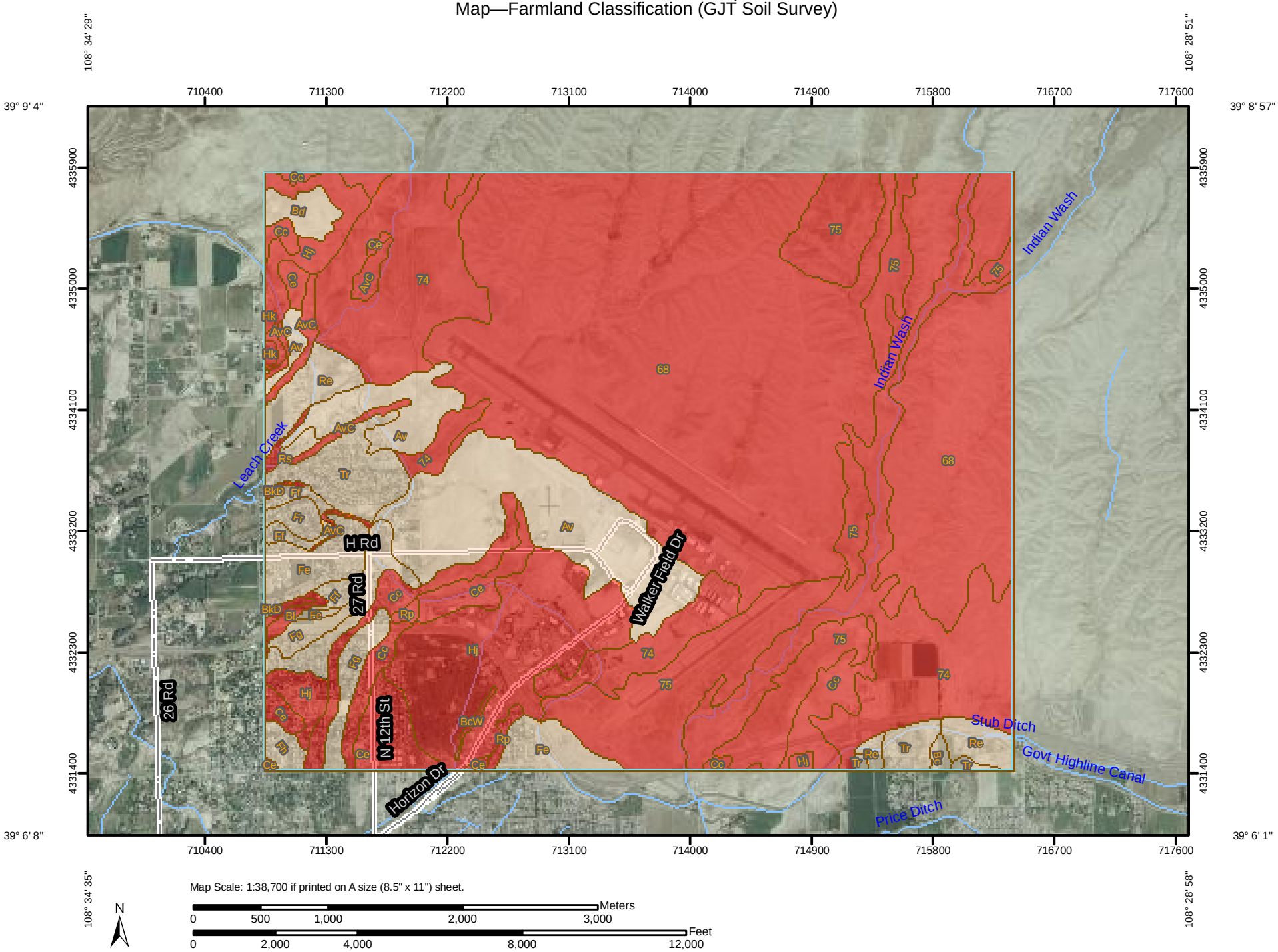
Land Classifications

Land Classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Farmland Classification (GJT Soil Survey)

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

Custom Soil Resource Report
Map—Farmland Classification (GJT Soil Survey)



Map Scale: 1:38,700 if printed on A size (8.5" x 11") sheet.

N

Meters
0 500 1,000 2,000 3,000

Feet
0 2,000 4,000 8,000 12,000

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:38,700 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

Date(s) aerial images were photographed: 8/24/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Farmland Classification (GJT Soil Survey)

Farmland Classification— Summary by Map Unit — Mesa County Area, Colorado (CO680)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
68	Killpack-Badlands-Persayo complex, 3 to 25 percent slopes, saline	Not prime farmland	2,486.1	40.9%
74	Turley-Sagrlite-Fruitland complex, 0 to 3 percent slopes	Not prime farmland	933.1	15.3%
75	Uffens fine sandy loam, 1 to 6 percent slopes	Not prime farmland	569.3	9.4%
Av	Avalon sandy loam, gravelly substratum, 2 to 5 percent slopes	Prime farmland if irrigated	495.5	8.1%
AvC	Avalon loam, gravelly substratum, 5 to 25 percent slopes	Not prime farmland	57.1	0.9%
Bc	Sagers silty clay loam, 0 to 2 percent slopes	Prime farmland if irrigated	7.9	0.1%
BcW	Cojam loam, 0 to 2 percent slopes	Not prime farmland	4.2	0.1%
Bd	Sagers silty clay loam, 2 to 5 percent slopes	Prime farmland if irrigated	37.1	0.6%
BkD	Blackston very gravelly loam, 5 to 25 percent slopes	Not prime farmland	9.1	0.1%
Bl	Blackston gravelly loam, 2 to 5 percent slopes	Not prime farmland	10.6	0.2%
Cc	Persayo silty clay loam, 5 to 12 percent slopes	Not prime farmland	194.2	3.2%
Ce	Persayo silty clay loam, 2 to 5 percent slopes	Not prime farmland	151.1	2.5%
Fe	Fruita clay loam, 0 to 2 percent slopes	Prime farmland if irrigated	139.1	2.3%
Ff	Fruita clay loam, 2 to 5 percent slopes	Prime farmland if irrigated	97.3	1.6%
Fg	Fruitvale clay loam, 0 to 2 percent slopes	Prime farmland if irrigated	70.0	1.2%
Fh	Fruitvale clay loam, 2 to 5 percent slopes	Prime farmland if irrigated	19.7	0.3%
Fr	Fruitland fine sandy loam, 2 to 5 percent slopes	Prime farmland if irrigated	21.5	0.4%
Hj	Killpack silty clay, 2 to 5 percent slopes	Not prime farmland	494.7	8.1%
Hk	Killpack silty clay, 0 to 2 percent slopes	Not prime farmland	6.0	0.1%
Re	Sagrlite loam, 0 to 2 percent slopes	Prime farmland if irrigated	107.5	1.8%
Rp	Persayo silty clay loam, 12 to 40 percent slopes	Not prime farmland	14.9	0.2%
Rs	Ustifluvents, 0 to 2 percent slopes	Not prime farmland	6.5	0.1%
Tr	Turley clay loam, 0 to 2 percent slopes	Prime farmland if irrigated	150.9	2.5%
Totals for Area of Interest			**6,083.2**	**100.0%**

Rating Options—Farmland Classification (GJT Soil Survey)

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://soils.usda.gov/

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://soils.usda.gov/

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://soils.usda.gov/

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.glti.nrcs.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://soils.usda.gov/

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 5

WILDLIFE, VEGETATION AND FISH, AND WETLANDS TECHNICAL MEMORANDUMS

Affected Environment
Wildlife, Vegetation and Fish

Introduction

The Grand Junction Airport area of potential effect (APE) includes both private land and land currently managed by Bureau of Land Management (BLM). A brief overview of the APE landscape provides an indication of the extent of land use and lack of native plant communities. Adjacent to the developed airport area, which supports airport buildings, ramps, runways and a taxiway, the private land contains graded areas and natural areas consisting of salt desert shrub communities in the adobe badlands. The BLM land, located to the north of the airport private property, is heavily utilized by OHV (off-highway vehicles) resulting in a severely damaged landscape. The parking areas along side $27^{1/4}$ Road are completely denuded of vegetation as are the adjacent adobe hills. Farther to the east, additional areas of severe habitat destruction are marked by roads on nearly every hilltop and on surrounding slopes. Vegetation that remains consists of saltbush species and annual plants on the hills and slopes and greasewood and rabbitbrush in the arroyos. Given the landscape condition the presence of wildlife typically associated with the adobe badlands is limited.

However, to fully describe the plant and wildlife that may be present in this area, several sources of information were utilized to document the plants, wildlife and their habitat within the project boundary. These sources include:

USGS 7.5 Topographical Map, Corcoran Point and Grand Junction Quadrangles
Aerial photographs
NRCS Mesa County Soil Survey
BLM correspondence data
Colorado Natural Heritage Program correspondence data
USFWS correspondence
Colorado Native Plant Society, *Rare Plants of Colorado, second edition* (1997)
Andrews and Righter, *Colorado Birds* (1992)
Righter et al. *Birds of Western Colorado Plateau and Mesa County* (2004)
Hammerson, *Amphibians and Reptiles in Colorado* (1999)
Fitzgerald et al. *Mammals of Colorado* (1994)
Dexter et al. *Bird Check List for Mesa County, Colorado* (1995)
Kingery, *Colorado Breeding Bird Atlas* (1998)
Weber, *Colorado Flora Western Slope* (2001)

Also, descriptions of critical habitats for federally listed threatened, endangered and candidate fish and wildlife species were reviewed in the Federal Register, U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS). In addition, the Bureau of Land Management (BLM) (2009) has published a list of sensitive species and their habitats. This list includes federally listed endangered, threatened, and candidate species likely to occur on BLM lands.

A list of Birds of Conservation Concern (BCC) and their habitats was also reviewed. This list is published by the USFWS through a Memorandum of Understanding with the

BLM and the U.S. Forest Service (USFS), which places high conservation priorities for BCC species (USFWS, 2008). Not all of these BCC species occur regularly in Colorado, and some are present only as seasonal migrants. Of those known to breed in Colorado, only a select few are known or suspected to breed within the vicinity of the airport.

Avian literature sources such as the *Birds of Western Colorado Plateau and Mesa County* (Righter et al. 2004) and the *Colorado Breeding Bird Atlas* (Kingery 1998) were reviewed to determine the likelihood for species occurrence within the survey area. Also reviewed was Dexter et al. (1995) *Bird Check List for Mesa County, Colorado*. The bird identification and taxonomic nomenclature are in accordance with that applied by the Colorado Breeding Bird Atlas Project (Kingery 1998). Information on reptiles and amphibians came from Hammerson (1999). Fitzgerald et al. (1994) provides information on mammal habitats and geographic distribution

In addition, the Colorado Natural Heritage Program (CNHP) was contacted via letter in April 2010, and the USFWS and the Colorado Division of Wildlife were contacted via letters in May 2010 with requests for information on known federally threatened and endangered species, sensitive species or species of concern, areas of potential ecological concern, or significant/critical wildlife habitat, unique natural communities, or other significant features within the sections, ranges and townships of the airport. The Heritage program responded, but the Colorado Division of Wildlife did not respond. Calls to the USFWS and their response indicated that they would rely on species lists provided by the BLM.

Because the BLM property will become a part of the airport property through dispersal, the BLM requested surveys for several plant species, prairie dog towns and burrowing owls (*Athene cunicularia*) and raptors if nesting habitat was located within 1/2 mile of the APE boundary. The BLM further refined their list of Grand Junction Field Office special status plants by indicating those species that might be encountered in the APE. This information was provided to the survey team prior to field work. The BLM also requested surveys for prairie dog colony location and burrowing owls.

Field Methodologies

Plants

Since all of plant species of interest bloom in spring, field surveys were planned for and conducted during the spring of 2010 on May 5-7 and May 11-14. An additional survey was conducted on June 30 to confirm locations of Grand buckwheat populations and individuals of the smallflower fishhook cactus. A pre-survey field site visit with the BLM Grand Junction Field Office Ecologist was conducted. Known sites of the Grand buckwheat and the smallflower fishhook cactus west of the APE were visited.

In addition to the pre-survey field visits, the survey team, which consisted of two individuals, reviewed the Rare Plant Field Guide for the special status species. A team member also visited the Colorado State University herbarium to examine the special status plant species.

The field survey team utilized an intuitive controlled method of surveying the area. Since much the proposed BLM dispersal land was highly disturbed due to off-highway vehicles (OHV) use, the team concentrated on areas where the landscape was not denuded of vegetation. The abundance of roads enabled the team to access the area relatively easily with ATVs. The team drove all of the roads that would allow access to side slopes and drainages that supported vegetation. After dismounting the ATVs, the survey team walked the drainages and the alluvial fans in search of special status plant species. In addition, the team walked transects approximately 75 m apart on 3 days. Four transects ran north to south on the west side of the 27-1/4 Road. An additional four transects, east of 27-1/4 Road and south of the Airport Operation Area, ran east to west. Another 2 transects on BLM land were walked from east to west. Other transects occurred on airport property south of the proposed BLM dispersal land. Additional foot surveys were completed in the very northern reaches of the BLM dispersal parcel. Approximately 77 person-hours were spent surveying for the special status plants.

Wildlife

Prairie dog colony mapping took place in early morning and late afternoon when the animals were above ground foraging. It was customary to walk or drive to a high point and view the surrounding flats through binoculars and spotting scope. Locations of observed prairie dogs were plotted on 7.5-minute topo maps. Only active burrows were mapped.

By far the most time during the survey was consumed by the burrowing owl nest site search. In 2010, BLM Grand Junction Field Office adopted the protocol developed by the Colorado Division of Wildlife (2007). In this method, after prairie dog colony mapping, call stations are set up approximately 500 meters apart, or as far apart as necessary to view the entire prairie dog colony (owl nesting habitat). Recorded owl calls are played over a ten-minute period at each station while the observer searches the colony with binoculars and spotting scope. Searches must be carried out in the morning between one-half hour before to two hours after sunrise, and again in late afternoon between two hours before sunset to one-half hour after sunset. This procedure must be conducted again the following week and the week after that for a total of six visits to each station. Calling took place June 7, 16, and 23. Follow-up visits using binocular scans but no calling were made June 30 and July 15. Call stations were set up so that during a given 2 ½-hour session, all prairie dog colonies within the APE plus a surrounding ¼-mile buffer would be covered. As a result, both BLM and airport property were searched for nesting owls. All call stations were located atop ridges or hills. Informal pedestrian surveys for owl nest burrows were conducted on a random basis in suitable habitat. Occupied nest burrows are readily identified even if no adult owls are observed at the time (Photo 3).

Searches for other species took place concurrently with the prairie dog mapping and burrowing owl surveys. In the case of kit fox, all canid scats and tracks were examined, and all burrow openings of approximately eight inches in diameter or more were examined for fox sign. All locations were determined by use of hand-held GPS (global positioning system) unit.

Results from the BLM, USFWS and the Colorado Natural Heritage Program

Based on correspondence from the BLM dated March 25, 2010 and the Colorado Natural Heritage Program (CNHP) dated April 13, 2010, and the USFWS dated May 17, 2010 there are no known occurrences of federally threatened or endangered species, or significant natural areas within the APE. However, the BLM indicated known locations of Colorado hookless cactus (*Sclerocactus glaucus*) and smallflower fishhook cactus (*Sclerocactus parviflorus*) to the west of the APE. The survey team visited the smallflower fishhook cactus site and found two specimens. The status of special status plant species provided by the BLM is presented in Table 1. The status of rare and/or imperiled species and communities based on a search by the CNHP is presented in Table 2.

Table 1. Special Status Plant Species (BLM Grand Junction Field Office, 1/2010)

PLANTS		**Status**
Scientific Name	Common Name	
Sclerocactus glaucus	Colorado hookless cactus	FT
Penstemon debilis	Parachute beardtongue	FC
Phacelia submutica	DeBeque phacelia	FC
Aliciella stenothyrsa (Gilia stenothyrsa)	Narrow-stem gilia	S
Amsonia jonesii	Jones' bluestar	S
Astragalus debequaeus	DeBeque milkvetch	S
Astragalus equisolensis	Horseshoe milkvetch	S
A. linifolius	Grand Junction milkvetch	S
A. musiniensis	Ferrons' milkvetch	S
A. naturitensis	Naturita milkvetch	S
A. piscator	Fisher milkvetch	S
A. rafaelensis	San Rafael milkvetch	S
Camissonia eastwoodiae	Grand Junction suncup	S
Cryptantha gypsophila	Gypsum Valley cateye	S
Cryptantha osterhoutii (Oreocarya osterhoutii)	Osterhout's cryptantha	S
Erigeron kachinesis	Kachina fleabane	S
Eriogonum contortum	Grand buckwheat	S
Frasera paniculatum	Tufted frasera	S
Lesquerella parviflora	Piceance bladderpod	S
Lomatium latilobum	Canyonlands biscuitroot	S
Lygodesmia doloresensis	Dolores River skeletonplant	S
Mentzelia argillosa	Roan cliffs blazingstar	S
Mimulus eastwoodii	Eastwood's monkeyflower	S

Pediomelum aromaticum	Aromatic Indian breadroot	S
Thalictrum heliophilum	Cathedral Bluff meadow-rue	S
Cirsium perplexans	Adobe thistle	*

FC – Federal Candidate FT – Threatened
S – BLM listed special status species * – Species of interest

Of the species listed in Table 1, BLM identified only four species that might be present within the APE (see highlighted species). These included the Colorado hookless cactus (*Sclerocactus glaucus*), narrow-stem gilia (*Aliciella stenothyrsa*), Grand Junction suncup (*Camissonia eastwoodiae*) and Grand buckwheat (*Eriogonum contortum*). All of these species bloom in spring, and thus, the field survey was conducted during the spring of 2010. The other species are not known to inhabit the area around the airport or would not be located in an adobe badlands environment. For example, although Grand Junction milkvetch might be found in the vicinity, it is typically located on Chinle and Morrison formations in pinyon-juniper and sagebrush habitats.

Of the birds that might occur in or near the APE, the BLM expressed concern about the burrowing owl (*Athene cunicularia*), which is a state threatened species. The owl nests in prairie dog holes, and therefore, the location of prairie dog colonies is essential to assessing the bird's presence. Prairie dog colonies abound within the APE and therefore, the BLM requested a survey of the colonies for the presence of burrowing owls.

Correspondence from the CNHP indicated that eleven species of rare or imperiled species were known or likely to occur within a two-mile radius of the proposed airport expansion. These are shown in Table 2. Of these species only one, Wetherhill's milkvetch (*Astragalus wetherhillii*) was encountered within the same township, range and section as the airport project. The CNHP reported no designated Potential Conservation Areas within the APE as noted in their April 13, 2010 letter.

Table 2. Status of Rare and/or Imperiled Species and Communities (CNHP, April 13, 2010).

Scientific Name	Common Name	Global and State Rank*	State Status	Federal Status
Hyla arenicolor	Canyon treefrog	G5/S2	-----	-----
Spea intermontana	Great Basin spadefoot	G5/S3	-----	-----
Gila robusta	Roundtail chub	G3/S2	SC	-----
Coluber constrictor mormon	Western yellowbelly racer	G5T5/S3	-----	-----
Gambelia wislizenii	Longnose leopard lizard	G5/S1	SC	-----
Eriogonum contortum	Grand buckwheat	G3/S3	-----	-----
Oreocarya aperta	Grand Junction cat's eye	GH/SH		
Oreocarya elata	Cliff dweller's candlestick catseye	G3S2	-----	-----
Xyrauchen texanus	Razorback sucker	G1/S1	SE	LE

Astragalus linifolius	Grand Junction milkvetch	G3Q/S3	-----	-----
Astragalus wetherhillii	Wetherhill's milkvetch	G3/S3	-----	-----

G3- Globally vulnerable; typically 21 to 100 occurrences
G4- Globally apparently secure; usually > 100 occurrences
G5- Globally demonstrably secure although it may be rare in parts of its range
T# - rank applies to a subspecies
S1- State critically imperiled; typically 5 or fewer occurrences
S2 - State imperiled; typically 6 to 20 occurrences
S3- State vulnerable; typically 21 to 100 occurrences
SU- Unrankable; not enough information is known

Of the species listed in Table 2, only the Grand buckwheat of the CNHP list is likely to be found within the APE per conversations with the BLM Grand Junction Field Office. Of the remaining plant species, only the cliff dweller's catseye may be present in the APE since it prefers clay soils in salt desert communities. The two milkvetches are typically found in pinyon-juniper and sagebrush plant communities.

Breeding habitat is present in the survey area for the following mammals, birds, reptiles and amphibians:

Black-footed Ferret. (*Mustela nigripes*). Federal endangered. Habitat is shortgrass prairie to semi-desert shrublands with large populations of prairie dogs (*Cynomys*). Extirpated from Colorado in the 1940s, the species was reintroduced into northwest Colorado in 2001.

Botta's Pocket Gopher. (*Thomomys bottae rubidus*). BLM sensitive. Species is found in a variety of vegetative types where soils suitable for burrowing are present.

Kit Fox. (*Vulpes macrotis*). BLM sensitive. Habitat is semi-desert shrubland and the edges of pinyon-juniper woodlands. There are also records of occurrence in rimrock.

White-tailed Prairie Dog. (*Cynomys leucurus*). BLM sensitive. Species may be found in a variety of habitats generally below 8500 feet. Open, semi-desert shrublands, grasslands, and agricultural lands are preferred. Species is social and is often found in large colonies over a wide area.

American Kestrel. (*Falco sparverius*). Found in a variety of habitats. Nests in cavities in trees, buildings, and cliffs.

Barn Owl. (*Tyto alba*). Nests in buildings and cavities; forages over a variety of habitats including marshlands, shrublands, and agricultural areas.

Burrowing Owl. (*Athene cunicularia*). BCC, BLM sensitive. This species nests in burrows made by prairie dogs and other animals in sparsely vegetated habitats at lower elevations.

Ferruginous Hawk. (*Buteo regalus*). BCC, BLM sensitive. Habitat is large expanses of grassland/shrubland with high rodent or lagomorphs populations. Nests may be placed in isolated junipers, on man-made platforms, on rock pinnacles, and even on the ground.

Loggerhead Shrike. (*Lanius ludovicianus*). BCC, BLM sensitive. Species breeds in a variety of habitats including agricultural lands, woodlands, and shrublands at lower elevations. Nests in trees and shrubs.

Red-tailed Hawk. (*Buteo jamaicensis*). Species occupies diverse habitats including grasslands, pinyon-juniper woodlands and deciduous, coniferous and riparian forests. Nests in mature trees (especially cottonwood, aspen, and pines) and on cliffs and utility poles.

Longnose Leopard Lizard. (*Gambelia wislizenii*). BLM sensitive. Habitat is semi-desert shrublands and areas of open junipers with rodent burrows and bare soil or sparse vegetation at lower elevations.
Midget Faded Rattlesnake. (*Crotalus viridis concolor*). BLM sensitive. Habitat varies from riparian to semi-desert shrublands at lower elevations.
Milk Snake. (*Lampropeltis triangulum taylori*). BLM sensitive. Species may occupy shortgrass grasslands, shrublands, hillsides, canyons, pinyon-juniper, and Gambel oak to 8000 feet.
Great Basin Spadefoot. (*Spea intermontana*). BLM sensitive. Habitat includes rocky canyons, shrublands, semi-desert shrublands, or pinyon-juniper woodlands with temporary water for reproduction.

Other birds that may be encountered in the area are presented in Appendix A. Since the APE encompasses both developed land and semi-desert shrublands waterfowl, shorebirds and other similar birds are not likely to be encountered in the area. However, Highline Canal abuts a portion of the western boundary; therefore, some waterfowl or water-loving birds may flyover the APE. Some of these birds, such as the swallows, are included in Table 3.

Results from the Field Survey

General Conditions

The Grand Junction County Airport APE is situated about 5 miles north of downtown Grand Junction, CO adjacent to the adobe badlands. The badlands are typified by soils derived from Mancos shale and they support a salt desert plant community. The APE encompasses both private land and BLM lands. The private land supports airport features where the landscape immediately adjacent to the runways, taxiway and ramp are graded. Outside of the graded area, remnants of the saltbush community exists, though it is degraded and supports exotic, invasive plant species, which are mostly annuals. The BLM portion of the APE, which is marked for dispersal to the airport, is highly degraded as a result of OHV use; however, it, too, supports remnants of salt desert plant communities dominated by annual invasives in the spring. Thirteen ephemeral drainages, (arroyos) sloping generally from north to south, support a multitude of side drainages, gullies and rills which naturally form in the Mancos shale.

Within the last 100 years, the area north of the airport was intensively grazed by livestock. Currently the BLM land is grazed in the spring, and with little in the way of native perennial forage, cattle concentrate on the invasive annual grass species that flourish in at that time of the year.

Grand Junction and the airport are located in a temperate desert environment where the total annual average precipitation is 8.99 inches (based on data from 1971-2000, National Weather Service website). The annual average maximum temperature is about 65.8^{o}F and the annual average minimum temperature is about 40.2^{o}F. The average annual temperature is 53^{o}F. The total annual snowfall is approximately 21.7 inches. Generally, the area is sunny with the greatest amount of precipitation comes in March and October with about 1 inch falling on average during these months. The climate is cold in the

winter, warm to hot in the summer with a late summer through fall monsoon, whereby late afternoon rain showers may occur frequently throughout the week.

The Mancos Shale of Upper Cretaceous period dominates the landscape in this area. Indian Wash, which passes through the most eastern edge of the APE, is underlain by alluvium distributed by tributary streams during the Holocene and late Pleistocene epochs. At the west end of the APE, pediment of the Walker Field was deposited during the Pleistocene epoch. The formations and deposits are all highly erodible and give rise to the native clay soils that are present within the APE. The majority of the APE encompasses the Killpack-Badlands-Persayo soil complex on 3-25 percent slopes, which is a saline complex of weathered clayey shale. This complex is well drained and movement of water at the most restrictive layer, about 20-40 inches beneath the surface, is moderately high. The shrink-swell capacity ranges from low to moderate. The Turley-Sagrlite-Fruitland complex, 0-3 percent slopes is found on alluvial fans and valley floors that are derived from sandstone and shale. The components of this complex are well-drained. The Avalon series are found on terraces and derived from alluvium or slope-alluvium of sandstone and shale. These well-drained saline soils provide adequate conditions for desert saltbush and shadscale communities in which to exist. Figure A-Soils Map provides a map of the soils within the APE

Vegetation

The survey team did not encounter the Colorado hookless cactus (*Sclerocactus glaucus*), narrow-stem gilia (*Aliciella stenothyrsa*) or Grand Junction suncup (*Camissonia eastwoodiae*) in their more than 7 days of surveys on the proposed BLM dispersal land. However, within the APE they did encounter Grand buckwheat (*Eriogonum contortum*) on the BLM and the airport properties within the less degraded areas. They encountered 1.06 acres of Grand buckwheat on the airport property, and within the BLM dispersal property boundaries they found approximately 93 acres located in the northeastern portion of the property. The population extends north of the BLM dispersal property (Figure B – Affected Environment Vegetation Map).

In addition to the location of the Grand buckwheat, the survey team also encountered 8-10 individuals of the smallflower fishhook cactus. The survey team encountered them in the northeastern portion of the BLM land.

The survey team also mapped the location of general plant communities within the APE. The following description presents the types of plant communities found and the plants encountered. Since the survey occurred in early May, some species, other than the special status plant species, may have not been encountered as they may bloom later in the season. Tumbleweed (*Salsola australis*) is an example of one of these late bloomers. Remnants of it were found in all drainages and new plants were also encountered throughout the area.

Site conditions such as soils, slope, exposure to solar radiation and disturbance dictate where plant communities exist within the site boundaries. For example, graded areas were likely seeded with a mixture of native and non-native species, but given the lack of

precipitation, bareground and annuals invasives prevail. In one area where little disturbance has occurred, intact saltbush communities exist. Where OHV use is prevalent bareground dominates, but where the slopes and alluvial fans have experienced no vehicular use saltbush and shadscale mixed with annuals prevails. Figure B provides the general location of the plant communities described below. Photos are also presented.

Annuals/Bareground

To the north, east and west of the airport buildings, ramp, runways and taxiway, the land has been graded. Bareground and a mix of exotic, invasive annual grasses dominate. The grasses include cheatgrass (*Anisantha tectorum*) and annual wheatgrass (*Eremopyrum triticeum*). This community feature is present in draws on the BLM land where OHV use has occurred and where there is adequate moisture for the annual wheatgrass and cheatgrass to grow. In flat areas immediately north of the airport operation area (AOA) on BLM land, both invasives are present. Bareground is prevalent in this featured landscape as OHVs have destroyed much of the vegetation. This area comprises approximately 115 acres on the BLM land and 474 acres on the airport property within the APE (Photograph 1).



Photograph 1. Photograph taken May 11, 2010 looking south over the portion of the BLM land transfer parcel that is located just north of the Airport Area of Operation. Bare ground is prevalent in many areas of the parcel due to historical OHV use (Proposed Grand Junction Regional Airport Expansion).

Degraded Saltbush

On a portion of the BLM to the west of the airport, the landscape supports saltbush (*Atriplex canescens, A. corrugata, A. confertifolia, A. gardneri*), but the area has been impacted extensively by OHVs. Annual invasive grasses and some native flowering annuals are also present. Also, historical grazing may contribute to the sparse cover by saltbush species and the lack of perennial grasses. Other common species at the time of the survey included cheatgrass, annual wheatgrass, milkvetch (*Astragalus flavus*), and evening primrose (*Oenothera caespitosa*). The area comprises approximately 50 acres of the proposed BLM dispersal land and 380 acres of the airport property within the APE (Photograph 2).



Photograph 2. Photograph taken May 6, 2010 of the *Degraded Saltbush* community that exists in the BLM land transfer parcel (Proposed Grand Junction Regional Airport Expansion).

Saltbush/Annuals

The adobe badlands throughout the west support saltbush species, and within the proposed BLM dispersal property, the saltbush community is present to the north, northeast and southwest of the airport property. This community is associated with the steep hills surrounding the denuded flatlands and airport operation area. With the exception of the saltbush community to the southwest of the airport operation area, the saltbush community is disturbed by a multitude of roads used by motorcyclists and all-

terrain vehicles. Some of the alluvial fans grading down from the tops of the hills support saltbush without a prevalence of annual invasive grasses, however, most drainage features and any place where disturbance has occurred, including hoof prints and new motor tracks, support growth of the annual wheatgrass and cheatgrass. While most of the site is comprised of A. *corrugata, A. confertifolia and A. gardneri*, some sites on the tops of hills with sandier soils support four-wing saltbush (*A. canescens*), Indian ricegrass (*Achnatherum hymenoides*), and rubber rabbitbrush (*Chrysothamnus nauseosus*). Other species found during the survey in this area include: sand verbena (*Abronia elliptica* or *A. argillosa*); wild hyacinth (*Adronstephium breviflorum*); milkvetch (*Astragalus chamaeleuce, A. flavus*); suncup (*Camissonia scapoidea*); rabbitbrush (*Chrysothamnus viscidiflorus*); *Cympoterus bulbosus*, and *C. constancei*; squirreltail (*Elymus elymoides*); buckwheat (*Eriogonum gordonii, E. inflatum*); gumweed (*Grindelia* sp.); dame's rocket (*Hesperis matronalis*); galletagrass (*Hilaria jamesii*); skeleton weed (*Lygodesmia grandiflora*); evening primrose (*Oenothera caespitosa*); locoweed (*Oxytropis lambertii*); *Phacelia crenulata*; phlox (*Phlox longifolia*); mutton grass (*Poa fendleriana*); globe mallow (*Spharalcea coccinea*); horsebrush (*Tetradymia spinosa*); easter daisy (*Townsendia* sp.); and poison aster (*Xylorhiza venusta*). Wienerleaf (*Halogeton glomeratus*), another invasive species, is prevalent throughout this area. This community encompasses approximately 525 acres of BLM land and 200 acres of airport property within the APE (Photograph 3).



Photograph 3. Photograph taken May 6, 2010. Photographs exemplify the *Saltbush/Annuals* plant community that exists on the BLM land transfer parcel north of existing airport property (Proposed Grand Junction Regional Airport Expansion).

Saltbush/Grand Buckwheat

Grand buckwheat (*Eriogonum contortum*), a BLM sensitive species, was located on airport property west of 27-1/4 Road and on the BLM dispersal property. Lacking invasive species such as cheatgrass and the annual wheatgrass, the grand buckwheat is indicative of a less disturbed site where grazing and use by off-road vehicles has occurred minimally. One population and three subpopulations were located in association with saltbush (*A. corrugata and A. confertifolia*). The buckwheat dominated the vegetation within the mapped area, and the populations graded into the saltbush community at its margins. On the flats in the vicinity of airport populations, winterfat (*Krascheninnikovia lanata*) formed a small, but significant community. Again, the area had not experienced recent grazing or other impacts. Other plant species within this community were Indiana ricegrass, rabbitbrush (*Chrysothamnus viscidiflorus*), winterfat, galletagrass, poison aster and prince's plume (*Stanleya pinnata*). The populations of the Grand buckwheat on the airport property totaled 1.06 acres based on GPS survey of the populations. Approximately 93 acres of Grand buckwheat mixed with the saltbush community was encountered on the BLM property within the APE.

Greasewood/Rabbitbrush

Several greasewood (*Sarcobatus vermiculatus*) communities were located adjacent to the Highline Canal and have formed in areas where arroyos reach the canal and are channeled underneath it through pipes or where the grade of the arroyo flattens and sediment has accumulated. This community also supports rubber rabbitbrush (*Chysothamnus nauseosus*) and annual grass species. The greasewood encompasses approximately 16 acres on airport property. Greasewood and rabbitbrush are also found lining the major drainages that course through the BLM land towards the airport (Photograph 4).



Photograph 4. Photograph taken May 6, 2010 looking south down one of the many drainage features that run generally northeast to southwest through the BLM land transfer parcel. *Greasewood/Rabbitbrush* plant communities line portions of these drainages as they approach the existing airport property (Proposed Grand Junction Regional Airport Expansion).

Drainages

Two named (Leach Creek and Indian Wash) and eleven unnamed ephemeral drainages grade northeast to southwest within the proposed BLM dispersal property. These drainages are arroyos that have cut deeply into the highly erodible adobe badland environment. They form as a result of precipitation events and geological position. There is no subsurface or shallow ground water present under these drainages. They typically support bare banks at places where the banks are at right angles to the drainage bottom or a combination of greasewood (*Sarcobatus vermiculatus*) and rubber rabbitbrush if the bank slopes to the drainage bottom. Remnants of last year's tumbleweed growth were present in all drainages. Also, many if not all of the drainages were crossed by OHV tracks, and these crossing included location of tracks down the banks, on occasion through the drainage and then up the other bank. At least four dams have been placed within the drainages, and only one remains unbreached. The dam that remains intact does not hold water and is a grassed flatland supporting a few tamarisk shrubs (*Tamarix ramosissima*), greasewood and rubber rabbitbrush.

Fish

There are no intermittent or perennial sources of water within the APE and therefore, likely no habitat for fish species. Arroyos which may support ephemeral flows are present, and several dam features have been constructed, but all of them have breached. Thus, no fish are anticipated to be within the APE.

Wildlife

Black-footed ferret habitat (prairie dog colonies) is present, but no ferret sign was observed. All known wild ferret populations in North America were introduced from captive-bred stock. Due to the highly disturbed nature of the survey area, it is unlikely that it would ever have been considered for black-footed ferret introduction.

Despite the aforementioned disturbance, at least three BLM sensitive animal species were confirmed present. Those species are white-tailed prairie dog, Botta's pocket gopher, and Loggerhead Shrike (Figure C- Affected Environment Wildlife Map). Two additional species, Great Basin spadefoot and burrowing owl, were known to be present in the past, but were not observed in 2010.

White-tailed prairie dogs are common. Most burrows are located in the drainages, but some can be found on the sides and even the tops of the lower ridges. In late May of 2010, perhaps half of the burrows were inactive, which indicates a population crash in the recent past. But by end of field work in July, dispersing young of the year had occupied most vacant burrows. Active burrow densities in July were estimated at ten to fifteen per acre, with even greater densities between the north side of the airport runway and the BLM boundary.

Botta's pocket gopher appears confined to the slopes and tops of the lower hills (Photograph 5). No burrow mounds were observed in the drainages amid the prairie dog burrows. No population estimates were made, but fresh diggings were readily observed in suitable habitat.



Photograph 5. Diggings of Botta's pocket gopher (Proposed Grand Junction Regional Airport Expansion).

No kit fox sign was noted during the survey. A loggerhead shrike nest was found June 7 in a tamarisk near a stock pond (Photograph 6). This tamarisk is probably the only suitable nest site in the project area. Great Basin spadefoot was not observed during the survey; however, in past years adults and tadpoles have been encountered in temporary rain pools along 27 ¼ Road in the project area. Since off-road vehicle operators are prone to repeatedly drive through temporary rain pools, reproductive success for this species in the survey area is probably extremely low.

No burrowing owl nests were found in the APE or in the surrounding ¼-mile buffer. Three active nests were found a short distance to the north outside the buffer, and were reported to BLM in a separate report (Photograph 7). In 2009, an active nest burrow was encountered on airport property on the west side of 27 ¼ Road, within the present buffer, but the birds apparently did not return in 2010.



Photograph 6. Loggerhead Shrike nest**.**



Photograph 7. Burrowing owl nest burrow north of survey area.

In the case of other raptor species, the lack of suitable nesting habitat, along with the constant disturbance from off-road vehicles, makes the survey area unattractive for nesting. Niches in the walls of Indian Wash (Photograph 8) could be used as nest sites by barn owl and American kestrel, but the noise and human activity would likely cause these species to nest elsewhere. The niche in Photo 4 did not appear to be used by a raptor species as there were no pellets at the base.

An historic barn owl nest site is located in Indian Wash near Interstate 70 outside the ¼-mile buffer on airport property (Photograph 9). There were no signs of activity in 2010.

There is a high, nearly vertical bank on the west side of Indian Wash at the east end of the runway. This bank has numerous ledges which could provide nest platforms for red-tailed hawk. There was an active common raven nest on this bank in 2010.



Photograph 8. Potential raptor nest site along Indian Wash being used as a roost by unknown species.



Photograph 9. Historic Barn Owl nest site in Indian Wash**.**

Wildlife species identified in the field are presented in Table 3. This table also includes species recognized by scat, bones or other means within the property boundaries. These species are typically associated with desert environments, drainages or irrigation ditches. No threatened or endangered species were encountered.

Table 3. Species encountered during site visit on May 6-13, 2010.

Common Name	**Scientific Name**	**Evidence**
White-tailed prairie dog	*Cynomys leucurus*	Sighting
Black-billed magpie	*Pica hudsonia*	Sighting
Horned lark	*Eremophila alpestris*	Sighting
American robin	*Turdus migratorius*	Sighting
Western kingbird	*Tyrannus verticalis*	Sighting
Mourning dove	*Zenaida macroura*	Sighting
Gambel's quail	*Callipepla gambelii*	Sighting
American kestrel	*Falco sparverius)*	Sighting
Cliff swallow	*Petrochelidon pyrrhonota*	Sighting
Barn swallow	*Hirundo rustica*	Sighting
Violet-green swallow	*Tachycineta thalassina*	Sighting
Western Meadowlark	*Sturnella neglecta*	Sighting
Spotted towhee	*Pipilo maculatus*	Sighting
Rock wren	*Salpinctes obsoletus*	Sighting
Loggerhead shrike	*Lanius ludovicianus*	Sighting

Common Raven	*Corvus corax*	Sighting
Golden eagle	*Aquila chrysaetos*	Flyover
Red-tailed hawk	*Buteo jamaicensis*	Sighting
House sparrow	*Passer domesticus*	Sighting

Another feature related to the adobe badlands both within the airport property and the BLM lands is the presence of ant mounds with a circular area nearing 20-feet in diameter of denuded ground. These features are so significant that they appear along with prairie dog holes in aerial photography.

Wetlands and Waters of the United States

Wetland and other water of the United States were investigated throughout the spring and summer of 2010. Waters of the United States" are within the jurisdiction of the Corps of Engineers under the Clean Water Act. "Waters of the United States" is a broad term which includes waters that are used or could be used for interstate commerce. This includes wetlands, ponds, lakes, territorial seas, rivers, tributary streams including any definable intermittent waterways, and some ditches below the "Ordinary High Water Mark (OHWM)." Also included are manmade waterbodies such as quarries and ponds which are no longer actively being mined or constructed. Wetlands, mudflats, vegetated shallows, riffle and pool complexes, coral reefs, sanctuaries, and refuges are all considered special aquatic sites which involve more rigorous regulatory permitting requirements. A specific, detailed definition of "waters of the United States" can be found in the Federal Register (33 CFR 328.3).

Although no jurisdictional wetlands were found within the project area, two named ephemeral drainages and eleven unnamed ephemeral drainages were encountered in the field (Figure D- Wetland Delineation Map). In our professional opinion, three of the identified features (WF-1, WF-2, WF-3) could be considered non- regulated waterways due to current ground conditions and a lack of hydrologic connection to Traditionally Navigable Waters of the US, however; all thirteen of the ephemeral (non-relatively permanent) drainages are identified as jurisdictional water features in this report to meet the requirements of a "Preliminary Jurisdictional Determination" by the USACE. The ephemeral drainages (arroyos) may carry water during precipitation events. They are not intermittent or seasonal, and they carry water only when sufficient rain falls to saturate the ground and cause surface flow to occur. Snowmelt may also contribute to surface flow in the drainages. Dams have been constructed on at least 4 of the drainages, but all have breached with the exception of one. The dam that remains intact does not hold water and is a grassed flatland supporting a few tamarisk shrubs (*Tamarix ramosissima*), greasewood and rubber rabbitbrush.

Limits to waters of the U.S. are generally delineated at the Ordinary High Water Mark (OHWM) which is identified by the shallow scoured bed, a natural scour line on the bank of the channel, erosional patterns, and lack of impacts to vegetation that exists in the bottoms of these features. The ephemeral drainages are generally classified as arroyo type discontinuous ephemeral channel features. Due to the sometimes deeply incised nature of these arroyos, the waterways appear to include a limited active floodplain

within the arroyo channel confining the conveyance of surface run-off as well as erosional and depositional impacts to an incised channel.

It appears that the higher flows in the past in identified drainages may be reduced in some cases by the dam features. Not only has the placement of these dams reduced higher flows, they may contribute to the unstable banks and the narrowing and incised nature of these ephemeral drainages. In addition, all of the drainages have been subject to human disturbance and flow modifications in the form of grading and channelization within the Airport Area of Operations (AAO). Flow modifications may result in the aggradation or loss of an identifiable channel due to the diversion or withdrawal of surface water, while channelization may contribute to increased sediment transport and increased channel incision. Eight of the jurisdictional ephemeral drainages identified in this report are piped underneath airport runways, airport facilities and the Highline Canal to join drainage detention features and/or City of Grand Junction drainage systems. Although three of the identified water features do not appear to have hydrologic connection to "waters of the U.S." and may be considered "non- regulated" water feature, all 13 drainage features are identified as jurisdictional to meet the requirements of a USACE "Preliminary Jurisdictional Determination". Type of jurisdictional water, linear footage, and acreage are recorded in Table 4. Ten of the regulated "waters of the US" identified in this report have hydrologic connection to the Colorado River Basin.

Table 4. Linear Footage, Width and Depth of Waters of the US within the APE.

Water of the US	NWI classification; Jurisdictional Status	Linear Feet Within APE	Avg. Width at OHWM (ft)	Avg. Depth at OHWM (in)
Leach Creek	Riverine, intermittent, streambed, seasonally flooded; Intermittent -RPW jurisdictional	7,200	2.0.	3.0
Indian Wash	Riverine, intermittent, streambed, seasonally flooded; Intermittent -RPW jurisdictional	1,800	4-6	4.0
E-1	OHWM present; –Non-RPW – jurisdictional	886	1.0	1.0
E-2	OHWM present; –Non-RPW - jurisdictional	3,872	2.0	4.0
E-3 North	OHWM present; –Non-RPW - jurisdictional	5,571	5.0	1.5
E-3 South	OHWM present; –Non-RPW - jurisdictional	3,237	2.5	6.0
E-4	OHWM present; –Non-RPW - jurisdictional	3,655	1.5	2.0
E-5	OHWM present; –Non-RPW - jurisdictional	2,216	1.5	2.0
E-6	OHWM present; –Non-RPW - jurisdictional	4,266	2.0	2.0
E-7	OHWM present; –Non-RPW – jurisdictional	1,253	2.0	2.0

E-8	OHWM present; –Non-RPW – jurisdictional	1,066	2.0	2.0
WF-1	Jurisdictional-Preliminary Determination	694		
WF-2	Jurisdictional- Preliminary Determination	550		
WF-3	Jurisdictional_ Preliminary Determination	1,456		
Total		**28,914**	**N/A**	**N/A**

Literature Cited

Andrews, R., and R. Righter. 1992. Colorado Birds: A Reference to Their Distribution and Habitat. Denver Museum of Natural History, Colorado.

BLM. 2009. Colorado BLM State Director's Sensitive Species List. U.S. Bureau of Land Management. Lakewood, Colorado.

CDOW. 2007. Recommended Survey Protocol and Actions to Protect Nesting Burrowing Owls. Colorado Division of Wildlife, Grand Junction, CO.

Dexter, Levad, & Moran. 1995. Bird Check List for Mesa County, Colorado. Grand Valley Audubon Society.

Fitzgerald, J.P., C.A. Meaney, D.M. Armstrong. 1994. Mammals of Colorado. Denver Museum of Natural History. University Press of Colorado. Niwot.

Hammerson, G.A. 1999. Amphibians and Reptiles in Colorado, Second Edition. University Press of Colorado and Colorado Division of Wildlife. Niwot, CO.

Kingery, H. E. 1998. Colorado Breeding Bird Atlas. Colorado Bird Atlas Partnership, Colorado Division of Wildlife, Denver.

National Weather Service. 1971-2000. http://www.weather.gov/climate/xmacis.php?wfo=gjt

Righter, R., R. Levad, C. Dexter, and K. Potter. 2004. Birds of Western Colorado Plateau and Mesa Country. Grand Valley Audubon Society, Grand Junction, Colorado.

USFWS. 2008. Birds of Conservation Concern 2008. U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia.

Appendix A. List of Birds in Grand Junction, Colorado likely found in APE (list excerpt from USGS Birds of the Grand Junction Resource Area*, "x" indicates sighting during field survey).

AMERICAN VULTURES
x___Turkey Vulture

EAGLES & HAWKS
___Osprey
___Bald Eagle
___Northern Harrier
___Swainson's Hawk
___Red-tailed Hawk
___Ferruginous Hawk
___Rough-legged Hawk
x__Golden Eagle

FALCONS
x__American Kestrel
___Peregrine Falcon
___Prairie Falcon

GROUSE, TURKEYS & QUAIL
___Chukar
___Ring-necked Pheasant
x__Gambel's Quail

PLOVERS
___Killdeer

PIGEONS & DOVES
___Rock Dove
x__Mourning Dove

BARN OWLS
___Barn Owl

TYPICAL OWLS
___Western Screech-Owl
___Great-Horned Owl
___Burrowing Owl

NIGHTJARS
___Common Nighthawk
___Common Poorwill

SWIFTS
___White-throated Swift

HUMMINGBIRDS

___Black-chinned Hummingbird
___Broad-tailed Hummingbird

KINGFISHERS
___Belted Kingfisher

TYRANT FLYCATCHERS
___Olive-sided Flycatcher
___Say's Phoebe
___Ash-throated Flycatcher

x__Western Kingbird

LARKS
x__Horned Lark

SWALLOWS
___Purple Martin
___Tree Swallow
x__Violet-green Swallow
___N. Rough-winged Swallow
___Bank Swallow
x__Cliff Swallow
x__Barn Swallow

JAYS, MAGPIES & CROWS
x__Black-billed Magpie
___American Crow
x__Common Raven

WRENS
x__Rock Wren
___Canyon Wren
___Bewick's Wren
___House Wren

KINGLETS, BLUEBIRDS, & THRUSHES
___Western Bluebird
x__American Robin

MOCKINGBIRDS & THRASHERS
___Gray Catbird
___Northern Mockingbird
___Sage Thrasher

SHRIKES
___Northern Shrike
x___Loggerhead Shrike

STARLINGS
x__European Starling

VIREOS
___Warbling Vireo

WOOD-WARBLERS, TANAGERS,
SPARROWS & BLACKBIRDS
___Yellow Warbler
___Lazuli Bunting
___Green-tailed Towhee
x__Spotted Towhee
___Chipping Sparrow
___Brewer's Sparrow
___Vesper Sparrow
___Black-throated Sparrow
___Sage Sparrow
___Song Sparrow
___White-crowned Sparrow
___Dark-eyed Junco
___Red-winged Blackbird
x__Western Meadowlark
___Brewer's Blackbird
___Brown-headed Cowbird

FINCHES
___House Finch
___Lesser Goldfinch
___American Goldfinch

WEAVER FINCHES
x___House Sparrow

*http://www.npwrc.usgs.gov/resource/birds/chekbird/r6/grandjct.htm

ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 6

BIOLOGICAL ASSESSMENT

Biological Assessment
BLM Land Transfer to Grand Junction Regional Airport
February 2013

Bureau of Land Management
Grand Junction Field Office

Introduction

This biological assessment (BA) addresses the impact to the Colorado hookless cactus (*Sclerocactus glaucus*) (the cactus) from the approximate 188-acre BLM land transfer to the Grand Junction Regional Airport. The Colorado hookless cactus was not observed within the proposed transfer area, but eight individuals were located north of the transfer area during biological surveys completed for the proposed land transfer. The assessment focuses on effects to the cactus from the transfer related to continued grazing and recreational use north of the transfer area. Some grazing and recreation use occurs within the 188-acre transfer area currently. These activities also occur north of the proposed transfer area on BLM lands, and will continue to occur in this area with no substantial changes after implementation of the proposed project. The assessment also includes the effects to the cactus resulting from the construction of required detention ponds, and security fence associated with the runway expansion. The construction of the detention ponds and security fence is proposed approximately 1,300 feet south of the cactus locations.

Proposed Action

The proposed action for this project includes the land transfer of approximately 188 acres of BLM land, Right-of-Way grants for the construction, operation and maintenance of drainage related facilities and the amendment of the Resource Management Plan for the Grand Junction Field office. The land transfer is authorized for airport purposes under Section 516 of the Airport and Airway Improvement Act of 1982. Also, the following actions are considered connected actions to the proposed action:

- Conversion of the existing Runway 11/29 into a parallel taxiway and construction of associated connector taxiways.
- Relocation of 27 ¼ Road to the northwest, outside the relocated Runway Protection Zone (RPZ) for Runway 11/29.
- Construction of 6 detention ponds, 3 water quality ponds, and culverts to accommodate changes in drainage patterns associated with the new runway.
- Installation/relocation of Runway 11/29 navigational aids, visual aids, and runway lighting.
- Installation/relocation of taxiway lighting.
- Construction of airport perimeter road and fencing.
- Removal of any existing runway and taxiway pavement sections not required for the parallel taxiway conversion.
- Relocation of the existing aircraft maintenance run-up area and installation of blast fences.
- The placement of approximately 1.1 million cubic yards of fill material from the runway project.
- The construction of general use parking areas for recreational users of BLM land.

Once the transfer is complete, the airport proposes to grade a portion of the transfer area, construct water quality improvement features on existing airport property, and cross some ephemeral features

that exist within the transfer area. Necessary permits associated with waters of the US are being pursued now. The Airport does not propose to conduct any activity on BLM land north of the transfer area, with the exception of the requested ROW on 8 acres for 3 detention ponds, where the cactus has not been observed. The proposed action also includes the construction of an OHV parking/staging area as mitigation for the taking of BLM recreational land. However, the exact location of this parking/staging area is yet to be determined but will be located on BLM land adjacent to 27 ¼ road north of airport property and south of the BLM shooting range.

Project/Study Area

The project area is located on the northern edge of the Grand Junction city limits in Mesa County, Colorado. The project area is accessed via H Rd, and 27 ¼ Rd, directly north of the Grand Junction Regional Airport. The legal description of the BLM land to be transferred to the airport is: T. 1 N., R. 1 E., sec. 30: Lots 6, 8, 9 and 11; T. 1 N., R. 1 W., sec. 23: S ½ NE ¼, sec. Lots 2 and 3, Ute Principal Meridian.

The direct effect study area includes the land currently managed by the BLM, and the area on airport property impacted by the project (see attached Figures 3-4, 4-2, 4-4). The action area for the project, or the area to be disturbed includes the area where grading is expected to take place for the runway project (shown in Figure 4-4 as the vegetation impact areas). The impact area also includes the relocated portion of 27 ¼ Road and the perimeter fence/perimeter service road and detention pond areas.

Schedule

Construction activities are not anticipated to begin until 2014, following the transfer of BLM land to the Grand Junction Regional Airport, and the granting of the ROW on BLM for the detention ponds. Construction will be phased in over an eight-year time frame, with the re-routing of 27 1/4 Rd expected to be completed in the first year after the land transfer.

Consultation History

May 2010: The BLM requested information regarding endangered, threatened, or candidate species on property located at the Grand Junction Regional Airport (Section 30, the SW¼ SE¼ Section 31 and the NW ¼ Section 32, T 1R 1E PM Ute 1880, Lat 39˚ 7’ 17.10” N, Long 108˚ 31’ 27.43” W NAD83) and adjacent BLM land.

April 21, 2011: Based on a phone conversation and letter, the Fish and Wildlife Service (FWS) directed investigation of potential impacts to four federally listed fishes that exist off-site in the Upper Colorado. FWS also indicated that the yellow-billed cuckoo (Coccyzus americanus), Canada lynx (Lynx canadensis), greenback cutthroat trout (Onchorynchus clarki stomias), Colorado hookless cactus (Scelerocactus glaucus) and DeBeque phacelia (Phacelia submutica) were observed in Mesa County. FWS indicated that cumulative water depletions over the FWS determined threshold from the Colorado River Basin are considered likely to jeopardize the continued existence of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker and result in the destruction or adverse modification of their critical habitat. In response to FWS’ letter, analysis was conducted to determine if the proposed project would result in water depletions, and adversely affect the four federally listed fish.

Status of the Species and Critical Habitat within the Action Area

Colorado River Endangered Fish Species.

Four species of endangered Colorado River fish- the bonytail, Colorado pikeminnow, humpback chub, and razorback sucker – are listed as endangered within Mesa County (USFWS, 1967, 1970, 1980, and 1991). Critical habitats for the Colorado pikeminnow and razorback sucker have been designated in the Colorado River and the 100-year floodplain (USFWS, 1994), approximately 5 miles from the project area.

Analysis of the proposed project determined that all water that could flow within the ephemeral drainages will still be directed towards the Colorado River, and water temporally captured in detention features or water quality features will eventually flow to the Colorado River, except for very minor depletions in the form of evaporation from the detention features. Based on preliminary engineering and design of the detention features, in the event of a measurable storm, any water that is detained in the proposed detention features will be released within approximately 40 hours of a storm event; the pond basins will be inundated for a very short duration with little evaporation taking place. The detention features were designed per the Grand Junction Stormwater Management Manual for 10-year (1.12 inch) and 100-year (2.01 inches) storm events. If water remains in the detention features for only 40 hours, evaporation is minimal – approximately 0.26 ac-ft/year based on a calculation using the Thornwaite method for estimating PET (potential evapotranspiration) (Dunne and Leopold, 1978).

Given that the proposed action would result in the depletion of .26 acre-feet of water from within the Colorado River basin, this project falls under BLM Colorado's Programmatic Biological Assessment (PBA) for water depleting activities (excluding fluid minerals development) on BLM lands in the Colorado River basin in Colorado (BLM 2008).

In response to BLM's PBA, the U. S. Fish and Wildlife Service (FWS) issued a Programmatic Biological Opinion (PBO) (ES/GJ-6-CO-08-F-0010) on February 25, 2009, which concurred with BLM's determination that water depletions are "Likely to Adversely Affect" the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker. Likewise, the project is also likely to adversely affect designated critical habitats for these endangered fish along the Green, Yampa, White, Colorado, and Gunnison rivers. However, the FWS also determined that BLM water depletions from the Colorado River Basin are not likely to jeopardize the continued existence of the Colorado pikeminnow, humpback chub, bonytail, or razorback sucker, and that BLM water depletions are not likely to destroy or adversely modify designated critical habitat.

A Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin was initiated in January 1988. The Recovery Program serves as the reasonable and prudent alternative to avoid jeopardy and aid in recovery efforts for these endangered fishes resulting from water depletions from the Colorado River Basin. The PBO addresses internal and external BLM projects including impoundments, diversions, water wells, pipelines, and spring developments. The FWS determined that projects that fit under the umbrella of the PBO would avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletion impacts to the Upper Colorado River Basin if they deplete relatively small amounts of water (less than 100 AF) and BLM makes a one-time contribution to the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program) in the amount equal to the average annual acre-feet depleted by each project. The PBO instructed BLM to make an annual payment to the National Fish and Wildlife Foundation (NFWF) to cover all BLM authorized actions that result in water depletions. The Grand Junction Regional Airport land transfer will deplete approximately 0.26 AF annually. The depletion fee for this project is $5.02 ($19.32 x .26 AF). This project will been entered into the Grand Junction Field Office water depletion log

which will be submitted to the Colorado State Office at the end of the Fiscal Year. The CSO is responsible for paying depletion fees based on the annual statewide total.

Yellow-Billed Cuckoo, Canada Lynx, Greenback Cutthroat Trout, and DeBeque Phacelia.

There is no habitat for the Canada lynx or yellow-billed cuckoo within the project area. Also, there is no perennial, cold-water stream habitat for the greenback cutthroat trout. As a result no impacts to the Canada lynx, the yellow-billed cuckoo or the greenback cutthroat trout will occur and therefore there will be no effect on these species from this project.

The project area is not within the designated critical habitat of the DeBeque phacelia, and this species was not observed during the field survey. It is a plant endemic to clay soils derived from the Atwell Gulch and Shire members of the Wasatch Formation. The project area is located on Mancos Shale, and therefore is it highly unlikely that the DeBeque phacelia would be found within the project area. As such there will be no effect on this species as a result of this project

Colorado Hookelss Cactus.

The following information is from the *Programmatic Biological Assessment Effects to Listed Plant Species from the Bureau of Land Management Livestock Grazing Program: Colorado hookless cactus, clay-loving wild buckwheat, Debeque phacelia* (US Dept. of Interior et al., 2012).

> Colorado hookless cactus is a small ball or barrel-shaped cactus endemic to Montrose, Delta, Mesa, and Garfield Counties in western Colorado. According to the *Recovery Outline for the Colorado Hookless Cactus*, CNHP data indicate that this species is currently known from a few more than 98 occurrences totaling approximately 19,000 individuals (FWS 2010). The occurrences are spread over approximately 1,700 square miles, with an estimated 618,000 acres of potential habitat (FWS 2010). This species has two population centers, one associated with the Gunnison River and its tributaries near the City of Delta, and the other with the Colorado River and its tributaries near Debeque, Colorado. Colorado hookless cactus was originally listed as threatened on October 11, 1979 (44 FR 58868), with revised listing due to taxonomic changes published on September 15, 2009 (74 FR 47112). Critical habitat has not been proposed for this species. The *Recovery Outline* released by the Service in 2010 (FWS 2010) presents an updated and thorough review of the species' status.
>
> Colorado hookless cactus grows primarily in the salt desert scrub community found on alluvial terraces associated with the Gunnison and Colorado Rivers. Soils are commonly derived from Mancos shale, often overlain with a thin layer of alluvium, and range from fine silty clay to coarse gravel, often with volcanic cobbles and boulders scattered on the surface. The dominant co-occurring plant species include *Atriplex confertifolia, Artemisia nova, Opuntia* spp., *Echinocereus triglochidiatus, Pleuraphis jamesii,* and *Acnatherum hymenoides*. Populations also occur in sagebrush and the transition zone between sagebrush and pinyon-juniper woodland. Within these communities, Colorado hookless cactus is often found under small nurse shrubs, especially *Atriplex confertifolia*. In many populations, Colorado hookless cactus co-occurs with exotics, especially *Bromus tectorum* and/or *Halogeton glomeratus*, and along some drainages. Typical elevations for the species range from 4,593 to 6,562 feet (1,400 to 2000 meters) above mean sea level (Heil and Porter 2004). According to the North Delta LHA

report, BLM considers the Mancos shale communities that the cactus occurs in to have little resilience to disturbance due to soil chemistry and structure and the small amount of available moisture (BLM 2002).

The Programmatic Biological Assessment (US Dept. of Interior et al., 2012) provides additional information about the cactus including its demography. In addition to a records review, a field inventory was conducted in 2010 for the proposed land transfer. Eight occurrences of the cactus were observed approximately 1,300 feet north of the transfer area boundary. These occurrences appear to be ecologically intact because the cacti exist in undisturbed soils that have cryptogrammic characteristics, native vegetation is immediately adjacent and there is evidence of litter surrounding the individual cacti.

Existing threats with respect to the proposed action include livestock grazing and trampling and off-highway vehicle (OHV) use, and will be examined in this BA. Threats from predation and herbicides are unlikely. Damage by insects, rodents and lagomorphs has been documented (US Dept. of Interior et al., 2012), but were not documented during investigations in 2010. Illegal collection does not appear to be a significant issue for the cactus. However, until 2012 the cactus in this location was thought to be *Sclerocactus parviflorus,* and collection was not illegal, and not tracked.

Climate change, as documented by the FWS (US Dept. of Interior et al., 2012), include changes in temperature and precipitation patterns. These changes are expected to influence plant establishment and survivorship, but are not quantifiable for the proposed action.

Environmental Baseline

Within the proposed transfer area and 8-acre ROW, three plant communities exist. These communities include 1) annuals/bare ground; 2) degraded saltbush; 3) saltbush/annuals. The annuals/bare ground is a highly disturbed area that supports little vegetation. The degraded saltbush area comprised much of the study area and is heavily impacted by OHV use, though it does support a spare community of saltbush and annual species. The saltbush/annuals area is a saltbush community and has not been heavily impacted by OHV use but still receives recreational activity and is grazed.

Livestock Grazing

According to the Programmatic Biological Assessment (US Dept. of Interior et al., 2012), widespread use of public lands for livestock grazing has occurred since the region was settled in 1880. Undocumented memories of grazing in the area indicate that grazing intensity was much greater in the early years than currently. Such modification of habitat may have influenced the abundance and distribution of the cactus, while also influencing the general plant communities in the area.

Off-highway Vehicles

The action area is open to OHV use. According to the Programmatic Biological Assessment (US Dept. of Interior et al., 2012), use restrictions apply in occupied habitat, but OHV use is hard to control. Much of the OHV use in the action area is to the south and west of the known cactus occurrences. Under current management (1987 RMP) the action area is open to cross country travel, and a system of designated routes does not exist in this area.

Soils of the badlands are particularly vulnerable to degradation once the soil crust is damaged; wind and soil erosion can increase as a result of disturbance when the crust is damaged. Existing OHV use can damage the soil crust and may indirectly impact the cactus through soil loss and loss of water infiltration.

Effects Analysis
The proposed action will not directly impact the cactus as it is over 1,000 feet away from the proposed transfer land, fence, and detention ponds. However, the proposed action may indirectly affect the Colorado hookless cactus on BLM land not transferred through: 1) shifting livestock use to the north through herbivory, trampling, nutrient deposition, seed/weed dispersal related to livestock grazing; and 2) soil disturbance and obliteration from OHV use.

The proposed transfer land comprises 0.01% of the BLM's Off Highway Vehicle (OHV) area north of the Airport. The 188 acre transfer area is small in size compared to the 11,400 acre OHV area. The transfer is unlikely to concentrate or intensify livestock grazing and OHV use in the area of the cactus occurrences. Furthermore, based on preliminary engineering and design of the detention features, in the event of a measureable storm, any water that is detained in the proposed detention features will be released within approximately 40 hours of a storm event so the detention features are not likely to attract cattle, birds or other wildlife.

The amount of recreational use and livestock grazing in the transfer area is estimated to be minimal, thus: the amount of recreational use and livestock grazing displaced as a result of the proposed action is anticipated to be negligible. The construction of a new OHV parking/staging area will likely take place adjacent to 27 ¼ road on previously disturbed ground. At this time, because a location for the vehicle parking/staging area has not been determined, the area cannot be surveyed for potential biological resources. The size and layout of the parking/staging area has also not yet been determined. According to traffic counters on 27 ¼ road, the BLM recreation staff estimate 135,000 visitors/54,000 cars per year. This estimate includes individuals accessing the shooting area north of the airport. Biological surveys will be completed once the new OHV parking/staging area is determined, and additional consultation will occur if listed species are affected.

There is no anticipated direct effect to the cactus by construction and use of the detention ponds, construction of the security fence, perimeter road and the relocation of 27 ¼ Road as the action area is more than 1,000 feet from the closest known cactus.

Given the relatively small acreage of land being transferred to the airport, the amount of displaced recreational use and grazing is unlikely to adversely impact the cactus.

Effects Determination
No Colorado hookless cacti were found within the BLM proposed transfer property, but were located approximately 1,300 feet to the north of proposed transfer property on BLM lands that are historically and currently subject to livestock grazing and OHV use. The proposed transfer will not concentrate livestock grazing or OHV use around the cactus occurrences to any measureable level on BLM land to the north of the proposed transfer area. These uses will continue to exist and thus disturbance and damage to the cactus is possible but not probable. As a result, the FAA and BLM have determined that the proposed transfer of BLM land to the Grand Junction Regional Airport **may affect, but is not likely to adversely affect** the Colorado hookless cactus.

References:
US Dept. of Interior. 2012. *Programmatic Biological Assessment Effects to Listed Plant Species from the Bureau of Land Management Livestock Grazing Program: Colorado hookless cactus, clay-loving wild buckwheat, Debeque phacelia* . Grand Junction, CO. 59 pp.



ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 7

ENGINEER'S REPORT

ENGINEER'S REPORT

Environmental Assessment
Runway 11/29 Conceptual (25%) Design
County Road 27-¼ Realignment Conceptual (25%) Design

Project No. BD GJT 11-01

Grand Junction Regional Airport
Grand Junction, Colorado

Sponsored By:
Grand Junction Regional Airport Authority
Federal Aviation Administration

JVIATION®
900 S. Broadway, Suite 350
Denver, CO 80209
Main 303.524.3030
Fax 303.524.3031
JVIATION.COM

Volume 1
August 17, 2012

TABLE OF CONTENTS

Volume 1 Page

1. Scope of Work 1

2. Photographs 5

3. Life Cycle Cost Analysis 11

4. Design Standards 12

5. Soils and Grading 14

6. Drainage 16

7. Pavement Design 18

8. Pavement Marking 25

9. Signage, Lighting, and NAVAIDS 26

10. Engineer's Estimate 28

APPENDICES

A. Project Sketch

B. Life Cycle Cost Analysis

C. Engineer's Estimate

D. Geotechnical Investigation Report

Volume 2

E. Drainage Analysis

F. Pavement Design Forms & Supporting Documentation

1. SCOPE OF WORK

A. Narrative

This Engineering Design Report is in association with the Environmental Assessment – ***Runway Alternatives Analysis for the Reconstruction/Relocation of Runway 11/29 at the Grand Junction Regional Airport located in Grand Junction, Colorado***. A conceptual (25%) level design for each of the two proposed runway improvement alternatives for the Runway 11/29 Reconstruction/Relocation Project at the Grand Junction Regional Airport have been provided. These conceptual designs analyzed each alternative in sufficient detail to adequately assess their environmental impacts, as well as provide accurate preliminary cost estimates.

The proposed Runway 11/29 alternatives include: **1) Reconstruct the runway in its current location and to the existing current non-standard conditions; 2) Construct a new parallel Runway 11/29, meeting all FAA design standards, at a 637.5 foot offset to the existing Runway 11/29 centerline.** The conceptual design for each alternative consisted of evaluating and quantifying the major design elements to a level sufficient to compare the proposed alternatives, both economically and environmentally. The major design elements considered for this analysis included, airfield geometry, overall site grading and drainage, runway and taxiway pavement sections, utility installation and/or relocations, airfield security fencing, runway/taxiway electrical systems, and navigational aids (NAVAID's). Conceptual level cost estimates were prepared using historically tabulated unit costs.

The proposed runway and taxiway geometric layout for each alternative was established as part of the conceptual design. All geometry was established in accordance with ***FAA Advisory Circular 150/5300-13, Airport Design***, for Airplane Design Group (ADG) IV aircraft. The proposed layout for each alternative was utilized to assist in determining pavement section quantities, earthwork quantities, and electrical and NAVAID locations and quantities.

Conceptual design of the overall site grading consisted of evaluating the required earthwork for each alternative. Conceptual profiles, cross sections, and safety area grading were generated in order to determine design contours and earthwork volumes for each alternative. Potential borrow sites and/or waste areas were analyzed on a conceptual basis to determine the availability of additional material or possible waste locations for excess material. In association with the conceptual grading, specific drainage was also analyzed to determine storm drainage basins, required culverts, inlets, detention ponds, and all other storm sewer infrastructure improvements required.

Pavement design for the required pavement sections for the runway and taxiways were also analyzed for this report. Pavement strengths were calculated in accordance with ***FAA Advisory Circular 150/5320-6E, Airport Pavement Design and Evaluation***, using the forecasted airport fleet mix, from the Terminal Area Plan, to account for the anticipated future increase in air operations.

A conceptual utility plan was developed in order to determine the general layout of new and/or relocated utilities in the vicinity of the project. The conceptual utility plan accounted for the general layout and estimated quantity of sanitary sewer service, potable water, natural gas, telephone, electrical, fiber optics,

and FAA utilities. Coordination with each utility service provider will be established to assure that all local requirements are met.

New security fencing for the airport's perimeter will be required on the north side of the airport and will tie to the airport's existing southern perimeter fence that was constructed in 2011 under AIP Project No. 3-08-0027-46. General fencing layouts have been provided, including gate locations and types, as well as quantities of all fencing materials.

Conceptual level electrical design was also analyzed for this report. Electrical elements considered included the general layout and quantities for the runway and taxiway lighting and guidance systems, and all NAVAID's. Preliminary review for required circuit layouts and power requirements were also considered.

For Alternative 2, a conceptual level design was also performed for relocating a portion of County Road 27-¼ (27 ¼ Road) out of the new Runway 11/29 runway protection zone (RPZ). Approximately 7,700 feet of 2 lane road will need to be relocated. The road will move approximately 2,500 feet to the west of its current location, which is directly west of Runway 11/29 and north of Landing View Lane. The proposed road was conceptually designed to meet City of Grand Junction and Mesa County design requirements.

B. Unique and Unusual Site Conditions

The existing Runway 11/29 has longitudinal and transverse grades that are outside of FAA design standards. The existing Runway 11/29 longitudinal grades exceed the 0.8% maximum grade. Much of the runway's existing transverse grades exceed the maximum 1.5% standard. Additionally, the runway crown is not located along the runway centerline, but is offset 50 feet to the north of the centerline.

Currently, the airport's two runways intersect near the Runway 29 threshold. This intersection creates "hot spots" which are aircraft operational areas that are less safe due to confusing geometry that can lead to pilot error or loss of situational awareness. These "hot spots" are a direct result of the intersecting runways and will exist as long as the two runways remain in their current configuration.

When two runways intersect, a Runway Visual Zone (RVZ) between the two runways must be established to allow for adequate line of sight for pilots between the two intersecting runways. The existing RVZ between the two runways does not meet FAA standards. The existing layout of airport buildings and the runway system does not allow for an unobstructed RVZ. The hangars and aircraft support facilities located to the southwest of the Runway 11/29 and Runway 4/22 intersection fall within the RVZ for the runways, and limit the pilot's line of sight to the other runway.

C. Age of the Existing Pavement

The original asphalt pavement was constructed in 1958 and is more than 50 years old. Additional pavements that comprise the existing Runway 11/29 are essentially a hodgepodge of overlays and widenings on top of the runway's original asphalt pavement. Rehabilitation projects were completed in 1966, 1983, 1995, 1996, and the latest completed in 2009 when the entire runway was rotomilled and overlaid (resurfaced) with a nominal 2-inches of asphalt pavement. At the time of the resurfacing project in 2009, it was understood by the airport and the FAA, that the resurfacing was considered a short term

(10 year) fix until funds could be procured to either reconstruct the entire runway pavement section, or construct an entirely new runway since the underlying pavements had reached the end of their useful life.

D. Current PCI Value

As noted above, the most recent Runway 11/29 pavement is a 2-inch nominal overlay that was completed in May, 2009 and the surface was subsequently grooved in August, 2009. The most recent inspection to determine the current PCI value was conducted in October, 2010, by the Colorado Department of Transportation Aeronautics Division (CDOA). Based on this inspection, the PCI value was reported as 100. It is important to note that the inspection process for determining the PCI value of a pavement only considers the surface condition of pavement, which in this case was just over a year old at the time of the inspection.

While the surface of the runway appears to be in good shape, the underlying pavements and aggregate bases are very old. With these underlying pavements ranging from 40-50 years in age, it was understood by the FAA and airport staff that the 2009 project was simply a "band-aid" to extend the life of the runway for approximately 10 years until funds could be secured to either reconstruct the entire runway pavement section, or construct an entirely new runway.

E. History of Work Performed in Project Area

As illustrated on the current pavement strength survey, the existing runway consists of 16 separate pavement sections. The runway has a 60 foot wide keel section that runs from station 13+50 to station 75+53 which is constructed of 6-inches to 13-inches of P-401 Bituminous Paving Course (P-401) on 19-inches of P-201 Stabilized Base (P-201). Adjacent to the keel sections, the outer portion of the runway is generally constructed of 9-inches to 15-inches of P-401, on 8-inches of P-209 Crushed Aggregate Base Course (P-209), on 11-inches of P-154 Subbase Course (P-154). The runway's western end from station 75+53 to station 105+01 is constructed of 22-inches of P-401 on subgrade. The following is a synopsis of major work completed on Runway 11/29 over the past 50-years, based on the pavement strength survey.

1. **Original Construction – 1958**
   - Pavement section consisted of;
     - 4-inches P-401
     - 8-inches P-209
     - 13-inches P-154
2. **Overlay – 1966**
   - 2-inch to 4-inch overlay of original runway
3. **Keel Pavement Section – 1971**
   - Keel Pavement Section consisted of;
     - 14-inches to 19-inches P-201
     - 3-inches to 4-inches P-401
4. **Overlay/Leveling – 1983**

- 3-inch to 11-inch overlay of runway

5. Overlay/Leveling - 1995

- 1/2-inch overlay
- 1-inch P-402 Porous Friction Course (P-402)

6. AIP 15 "Fix"/Overlay – 1996

- 0-inches to 2-inches P-402 on Runway 11/29 shoulders

7. Overlay/Leveling – 2009

- 2-inch Mill/Overlay and Grooving of Runway.

2. PHOTOGRAPHS

The following pages contain photos of existing site conditions. Included are photos of various Runway 11/29 facilities that are impacted by this project.



Photo 1 – Remote Transmitter/Receiver (RTR) structure and antennas required to be relocated with Alternative 2



Photo 2 – Overlooking existing detention pond on the north side of the runway (looking east)

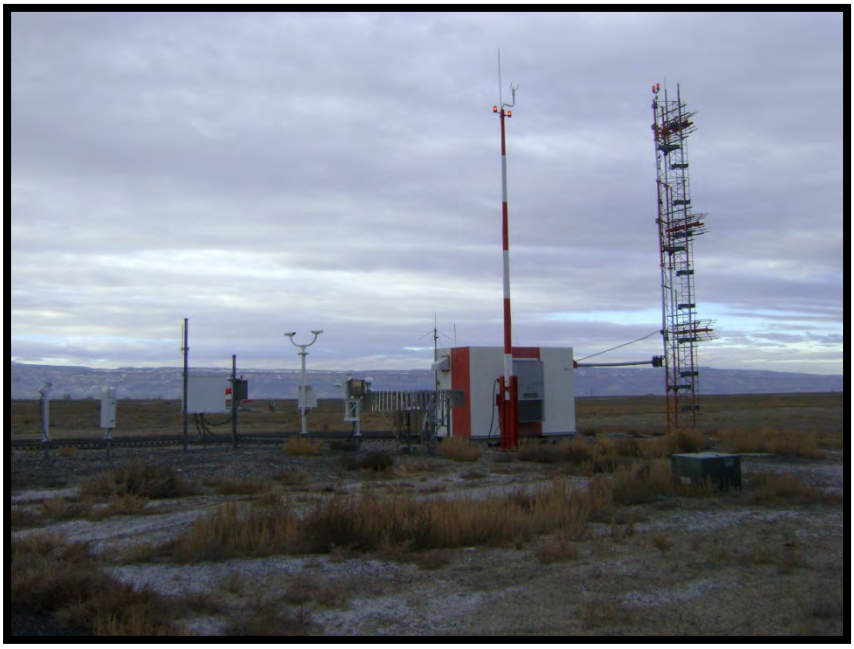


Photo 3 – Existing Glide Slope Antenna, Runway Visual Range (RVR), and Automated Surface Observing System (ASOS) requiring relocation with Alternative 2



Photo 4 – Existing Localizer Antenna requiring relocation with Alternative 2



Photo 5 –Existing Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR) Building requiring relocation with Alternative 2



Photo 6 – Existing Alignment Identifier Lighting (RAIL) Station requiring relocation with Alternative 2



Photo 7 – Existing Localizer Building requiring relocation with Alternative 2



Photo 8 – View from RTR towards the south over looking Run-up Pad



Photo 9 – View from the North Detention Pond towards the south



Photo 10 – View towards the south



Photo 11 – View from the Run-up Pad towards the west



Photo 12 – North of Runway towards the east

3. LIFE CYCLE COST ANALYSIS

A life cycle cost analysis was performed to compare the costs of a concrete pavement section and an asphalt pavement section. The analysis did not include the total amount of embankment required to construct the new runway alternative, however it does include any additional embankment required to bring the respective pavement section to design grades. Section 7 of this report contains a detailed discussion of the pavement design analysis. The two preferred pavement sections produced from this analysis are shown below.

A. Concrete Alternative

15.5-inches of P-501 Portland Cement Concrete Pavement (P-501), 8-inches of P-304 Lean Concrete Base Course (P-304), and 6-inches of P-209.

B. Asphalt Alternative

12-inches of P-401 and 21-inches of P-209.

The life cycle cost comparison favors an asphalt section due to both the lower initial construction cost and the 20-year overall cost, including the proposed maintenance and rehabilitation of each pavement section. The analysis takes into consideration initial cost and maintenance of each section over a 20-year time period. The comparison yielded the following results:

Initial Costs – Concrete	$146.01 per Square Yard
Initial Costs – Asphalt	$108.11 per Square Yard
20-Year Lifespan Cost – Concrete	$171.26 per Square Yard
20-Year Lifespan Cost – Asphalt	$141.21 per Square Yard

See Appendix B for supporting documentation for the Life Cycle Cost Analysis.

4. DESIGN STANDARDS

Runway 11/29 can accommodate Airport Approach Category D, Design Group IV (D-IV) aircraft. There are currently non-standard conditions associated with the existing Runway, (i.e. longitudinal grades, transverse grades, runway visibility zone (RVZ) between Runway 11/29 and Runway 4/22 and the location of the crown of the runway). Since Alternative 1 would reconstruct the runway in its current location, pavement ties to the existing taxiway connectors and Runway 4/22 will remain the same, thus, the non-standard conditions that exist cannot be corrected. The following is a summary of the non-standard conditions that currently exist for the runway and that would continue to exist with Alternative 1:

- Longitudinal Runway Grades – The FAA allows for the maximum longitudinal grades (parallel to the runway centerline) in the end quarters of the runway to be 0.8%. This is to allow for easier rollouts during departures as well as shorter touchdowns during landings. The existing longitudinal slope in the Runway 29 end quarter is in excess of 1.3%.
- Transverse Runway Grades – The FAA allows for a maximum transverse grade of 1.5% at any point across the runway. In most areas, the existing transverse grades are in excess of this limit and reach as high as 1.9%.
- RVZ – Because Runway 11/29 and Runway 4/22 intersect, a RVZ exists between the two runways. The existing layout of airport buildings and the runway system does not allow for an unobstructed RVZ. The hangars and aircraft support facilities located to the southwest of the Runway 11/29 and Runway 4/22 intersection fall within the RVZ for the runways. This does not allow for a clear line of sight between the runways.
- Runway Crown – The current runway crown is not on runway centerline, but is offset 50 feet to the north.

The design for both Alternatives 1 and 2 utilized the requirements for a Category D, Design Group IV aircraft, per ***FAA Advisory Circular 150/5300-13, Airport Design***. Since Alternative 1 will simply reconstruct the runway in its current location, the existing non-standard conditions will not be corrected. On the contrary, the new runway and connector taxiways constructed with Alternative 2 will be designed to meet all FAA standards for longitudinal and transverse grades and crown. Additionally, the relocated Runway will not intersect with Runway 4/22, therefore a RVZ will not exist, thus eliminating the "hot spots" and the Runway 4/22 operational restrictions when the Air Traffic Control Tower (ATCT) is closed.

Pavements were analyzed and designed to ensure positive drainage of all pavement surfaces. All portions of the proposed airfield pavement will be situated below the Primary Surface, Transitional Surface and/or Approach Surface, as required by CFR Part 77, for Runway 11/29.

The following table summarizes summarizes the design criteria utilized in the design of the relocated runway and the transition of the existing runway into a parallel taxiway, as contained in Alternative 2. As previously mentioned, meeting all the standards shown in the table below could not be achieved with Alternative 1.

TAXIWAY ITEM	AIRPLANE DESIGN GROUP IV STANDARD	Alternative 1 Standard Met?	Alternative 2 Standard Met?
Taxiway Width	75’	YES	YES
Taxiway Shoulder Width	25’	YES	YES
Taxiway Safety Area (TSA) Width	171’	YES	YES
Taxiway Object Free Area (TOFA) Width	259’	YES	YES
Taxiway Longitudinal Grade	±1.5% (Max)	**NO**	YES
Taxiway Transverse Grade	-1.0% to -1.5%	**YES**	YES
Taxiway Centerline to Fixed or Movable Object (Parked Aircraft)	129.5’	YES	YES
Taxilane Object Free Area	225’	YES	YES
Taxiway Separation from Runway (To Allow for High Speed Taxiways)	600’	**NO**	YES
RUNWAY ITEM	**STANDARD**	**Standard Met?**	**Standard Met?**
Runway Width	150’	YES	YES
Runway Shoulder Width	25’	YES	YES
Runway Blast Pad Length	200’	YES	YES
Runway Blast Pad Width	200’	YES	YES
Runway Safety Area (TSA) Width	500’	YES	YES
Runway Object Free Area (ROFA) Width	800’	YES	YES
Longitudinal Grade End ¼ of Runways	0% to 0.8%	**NO**	YES
Longitudinal Grade Center ½ of Runways	0% to 1.5%	YES	YES
Runway Transverse Grade	1% to 1.5%	**NO**	YES
Runway Shoulder Transverse Grade	1.5% to 5%	YES	YES
Runway Safety Area Transverse Grade	1.5% to 3%	YES	YES
Runway Crown	On Centerline	**NO**	YES
Runway Visual Zone (RVZ)	Standard Line of Sight	**NO**	YES

5. SOILS AND GRADING

It is estimated that approximately 3.5 million cubic yards of earth will be required to be moved to construct Alternative 2. With the extensive quantity of earthwork required, a preliminary geotechnical investigation was performed to determine the types of soils that could be anticipated to be encountered during construction. The preliminary investigation allowed for a better understanding of soil characteristics that will impact the costs for excavation as well as construction of the embankments for the new runway. The soil properties gathered during the preliminary geotechnical investigation were also utilized in the design of the preliminary pavement sections.

In addition, the large volume of embankment that will need to be placed with Alternative 2 will require extensive amounts of water for compaction. Sources and rights for this water will need to be procured, and the existing soil types available for embankment will dramatically alter this volume of water required. The preliminary geotechnical investigation consisted of 22 borings ranging between 9-feet and 40-feet in depth below the existing grades. Samples were obtained from the borings to determine soil classification, Atterberg Limits (Liquid Limit (LL), Plastic Limit (PL) and Plasticity Index (PI)), In-situ moisture contents and densities, particle size, Moisture/Density Relations (Modified Proctor), Swell/Consolidation Potential, California Bearing Ratio (CBR) and Subgrade Modulus (k).

The Alternative 2 preliminary geotechnical investigation was performed by Ground Engineering Consultants, Inc. (GROUND) in October 2011. The findings and recommendations of their investigation are presented in the report titled, ***Preliminary Geotechnical Subsurface Exploration Program, Proposed New Runway 11/29, Grand Junction Regional Airport, Grand Junction, Colorado*****,** dated March 13, 2012. The entire report can be found in Appendix D.

The geotechnical investigation indicated that variable soil types would be encountered during construction including; overburden materials consisting of sands and silty clays, weathered claystone, sandstone bedrock, weathered shale bedrock, competent shale bedrock and competent hard shale bedrock. These materials exhibited low to high swell potentials. The competent shale bedrock and the competent hard shale bedrock is anticipated to be difficult to excavate and difficult to process for fill material.

A variable thickness of overburden soils were encountered that generally consisted of low to highly plastic sandy silts and clays, the soils were classified in accordance with the Unified Soil Classification System as primarily lean clays (CL) along with some areas of fat clays (CH) and silty clays (CL-ML). The preliminary geotechnical investigation identified weathered claystone, sandstone bedrock, weathered shale bedrock, competent shale bedrock and competent hard shale bedrock underlying the overburden materials. These materials are generally classified as lean clays (CL), fat clays (CH) and silty clays (CL-ML) when classified in accordance with the Unified Soil Classification System. Additionally, the report indicated that site soils represented a "moderate" environment for sulfate attack on concrete exposed to the site soils.

The preliminary geotechnical investigation reported California Bearing Ratio (CBR) values ranging from 1.5 to 9.0 for materials compacted to 95% of a Modified Proctor density (ASTM D1557). For preliminary design considerations a CBR value of 5.4 was utilized. The CBR value was converted to a subgrade modulus value (k-value) in general conformance with ***FAA Advisory Circular 150/5320/6E, Airport***

Pavement Design and Evaluation. The following laboratory testing was included as part of GROUND's preliminary pavement investigation; California Bearing Ratio (CBR) tests, modified Proctor tests, gradation tests, Atterberg limits, soluble sulfates, and Swell/Consolidation tests on the material. Twenty-two (22) corings/borings were completed in various locations within the proposed runway alignment and potential cut/borrow areas.

Based on the information in the preliminary geotechnical investigation it is likely the subgrade materials for Alternative 2 will primarily consist of lean clays (CL), fat clays (CH) and sandy silty clays (CL-ML). The frost group for these types of materials is Frost Group 4 (FG-4), which precludes the use of the reduced subgrade strength option as described in ***FAA Advisory Circular 150/5320/6E, Airport Pavement Design and Evaluation***. Subgrade material replacement is the only method to mitigate frost heave with this soil type. Specific information regarding considerations for frost heave in the pavement section is covered under Section 7 of this report.

Groundwater was encountered in one of the preliminary test holes at the time of the geotechnical and pavement investigation in October, 2011. During initial drilling operations the groundwater was measured at 36 feet below the existing grade and when it was measured 10-days later the water was at 29-feet below the existing grades.

As mentioned above, a significant amount of earthwork will be required with Alternative 2. All additional material will be disposed of in designated fill locations. Any required borrow material will come from areas designated in the plans and by the Engineer. All earthwork operations will conform to P-152 Excavation and Embankment (P-152) specification.

All compaction requirements for subgrade and overexcavation will conform to the P-152 specification. Subgrade depths and moisture/densities requirements were determined using the geotechnical report and the ***FAA Advisory Circular 150/5320/6E, Airport Pavement Design and Evaluation***.

Quantities for overexcavation were included in this conceptual design to account for unsuitable subgrade soils that may be encountered during construction. These soils may consist of soils that demonstrate swell potential or organic soils that can cause problems through decomposition. When soils of these types are encountered, the soil will be excavated to a depth up to 2-feet and replaced with select fill material designated by the Contractor and approved by the Engineer. The unsuitable material will be disposed of at designated stockpiling locations.

Required amounts of excavation and overexcavation would be relatively minor for Alternative 1 since it will simply reconstruct the runway in its current location. The historical geotechnical information would be used for determination of subgrade strength as the basis for pavement design.

6. DRAINAGE

There are three major drainage basins that could be affected by construction of Alternative 2. Those basins are Ranchman's Ditch, Leach Creek, and Indian Wash. There would be minimal drainage impacts associated with Alternative 1 since the alternative is to simply reconstruct the runway in its current location. Drainage impacts associated with Alternative 2 construction may potentially affect the three aforementioned basins.

To assess the drainage characteristics of the proposed construction, the previous drainage study was analyzed titled ***Ranchman's Ditch (Horizon Drive Channel), Leach Creek, & North Leach Creek Conditional Letter of map Revision (CLOMR***), written in October 2004 by Icon Engineering. This study evaluated the existing conditions of the major drainage basins using HEC-1, a software developed for the U.S. Army Corps of Engineers.

To analyze the drainage characteristics of the proposed construction, HEC-1 was used as the computer software to calculate peak flows for the 10-year and 100-year flow as required by the ***City of Grand Junction Stormwater Management Manual***. All drainage design for this project meets all applicable requirements of **FAA AC 150-5320-5C,** ***Unified Facilities Criteria – Surface Drainage Design***.

There were several methods used to determine the input values for HEC-1 to characterize each drainage basin for this project. All methods are approved by the ***City of Grand Junction Stormwater Management Manual***, and Rick Dorris, the City of Grand Junction engineer. These methods are the SCS Curve Method, the Green Ampt Method (Maricopa County Hydrology), and the Snyder Method (rural areas use SCS – Mesa County, urban areas use SCS-CUHP 2005) which was evaluated by Dr. James Guo from the University of Colorado Denver.

All detention ponds and water quality volumes have been sized with the guidance of ***Urban Storm Drainage - Criteria Manual,*** written in June 2002 by Urban Drainage and Flood Control District. There are nine proposed detentions ponds that will need to be construction with the project. Ponds 1, 6, and 7 will require water quality features since these ponds outfall offsite.

Another major change to the hydrology of these affected basins is the planned construction of the Upper Leach Creek Dam that is schedule to be completed in the fall of 2012 by the City of Grand Junction. This dam is located in the Leach Creek basin and releases 40 cubic feet per second during the 100-year storm event. In comparison, prior to the construction of this dam, this area releases 948 cubic feet per second. The dam allows proposed Pond 1 to only be a water quality pond.

The following are the required ponds and volumes:

Pond Names	Detention Volume (Water Quality Volume
Pond 1	4.00 AC-FT (Water Quality Only)
Pond 2	6.60 AC-FT
Pond 3	22.39 AC-FT
Pond 4	5.75 AC-FT
Pond 4a	7.01 AC-FT
Pond 4b	5.01 AC-FT
Pond 5	3.91 AC-FT
Pond 6	3.83 AC-FT (1.24 AC-FT)
Pond 7	28.29 AC-FT (8.46 AC-FT)

All of the drainage analysis as described above has been comprised into a document titled ***Master Drainage Report for Grand Junction Regional Airport,*** written in June 2012 by Jviation, Inc. This report includes the ultimate build out of the Airport including the scheduled construction of the runway (Alternative 1). The master drainage report was approved by the City of Grand Junction on June 15, 2012 and is attached in Appendix E.

7. PAVEMENT DESIGN

Preliminary pavement sections were developed for both runway Alternatives 1 and 2. The preliminary pavement design considers subgrade strength, subbase and base course materials, and both concrete and asphalt pavement surfaces. The following sections present the method used to develop pavement designs for the critical and non-critical areas associated with the proposed project.

For Alternative 1, subgrade strengths were determined from historical values obtained from the Airport's Pavement Strength Survey (PSS). The PSS contains the design pavement sections and design subgrade California Bearing Ratio (CBR) values for all the projects that have constructed runway pavements over the past 30-40 years. The subgrade CBR values listed in this survey were utilized to determine a design CBR value for the basis of the Alternative 1 pavement section presented in this report.

For Alternative 2, the results of the March 13, 2012 preliminary geotechnical and pavement investigation performed by Ground Engineering, Inc. (Ground), in October 2011 were used for the basis of the pavement design. The investigation included 22 borings within the proposed limits of disturbance, to collect soil samples for laboratory analysis. The findings and recommendations from the preliminary geotechnical and pavement investigation are presented in the report titled, ***Preliminary Geotechnical Subsurface Exploration Program, Proposed New runway 11/29, Grand Junction Regional Airport, Grand Junction, Colorado***, dated March 13, 2012. The entire report can be found in Appendix D. This geotechnical and pavement investigation made a preliminary determination of the subgrade characteristics and preliminarily identified soil conditions of potential borrow areas.

Design Assumptions

As mentioned above, the proposed pavement sections were designed using the results of either the PSS or the preliminary geotechnical investigation performed for the relocated runway alternative. Soils encountered during the geotechnical investigation generally consisted of variable depth overburden soils consisting of highly plastic sandy silts and clays, overlying sandstone, claystone and weathered to competent shale bedrock. The shale materials were noted as being stiff to very hard. Localized areas of previous man made fill materials were encountered. The soils within the project area were generally classified as primarily fine grained Lean Clays (CL) and fine grained Fat Clays (CH). Plasticity Index (PI) for the soil samples ranged from 6 to 33. The soils were also noted as having low to high swell potential in their in-situ state. Average CBR values, from composite samples, ranged from 1.5 to 9.0 for materials encountered during the preliminary investigation. Furthermore, soil classifications indicate that the native subgrade materials are cohesive, PI greater than 2, for design purposes of the proposed pavement sections.

For both alternatives, a CBR of 5.4 was used for the pavement design. For Alternative 1, this was based on the documented subgrade CBR values obtained from the PSS. For Alternative 2, this was determined from the borrow source's overburden material that will be used to construct the new pavement subgrades.

On previous projects, locally available quarry and gravel pits have been able to successfully produce aggregate meeting the requirements for P-154, P-209, P-305, P-401 and P-501 materials. Materials to be used as P-152 embankment are anticipated to be generated from select cut operations along the northeast side of the proposed runway. Each aggregate supplier will be required to adhere to the required aggregate quality and reactivity tests for each of the various items. In particular, aggregate proposed for use in concrete will undergo Alkali Silica Reaction (ASR) testing as required per the P-501 specification.

The pavement designs were completed utilizing a 20-year design life, maximum aircraft takeoff weights, and since the traffic mix includes aircraft exceeding 100,000 pounds, a stabilized base course was utilized within the proposed pavement sections.

Fleet Mix and Number of departures for each aircraft

The aircraft fleet mix from the most current Terminal Area Plan is used for the pavement designs and is included in this section of the report. It includes commercial service aircraft, military aircraft, as well as the most critical general aviation aircraft. All pavement design calculations were determined using FAA design software for flexible pavements (FAARFIELD version 1.305). Annual growth rates for operations were also derived from the current Terminal Area Plan.

The fleet mix table below summarizes the aircraft utilized in the development of the pavement sections. The commercial fleet mix at the airport consists of Bombardier CRJ-200ER's, CRJ-700's, Embraer 145's, Boeing MD-80's and Dash 8's. The General Aviation fleet mix consists of primarily Gulfstream, Lear, Cessna and Beechcraft aircraft. Additionally, FedEx maintains an air hub at the airport that is serviced with Boeing 757's and the military utilizes the Airport with an assortment of aircraft, which are included in the fleet mix. The results of the fleet mix analysis indicated that the Air Force KC-135 Stratotanker, a 322,500-lb dual tandem gear aircraft operating at 400 departures per year, and the Navy's E6, a 342,000-lb dual tandem gear aircraft, operating at 100 departures per year, are the most demanding aircraft from a standpoint of the cumulative damage factor (CDF), followed by FedEx's 757's.

Airport Fleet Mix Information

Name	Gross Wt. (lbs)	Annual Departures	% Annual Growth
RegionalJet- CRJ 200ER	47,450	2,462	4.70
Regional Jet-CRJ 700	72,500	224	6.00
MD83	161,000	246	6.80
B757-200	256,000	500	5.00
Dual Wheel-45 (EMB 145)	42,328	718	10.00
Single Wheel-30	36,300	1,900	-5.0
Single Wheel-15	16,000	3,737	1.60
Single Wheel-3	3,000	11,053	1.00
Single Wheel-10	10,000	2,395	1.00
Gulfstream-G-V	90,900	4,606	1.60
Dual Tan-400 (Navy E6)	342,000	100	0.00
F-15C	68,000	2,307	0.00
B737-600	146,000	52	3.00
B707-320C (KC-135)	322,500	400	0.0

FAARFIELD Pavement Design Output

In accordance with ***FAA Advisory Circular 150/5320-6E, Airport Pavement Design and Evaluation***, all pavement designs were computed with the FAA design software for rigid and flexible pavements (FAARFIELD version 1.305). Based upon the design data presented above, the following pavement sections have been computed by FAARFIELD software with a design life cycle of 20 years. The output from the FAARFIELD design program and cumulative damage factor (CDF) graphs for the pavement sections can be found in Appendix F.

For Alternatives 1 and 2, pavement designs were calculated for four alternate pavement sections. The results from FAARFIELD are shown in the following table.

Pavement Section	A	B	C	D
Asphaltic Concrete (P-401) Surface	5”	5”	5”	N/A
Asphaltic Concrete (P-401/403) Structural (Stabilized Base)	7”	13.5”	7”	N/A
Portland Cement Concrete (P-501)	N/A	N/A	N/A	15.5”
Econocrete (P-306)	N/A	N/A	N/A	8”
Subbase Course (P-209)	21”	N/A	N/A	6”
Concrete Treated Base Course (P-304)	N/A	N/A	6.25”	N/A
Geosynthetic Support Fabric	Yes	Yes	Yes	Yes
Subgrade Preparation	18”	18”	18”	18”
Total Thickness	33”	18.5”	18.25”	29.5”

.

Due to the limited depths of pavement sections Sections B and C, they were eliminated as options for reasons of frost protection. Only Sections A and D will be further considered in this report. Outputs from the FAA's pavement design program (FAARFIELD) are shown in the following figures:

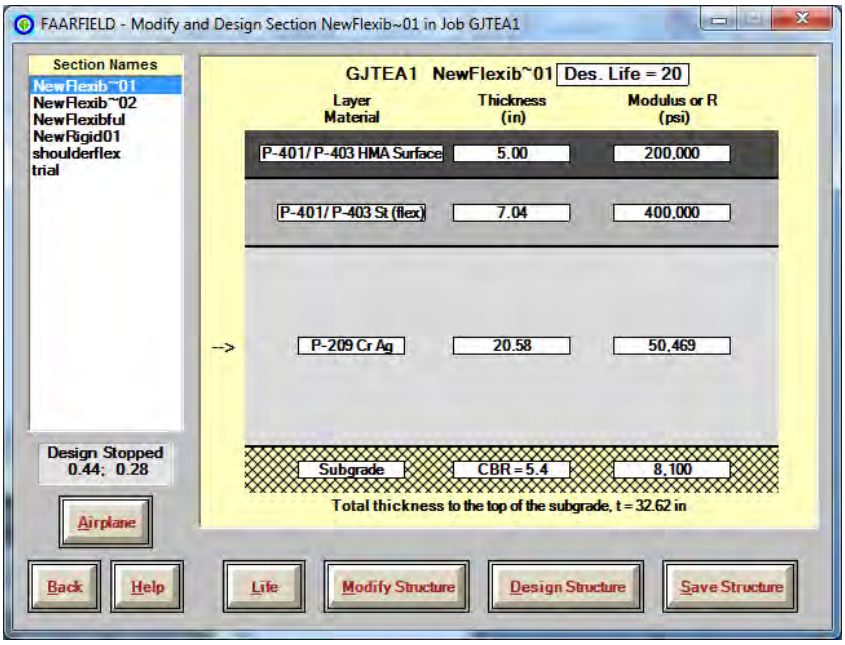


Figure 1 – FAARFIELD Data for Section A

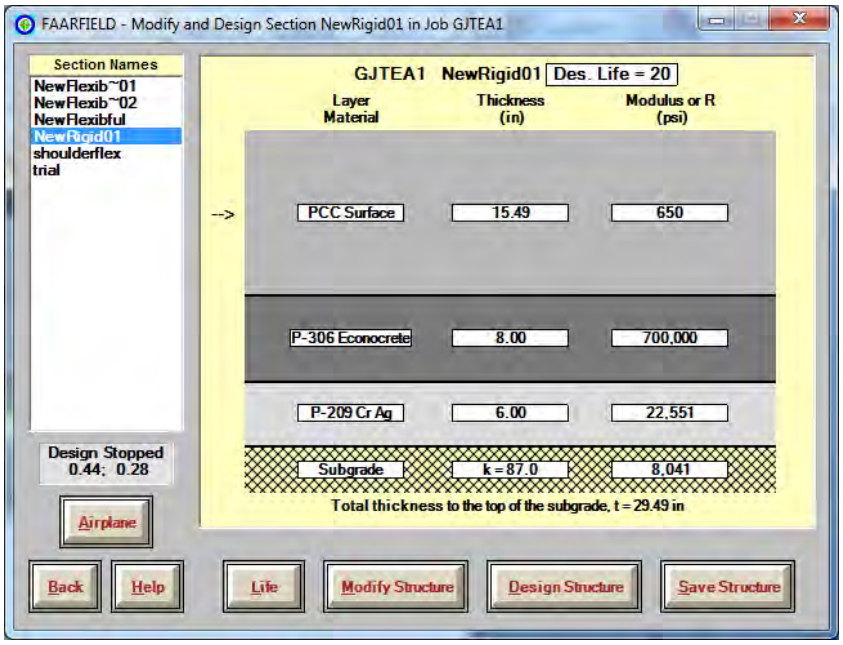


Figure 2 – FAARFIELD Data for Section D

Frost Design

Considering the soil classifications and conditions reported in the preliminary geotechnical report and considering data from previous projects at the Airport, the native soils to be utilized as subgrade have been deemed to be Frost Group FG-4 in accordance with ***FAA Advisory Circular 150/5320-6E, Airport Pavement Design and Evaluation***. According to the ***FAA Advisory Circular 150/5320-6E, Airport Pavement Design and Evaluation***, it is recommended that Limited Subgrade Frost Penetration should be incorporated into the pavement section for these soil types. A frost depth of 43-inches has been historically utilized at the Airport. Utilizing the Limited Subgrade Frost Penetration methodology, 65% of the frost penetration depth of 43-inches should be made up of non-frost susceptible material. Based on this requirement, Pavement Sections B and C were eliminated from consideration. However, based upon past performance of the existing pavements and existing conditions, no evidence of frost heave exists at the Airport beyond 22-inches of depth. In addition, similar geotechnical investigations on various projects at the airport have historically indicated that there is little, if any, groundwater present in pavement cores and soil borings.

An underdrain system that will convey water through the subgrade layers is anticipated as part of the runway construction, to reduce the potential for trapped water and frost heave. Routine maintenance of the new pavement, including joint sealant repair and crack sealing, will also help prevent water migrating into the subgrade layers, thus reducing the potential of frost heave due to trapped water.

Life Cycle Analysis

A life cycle analysis was performed to compare the costs associated with the different proposed critical pavement sections, as described above based on a 20-year life.

Pavement Section	Initial Cost ($/SY)	Present Worth Life Cycle ($/SY)
A (Asphalt Composite Pavement)	108.11	141.21
D (Portland Cement Concrete Pavement)	146.01	171.26

In addition, a life cycle analysis was completed for the non-critical pavement section (runway shoulders and blast pads) consisting of 6-inches of asphalt over 12.5- inches of aggregate base course. The initial cost is estimated at $60.98 per square yard and the present worth life cycle cost at 20-years is estimated at $93.78 per square yard. Summary tables for the life cycle analysis are included in Appendix B.

Conclusion

Based on the life cycle cost analysis and the good historical performance of asphalt at the airport, it is recommended that Pavement Section A be utilized. The recommended pavement section was computed by FAARFIELD and consists of 5-inches of asphalt surface course, on 7-inches of stabilized asphalt base course, on 21-inches of a crushed aggregate base course, on 18-inches of subgrade material compacted to at least 95% of a Modified Proctor (ASTM D 1557) density. This

recommendation takes into account the sponsor certification criteria that requires all FAA funded AIP projects to follow the guidelines presented in the current versions of the FAA Advisory Circulars.

8. PAVEMENT MARKING

All proposed pavement markings will conform to ***FAA Advisoy Circular 150/5340-1k, Standards for Airport Markings***, and project specification P-620 Runway and Taxiway Painting.

Markings for the runway will include centerline markings, edge markings, runway designation, threshold markings, touchdown zone markings and aiming point markings. The taxiway markings will include taxiway edge markings, taxiway centerline markings, enhanced runway holding position markings, chevrons, and non-movement area markings.

Historically, the paint utilized for markings at the Airport has been striated, and is proposed to remain striated to minimize maintenance and repair costs.

All markings shall receive glass beads. Permanent marking applications will take place 30 days after placement of the pavement surface.

9. SIGNAGE, LIGHTING, AND NAVAID'S

For Alternative 1, no significant upgrades to the existing signage, lighting, and NAVAID systems are needed. However, several components of the existing runway lighting and signage systems are approaching the end of their usable life and would therefore need to be replaced as part of Alternative 1. The components in need of replacement are the runway lighting fixtures, isolation transformers, runway lighting cable, and guidance signs.

For Alternative 2, significant modifications to the signage, lighting, and NAVAID systems are needed. A completely new high intensity runway lighting system will be required as well as new taxiway edge lighting for all connector taxiways and along the new Taxiway A (converted Runway 11/29). New signage will also be needed to clearly identify all new runway and taxiway pavements. In addition, significant portions of the existing guidance sign system will need to be replaced in order to correctly identify the existing runway and taxiways which will be re-identified as part of Alternative 2.

All new airfield lighting will be installed using a conduit and base can system. Although this method has higher initial costs than using a direct burial system, it has been proven to provide a longer service life and is significantly easier for airport staff to troubleshoot and maintain.

Approximately three additional constant current regulators will be required to provide power to the new airfield lighting circuits. Because the existing lighting vault is nearing its capacity, a new, larger vault, or an addition to the existing vault may be required. In addition, the existing lighting control system was manufactured by a company which is no longer in business. Because of this, it is not possible to expand the system to control the new regulators. Therefore, a new computerized lighting control system will be required.

In addition to airfield lighting and signage, many of the NAVAID's will need to be relocated to serve the new runway. These NAVAID's include:

- Runway 11 Instrument Landing System
  - Includes localizer antenna and equipment building, glideslope antenna and equipment building, runway visual range equipment (RVR), and medium intensity approach lighting system with runway alignment indicator lights (MALSR).
- Runway 29 Localizer Type Directional Aid
- Runway 29 Visual Approach Slope Indicator (VASI)
  - Existing VASI will be replaced with a PAPI
- Runway 29 Runway End Identifier Lights (REIL)
- Runway 11 Precision Approach Slope Indicator (PAPI)
  - Existing PAPI is airport owned, new PAPI will be FAA owned
- Remote Transmitter/Receiver (RTR)

All of the new or relocated NAVAID's listed will be FAA owned and the design and construction of their relocation will be completed by the FAA. Reimbursable agreements will be used to pay the FAA for the design and construction of their NAVAID equipment.

There is currently a National Weather Service owned automated surface observation system (ASOS) located near the glideslope equipment building that will need to be relocated. Relocation of the ASOS will be coordinated with the National Weather Service.

New underground electrical service will be required to serve all of the new NAVAID's. Depending on the location of each NAVAID, electrical power will be provided by either Xcel Energy or Grand Valley Power. New electrical services will be designed and constructed by the respective power companies.

10. ENGINEER'S ESTIMATE

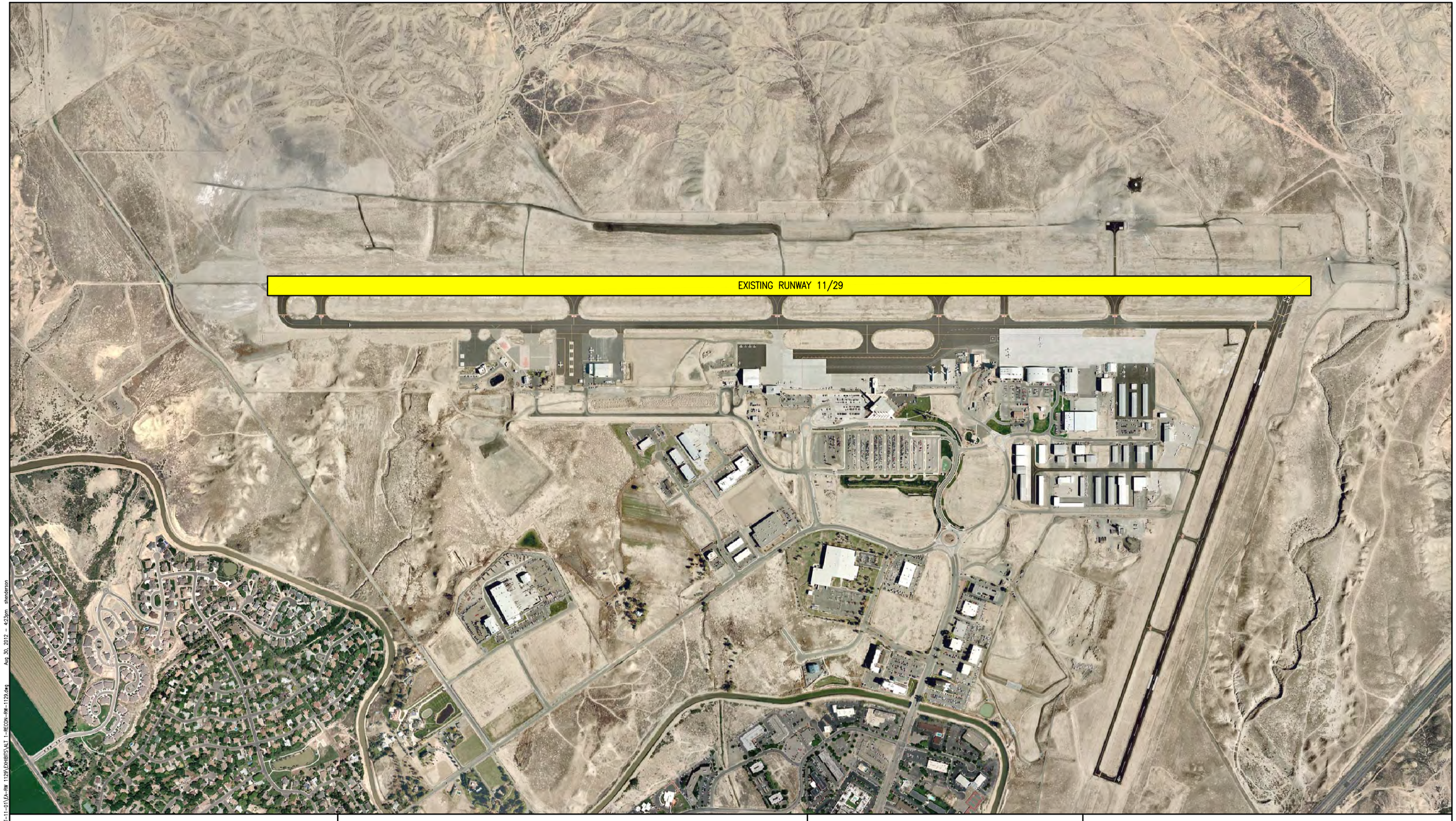
Preliminary costs for Alternative 1 are estimated to be approximately $40.5 million. This cost includes removing the existing runway and shoulder asphalt pavements, removal of all existing runway lighting and guidance systems, excavating to subgrade elevations, overexcavating areas of soft subgrade, subgrade preparation, underdrain installation, base course construction, asphalt paving, runway grooving, pavement markings, and construction of a new runway lighting and guidance system. As mention previously in this report, none of the non-standard conditions that currently exist for the runway will be corrected under Alternative 1.

The costs for Alternative 2 are estimated to be approximately $80 million. This cost will include constructing a new runway and connector taxiways that meet all FAA design standards. The runway will be constructed 637.5 feet to the northeast of the existing runway, and the existing runway will be converted into a parallel taxiway. In addition to the new runway, initial construction will also include six new connector taxiways, a 900 foot extension to the new parallel taxiway, a new runup pad, and the realignment of County Road 27-¼ to avoid the new runway protection zone (RPZ). Three future taxiways, which include two high speed taxiways, along with a holding bay will be constructed at some time after the initial construction, as funding and operational needs necessitate. Approximately 3.5 million cubic yards of earth will be required to be moved in order to build the new runway and grade for Part 77 surfaces. All NAVAID's including the airport's remote transmitter receiver (RTR) will be moved to accommodate the new runway.

Cost estimates have been prepared for both Alternatives 1 and 2. The estimates include costs for both engineering as well as construction. The unit costs used in the estimates were determined from both recently bid projects and historical bid tabulations and scaled to match the overall size of the project. All costs shown on the estimates are in 2012 dollars. The detailed estimates can be found in Appendix C of this report.

APPENDIX A

Project Sketch



GRAND JUNCTION REGIONAL AIRPORT

GRAPHIC SCALE
450 0 450 900
(IN FEET)

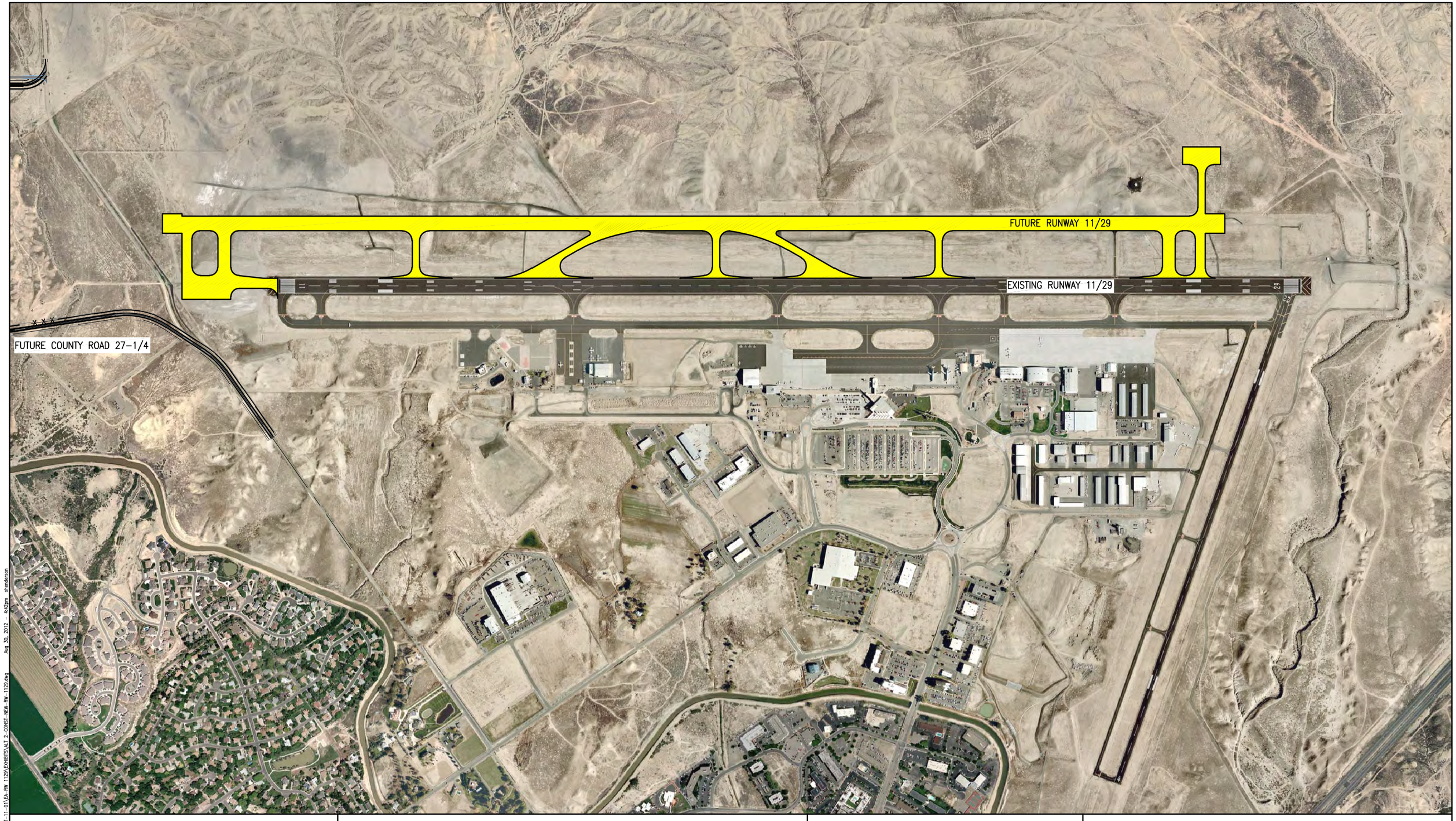
N

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

ALTERNATIVE 1
RECONSTRUCT RUNWAY 11/29

DATE: AUGUST 17, 2012

I:\Projects\GJT\CAD\GJT-FAV 1129-GPW 69-GJT-11-01\EX-FAV 1129\EXHIBITS\ALT 1-RECON-FAV-1129.dwg Aug 30, 2012 - 4:23pm shenderson



GRAND JUNCTION REGIONAL AIRPORT

GRAPHIC SCALE
450 0 450 900
(IN FEET)

N

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

ALTERNATIVE 2
CONSTRUCT NEW RUNWAY 11/29
AND ASSOCIATED TAXIWAYS

DATE: AUGUST 17, 2012

J:\Projects\GJT\CAD\GJT-FAV 1129-GPV(BD-GJT-11-01\EX-FAV 1129\EXHIBITS\ALT 2-CONST-NEW-RW-1129.dwg Aug 30, 2012 - 4:42pm sthenderson

APPENDIX B

Life Cycle Cost Analysis

Grand Junction Regional Airport - Envrionmenal Assessment
Asphalt Alternate

Design Life	20	Years
Discount Rate	4%	

			Total Asphalt Section (in.)	Total Concrete Section (in.)
Area	175,000	SY		
Asphalt Depth	12	Inches	33	29.5
Base Depth	21	Inches		
Subbase Depth	0	Inches		
Subgrade Depth	18	Inches		

Upfront Costs			Units	Quantity	
P-152a	Unclassified Excavation	$ 3.50	CY	-	CY
P-152b	Subgrade Prep	$ 2.00	SY	175,000	SY
P-154	Subbase	$ 20.00	CY	-	CY
P-209	Aggregate Base Course	$ 40.00	CY	102,083	CY
P-310	Stabilization Fabric	$ 2.00	SY	175,000	SY
P-401a	Bituminous Paving Course	$ 65.00	TONS	118,125	tons
P-401b	Modified Bituminous Material	$ 800.00	TONS	7,678	tons
P-603a	Tack Coat	$ 2.00	GAL	35,000	gallons
P-603b	Fog Seal after grooving	$ 2.00	GAL	35,000	gallons
P-650a	Grooving	$ 1.00	SY	175,000	SY

Maintenance Costs			Quantity	
	Joint Sealing	$ 2.50	LF	8,750	LF
	Asphalt Patching	$ 60.00	SY	3,500	SY
P-401c	Tack Coat	$ 5.00	GAL	3,500	gallons

Rehabilitation Costs (Overlay)			Quantity	
P-140a	Partial Pavement Removal	$ 5.50	SY	175,000	SY
P-310b	Stabilization Fabric	$ 2.00	SY	175,000	SY
P-401a	Bituminous Paving Course	$ 65.00	TONS	19,688	tons
P-401b	Modified Bituminous Material	$ 800.00	TONS	1,280	tons
P-650a	Grooving	$ 1.00	S.Y	175,000	SY
P-603b	Fog Seal After Grooving	$ 2.00	GAL	35,000	gallons
P-401c	Tack Coat	$ 2.00	GAL	26,250	gallons

Year	Project Description	Total Upfront Cost	Discount Factor	Present Worth	Present Worth / SY
0	Improvement	$ 18,918,958.33	1.0000	**$18,918,958.33**	**$108.11**
3	Crack and Fog Seal	$ 249,375.00	0.8890	$221,693.47	**$1.27**
6	Crack and Fog Seal	$ 249,375.00	0.7903	$197,084.68	**$1.13**
8	Rehabilitation	$ 3,913,437.50	0.7307	$2,859,510.45	**$16.34**
11	Crack and Fog Seal	$ 249,375.00	0.6496	$161,989.24	**$0.93**
14	Crack and Fog Seal	$ 249,375.00	0.5775	$144,007.85	**$0.82**
16	Rehabilitation	$ 3,913,437.50	0.5339	$2,089,416.28	**$11.94**
19	Crack and Fog Seal	$ 249,375.00	0.4746	$118,363.95	**$0.68**
20	**Year Lifecyle Cost - Total**			**$24,711,024.26**	**$141.21**

Grand Junction Regional Airport - Envrionmenal Assessment
Concrete Alternate

Design Life	20	Years
Discount Rate	4%	

			Total Asphalt Section (in.)	Total Concrete Section (in.)
Area	175,000	SY		
Concrete Thickness	15.5	Inches	33	29.5
P-305 Depth	8	Inches		
P-209 Depth	6	Inches		
Subgrade Depth	18	Inches		

Upfront Costs

				Quantities:	
P-152a	Unclassified Excavation	$ 3.50	/CY	17,014	CY
P-152b	Subgrade Prep	$ 2.00	/SY	175,000	SY
P-209	Aggregate Base Course	$ 40.00	/CY	29,167	CY
P-305	Lean Concrete Base	$ 26.00	/SY	175,000	SY
P-310b	Stabilization Fabric	$ 2.00	/SY	175,000	SY
P-310c	Bond Breaker Fabric	$ 4.00	/SY	175,000	SY
P-501a	15.5" Concrete Pavement	$ 105.00	/SY	175,000	SY

Maintenance Costs

				Quantities:	
	Slab Replacement	$ 150.00	/SY	7,000	SY
	Spall Repair	$ 100.00	/SF	8,750	SF
	Joint Resealing	$ 3.00	/LF	297,500	LF

Year	Project Description		Total Upfront Cost	Discount Factor	Present Worth	Present Worth / SY
0	Improvement	$	25,551,215	1.0000	**$25,551,215**	**$146.01**
5	Joint Resealing	$	892,500	0.8219	$733,570	**$4.19**
10	Maintenance	$	2,817,500	0.6756	$1,903,402	**$10.88**
15	Joint Resealing	$	892,500	0.5553	$495,574	**$2.83**
20	Maintenance	$	2,817,500	0.4564	$1,285,870	**$7.35**
20	**Year Lifecyle Cost - Total**				**$29,969,631**	**$171.26**

Grand Junction Regional Airport
Grand Junction, Colorado
Environmental Assessment - Runway Alternative Analysis

Present Worth Life-Cycle Costing
Asphalt Pavement

Year	4.00% Discount	Improvement Items	Cost/S.Y.	Present Worth
0	1	Reconstruct Air Carrier Ramp- Asphalt	$108.11	$108.11
1	0.9615			
2	0.9246			
3	0.8890	Fog Seal/Crack Seal	$ 1.43	$1.27
4	0.8548			
5	0.8219			
6	0.7903	Fog Seal/Crack Seal	$ 1.43	$1.13
7	0.7599			
8	0.7307	Overlay	$ 22.36	$16.34
9	0.7026			
10	0.6756			
11	0.6496	Fog Seal/Crack Seal	$ 1.43	$0.93
12	0.6246			
13	0.6006			
14	0.5775	Fog Seal/Crack Seal	$ 1.43	$0.82
15	0.5553			
16	0.5339	Overlay	$ 22.36	$11.94
17	0.5134			
18	0.4936			
19	0.4746	Fog Seal/Crack Seal	$ 1.43	$0.68
20	0.4564			
		Total	**$ 159.96**	**$ 141.21**

Grand Junction Regional Airport
Grand Junction, Colorado
Environmental Assessment - Runway Alternative Analysis

Present Worth Life-Cycle Costing
Concrete Pavement

Year	4.00% Discount	Improvement Items	Cost/S.Y.	Present Worth
0	1	Upfront Pavement Costs Concrete Pavement	$146.01	$146.01
1	0.9615			
2	0.9246			
3	0.8890			
4	0.8548			
5	0.8219	Joint Resealing	$ 5.10	$4.19
6	0.7903			
7	0.7599			
8	0.7307			
9	0.7026			
10	0.6756	Crack and Spall Repair/Panel Replacement	$ 16.10	$10.88
11	0.6496			
12	0.6246			
13	0.6006			
14	0.5775			
15	0.5553	Joint Resealing	$ 5.10	$2.83
16	0.5339			
17	0.5134			
18	0.4936			
19	0.4746			
20	0.4564	Crack and Spall Repair	$ 16.10	$7.35
		Total	**$ 188.41**	**$ 171.26**

APPENDIX C

Engineer's Estimate

Grand Junction Regional Airport
Grand Junction, Colorado

Reconstruct Runway 11/29

ITEM	ITEM DESCRIPTION	UNIT	Reconstruct Runway 11/29 QUANTITY	ENGINEER'S ESTIMATE UNIT $	ENGINEER'S ESTIMATE ITEM $
P-100a	Mobilization (8%)	EA	1	$ 2,297,265.16	$ 2,297,265.16
P-140a	Asphalt Pavement Removal (Complete)	SY	239,167	$ 8.00	$ 1,913,333.33
P-152a	Unclassified Excavation	CY	159,444	$ 7.00	$ 1,116,111.11
P-152b	Subgrade Preparation	SY	239,167	$ 2.00	$ 478,333.33
P-152c	Overexcavation	CY	111,611	$ 20.00	$ 2,232,222.22
P-209a	Crushed Aggregate Base Course	CY	146,157	$ 35.00	$ 5,115,509.26
P-310a	Stabilization Fabric	SY	263,083	$ 2.00	$ 526,166.67
P-401a	Bituminous Paving Course (3/4" Mix)	TON	167,063	$ 50.00	$ 8,353,125.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	10,859	$ 750.00	$ 8,144,296.88
P-603a	Bituminous Tack Coat	GAL	143,500	$ 3.00	$ 430,500.00
P-603b	Fog Seal for Runway Grooving	GAL	17,500	$ 3.00	$ 52,500.00
P-620a	Temporary Runway and Taxiway Painting	SF	100,000	$ 0.75	$ 75,000.00
P-620b	Permanent Runway and Taxiway Painting	SF	100,000	$ 1.00	$ 100,000.00
P-620c	Obliterate Existing Runway Markings	SF	100,000	$ 1.00	$ 100,000.00
P-650a	Runway Sawcut Grooving	SY	175,000	$ 1.00	$ 175,000.00
D-701d	Underdrains	LF	24,200	$ 20.00	$ 484,000.00
F-162a	Install 8-Foot Chain-Link Fence with 3 Stranded Barbed Wire	LF	16,000	$ 25.00	$ 400,000.00
F-162b	Install 16-Foot Double Swing Gate (Manual)	EA	8	$ 2,500.00	$ 20,000.00
F-163a	Install Wildlife Deterrent Skirt	LF	16,000	$ 20.00	$ 320,000.00
L-108a	L-824C #8 AWG 5000V Cable	LF	94,500	$ 1.50	$ 141,750.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	78,750	$ 1.20	$ 94,500.00
L-110a	1-2" PVC Conduit (Direct Buried)	LF	21,900	$ 10.00	$ 219,000.00
L-125i	New L-858 RDR Signs	EA	10	$ 5,200.00	$ 52,000.00
L-125k	New L-858 Guidance Sign (3-Panel /Size 1)	EA	12	$ 6,400.00	$ 76,800.00
L-125l	New REILS Lights	LS	1	$ 9,000.00	$ 9,000.00
				SUBTOTAL	**$ 32,926,412.96**

Contingency (5%)	$ 1,646,320.65
Design Engineering (%)	$ 2,634,113.04
Construction Management (%)	$ 3,292,641.30
GRAND TOTAL	**$ 40,499,487.94**

Alternative 2 - Construct New Runway 11/29 at 637.5' Offset

Summary of Costs

Initial Runway 11/29 Development Projects

New 637.5 Foot Offset Runway 11/29	$	52,059,852.73
New Runway 11/29 - Overall Design	$	2,500,000.00
Holding Bay at Taxiway A1	$	1,042,511.34
New Taxiway A1	$	1,053,126.23
New Taxiway A2	$	1,353,245.81
New Taxiway A3	$	1,437,764.95
New Taxiway A5	$	1,493,389.78
New Taxiway A7	$	1,451,767.80
New Taxiway A8	$	1,856,513.61
New Taxiway A9	$	1,427,419.59
New Taxiway A Extension	$	2,217,676.62
Runup Pad	$	2,568,615.50
New Runway 11/29: Construct Northern Perimeter Road and Fence	$	2,858,371.75
Convert Existing R/W 11/29 to T/W A	$	3,458,525.73
Construct 27 1/4 Road	$	3,461,201.02
Total:	**$**	**80,239,982.48**

Reimbursable Agreements

New Runway 11/29 - RTR Relocation - Preliminary Design Reimbursable	$	30,000.00
New Runway 11/29 - RTR Relocation - Design Reimbursable	$	100,000.00
New Runway 11/29 - RTR Relocation - Construction Reimbursable	$	1,247,400.00
NAVAID for New Runway - Design	$	100,000.00
NAVAID for New Runway - Construction	$	2,133,054.00
Total:	**$**	**3,610,454.00**

Future Runway 11/29 Development Projects

New Taxiway A4 High Speed	$	3,384,064.22
New Taxiway A6 High Speed	$	3,388,446.56
Total:	**$**	**6,772,510.79**

Grand Total:	**$**	**90,622,947.26**

JVIATION®

Grand Junction Regional Airport
Grand Junction, Colorado

New 637.5 Foot Offset Runway 11/29

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 3,232,010.30	$ 3,232,010.30
P-151a	Clearing and Grubbing	AC	100	$ 1,200.00	$ 120,000.00
P-152a	Unclassified Excavation	CY	3,605,000	$ 3.25	$ 11,716,250.00
P-152a	Unclassified Excavation **(BP-2)**	CY	249,667	$ 6.50	$ 1,622,833.33
P-152a	Unclassified Excavation **(BP-3)**	CY	83,222	$ 7.50	$ 624,166.67
P-152b	Subgrade Preparation	SY	249,700	$ 1.75	$ 436,975.00
P-152c	Overexcavation	CY	75,425	$ 18.00	$ 1,357,650.00
P-209a	Crushed Aggregate Base Course	CY	127,540	$ 35.00	$ 4,463,900.00
P-310a	Stabilization Fabric	SY	185,060	$ 1.00	$ 185,060.00
P-310a	Stabilization Fabric (Top of Base Course)	SY	185,060	$ 1.00	$ 185,060.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	139,915	$ 50.00	$ 6,995,750.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	9,100	$ 750.00	$ 6,825,000.00
P-603a	Bituminous Tack Coat	GAL	87,620	$ 2.00	$ 175,240.00
P-603b	Fog Seal for Runway Grooving	GAL	27,565	$ 2.00	$ 55,130.00
P-620a	Temporary Runway and Taxiway Painting	SF	113,200	$ 0.75	$ 84,900.00
P-620b	Permanent Runway and Taxiway Painting	SF	113,200	$ 1.00	$ 113,200.00
P-650a	Runway Sawcut Grooving	SY	151,670	$ 1.00	$ 151,670.00
D-701a	Construct Detention and Water Quality Ponds	LS	1	$ 1,000,000.00	$ 1,000,000.00
D-701b	Storm Sewer - Infields	LF	9,000	$ 100.00	$ 900,000.00
D-701c	Inlets - Infields	EA	50	$ 5,000.00	$ 250,000.00
D-701d	Underdrains	LF	23,100	$ 20.00	$ 462,000.00
D-701e	Storm Sewer - Runway and 27 1/4 Road Crossings	LF	2,000	$ 120.00	$ 240,000.00
D-701f	Storm Sewer - TW A and GA Embankments	LF	3,600	$ 120.00	$ 432,000.00
T-901a	Seeding and Erosion Control	AC	530	$ 1,500.00	$ 795,000.00
L-108a	L-824C #8 AWG 5000V Cable	LF	47,700	$ 2.00	$ 95,400.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	25,175	$ 2.25	$ 56,643.75
L-109a	Constant Current Regulator	EA	1	$ 22,000.00	$ 22,000.00
L-109b	Airfield Lighting Control System	LS	1	$ 200,000.00	$ 200,000.00
L-110a	1-2" PVC Conduit (DEB)	LF	21,200	$ 8.50	$ 180,200.00
L-110b	1-2" PVC Conduit (CE)	LF	2,650	$ 20.00	$ 53,000.00
L-110c	4-3" PVC Conduit (CE)	LF	1,325	$ 40.00	$ 53,000.00
L-125a	New L-862 R/W Light in L-867 Can, Complete	EA	111	$ 1,200.00	$ 133,200.00
L-125c	New L-850C In-Pavement Runway Light	EA	9	$ 1,600.00	$ 14,400.00
L-125k	New L-858 RDR Sign	EA	9	$ 4,500.00	$ 40,500.00
L-400c	Relocate ASOS	LS	1	$ 75,000.00	$ 75,000.00
L-400f	Temporary MALSR	LS	1	$ 75,000.00	$ 75,000.00
U-100a	Electrical Distribution (Xcel)	LF	14,000	$ 15.00	$ 210,000.00
				SUBTOTAL	**$ 43,632,139.05**

Contingency (5%)	$ 2,181,606.95
Design Engineering	$ 1,664,732.13
Construction Management	$ 4,581,374.60
GRAND TOTAL	**$ 52,059,852.73**

Grand Junction Regional Airport
Grand Junction, Colorado

Holding Bay at Taxiway A1

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 64,721.80	$ 64,721.80
P-152a	Unclassified Excavation **(BP-2)**	CY	8,770	$ 6.50	$ 57,005.00
P-152a	Unclassified Excavation **(BP-3)**	CY	2,380	$ 7.50	$ 17,850.00
P-152b	Subgrade Preparation	SY	11,490	$ 1.75	$ 20,107.50
P-209a	Crushed Aggregate Base Course	CY	5,175	$ 35.00	$ 181,125.00
P-310a	Stabilization Fabric	SY	6,780	$ 1.00	$ 6,780.00
P-310a	Stabilization Fabric (Top of Base Course)	SY	6,780	$ 1.00	$ 6,780.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	5,090	$ 50.00	$ 254,500.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	330	$ 750.00	$ 247,500.00
P-603a	Bituminous Tack Coat	GAL	4,750	$ 2.00	$ 9,500.00
P-620a	Temporary Runway and Taxiway Painting	SF	4,500	$ 0.75	$ 3,375.00
P-620b	Permanent Runway and Taxiway Painting	SF	4,500	$ 1.00	$ 4,500.00
				SUBTOTAL	**$ 873,744.30**

Contingency	$	43,687.22
Design Engineering (%)	$	33,336.67
Construction Management (%)	$	91,743.15
GRAND TOTAL	**$**	**1,042,511.34**

JVIATION

Grand Junction Regional Airport
Grand Junction, Colorado

New Taxiway A1

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 65,380.80	$ 65,380.80
P-152a	Unclassified Excavation **(BP-2)**	CY	7,220	$ 6.50	$ 46,930.00
P-152a	Unclassified Excavation **(BP-3)**	CY	2,070	$ 7.50	$ 15,525.00
P-152b	Subgrade Preparation	SY	8,815	$ 1.75	$ 15,426.25
P-209a	Crushed Aggregate Base Course	CY	4,295	$ 35.00	$ 150,325.00
P-310a	Stabilization Fabric	SY	5,900	$ 1.00	$ 5,900.00
P-310a	Stabilization Fabric (Top of Base Course)	SY	5,900	$ 1.00	$ 5,900.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	4,620	$ 50.00	$ 231,000.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	300	$ 750.00	$ 225,225.00
P-603a	Bituminous Tack Coat	GAL	3,230	$ 2.00	$ 6,460.00
P-620a	Temporary Runway and Taxiway Painting	SF	4,020	$ 0.75	$ 3,015.00
P-620b	Permanent Runway and Taxiway Painting	SF	4,020	$ 1.00	$ 4,020.00
D-701a	Underdrains	LF	1,900	$ 25.00	$ 47,500.00
L-108a	L-824C #8 AWG 5000V Cable	LF	2,050	$ 2.00	$ 4,100.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	1,165	$ 2.25	$ 2,621.25
L-110a	1-2" PVC Conduit (DEB)	LF	1,025	$ 8.50	$ 8,712.50
L-110c	4-3" PVC Conduit (CE)	LF	140	$ 40.00	$ 5,600.00
L-125d	New L-861T T/W Lights in L-867 Cans, Complete	EA	20	$ 1,000.00	$ 20,000.00
L-125i	New L-858 Guidance Sign (2-Module/Size 1)	EA	3	$ 4,500.00	$ 13,500.00
L-125j	New L-858 Guidance Sign (3-Module/Size 1)	EA	1	$ 5,500.00	$ 5,500.00
				SUBTOTAL	**$ 882,640.80**

Contingency (5%)	$ 44,132.04
Design Engineering	$ 33,676.11
Construction Management	$ 92,677.28
GRAND TOTAL	**$ 1,053,126.23**

Grand Junction Regional Airport
Grand Junction, Colorado

New Taxiway A2

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 84,013.00	$ 84,013.00
P-152a	Unclassified Excavation **(BP-2)**	CY	10,750	$ 6.50	$ 69,875.00
P-152a	Unclassified Excavation **(BP-3)**	CY	2,700	$ 7.50	$ 20,250.00
P-152b	Subgrade Preparation	SY	10,910	$ 1.75	$ 19,092.50
P-209a	Crushed Aggregate Base Course	CY	5,505	$ 35.00	$ 192,675.00
P-310a	Stabilization Fabric	SY	7,705	$ 1.00	$ 7,705.00
P-310a	Stabilization Fabric (Top of Base Course)	SY	7,705	$ 1.00	$ 7,705.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	5,915	$ 50.00	$ 295,750.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	385	$ 750.00	$ 288,750.00
P-603a	Bituminous Tack Coat	GAL	4,045	$ 2.00	$ 8,090.00
P-620a	Temporary Runway and Taxiway Painting	SF	5,270	$ 0.75	$ 3,952.50
P-620b	Permanent Runway and Taxiway Painting	SF	5,270	$ 1.00	$ 5,270.00
D-701a	Underdrains	LF	1,975	$ 25.00	$ 49,375.00
L-108a	L-824C #8 AWG 5000V Cable	LF	2,700	$ 2.00	$ 5,400.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	1,510	$ 2.25	$ 3,397.50
L-110a	1-2" PVC Conduit (DEB)	LF	1,350	$ 8.50	$ 11,475.00
L-110c	4-3" PVC Conduit (CE)	LF	160	$ 40.00	$ 6,400.00
L-125d	New L-861T T/W Lights in L-867 Cans, Complete	EA	24	$ 1,000.00	$ 24,000.00
L-125i	New L-858 Guidance Sign (2-Module/Size 1)	EA	2	$ 4,500.00	$ 9,000.00
L-125j	New L-858 Guidance Sign (3-Module/Size 1)	EA	4	$ 5,500.00	$ 22,000.00
				SUBTOTAL	**$ 1,134,175.50**

Contingency (5%)	$ 56,708.78
Design Engineering	$ 43,273.11
Construction Management	$ 119,088.43
GRAND TOTAL	**$ 1,353,245.81**

JVIATION

Grand Junction Regional Airport
Grand Junction, Colorado

New Taxiway A3

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 89,260.17	$ 89,260.17
P-152a	Unclassified Excavation **(BP-2)**	CY	10,400	$ 6.50	$ 67,600.00
P-152a	Unclassified Excavation **(BP-3)**	CY	2,450	$ 7.50	$ 18,375.00
P-152b	Subgrade Preparation	SY	11,710	$ 1.75	$ 20,492.50
P-152c	Overexcavation	CY	4,317	$ 20.00	$ 86,333.33
P-209a	Crushed Aggregate Base Course	CY	5,320	$ 35.00	$ 186,200.00
P-310a	Stabilization Fabric	SY	7,000	$ 1.00	$ 7,000.00
P-310a	Stabilization Fabric (Top of Base Course)	SY	7,000	$ 1.00	$ 7,000.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	5,600	$ 50.00	$ 280,000.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	365	$ 750.00	$ 273,750.00
P-603a	Bituminous Tack Coat	GAL	5,455	$ 2.00	$ 10,910.00
P-620a	Temporary Runway and Taxiway Painting	SF	4,610	$ 0.75	$ 3,457.50
P-620b	Permanent Runway and Taxiway Painting	SF	4,610	$ 1.00	$ 4,610.00
D-701a	Underdrains	LF	2,410	$ 25.00	$ 60,250.00
L-108a	L-824C #8 AWG 5000V Cable	LF	3,300	$ 2.00	$ 6,600.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	1,755	$ 2.25	$ 3,948.75
L-110a	1-2" PVC Conduit (DEB)	LF	1,650	$ 8.50	$ 14,025.00
L-110c	4-3" PVC Conduit (CE)	LF	105	$ 40.00	$ 4,200.00
L-125d	New L-861T T/W Lights in L-867 Cans, Complete	EA	30	$ 1,000.00	$ 30,000.00
L-125i	New L-858 Guidance Sign (2-Module/Size 1)	EA	2	$ 4,500.00	$ 9,000.00
L-125j	New L-858 Guidance Sign (3-Module/Size 1)	EA	4	$ 5,500.00	$ 22,000.00
				SUBTOTAL	**$ 1,205,012.25**

Contingency (5%)	$ 60,250.61
Design Engineering	$ 45,975.80
Construction Management	$ 126,526.29
GRAND TOTAL	**$ 1,437,764.95**

JVIATION

Grand Junction Regional Airport
Grand Junction, Colorado

New Taxiway A5

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 92,713.50	$ 92,713.50
P-152a	Unclassified Excavation **(BP-2)**	CY	10,400	$ 6.50	$ 67,600.00
P-152a	Unclassified Excavation **(BP-3)**	CY	2,450	$ 7.50	$ 18,375.00
P-152b	Subgrade Preparation	SY	11,710	$ 1.75	$ 20,492.50
P-152c	Overexcavation	CY	6,475	$ 20.00	$ 129,500.00
P-209a	Crushed Aggregate Base Course	CY	5,320	$ 35.00	$ 186,200.00
P-310a	Stabilization Fabric	SY	7,000	$ 1.00	$ 7,000.00
P-310a	Stabilization Fabric (Top of Base Course)	SY	7,000	$ 1.00	$ 7,000.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	5,600	$ 50.00	$ 280,000.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	365	$ 750.00	$ 273,750.00
P-603a	Bituminous Tack Coat	GAL	5,455	$ 2.00	$ 10,910.00
P-620a	Temporary Runway and Taxiway Painting	SF	4,610	$ 0.75	$ 3,457.50
P-620b	Permanent Runway and Taxiway Painting	SF	4,610	$ 1.00	$ 4,610.00
D-701a	Underdrains	LF	2,410	$ 25.00	$ 60,250.00
L-108a	L-824C #8 AWG 5000V Cable	LF	3,300	$ 2.00	$ 6,600.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	1,755	$ 2.25	$ 3,948.75
L-110a	1-2" PVC Conduit (DEB)	LF	1,650	$ 8.50	$ 14,025.00
L-110c	4-3" PVC Conduit (CE)	LF	105	$ 40.00	$ 4,200.00
L-125d	New L-861T T/W Lights in L-867 Cans, Complete	EA	30	$ 1,000.00	$ 30,000.00
L-125i	New L-858 Guidance Sign (2-Module/Size 1)	EA	2	$ 4,500.00	$ 9,000.00
L-125j	New L-858 Guidance Sign (3-Module/Size 1)	EA	4	$ 5,500.00	$ 22,000.00
				SUBTOTAL	**$ 1,251,632.25**

Contingency (5%)	$ 62,581.61
Design Engineering	$ 47,754.53
Construction Management	$ 131,421.39
GRAND TOTAL	**$ 1,493,389.78**

JVIATION

Grand Junction Regional Airport
Grand Junction, Colorado

New Taxiway A7

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 90,129.50	$ 90,129.50
P-152a	Unclassified Excavation **(BP-2)**	CY	10,400	$ 6.50	$ 67,600.00
P-152a	Unclassified Excavation **(BP-3)**	CY	2,450	$ 7.50	$ 18,375.00
P-152b	Subgrade Preparation	SY	11,710	$ 1.75	$ 20,492.50
P-152c	Overexcavation	CY	4,550	$ 20.00	$ 91,000.00
P-209a	Crushed Aggregate Base Course	CY	5,320	$ 35.00	$ 186,200.00
P-310a	Stabilization Fabric	SY	7,000	$ 1.00	$ 7,000.00
P-310a	Stabilization Fabric (Top of Base Course)	SY	7,000	$ 1.00	$ 7,000.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	5,600	$ 50.00	$ 280,000.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	365	$ 750.00	$ 273,750.00
P-603a	Bituminous Tack Coat	GAL	5,455	$ 2.00	$ 10,910.00
P-620a	Temporary Runway and Taxiway Painting	SF	4,610	$ 0.75	$ 3,457.50
P-620b	Permanent Runway and Taxiway Painting	SF	4,610	$ 1.00	$ 4,610.00
D-701a	Underdrains	LF	2,410	$ 25.00	$ 60,250.00
L-108a	L-824C #8 AWG 5000V Cable	LF	3,300	$ 2.00	$ 6,600.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	1,755	$ 2.25	$ 3,948.75
L-110a	1-2" PVC Conduit (DEB)	LF	1,650	$ 8.50	$ 14,025.00
L-110c	4-3" PVC Conduit (CE)	LF	105	$ 40.00	$ 4,200.00
L-125d	New L-861T T/W Lights in L-867 Cans, Complete	EA	30	$ 1,000.00	$ 30,000.00
L-125i	New L-858 Guidance Sign (2-Module/Size 1)	EA	4	$ 4,500.00	$ 18,000.00
L-125j	New L-858 Guidance Sign (3-Module/Size 1)	EA	3	$ 6,400.00	$ 19,200.00
				SUBTOTAL	**$ 1,216,748.25**

Contingency (5%)	$ 60,837.41
Design Engineering	$ 46,423.58
Construction Management	$ 127,758.57
GRAND TOTAL	**$ 1,451,767.80**

Grand Junction Regional Airport
Grand Junction, Colorado

New Taxiway A8

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 115,257.17	$ 115,257.17
P-152a	Unclassified Excavation **(BP-2)**	CY	13,320	$ 6.50	$ 86,580.00
P-152a	Unclassified Excavation **(BP-3)**	CY	3,270	$ 7.50	$ 24,525.00
P-152b	Subgrade Preparation	SY	14,040	$ 1.75	$ 24,570.00
P-152c	Overexcavation	CY	8,867	$ 20.00	$ 177,333.33
P-209a	Crushed Aggregate Base Course	CY	6,815	$ 35.00	$ 238,525.00
P-310a	Stabilization Fabric	SY	9,335	$ 1.00	$ 9,335.00
P-310a	Stabilization Fabric (Top of Base Course)	SY	9,335	$ 1.00	$ 9,335.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	7,155	$ 50.00	$ 357,750.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	465	$ 750.00	$ 348,806.25
P-603a	Bituminous Tack Coat	GAL	6,770	$ 2.00	$ 13,540.00
P-620a	Temporary Runway and Taxiway Painting	SF	6,340	$ 0.75	$ 4,755.00
P-620b	Permanent Runway and Taxiway Painting	SF	6,340	$ 1.00	$ 6,340.00
D-701a	Underdrains	LF	2,220	$ 25.00	$ 55,500.00
L-108a	L-824C #8 AWG 5000V Cable	LF	2,720	$ 2.00	$ 5,440.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	1,520	$ 2.25	$ 3,420.00
L-110a	1-2" PVC Conduit (DEB)	LF	1,360	$ 8.50	$ 11,560.00
L-110c	4-3" PVC Conduit (CE)	LF	160	$ 40.00	$ 6,400.00
L-125d	New L-861T T/W Lights in L-867 Cans, Complete	EA	26	$ 1,000.00	$ 26,000.00
L-125i	New L-858 Guidance Sign (2-Module/Size 1)	EA	2	$ 4,500.00	$ 9,000.00
L-125j	New L-858 Guidance Sign (3-Module/Size 1)	EA	4	$ 5,500.00	$ 22,000.00
				SUBTOTAL	**$ 1,555,971.75**

Contingency	$	77,798.59
Design Engineering (%)	$	59,366.24
Construction Management (%)	$	163,377.03
GRAND TOTAL	**$**	**1,856,513.61**

Grand Junction Regional Airport
Grand Junction, Colorado

New Taxiway A9

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 88,617.90	$ 88,617.90
P-152a	Unclassified Excavation **(BP-2)**	CY	10,310	$ 6.50	$ 67,015.00
P-152a	Unclassified Excavation **(BP-3)**	CY	2,430	$ 7.50	$ 18,225.00
P-152b	Subgrade Preparation	SY	11,630	$ 1.75	$ 20,352.50
P-152c	Overexcavation	CY	6,650	$ 20.00	$ 133,000.00
P-209a	Crushed Aggregate Base Course	CY	5,270	$ 35.00	$ 184,450.00
P-310a	Stabilization Fabric	SY	6,925	$ 1.00	$ 6,925.00
P-310a	Stabilization Fabric (Top of Base Course)	SY	6,925	$ 1.00	$ 6,925.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	5,385	$ 50.00	$ 269,250.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	350	$ 750.00	$ 262,518.75
P-603a	Bituminous Tack Coat	GAL	5,110	$ 2.00	$ 10,220.00
P-620a	Temporary Runway and Taxiway Painting	SF	4,720	$ 0.75	$ 3,540.00
P-620b	Permanent Runway and Taxiway Painting	SF	4,720	$ 1.00	$ 4,720.00
D-701a	Underdrains	LF	1,980	$ 25.00	$ 49,500.00
L-108a	L-824C #8 AWG 5000V Cable	LF	2,260	$ 2.00	$ 4,520.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	1,270	$ 2.25	$ 2,857.50
L-110a	1-2" PVC Conduit (DEB)	LF	1,130	$ 8.50	$ 9,605.00
L-110c	4-3" PVC Conduit (CE)	LF	140	$ 40.00	$ 5,600.00
L-125d	New L-861T T/W Lights in L-867 Cans, Complete	EA	23	$ 1,000.00	$ 23,000.00
L-125i	New L-858 Guidance Sign (2-Module/Size 1)	EA	2	$ 4,500.00	$ 9,000.00
L-125j	New L-858 Guidance Sign (3-Module/Size 1)	EA	3	$ 5,500.00	$ 16,500.00
				SUBTOTAL	**$ 1,196,341.65**

Contingency (5%)	$ 59,817.08
Design Engineering	$ 45,644.99
Construction Management	$ 125,615.87
GRAND TOTAL	**$ 1,427,419.59**

JVIATION

Grand Junction Regional Airport
Grand Junction, Colorado

New Taxiway A Extension

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 137,679.10	$ 137,679.10
P-152a	Unclassified Excavation **(BP-2)**	CY	18,650	$ 6.50	$ 121,225.00
P-152a	Unclassified Excavation **(BP-3)**	CY	4,940	$ 7.50	$ 37,050.00
P-152b	Subgrade Preparation	SY	17,000	$ 1.75	$ 29,750.00
P-209a	Crushed Aggregate Base Course	CY	9,565	$ 35.00	$ 334,775.00
P-310a	Stabilization Fabric	SY	14,115	$ 1.00	$ 14,115.00
P-310a	Stabilization Fabric (Top of Base Course)	SY	14,115	$ 1.00	$ 14,115.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	10,310	$ 50.00	$ 515,500.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	670	$ 750.00	$ 502,612.50
P-603a	Bituminous Tack Coat	GAL	9,455	$ 2.00	$ 18,910.00
P-620a	Temporary Runway and Taxiway Painting	SF	9,810	$ 0.75	$ 7,357.50
P-620b	Permanent Runway and Taxiway Painting	SF	9,810	$ 1.00	$ 9,810.00
D-701a	Underdrains	LF	1,880	$ 25.00	$ 47,000.00
L-108a	L-824C #8 AWG 5000V Cable	LF	3,370	$ 2.00	$ 6,740.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	1,825	$ 2.25	$ 4,106.25
L-110a	1-2" PVC Conduit (DEB)	LF	1,685	$ 8.50	$ 14,322.50
L-110c	4-3" PVC Conduit (CE)	LF	140	$ 40.00	$ 5,600.00
L-125d	New L-861T T/W Lights in L-867 Cans, Complete	EA	27	$ 1,000.00	$ 27,000.00
L-125j	New L-858 Guidance Sign (3-Module/Size 1)	EA	2	$ 5,500.00	$ 11,000.00
				SUBTOTAL	**$ 1,858,667.85**

Contingency (5%)	$ 92,933.39
Design Engineering	$ 70,915.25
Construction Management	$ 195,160.12
GRAND TOTAL	**$ 2,217,676.62**

Grand Junction Regional Airport
Grand Junction, Colorado

Runup Pad

ITEM	ITEM DESCRIPTION	UNIT	Construct New Runway 11/29 QUANTITY	ENGINEER'S ESTIMATE UNIT $	ENGINEER'S ESTIMATE ITEM $
P-100a	Mobilization (8%)	EA	1	$ 159,466.29	$ 159,466.29
P-152a	Unclassified Excavation **(BP-2)**	CY	13,596	$ 6.50	$ 88,376.17
P-152a	Unclassified Excavation **(BP-3)**	CY	4,532	$ 7.50	$ 33,990.83
P-152b	Subgrade Preparation	SY	13,600	$ 1.75	$ 23,800.00
P-152c	Overexcavation	CY	13,533	$ 20.00	$ 270,666.67
P-209a	Crushed Aggregate Base Course	CY	8,725	$ 35.00	$ 305,375.00
P-310a	Stabilization Fabric	SY	14,005	$ 1.00	$ 14,005.00
P-310a	Stabilization Fabric (Top of Base Course)	SY	14,005	$ 1.00	$ 14,005.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	9,180	$ 50.00	$ 459,000.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	597	$ 750.00	$ 447,525.00
P-603a	Bituminous Tack Coat	GAL	5,440	$ 2.00	$ 10,880.00
P-620a	Temporary Runway and Taxiway Painting	SF	5,200	$ 0.75	$ 3,900.00
P-620b	Permanent Runway and Taxiway Painting	SF	5,200	$ 1.00	$ 5,200.00
D-701a	Underdrains	LF	1,800	$ 25.00	$ 45,000.00
L-108a	L-824C #8 AWG 5000V Cable	LF	450	$ 2.00	$ 900.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	330	$ 2.25	$ 742.50
L-110a	1-2" PVC Conduit (DEB)	LF	225	$ 8.50	$ 1,912.50
L-110c	4-3" PVC Conduit (CE)	LF	105	$ 40.00	$ 4,200.00
L-125h	New L-858 Guidance Sign (1-Module/Size 1)	EA	1	$ 3,500.00	$ 3,500.00
L-125i	New L-858 Guidance Sign (2-Module/Size 1)	EA	1	$ 4,500.00	$ 4,500.00
L-126a	Retroreflective Markers	EA	39	$ 150.00	$ 5,850.00
G-100a	Blast Deflectors	LS	1	$ 250,000.00	$ 250,000.00
				SUBTOTAL	**$ 2,152,794.96**

Contingency (5%)	$ 107,639.75
Design Engineering	$ 82,137.32
Construction Management	$ 226,043.47
GRAND TOTAL	**$ 2,568,615.50**

Grand Junction Regional Airport
Grand Junction, Colorado

New Runway 11/29: Construct Northern Perimeter Road and Fence

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	LS	1	$ 177,455.11	$ 177,455.11
P-140a	Place and Compact Rotomill Tailings (Perimeter Roads)	SY	7,496	$ 30.00	$ 224,888.89
P-151a	Clearing and Grubbing	AC	10.00	$ 1,200.00	$ 12,000.00
P-152a	Embankment	CY	175,000	$ 6.50	$ 1,137,500.00
D-701a	Install 36-Inch Reinforced Concrete Pipe	LF	200	$ 110.00	$ 22,000.00
D-701b	Install 36-Inch Concrete Flared End Section W/Trash Rack	EA	4	$ 1,750.00	$ 7,000.00
D-701c	Install 60-Inch Reinforced Concrete Pipe	LF	400	$ 165.00	$ 66,000.00
D-701d	Install 60-Inch Concrete Flared End Section W/Trash Rack	EA	4	$ 2,200.00	$ 8,800.00
F-162a	Install 8-Foot Chain-Link Fence with 3 Stranded Barbed Wire	LF	16,000	$ 25.00	$ 400,000.00
F-162b	Install 16-Foot Double Swing Gate (Manual)	EA	8	$ 2,500.00	$ 20,000.00
F-163a	Install Wildlife Deterrent Skirt	LF	16,000	$ 20.00	$ 320,000.00
				SUBTOTAL	**$ 2,395,644.00**

Contingency (5%)	$ 119,782.20
Design Engineering	$ 91,402.93
Construction Management	$ 251,542.62
GRAND TOTAL	**$ 2,858,371.75**

JVIATION

Grand Junction Regional Airport
Grand Junction, Colorado

Convert Existing R/W 11/29 to T/W A

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	LS	1	$ 92,492.00	$ 92,492.00
P-140a	Ashpalt Concrete Pavement Removal (Full Depth)	SY	110,000	$ 10.00	$ 1,100,000.00
P-152a	Embankment	CY	55,000	$ 10.00	$ 550,000.00
P-603a	Fog Seal	GAL	13,200	$ 3.00	$ 39,600.00
P-620a	Temporary Pavement Markings	SF	36,000	$ 0.75	$ 27,000.00
P-620b	Permanent Pavement Markings	SF	36,000	$ 1.00	$ 36,000.00
P-620c	Obliterate Existing Runway Markings	SF	105,000	$ 1.00	$ 105,000.00
L-108a	L-824C #8 AWG 5000V Cable	LF	37,200	$ 2.00	$ 74,400.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	18,600	$ 2.25	$ 41,850.00
L-109a	Constant Current Regulator	EA	2	$ 17,000.00	$ 34,000.00
L-110a	1-2" PVC Conduit (DEB)	LF	18,600	$ 15.00	$ 279,000.00
L-125b	New L-861 R/W Light on L-867 Can, Complete	EA	1	$ 1,000.00	$ 1,000.00
L-125d	New L-861T T/W Light on L-867 Cans, Complete	EA	217	$ 1,000.00	$ 217,000.00
L-125e	Remove Existing T/W or R/W light	EA	183	$ 200.00	$ 36,600.00
L-125f	New L-867 Junction Can	EA	2	$ 800.00	$ 1,600.00
L125g	Remove Existing Junction Box	EA	20	$ 150.00	$ 3,000.00
L-125h	New L-858 Guidance Sign (1-Module/Size 1)	EA	1	$ 3,500.00	$ 3,500.00
L-125i	New L-858 Guidance Sign (2-Module/Size 1)	EA	4	$ 4,500.00	$ 18,000.00
L-125j	New L-858 Guidance Sign (3-Module/Size 1)	EA	39	$ 5,500.00	$ 214,500.00
L-125l	Install New Panels in Existing Guidance Sign	EA	11	$ 500.00	$ 5,500.00
L-125m	Remove Existing Guidance Sign	EA	39	$ 400.00	$ 15,600.00
L-125p	Remove Existing PAPI	LS	1	$ 3,000.00	$ 3,000.00
				SUBTOTAL	**$ 2,898,642.00**

Contingency (5%)	$ 144,932.10
Design Engineering	$ 110,594.22
Construction Management	$ 304,357.41
GRAND TOTAL	**$ 3,458,525.73**

Grand Junction Regional Airport
Grand Junction, Colorado

RTR Relocation

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 80,000.00	$ 80,000.00
L-400e	Relocate RTR	LS	1	$ 1,000,000.00	$ 1,000,000.00
				SUBTOTAL	**$ 1,080,000.00**

Contingency (5%)	$ 54,000.00
Design Engineering	$ 100,000.00
Construction Management	$ 113,400.00
GRAND TOTAL	**$ 1,347,400.00**

JVIATION®

Grand Junction Regional Airport
Grand Junction, Colorado

NAVAID for New Runway

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 136,800.00	$ 136,800.00
L-125n	New REIL System	LS	1	$ 40,000.00	$ 40,000.00
L-125o	New MALSR System	LS	1	$ 800,000.00	$ 800,000.00
L-400a	Relocate ILS (Localizer and Glideslope)	LS	1	$ 500,000.00	$ 500,000.00
L-400b	Relocate LDA	LS	1	$ 250,000.00	$ 250,000.00
L-400d	New PAPI system	EA	2	$ 60,000.00	$ 120,000.00
				SUBTOTAL	**$ 1,846,800.00**

Contingency (5%)	$ 92,340.00
Design Engineering	$ 100,000.00
Construction Management	$ 193,914.00
GRAND TOTAL	**$ 2,233,054.00**

Grand Junction Regional Airport
Grand Junction, Colorado

New Taxiway A4 High Speed

ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	Construct New Runway 11/29 ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 201,517.53	$ 201,517.53
P-151a	Clearing and Grubbing	AC	9	$ 1,200.00	$ 10,800.00
P-152a	Unclassified Excavation	CY	21,610	$ 7.00	$ 151,270.00
P-152a	Unclassified Excavation **(BP-3)**	CY	5,370	$ 7.00	$ 37,590.00
P-152b	Subgrade Preparation	SY	22,310	$ 2.00	$ 44,620.00
P-152c	Overexcavation	CY	9,858	$ 20.00	$ 197,166.67
P-209a	Crushed Aggregate Base Course	CY	11,060	$ 40.00	$ 442,400.00
P-310a	Stabilization Fabric	SY	15,335	$ 2.00	$ 30,670.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	11,825	$ 65.00	$ 768,625.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	770	$ 800.00	$ 616,000.00
P-603a	Bituminous Tack Coat	GAL	11,215	$ 2.00	$ 22,430.00
P-620a	Temporary Runway and Taxiway Painting	SF	10,400	$ 0.75	$ 7,800.00
P-620b	Permanent Runway and Taxiway Painting	SF	10,400	$ 1.00	$ 10,400.00
D-701a	Underdrrains	LF	3,070	$ 25.00	$ 76,750.00
L-108a	L-824C #8 AWG 5000V Cable	LF	5,000	$ 2.00	$ 10,000.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	2,710	$ 2.25	$ 6,097.50
L-110a	1-2" PVC Conduit (DEB)	LF	2,500	$ 8.50	$ 21,250.00
L-110c	4-3" PVC Conduit (CE)	LF	210	$ 40.00	$ 8,400.00
L-125d	New L-861T T/W Lights in L-867 Cans, Complete	EA	41	$ 1,000.00	$ 41,000.00
L-125i	New L-858 Guidance Sign (2-Module/Size 1)	EA	1	$ 4,500.00	$ 4,500.00
L-125j	New L-858 Guidance Sign (3-Module/Size 1)	EA	4	$ 5,500.00	$ 22,000.00
				SUBTOTAL	**$ 2,731,286.70**

Contingency	$ 136,564.34
Design Engineering (est.)	$ 229,428.08
Construction Management (est.)	$ 286,785.10
GRAND TOTAL	**$ 3,384,064.22**

Grand Junction Regional Airport
Grand Junction, Colorado

New Taxiway A6 High Speed

			Construct New Runway 11/29		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	EA	1	$ 201,779.53	$ 201,779.53
P-151a	Clearing and Grubbing	AC	9	$ 1,200.00	$ 10,800.00
P-152a	Unclassified Excavation	CY	21,610	$ 3.50	$ 75,635.00
P-152b	Subgrade Preparation	SY	22,310	$ 2.00	$ 44,620.00
P-152c	Overexcavation	CY	14,583	$ 20.00	$ 291,666.67
P-209a	Crushed Aggregate Base Course	CY	11,060	$ 40.00	$ 442,400.00
P-310a	Stabilization Fabric	SY	15,335	$ 2.00	$ 30,670.00
P-401a	Bituminous Paving Course (3/4" Mix)	TON	11,825	$ 65.00	$ 768,625.00
P-401b	Modified Bituminous Material (PG 64-28)	GAL	770	$ 800.00	$ 616,000.00
P-603a	Bituminous Tack Coat	GAL	11,215	$ 2.00	$ 22,430.00
P-620a	Temporary Runway and Taxiway Painting	SF	10,400	$ 0.75	$ 7,800.00
P-620b	Permanent Runway and Taxiway Painting	SF	10,400	$ 1.00	$ 10,400.00
D-705a	Install 6-Inch Perforated Polyethylene Pipe Underdrain	LF	3,070	$ 25.00	$ 76,750.00
D-705b	Install 6-Inch Non-Perforated Polyethylene Pipe Underdrain	LF	200	$ 18.00	$ 3,600.00
D-751b	Install Underdrain Cleanout	EA	8	$ 1,800.00	$ 14,400.00
D-751c	Install Inspection Pit	EA	2	$ 4,000.00	$ 8,000.00
L-108a	L-824C #8 AWG 5000V Cable	LF	5,000	$ 2.00	$ 10,000.00
L-108b	Bare #6 AWG Solid Counterpoise Conductor	LF	2,710	$ 2.25	$ 6,097.50
L-110a	1-2" PVC Conduit (DEB)	LF	2,500	$ 8.50	$ 21,250.00
L-110c	4-3" PVC Conduit (CE)	LF	210	$ 40.00	$ 8,400.00
L-125d	New L-861T T/W Lights in L-867 Cans, Complete	EA	37	$ 1,000.00	$ 37,000.00
L-125i	New L-858 Guidance Sign (2-Module/Size 1)	EA	1	$ 4,500.00	$ 4,500.00
L-125j	New L-858 Guidance Sign (3-Module/Size 1)	EA	4	$ 5,500.00	$ 22,000.00
				SUBTOTAL	**$ 2,734,823.70**

Contingency	$ 136,741.19
Design Engineering (est.)	$ 229,725.19
Construction Management (est.)	$ 287,156.49
GRAND TOTAL	**$ 3,388,446.56**

Grand Junction Regional Airport
Grand Junction, Colorado

Realign County 27 1/4 Road

			Construct 27 1/4 Road Option		
ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	ENGINEER'S ESTIMATE	
				UNIT $	ITEM $
P-100a	Mobilization (8%)	LS	1	$ 194,544.00	$ 194,544.00
P-140a	Asphalt Pavement Removal	SY	10,450	$ 16.00	$ 167,200.00
P-151a	Clearing and Grubbing	AC	16.00	$ 1,200.00	$ 19,200.00
P-152a	Unclassified Excavation	CY	60,000	$ 10.00	$ 600,000.00
P-152b	Subgrade Preparation	SY	28,600	$ 3.00	$ 85,800.00
P-304a	Class 6 Base Course	TON	7,100	$ 25.00	$ 177,500.00
P-304b	Class 6 Base Course (Shoulder)	TON	2,580	$ 25.00	$ 64,500.00
P-304c	Median Cover Material	SY	290	$ 150.00	$ 43,500.00
P-403a	Hot Bituminous Pavement	TON	7,540	$ 110.00	$ 829,400.00
P-407a	Bituminous Tack Coat	GAL	3,820	$ 2.00	$ 7,640.00
P-407b	Paint	SF	10,300	$ 2.00	$ 20,600.00
D-701a	Install 36-Inch Reinforced Concrete Pipe	LF	200	$ 110.00	$ 22,000.00
D-701b	Install 36-Inch Concrete Flared End Section W/Trash Rack	EA	4	$ 1,750.00	$ 7,000.00
D-701c	Install 60-Inch Reinforced Concrete Pipe	LF	400	$ 165.00	$ 66,000.00
D-701d	Install 60-Inch Concrete Flared End Section W/Trash Rack	EA	4	$ 2,200.00	$ 8,800.00
D-713a	Traffic Signs	SF	20	$ 100.00	$ 2,000.00
D-713b	Mile Marker Signs	SF	12	$ 250.00	$ 3,000.00
D-713c	Reflectors	EA	34	$ 200.00	$ 6,800.00
D-714d	Guardrail	LF	2,600	$ 15.00	$ 39,000.00
D-754a	Portland Cement Curb and Gutter	LF	680	$ 17.00	$ 11,560.00
F-162a	Install 8-Foot Chain-Link Fence with 3 Stranded Barbed Wire	LF	8,000	$ 25.00	$ 200,000.00
F-162b	Install 16-Foot Double Swing Gate (Manual)	EA	3	$ 2,500.00	$ 7,500.00
F-163a	Install Wildlife Deterrent Skirt	LF	8,000	$ 20.00	$ 160,000.00
U-801a	Utility Adjustments	LS	1	$ 50,000.00	$ 50,000.00
				SUBTOTAL	**$ 2,793,544.00**

Contingency (5%)	$ 139,677.20
Design Engineering	$ 234,657.70
Construction Management	$ 293,322.12
GRAND TOTAL	**$ 3,461,201.02**

APPENDIX D

Geotechnical Investigation Report

Preliminary Geotechnical Subsurface Exploration Program
Proposed New Runway 11/29
Grand Junction Regional Airport
Grand Junction, Colorado



Prepared for:

JVIATION
900 South Broadway, Suite 300
Denver, Colorado 80209

Attention: Mr. Jason Virzi

Job Number: 11-6016 **March 13, 2012**

GROUND
ENGINEERING CONSULTANTS INC.
379 Indian Road, Grand Junction, CO 81501 Phone (970) 242-4300 Fax (970) 242-4301 www.groundeng.com
Office Locations: Englewood • Commerce City • Loveland • Granby • Gypsum • Grand Junction • Casper

TABLE OF CONTENTS

Page

Purpose and Scope of Study 1
Proposed Construction 2
Site Conditions 2
Geologic Setting 3
Geologic Hazards 4
Subsurface Exploration 6
Laboratory Testing 8
Subsurface Conditions 9
Water-Soluble Sulfates 11
Soil Corrosivity 12
Project Earthwork Considerations 15
Preliminary Pavement Design Parameters 22
Additional Exploration Requirements 23
Closure 23
Locations of Test Holes ..... Figure 1a & 1b
Logs of Test Holes ..... Figure 2-7
Logs of Coring Test Holes ..... Figure 8-14
Legend and Notes ..... Figure 15-16
Swell-Consolidation Test Results ..... Figures 17-24
Gradation/Hydrometer Test Results ..... Figures 25-29
Modified Proctor Compaction Test Report ..... Figures 30-33
California Bearing Ratio (CBR) Test Results ..... Figures 34-37
Summary of Laboratory Test Results ..... Table 1
Summary of CBR Test Results ..... Table 2
Summary of Soil Corrosion Test Results ..... Table 3
Preliminary Geologic Cross Section ..... Appendix A
Photographs of Core Samples ..... Appendix B
Photographs of 'Slake' Testing ..... Appendix C

PURPOSE AND SCOPE OF STUDY

This report presents the results of a preliminary subsurface exploration program performed by GROUND Engineering Consultants, Inc. (GROUND) to provide preliminary geotechnical recommendations, pavement design considerations, and material borrow source information for the proposed new Runway 11/29 to be located north of the existing Runway 11/29 within the Grand Junction Regional Airport in Grand Junction, Colorado. Our study was conducted in general accordance with GROUND's Proposal No. 1108-1232, dated August 30, 2011.

Field and office studies provided information regarding surface and subsurface conditions, including depths to bedrock, preliminary bedrock types, and groundwater. Material samples retrieved during the subsurface exploration were tested in our laboratory to assess the engineering characteristics of the site earth materials, and assist in the development of our preliminary geotechnical recommendations. Results of the field, office, and laboratory studies are presented below.

This report has been prepared to summarize the data obtained and to present our preliminary conclusions and recommendations based on the proposed runway relocation and the subsurface conditions encountered. Preliminary design considerations and a discussion of engineering items related to the proposed construction are included herein.



GROUND previously completed subsurface exploration and geotechnical reports for the Grand Junction Regional Airport for projects including; *AIP # 3-08-0027-39 (Job No. 09-6000, dated January 23, 2009), Rental Car Service Facility #GJT-LOC-09-01 (Job No. 09-6006, dated April 6, 2009), Commercial Ramp Reconstruction AIP #3-08-0027-42 (Job No. 09-6024, dated November 16, 2009), and ARFF/SRE Drilled Pier Evaluation (Job No. 10-6007, dated March 3, 2010).*

PROPOSED CONSTRUCTION

We understand that the proposed improvements will include the construction of a new concrete or asphalt runway located north of the existing Runway 11/29, including connecting taxiways, at the Grand Junction Regional Airport in Grand Junction, Colorado. Additionally, construction will involve significant earthwork operations including material cuts up to 65 feet into adjacent slopes to the north and up to approximately 35 feet of fill in western areas of the proposed runway. Please note that within this report, the term "fill" pertains to both previously/historically placed materials and future materials placed in a moisture-density treated state. As the proposed design and construction is determined, additional exploration should be undertaken to further evaluate the preliminary recommendations contained herein.

SITE CONDITIONS



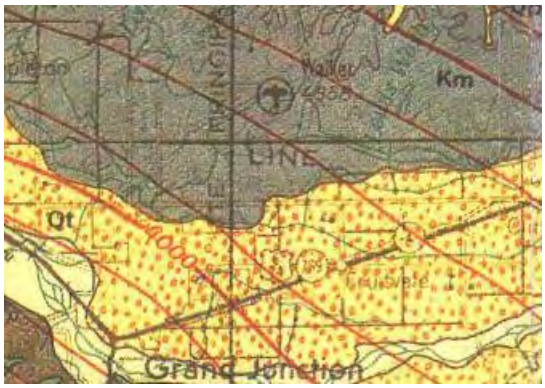
The project area for the new runway is located within the confines of The Grand Junction Regional Airport property, bounded to the north by public lands managed by the Bureau of Land Management. The general topography of the existing runway is relatively flat with overall slopes of approximately 1 percent descending towards the southwest. Hillsides to the north are moderately and steeply sloping 'badlands' areas generally devoid of vegetation with steep-sided drainage channels. Hillsides adjacent to the existing runway are sloped back to the north at 3:1 (H):(V) or steeper. Rainfall erosion of cut slopes was observed throughout the site. Indications of underground utilities were also observed at the project site.



As indicated in various sections of this report, man-made fill was encountered in some of the test holes. The exact extents, limits, and composition of the man-made fill were not determined as part of the scope of work addressed by this study, and should be expected to exist at varying depths and locations across the site.

GEOLOGIC SETTING

The subject parcel lies on the margin between the Uncompahgre Uplift geologic province to the southwest and the Piceance Basin to the northeast. In the general project area, these provinces consist of sedimentary rocks that generally dip northeastward at low to moderate angles (5 to 15 degrees, typically) and are overlain by a variety of surficial deposits including alluvial (stream-laid) sediments, eolian (wind-blown) materials and colluvial (slope-wash) deposits.



Published maps, e.g. Scott and others (2002)[1] depict the site as underlain by upper Pleistocene to Holocene alluvial / colluvial sediments. At the project site surficial soil thickness is quite variable, even non-existent in some areas with bedrock material at the surface. The surficial soils are mapped as underlain by interbedded strata of the upper Cretaceous Mancos Shale formation. In the Grand Junction area, the Mancos Shale consists of a thick sequence of clay and silt shales with thin sandstones. The shales typically are moderately to highly expansive. The bedrock strata typically dip (are tilted) northeastward at shallow angles. At the project site, and for the purposes of this exploration, the Mancos Shale has been separated into three zones: highly weathered to weathered, competent, and competent hard. Descriptions of these zones are discussed within this report.



[1] Scott, R.B., P.E. Carrara, W.C. Hood, and K.E. Murray, 2002, *Geologic Map of the Grand Junction Quadrangle, Mesa County, Colorado*, U.S. Geological Survey Miscellaneous Field Studies Map MF-2363.

GEOLOGIC HAZARDS

Expansive Soils As discussed in the *Subsurface Conditions* section of this report, the shallow earth materials underlying the site include sand, clay, silt, claystone and shale bedrock. Swelling, clayey soils and bedrock change volume in response to changes in moisture content. This can occur seasonally, or in response to changes in land use, including development. Expansion potentials vary with moisture contents, density and details of the clay chemistry and mineralogy. The swell potential in any particular area can vary markedly both laterally and vertically due to the complex interbedding of the site soil and bedrock materials. Moisture changes also occur erratically, resulting in conditions that cannot always be predicted.

The site soils were generally low to highly plastic (see Table 1). Swell-consolidation testing indicated relatively low to high potentials for expansion in the overburden soils and bedrock. There is some risk involved where asphalt/concrete is placed on these types of materials. However, with appropriate geotechnical design, properly implemented during construction, the proposed runway appears feasible with regard to expansive earth materials.

Collapsible Soils Certain surficial deposits along the western slope areas of Colorado, typically eolian (wind-blown) materials including loess, are known to be susceptible to local hydro-consolidation or "collapse." Hydro-consolidation consists of a significant volume loss due to re-structuring of the constituent grains of the soil to a more compact arrangement upon wetting under a surcharge load.

Site surficial soils are interpreted to be windblown and loess materials and the index parameters for the majority of the site soils assessed for this study did not fall into the range typically associated with collapsible soils (e.g. Naval Facilities Engineering Command, 1986)[2]. Swell-consolidation testing indicated potentials for hydro-consolidation in the shallow soils and fill areas. Therefore, the likelihood of encountering collapsible soils on the subject site is considered low to moderate overall and low at any specific location, given the grading proposed for the site.

[2] Naval Facilities Engineering Command, 1986, *Design Manual 7.1, Soil Mechanics*, 40 pp.

Seismic Activity / Faulting Neither limited site reconnaissance nor review of available geologic maps indicated the trace of an active or potentially active fault traversing or immediately adjacent to the site. Therefore, the likelihood of surface fault rupture at the site is considered to be low.

The largest recorded earthquake (estimated magnitude 6.2 to 6.6) in Colorado occurred in November 1882. While the specific location of this earthquake is very uncertain, it is postulated to have occurred in the Front Range near Rocky Mountain National Park. The most recent significant seismic movements associated with the Rocky Mountain Arsenal Fault (Commerce City, Colorado) occurred in the 1960s, generating earthquakes up to magnitude 5.5. Since the early 1960s, numerous earthquakes with magnitudes up to approximately 5, with the majority possessing magnitudes of 2 to 4, have been experienced within the State. Recently, earthquakes ranging in magnitude from 3.7 (Craig, Colorado) to 3.9 (Eads, Colorado and Trinidad, Colorado) occurred during the time period of July, 2009 through August, 2009. Earthquakes with similar magnitudes, and potentially greater, are anticipated to continue by the USGS, throughout the State. The risk of damaging, earthquake-induced ground motions at the site is considered to be relatively low given the low, previously recorded, seismic magnitudes. Furthermore, based on the subsurface conditions at the site and the risks associated with this nearest fault, the risk of liquefaction of the site soils is considered low.

Slope Stability and Erosion Geologic maps providing coverage of the site that were reviewed for this study, did not depict landslide deposits on or adjacent to the subject site.

As noted in the *Site Conditions* section of this report, the site is graded relatively flat with slopes to the north moderately and steeply sloping ‘badlands’ areas generally devoid of vegetation with steep-sided drainage channels. During our preliminary reconnaissance of the site area, evidence was noted of slope-wash and minor mass-wasting processes associated with steep slopes devoid of vegetation.

Flooding The subject property is located south of several small tributary drainages. All drainages were dry at the time of our exploration, however, significant fluctuation in flow of these drainages can be expected during seasonal run and periods of intense rainfall.

The site is not depicted on the Urban Drainage Floodplain data map[3] as lying within a flood-prone area, however an intense thunderstorm in late Summer of 2011 reportedly nearly overtopped the storm drainage culvert at the southwest corner of the runway area. Drainage issues including slope-wash and flash flooding events should be incorporated into runway design by a qualified hydrological engineer.

Wetlands Potential According to the U.S. Fish and Wildlife Service[4], the project site does not include any designated wetland areas. Explicit designation of wetland areas is not within our scope of service.

Mining Activity and Subsidence Review of U.S. Geological Survey topographic maps covering the site did not indicate past mining activities on the subject parcel. However, coal and other mining operations do exist in the surrounding areas. Indications of mining operations were not observed on-site during our exploration program.

Published geologic maps do not indicate formations underlying the site at shallow depths that include evaporite (salt, gypsum, etc.) deposits, limestones or other materials vulnerable to subsurface dissolution. Therefore, the likelihood of subsidence or other mining-related hazards appears to be low.

SUBSURFACE EXPLORATION

Drilling



As requested by JVIATION and outlined in the Request For Proposal (RFP), ten (10) locations were drilled within the proposed runway and ten (10) locations were drilled within borrow source areas with a truck-mounted, continuous flight power auger rig to preliminarily evaluate the subsurface conditions as well as to retrieve soil and bedrock samples for laboratory testing and analysis. Two (2)

[3] FEMA, Urban Drainage Flood Control District, www.udfcd.org
[4] U.S. Fish and Wildlife Service, National Wetlands Inventory, May 20, 2010, www.fws.gov/wetlands

test holes included in the runway study were drilled within proposed taxiway areas. The test holes were advanced to depths of approximately 9 to 40 feet below existing grades. At the request of Jviation, a preliminary geologic cross-section for the borrow source area is provided in Appendix A.

Coring



Three test holes in the proposed borrow source area were advanced to depths between approximately 40 and 55 feet using air-rotary coring with diamond-impregnated, 4-inch diameter core bits. Representative core recovery materials were photographed and are displayed in Appendix B.

A representative of GROUND directed the subsurface exploration, logged the test holes in the field, and prepared the soil and bedrock samples for transport to our laboratory.

Additionally, PVC pipe was placed in Test Hole TH-60 where groundwater was encountered to assist in future observation of groundwater levels. GROUND will continue to perform on-site readings on a limited monthly basis.

Samples of the subsurface materials were retrieved with a 2-inch I.D. California liner and a 1⅜-inch I.D. Standard Penetration Test ("split spoon") sampler. The samplers were driven into the substrata with blows from a 140-pound hammer falling 30 inches. This procedure is similar to the Standard Penetration Test described by ASTM Method D1586. Penetration resistance values, when properly evaluated, indicate the relative density or consistency of soils. In addition, large disturbed samples were obtained from the auger cuttings for compaction and CBR testing. Depths at which the samples were obtained and associated penetration resistance values are shown on the test hole logs.

The approximate locations of the test holes are shown in Figures 1a and 1b. Logs of the exploratory test holes are presented in Figures 2 through 7, with core logs presented in Figures 8 through14. Explanatory notes and a legend are provided in Figures 15 and 16.

Test Holes were surveyed in the field with location and elevation by River City Consultants.

LABORATORY TESTING

Samples obtained from the exploratory holes were examined and classified in the laboratory by the project engineer. The following laboratory testing was performed in general accordance with the test standard shown:

- Grading Analysis Curves — AASHTO T 27
- Atterberg Limits — ASTM D 4318
- Soil Classification — ASTM D 2487 / AASHTO M 145
- Moisture Density Curves — ASTM D 698, 1557
- Natural Moisture/Density — AASHTO T 265 and T 204
- Percent Passing No. 200 sieve — ASTM C 117 / AASHTO T 11
- Sulfate Tests — AASHTO T 290
- Swell / Consolidation Tests — ASTM D 4546
- Hydrometer Tests — ASTM D 422
- Durability of Shales (Slake) — CP-L 3104 (Colorado Method A)

Additionally, pH and corrosivity tests were completed on selected samples of the soils as well. Compaction and California Bearing Ratio (CBR) ASTM D 1883 tests were performed on the representative composite bulk samples.

It should be noted that it is not possible to characterize coarse gravel-, cobble- and boulder-sized material fragments in small diameter test holes. Therefore, those relying on this report should anticipate that coarser materials than recognized herein may be present in the soils at this site. Gradations are representative of recovered materials and may not represent actual field conditions.

Slake-durability testing was performed in accordance to observe bedrock competency after being submersed in water over a period of time. Slake-durability testing on shale is a procedure to classify shales as soil-like (non-durable) or rock-like (durable). Methodology generally followed Colorado testing procedure 3104 (26-90) but was not all-inclusive. The general descriptive behavior (3104-6.1) was followed for this report. Representative core recovery samples for 'slake' testing were photographed and are displayed in Appendix C.

Results of the laboratory testing program are summarized on Tables 1, 2, and 3. Results of the swell-consolidation tests, gradation/hydrometer tests, compaction testing (Proctor) and CBR test data are plotted on Figures 17 to 37.

The laboratory testing was conducted in general accordance with applicable ASTM and AASHTO specifications.

California Bearing Ratio (CBR)

Representative samples of the subgrade soils were tested to evaluate their subgrade support properties for use in pavement design. Composite samples of the materials were remolded to varying percentages of the modified Proctor density (ASTM D-1557) near the optimum moisture content. The compaction test results are shown in Figures 30 to 33.

CBR testing (ASTM D-1883) was performed on remolded samples after being submerged in water for a period of 96 hours. The CBR test is a penetration test wherein a standard 3-square-inch piston penetrates the soil at a rate of 0.05 inches per minute. The CBR value is the ratio of the test load to a standard unit load and is an indication of the strength of the soil. It is empirically related to the required thickness of the pavement structure for a given traffic load.

The CBR testing for the shale subgrade materials within the runway indicated a CBR value of 9.0 at approximately 95 percent of the maximum modified dry density. The CBR testing for the clay subgrade materials within the runway indicated a value of 2.9 at approximately 95 percent of the maximum modified dry density. The CBR testing for the shale borrow source materials indicated a value of 1.5 at approximately 95 percent of the maximum modified dry density. The CBR testing for the clay borrow source

materials indicated a value of 6.4 at approximately 95 percent of the maximum modified dry density. Following additional exploration and testing, and as the design proceeds, specific design CBR data can be further evaluated and recommendations made based on material types selected for construction. Results of CBR testing are presented in Figures 34 to 37.

SUBSURFACE CONDITIONS

The subsurface conditions encountered in test holes within the proposed Runway 11/29, connecting taxiways, and borrow source areas generally consisted of a layer of variable thickness of overburden soils consisting of low to high plasticity sandy silts and clays overlying Mancos Shale bedrock. No significant thickness of topsoil was observed at the site. Man-placed fill was observed in Test Hole 24 for the existing airport runway, and discarded asphalt fill was observed in Test Hole 10. The test holes were extended to the test hole termination depth of approximately 9 to 55 feet below the existing grades.

Groundwater was encountered in Test Hole 60 at a depth of approximately 36 feet below existing grade at the time of drilling, and 29 feet when checked 10 days later. Groundwater levels can be expected to fluctuate, however, in response to annual and longer-term cycles of precipitation, irrigation, surface drainage, land use, and the development of transient, perched water conditions.

Man-Made Fill was comprised of sandy clay and occasional gravel, was fine to medium grained, medium to highly plastic, moist to very moist, occasionally calcareous, and brown in color. A section of fill observed in Test Hole 10 was discarded asphalt. The tested fill materials generally classified as CL materials.

Sand and Clay consisted of stratified layers of interbedded sands and silty clays, fine to medium grained sand, low to highly plastic, slightly moist to moist, stiff to very stiff/medium dense to dense, and tan to brown in color. The tested sand and clay materials generally classified as SC and CL materials.

Shale Bedrock was slightly sandy, fine to medium grained, highly plastic, moist, medium hard to hard, grey in color, and occasionally iron stained with clay and calcite infilling. Bedrock consists of the Mancos Shale Member. Shale lithology consists of interbedded layers of claystone, sandstone, and highly weathered shale as well as

competent shale. The tested claystone and weathered shale materials generally classified as CL and CH. A representative tested sample of interbedded claystone materials exibited unconfined compressive strengths between 16,320 and 28,257 psf (pounds per square foot). Representative tested samples of weathered shale materials exhibited unconfined compressive strengths between 6,540 and 17,554 psf (pounds per square foot). The tested interbedded sandstone materials generally classified as SM and ML materials. A representative tested sample of sandstone/siltstone materials exhibited an unconfined compressive strength of 14,250 psf (pounds per square foot). The tested competent shale materials generally classified as CL-CH materials. Representative tested samples of competent shale materials exhibited unconfined compressive strengths between 13,579 and 25,380 psf (pounds per square foot).

Competent Hard Shale Bedrock was slightly sandy, fine to medium grained, highly plastic, moist, hard to very hard, brown in color, and occasionally iron stained with clay and calcite infilling. The tested competent hard shale materials generally classified as CL materials. A representative tested sample of competent hard shale material exhibited an unconfined compressive strength of 534,240 psf (pounds per square foot).

Swell-consolidation testing indicated a low to severe potential for heave in the tested on-site materials. Swells ranging from approximately 1.1 to 6.2 percent and consolidations of approximately 2.0 to 3.7 percent were measured against a 250 psf surcharge load (Table 1).

A detailed environmental study was not included as a work-scope item addressed by this study. During drilling operations, GROUND did not observe any conditions in the subsurface, such as staining or odors, that would obviously indicate contamination.

WATER-SOLUBLE SULFATES

The concentrations of water-soluble sulfates measured in selected samples retrieved from the test holes ranged from approximately .07 to 0.16 percent by weight (See Table 2). Such concentrations of soluble sulfates represent a moderate environment for sulfate attack on concrete exposed to these materials. Degrees of attack are based on the scale of 'negligible,' 'moderate,' 'severe' and 'very severe' as described in the “Design and Control of Concrete Mixtures,” published by the Portland Cement Association (PCA). The Colorado Department of Transportation (CDOT) utilizes a corresponding

scale with 4 classes of severity of sulfate exposure (Class 0 to Class 3) as described in the published table below.

REQUIREMENTS TO PROTECT AGAINST DAMAGE TO CONCRETE BY SULFATE ATTACK FROM EXTERNAL SOURCES OF SULFATE

Severity of Sulfate Exposure	**Water-Soluble Sulfate (SO_4) In Dry Soil** *(%)*	**Sulfate (SO_4) In Water** *(ppm)*	**Water Cementitious Ratio** *(maximum)*	**Cementitious Material Requirements**
Class 0	0.00 to 0.10	0 to 150	0.45	Class 0
Class 1	0.11 to 0.20	151 to 1500	0.45	Class 1
Class 2	0.21 to 2.00	1501 to 10,000	0.45	Class 2
Class 3	2.01 or greater	10,001 or greater	0.40	Class 3

Based on our test results and PCA and CDOT guidelines, GROUND recommends use of sulfate-resistant cement in all concrete exposed to site soil and bedrock, conforming to one of the following Class 1 requirements:

(1) ASTM C 150 Type II or V; Class C fly ash shall not be substituted for cement.

(2) ASTM C 595 Type IP(MS) or IP(HS); Class C fly ash shall not be substituted for cement.

(3) ASTM C 1157 Type MS or HS; Class C fly ash shall not be substituted for cement.

(4) When ASTM C 150 Type III cement is allowed, as in Class E concrete, it shall have no more than 8 percent C_3A. Class C fly ash shall not be substituted for cement.

When fly ash is used to enhance sulfate resistance, it shall be used in a proportion greater than or equal to the proportion tested in accordance to ASTM C 1012, shall be the same source and it shall have a calcium oxide content no more than 2.0 percent greater than the fly ash tested according to ASTM C 1012.

In addition, all concrete used should have a minimum compressive strength of 4,000 psi.

The contractor should be aware that certain concrete mix components affecting sulfate resistance including, but not limited to, the cement, entrained air, and fly ash, can affect workability, set time, and other characteristics during placement, finishing and curing. The contractor should develop mix(es) for use in project concrete which are suitable with regard to these construction factors, as well as sulfate resistance. A reduced, but still significant, sulfate resistance may be acceptable to the owner, in exchange for desired construction characteristics.

SOIL CORROSIVITY

The degree of risk for corrosion of metals in contact with soils commonly is considered to be in two categories: corrosion in undisturbed soils and corrosion in disturbed soils. The potential for corrosion in undisturbed soil is generally low, regardless of soil types and conditions, because it is limited by the amount of oxygen that is available to create an electrolytic cell. In disturbed soils, the potential for corrosion typically is higher, but is strongly affected by soil conditions for a variety of reasons but primarily soil chemistry.

A corrosivity analysis was performed to provide a general assessment of the potential for corrosion of ferrous metals installed in contact with earth materials at the site, based on the conditions existing at the time of GROUND's evaluation. Soil chemistry and physical property data including pH, oxidation-reduction (redox) potential, sulfides, and moisture content were obtained. Test results are summarized on Table 2.

Soil Resistivity In order to assess the "worst case" for mitigation planning, samples of materials retrieved from the test holes were tested for resistivity in the in the laboratory, after being saturated with water, rather than in the field. Resistivity also varies inversely with temperature. Therefore, the laboratory measurements were made at a controlled temperature.

Measurements of electrical resistivity indicated values ranging from approximately 1,298 to 22,381 ohm-centimeters in four samples of retrieved soil. The following table presents the relationship between resistivity and a qualitative corrosivity rating[5]:

[5] ASM International, 2003, *Corrosion: Fundamentals, Testing and Protection,* ASM Handbook, Volume 13A.

Corrosivity Ratings Based on Soil Resistivity

Soil Resistivity (ohm-cm)	*Corrosivity Rating*
>20,000	Essentially non-corrosive
10,000 – 20,000	Mildly corrosive
5,000 – 10,000	Moderately corrosive
3,000 – 5,000	Corrosive
1,000 – 3,000	Highly corrosive
<1,000	Extremely corrosive

pH Where pH is less than 4.0, soil serves as an electrolyte; the pH range of about 6.5 to 7.5 indicates soil conditions that are optimum for sulfate reduction. In the pH range above 8.5, soils are generally high in dissolved salts, yielding a low soil resistivity[6]. Testing indicated pH values ranging from approximately 7.2 to 7.8.

The American Water Works Association (AWWA) has developed a point system scale used to predict corrosivity. The scale is intended for protection of ductile iron pipe but is valuable for project steel selection. When the scale equals 10 points or higher, protective measures for ductile iron pipe are recommended. The AWWA scale is presented below. The soil characteristics refer to the conditions at and above pipe installation depth.

Table A.1 Soil-test Evaluation [7]

Soil Characteristic / Value	Points
Resistivity	
<1,500 ohm-cm	10
1,500 to 1,800 ohm-cm	8
1,800 to 2,100 ohm-cm	5
2,100 to 2,500 ohm-cm	2
2,500 to 3,000 ohm-cm	1
>3,000 ohm-cm	0

[6] American Water Works Association ANSI/AWWA C105/A21.5-05 Standard
[4] American Water Works Association ANSI/AWWA C105/A21.5-05 Standard

pH

0 to 2.0	5
2.0 to 4.0	3
4.0 to 6.5	0
6.5 to 7.5	0 *
7.5 to 8.5	0
>8.5	3

Redox Potential

< 0 (negative values)	5
0 to +50 mV	4
+50 to +100 mV	3½
> +100 mV	0

Sulfide Content

Positive	3½
Trace	2
Negative	0

Moisture

Poor drainage, continuously wet	2
Fair drainage, generally moist	1
Good drainage, generally dry	0

* If sulfides are present and low or negative redox-potential results (< 50 mV) are obtained, add three points for this range.

"The redox potential of a soil is significant, because the most common sulfate-reducing bacteria can live only in anaerobic conditions. A negative redox potential definitely indicates the anaerobic conditions in which sulfate reducers thrive. A positive sulfide reaction reveals a potential problem caused by sulfate-reducing bacteria." Anaerobic conditions are regarded as potentially corrosive.

We expect that drainage at the site after construction will be good. Nevertheless, based on the values obtained for the soil parameters, the overburden soils/bedrock appear(s) to comprise a severe corrosive environment for metals (point value up to 21½).

If additional information or recommendations are needed regarding soil corrosivity, GROUND recommends contacting the American Water Works Association or a Corrosion Engineer. It should be noted, however, that changes to the site conditions during construction, such as the import of other soils, or the intended or unintended introduction of off-site water, may alter corrosion potentials significantly.

PROJECT EARTHWORK CONSIDERATIONS

Existing Fill Soils: Man-made fill material was encountered in some of the test holes at the time of drilling. Detailed extent and composition of the man-made fill materials are not known; therefore, some of the excavated man-made fill materials may not be suitable for replacement as backfill. The geotechnical engineer should be retained during site excavations to observe the excavated fill materials and provide recommendations for its suitability for reuse. Discarded asphalt is not recommended for use as fill.

Use of Existing Native Soils / Borrow Source Areas: Overburden soils that are free of trash, organic material, construction debris, and other deleterious materials are suitable, in general, for placement as compacted fill. Organic materials should not be incorporated into project fills.

Fragments of rock, cobbles, and inert construction debris (e.g., concrete or asphalt) larger than 3 inches in maximum dimension will require special handling and/or placement to be incorporated into project fills. In general, such materials should be placed as deeply as possible in the project fills. A Geotechnical Engineer should be consulted regarding appropriate recommendations for usage of such materials on a case-by-case basis when such materials have been identified during earthwork as not all materials will be suitable for use.

We recommend that all project fills consisting of expansive shale bedrock (expansion greater than 0%) should ideally be properly processed to a soil-like mass (100 percent passing the No. 4 screen). Excavated shale bedrock material will require a well-coordinated effort to moisture treat, process, place, and compact properly. Some shale material may not be suitable for use as fill due to difficulty of excavation and processing.

As a preliminary recommendation, most bedrock soils can be used as fill material provided it is properly processed and placed. Fragments larger than 3 inches in maximum dimension will require special handling and/or placement to be incorporated into project fills. Such materials should be placed as deeply as possible in the project fills. Fills placed below a depth of 10 feet should be held to a greater minimum compaction effort, such as 98 percent of the Modified Proctor.

Processed shale and bedrock fragments smaller than 3 inches in greatest dimension could potentially be used when properly mixed with the site clay soils, and resulting in a well compacted homogenous mass. Additional laboratory testing will be necessary during construction to further evaluate actual mixed quantities and swell potentials. Furthermore, a test area may need to be established to verify that sufficient compaction can be obtained by the contractor, as well as subgrade stability. The test section must demonstrate that the method of placement results in a dense, stable compacted mass. The thickness of each layer should be less than 1½ times the greatest dimension of the maximum approved size. Each layer of mixed fill soils should be separated by a minimum of 8 inches of compacted and approved site-generated fill soils. Mixed fill and/or shale fill should not be placed within 3 feet of the final surface grades.

***Reconditioning Expansive Shale Bedrock*:** Expansive shale materials including weathered shale were observed in the test holes and include swell potentials up to 6.2 percent measured against various surcharge pressures. Material with higher swell potentials should be expected to exist on-site. In the Mesa County area, these materials have been excavated and replaced with variable success due to the natural properties of highly expansive materials as well as poorly controlled materials processing and varying placement techniques. JVIATION and potential contractors must understand that expansive shale bedrock will require additional processing including but not limited to stockpile moisture conditioning and multiple sub-excavations including partial to complete removal of previously moisture conditioned and compacted fill materials. The following recommendations will not eliminate post-construction movement associated with improvements constructed on expansive shale, but may tend to make movements more uniform.

Excavated shale will require a well-coordinated effort to moisture treat, process, place, and compact properly. In-place shale deposits were dense to hard and relatively dry, and may require a significant volume of water to be mixed into the excavated material to bring it to uniform moisture contents from optimum to 4 percent above the optimum prior to compaction (see *Borrow Source Soil Types, Estimated Quantities and Water Needed)*. The daily moisture content in the tested fill should be between 2 and 4 percent above the optimum as an additional requirement. If expansive, shale fragments should be reduced so as to achieve a soil-like mass. Adequate watering, and compaction equipment that aids in breaking down the material (e.g., a Caterpillar 825 compactor-

roller), likely will be needed. Excavated shale will require additional moisture conditioning and processing in an open area outside of utility trenches or foundation excavations prior to placement as backfill.

Potential earthwork contractors should be made aware that as stated, significant processing and reprocessing of the on-site materials will likely be required. The placement of on-site fill materials should be monitored by a representative of the geotechnical engineer, under separate contract, requested by JVIATION. Moisture content and relative compaction testing may need to be conducted at an increased frequency in order to provide a greater level of information to the contractor. In addition, immediately following placement and compaction, a geotechnical engineer should be retained to collect drive samples of the fill materials and they should be tested to determine the resultant swell-potential of the in-place materials. Scheduling of this testing is not the responsibility of the geotechnical engineer. Materials represented by samples exhibiting 0.5 percent swell or greater upon wetting against a 250 psf surcharge should be re-worked at increased moisture contents and re-compacted in accordance with the recommendations above. Typical earthworking procedures may not be successful in reducing swell potentials to less than 0.5 percent. As previously stated, when processed, movements as a result of heave may still occur in these fill soils, in some areas significant (greater than 1 inch). We recommend re-molded swell testing be performed on borrow source areas to further evaluate remnant fill swell potentials. Adequate mixing / processing should be performed such that material is uniform in composition. Moisture content should be monitored carefully to reduce potential of soft / yielding subgrade.

Further exploration may be necessary for further evaluating surface and subsurface drainage measures, underdrain recommendations, site grading, and maintenance. This may include installation of several piezometers, performance of percolation/permeability testing, and determination of hydraulic conductivity, ect. Additionally, JVIATION should be aware that fill prisms consisting of the thicknesses presented herein will also experience some settlement, potentially significant (in excess of 1 inch). As a result, differential movement should be expected.

Settlements will occur in filled ground, typically on the order of 1 to 2 percent of the fill depth. For a 35-foot fill, this corresponds to settlements on the order of 5 to 10 inches,

without imposition of loads. If fill placement is performed properly and is tightly controlled, in GROUND's experience the majority of that settlement will take place during earthwork construction. The remaining potential settlements likely will take several months or longer, to be realized. To further reduce potential settlements, deep fill placement (deeper than 10 feet/100 percent of the standard proctor) should be held to a greater compaction, such as 98 percent of the modified Proctor and placed as soon as possible when construction begins. While achieving this compaction level may prove difficult and time consuming, it can be accomplished in the area.

Additionally, a method to "induce" additional settlement upon the completion of initial fill placement, known as surcharging, could also be performed. Again, estimating the thickness of additional fill soils to be placed and the time allowed to elapse, is difficult. Typically, the greater the thickness over a longer period of time induces greater settlements. We would anticipate a minimum of 20 feet of additional fill soils would be necessary to induce the necessary surcharge load. This layer should extend at least 20 feet beyond the planned fill areas so as to reduce differential settlements. This settlement inducement may require a year or more. Additional consultation and/or filed work will be required should this option be considered.

Borrow Source Soil Types, Estimated Quantities and Water Needed: Test Holes 42, 54, and 63 were cored to provide better detail of bedrock types and durability. The following material volumes were estimated on the 'cut depth' map provided and our limited exploration in the borrow source area. Estimated water quantities were based on modified Proctor values for similar soil types and the lowest water content in-situ condition based on our limited exploration and lab testing. These values are estimates for preliminary planning purposes only. Additional exploration and testing is needed to further evaluate and quantify values, material types, and extents contained within this preliminary report. A preliminary cross section of the borrow area is presented in Appendix A. A civil engineer should be consulted to quantify the likely earthwork volumes for more detailed planning and design purposes, as well as for bidding.

(Soil) Sand and Clay The tested sand and clay materials generally classified as SC and CL materials with dry densities between 86.1 and 109.8 pcf (pounds per cubic foot) and moisture contents between 5.1 and 12.2 percent. A preliminary estimate of sand and clay from the specified borrow source area usable as fill is 1,050,000 yd^3 (cubic

yards) These materials may be best utilized for upper fill layers. The modified Proctor for a representative clay sample exhibited a maximum dry density and optimum moisture was 125.4 pcf and 10.9 percent respectively. A two percent above optimum value of 12.9 percent was used for water estimations. Using an in-situ dry density of 109.8 and moisture content of 5.1 percent, we estimate 32 gallons of water is needed for every cubic yard of clay for moisture-density placement. This equates to approximately 33,600,000 gallons for estimated clay quantities.

(Bedrock) Shale Classifications Based on our preliminary exploration, dominant shale bedrock materials from the borrow source area are characterized in two zones: *1) shale and 2) competent hard shale.* Required processing will likely be different for each type of shale layer. The *shale* layer was interbedded with claystone, sandstone, and highly weathered shale as well as competent shale. The *competent hard shale layer* was difficult to core and drill and auger refusal was encountered in this layer. Bedrock classification and durability analysis was based primarily on cored Test Holes 42, 54, and 63. Rock Quality Designation (RQD) and Slake Durability testing from core samples are indicators to classify shale 'rock quality' and durability (non-durable or durable). Unconfined compressive strengths from auger drilled test holes also may indicate bedrock durability.

Rock Quality Designation (RQD) RQD measures the degree of jointing or fracturing in a rock mass. High quality rock has an RQD of more than 75%, low quality of less than 50%, and values less than 25% are considered very poor. Very poor rock quality in shale may indicate the processing of these materials is feasible for use as fill. Typical *Shale* RQD ranged from 0 to 17% with more competent inter-bedded layers ranging from 37 to 80%. Typical *competent hard shale* RQD ranged from 57 to 88% indicating that the higher rock quality shale may not be feasible for use as processed fill.

Slake Durability Test (Colorado Procedure-Laboratory 3104) Slake durability testing was performed on samples of shale bedrock to estimate how these materials degrade when exposed to water. In accordance with CP-L 3104, shale material was placed in a glass jar, filled with water as to completely cover the sample, and visually observed over time for 'slaking'. The six values of slaking for a minimum 24 hour period of a sample submerged in water are as follows: 1) Degrades into a pile of flakes or mud, 2) Breaks rapidly and/or forms many chips, 3) Breaks rapidly and/or forms few chips, 4) Breaks

slowly and/or forms several fractures, 5) Breaks slowly and/or forms few fractures, and 6) no visible change. The slake durability test was performed on seven samples from cored Test Holes 42, 54, and 63. Samples of *shale* and the respective slake values (in parenthesis) are: TH-42 at 19.0' (1 to 2), TH-42 at 33.0' (4 to 5), TH-54 at 10.5' (2 to 3), TH-54 at 31.0' (4 to 5), TH-63 at 12.5' (2 to 3), and TH-063 at 27.0' (5). A sample of *competent hard shale* from TH-54 at a depth of 50.0 feet had a slake value of 6. Photographs of 'slake' test samples are shown in Appendix B.

Shale Zone Material and Water Estimates *Shale* material is low to highly plastic, with interbedded zones of claystone, siltstone, and friable shale to more resistant blocky sections, grey in color. Weathered material breaks down readily (RQD of less than 25% and non-durable, descriptive behavior 1 through 3) while more competent shale material exhibits some weathering (RQD of 37 to 80% and some durability, descriptive behavior 2 through 5) after being submerged in water over a period of 6 to 24 hours. The processing of the weathered materials is feasible for use as fill. More competent shale showed further de-gradation after 3 to 14 days indicating the processing of these materials is probably feasible, but will require additional processing for use as fill. These more competent materials may be best utilized for deeper fill layers. Unconfined compressive strengths of these materials ranged between 6,540 and 28,257 psf (pounds per square foot). The tested shale materials generally classified as "CL" and "CH" with dry densities between 111.5 and 123.1 pcf (pounds per cubic foot) and moisture contents between 7.5 and 12.8 percent. A preliminary estimate of shale from the specified borrow source area usable as fill is 2,240,000 yd^3 (cubic yards). The modified Proctor for a representative shale sample exhibited maximum dry density and optimum moisture content of 126.0 pcf and 11.5 percent respectively. A two percent above optimum value of 13.5 percent was used for water estimations. Using an in-situ dry density of 111.5 and moisture content of 7.5 percent, we estimate 28 gallons of water is needed for every cubic yard of *shale*. This equates to approximately 62,720,000 gallons for estimated *shale* quantities.

Competent Hard Shale Zone Material and Water Estimates Material is highly plastic, blocky, hard to very hard, and dark grey in color. Material shows RQD values of 57 to 88 percent, an unconfined compressive strength of 534,240 psf (pounds per square foot), and limited loss of durability (descriptive behavior 6) after being submerged in water over a period of several weeks indicating the processing of these materials may

not be feasible. Further testing (RQD, slake durability, and Los Angeles Abrasion Tests) from additional cored test holes is needed to determine feasibility of this material for use as fill. The tested hard shale materials generally classified as “CL”, “CH”, and “GC”. A preliminary estimate of hard shale from the specified borrow source area according to cut depths is 170,000 yd^3 (cubic yards).

Excluding the competent hard shale, we estimate 3,290,000 yd^3 may be usable as fill material for construction and an estimated 96,320,000 gallons of water may be needed for processing these entire fill quantities. Additional exploration is necessary to confirm material quantities. Additional testing, such as L.A. abrasion testing, should be considered to further evaluate the usability of shale bedrock soils as fill materials. Adequate watering, and compaction equipment that aids in breaking down the material (e.g., a Caterpillar 825 compactor-roller), likely will be needed. Excavated shale will require moisture conditioning and processing in an open area outside of utility trenches or excavations prior to placement as backfill. Additional evaluation will be necessary to determine feasibility of some competent and competent hard shale for use as fill material.

Excavation and Groundwater Considerations The test holes for the preliminary subsurface exploration were excavated to the depths indicated by means of truck-mounted, flight auger drilling equipment. We anticipate excavation difficulties to vary widely across the proposed borrow area with deeper hard shale significantly difficult to excavate. We anticipate excavation in the upper weathered and portions of the competent shale to be feasible with conventional heavy-duty excavation equipment in good working condition. Depending upon specific excavation depths, localized blasting may be necessary.

As previously stated, groundwater was encountered in Test Hole 60 during our exploration program. Groundwater levels can be expected to fluctuate, however, in response to annual and longer-term cycles of precipitation, irrigation, surface drainage, land use, and the development of transient, perched water conditions. Water may be present in other areas not explored by this study. In the vicinity of Test Hole 60, water may be encountered at the proposed bottom cut depths. Further exploration may further define groundwater levels and extents at the project site vicinity. Water mitigation methods may include diverting water off site, or sump-pumping to remove excess water.

PRELIMINARY PAVEMENT DESIGN PARAMETERS

Based on the results of our preliminary field exploration and laboratory testing, the potential pavement subgrade materials classify as A-2-6 to A-7-6 soils with group indices of 0 to 36 in accordance with the American Association of State Highway and Transportation Officials (AASHTO) classification system and SC to CH utilizing the Unified Soil Classification System (USCS). Based on our laboratory testing results for the site soils and as discussed in the *California Bearing Ratio* section of this report, the CBR testing for representative composite samples of two types of subgrade materials within the runway indicate an approximate value of 9.0 for shale materials and 2.9 for clay materials at approximately 95 percent of the maximum modified dry density. CBR testing for representative composite samples of two types of subgrade materials within the borrow areas indicate an approximate value of 1.5 percent for shale materials and 6.4 percent for clay materials at approximately 95 percent of the maximum modified dry density. An approximate correlation between CBR values and modulus of subgrade reaction (k-value) suggests a k-value of approximately 70 psi/in. Blow counts in the shale subgrade may suggest higher values. Modulus of subgrade reaction testing can be performed during future explorations to verify this correlation with regard to the proposed new runway.

Following additional exploration and testing, and as the design proceeds, specific design CBR data can be further evaluated and recommendations made based on material types selected for construction. Results of CBR testing are presented in Figures 30 to 37.

ADDITIONAL EXPLORATION REQUIREMENTS

The above data and recommendations are based on a limited preliminary subsurface exploration only. Additional geotechnical studies must be performed to further evaluate the site for specific runway and material borrow area recommendations, final site grading, and pavement recommendations.

CLOSURE

Geotechnical Review

The author of this report should be retained to review project plans and specifications to evaluate whether they comply with the intent of the recommendations in this report. The review should be requested in writing.

In addition, building-specific geotechnical exploration(s) must be completed for the project prior to final design and construction. The preliminary geotechnical recommendations presented in this report are contingent upon observation and testing of project earthworks by representatives of GROUND. If another geotechnical consultant is selected to provide materials testing, then that consultant must assume all responsibility for the geotechnical aspects of the project by concurring in writing with the recommendations in this report, or by providing alternative recommendations.

Materials Testing

JVIATION should consider retaining a Geotechnical Engineer to perform materials testing during construction. The performance of such testing or lack thereof, in no way alleviates the burden of the contractor or subcontractor from constructing in a manner that conforms to applicable project documents and industry standards. The contractor or pertinent subcontractor is ultimately responsible for managing the quality of their work; furthermore, testing by the geotechnical engineer does not preclude the contractor from obtaining or providing whatever services they deem necessary to complete the project in accordance with applicable documents.

Limitations

This report has been prepared for JVIATION as it pertains to the New Runway 11/29 Reconstruction of The Grand Junction Regional Airport as described herein. It may not contain sufficient information for other parties or other purposes. JVIATION or any prospective buyer or contractor relying upon this report must be made aware of and must agree to the terms, conditions, and liability limitations outlined in the proposal.

In addition, GROUND has assumed that the final geotechnical subsurface exploration will be performed prior to construction. Changes in project plan development or

schedule should be brought to the attention of the Geotechnical Engineer, in order that the preliminary geotechnical recommendations may be re-evaluated and, as necessary, modified.

The preliminary geotechnical conclusions and recommendations in this report relied upon subsurface exploration at a limited number of exploration points, as shown in Figure 1, as well as the means and methods described herein. Subsurface conditions were interpolated between and extrapolated beyond these locations. It is not possible to guarantee the subsurface conditions are as indicated in this report. Actual conditions exposed during construction may differ from those encountered during site exploration.

If during construction, surface, soil, bedrock, or groundwater conditions appear to be at variance with those described herein, the Geotechnical Engineer should be advised at once, so that re-evaluation of the recommendations may be made in a timely manner. In addition, a contractor who relies upon this report for development of his scope of work or cost estimates may find the geotechnical information in this report to be inadequate for his purposes or find the geotechnical conditions described herein to be at variance with his experience in the greater project area. The contractor is responsible for obtaining the additional geotechnical information that is necessary to develop his workscope and cost estimates with sufficient precision. This includes current depths to groundwater, etc.

The materials present on-site are stable at their natural moisture content, but may change volume or lose bearing capacity or stability with changes in moisture content. Performance of the proposed pavement will depend on implementation of the preliminary recommendations in this report, final geotechnical exploration, and on proper maintenance after construction is completed. Because water is a significant cause of volume change in soils and rock, allowing moisture infiltration may result in movements, some of which will exceed estimates provided herein and should therefore be expected by JVIATION.

This report was prepared in accordance with generally accepted soil and foundation engineering practice in Mesa County at the date of preparation. GROUND makes no warranties, either expressed or implied, as to the professional data, opinions or recommendations contained herein. Because of numerous considerations that are

beyond GROUND's control, the economic or technical performance of the project cannot be guaranteed in any respect.

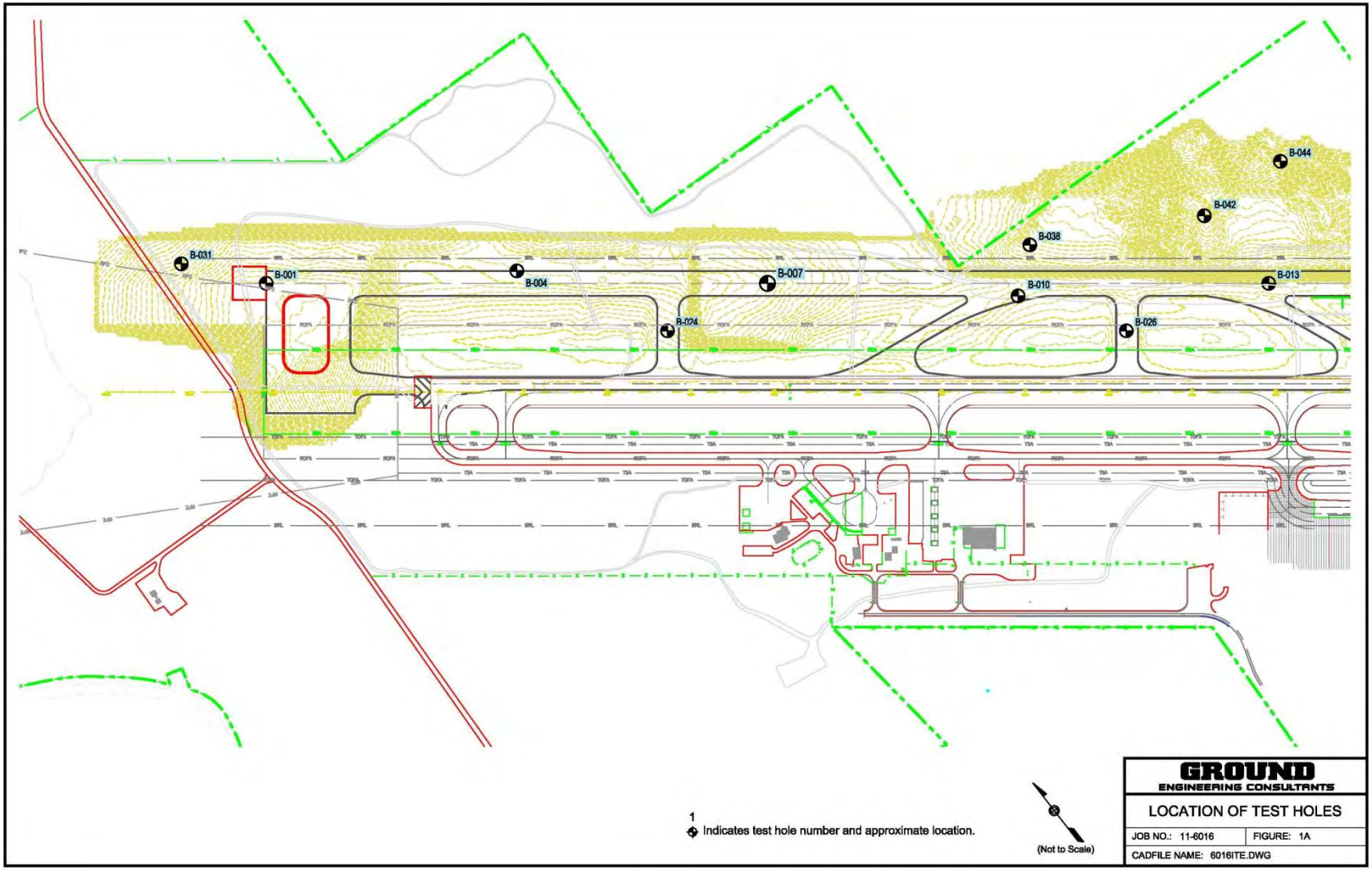
We appreciate the opportunity to complete this portion of the proposed project. GROUND welcomes the opportunity to provide the Client with proposals for final subsurface exploration programs as well as construction observations and materials testing services prior to the commencement of construction activities.

Sincerely,
GROUND Engineering Consultants, Inc.



Scott W. Richards, P.E.

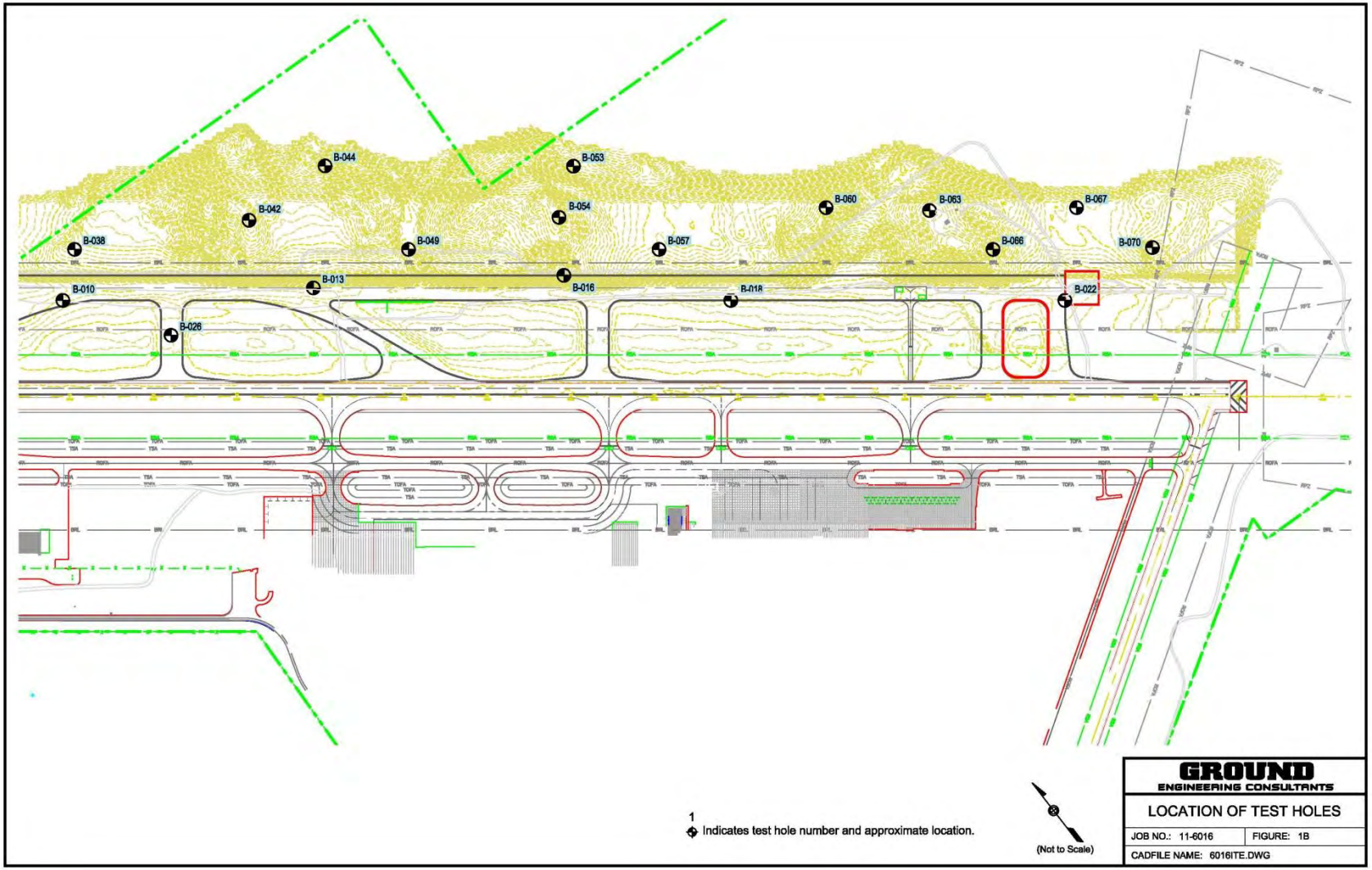
Reviewed by Jason A. Smith, REM, P.E.

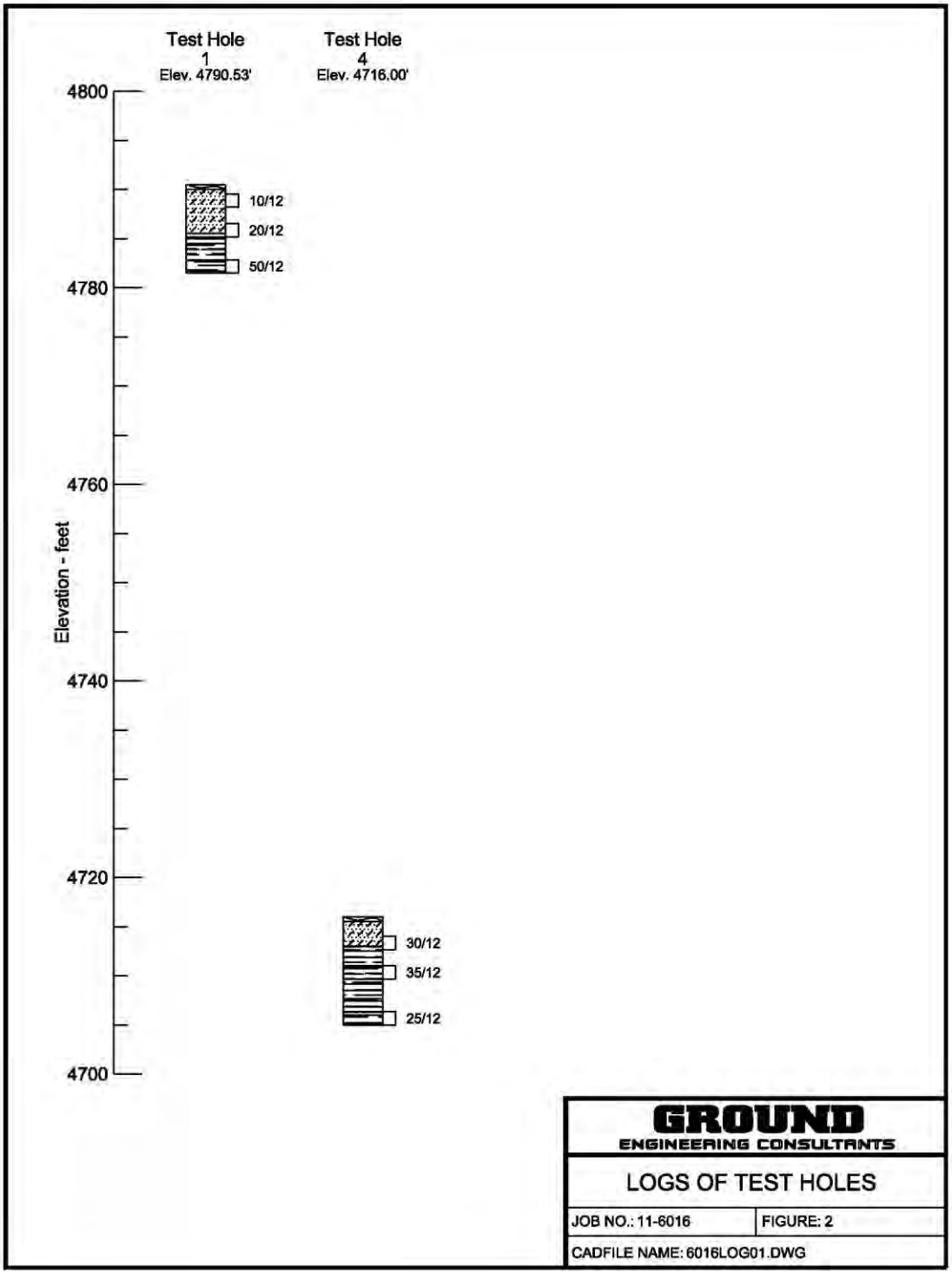


GROUND
ENGINEERING CONSULTANTS

LOCATION OF TEST HOLES

JOB NO.: 11-6016	FIGURE: 1A
CADFILE NAME: 6016ITE.DWG	

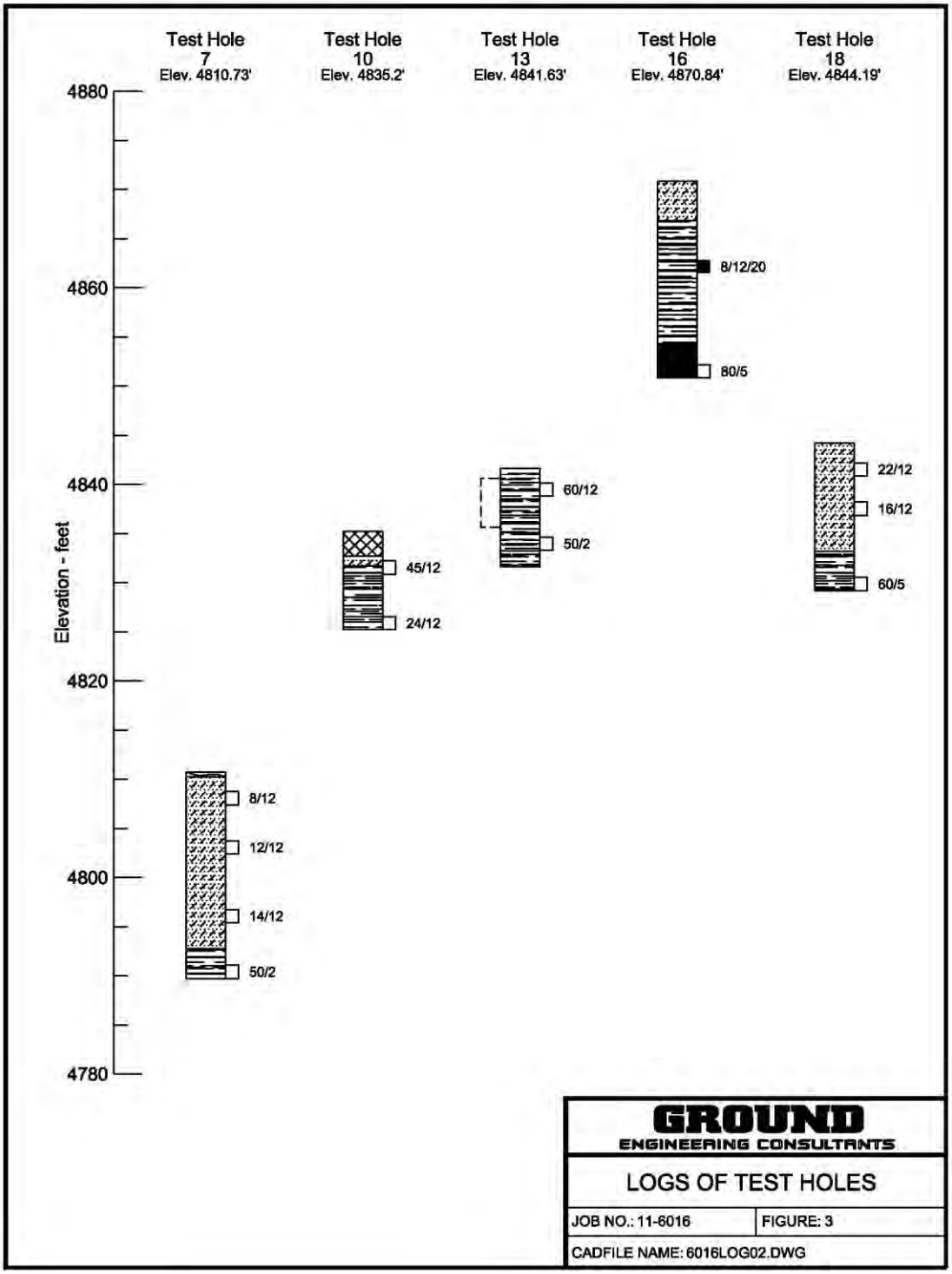

B-044
B-053
B-042
B-054
B-060
B-063
B-067
B-038
B-049
B-057
B-066
B-070
B-013
B-016
B-010
B-018
B-022
B-026
1
Indicates test hole number and approximate location.
(Not to Scale)
GROUND
ENGINEERING CONSULTANTS
LOCATION OF TEST HOLES
JOB NO.: 11-6016
FIGURE: 1B
CADFILE NAME: 6016ITE.DWG



GROUND
ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

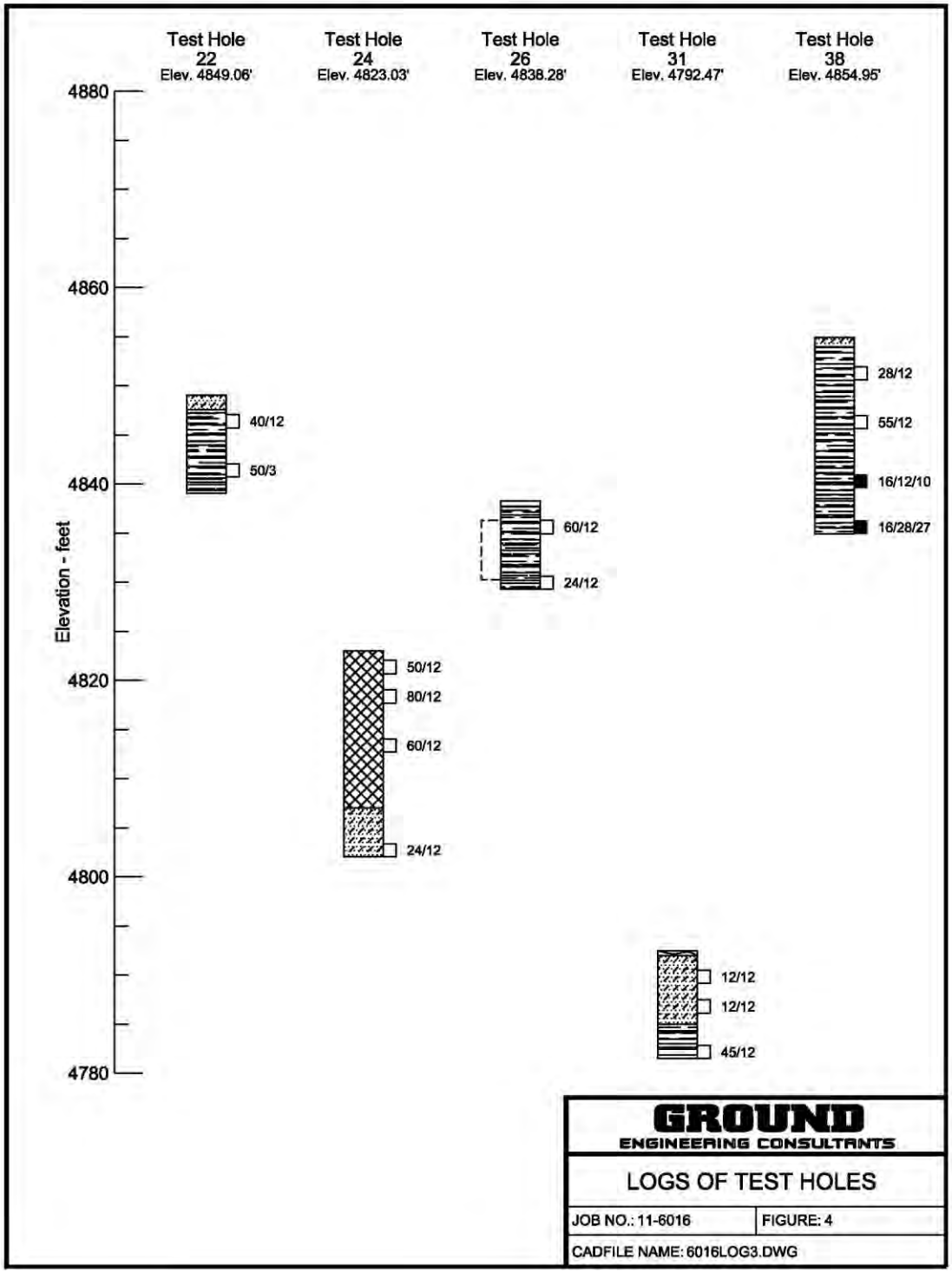
JOB NO.: 11-6016	FIGURE: 2
CADFILE NAME: 6016LOG01.DWG	

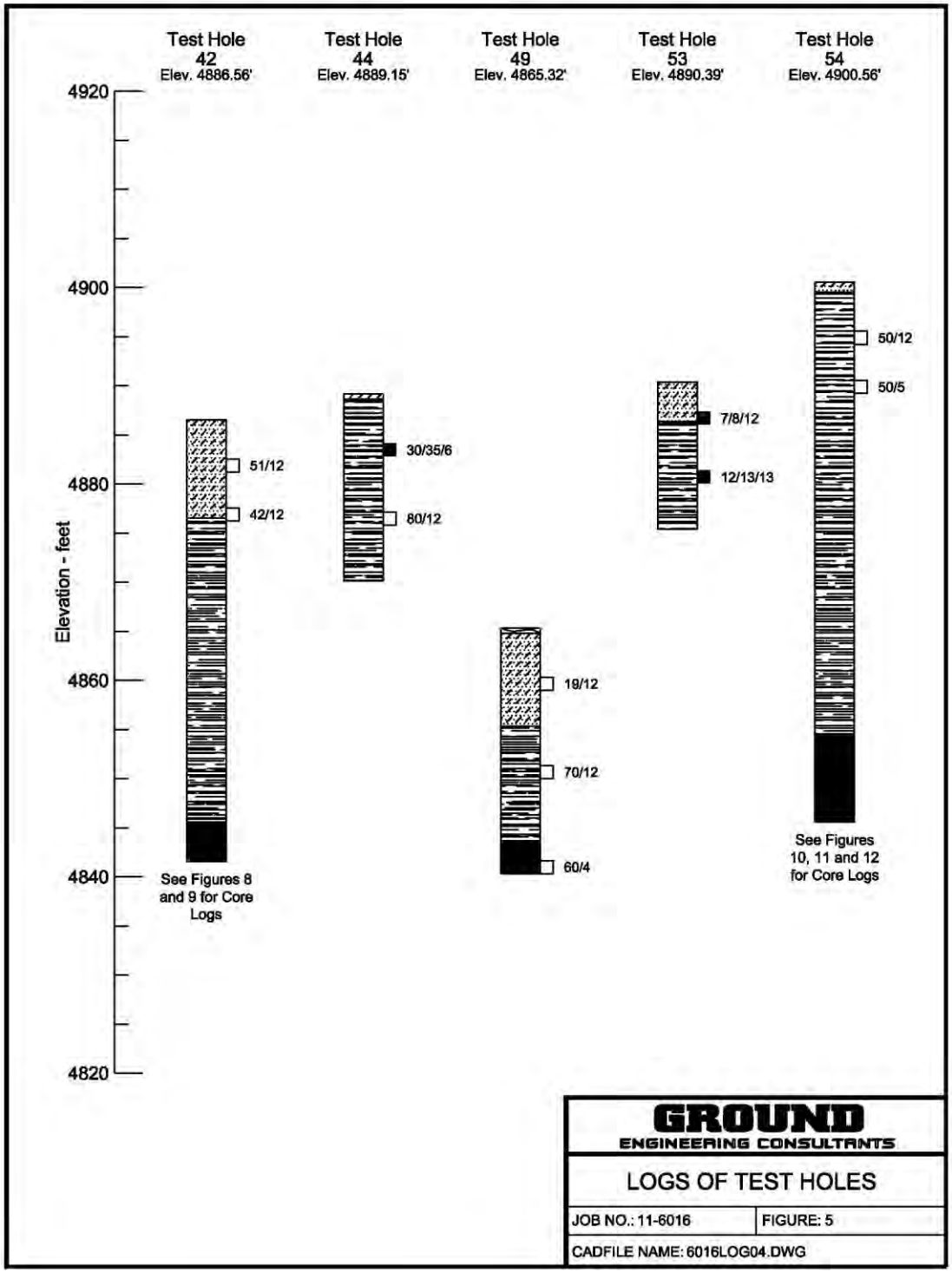


GROUND
ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 11-6016	FIGURE: 3
CADFILE NAME: 6016LOG02.DWG	

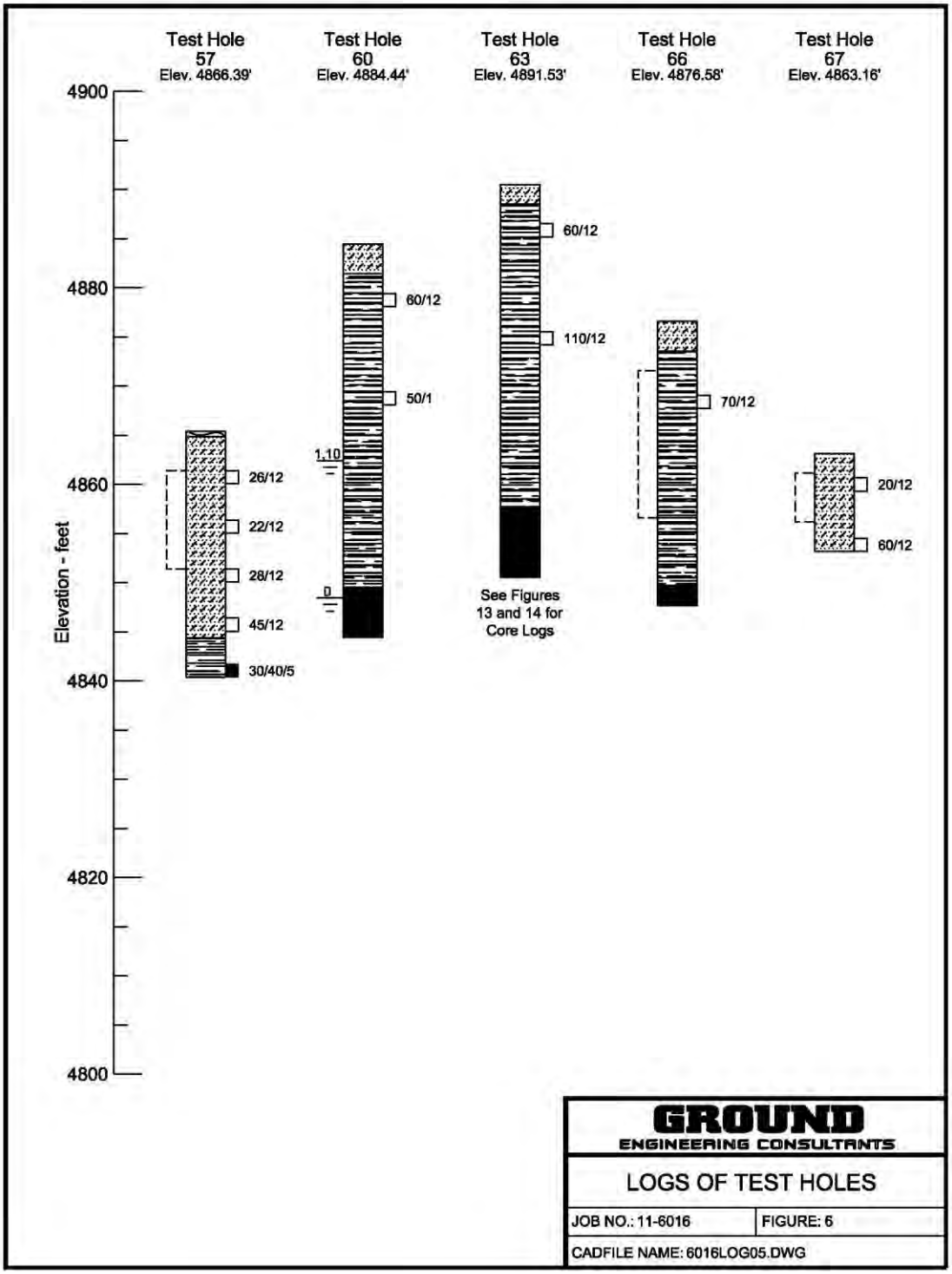

Test Hole 22
Elev. 4849.06'
Test Hole 24
Elev. 4823.03'
Test Hole 26
Elev. 4838.28'
Test Hole 31
Elev. 4792.47'
Test Hole 38
Elev. 4854.95'
4880
4860
4840
4820
4800
4780
Elevation - feet
40/12
50/3
50/12
80/12
60/12
24/12
60/12
24/12
12/12
12/12
45/12
28/12
55/12
16/12/10
16/28/27
GROUND
ENGINEERING CONSULTANTS
LOGS OF TEST HOLES
JOB NO.: 11-6016
FIGURE: 4
CADFILE NAME: 6016LOG3.DWG



GROUND
ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

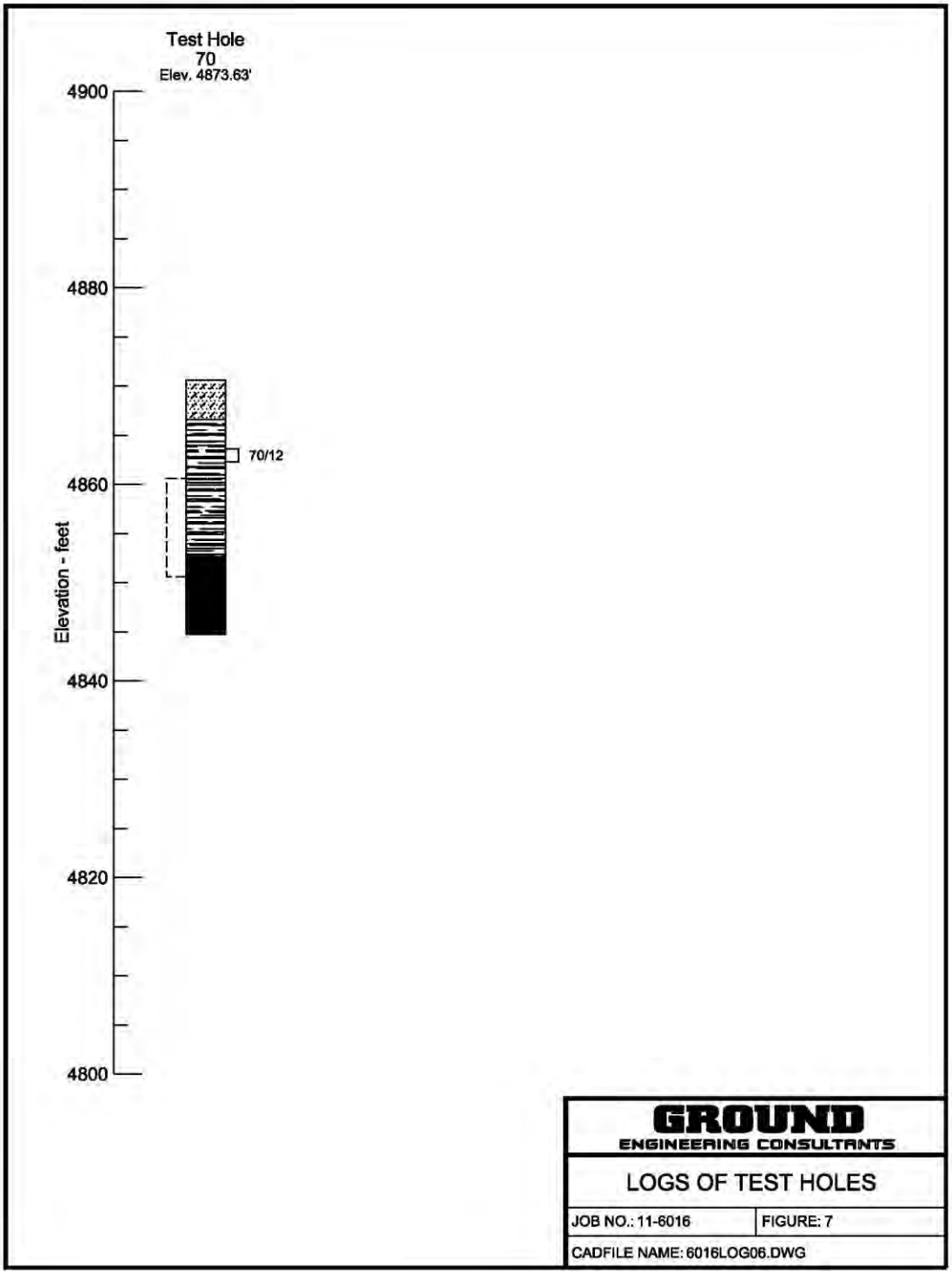
JOB NO.: 11-6016	FIGURE: 5
CADFILE NAME: 6016LOG04.DWG	



GROUND
ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 11-6016	FIGURE: 6
CADFILE NAME: 6016LOG05.DWG	



GROUND
ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 11-6016	FIGURE: 7
CADFILE NAME: 6016LOG06.DWG	

GROUND ENGINEERING CONSULTANTS, INC. BORING LOG

PROJECT NO. 11-6016	PROJECT Grand Junction Airport	SURFACE ELEV. 4886.56 Ft. ±	BORING NO. 42
LOGGED BY S.Richards, GEC	LOCATION Grand Junction, Colorado	DEPTH TO GROUNDWATER N/A	SHEET 1 OF 2
DATE 10/17/2011	COORDINATES	DEPTH TO BEDROCK 10 Ft.	HOLE DIAMETER 4"
DRILLER S. McCracken		TOTAL DEPTH 45 Ft.	TREND -
DRILL RIG TRUCK-AIR CORE RIG	CAD FILE NAME 6016DRILLLOG01.DWG	FIGURE 8	PLUNGE 90°

STRATA ELEVATION	SAMPLE DATA: SAMPLE TYPE	SAMPLE DATA: SAMPLE NO.	SAMPLE DATA: BLOW COUNT	CORE DATA: PERCENT RECOVERY	CORE DATA: RQD	CORE DATA: FRACTURES DESCRIPTION	CORE DATA: FRACTURES LOG	DEPTH (FEET)	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	NOTES ON DRILLING CONDITIONS
	CAL		51/12			M Mechanical break P Planarity Index: 1 Planar 2 Somewhat Planar 3 Somewhat Irregular 4 Irregular R Roughness Index: 1 Smooth 2 Fairly Smooth 3 Fairly Rough 4 Rough S Stepped Fracture Surface		0 5		Sandy CLAY/ Clayey SAND	
	CAL		42/12								
		R1		40%	0%			10		WEATHERED SANDSTONE/CLAYSTONE	
						R St C 0°	M M M M				
		R2		93%	80%			15		SHALE/CLAYSTONE BEDROCK	
						R St Ca 5°	M	20			

GROUND ENGINEERING CONSULTANTS, INC. BORING LOG

PROJECT NO.	PROJECT	FIGURE / CAD FILE NAME	BORING NO.
11-6016	Grand Junction Airport Grand Junction, Colorado	FIGURE 9/ 6016DRILLLOG02.DWG	42

STRATA ELEVATION	SAMPLE DATA: SAMPLE TYPE	SAMPLE DATA: SAMPLE NO.	SAMPLE DATA: BLOW COUNT	CORE DATA: PERCENT RECOVERY	CORE DATA: RQD	CORE DATA: FRACTURES DESCRIPTION	CORE DATA: FRACTURES LOG	DEPTH (FEET)	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	NOTES ON DRILLING CONDITIONS
		R3		40%	0%	M Mechanical break P Planarity Index: 1 Planar 2 Somewhat Planar 3 Somewhat Irregular 4 Irregular R Roughness Index: 1 Smooth 2 Fairly Smooth 3 Fairly Rough 4 Rough S Stepped Fracture Surface		20		SHALE	
		R4		50%	0%	S St CL 8° S St CL 75°		25			
		R5		80%	17%	S PL CL 5° S PL Ca 5°		30			
		R6		90%	17%	S PL CL Ca 5° S PL CL Ca 50° 5° S PL Ca 20° S PL Ca		35			
		R7		95%	82%	J P CL 5° SR W Ca 20° S ST CL 30° S ST CL 5° S P CL 5° S P CL 5° S P CL 5°		40		Hard SHALE	

GROUND ENGINEERING CONSULTANTS, INC. BORING LOG

PROJECT NO. 11-6016	PROJECT Grand Junction Airport	SURFACE ELEV. 4900.56 Ft. ±	BORING NO. 54
LOGGED BY S.Richards, GEC	LOCATION Grand Junction, Colorado	DEPTH TO GROUNDWATER N/A	SHEET 1 OF 3
DATE 10/19/2011	COORDINATES	DEPTH TO BEDROCK 5 Ft.	HOLE DIAMETER 4"
DRILLER S. McCracken		TOTAL DEPTH 55 Ft.	TREND -
DRILL RIG TRUCK-AIR CORE RIG	CAD FILE NAME 6016DRILLLOG03.DWG	FIGURE 10	PLUNGE 90°

STRATA ELEVATION	SAMPLE DATA: SAMPLE TYPE	SAMPLE DATA: SAMPLE NO.	SAMPLE DATA: BLOW COUNT	CORE DATA: PERCENT RECOVERY	CORE DATA: RQD	CORE DATA: FRACTURES DESCRIPTION	CORE DATA: FRACTURES LOG	DEPTH (FEET)	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	NOTES ON DRILLING CONDITIONS
						M Mechanical break P Planarity Index: 1 Planar 2 Somewhat Planar 3 Somewhat Irregular 4 Irregular R Roughness Index: 1 Smooth 2 Fairly Smooth 3 Fairly Rough 4 Rough S Stepped Fracture Surface		0		SAND and CLAY SHALE	
	CAL		50/12					5			
	CAL	R1	50/5	83%	0%	S PL Ca S PL Ca S PL Lc S PL CL		10			Calcite/Gypsum? CLAY Iron staining in joints
		R2		40%	0%	S PL Ca S PL Ca S PL Lc S PL CL		15			
								20			

GROUND ENGINEERING CONSULTANTS, INC. BORING LOG

PROJECT NO.	PROJECT	FIGURE / CAD FILE NAME	BORING NO.
11-6016	Grand Junction Airport Grand Junction, Colorado	FIGURE 11/ 6016DRILLLOG04.DWG	54

STRATA ELEVATION	SAMPLE DATA: SAMPLE TYPE	SAMPLE DATA: SAMPLE NO.	SAMPLE DATA: BLOW COUNT	CORE DATA: PERCENT RECOVERY	CORE DATA: RQD	CORE DATA: FRACTURES DESCRIPTION	CORE DATA: FRACTURES LOG	DEPTH (FEET)	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	NOTES ON DRILLING CONDITIONS
		R3		70%	0%	S PL Ca S PL Ca S PL Lc S PL CL		20		SHALE	
		R4		90%	0%	**M** Mechanical break **P** Planarity Index: 1 Planar 2 Somewhat Planar 3 Somewhat Irregular 4 Irregular **R** Roughness Index: 1 Smooth 2 Fairly Smooth 3 Fairly Rough 4 Rough **S** Stepped Fracture Surface		25			
		R5		92%	10%			30			SHALE Deep SHALE
		R6		100%	53%	S PL $^{CL}_{Ca}$ 5°	M	35			
		R7		97%	37%	S PL CL 80° S PL Ca 30° S PL CL 30° St PL Ca 5° St PL CL 5° S PL $^{CL}_{Ca}$ 90°	M	40			

GROUND ENGINEERING CONSULTANTS, INC. BORING LOG

PROJECT NO.	PROJECT	FIGURE / CAD FILE NAME	BORING NO.
11-6016	Grand Junction Airport Grand Junction, Colorado	FIGURE 12 6016DRILLLOG05.DWG	54

STRATA ELEVATION	SAMPLE DATA: SAMPLE TYPE	SAMPLE DATA: SAMPLE NO.	SAMPLE DATA: BLOW COUNT	CORE DATA: PERCENT RECOVERY	CORE DATA: ROD	CORE DATA: FRACTURES DESCRIPTION	CORE DATA: FRACTURES LOG	DEPTH (FEET)	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	NOTES ON DRILLING CONDITIONS
		R8		100%	73%	S PL $\frac{Cl}{Ca}$ 80°	M	45		SHALE	
							M			Hard SHALE	
						S PL $\frac{CL}{Ca}$ 5°					
							M				
							M				
		R9		93%	88%			50			
						S PL C	M				
							M				
							M				
								55			
								60			
								65			

M Mechanical break

P Planarity Index:
1 Planar
2 Somewhat Planar
3 Somewhat Irregular
4 Irregular

R Roughness Index:
1 Smooth
2 Fairly Smooth
3 Fairly Rough
4 Rough

S Stepped Fracture Surface

GROUND ENGINEERING CONSULTANTS, INC. BORING LOG

PROJECT NO. 11-6016	PROJECT Grand Junction Airport	SURFACE ELEV. 4891.53 Ft. ±	BORING NO. 63
LOGGED BY S.Richards, GEC	LOCATION Grand Junction, Colorado	DEPTH TO GROUNDWATER N/A	SHEET 1 OF 2
DATE 10/18/2011	COORDINATES	DEPTH TO BEDROCK 10 Ft.	HOLE DIAMETER 4"
DRILLER S. McCracken		TOTAL DEPTH 40 Ft.	TREND -
DRILL RIG TRUCK-AIR CORE RIG	CAD FILE NAME 6016DRILLLOG06.DWG	FIGURE 13	PLUNGE 90°

STRATA ELEVATION	SAMPLE DATA: SAMPLE TYPE	SAMPLE DATA: SAMPLE NO.	SAMPLE DATA: BLOW COUNT	CORE DATA: PERCENT RECOVERY	CORE DATA: RQD	CORE DATA: FRACTURES DESCRIPTION	CORE DATA: FRACTURES LOG	DEPTH (FEET)	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	NOTES ON DRILLING CONDITIONS
						M Mechanical break P Planarity Index: 1 Planar 2 Somewhat Planar 3 Somewhat Irregular 4 Irregular R Roughness Index: 1 Smooth 2 Fairly Smooth 3 Fairly Rough 4 Rough S Stepped Fracture Surface		0		SAND and CLAY	
	CAL		51/12							SHALE	
		R1		33%	0%		M M M M M M	5			
		R2		54%	0%						
		R3		53%	0%			10			
							M M M M				
	CAL	R4	42/12	77%	0%		M M M M M M M M	15			
		R5		73%	13%		M M M M				
							M	20			

GROUND ENGINEERING CONSULTANTS, INC. BORING LOG

PROJECT NO.	PROJECT	FIGURE / CAD FILE NAME	BORING NO.
11-6016	Grand Junction Airport Grand Junction, Colorado	FIGURE 14/ 6016DRILLLOG07.DWG	63

STRATA ELEVATION	SAMPLE DATA: SAMPLE TYPE	SAMPLE DATA: SAMPLE NO.	SAMPLE DATA: BLOW COUNT	CORE DATA: PERCENT RECOVERY	CORE DATA: RQD	CORE DATA: FRACTURES DESCRIPTION	CORE DATA: FRACTURES LOG	DEPTH (FEET)	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	NOTES ON DRILLING CONDITIONS
		R6		77%	0%	S Ca 5°	M	20		SHALE	
		R7		88%	13%		M M M M M M M M	25			
		R8		100%	30%	S S Fe 90°	M M M M M M M M

LEGEND:



Topsoil



Fill: Consisted of abandoned asphalt at test hole 10, and silty sandy clay with occasional gravels, fine to medium grained, low to medium plasticity. slightly moist to moist, stiff and brown in color at test hole 24.



Sand and Clay: Stratified layers, interbedded, non to medium plasticity, very stiff/medium dense - dense, slightly moist - moist, brown in color, and trace calcareous.



Shale: Mancos shale, competent layers, slightly moist to moist, moderately to highly plastic, hard, and gray in color.



Hard Shale: Mancos shale, hard competent layers, slightly moist, moderately to highly plastic, very hard, and gray to black on color.



Drive sample, 2-inch I.D. California liner sample



Drive sample, 1-3/8 inch I.D. standard sample

23/12 Drive sample blow count, indicates 23 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

20/25/30 Drive sample blow count, indicates 20, 25, and 30 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 18 inches.



Large disturbed sample.



Depth to water level and number of days after drilling that measurement was taken.

GROUND
ENGINEERING CONSULTANTS

LEGEND AND NOTES

JOB NO.: 11-6016	FIGURE: 15
CADFILE NAME: 6016LEG01.DWG	

NOTES:

1) Test holes were drilled in October 2011 with 4-inch diameter continuous flight power augers.

2) Coring was performed at test holes TH-042, TH-054, and TH-63 using a conventional truck mounted, air coring rig.

3) Locations of the test holes were surveyed by River City Consultants and shown on the site plan provided.

4) Elevations of the test holes were provided by River City Consultants and the logs of the test holes are drawn to elevation.

5) The test hole locations and elevations should be considered accurate only to the degree implied by the method used.

6) The lines between materials shown on the test hole logs represent the approximate boundaries between material types and the transitions may be gradual.

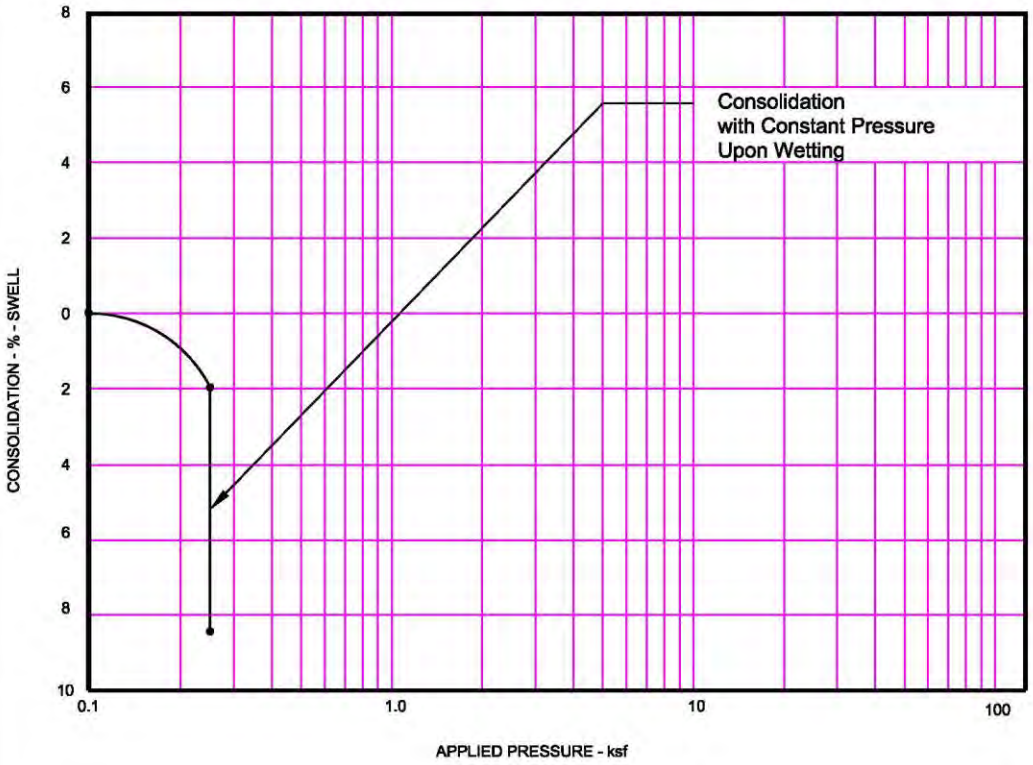
7) Groundwater was encountered in test hole 60 at a depth of 25 feet below surface grade. Groundwater levels can fluctuate seasonally.

8) The material descriptions on this legend are for general classification purposes only. See the full text of this report for descriptions of the site materials and related recommendations.

GROUND
ENGINEERING CONSULTANTS

LEGEND AND NOTES

JOB NO.: 11-6016	FIGURE: 16
CADFILE NAME: 6016LEG02.DWG	



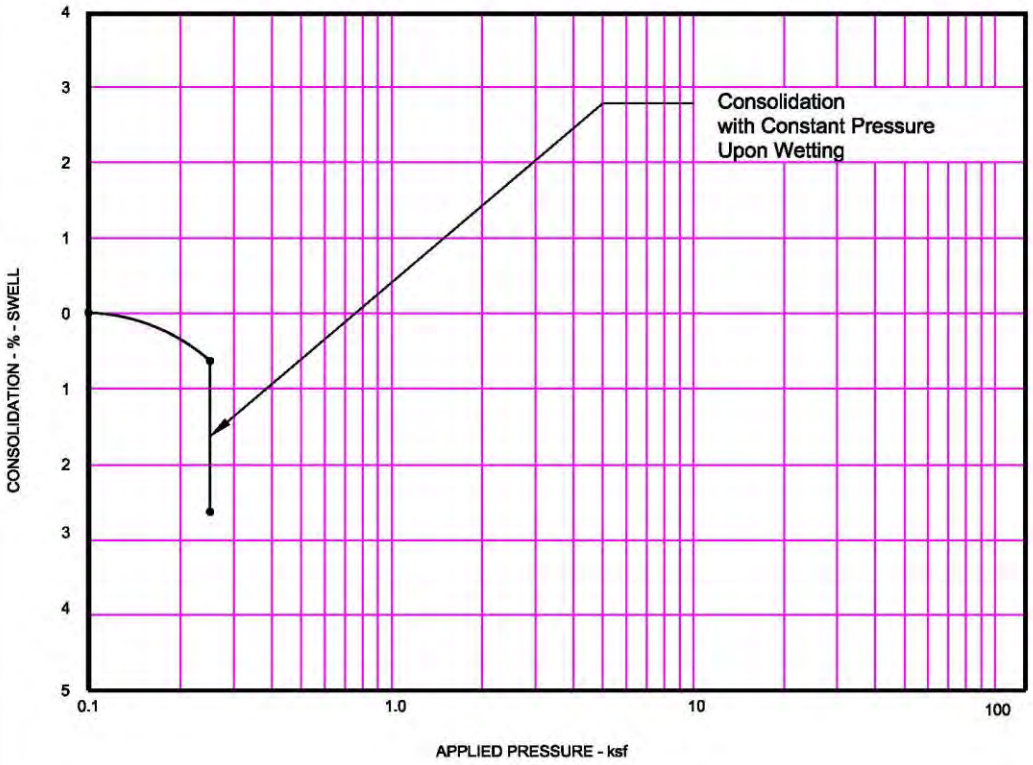
Moisture Content = 12.0 percent

Dry Unit Weight = - pcf

Sample of: Sandy Clay with Gravel

From: Test Hole 1 at 1 ft

GROUND ENGINEERING CONSULTANTS	
SWELL-CONSOLIDATION TEST RESULTS	
JOB NO.: 11-6016	FIGURE: 17
CADFILE NAME: 6016SWL01.DWG	



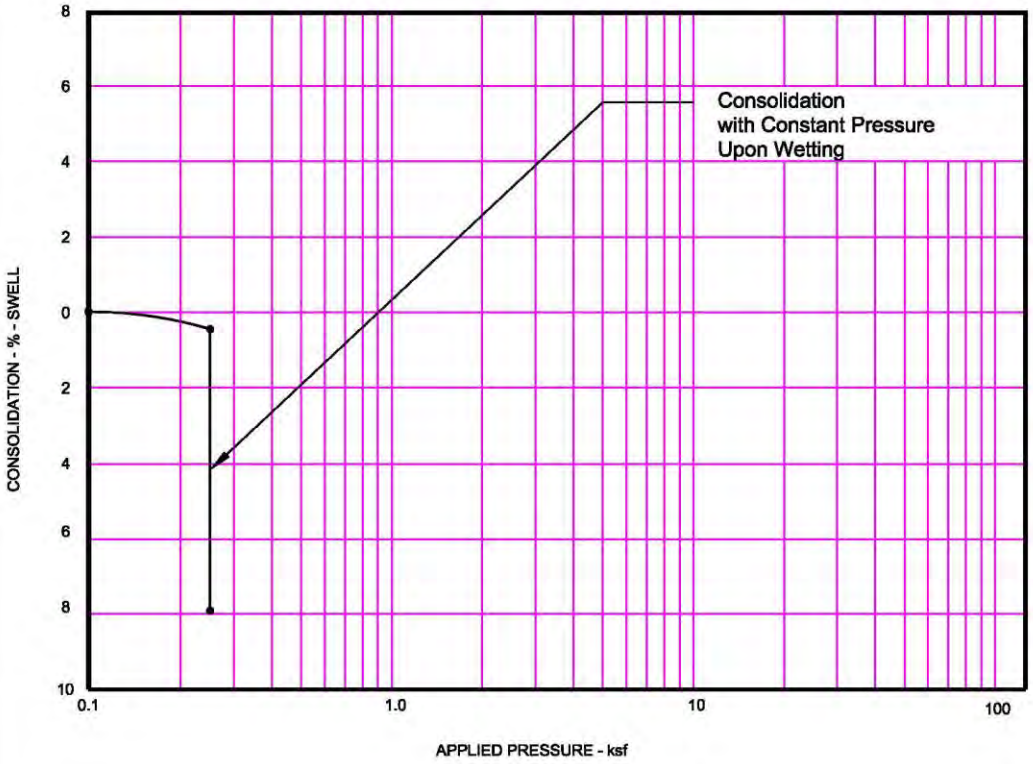
Moisture Content = 14.3 percent

Dry Unit Weight = 86.0 pcf

Sample of: Shale Bedrock

From: Test Hole 4 at 5 ft

GROUND ENGINEERING CONSULTANTS	
SWELL-CONSOLIDATION TEST RESULTS	
JOB NO.: 11-6016	FIGURE: 18
CADFILE NAME: 6016SWL02.DWG	



Moisture Content = 7.8 percent

Dry Unit Weight = - pcf

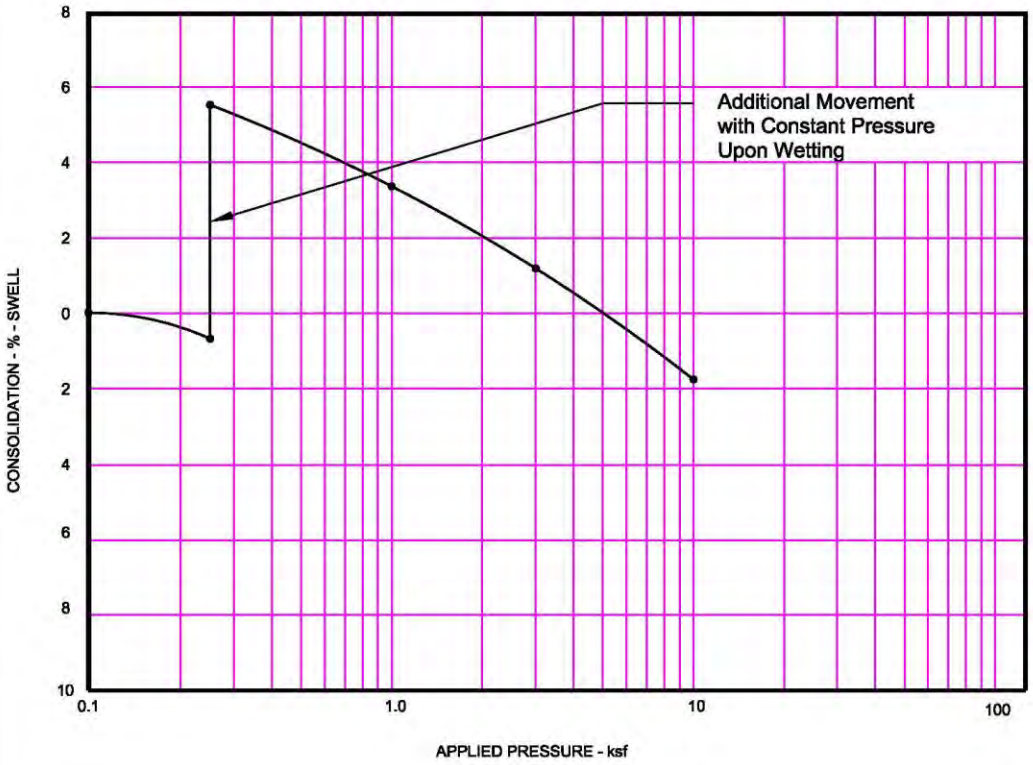
Sample of: Clay with Sand

From: Test Hole 7 at 2 ft

GROUND
ENGINEERING CONSULTANTS

SWELL-CONSOLIDATION
TEST RESULTS

JOB NO.: 11-6016	FIGURE: 19
CADFILE NAME: 6016SWL03.DWG	



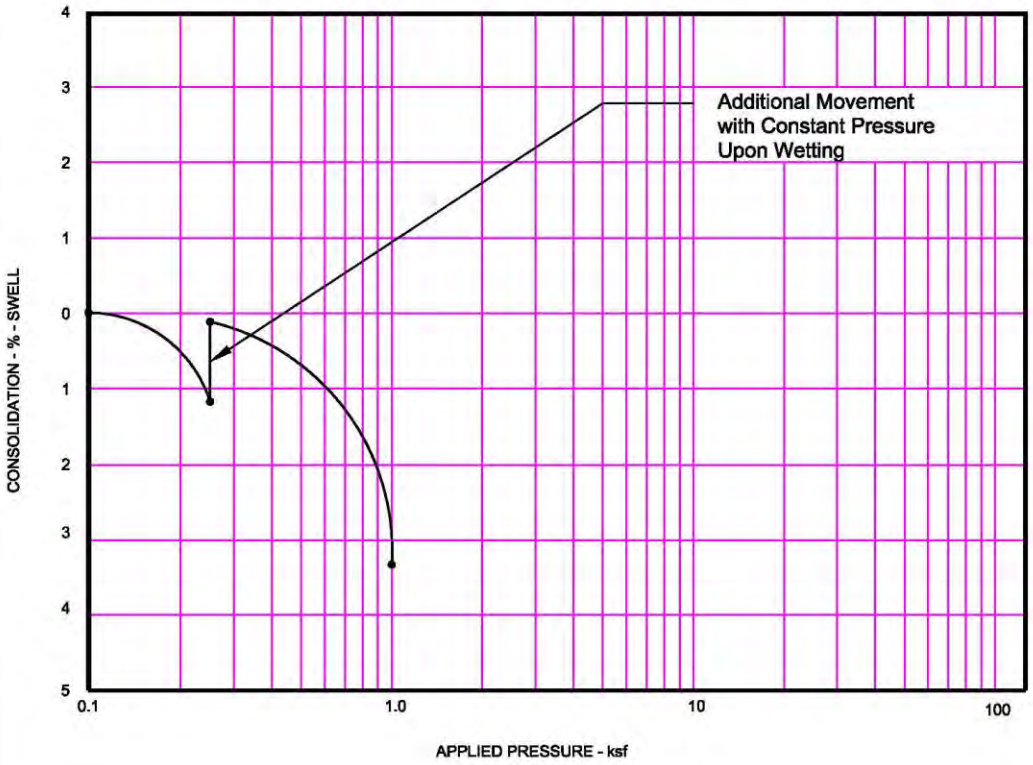
Moisture Content = 14.3 percent

Dry Unit Weight = 111.2 pcf

Sample of: Sandy Clay

From: Test Hole 10 at 3 ft

GROUND ENGINEERING CONSULTANTS	
SWELL-CONSOLIDATION TEST RESULTS	
JOB NO.: 11-6016	FIGURE: 20
CADFILE NAME: 6016SWL04.DWG	



Moisture Content = 11.0 percent

Dry Unit Weight = 119.6 pcf

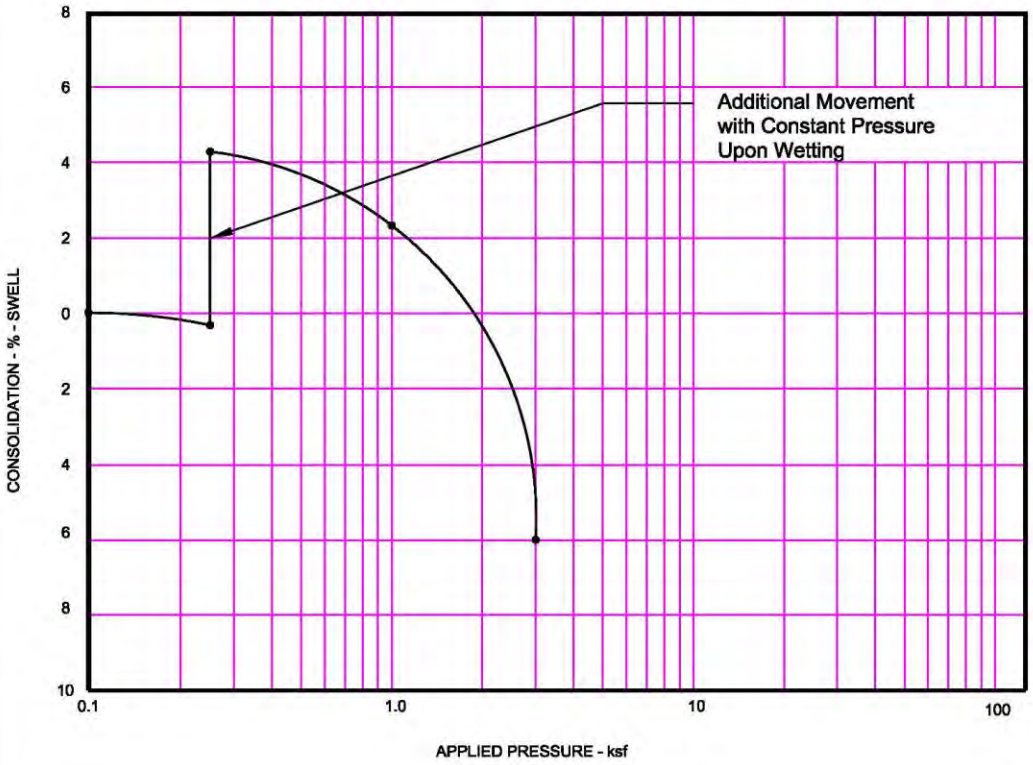
Sample of: Shale Bedrock

From: Test Hole 13 at 1.5 ft

GROUND
ENGINEERING CONSULTANTS

SWELL-CONSOLIDATION
TEST RESULTS

JOB NO.: 11-6016	FIGURE: 21
CADFILE NAME: 6016SWL05.DWG	



Moisture Content = 9.2 percent

Dry Unit Weight = 86.1 pcf

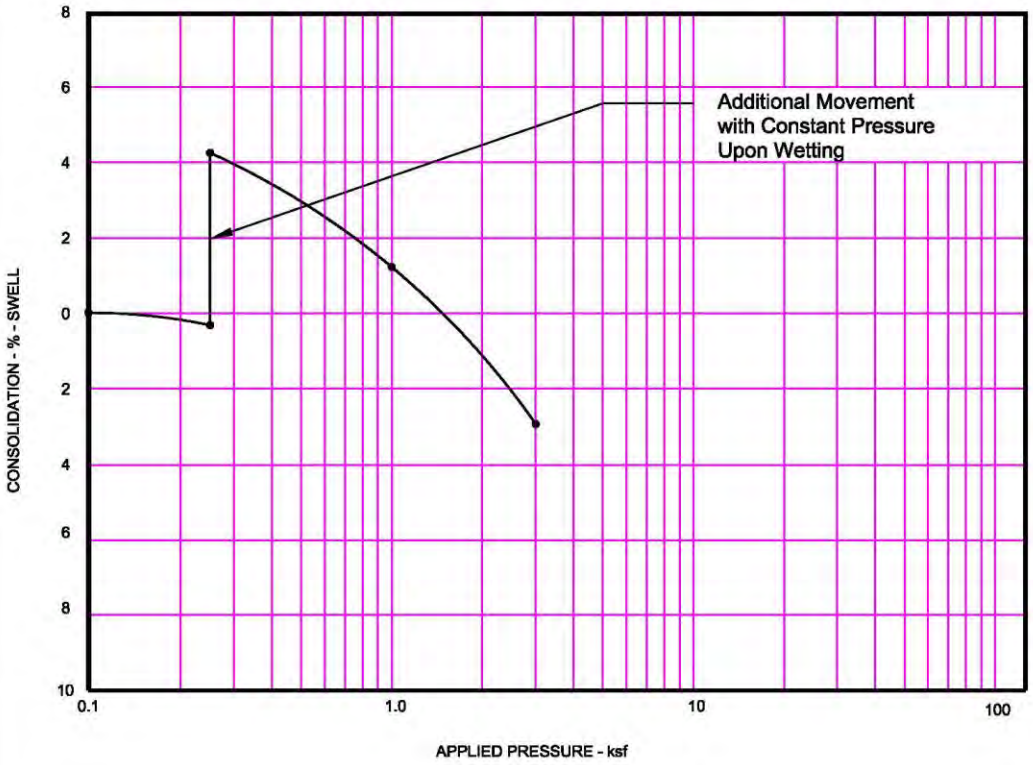
Sample of: Clay with Sand

From: Test Hole 22 at 2 ft

GROUND
ENGINEERING CONSULTANTS

SWELL-CONSOLIDATION
TEST RESULTS

JOB NO.: 11-6016	FIGURE: 22
CADFILE NAME: 6016SWL06.DWG	



Moisture Content = 8.2 percent

Dry Unit Weight = 121.6 pcf

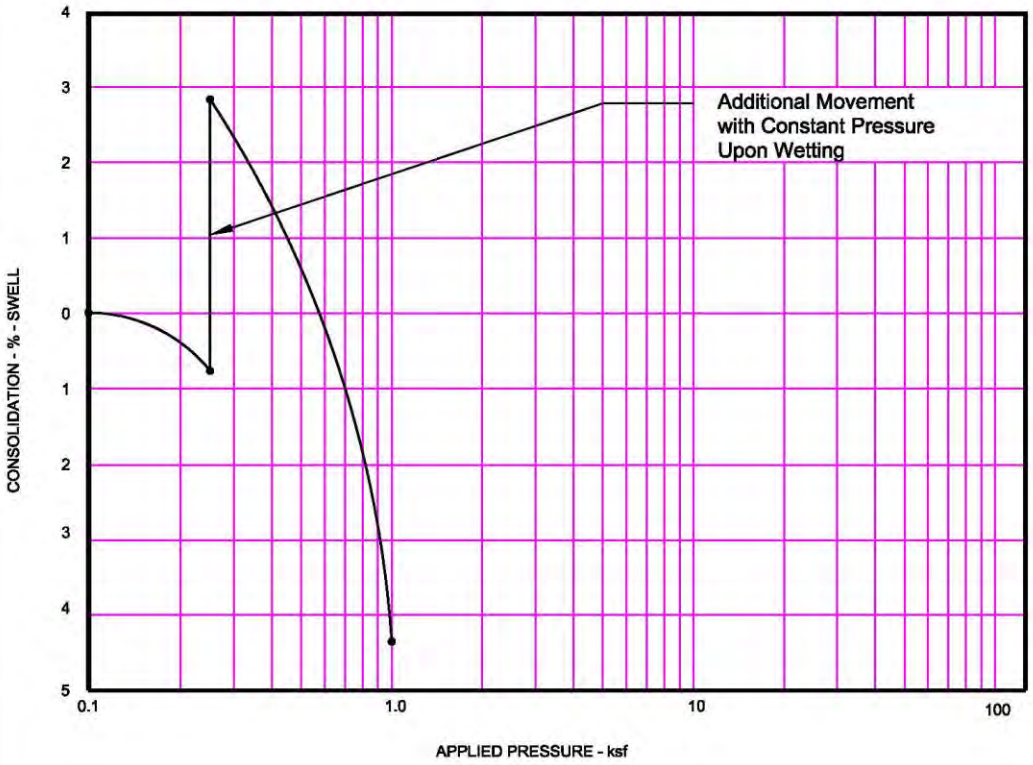
Sample of: Fill

From: Test Hole 24 at 1 ft

GROUND
ENGINEERING CONSULTANTS

SWELL-CONSOLIDATION
TEST RESULTS

JOB NO.: 11-6016	FIGURE: 23
CADFILE NAME: 6016SWL07.DWG	



Moisture Content = 12.8 percent

Dry Unit Weight = - pcf

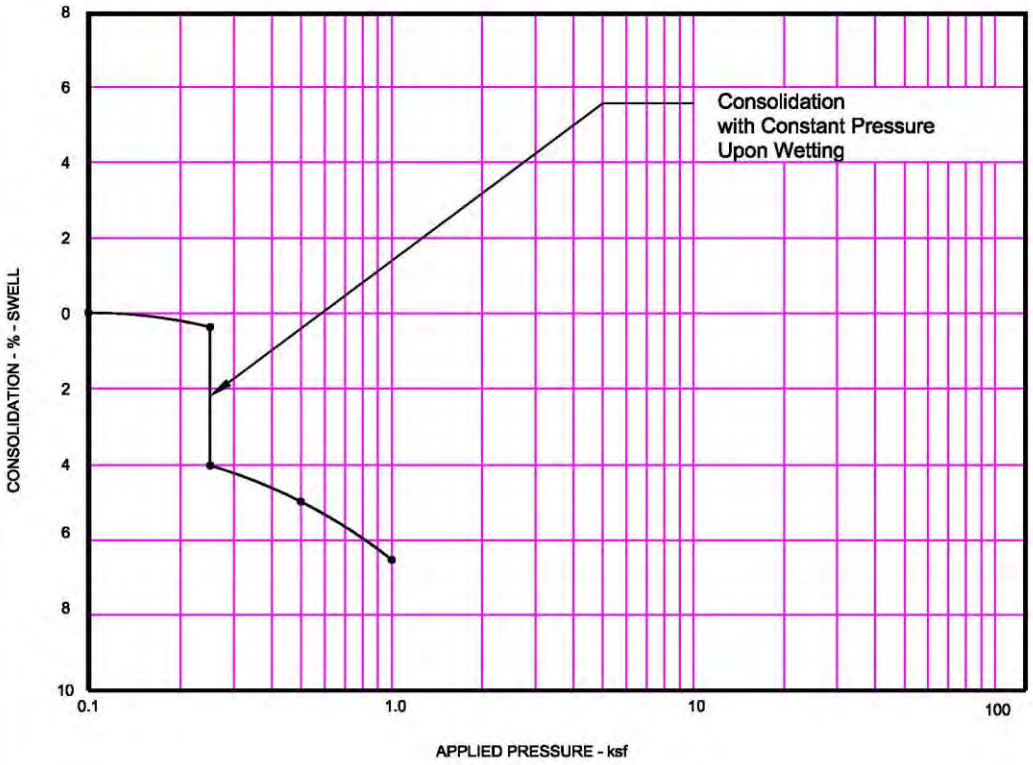
Sample of: Shale Bedrock

From: Test Hole 26 at 2 ft

GROUND
ENGINEERING CONSULTANTS

SWELL-CONSOLIDATION
TEST RESULTS

JOB NO.: 11-6016	FIGURE: 24
CADFILE NAME: 6016SWL08.DWG	



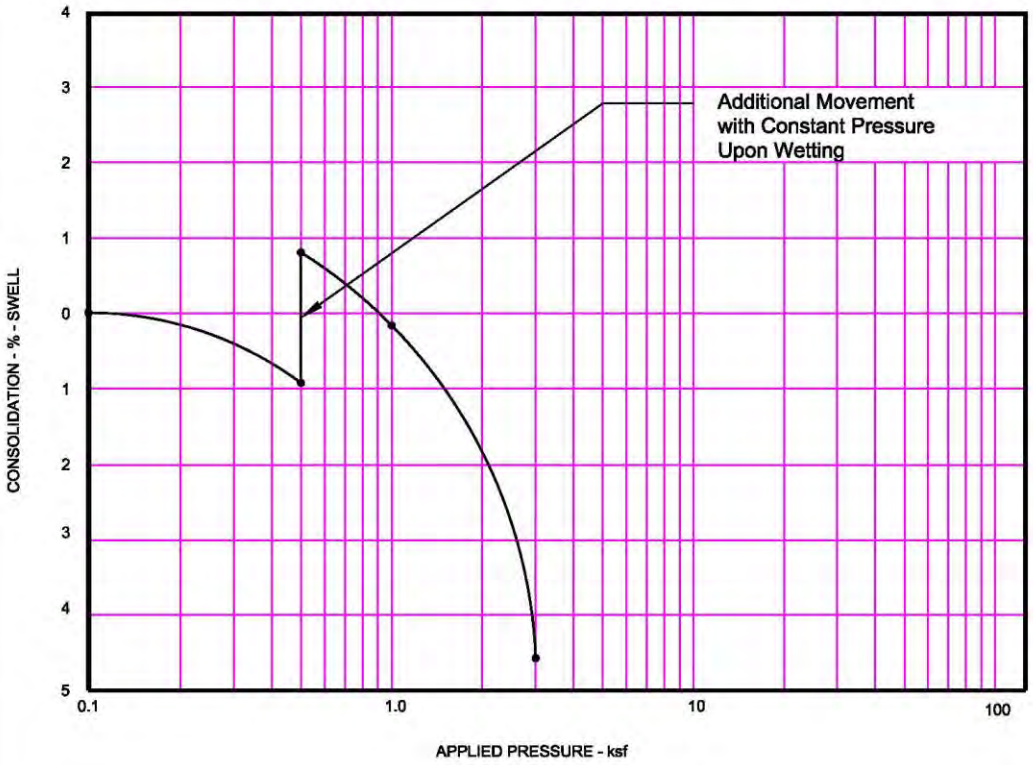
Moisture Content = 12.2 percent

Dry Unit Weight = 91.8 pcf

Sample of: Clay with Sand

From: Test Hole 37 at 2 ft

GROUND ENGINEERING CONSULTANTS	
SWELL-CONSOLIDATION TEST RESULTS	
JOB NO.: 11-6016	FIGURE: 25
CADFILE NAME: 6016SWL09.DWG	



Moisture Content = 11.2 percent

Dry Unit Weight = 100.4 pcf

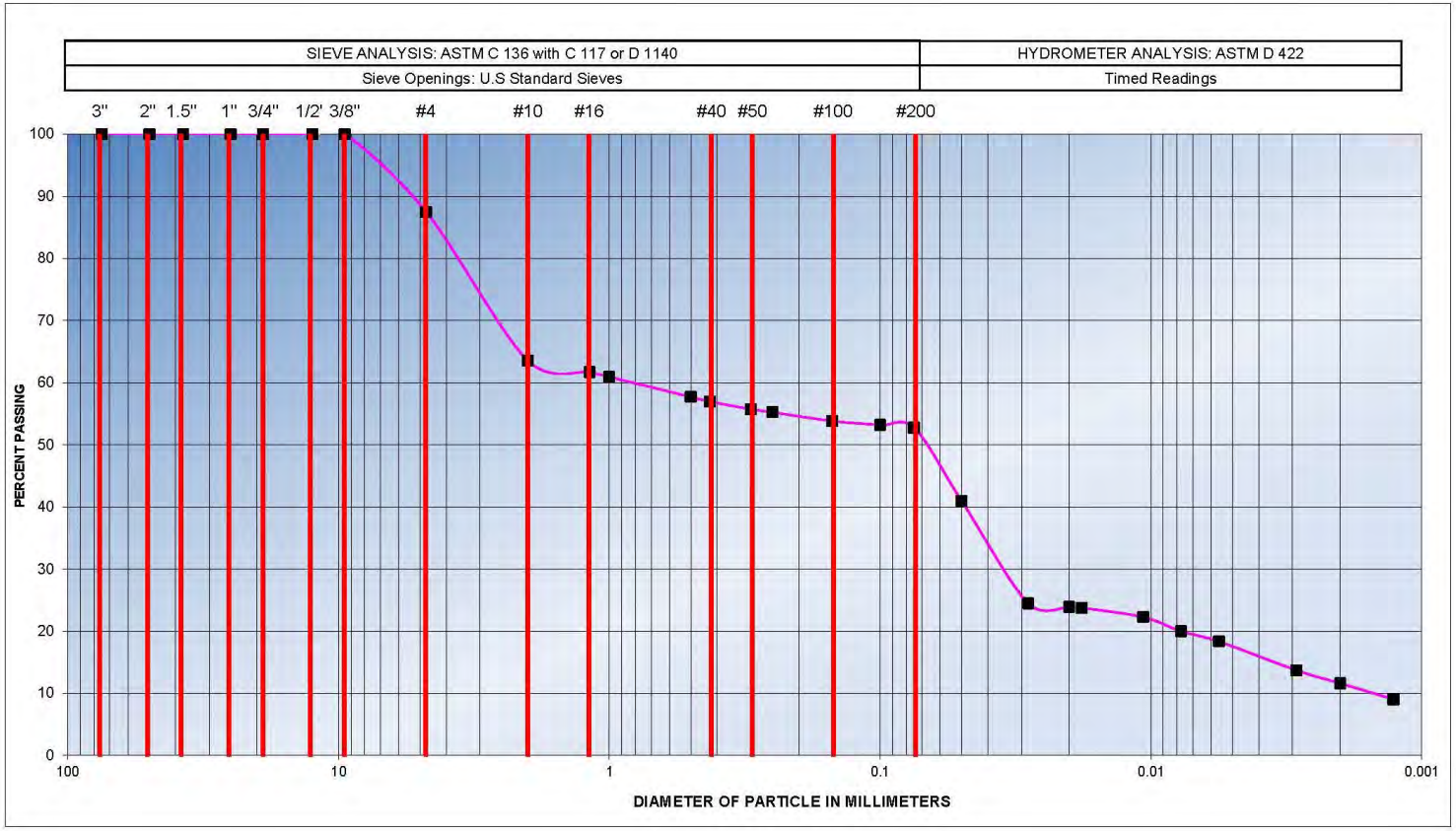
Sample of: Shale Bedrock

From: Test Hole 31 at 10 ft

GROUND
ENGINEERING CONSULTANTS

SWELL-CONSOLIDATION
TEST RESULTS

JOB NO.: 11-6016	FIGURE: 26
CADFILE NAME: 6016SWL10.DWG	

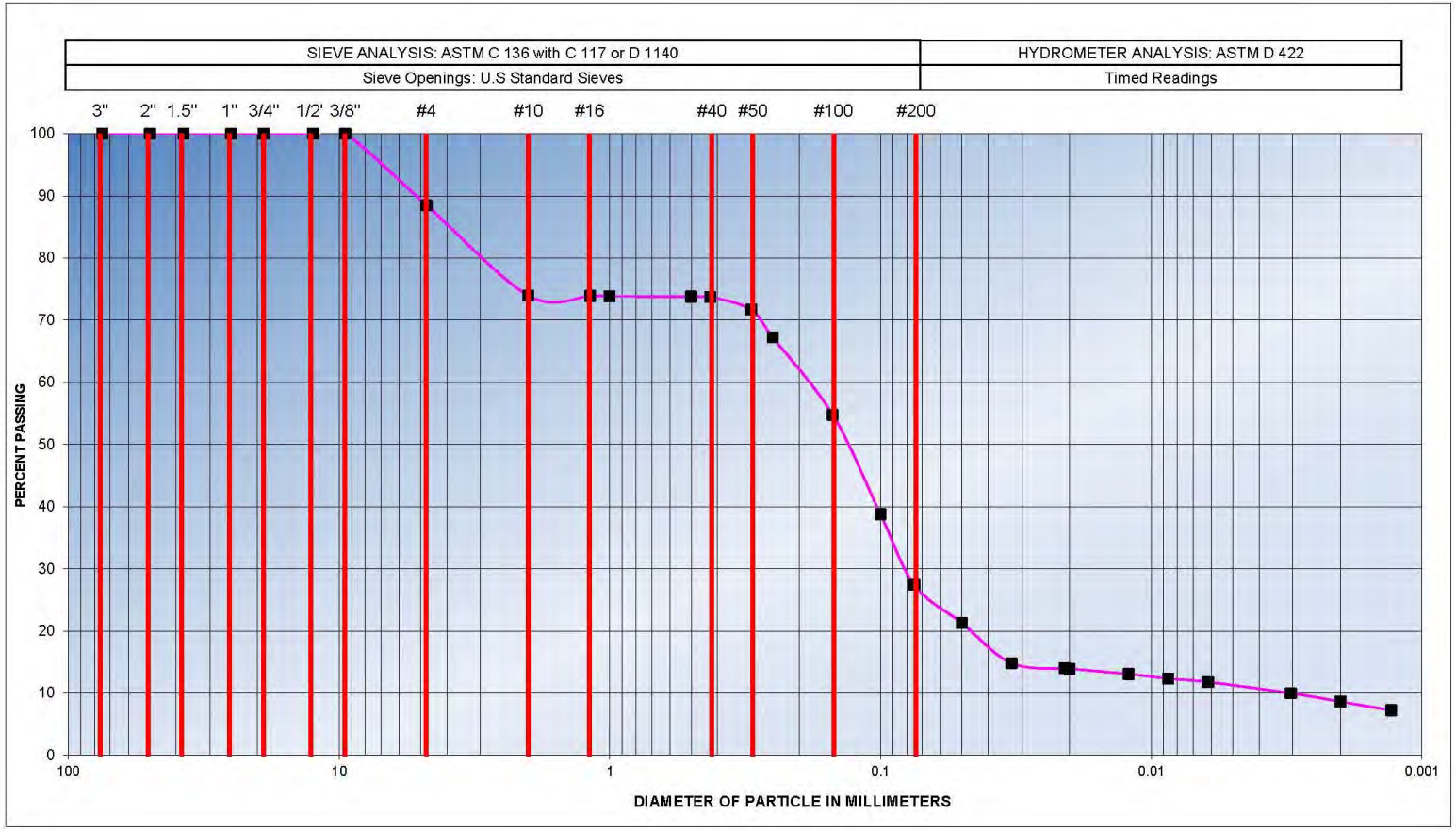


COBBLE	GRAVEL		SAND			SILT	CLAY
	Coarse	Fine	Coarse	Medium	Fine		

Sample of: Sandy Lean Clay	Gravel 13%	Sand 35%	Silt and Clay 52%
From: TH-26 @ 2'	Liquid Limit 42	Plastic Limit 16	

GROUND
ENGINEERING CONSULTANTS

GRADATION TEST RESULTS
JOB NO.: 11-6016
FIGURE: 27



COBBLE	GRAVEL		SAND			SILT	CLAY
	Coarse	Fine	Coarse	Medium	Fine		

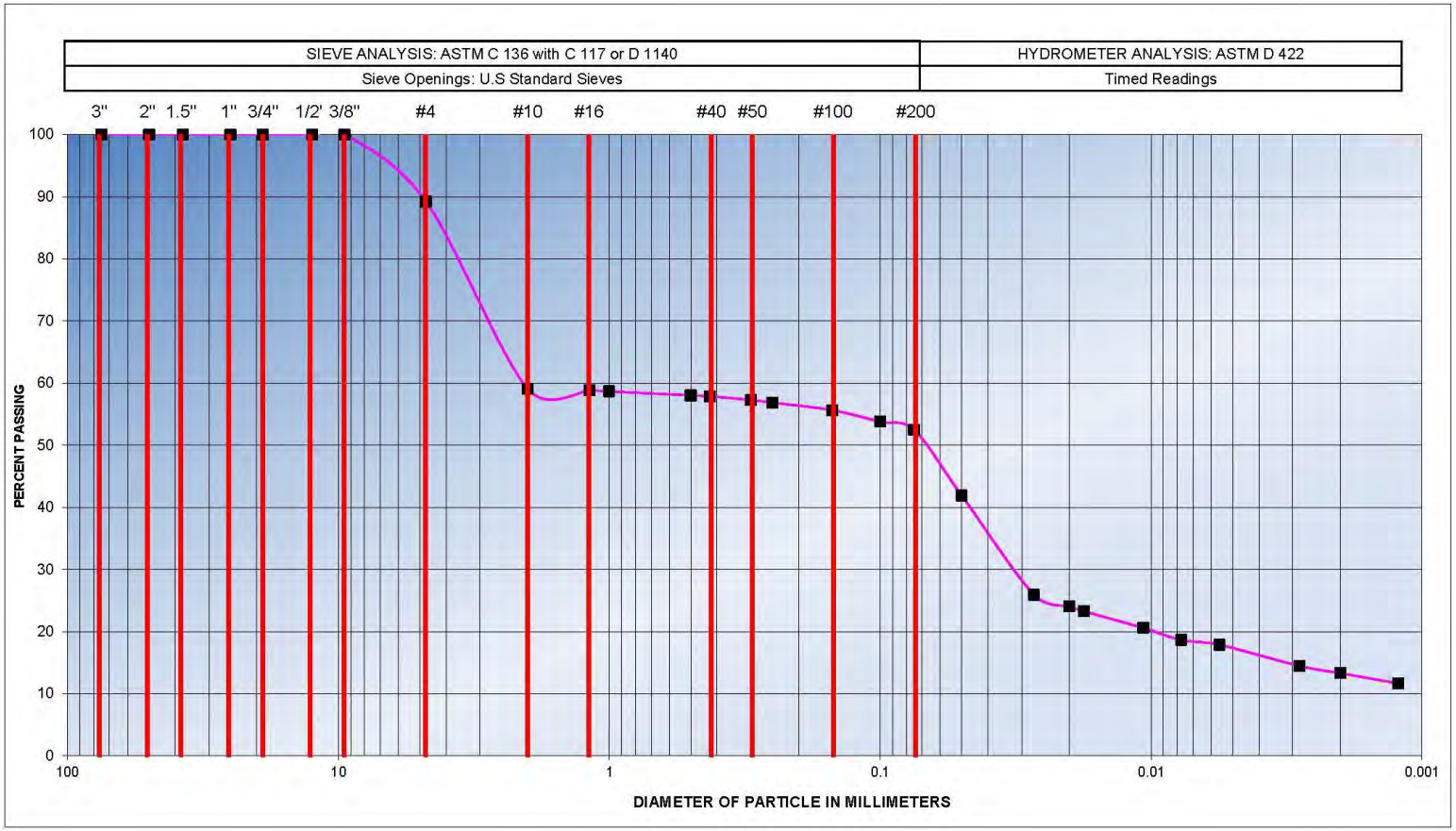
Sample of: Clayey Sand	Gravel 12%	Sand 61%	Silt and Clay 27%
From: TH-42 @ 4'	Liquid Limit 19	Plastic Limit 6	

GROUND ENGINEERING CONSULTANTS

GRADATION TEST RESULTS

JOB NO.: 11-6016

FIGURE: 28



Sample of: Sandy Lean Clay	Gravel 11% Sand 37% Silt and Clay 52%	GROUND ENGINEERING CONSULTANTS	
From: TH-67 @ 9'	Liquid Limit 32 Plastic Limit 15	GRADATION TEST RESULTS	
		JOB NO.: 11-6016	
		FIGURE: 29	

COMPACTION TEST REPORT

Project No.: 11-6016 **Date:** 2/6/12
Project: Grand Junction Airport
Client:
Location: CBR #1 Shale @ Runway Area

Remarks:

MATERIAL DESCRIPTION

Description:

Classifications - **USCS:** SC **AASHTO:** A-2-6(0)
Nat. Moist. = **Sp.G. =**
Liquid Limit = 31 **Plasticity Index =** 11
% < No.200 = 21.9 %

TEST RESULTS
Maximum dry density = 126.0 pcf
Optimum moisture = 11.5 %

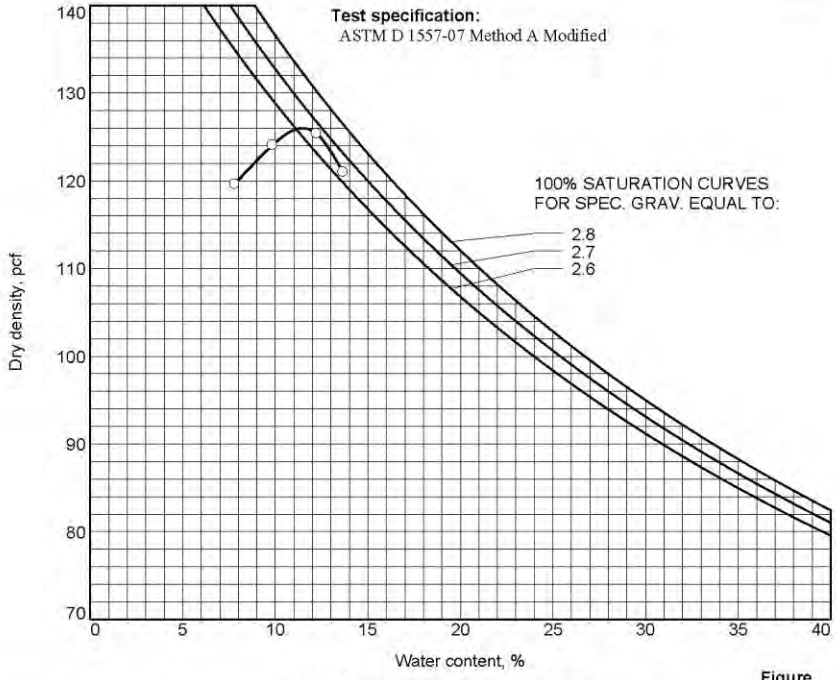


Figure 30

Ground Engineering Consultants, Inc.

COMPACTION TEST REPORT

Project No.: 11-6016 **Date:** 2/6/12
Project: Grand Junction Airport
Client:
Location: CBR #2 Clay @ Runway Area

Remarks:

MATERIAL DESCRIPTION

Description:

Classifications - **USCS:** (CL)s **AASHTO:** A-6(6)
Nat. Moist. = **Sp.G. =**
Liquid Limit = 26 **Plasticity Index =** 11
% < No.200 = 73.5 %

TEST RESULTS
Maximum dry density = 126.4 pcf
Optimum moisture = 10.7 %

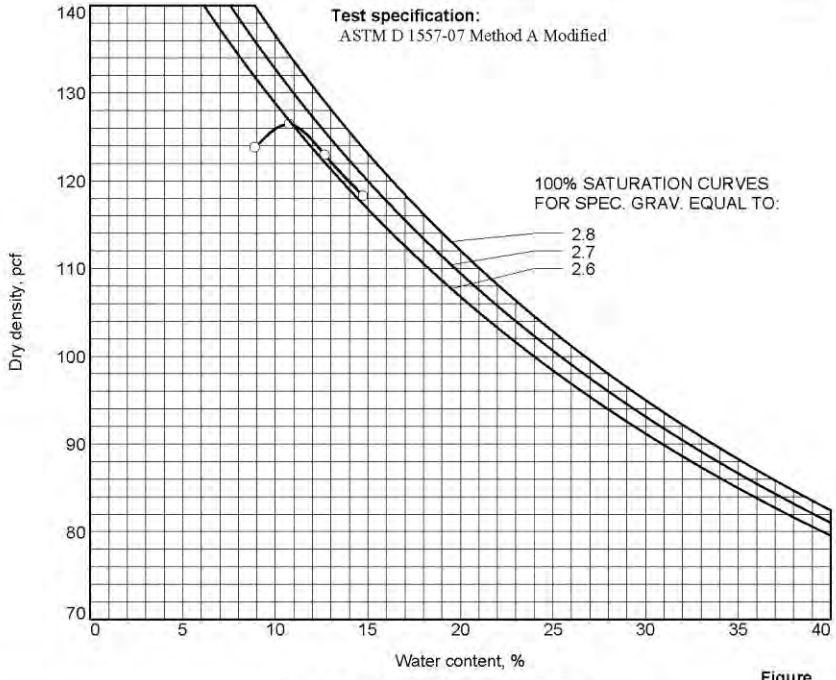


Figure 31

Ground Engineering Consultants, Inc.

COMPACTION TEST REPORT

Curve No.: Shale, Borrow Area

Project No.: 11-6016 **Date:** 1/24/12
Project: Grand Junction Airport
Client:
Location: CBR #3 Shale @ Borrow Area
Sample Number: 3478
Remarks:

MATERIAL DESCRIPTION

Description:

Classifications - **USCS:** CL **AASHTO:** A-7-6(22)
Nat. Moist. = **Sp.G. =**
Liquid Limit = 46 **Plasticity Index =** 22
% < No.200 = 89.8 %

TEST RESULTS
Maximum dry density = 119.6 pcf
Optimum moisture = 12.0 %

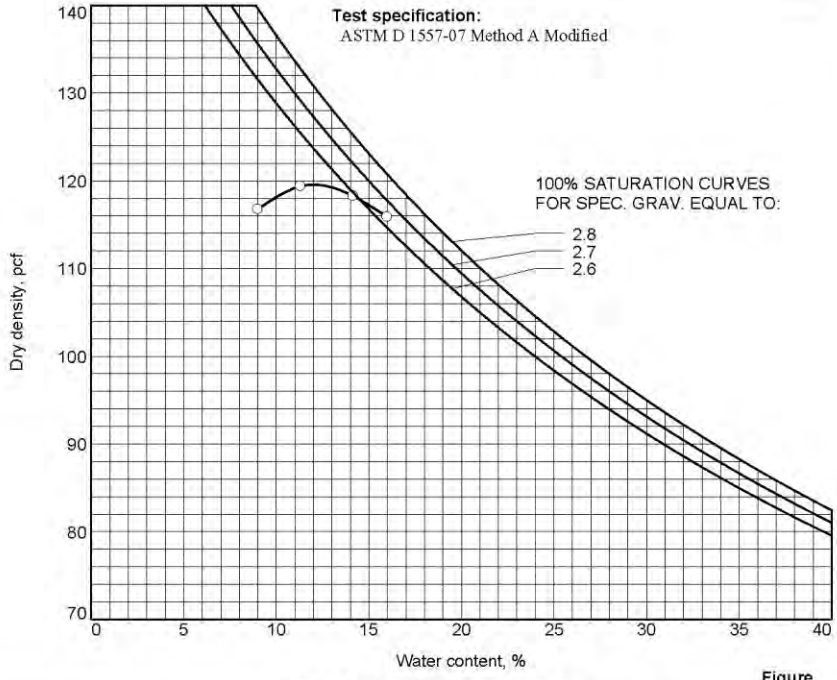


Figure 32

Ground Engineering Consultants, Inc.

COMPACTION TEST REPORT

Project No.: 11-6016 **Date:** 2/6/12
Project: Grand Junction Airport
Client:
Location: CBR #4 Clay @ Borrow Area

Remarks:

MATERIAL DESCRIPTION

Description:

Classifications - **USCS:** s(CL-ML) **AASHTO:** A-4(0)
Nat. Moist. = **Sp.G. =**
Liquid Limit = 21 **Plasticity Index =** 4
% < No.200 = 65.6 %

TEST RESULTS
Maximum dry density = 125.4 pcf
Optimum moisture = 10.9 %

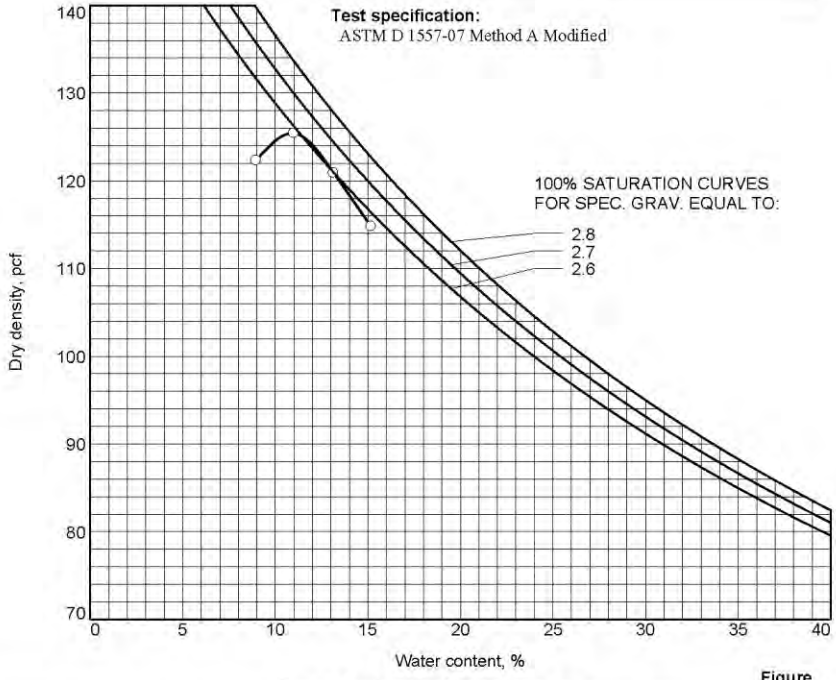


Figure 33

Ground Engineering Consultants, Inc.

CALIFORNIA BEARING RATIO TEST *(ASTM D 1883)*

Job Number: **11-6016** Job Name: **Grand Junction Regional Airport** Date: **February 14, 2012**

Soil Description: SHALE Proposed Runway (Test Holes #13 & #16)

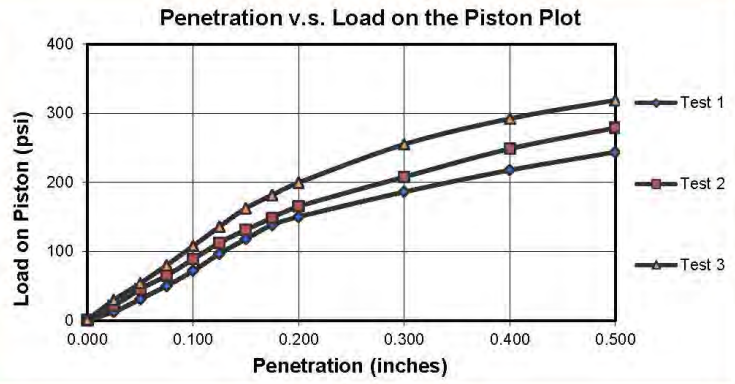
Sampled From: CBR #1

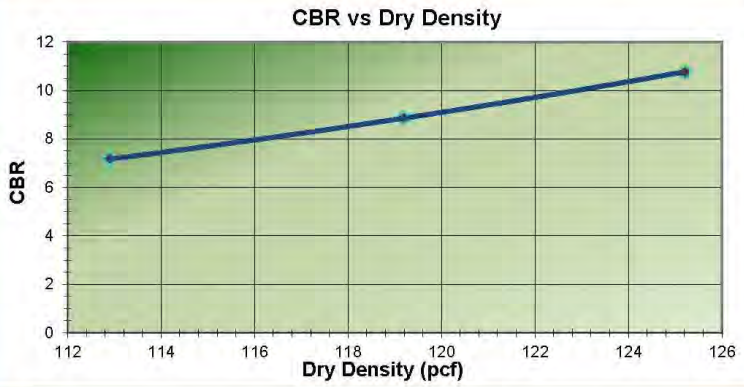
Comments:

Penetration *(inches)*	Test Number 1 Load (psi)	2 Load (psi)	3 Load (psi)
0.000	1	1	1
0.025	12	21	29
0.050	31	45	54
0.075	50	65	80
0.100	72	89	108
0.125	96	112	136
0.150	118	131	162
0.175	138	148	182
0.200	150	165	199
0.300	186	208	255
0.400	218	248	292
0.500	244	279	319

Test Number	1	2	3
Dry Dens. Before Soaking *(pcf)*	112.9	119.2	125.2
Relative Compaction *(%)*	89.7	94.7	99.4
Moist. Cont. Before Comp. *(%)*	11.4	11.5	11.6
Dry Dens. After Soaking *(pcf)*	114.2	118.3	118.6
Avg. Moist. Cont. After Soaking *(%)*	15.3	14.9	15.7
Swell *(%)*	1.0	0.8	0.7
Surcharge Weight *(lbs.)*	10	10	10

Maximum Dry Density	125.9
Optimum Moisture	11.5





		CBR at 0.1-inch Penetration	Dry Dens. Before Soaking (pcf)	CBR Values: Percentage Density	CBR Values: CBR
Test Number	1	7.2	112.9	90%	7.3
	2	8.9	119.2	**95%**	**9.0**
	3	10.8	125.2	100%	11.0

GROUND ENGINEERING CONSULTANTS

CBR TEST RESULTS

JOB NO.:11-6016

FIGURE: 34

CALIFORNIA BEARING RATIO TEST *(ASTM D 1883)*

Job Number: **11-6016** Job Name: **Grand Junction Regional Airport** Date: **February 14, 2012**

Soil Description: SILTY CLAY Proposed Runway (Test Holes #13 & #16 from 2 to 6 feet)

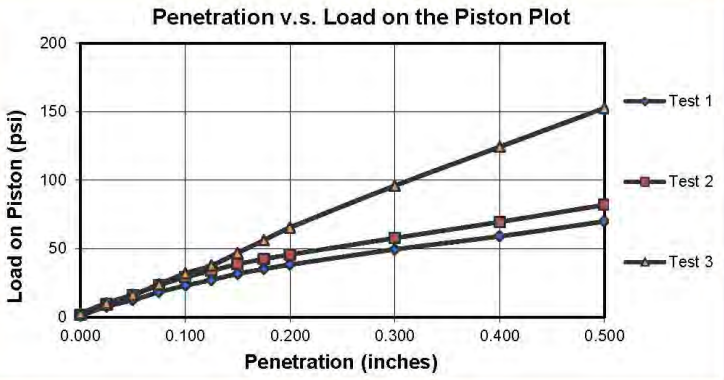
Sampled From: CBR #2

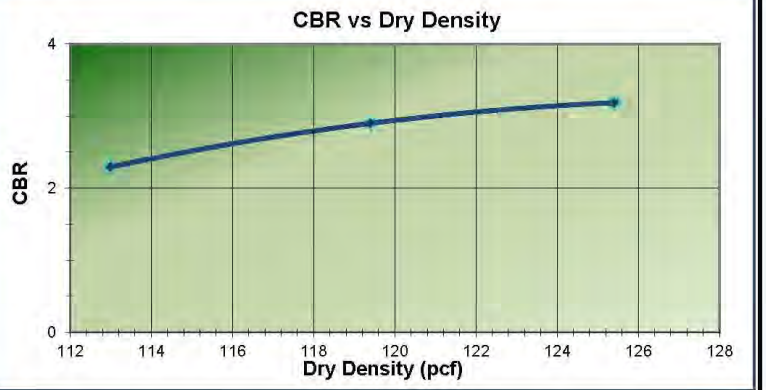
Comments:

Penetration *(inches)*	Test Number 1 Load (psi)	2 Load (psi)	3 Load (psi)
0.000	1	2	3
0.025	8	9	10
0.050	12	16	16
0.075	18	23	24
0.100	23	29	32
0.125	27	34	38
0.150	32	39	47
0.175	35	42	56
0.200	38	46	65
0.300	49	58	96
0.400	59	69	124
0.500	70	82	153

Test Number	1	2	3
Dry Dens. Before Soaking *(pcf)*	113.0	119.4	125.4
Relative Compaction *(%)*	89.4	94.5	99.2
Moist. Cont. Before Comp. *(%)*	10.8	10.7	10.8
Dry Dens. After Soaking *(pcf)*	112.5	113.5	124.6
Avg. Moist. Cont. After Soaking *(%)*	19.3	18.4	16.3
Swell *(%)*	2.1	2.4	3.1
Surcharge Weight *(lbs.)*	10	10	10

Maximum Dry Density	126.4
Optimum Moisture	10.7





		CBR at 0.1-inch Penetration	Dry Dens. Before Soaking (pcf)	CBR Values: Percentage Density	CBR Values: CBR
Test Number	1	2.3	113.0	90%	2.4
	2	2.9	119.4	**95%**	**2.9**
	3	3.2	125.4	100%	3.2

GROUND ENGINEERING CONSULTANTS

CBR TEST RESULTS

JOB NO.:11-6016

FIGURE: 35

CALIFORNIA BEARING RATIO TEST *(ASTM D 1883)*

Job Number: **11-6016** Job Name: **Grand Junction Regional Airport** Date: **February 14, 2012**

Soil Description: SHALE Borrow Source Area (Test Holes #38 & #54 from 6 to 15 feet)

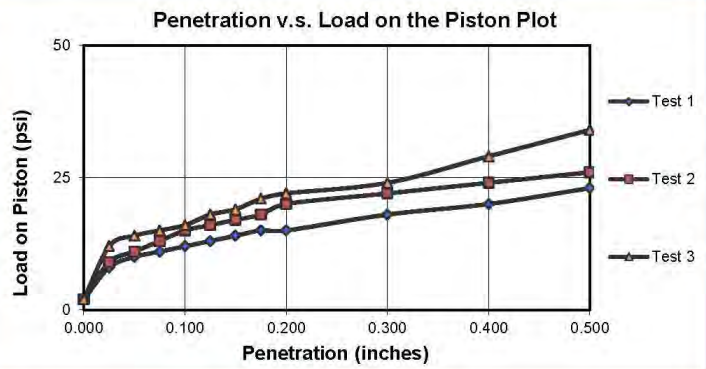
Sampled From: CBR #3

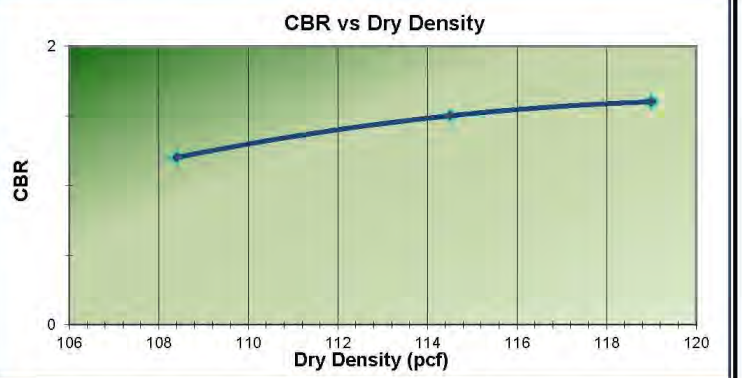
Comments:

Penetration *(inches)*	Test Number 1 Load (psi)	2 Load (psi)	3 Load (psi)
0.000	2	2	2
0.025	8	9	12
0.050	10	11	14
0.075	11	13	15
0.100	12	15	16
0.125	13	16	18
0.150	14	17	19
0.175	15	18	21
0.200	15	20	22
0.300	18	22	24
0.400	20	24	29
0.500	23	26	34

Test Number	1	2	3
Dry Dens. Before Soaking *(pcf)*	108.4	114.5	119.0
Relative Compaction *(%)*	90.6	95.7	99.5
Moist. Cont. Before Comp. *(%)*	11.9	11.7	11.8
Dry Dens. After Soaking *(pcf)*	107.9	108.2	112.5
Avg. Moist. Cont. After Soaking *(%)*	24.9	28.3	24.3
Swell *(%)*	5.1	3.3	3.0
Surcharge Weight *(lbs.)*	10	10	10

Maximum Dry Density	119.6
Optimum Moisture	12.0





		CBR at 0.1-inch Penetration	Dry Dens. Before Soaking (pcf)	CBR Values: Percentage Density	CBR Values: CBR
Test Number	1	1.2	108.4	90%	1.1
	2	1.5	114.5	**95%**	**1.5**
	3	1.6	119.0	100%	1.6

GROUND ENGINEERING CONSULTANTS

CBR TEST RESULTS

JOB NO.:11-6016

FIGURE: 36

CALIFORNIA BEARING RATIO TEST *(ASTM D 1883)*

Job Number: **11-6016** Job Name: **Grand Junction Regional Airport** Date: **February 14, 2012**

Soil Description: SILTY CLAY Borrow Source Area (Test Holes #42 & #57 from 2 to 12 feet)

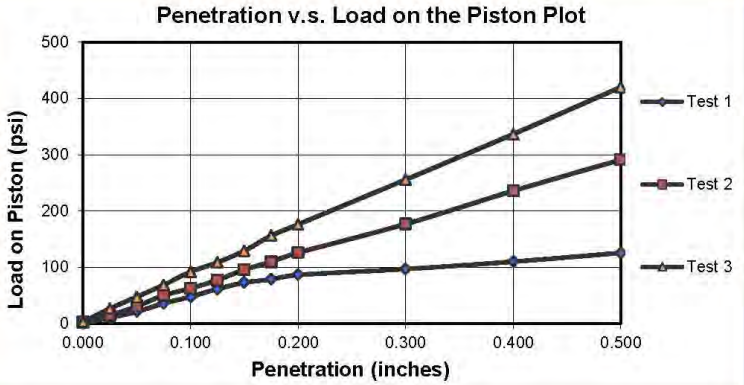
Sampled From: CBR #4

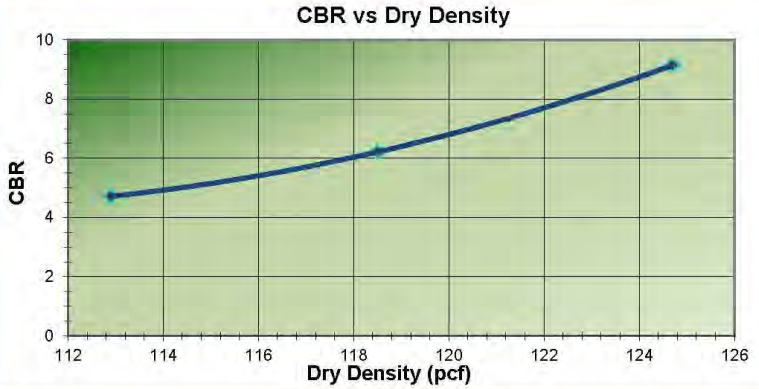
Comments:

Penetration *(inches)*	Test Number 1 Load (psi)	2 Load (psi)	3 Load (psi)
0.000	1	2	3
0.025	10	14	26
0.050	21	30	47
0.075	36	50	68
0.100	47	62	91
0.125	61	77	108
0.150	72	95	129
0.175	78	109	156
0.200	86	125	176
0.300	96	176	255
0.400	110	235	336
0.500	125	291	420

Test Number	1	2	3
Dry Dens. Before Soaking *(pcf)*	112.9	118.5	124.7
Relative Compaction *(%)*	90.0	94.5	99.4
Moist. Cont. Before Comp. *(%)*	10.7	11.0	10.8
Dry Dens. After Soaking *(pcf)*	113.5	117.7	122.9
Avg. Moist. Cont. After Soaking *(%)*	16.7	16.4	15.1
Swell *(%)*	0.4	1.0	1.0
Surcharge Weight *(lbs.)*	10	10	10

Maximum Dry Density	125.4
Optimum Moisture	10.9





		CBR at 0.1-inch Penetration	Dry Dens. Before Soaking (pcf)	CBR Values: Percentage Density	CBR Values: CBR
Test Number	1	4.7	112.9	90%	4.7
	2	6.2	118.5	**95%**	**6.4**
	3	9.1	124.7	100%	9.6

GROUND ENGINEERING CONSULTANTS

CBR TEST RESULTS

JOB NO.:11-6016

FIGURE: 37

GROUND
ENGINEERING CONSULTANTS

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

Sample Location		Natural	Natural	Gradation		Percent	Atterberg Limits		Percent	Unconfined	USCS	AASHTO	Soil or
Test Hole No.	Depth (feet)	Moisture Content (%)	Dry Density (pcf	Gravel (%)	Sand (%)	Passing No. 200 Sieve	Liquid Limit (%)	Plasticity Index (%)	Swell (250 psf Surcharge)	Compressive Strength (psf	Classification	Classification (GI)	Bedrock Type
1	1	12.2		10	37	53	24				s(ML)g	A-4 (0)	Sandy Silt w/Gravel
1	5	9.7	125.2			61	36	19		28,267	s(CL)	A-6 (9)	Claystone
4	5	14.3	86.0			66	41	16	-2.0		s(CL)	A-7-6(9)	Claystone
7	2	7.8		0	11	89	22	7			(CL-ML)	A-4 (1)	Sandy Silty Clay
7	14	7.0		25	56	19	33	16			g(SC)	A-2-6(9)	Gravelly Sand with Clay
10	3	14.3	111.2			68	40	16	6.2		s(CL)	A-6(10)	Claystone
13	18	11.0	119.6			52	48	24	1.1		s(CL)	A-7-6(9)	Weathered Shale (Zone 1)
16	19	7.8				8	34	13			s(GC)	A-2-6(0)	Competent Hard Shale (Zone 3)
18	2	11.8		0	8	92	31	13		14,260	CL	A-6(11)	Silty Clay
22	2	9.2	86.1			93	30	11	4.6		CL	A-6 (9)	Silty Clay
24	1	8.2	121.6			61	32	14	5.1		s(CL)	A-6 (6)	Fill
26	2	12.8		0	10	90	42	16	3.6		CL	A-7-6(16)	Weathered Shale (Zone 1)
31	2	12.2	91.8			89	25	10	-3.7		CL	A-4 (7)	Silty Clay
31	10	11.2	100.4			96	58	33	1.7		CH	A-7-6(36)	Siltstone / Claystone
36	8	9.3	121.1			97	46	19		17,554	CL	A-7-6(22)	Weathered Shale (Zone 1)
42	4	8.3		0	36	64	19	6			s(CL-ML)	A-4 (1)	Sandy Silty Clay
49	14	11.1	117.4			94	51	26		20,765	CH	A-7-6(28)	Competent Shale (Zone 2)
53	3	12.1				94	43	22			CL	A-7-6(22)	Silty Clay
54	5	7.5	111.5			94	47	26		8,726	CL	A-7-6(27)	Weathered Shale (Zone 1)
57	9	5.1	109.5			80	28	11		13,579	s(CL)	A-6 (7)	Silty Clay
57	19	8.7	88.3			77	39	20		21,080	s(CL)	A-6(14)	Silty Clay
60	5	7.5	119.3			84	46	25		6,540	s(CL)	A-7-6(22)	Weathered Shale (Zone 1)
63	10	8.1	123.1			94	49	26		18,980	CL	A-7-6(27)	Competent Shale (Zone 2)
67	9	7.5		0	6	94	32	15		16,320	CL	A-6(13)	Silty Clay
70	7	9.5	119.1			97	51	28		25,380	CH	A-7-6(31)	Competent Shale (Zone 2)
54	49-50									534,240	CL	A-7-6(35)	2½-inch diameter core sample

Job No. 11-6016

GROUND

ENGINEERING CONSULTANTS

TABLE 2

SUMMARY OF LABORATORY CBR TEST RESULTS

Sample Location		CBR Value	Optimum Moisture Content (%)	Maximum Dry Density (pcf)	Gradation		Passing No. 200 Sieve (%)	Atterberg Limits		USCS Classification	Soil or Bedrock Type
Test Hole No.	Area/Soil Type				Gravel (%)	Sand (%)		Liquid Limit (%)	Plasticity Index (%)		
CBR 1	Runway / Shale	9.0	11.5	126.0	5	73	22	31	11	CL	Weathered Shale
CBR 2	Runway / Clay	2.9	10.7	126.4	0	26	74	26	11	CL	Silty Clay
CBR 3	Borrow / Shale	1.5	12.0	119.6			90	46	22	CL	Shale
CBR 4	Borrow / Clay	6.4	10.9	125.4	0	34	66	21	4	CL	Silty Clay

N P indicates 'non-pla

Job No. 11-6027

GROUND
ENGINEERING CONSULTANTS

TABLE 3
SUMMARY OF LABORATORY TEST RESULTS

Sample Location		Water Soluble Sulfates	pH	Redox Potential	Sulfides Content	Resistivity	USCS Classifi-cation	Soil or Bedrock Type
Test Hole No.	Depth (feet)	(%)		(m V)		(ohm-cm)		
1	1	.07	7.2	-14	Positive	7,841	s(ML)g	Sandy Silt w/Gravel
18	2	.10	7.8	-50	Positive	1,298	CL	Silty Clay
26	2	.16	7.8	46	Positive	19,583	CL	Weathered Shale
57	9	.12	7.5	-29	Positive	22,381	s(CL)	Silty Clay

Job No. 11-6016

ENGINEER'S REPORT

Environmental Assessment
Runway 11/29 Conceptual (25%) Design
County Road 27-¼ Realignment Conceptual (25%) Design

Project No. BD GJT 11-01

Grand Junction Regional Airport
Grand Junction, Colorado

Sponsored By:
Grand Junction Regional Airport Authority
Federal Aviation Administration

JVIATION®
900 S. Broadway, Suite 350
Denver, CO 80209
Main 303.524.3030
Fax 303.524.3031
JVIATION.COM

Volume 2
August 17, 2012

TABLE OF CONTENTS

Volume 1 Page

1. Scope of Work 1

2. Photographs 5

3. Life Cycle Cost Analysis 11

4. Design Standards 12

5. Soils and Grading 14

6. Drainage 16

7. Pavement Design 18

8. Pavement Marking 25

9. Signage, Lighting, and NAVAIDS 26

10. Engineer's Estimate 28

APPENDICES

A. Project Sketch

B. Life Cycle Cost Analysis

C. Engineer's Estimate

D. Geotechnical Investigation Report

Volume 2

E. Drainage Analysis

F. Pavement Design Forms & Supporting Documentation

APPENDIX E

Drainage Analysis

David Le

Subject: FW: Response to Second Round of Staff Comments for the Grand Junction Regional Airport Civic and Institutional Facilities Master Plan

From: Rick Dorris <rickdo@ci.grandjct.co.us>
Date: June 15, 2012 1:41:20 PM MDT
To: Lori Bowers <lorib@ci.grandjct.co.us>, Tim Malloy <tgmalloy@sopris.net>
Cc: 'Mark McFarland' <mark@bd-c.com>, 'Ryan Hayes' <ryan@bd-c.com>, <ajordan@gjairport.com>, <rtippetts@gjairport.com>, Mark Lovato <Mark.Lovato@jviation.com>
Subject: Re: Response to Second Round of Staff Comments for the Grand Junction Regional Airport Civic and Institutional Facilities Master Plan

All,

Nice job on the response. I have no further comments.

Can you please get us an electronic copy of the drainage report for our database?

Thanks,

Rick Dorris, PE, CFM
Development Engineer
City of Grand Junction
250 N. 5th Street
Grand Junction, CO 81501
voice 970-256-4034
fax 970-256-4031
email: rickdo@gjcity.org>>> On 6/8/2012 at 5:19 PM, in message <004901cd45cd$16c9ab60$445d0220$@sopris.net>, "Tim Malloy" <tgmalloy@sopris.net> wrote:

> Hi Lori and Rick! The attached documents constitute the Grand Junction Regional Airport's response to staff's second r
> Airport's Civic and Institutional Master Plan application (FMP-2012-255). The attached documents include a letter fron
> addressing Rick's questions related to the drainage plan and a copy of the current stormwater discharge permit, which w
> year. If you need anything further please let me know.
>
> I look forward to discussing potential dates for the Planning Commission and City Council hearings.
>
> Tim
>
> Tim Malloy, Principal
> **TG Malloy Consulting, LLC**
> 402 Park Drive
> Glenwood Springs, Colorado 81601
> Phone: 970-945-0832
> Fax: 970-945-0833

e-mail: tgmalloy@sopris.net

This email and any attached files are confidential and intended solely for the intended recipient(s). Any unauthorized review, disclo
prohibited. If you have received this e-mail by mistake, please notify us immediately by reply e-mail and destroy all copies of the o

---

From: Lori Bowers [mailto:lorib@ci.grandjct.co.us]
Sent: Wednesday, May 23, 2012 4:13 PM
To: ajordan@gjairport.com; tgmalloy@sopris.net
Cc: rtippetts@gjairport.com
Subject: Second round of Review Comments

Tim,
Please find attached the second round of Review Comments.

Lori

Lori V. Bowers, Senior Planner
Public Works, Planning Division
970-256-4033
lorib@gjcity.org

MASTER DRAINAGE REPORT



Grand Junction Regional Airport

Grand Junction, Colorado

Sponsored By:

Grand Junction Regional Airport Authority
Federal Aviation Administration

JUNE 2012

JVIATION®

900 S. Broadway, Suite 350
Denver, CO 80209

Main 303.524.3030
Fax 303.524.3031

JVIATION.COM

ENGINEER'S STATEMENT

I hereby certify that this Drainage Analysis for the Master Drainage Report was prepared by me (or under my direct supervision) in accordance with the provisions of the *Stormwater Management Manual*. I understand that the City of Grand Junction does not and will not assume liability for drainage facilities analyzed by others.

Mark J. Lovato, PE
State of Colorado No. 35184
(Affix Seal)



OWNER'S CERTIFICATION

The Grand Junction Regional Airport Authority hereby certifies that the drainage facilities for the Grand Junction Regional Airport shall be constructed according to the design presented in this report. We understand that the City of Grand Junction does not and will not assume liability for the drainage facilities analyzed and/or certified by our engineer. We understand that the City of Grand Junction reviews drainage plans but cannot, on behalf of the Grand Junction Regional Airport, guarantee that final drainage design review will absolve the Grand Junction Regional Airport Authority and/or their successors and/or assigns of future liability for improper design. We further understand that approval of the Master Drainage Report does not imply approval of our engineer's drainage design.

Grand Junction Regional Airport Authority

6-11-12

Authorized Signature Date

TABLE OF CONTENTS

	Pages
INTRODUCTION	
A. Background	1
B. Project Location	1
C. Project Description	1
D. Previous Investigations	2
DRAINAGE SYSTEM DESCRIPTION	
A. Existing/Proposed Drainage Conditions	2
B. Offsite Tributary Area	5
C. Drainage Facility Maintenance	5
DRAINAGE ANALYSIS AND DESIGN CRITERIA	
A. Regulations	6
B. Regulation – Lag Time	6
C. Development Criteria	8
D. Hydrologic Criteria	8
E. Hydraulic Criteria	8
F. Water Quality Requirements	8
G. Variance from Criteria	9
DRAINAGE FACILITY DESIGN	
A. General Concept	9
B. Specific Details	10
CONCLUSION	
A. Compliance with Manual	10
B. Design Effectiveness	10
C. Areas in Flood Hazard Zone	10
D. Variances from Manual	11
REFERENCES	12
APPENDIX A – CHECKLIST	
Drainage Report Checklist – Table 302 – Stormwater Management Manual	
Drainage Plan Checklist – Table 303 – Stormwater Management Manual	
APPENDIX B – DESIGN CHARTS	
Vicinity Map	
Flood Insurance Rate Map	
Excerpts from Stormwater Management Manual	
NRCS Web Soil Survey Data	
Excerpt from AC 150/5200-33B	
SCS Method Reference Data	
Water Quality Capture Volume Criteria	
Regional Analysis for Flood Peak Flows (March 10, 2012) – Prepared by Dr. Guo	

APPENDIX C – LEACH CREEK PLANS (BY OTHERS)

Leach Creek Detention Basin June 2003, City of Grand Junction
Leach Creek Detention Basin Water District 5, March 2003, City of Grand Junction

APPENDIX D – HYDROLOGIC CALCUALTIONS

Pre-Developed Hydrologic Computations
Developed Conditions Hydrologic Computations

APPENDIX E – HYDRAULIC CALCUALTIONS

Graphical HEC-1 Connectivity Diagrams
HEC-1 Model 10-yr Existing Conditions
HEC-1 Model 100-yr Existing Conditions
HEC-1 Model 10-yr Proposed Conditions
HEC-1 Model 100-yr Proposed Conditions
Pond Design

APPENDIX F – MAPS

Drainage Maps

INTRODUCTION

A. Background

This report, written by Mark Lovato P.E., summaries the hydrology and hydraulics of the Grand Junction Regional Airport for the ultimate build-out of the airport. This report incorporates the master plan report, which discusses all current and future plans for the airport.

The Master Drainage Plan, dated June 2012, addressed the City of Grand Junction's second round of comments for the Airport Master Plan, dated May 23, 2012.

B. Location

This project is located at the Grand Junction Regional Airport (see Vicinity Map in Appendix B). The project is located northeast of the City of Grand Junction, Colorado in Mesa County, north of Interstate 70 (I-70), approximately one mile along Horizon Drive. The airport is bordered by Bureau of Land Management (BLM) property to the north and east, I-70 and the Government Highline Canal to the south, and Road 27 ¼ to the west.

The area studied in this report includes land in Sections 24 and 25 of Township 1 North, Range 1 West of the Ute Meridian and Sections 19, 29, 30, and 32 of Township 1 North, Range 1 East of the Ute Meridian.

A vicinity map of the project is located in Appendix B of this report.

C. Description of Property

The property is made up of commercial and general aviation areas that utilize the airport for business. The land consists of runways, taxiways, aprons, parking lots, buildings, roadway networks, and utility infrastructure to serve the operations at the airport.

A majority of the airport consists of undisturbed sandy soils. Existing grades vary a wide range with a maximum slope of 50%. There are three major drainage basins that run throughout the site: Ranchman's Creek, Leach Creek, and Indian Wash.

In general, the airport is planning on relocating Runway 11/29 to the north, relocating 27 ¼ Road to the north, constructing pavement west of Runway 4/22, and constructing additional buildings through the airport. Because these improvements will be built, detention and water quality ponds will need to be constructed to meet Grand Junction stormwater requirements. This report will determine necessary locations and sizes of the proposed detention and water quality pond facilities.

D. Previous Investigations

From the Flood Insurance Rate Map, Community Panel Number 080117 0001 0009, revised July 15, 1992, the entire airport lies in Zone X. Zone X is determined to be outside of the 500-year floodplain. A Flood Insurance Rate Map can be found in Appendix B of this report.

The most recent report that pertains to this site is *Ranchman's Ditch (Horizon Drive Channel), Leach Creek, & North Leach Creek Conditional Letter of Map Revision (CLOMR)*, which was prepared by Icon Engineering in October 2004. A majority of assumptions and information was based on this report.

DRAINAGE SYSTEM DESCRIPTION

A. Existing/Proposed Drainage Conditions

There are three major drainage basins that go throughout the site: Ranchman's Creek, Leach Creek, and Indian Wash. Additionally, Corcoran Basin, which is adjacent to the airport, will be discussed in this section of the report.

RANCHMAN'S CREEK

Ranchman's Creek is subdivided into twenty-one subbasins and is the main basin that conveys flows through the airport. Major changes to the previous drainage report (Icon 2004) include the revisions to all drainage subbasin areas, imperviousness of all subbasins, and the division of subbasins DB21a and DB22.

Based on updated topography data, all subbasin areas were re-evaluated to more accurately delineate each basin. Subbasin DB21a was divided into three subbasins (DB21a, DB21a1, and DB21a2) and subbasin DB22 was divided into two subbasins (DB22 and DB22a) to incorporate the proposed relocation of Runway 11/29 and 27 ¼ Raod.

Subbasin DB21 is north of Runway 11/29 and is comprised of 100.5 acres that convey flows to an existing detention pond (Pond A). Flows from Pond A are conveyed into Subbasin DB21a2. Subbasin DB21a2 is comprised of 49.9 acres which convey flows to proposed Pond 4a. Subbasin DB21a1 is comprised of 44.8 acres which convey flows to proposed Pond 4. Both Pond 4 and 4a are directly north of the relocated 27 ¼ Road and proposed Runway 11/29 and outfall into subbasin DB21a. Both Pond 4 and 4a are designed to be detention ponds with water quality elements to reduce sediment from entering downstream basins. Subbasin DB21a is comprised of 150.2 acres and includes a portion of relocated Runway 11/29. Overland flows in subbasin DB21a are conveyed into proposed Pond 4b. The outfall of Pond 4b is an existing 36" Reinforced Concrete Pipe (RCP pipe). The remaining subbasins downstream to subbasin DB21a include DB23b, DB23c, DB23d, DB23e, and DB23a, remain unchanged, and flows eventually enter the city's existing upper detention pond (R_PDU).

Subbasin DB22, which is north of the relocated 27 ¼ Road and proposed Runway 11/29, is comprised of 36.1 acres. Overland flows of subbasin DB22 are conveyed into proposed Pond 5. Pond 5 is designed to be a detention pond with water quality elements to reduce sediment from entering subbasin DB22a. The outfall of Pond 5 is a 24" RCP pipe which crosses 27 ¼ Road and enters subbasin DB22a. Subbasin

DB22a is comprised of 100.1 acres and outfalls into an existing 36" RCP pipe. The remaining subbasins downstream to subbasin DB22a include DB24a, DB24, DB25, and DB25a, remain unchanged, and flows eventually enter the existing city's upper detention pond (R_PDU). To meet all water quality requirements from the City of Grand Junction, the outlet structure of this pond will be modified to provide a permanent BMP. Flows from detention pond R_PDU enter the existing city's lower detention pond (R_PDL), where flows outfall offsite with a 48" RCP pipe.

Subbasin R16 (100.5 acres) is comprised of undeveloped land and recently constructed parking lots and detention ponds. There are two ponds within subbasin R16 that are designed by others. The hydrologic characteristics of this subbasin did not incorporate the reduction of flows from the two ponds since this basin is not on airport property. Flows from subbasin R16 are conveyed into subbasin R14a through 2-48" CMPs beneath Horizon Road. Subbasin R14a consists of 26.3 acres of parking lots and buildings, which combine with flows from the existing city's lower detention pond (R_PDL).

Subbasin R15d is comprised of 97.9 acres of undeveloped land. Flows from subbasin R15d enter subbasin R13 with an existing 81"x64" box culvert beneath H Road. Subbasin R13 is comprised of 27.4 acres and outfalls offsite with an existing 24" polyvinyl chloride (PVC) pipe beneath the canal.

Subbasin R14 is comprised of 38.3 acres of undeveloped land that conveys flows into subbasin R5. Subbasin R5 consists of 54.0 acres of undeveloped land and outfalls offsite with a 24" RCP pipe beneath I-70.

In previous drainage reports, subbasin R17 was tributary to the Ranchman's Creek Basin, but proposed overlot grading for the relocation of Runway 11/29 now shows subbasin R17 tributary to the Leach Creek Basin.

All subbasins within the Ranchman's Creek Basin have been analyzed for the airport's ultimate build-out. All water quality and detention features have been sized for the change of imperviousness for the ultimate conditions of the Airport.

The four subbasins that outfall offsite are DB25a (Pond R_PDL), R14a, R13, and R5.

LEACH CREEK

Leach Creek is subdivided into eleven subbasins and conveys flows along the west side of the proposed runway. Leach Creek also includes flows along the proposed relocation of 27 ¼ Road.

All subbasin areas were re-evaluated to more accurately delineate each basin, based on updated topography data. Subbasin L10d was divided into two subbasins (L10d and L10d1) to incorporate the proposed relocation of 27 ¼ Road and proposed Runway 11/29.

Subbasin L11b is comprised of 4,744.3 acres of undeveloped land and conveys flows to a large upper city pond that is planned to be constructed in the fall of 2012. According to the City of Grand Junction, the large upper city pond is designed so that during the 100-year storm event, 40 cfs will be released downstream. Flows will then enter subbasin L11au, which is comprised of 649.5 acres, including undeveloped land and a majority of relocated 27 ¼ Road and Proposed Runway 11/29. Overland flows

in subbasin L11au are conveyed into proposed Pond 1. Pond 1 will serve as a water quality facility since the increase of imperviousness from subbasin L11au is insignificant. Flows from Pond 1 enter into subbasin L11ad, which consists of 14.7 acres of undeveloped land. Subbasin L11ad is unchanged with this project. In this basin, flows outfall offsite with 3-60" CMPs.

Subbasin L10u is comprised of 278.9 acres of undeveloped land. Flows from subbasin L10u are conveyed into Pond 2, which outfall into subbasin L10d. Pond 2 is design to be a detention and water quality pond to reduce sediment from entering subbasin L10d. Subbasin L10d1 is comprised of 53.5 acres; its flows outfall into subbasin L10d with a proposed 36" RCP pipe beneath the relocated 27 ¼ Road. Subbasin L10d is comprised of 323.3 acres of the western portion of the relocated Runway 11/29 and a portion of 27 ¼ Road. Flows from subbasin L10d are conveyed into Pond 6, which outfalls offsite with a 36" RCP pipe. Pond 6 is designed to be a detention and water quality pond, as required by the City of Grand Junction.

Subbasin L9.1u is comprised of 1,519.6 acres of undeveloped land. Flows from subbasin L9.1u are conveyed into Pond 3, which outfalls into subbasin L9.1d. Proposed Pond 3 is designed to be a detention and water quality pond to reduce sediment from entering subbasin L9.1d. Subbasin R17 was added to the Leach Creek Basin due to the proposed overlot grading. Subbasin R17 consists of 78.7 acres of undeveloped land that conveys its flows into subbasin L9.1d. Subbasin R15u was also added to the Leach Creek Basin because a site visit made it apparent that Subbasin R15u was tributary to the Leach Creek Basin. Subbasin R15u consists of 106.6 acres of proposed taxiways, aprons, and access roads. At the downstream end of Subbasin R15u, an existing detention pond exists which outfalls into Subbain L9.1d. Subbasin L9.1d is comprised of 189.9 acres of runway, taxiway, apron, and undeveloped land. A portion of the subbasin will convey flows downstream with a 72" RCP pipe. Flows from this subbasin will be conveyed to Pond 7. Pond 7 is designed to be a detention and water quality pond, as required by the City of Grand Junction. To alleviate any existing drainage issues downstream, Pond 7 was designed to over detain and release at a rate 208 cfs during the 100-year storm. Flows that leave Pond 7 will outfall offsite with 2-60" RCP pipes.

Subbasin L9 is comprised of 105.4 acres and includes the airport's undeveloped property which is part of a residential subdivision. There are plans for paving projects in Subbasin L9 which will require the construction of Pond L9. This pond is design to be a detention and water quality pond

All subbasins within the Leach Creek Basin have been analyzed for the airport's ultimate build-out. All water quality and detention features have been sized for the change of imperviousness for the ultimate conditions of the Airport.

The four subbasins that outfall offsite are L11ad, L10d, L9.1d, and L9.

INDIAN WASH

Indian Wash is subdivided into nine subbasins and conveys flows around the east side of Runway 11/29.

Subbasin I5 is comprised of 511.6 acres of undeveloped land. Flows from subbasin I5 are conveyed into the existing 16 acre-foot stock dam. Flows from the stock dam outfall into subbasin I4, which consists of

776.3 acres of undeveloped land. Flows from subbasin I4 are conveyed into subbasin I3 (2,051.6 acres) and subbasin I2 (622.6 acres). These flows eventually enter existing Dam R_I2, which is 128 acre-feet in volume. All overflow of Dam R_I2 is conveyed into subbasin I1 (484.0 acres), which have plans on constructing pavement and buildings in this subbasin. Finally, all flows from this subbasin will enter into detention and water quality Pond I1.

Subbasin I7 is comprised of 656.5 acres of undeveloped land. Flows from subbasin I7 are conveyed into the existing 2 acre-foot stock dam. Flows from the stock dam outfall into subbasin I6 (288.8 acres), which is also undeveloped. There are currently no plans for any development in these subbasins.

Subbasin I8 consists of 265.4 acres of undeveloped land. There are plans for pavement and buildings to be constructed in this subbasin. Proposed Pond I8 will detain flows from subbasin I8 prior to releasing them offsite. This pond is designed to be a detention and water quality pond.

Subbasin I9 is comprised of 435.7 acres of undeveleoped land. There are currently no plans for any development in this basin.

All subbasins within the Indian Wash have been analyzed for the airport's ultimate build-out. All water quality and detention features have been sized for the change of imperviousness for the ultimate conditions of the Airport.

The four subbasins that outfall offsite are I1, I6, I8, and I9.

CORCORAN WASH

Corcoran Wash consists of one basin, C3, which conveys flows west of the airport's property. This basin is not affected by the proposed improvements of the airport.

B. Offsite Tributary Area

Subbasins L11b (4,744.3 acres), I3 (2,051.6 acres), I4 (776.3 acres) and I9 (435.7 acres) are all subbasins that are tributary to flows on the airport but are not part of the airport's property. Flows from these basins were incorporated into the HEC-1 model to accurately depict, as seen in Appendix E.

C. Drainage Facility Maintenance

Drainage facility maintenance for all detention and water quality ponds on the property of the Grand Junction Regional Airport will be the responsibility of the airport. These ponds shall be inspected periodically or after a major storm event to ensure that these facilities are operating properly.

DRAINAGE ANALYSIS AND DESIGN CRITERIA

A. Regulations

The regulation for analysis for this study was the City of Grand Junction Stormwater Management Manual (ref. 2). Additional guidance was provided by the Urban Storm Drainage – Criteria Manual (ref. 1).

There are several methods used to determine the values used with HEC-1 for the characteristic of each basin: the SCS Curve Number Method, the Green Ampt Method, and the Snyder Method. These methods were computed in the analysis of this report. According to the City of Grand Junction Stormwater Management Manual, "Typical values for the Green-Ampt parameters were obtained from the Drainage Manual for Maricopa County Hydrology (Maricopa County 2003 [draft])." This procedure was also calculated for this report.

The final procedure used to determine the input values for HEC-1 is described below:

Every subbasin assumed a soil type of D throughout the entire drainage area. A Curve Number (CN) was then derived based on the soil type and imperviousness of each basin. The Initial Loss (IA) was then determined using the SCS Method.

The SCS Method uses a CN value calculated directly from the Imperviousness and soil type:

$$S = (1{,}000/CN)-10$$

$$IA = 0.2*S$$

$$Q = (P-IA)2/((P-IA)+S)$$

The values for precipitation losses, Volume Moisture Deficit (DTHETA), Wetting Front Suction (PSIF), and Hydraulic Conductivity (XKSAT) were selected from Table A1 – Table of Correspondence (see Appendix B), based on the Curve Number (CN).

B. Regulations – Lag Time

With respect to using lag time to determine the hydraulic characteristics with the HEC-1 program, the City of Grand Junction Stormwater Management Manual allows for two different empirical methodologies to be used to determine lag time.

In regards to the Snyder Method (specifically the CUHP) that was used to determine lag time (Tlag) and the coefficient related to peak rate of runoff (Cp), Icon's Drainage Report (ref. 5) used the following equations to calculate lag time:

$$T_{lag} = C_t\,(LxL_{ca}/S^{0.5})^{0.48}$$

$$C_p = PC_tA^{0.15}$$

In this report, it is proposed that the Snyder Method (CUHP equations) is only appropriate to urban areas. There are several basins for this project that are considered rural areas, and the Snyder Method (CUHP equations) does not properly characterize flows for these basins.

To address this issue, the Grand Junction Stormwater Management Manual (Setion 706.3) directed the lag time to be calculated using the SCS Method (USBR equations – Mesa County). The following are the equations used for rural areas:

If basins are greater than 1 square mile:

$$T_{lag} = 22.1K_n(LxL_{ca}/S^{0.5})^{0.33}$$

If basins are less than 1 square mile:

$$T_{lag} = 0.6T_c$$

To determine the threshold of what is considered rural or urban, a study was completed by Dr. James Guo (ref. 6) to analyze the SCS Method (USBR-Mesa County) against stream gages in Grand Junction. It was determined by the study that an imperviousness of 10% for a basin is a good threshold. Therefore, in basin areas where the imperviousness is less than 10%, the SCS Method (USBR – Mesa County) equations were used, and where imperviousness is greater than 10%, Snyder Method (CUHP) equations were used.

The four stream gages that were analyzed in Dr. Guo's study (ref. 6) were all taken in Mesa County. The collectiveness of the stream gages graphed on a log-log scale graph (see Figure 2 of study, Appendix B), shows that peak flows act linear with its tributary area being the driving factor for flow magnitude. This study indicates that large rural areas closely match the empirical formulas of the SCS Method (USBR-Mesa County). This study also indicates that small urban areas closely match the empirical Snyder Method formulas (CUHP equations) that were used on the previous drainage report completed by Icon (ref. 5).

A table with the final input values used with the HEC-1 model, along with Dr. Guo's study, can be found in Appendices D and B respectively.

C. Development Criteria References and Constraints

The development of the Grand Junction Regional Airport will be based on the proposed plan created for the FAA and the City of Grand Junction. The goal of this study is to provide the framework needed to guide future airport development that will cost-effectively satisfy aviation demands, while considering potential environmental and socioeconomic impacts.

D. Hydrologic Criteria

Rainfall intensities are obtained from the City of Grand Junction Stormwater Management Manual, Table 602 – Point Rainfall Values for the Leach Creek/Horizon Drive Watershed. The Depth Area Curves (Figure 614, Appendix B) were utilized with the 24-Hour Storm, NRCS Type II Rainfall Distribution to generate rainfall depths and runoff. The two design storms analyzed in this study are the 10-year and 100-year design storms.

According to the soil survey in Appendix B, soil types for the airport and the off-site tributary areas are made up of Type B, Type C, and Type D soils. Contrary, field investigations and knowledge of the project site indicate that a majority of the soils within the property are Type D soils.

All hydrologic calculations for existing and proposed conditions assumed a soil Type of D for 100% of the natural undisturbed terrain. This assumption allowed for more conservative flowrate released for both the 10-year and 100-year storm events. This assumption also better matched the hydraulic analysis from previous drainage reports (ref. 5).

E. Hydraulic Criteria

The existing storm sewer system was verified using AutoCAD Civil 3D Land Desktop. Pipe flow calculations were calculated using the Manning Formula shown below:

$$V = (1/n)*R^{2/3}*S^{1/2}$$

Where:
V = mean flow rate (ft/s)
R = hydraulic radius (ft)
S = slope of hydraulic gradeline (ft/ft)
n = Manning's roughness coefficient

F. Water Quality Requirements

The proposed drainage facilities were analyzed using the City of Grand Junction Stormwater Management Manual procedures and best management practices (BMP).

Each water quality pond is sized for ultimate conditions imperviousness. The following table outlines the water quality pond sizes for each subbasin:

Pond Name	Basin Included	Cumulative Area (acres)	Weighted I (%)	Required WQCV Volume
Pond 1	L11au, L11b	5393.8	2.0	3.99
Pond 6	L10d, L10d1, L10u	655.7	5.4	1.24
Pond 7	L9.1d, R17, R15u, L9.1u	1894.8	14.6	8.46
Pond I1	I1	484.0	12.0	1.84
Pond I8	I8	265.4	10.0	0.87
Pond L9	L9	105.4	21.0	0.77

The existing pond R_PDU's outlet structure will need to be modified to provide a water quality element, as required by the City of Grand junctions Stormwater Management Manual.

G. Variance from Criteria

In discussions with the City of Grand Junction Development Engineer, Rick Dorris, P.E., CFM, it was determined to use the Green-Ampt and SCS Curve Number Method. This is a variance from the Maricopa Method, as stated in the Stormwater Management Manual.

DRAINAGE FACILITY DESIGN

A. General Concept

All proposed water quality ponds will be sized to accommodate the ultimate conditions. The tweleve (12) proposed detention ponds are analyzed for the 10-year and 100-year detention volumes.

Pond Names	Volume 100-yr	Function
Pond 1	4.00 AC-FT	Water Quality
Pond 2	6.60 AC-FT	Detention and Water Quality
Pond 3	22.39 AC-FT	Detention and Water Quality
Pond 4	5.75 AC-FT	Detention and Water Quality
Pond 4a	7.01 AC-FT	Detention and Water Quality
Pond 4b	5.01 AC-FT	Detention
Pond 5	3.91 AC-FT	Detention and Water Quality
Pond 6	3.83 AC-FT	Detention and Water Quality
Pond 7	28.29 AC-FT	Detention and Water Quality
Pond L9	4.00 AC-FT	Detention and Water Quality
Pond I1	5.00 AC-FT	Detention and Water Quality
Pond I8	4.00 AC-FT	Detention and Water Quality

B. Specific Details

The proposed ponds are analyzed for the 10-year and 100-year detention volumes, which are controlled by an outlet structure to minimize impacts to downstream structures. The proposed detention ponds are analyzed to handle the flows generated from all development within these basins, per the Master Plan.

The Grand Junction Regional Airport will be in charge of maintaining the detention ponds and outlet structures. Regular maintenance and debris removal will be mandatory to ensure the functionality of the outlet structures. The detention ponds are an Extended Detention Basin-Sedimentation facility, which follows the design criteria for Best Management Practices of volume 3 of the *Urban Drainage & Flood Control District* (revised June 2001) (Ref. 1).

Detention ponds 2, 3, 4, 4a, and 5 are located upstream of their respective lower basins and are therefore oversized to ensure that adequate release from the overall subbasin is lower than current flow rates. At the downstream end of the system, Ponds 1, 6, 7, L9, I1, and I8 release at a lower rate than current conditions, as specified in previous drainage reports.

HEC-1 input and output data is provided in Appendix E. For specific reference to detention ponds in HEC data, please contact Jviation.

CONCLUSION

A. Compliance with Manual

This analysis is prepared in accordance with the procedures and concepts outlined in the City of Grand Junction Stormwater Management Manual (ref. 2), as well as the Urban Storm Drainage – Criteria Manual (ref. 1). Hydraulic Criteria, as defined in the Stormwater Management Manual, is adhered to and only the variance described above is requested.

B. Design Effectiveness

According to the drainage analysis done with this report, the addition of twelve detention/water quality ponds that outfall into the three major drainage basins are adequate drainage facilities to capture sediment and release flows at or below existing conditions. These ponds were sized and located to accommodate the master plan and all future improvements of the airport.

C. Areas in Flood Hazard Zone

From the Flood Insurance Rate Map, Community Panel Number 080117 0001 0009, revised July 15, 1992, the entire airport lies in Zone X. Zone X is determined to be outside of the 500-year flood plain.

D. Variances from Manual

In discussions with the City of Grand Junction Development Engineer, Rick Dorris, P.E., CFM, it was determined to use the Green-Ampt and SCS Curve Number Method. This is a variance from the Maricopa Method, as stated in the Stormwater Management Manual.

REFERENCES

1. *Urban Storm Drainage – Criteria Manual* (revised June 2002), Prepared by the Urban Drainage and Flood Control District, Denver, CO
2. *City of Grand Junction Stormwater Management Manual* (December 31, 2007), Prepared by WRC Engineering, Inc.
3. *FAA AC 150/5320-5C Surface Drainage Design* (August 01, 2006), Prepared by U.S. Department of Transportation, Federal Aviation Administration
4. *FAA AC 150/5200-33B Hazardous Wildlife Attractants on or Near Airports* (August 28, 2007), Prepared by U.S. Department of Transportation, Federal Aviation Administration
5. *Ranchman's Ditch (Horizon Drive Channel), Leach Creek, & North Leach Creek Conditional Letter of Map Revision (CLOMR)* (October 2004), Prepared by Icon Engineering, Inc.
6. *Regional Analysis for Flood Peak Flows* (March 10, 2012), Prepared By Dr. James Guo – Attached in Appendix B.

APPENDIX A - CHECKLIST

Drainage Report Checklist – Table 302 – Stormwater Management Manual
Drainage Plan Checklist – Table 303 – Stormwater Management Manual

Table 302
Stormwater Management Manual
Drainage Report Checklist

Instructions:
1. Applicant to identify with a "check-mark" if information is provided with report. If applicant believes information is not required, indicate with "n/a" and attach separate sheet with explanation
2. The reviewer will determine if information labeled "n/a" is required and whether information must be submitted.
3. Those items noted with an "asterisk" are not required for conceptual report.
4. Submit three (3) copies of report and include copy of check list bound with report.

TITLE PAGE

A. Type of report (Conceptual/Preliminary or Final Drainage Report).
B. Project Name.
C. Preparer name, firm, address, number, and date.
D. Professional Engineer's seal of preparer.
E. Certifications (see SWMM Section 303.1)

I. INTRODUCTION

A. Background
✓ 1. Identify report preparer and purpose.
✓ 2. Identify date of letter with previous County comments.

B. Project Location
✓ 1. Identify Township, Range, and Section.
✓ 2. Identify adjacent street and subdivision names.
✓ 3. Reference to General Location Map.

C. Property Description
✓ 1. Identify area in acres of entire contiguous ownership.
✓ 2. Describe existing ground cover, vegetation, soils, topography and slopes.
✓ 3. Describe existing drainage facilities, such as channels, detention areas, or structures.
4. Describe existing irrigation facilities, such as ditches, head-gates, or diversions.
✓ 5. Identify proposed types of land use and encumbrances.

D. Previous Investigations
✓ 1. Identify drainage master plans that include the project area, including floodplain studies.
✓ 2. Identify drainage reports for adjacent development.

II. DRAINAGE SYSTEM DESCRIPTION

A. Existing Drainage Conditions
✓ 1. Describe existing topography and provide map with contours extending a minimum of 100 feet beyond property limits.
✓ 2. Identify major drainageway or outfall drainageway and describe map showing location of proposed development within the drainageways.
✓ 3. Identify pre-developed drainage patterns and describe map showing pre-developed sub-basins and concentrated discharge locations. Provide calculations of pre-developed peak flows entering and leaving the site.

B. Master Drainage Plan
✓ 1. Describe location of the project relative to a previously prepared master drainage plan, including drainage plans prepared for adjacent development.

C. Offsite Tributary Area
✓ 1. Identify all offsite drainage basins that are tributary to the project. .

2. Identify assumptions regarding existing and future land use and effects of offsite detention on peak flows.

D. Proposed Drainage System Description

1. Identify how offisite stormwater is collected and conveyed through the site and ultimately to the receiving water(s).
2. Identify sub-basins and describe, in general terms, how onsite stormwater is collected and conveyed through the site for each location where stormwater is discharged from the site.
3. Describe detention volumes, release rates and pool elevations. *
4. Identify the difference in elevation between pond invert and the groundwater table. *
5. Describe how stormwater is discharged from the site, including both concentrated and dispersed discharges.
6. Describe stormwater quality facilities.
7. Describe maintenance access aspects of design. *
8. Describe easements and tracts for drainage purposes, including limitation on use. *

E. Drainage Facility Maintenance

1. Identify responsible parties for maintenance of each drainage and water quality facility. *
2. Identify general maintenance activities and schedules. *

III. DRAINAGE ANALYSIS AND DESIGN CRITERIA

A. Regulations

1. Identify that analysis and design was prepared in accordance with the provisions of the Manual.
2. Identify other regulations or criteria which have been used to prepare analysis and design.

B. Development Criteria

1. Identify drainage constraints placed on the project, such as by a major drainage study, floodplain study or other drainage reports relevant to the project.
2. Identify drainage constraints placed on the project, such as from major street alignments, utilities, existing structures, and other developments.

C. Hydrologic Criteria

(If Manual was followed without deviation, then a statement to that effect is all that is required. Otherwise provide the following information where the criteria used deviates from the Manual.)

1. Identify how storm runoff peak flows and volumes were determined, including rainfall intensity or design storm.
2. Identify which storm events were used for minor and major flood analysis and design.
3. Identify how and why any other deviations from the Manual occurred.

D. Hydraulic Criteria

(If Manual was followed without deviation, then a statement to that effect is all that is required. Otherwise provide the following information where the criteria used deviates from the Manual.)

1. Identify type(s) of streets within and adjacent to development and source for allowable street capacity. *
2. Identify which type(s) of storm inlets were analyzed or designed and source for allowable capacity. *
3. Identify which type of storm sewers which were analyzed or designed and Manning's n-values used. *

4. Identify which method was used to determine detention volume requirements and how allowable release rates were determined. ✓ *
5. Identify how the capacity of open channels and culverts were determined. ✓ *
6. Identify any special analysis or design requirements not contained with the Manual. ✓ *
7. Identify how and why any other deviations from the Manual occurred. ✓

E. Variance from Criteria

1. Identify any provisions of the Manual for which a variance is requested. ✓
2. Identify pre-existing conditions which cause the variance request. ✓

***IV. POST CONSTRUCTION STORMWATER MANAGEMENT. See Manual Section 1600 for requirements.**

Note: This section of the Final Drainage Report identifies additional information required by Mesa County's, City of Grand Junction's, and Town of Palisade's, Permit for Stormwater Discharges Associated with Municipal Separate Storm Sewer Systems (MS4s), permit No. COR-090000. The Final Drainage Plan and the Construction SWMP (see SWMM Section 1500) meets the requirements of the MS4s Permit. In general, this section identifies permanent BMP practices to control the discharge of pollutants after construction is complete.

*A. Stormwater Quality Control Measures

1. Describe the post-construction BMPs to control discharge of pollutants from the project site. ✓ *
2. If compensating detention is provided, discuss practices to address water quality from area not tributary to detention area. N/A *
3. If underground detention is proposed, discuss how water quality facilities will be provided on the surface. N/A *
4. If proprietary BMPs are proposed, provide the justification and sizing requirements (see SWMM Section 1603.3). N/A

*B. Calculations

1. Provide methods and calculations for WQCV, sediment storage, and water quality outlet structure. ✓

V. CONCLUSIONS

A. Compliance with Manual

Compliance with Manual and other approved documents, such as drainage plans and floodplain studies. ✓

B. Design Effectiveness

Effectiveness of drainage design to control impacts of storm runoff. ✓

C. Areas in Flood Hazard Zone

Meet requirements of Floodplain Regulations: Mesa County Land Development Code, Section 7.13; City of Grand Junction Zoning and Development Code, Section 7.1. ✓

D. Variances from Manual

Applicant shall identify any requested variances and provide basis for approving variance. If no variances are requested, applicant shall state that none are requested. ✓

VII. REFERENCES

Provide a reference list of all criteria, master plans, drainage reports, and technical information used. ✓

TABLES

Include copy of all tables prepared for report. ✓

FIGURES

A. General Location Map (See Section 303.2a) ✓

B. Flood Plain Information ✓

✓ C. Drainage Plan (See Section 303.2b)
✓ D. Other pertinent figures.

APPENDICIES

A. DESIGN CHARTS

✓ 1. Provide copy of all design charts (i.e.: tables, figures, charts from other criteria) used for the report.

B. HYDROLOGIC CALCULATIONS (see Manual Sections 600 and 700)

✓ 1. Land use assumptions for off-site runoff calculations.
✓ 2. Time of concentration and runoff coefficients for pre-existing and post development conditions.
✓ 3. Pre-developed hydrologic computations.
✓ 4. Developed conditions hydrologic computations.

C. HYDRAULIC CALCULATIONS

✓ 1. Capacity of existing channels, streets, storm sewers, inlets, culverts and other facilities.
✓ 2. Calculations for existing storm sewer and open channel.
✓ 3. Irrigation ditch flows and ditch system capacity.
✓ * 4. Detention pond design (see Manual, Section 1400 for requirements).
N/A * a. Storage volume, release rates, and pool elevations for 2-year and 100-year storm.
N/A * b. Outlet structure dimensions, orifice diameter, weir lengths, pipe headwater and other data.
N/A * c. Outlet velocity and energy dissipation requirements.
* d. Routing of outlet flows and emergency spillway flows.
N/A * 5. Street capacity calculations, if data in Manual not used (see Section 1100).
N/A * 6. Storm inlet capacity calculations, if data in Manual not used (see Section 1100).
N/A * 7. Storm sewer capacity calculations, if data in Manual not used (see Section 1000).
N/A * 8. Channel capacity calculations, if data in Manual not used (see Section 800).
N/A * 9. Culvert capacity calculations (see Manual, Section 1200).
✓ * 10. Other hydraulic structure calculations (see Manual, Section 900).

D. STORMWATER QUALITY CALCULATIONS

✓ 1. Water Quality Capture Volume (WQCV).
✓ * 2. Storage volume for sediment volume and pool elevations for WQCV.
N/A * 3. Outlet calculations for required area per row, diameter of individual holes, number of holes per row, and number of holes per column.

CERTIFICATION – PROFESSIONAL ENGINEER'S SEAL AND SIGNATURE

ACKNOWLEDGEMENTS

Drainage Report checklist was prepared by: Mark Lovato

Table 303
Stormwater Management Manual

Drainage Plan Checklist

Instructions:
1. Applicant to identify with a “check-mark” if information is provided. If applicant believes information is not required, indicate with “n/a”.
2. County will determine if information labeled “n/a” is required and whether information must be submitted.

I. EXISTING FACILITIES

A. Contours at two foot intervals, based on USGS datum. Contours to extend at least 50 feet past property line.
B. Location and elevation of USGS benchmarks or benchmarks referenced to USGS.
C. Property lines.
D. Drainage easements.
E. Street names.
F. Major and minor channels and floodplains.

II. PROPOSED FACILITIES

A. Contours at two-foot intervals, based on USGS datum.
B. Property lines.
C. Drainage easements.
D. Street names and grades.
E. Right of way and easement.
F. Finished floor elevations for protection from major storm run-off.
G. Detention pond information:
   1. Location of each detention pond with site at 1”=50’ scale or larger with 2-foot contour intervals.
   2. Inlet and outlet structure, and trickle channel design details.
   3. Details of emergency spillway and channel.
   4. Landscape information, including side slopes, vegetation and planting requirements.
   5. Details of water quality outlet structure.
H. Channel Information:
   1. Profiles with existing and proposed grades.
   2. Cross sections on 100-foot stations showing existing and proposed topography and required rights of way.
   3. Locations and size of all existing and proposed structures.
   4. Locations and profiles of adjacent utilities.
   5. Typical channel section and lining details.
I. Storm sewer information:
   1. Alignment and location of manholes, inlets, and outlet structures.
   2. Profile of invert and pipe crown.
   3. Invert elevations at manholes and inlets.
   4. Lengths and grades between manholes and inlets.
   5. Locations and elevations of utilities adjacent to and crossing storm sewer.
   6. Easement and other O&M access geometry.
   7. Outlet details, such as end sections, headwall and wingwalls, erosion control, and vegetation.
J. Street cross sections with design 100-year flood depth.
K. Other drainage related structures and facilities, including underdrains and sump pump discharge lines.
L. Other permanent BMP measures to control pollutant discharges to the County’s MS4 system.

III. HYDRAULIC AND HYDROLOGIC INFORMATION

A. Routing and accumulative runoff peaks at upstream and downstream ends of the site and at various critical points onsite for initial and major storms. Inflow and outflow from each subbasin shall be shown for both initial and major storms.

B. Street cross sections showing 100-year flood levels.

C. Major and minor channels and floodplains.

D. Detention pond data:
   1. Release rates for 2- and 100-year storm events.
   2. Required and provided volumes for 2- and 100-year storm events.
   3. Design depths for 2- and 100-year storm events.
   4. Water quality capture volume and pool elevation.

E. Channel data:
   1. Water surface profiles.
   2. Representative 100-year flow velocity and Froude number.

F. Storm sewer data:
   1. Profile of water surface for design flow rate.
   2. Peak flows for design flow, 2-year and 100-year storm events.

IV. STANDARD NOTES

A. No building, structure, or fill will be placed in the detention areas and no changes or alterations affecting the hydraulic characteristics of the detention areas will be made without the approval of the County.

B. Maintenance and operation of the detention and water quality areas is the responsibility of property owner. If owner fails in this responsibility, the County has the right to enter the property, maintain the detention areas, and be reimbursed for costs incurred.

C. Detention pond volumes, all drainage appurtenances, and basin boundaries shall be verified. As-built drawings shall be prepared by a registered professional engineer prior to issuance of certificate of occupancy for any structure within the development.

D. Permission to reproduce these plans is hereby given to Mesa County for County purposes associated with plan review, approval, permitting, inspection and construction of work.

V. PROFESSIONAL ENGINEER'S SEAL AND SIGNATURE

VI. OTHER

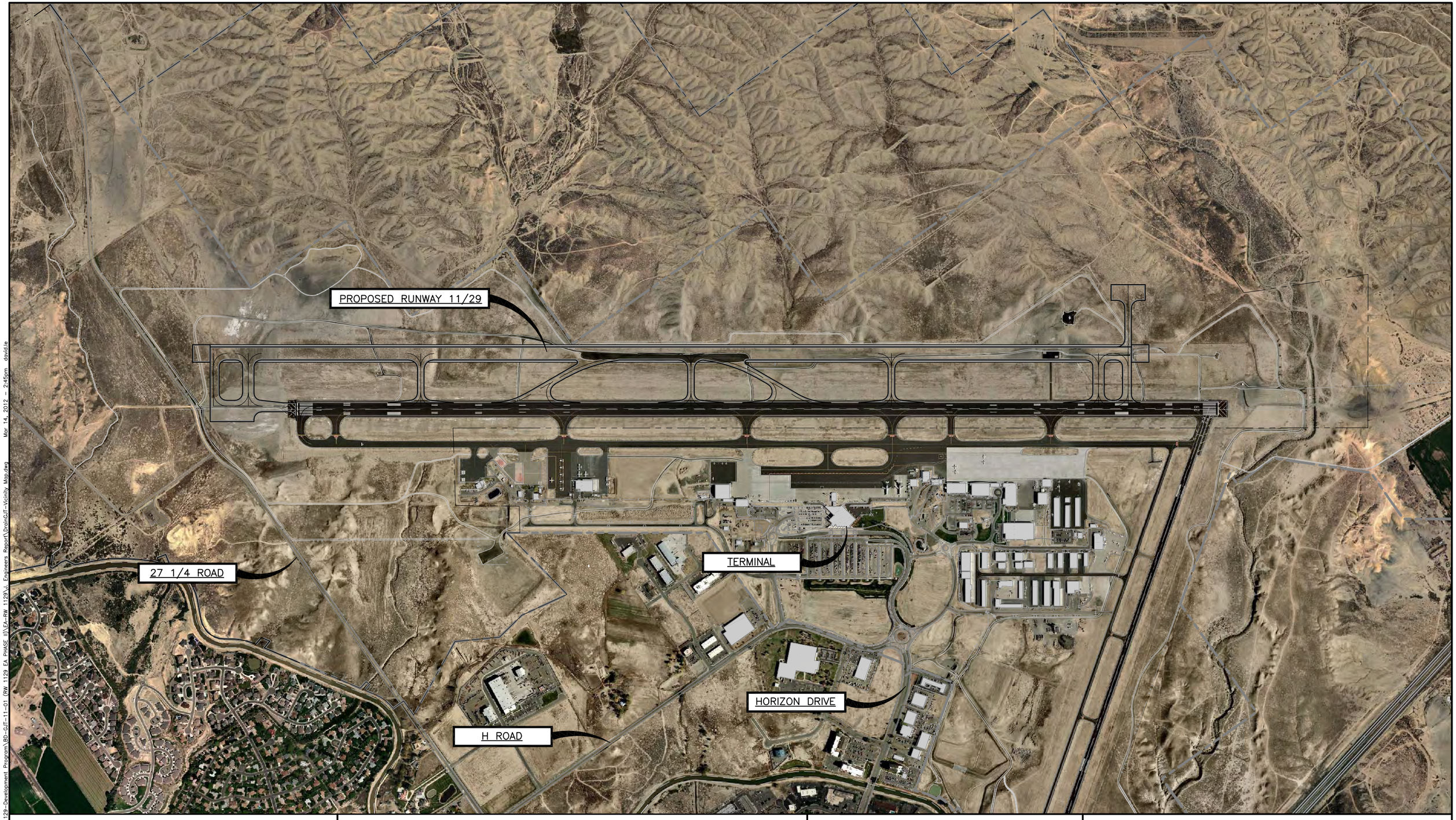
A. Horizontal and vertical control information and ties to existing and proposed features.

ACKNOWLEDGEMENTS

Drainage Plan checklist was prepared by: _____

APPENDIX B – DESIGN CHARTS

Vicinity Map
Flood Insurance Rate Map
Excerpts from Stormwater Management Manual
NRCS Web Soil Survey Data
Excerpt from AC 150/5200-33B
SCS Method Reference Data
Water Quality Capture Volume Criteria
Regional Analysis for Flood Peak Flows (March 10, 2012) – Prepared by Dr. Guo



GRAND JUNCTION REGIONAL AIRPORT

GRAPHIC SCALE
500 0 500 1000
(IN FEET)

N

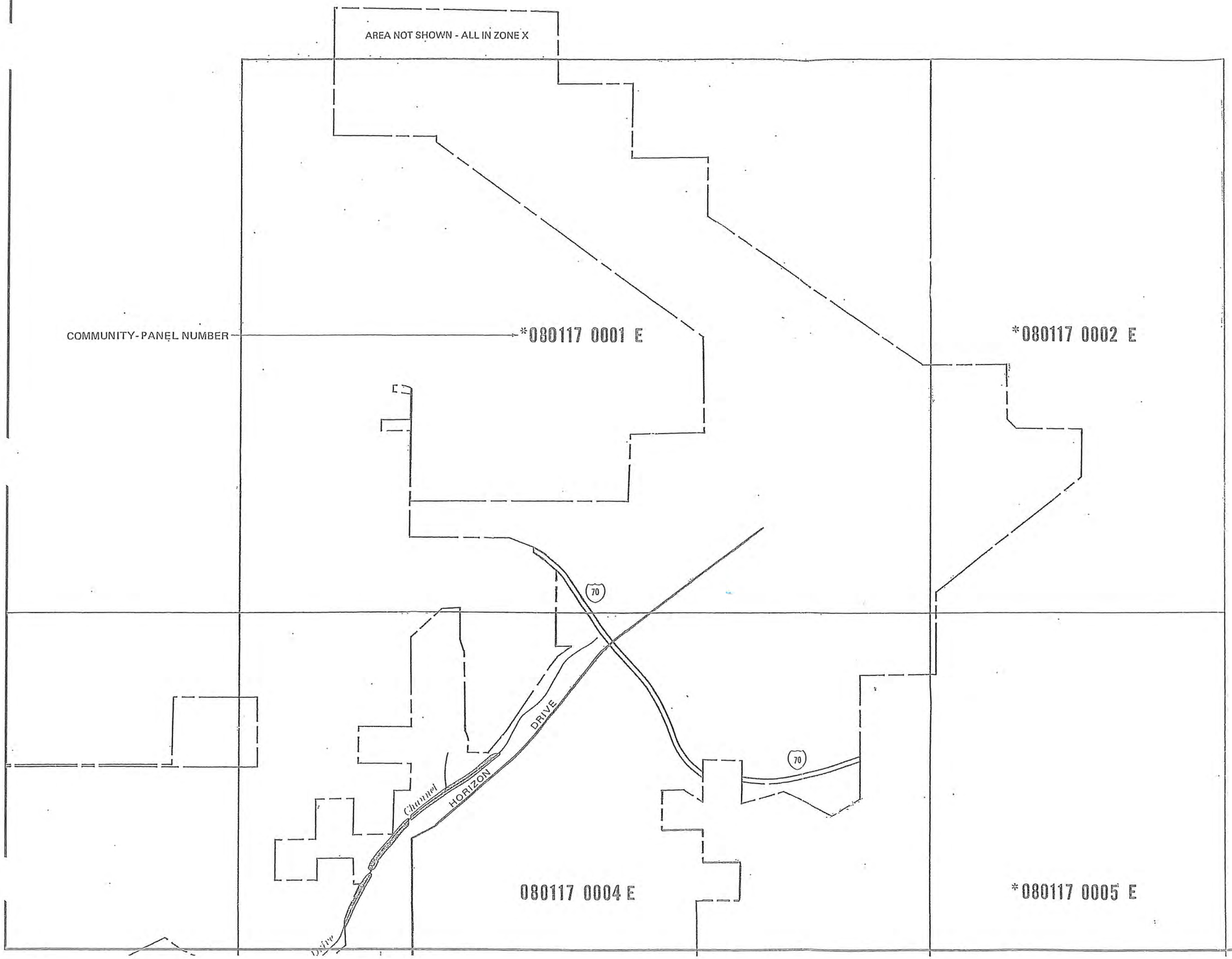
JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

GRAND JUNCTION REGIONAL AIRPORT VICINITY MAP

DATE: MARCH 14, 2012

SHEET 1 OF 1

Mar 14, 2012 - 2:45pm dovidio
J:\Projects\GJT\Engineering\GJT-RW 11?9-Development Program\90-GJT-11-01 (RW 1129 EA PHASE 2)\EA-RW 11?9\04 Engineers Report\Draft\GJT-Vicinity Map.dwg



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

CITY OF
GRAND JUNCTION,
COLORADO
MESA COUNTY

MAP INDEX
and
STREET INDEX

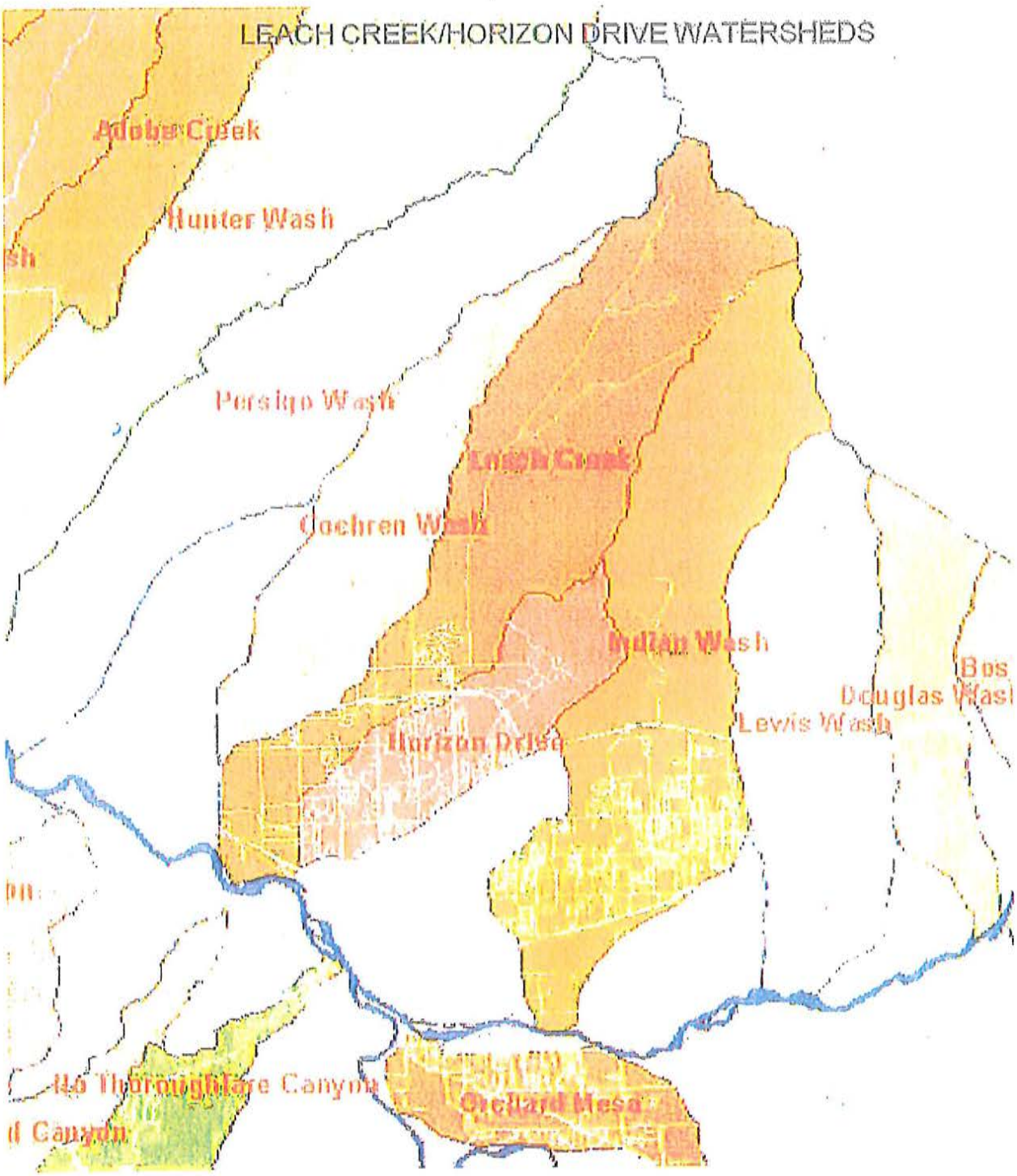
PANELS PRINTED: 3, 4, 6, 7, 9

COMMUNITY-PANEL NUMBERS
080117 0001 0009

MAP REVISED:
JULY 15, 1992

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



Revision	Date
ORIGINAL ISSUE	3/27/06

WRC ENGINEERING, INC

REFERENCE:
MESA COUNTY GIS WEBSITE

FIGURE 617

Table 601 - Point Rainfall Values for the Grand Valley Area

Storm Duration	Precipitation Depth (inches)					
	2-year Recurrence	5-year Recurrence	10-year Recurrence	25-year Recurrence	50-year Recurrence	100-year Recurrence
5-min	0.10	0.14	0.18	0.25	0.31	0.39
10-min	0.15	0.22	0.28	0.38	0.48	0.60
15-min	0.19	0.28	0.36	0.48	0.61	0.76
30-min	0.27	0.39	0.50	0.67	0.85	1.06
1-hr	0.34	0.49	0.63	0.85	1.07	1.34
2-hr	0.42	0.58	0.72	0.94	1.15	1.40
3-hr	0.47	0.63	0.77	0.99	1.19	1.44
6-hr	0.55	0.73	0.87	1.10	1.31	1.56
12-hr	0.55	0.83	0.98	1.22	1.44	1.69
24-hr	0.70	0.93	1.12	1.42	1.69	2.01

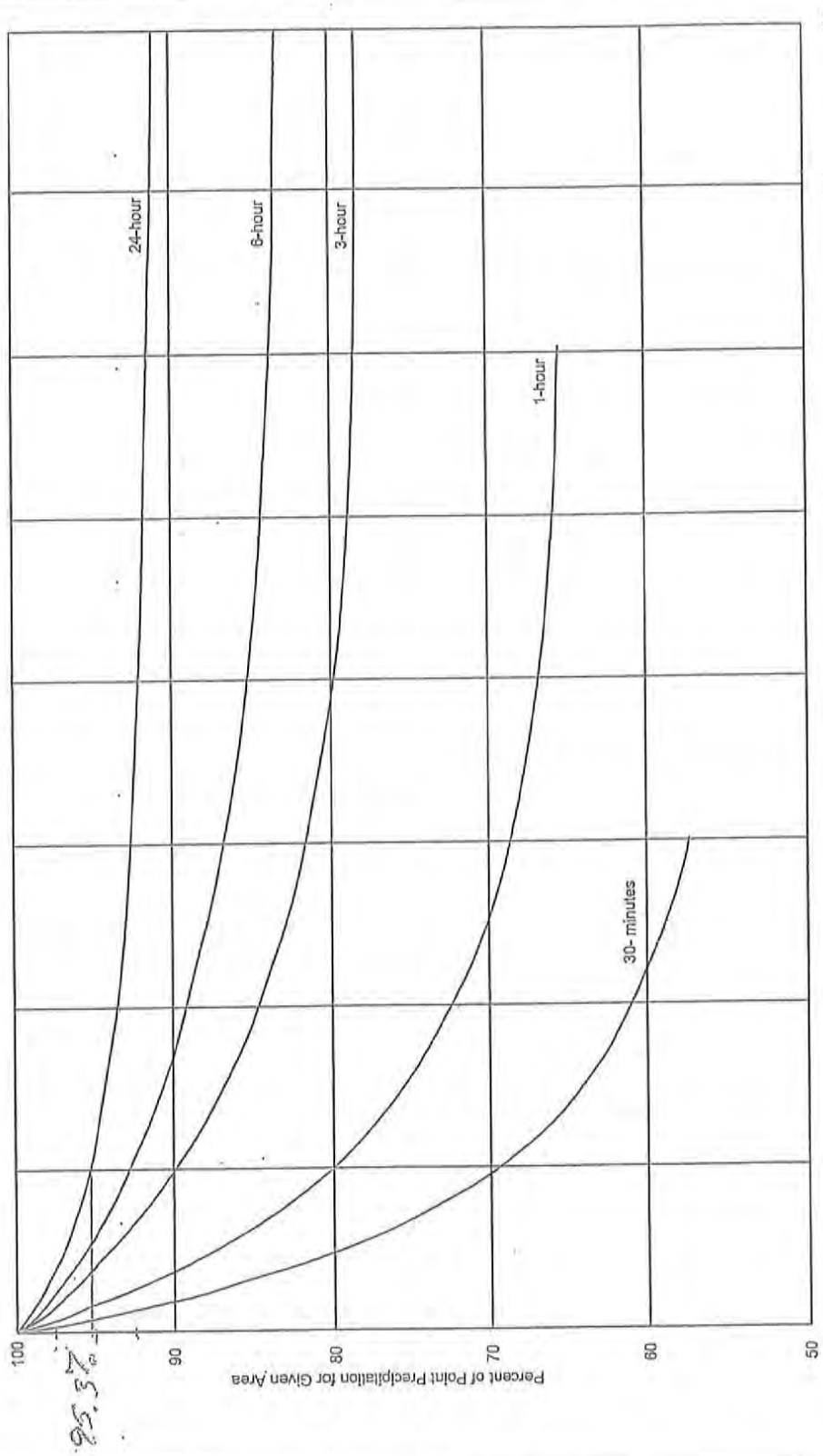
For the area outside of the Grand Valley, the NOAA Atlas 2 Rainfall Depth-Duration-Frequency Maps are reproduced for the Mesa County area in **Figures 602 through 613.** Maps are presented for the 6- and 24-hour durations for the 2-, 5-, 10-, 25-, 50-, and 100-year recurrence intervals. Depending on the location of the project, point rainfall values are read from these figures, converted to other storm durations, and used to generate intensity-duration-frequency curves and design storms, following procedures described below.

For the areas within the Leach Creek/Horizon Drive watershed, point precipitation values are provided in **Table 602** for various frequencies and durations.

Table 602 - Point Rainfall Values for the Leach Creek/Horizon Drive Watershed

Storm Duration	Precipitation Depth (inches)					
	2-year Recurrence	5-year Recurrence	10-year Recurrence	25-year Recurrence	50-year Recurrence	100-year Recurrence
5-min	0.10	0.14	0.18	0.25	0.31	0.39
10-min	0.15	0.22	0.28	0.38	0.48	0.60
15-min	0.19	0.28	0.36	0.48	0.61	0.76
30-min	0.27	0.39	0.50	0.67	0.85	1.06
1-hr	*0.29*	*0.41*	*0.52*	0.85	*0.86*	*1.07*
2-hr	0.42	0.58	0.72	0.94	1.15	1.40
3-hr	*0.46*	*0.63*	*0.78*	0.99	*1.24*	*1.52*
6-hr	*0.55*	*0.72*	*0.86*	1.10	*1.28*	*1.52*
12-hr	*0.67*	*0.85*	*0.99*	1.22	*1.39*	*1.61*
24-hr	*0.79*	*1.01*	*1.19*	1.42	*1.71*	*1.99*

NOTE: The *italicized* values are the actual FEMA-approved data. The remaining data was obtained from **Table 601.**



DEPTH AREA CURVES

e 50 = 95.3%
e 36.5 = 96.0%
e 24.0 = 97.0%
e 1.0 = 98.0%

10yr 24hr = 1.19 in
100yr 24hr = 1.99 in

Revision	Date
ORIGINAL ISSUE	3/27/06

WRC ENGINEERING, INC

REFERENCE:
National Weather Service, NOAA 1973. Precipitation Frequency Atlas of the Western United States Volume III-Colorado. NOAA Atlas 2

FIGURE 614

Table 705 Surface Retention Loss

Land Use and/or Surface Cover	Surface Retention Loss, IA (inches)
Natural	
Desert and rangeland, flat slope	0.35
Desert Hillslopes	0.15
Mountain with vegetated surface	0.25
Developed (Residential/commercial)	
Lawn and turf	0.20
Desert landscape	0.10
Pavement	0.05
Agricultural, filled fields and irrigate pasture	0.50

The second phase of the rainfall loss process is infiltration of rainfall into the soil. The infiltration is assumed to begin after the surface retention loss is completely satisfied. Excess precipitation is computed using the Green-Ampt equations after the initial loss is satisfied. Required parameters are then the hydraulic conductivity of the soil at saturation, volumetric moisture deficit at the beginning of rainfall, and wetting front capillary action.

Typical values for Green-Ampt parameters were obtained from the *Drainage Design Manual for Maricopa County Hydrology* (Maricopa County 2003 (draft)), available at http://www.fcd.maricopa.gov/Resources/HydrologyManual.asp.

704.3.1 Soil Hydraulic Conductivity

The soil hydraulic conductivity is based on soil texture classification. Typical values for different soil type are listed in Table 706. For watershed areas of sub-watersheds consisting of several different soil textures, a composite value for Green-Ampt parameters should be used.

Table 706 Soil Hydraulic Conductivity Values

Soil Texture Classification	(for bare ground) Hydrologic Soils Group	Soil Hydraulic Conductivity (in/hr)
Loamy-sand and sand	A	1.20
Sandy-Loam	B	0.40
Loam	B	0.25
Silty-loam	C	0.15
Sandy clay-loam	C	0.06
Clay-loam	D	0.04
Silty clay-loam	D	0.04
Sandy-clay	D	0.02
Silty-clay	D	0.02
Clay	D	0.01

Hydraulic conductivity is affected by several factors besides soil texture, including soil crusting, tillage, ground cover, and canopy cover and should be adjusted. Ground cover, such as grass, litter, and gravel, will generally increase the infiltration rate over that of bare ground conditions.

RECOMMENDED IMPERVIOUSNESS VALUES

Land Use or Surface Characteristic	Percentage Imperviousness
Business	
Commercial Areas	85
Neighborhood Areas	70
Residential	
Single Family	(see figures)
Multi-unit (detached)	60
Multi-unit (attached)	75
Half-acre lot or larger	(see figures)
Apartments	80
Industrial	
Light industrial	80
Heavy industrial	90
Parks, cemeteries	5
Playgrounds	10
Schools	50
Railroad yards	15
Undeveloped Areas	
Historic flow analysis	2
Greenbelts, agriculture	2
Off-site flow analysis (when land use not defined)	45
Streets	
Paved (concrete/asphalt)	100
Gravel	40
Drives and walks	90
Roofs	90
Lawns (all soils)	0

NOTES:

1. The imperviousness values are representative of land uses shown and are for future development projections only. Impervious values for existing land uses may vary.
2. For areas that will not be developed, 2% imperviousness is an appropriate assumption where soil and vegetative cover are present. Areas with geological features, including significant rock outcroppings, need to be accounted for. See Section 702.2.

Revision	Date
ORIGINAL ISSUE	3/27/06
CHANGED BUS. VALUES	12/6/07
ADDED NOTE 2	1/25/08

WRC ENGINEERING INC

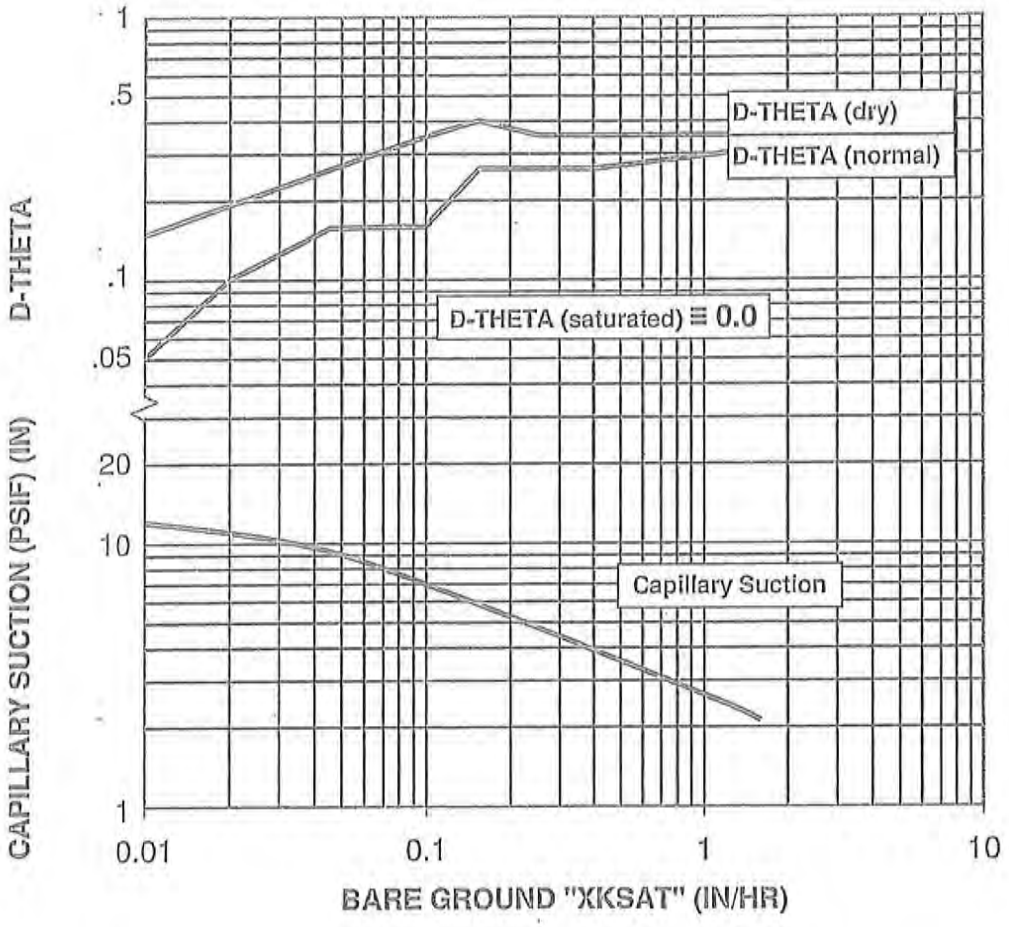
REFERENCE:
UDFCD 2001. Urban Storm Drainage Criteria Manual, Volume 1 (revised)

TABLE 701

ADJUSTMENT FOR SOIL MOISTURE DEFICIT AND CAPILLARY ACTION

SELECTION OF DTHETA CONDITION:

DRY – USE THIS FOR NON–IRRIGATED LANDS, SUCH AS DESERT AND RANGELAND.
NORMAL – USE THIS FOR IRRIGATED LAWN, TURF, AND PERMANENT PASTURE.
SATURATED – USE THIS FOR IRRIGATED AGRICULTURAL LAND.



NOTE:

DO NOT USE "XKSAT" VAU=LUES THAT HAVE BEEN ADJUSTED FOR VEGETATION COVER.

Revision	Date
ORIGINAL ISSUE	3/27/06

WRC ENGINEERING, INC.	REFERENCE: ADAPTED FROM MARIPOSA COUNTY DRAINAGE DESIGN MANUAL - HYDROLOGY (2002)	FIGURE 702

may not be correct. Incorrect results could cause serious consequences for flood control planning and design. Therefore, it is recommended that, for watersheds consisting of relatively small subareas of sand, the Green and Ampt parameter values for loamy sand be used for the sand portion of the watershed. If the area contains a large portion of sand, then either the Green and Ampt method should be used with the parameter values for loamy sand or the IL+ULR method should be used with the appropriately determined values for the parameters.

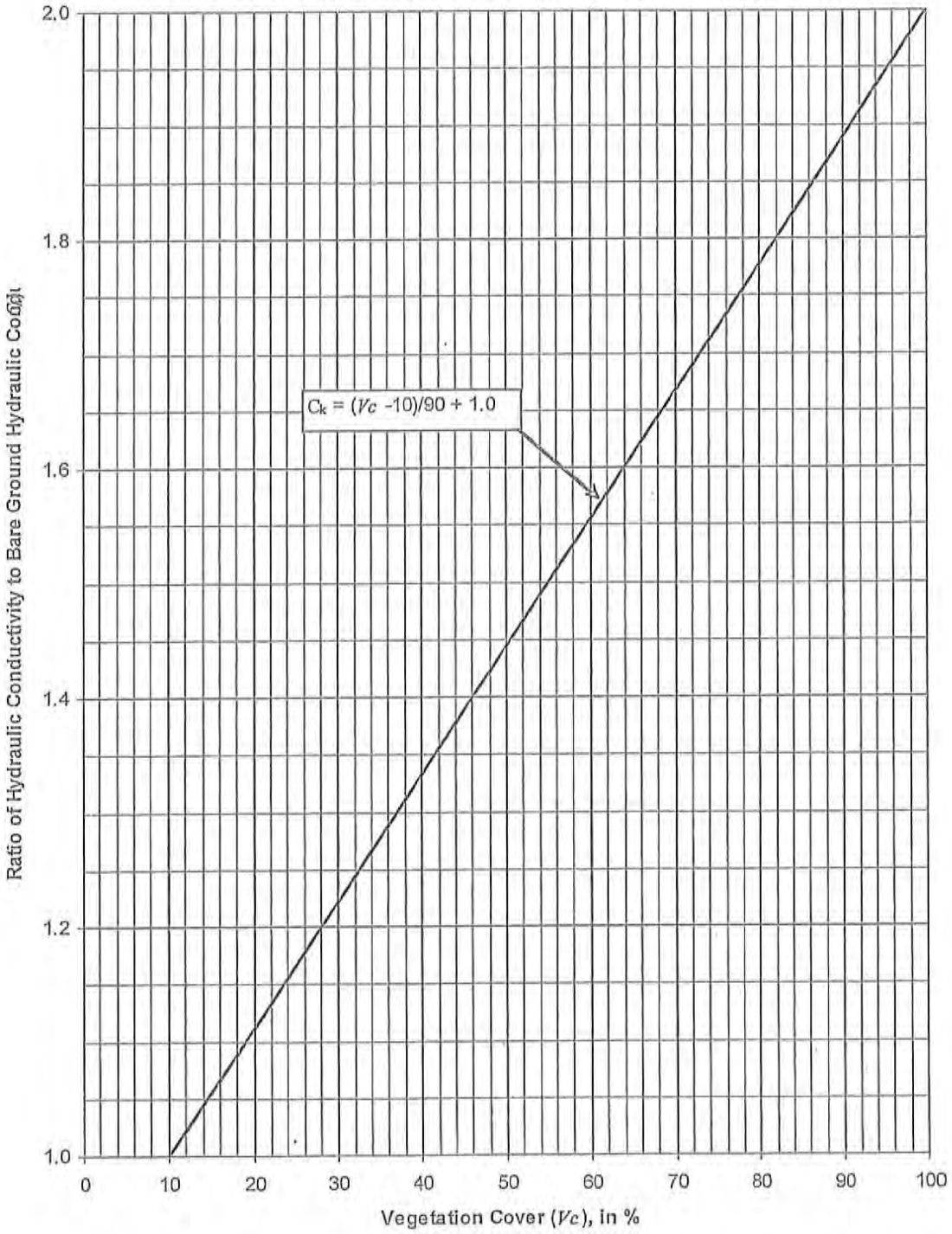
Table 4.1
GREEN AND AMPT LOSS RATE PARAMETER VALUES FOR BARE GROUND

Soil Texture Classification (1)	XKSAT inches/hour (2)	PSIF inches (3)	DTHETA[1] Dry (4)	Normal (5)	Saturated (6)
loamy sand & sand	1.20	2.4	0.35	0.30	0
sandy loam	0.40	4.3	0.35	0.25	0
loam	0.25	3.5	0.35	0.25	0
silty loam	0.15	6.6	0.40	0.25	0
silt	0.10	7.5	0.35	0.15	0
sandy clay loam	0.06	8.6	0.25	0.15	0
clay loam	0.04	8.2	0.25	0.15	0
silty clay loam	0.04	10.8	0.30	0.15	0
sandy clay	0.02	9.4	0.20	0.10	0
silty clay	0.02	11.5	0.20	0.10	0
clay	0.01	12.4	0.15	0.05	0

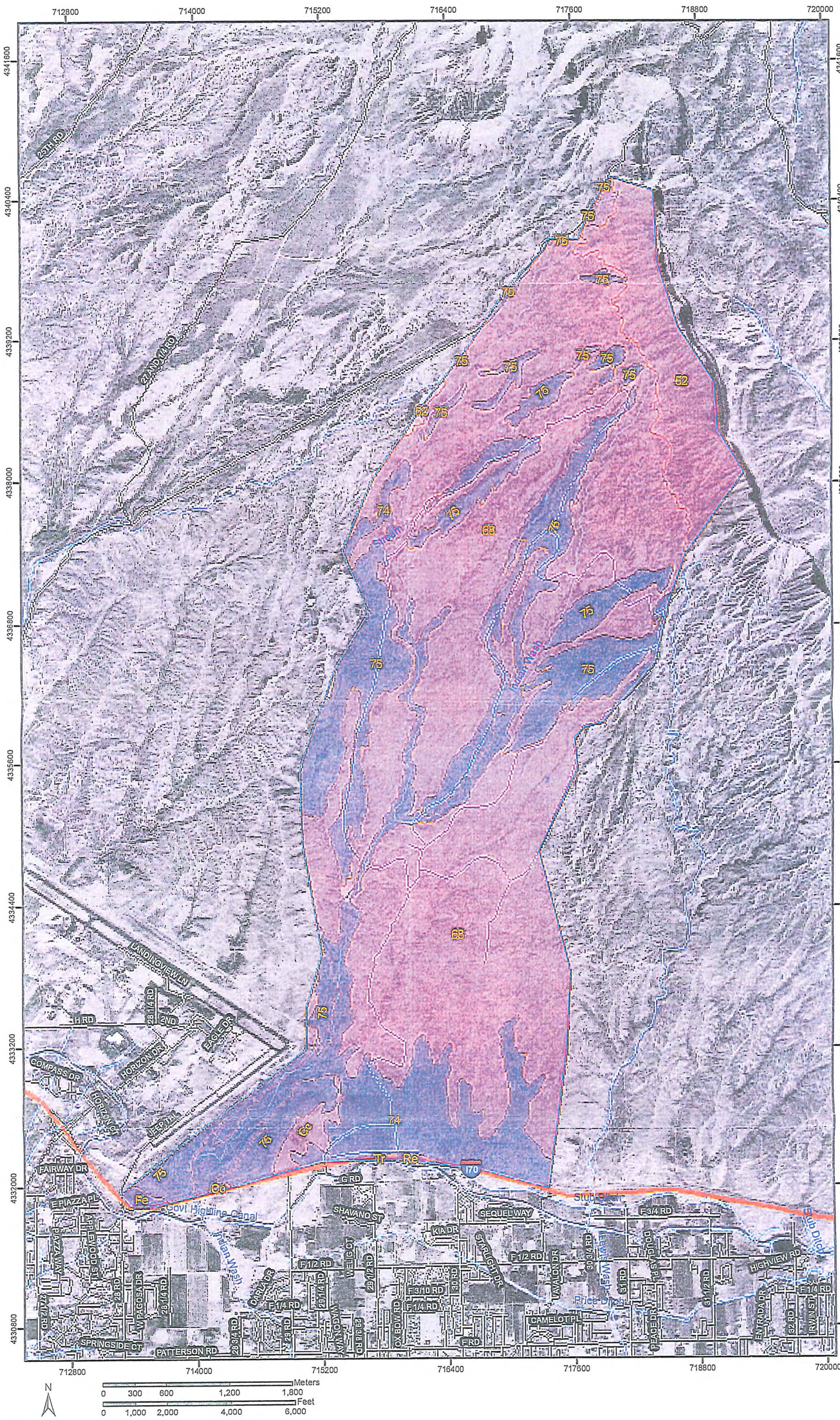
Notes:
1. Selection of DTHETA

Dry	=	Nonirrigated lands, such as desert and rangeland;
Normal	=	Irrigated lawn, turf, and permanent pasture;
Saturated	=	Irrigated agricultural land.

FIGURE 4.4
EFFECT OF VEGETATION COVER ON HYDRAULIC CONDUCTIVITY
FOR HYDRAULIC SOIL GROUPS B, C, AND D, AND FOR ALL SOIL TEXTURES
OTHER THAN SAND AND LOAMY SAND



Hydrologic Soil Group–Mesa County Area, Colorado
(Grand Junction Regional Airport - Master Drainage - Indian Wash)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

Date(s) aerial images were photographed: 8/3/1993; 9/14/1993; 9/28/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Mesa County Area, Colorado				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
52	Badlands-Deaver-Chipeta complex, 25 to 99 percent slopes, extremely stony	D	437.0	7.3%
68	Killpack-Badlands-Persayo complex, 3 to 25 percent slopes, saline	D	3,512.6	59.1%
74	Turley-Sagrlite-Fruitland complex, 0 to 3 percent slopes	B	753.0	12.7%
75	Uffens fine sandy loam, 1 to 6 percent slopes	B	1,166.5	19.6%
Cc	Persayo silty clay loam, 5 to 12 percent slopes	D	53.7	0.9%
Fe	Fruita clay loam, 0 to 2 percent slopes	B	13.9	0.2%
Re	Sagrlite loam, 0 to 2 percent slopes	B	6.9	0.1%
Tr	Turley clay loam, 0 to 2 percent slopes	B	3.1	0.1%
Totals for Area of Interest (AOI)			5,946.8	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

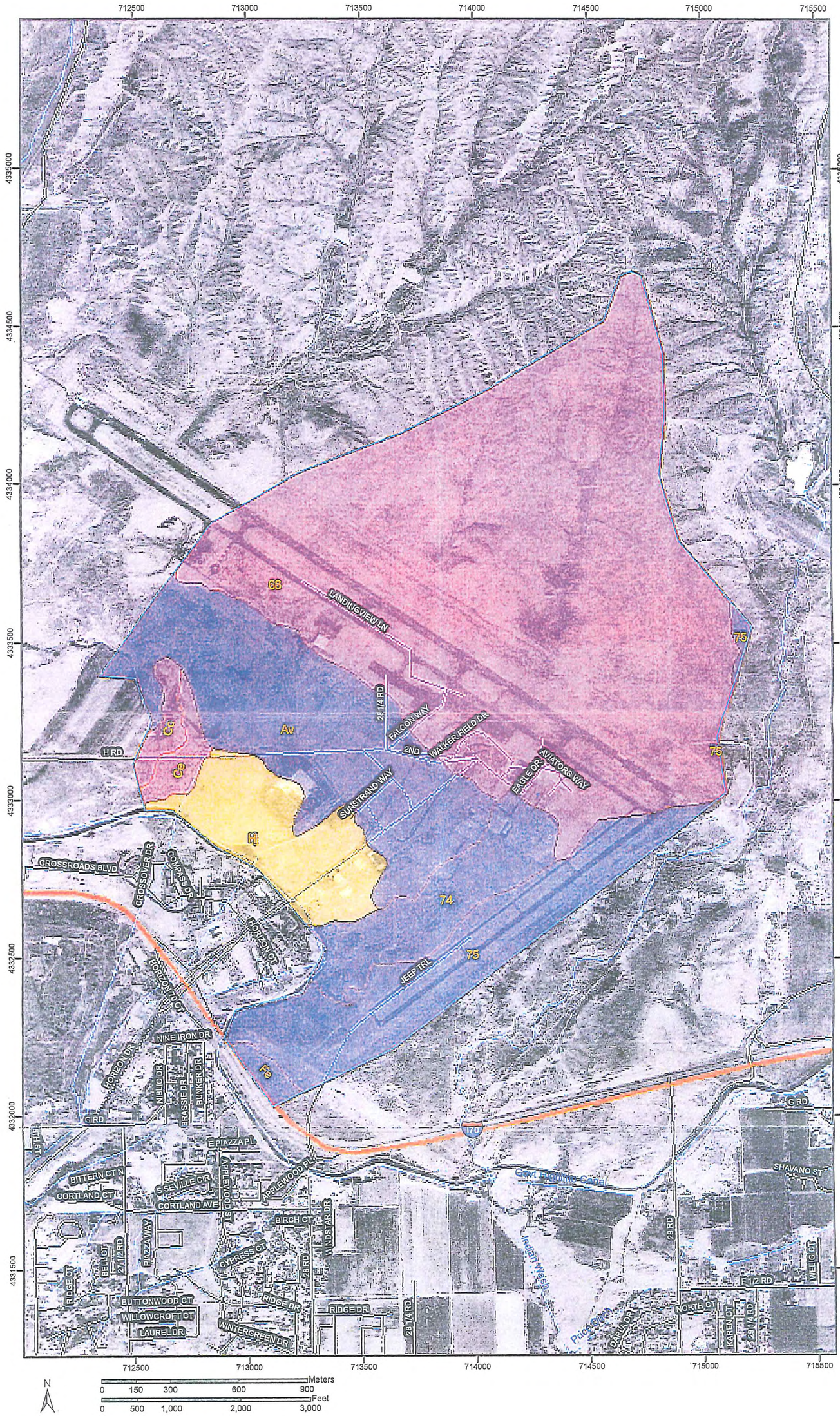
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower


712500
713000
713500
714000
714500
715000
715500
4335000
4334500
4334000
4333500
4333000
4332500
4332000
4331500
63
Av
Ce
M
74
75
Fe
LANDINGVIEW LN
H RD
28 1/4 RD
FALCON WAY
2ND
WALKER FIELD DR
EAGLE DR
AVIATORS WAY
SUNSTRAND WAY
GROSSROADS BLVD
GROSSOVER DR
CROSSOVER CT
JEEP TRL
NINE IRON DR
I 70
G RD
SHAVANO ST
Grand Valley Canal
Price Ditch
28 RD
F 1/2 RD
28 1/4 RD
NORTH CT
KAREN CT
WELLER CT
BIRCH CT
WINDSTAR DR
CYPRESS CT
RIDGE DR
WINTERGREEN DR
BUTTONWOOD CT
WILLOWCROFT CT
LAUREL DR
RIDGE CT
BELL CT
27 1/2 RD
PIAZZA WAY
PIAZZA PL
BITTERN CT N
CORTLAND CT E
CORTLAND AVE
CORTLAND CT W
APPLEWOOD PL
CRABAPPLE DR
BUNKER CT
BUNKER DR
NIEL DR
BRASSIE DR
LOMPOC CT
LOMPOC DR
N
Meters
0 150 300 600 900
Feet
0 500 1,000 2,000 3,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

Date(s) aerial images were photographed: 8/3/1993; 9/14/1993; 9/28/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Mesa County Area, Colorado				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
68	Killpack-Badlands-Persayo complex, 3 to 25 percent slopes, saline	D	780.6	56.7%
74	Turley-Sagrlite-Fruitland complex, 0 to 3 percent slopes	B	81.6	5.9%
75	Uffens fine sandy loam, 1 to 6 percent slopes	B	151.6	11.0%
Av	Avalon sandy loam, gravelly substratum, 2 to 5 percent slopes	B	232.3	16.9%
Cc	Persayo silty clay loam, 5 to 12 percent slopes	D	14.2	1.0%
Ce	Persayo silty clay loam, 2 to 5 percent slopes	D	16.2	1.2%
Fe	Fruita clay loam, 0 to 2 percent slopes	B	9.1	0.7%
Hj	Killpack silty clay, 2 to 5 percent slopes	C	92.0	6.7%
Totals for Area of Interest (AOI)			1,377.7	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

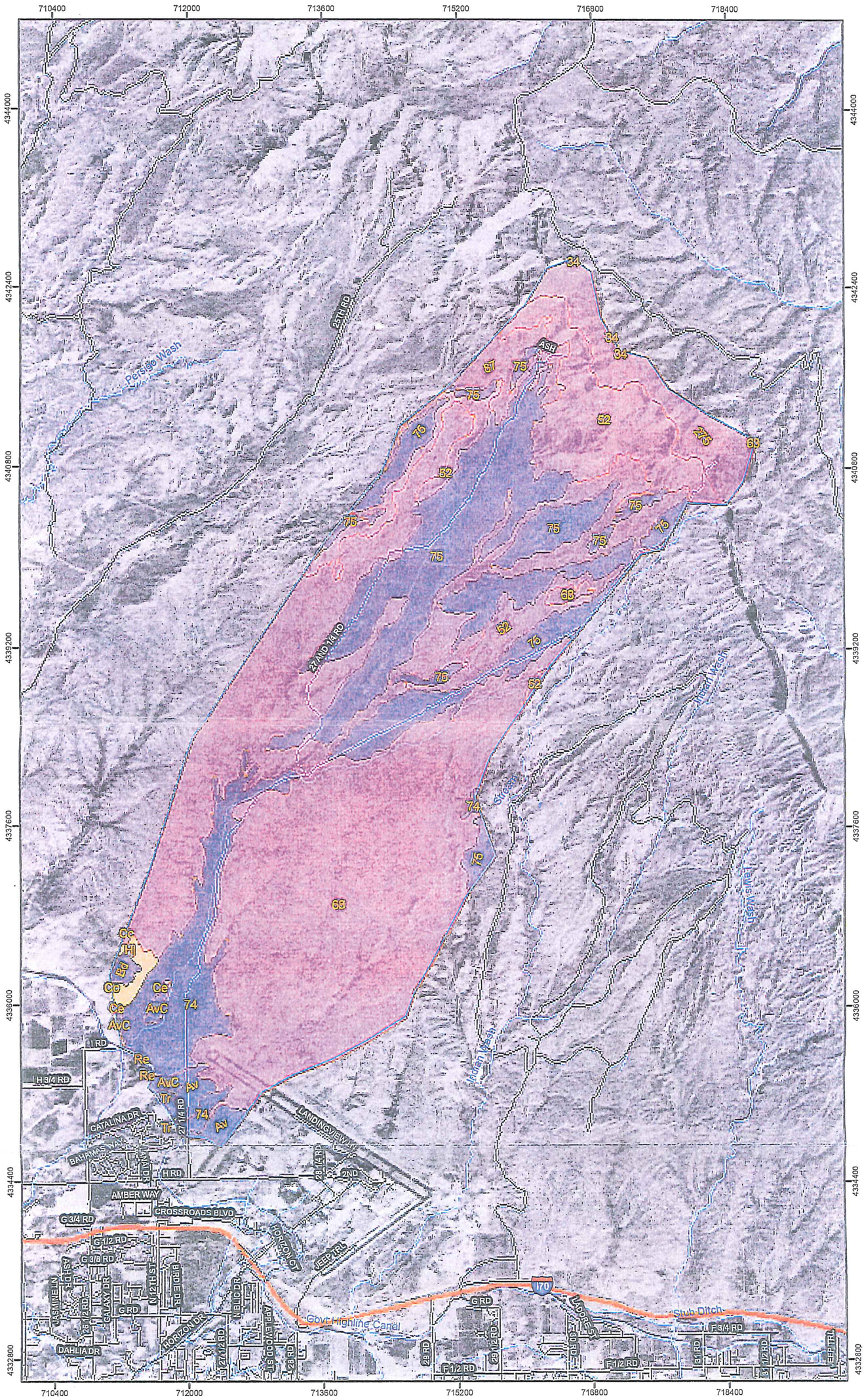
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

Hydrologic Soil Group–Mesa County Area, Colorado
(Grand Junction Regional Airport - Master Drainage - Leach Creek)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Municipalities
  - Cities
  - Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Roads
  - Interstate Highways
  - US Routes
  - State Highways
  - Local Roads
  - Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

Date(s) aerial images were photographed: 8/1/1993; 8/3/1993; 9/14/1993; 9/28/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group—Summary by Map Unit—Mesa County Area, Colorado				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
27	Rock outcrop-Biedsaw complex, 25 to 65 percent slopes, extremely bouldery	D	0.1	0.0%
34	Wrayha-Dollard-Fergus complex, 25 to 65 percent slopes, very stony	C	1.6	0.0%
52	Badlands-Deaver-Chipeta complex, 25 to 99 percent slopes, extremely stony	D	915.8	11.3%
63	Forelle-Cushool complex, 6 to 25 percent slopes	B	0.2	0.0%
68	Killpack-Badlands-Persayo complex, 3 to 25 percent slopes, saline	D	4,239.3	52.2%
74	Turley-Sagrlite-Fruitland complex, 0 to 3 percent slopes	B	523.0	6.4%
75	Uffens fine sandy loam, 1 to 6 percent slopes	B	1,686.6	20.8%
87	Persayo-Blackston complex, 6 to 45 percent slopes	D	170.3	2.1%
275	Torriorthents, warm-rock outcrop, 35 to 90 percent slopes	D	367.8	4.5%
Av	Avalon sandy loam, gravelly substratum, 2 to 5 percent slopes	B	109.5	1.3%
AvC	Avalon loam, gravelly substratum, 5 to 25 percent slopes	B	25.6	0.3%
Bd	Sagers silty clay loam, 2 to 5 percent slopes	B	23.0	0.3%
Cc	Persayo silty clay loam, 5 to 12 percent slopes	D	2.1	0.0%
Ce	Persayo silty clay loam, 2 to 5 percent slopes	D	4.3	0.1%
Hj	Killpack silty clay, 2 to 5 percent slopes	C	44.5	0.5%
Re	Sagrlite loam, 0 to 2 percent slopes	B	0.3	0.0%

Hydrologic Soil Group— Summary by Map Unit — Mesa County Area, Colorado				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Tr	Turley clay loam, 0 to 2 percent slopes	B	4.1	0.1%
Totals for Area of Interest (AOI)			8,118.1	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

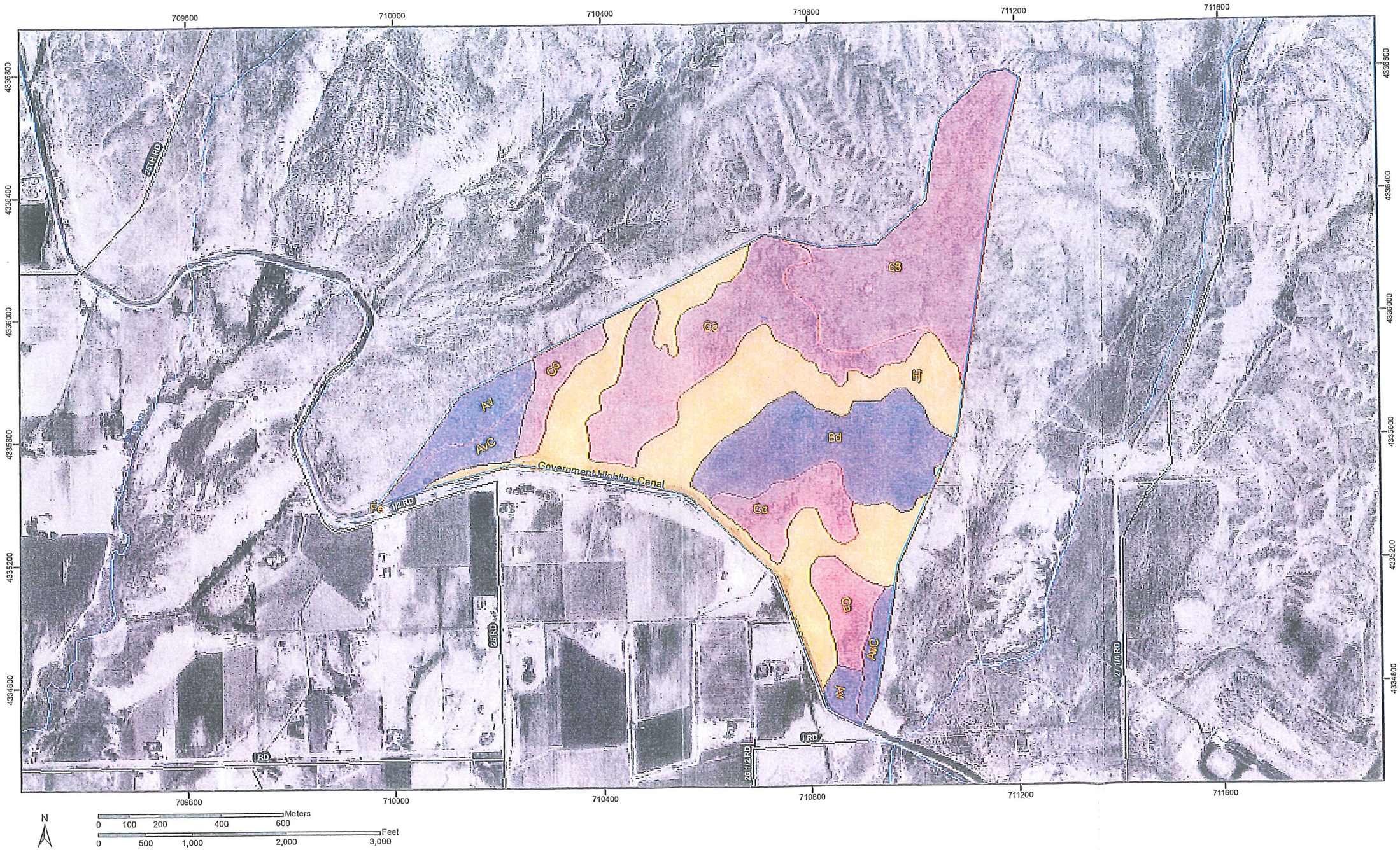
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower


709600
710000
710400
710800
711200
711600
4336800
4336400
4336000
4335600
4335200
4334800
25 1/2 RD
Av
AvC
Cs
Gs
Bd
Ce
Hj
Government Highline Canal
Fe 1/2 RD
26 RD
I RD
26 1/2 RD
27 1/2 RD
N
0 100 200 400 600 Meters
0 500 1,000 2,000 3,000 Feet

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

Date(s) aerial images were photographed: 8/3/1993

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Mesa County Area, Colorado				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
68	Killpack-Badlands-Persayo complex, 3 to 25 percent slopes, saline	D	76.6	20.7%
Av	Avalon sandy loam, gravelly substratum, 2 to 5 percent slopes	B	16.3	4.4%
AvC	Avalon loam, gravelly substratum, 5 to 25 percent slopes	B	16.8	4.5%
Bd	Sagers silty clay loam, 2 to 5 percent slopes	B	50.3	13.6%
Cc	Persayo silty clay loam, 5 to 12 percent slopes	D	87.5	23.6%
Ce	Persayo silty clay loam, 2 to 5 percent slopes	D	12.2	3.3%
Fe	Fruita clay loam, 0 to 2 percent slopes	B	0.0	0.0%
Hj	Killpack silty clay, 2 to 5 percent slopes	C	110.6	29.9%
Totals for Area of Interest (AOI)			370.3	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

f. **Underwater waste discharges.** The FAA recommends against the underwater discharge of any food waste (e.g., fish processing offal) within the separations identified in Sections 1-2 through 1-4 because it could attract scavenging hazardous wildlife.

g. **Recycling centers.** Recycling centers that accept previously sorted non-food items, such as glass, newspaper, cardboard, or aluminum, are, in most cases, not attractive to hazardous wildlife and are acceptable.

h. **Construction and demolition (C&D) debris facilities.** C&D landfills do not generally attract hazardous wildlife and are acceptable if maintained in an orderly manner, admit no putrescible waste, and are not co-located with other waste disposal operations. However, C&D landfills have similar visual and operational characteristics to putrescible waste disposal sites. When co-located with putrescible waste disposal operations, C&D landfills are more likely to attract hazardous wildlife because of the similarities between these disposal facilities. Therefore, a C&D landfill co-located with another waste disposal operation should be located outside of the separations identified in Sections 1-2 through 1-4.

i. **Fly ash disposal.** The incinerated residue from resource recovery power/heat-generating facilities that are fired by municipal solid waste, coal, or wood is generally not a wildlife attractant because it no longer contains putrescible matter. Landfills accepting only fly ash are generally not considered to be wildlife attractants and are acceptable as long as they are maintained in an orderly manner, admit no putrescible waste of any kind, and are not co-located with other disposal operations that attract hazardous wildlife.

Since varying degrees of waste consumption are associated with general incineration (not resource recovery power/heat-generating facilities), the FAA considers the ash from general incinerators a regular waste disposal by-product and, therefore, a hazardous wildlife attractant if disposed of within the separation criteria outlined in Sections 1-2 through 1-4.

2-3. WATER MANAGEMENT FACILITIES. Drinking water intake and treatment facilities, storm water and wastewater treatment facilities, associated retention and settling ponds, ponds built for recreational use, and ponds that result from mining activities often attract large numbers of potentially hazardous wildlife. To prevent wildlife hazards, land-use developers and airport operators may need to develop management plans, in compliance with local and state regulations, to support the operation of storm water management facilities on or near all public-use airports to ensure a safe airport environment.

a. **Existing storm water management facilities.** On-airport storm water management facilities allow the quick removal of surface water, including discharges related to aircraft deicing, from impervious surfaces, such as pavement and terminal/hangar building roofs. Existing on-airport detention ponds collect storm water, protect water quality, and control runoff. Because they slowly release water

after storms, they create standing bodies of water that can attract hazardous wildlife. Where the airport has developed a Wildlife Hazard Management Plan (WHMP) in accordance with Part 139, the FAA requires immediate correction of any wildlife hazards arising from existing storm water facilities located on or near airports, using appropriate wildlife hazard mitigation techniques. Airport operators should develop measures to minimize hazardous wildlife attraction in consultation with a wildlife damage management biologist.

Where possible, airport operators should modify storm water detention ponds to allow a maximum 48-hour detention period for the design storm. The FAA recommends that airport operators avoid or remove retention ponds and detention ponds featuring dead storage to eliminate standing water. Detention basins should remain totally dry between rainfalls. Where constant flow of water is anticipated through the basin, or where any portion of the basin bottom may remain wet, the detention facility should include a concrete or paved pad and/or ditch/swale in the bottom to prevent vegetation that may provide nesting habitat.

When it is not possible to drain a large detention pond completely, airport operators may use physical barriers, such as bird balls, wires grids, pillows, or netting, to deter birds and other hazardous wildlife. When physical barriers are used, airport operators must evaluate their use and ensure they will not adversely affect water rescue. Before installing any physical barriers over detention ponds on Part 139 airports, airport operators must get approval from the appropriate FAA Regional Airports Division Office.

The FAA recommends that airport operators encourage off-airport storm water treatment facility operators to incorporate appropriate wildlife hazard mitigation techniques into storm water treatment facility operating practices when their facility is located within the separation criteria specified in Sections 1-2 through 1-4.

b. **New storm water management facilities.** The FAA strongly recommends that off-airport storm water management systems located within the separations identified in Sections 1-2 through 1-4 be designed and operated so as not to create above-ground standing water. Stormwater detention ponds should be designed, engineered, constructed, and maintained for a maximum 48–hour detention period after the design storm and remain completely dry between storms. To facilitate the control of hazardous wildlife, the FAA recommends the use of steep-sided, rip-rap lined, narrow, linearly shaped water detention basins. When it is not possible to place these ponds away from an airport's AOA, airport operators should use physical barriers, such as bird balls, wires grids, pillows, or netting, to prevent access of hazardous wildlife to open water and minimize aircraft-wildlife interactions. When physical barriers are used, airport operators must evaluate their use and ensure they will not adversely affect water rescue. Before installing any physical barriers over detention ponds on Part 139 airports, airport operators must get approval from the appropriate FAA Regional Airports Division Office. All vegetation in or around detention basins that provide food or cover for hazardous wildlife should be eliminated. If soil conditions and other requirements allow, the FAA encourages

the use of underground storm water infiltration systems, such as French drains or buried rock fields, because they are less attractive to wildlife.

c. **Existing wastewater treatment facilities.** The FAA strongly recommends that airport operators immediately correct any wildlife hazards arising from existing wastewater treatment facilities located on or near the airport. Where required, a WHMP developed in accordance with Part 139 will outline appropriate wildlife hazard mitigation techniques. Accordingly, airport operators should encourage wastewater treatment facility operators to incorporate measures, developed in consultation with a wildlife damage management biologist, to minimize hazardous wildlife attractants. Airport operators should also encourage those wastewater treatment facility operators to incorporate these mitigation techniques into their standard operating practices. In addition, airport operators should consider the existence of wastewater treatment facilities when evaluating proposed sites for new airport development projects and avoid such sites when practicable.

d. **New wastewater treatment facilities.** The FAA strongly recommends against the construction of new wastewater treatment facilities or associated settling ponds within the separations identified in Sections 1-2 through 1-4. Appendix 1 defines wastewater treatment facility as "any devices and/or systems used to store, treat, recycle, or reclaim municipal sewage or liquid industrial wastes." The definition includes any pretreatment involving the reduction of the amount of pollutants or the elimination of pollutants prior to introducing such pollutants into a publicly owned treatment works (wastewater treatment facility). During the site-location analysis for wastewater treatment facilities, developers should consider the potential to attract hazardous wildlife if an airport is in the vicinity of the proposed site, and airport operators should voice their opposition to such facilities if they are in proximity to the airport.

e. **Artificial marshes.** In warmer climates, wastewater treatment facilities sometimes employ artificial marshes and use submergent and emergent aquatic vegetation as natural filters. These artificial marshes may be used by some species of flocking birds, such as blackbirds and waterfowl, for breeding or roosting activities. The FAA strongly recommends against establishing artificial marshes within the separations identified in Sections 1-2 through 1-4.

f. **Wastewater discharge and sludge disposal.** The FAA recommends against the discharge of wastewater or sludge on airport property because it may improve soil moisture and quality on unpaved areas and lead to improved turf growth that can be an attractive food source for many species of animals. Also, the turf requires more frequent mowing, which in turn may mutilate or flush insects or small animals and produce straw, both of which can attract hazardous wildlife. In addition, the improved turf may attract grazing wildlife, such as deer and geese. Problems may also occur when discharges saturate unpaved airport areas. The resultant soft, muddy conditions can severely restrict or prevent emergency vehicles from reaching accident sites in a timely manner.

Chapter 2: Estimating runoff

SCS Runoff Curve Number method

The SCS Runoff Curve Number (CN) method is described in detail in NEH-4 (SCS 1985). The SCS runoff equation is

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad \text{[Eq. 2-1]}$$

where

Q = runoff (in),
P = rainfall (in),
S = potential maximum retention after runoff begins (in), and
I_a = initial abstraction (in).

Initial abstraction (I_a) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. I_a is highly variable but generally is correlated with soil and cover parameters. Through studies of many small agricultural watersheds, I_a was found to be approximated by the following empirical equation:

$$I_a = 0.2S. \qquad \text{[Eq. 2-2]}$$

By removing I_a as an independent parameter, this approximation allows use of a combination of S and P to produce a unique runoff amount. Substituting equation 2-2 into equation 2-1 gives

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} \qquad \text{[Eq. 2-3]}$$

S is related to the soil and cover conditions of the watershed through the CN. CN has a range of 0 to 100, and S is related to CN by

$$S = \frac{1000}{CN} - 10. \qquad \text{[Eq. 2-4]}$$

Figure 2-1 and table 2-1 solve equations 2-3 and 2-4 for a range of CN's and rainfall.

Factors considered in determining runoff curve numbers

The major factors that determine CN are the hydrologic soil group (HSG), cover type, treatment, hydrologic condition, and antecedent runoff condition (ARC). Another factor considered is whether impervious areas outlet directly to the drainage system (connected) or whether the flow spreads over pervious areas before entering the drainage system (unconnected). Figure 2-2 is provided to aid in selecting the appropriate figure or table for determining curve numbers.

CN's in table 2-2 (*a* to *d*) represent average antecedent runoff condition for urban, cultivated agricultural, other agricultural, and arid and semiarid rangeland uses. Table 2-2 assumes impervious areas are directly connected. The following sections explain how to determine CN's and how to modify them for urban conditions.

Hydrologic soil groups

Infiltration rates of soils vary widely and are affected by subsurface permeability as well as surface intake rates. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. Appendix A defines the four groups and provides a list of most of the soils in the United States and their group classification. The soils in the area of interest may be identified from a soil survey report, which can be obtained from local SCS offices or soil and water conservation district offices.

Most urban areas are only partially covered by impervious surfaces: the soil remains an important factor in runoff estimates. Urbanization has a greater effect on runoff in watersheds with soils having high infiltration rates (sands and gravels) than in watersheds predominantly of silts and clays, which generally have low infiltration rates.

Any disturbance of a soil profile can significantly change its infiltration characteristics. With urbanization, native soil profiles may be mixed or removed or fill material from other areas may be introduced. Therefore, a method based on soil

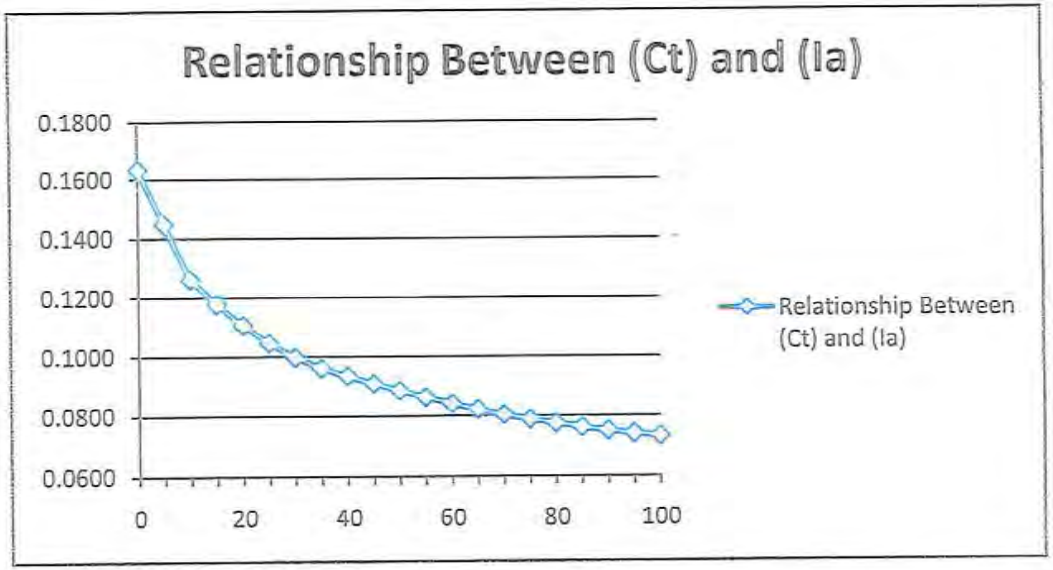
Table A1. Table of Correspondence.

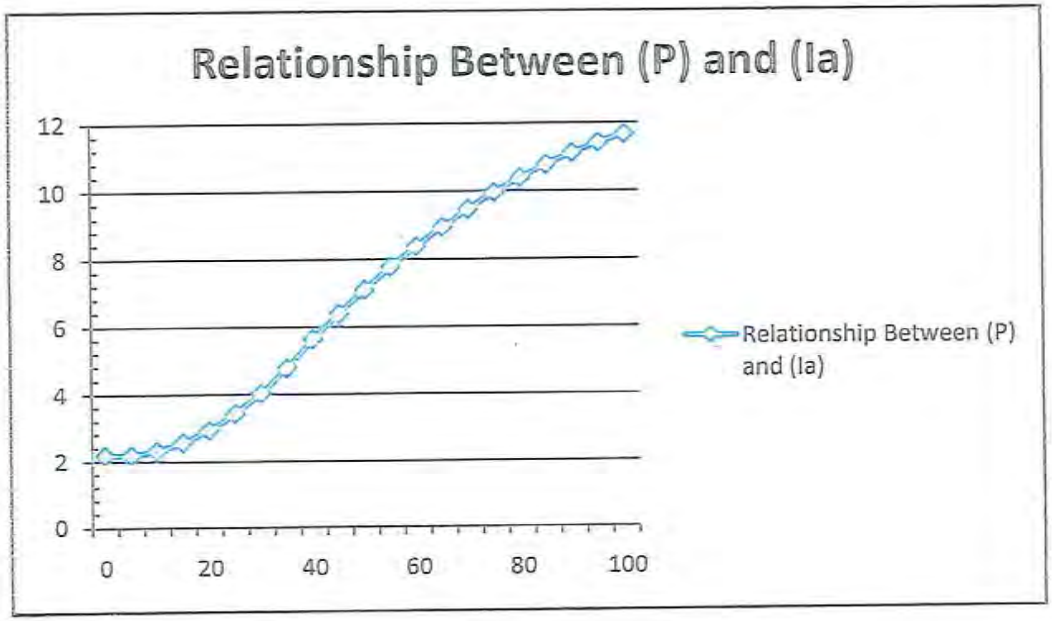
CURVE NUMBER	KT(IN/HR)	SF(IN)	SORPTIVITY(IN/HR**1/2)
100.0	0.000	I	0.0000
99.0	.003	.088	.0237
98.0	.006	.177	.0473
97.0	.010	.265	.0710
96.0	.013	.353	.0947
95.0	.016	.442	.1183
94.0	.019	.530	.1420
93.0	.022	.618	.1657
92.0	.025	.707	.1893
91.0	.029	.795	.2130
90.0	.032	.883	.2367
89.0	.035	.972	.2603
88.0	.038	1.060	.2840
87.0	.041	1.148	.3077
86.0	.044	1.237	.3313
85.0	.048	1.325	.3550
84.0	.051	1.414	.3787
83.0	.054	1.502	.4023
82.0	.057	1.590	.4260
81.0	.060	1.679	.4497
80.0	.063	1.767	.4734
79.0	.067	1.855	.4970
78.0	.070	1.944	.5207
77.0	.073	2.032	.5444
76.0	.076	2.120	.5680
75.0	.081	2.161	.5917
74.0	.096	1.964	.6154
73.0	.112	1.826	.6390
72.0	.127	1.726	.6627
71.0	.143	1.652	.6864
70.0	.158	1.595	.7100
69.0	.173	1.552	.7337
68.0	.189	1.519	.7574
67.0	.204	1.496	.7810
66.0	.220	1.474	.8047
65.0	.235	1.421	.8173
64.0	.250	1.352	.8230
63.0	.266	1.292	.8288
62.0	.281	1.238	.8345
61.0	.297	1.190	.8403
60.0	.312	1.147	.8460
59.0	.327	1.108	.8518
58.0	.343	1.073	.8575
57.0	.358	1.040	.8633
56.0	.374	1.011	.8690
55.0	.389	.984	.8748
54.0	.404	.959	.8805
53.0	.420	.935	.8863
52.0	.435	.914	.8920
51.0	.451	.894	.8978

CURVE NUMBER	KT(IN/HR)	SF(IN)	SORPTIVITY(IN/HR**1/2)
50.0	.466	.876	.9035
49.0	.481	.859	.9093
48.0	.497	.843	.9150
47.0	.512	.828	.9208
46.0	.528	.813	.9265
45.0	.543	.800	.9323
44.0	.558	.788	.9380
43.0	.574	.776	.9438
42.0	.589	.765	.9495
41.0	.605	.755	.9553
40.0	.620	.745	.9610
39.0	.635	.735	.9668
38.0	.651	.727	.9725
37.0	.666	.718	.9783
36.0	.687	.705	.9840
35.0	.719	.681	.9898
34.0	.751	.659	.9955
33.0	.784	.640	1.0013
32.0	.816	.621	1.0070
31.0	.849	.604	1.0128
30.0	.881	.589	1.0185
29.0	.913	.574	1.0243
28.0	.946	.561	1.0300
27.0	.978	.548	1.0358
26.0	1.011	.537	1.0415
25.0	1.043	.526	1.0473
24.0	1.075	.516	1.0530
23.0	1.108	.506	1.0588
22.0	1.140	.497	1.0645
21.0	1.173	.488	1.0703
20.0	1.205	.480	1.0760
19.0	1.237	.473	1.0818
18.0	1.270	.466	1.0875
17.0	1.302	.459	1.0933
16.0	1.335	.452	1.0990
15.0	1.367	.446	1.1048
14.0	1.399	.441	1.1105
13.0	1.432	.435	1.1163
12.0	1.464	.430	1.1220
11.0	1.497	.425	1.1278
10.0	1.529	.420	1.1335
9.0	1.561	.416	1.1393
8.0	1.594	.411	1.1450
7.0	1.626	.407	1.1508
6.0	1.659	.403	1.1565
5.0	1.691	.399	1.1623
4.0	1.723	.396	1.1680
3.0	1.756	.392	1.1738
2.0	1.788	.389	1.1795
1.0	1.821	.386	1.1853

GRAND JUNCTION ` .IONAL AIRPORT
MASTER DRAINAGE

Imp (%)	C_t	P
0	0.1630	2.1600
5	0.1445	2.1613
10	0.1259	2.2850
15	0.1176	2.5313
20	0.1104	2.9000
25	0.1044	3.3913
30	0.0995	4.0050
35	0.0958	4.7413
40	0.0932	5.6040
45	0.0906	6.3573
50	0.0882	7.0650
55	0.0859	7.7273
60	0.0838	8.3440
65	0.0819	8.9153
70	0.0801	9.4410
75	0.0785	9.9213
80	0.0770	10.3560
85	0.0758	10.7453
90	0.0746	11.0890
95	0.0737	11.3873
100	0.0729	11.6400





$C_t = aI_a^2 + bI_a + c$

I_a = 0 to 10	a=0	b=-0.00371	c=0.163
I_a = 10 to 40	a=0.000023	b=-0.00224	c=0.146
I_a = 40 to 100	a=0.0000033	b=-0.000801	c=0.120

$P = aI_a^2 + bI_a + c$

I_a = 0 to 40	a=0.00245	b=-0.012	c=2.16
I_a = 40 to 100	a=-0.00091	b=0.228	c=-2.06

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.

2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

2. Infiltration and depression losses can no longer be varied from storm to storm. To do so, the user has to set up a new CUHP run for each storm or a group of storms that have different infiltration and depression losses.
3. Depression storage loss values are entered separately for the pervious and impervious areas.
4. If a detailed storm hyetograph input option is used, the user needs to identify the storm and then input incremental rainfall depths for each time increment of the hyetograph.
   If the 1-hour design rainfall depth input option is to be used, the user needs to identify the design storm (i.e., 2-, 5-, 10-, 50-, or 100-year) and then enter the 1-hour depth. The Excel program will then generate the design hyetograph using the USDCM protocols. Should the user want to generate hydrographs for the 500-year storm with the 1-hour depth input option, enter the 500-year 1-hour depth and then 100-year for the design storm. The software will use the 100-year distribution to develop a 2-hour design storm.
5. For all practical purposes, there are no limits to the number of different hyetographs that can be entered. The user may input several sets of storms developed for different parts of the study area and then to specify the specific the storm to be used by a given catchment for each run of CUHP.

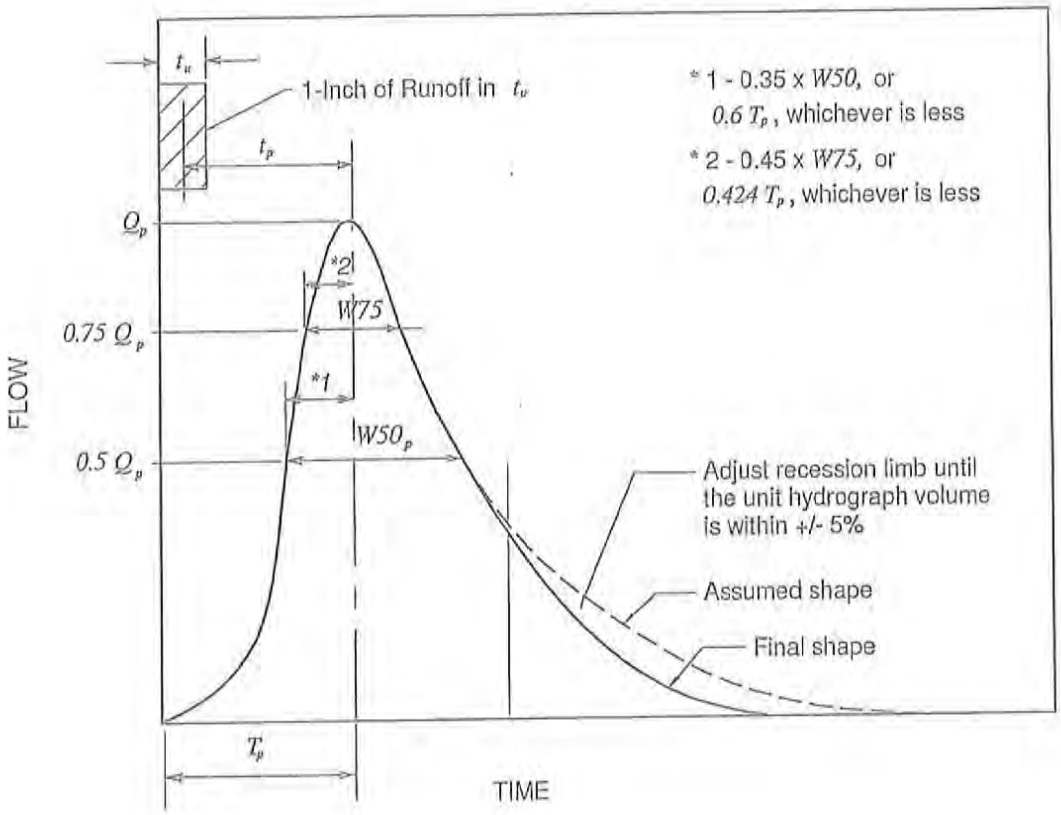
Unit and Storm Hydrograph

The CUHP2005 program will generate a unit hydrograph column matrix for each catchment. It will then set up an excess precipitation row matrix for each storm called by the catchment data, which it then cross-multiplies with the unit hydrograph matrix. The resultant storm hydrographs are then printed or routed to output files. Unit hydrographs are developed using several catchment parameters and the equations found in the USDCM. As an option, the coefficients *Cp* and *Ct*, if known or predetermined, can be input directly to override the values computed by the Excel macro using the USDCM protocols. The level of DCIA can be also be input as catchment data. If DCIA levels are not entered, the program defaults to "established practice" mode. The Excel spreadsheet also allows the user to enter calibrating multipliers to adjust the coefficients that are shown on the spreadsheet as "Used by CUHP2005". This feature was provided to permit the user to calibrate the CUHP2005 output to known rainfall/runoff data.

CUHP2005 is based on four basic equations used in defining the shape of the synthetic unit hydrograph. Figure 1 defines the terms used to describe the unit hydrograph and some of the default shaping factors. With this as a reference, the first equation defines the time to peak (t_p) the time from the center of the unit storm duration to the peak of the unit hydrograph:

$$t_p = C_t \cdot \left(\frac{L \cdot L_{ca}}{\sqrt{S}} \right)^{0.48}$$

in which, t_p = time to peak of the unit hydrograph from midpoint of unit rainfall in hours



L = length along the drainageway path from study point to the most upstream limits of the catchment in miles

L_{ca} = length along stream from study point to a point along stream adjacent to the centroid of the catchment in miles

Figure 1. Elements of a Unit Hydrograph.

S = length weighted average slope of catchment along the drainageway path to upstream limits of the catchment in feet per foot

C_t = coefficient reflecting time to peak

A 5-minute unit hydrograph produces reasonable length output files and longer using times are not recommended for urban hydrology. The user has the option of using any unit time increment regardless of the rainfall unit time increments used to define the hyetograph being used.

The second equation is,

$$T_p = 60 \cdot t_p + 0.5 \cdot t_u$$

in which, T_p = time from the beginning of unit rainfall to the peak of the unit hydrograph
t_u = duration of unit rainfall

The third equation is,

$$q_p = \frac{640 \cdot C_p}{t_p}$$

in which, q_p = peak rate of runoff in cfs per square mile
C_p = coefficient related to peak rate of runoff

The fourth equation is,

$$Q_p = q_p \cdot A$$

in which, Q_p = peak of the unit hydrograph in cfs
A = area of catchment in square miles

The maximum recommended catchment size for any single unit hydrograph is 5-square miles. Whenever a larger catchment is studied, it should be subdivided into sub-catchments of 5-square miles or less. These are then combined and routed downstream using appropriate channel routing procedures.

The minimum catchment size recommended for use with the CUHP2005 program is 5 to 10 acres. If the Rational Formula option is used, the minimum catchment size is five (5) acres for catchments with 25% or more imperviousness and 2 acres for catchments with less than 25% imperviousness.

Subdivide very long catchments (i.e., ones with length to width ratio of four or more) into more regularly shaped sub-catchments. Although not an absolute rule, the length to width ratio of four should not be exceeded.

Natural and grass-lined drainageways and channels become unstable when the Froude Number approaches 1.0 and natural processes work to limit the reduction in time to peak as these drainageways become steeper. To account for this, the slope used in the second equation, one to find

t_p, for natural and grass-lined channels needs to be adjusted using Figure 2. These adjustments have been determined to give more realistic hydrologic results in steep terrain.

Grass-lined channels designed and built using UDFCD criteria have a slope that limits maximum control velocities. A typical range in slopes for these channels is 0.004 ft/ft to 0.007 ft/ft and it is recommended that initial hydrologic runs use a slope of 0.005 ft/ft when grass-lined channels are to be designed using UDFCD criteria.

For riprap and concrete-lined channels and storm sewers use the actual flow line slope, especially where they dominate the catchment drainageways.

When the flow line slope varies along the drainageway path, calculate a length-weighted catchment slope. Do this by:

1. Segmenting the drainageway into reaches of similar longitudinal slopes
2. Correct the slope of a steep reach using the correction coefficient taken form Figure 2.
3. Apply the following equation using the corrected slope for each reach:

$$S = \left(\frac{L_1 \cdot S_1^{0.24} + L_2 \cdot S_2^{0.24} + \cdots + L_n \cdot S_n^{0.24}}{L_1 + L_2 + \cdots + L_n} \right)^{4.17}$$

in which, S = weighted catchment waterway slope in ft/ft

$S_1, S_2, \ldots S_n$ = slopes of individual reaches in ft/ft (after adjustments using Figure 2)

$L_1, L_2, \ldots L_n$ = lengths of corresponding reaches

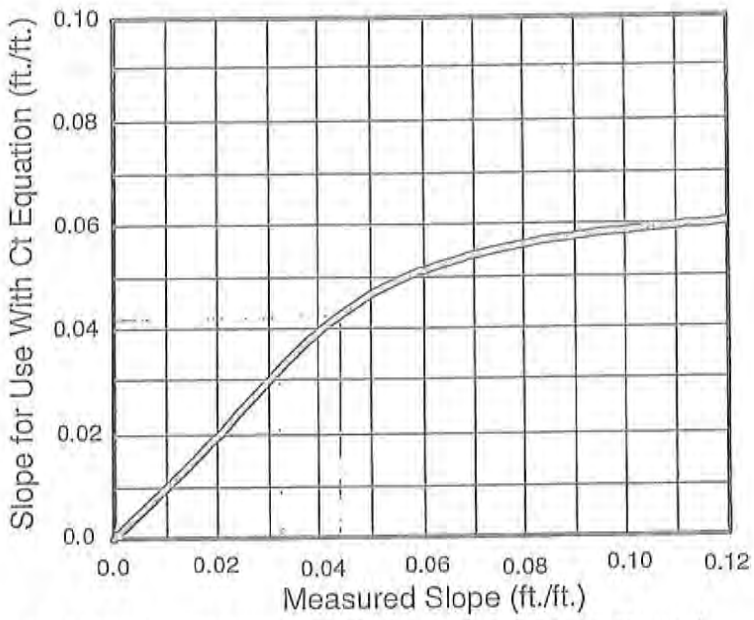


Figure 2: Slope Correction for Natural and Grass-Lined Channels

The value of C_t is calculated by CUHP2005 using the "Equations of Curve" in Figure 3.

The program uses the "Equations of Curve" shown on Figure 4 to determine the value of C_p. Using the Peaking Parameter P taken for Figure 4, C_p is calculated using the following equations:

If A>0.141

$$C_p = P \cdot C_t \cdot A^{0.15}$$

Otherwise

$$Cp = P\ Ct\ A^{\left(0.25-\frac{A}{0.141}\right)}$$

in which,

C_p	=	unit hydrograph peaking coefficient
C_t	=	Time to peak coefficient
P	=	peaking parameter
A	=	catchment area in square miles

The Figure 5 is used to help shape the unit hydrograph. The relationships shown are part of the CUHP2005 program and provide the width of the unit hydrograph at 50% and 75% of its peak discharge value. Using these values for widths and built-in values for how these widths are distributed in front of the time-to-peak of the unit hydrograph, a set of 6 coordinates are fixed that are used to shape the unit hydrograph. Curvilinear relationships are passed through these points and the

residual unit area is then adjusted using an exponential decay function so that the area under the unit hydrograph equals one-inch of runoff form the catchment.

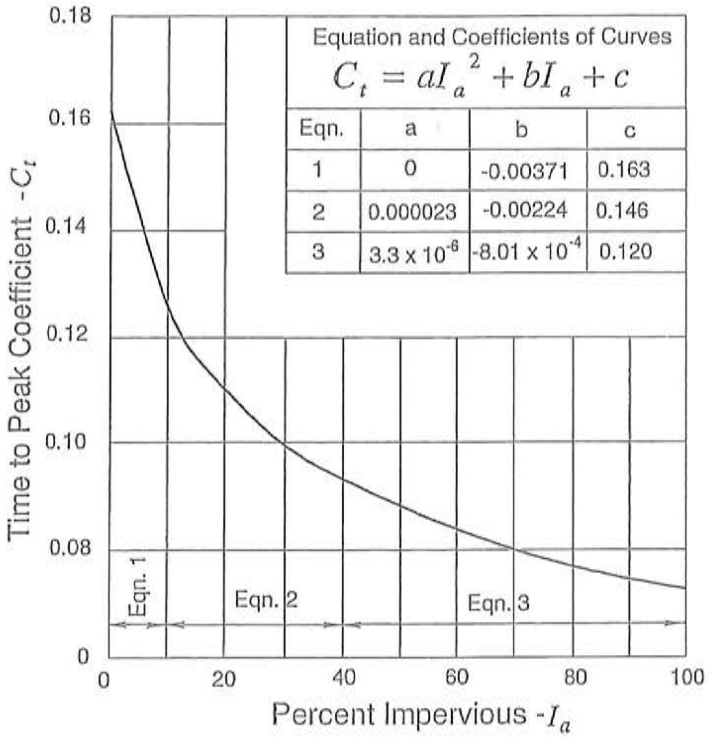


Figure 3: Relationship Between C_t and Imperviousness (I_a)

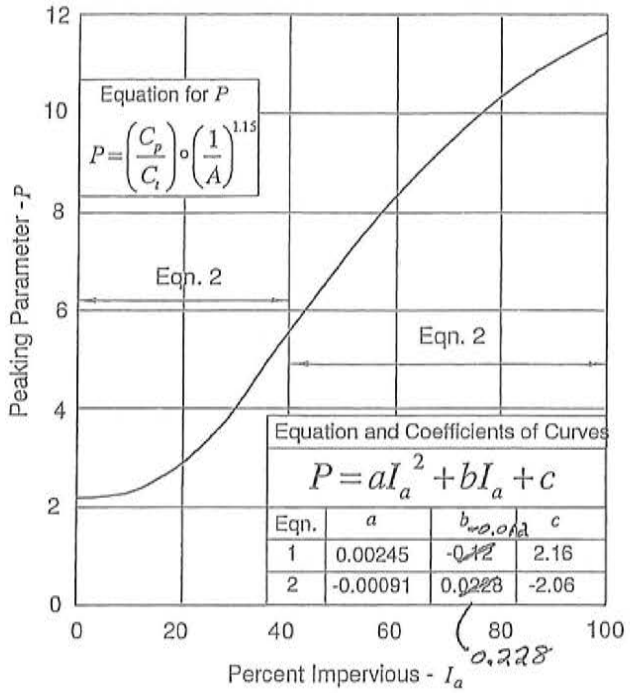


Figure 4: Relationship Between Peaking Parameter *(P)* and Imperviousness *(I_a)*

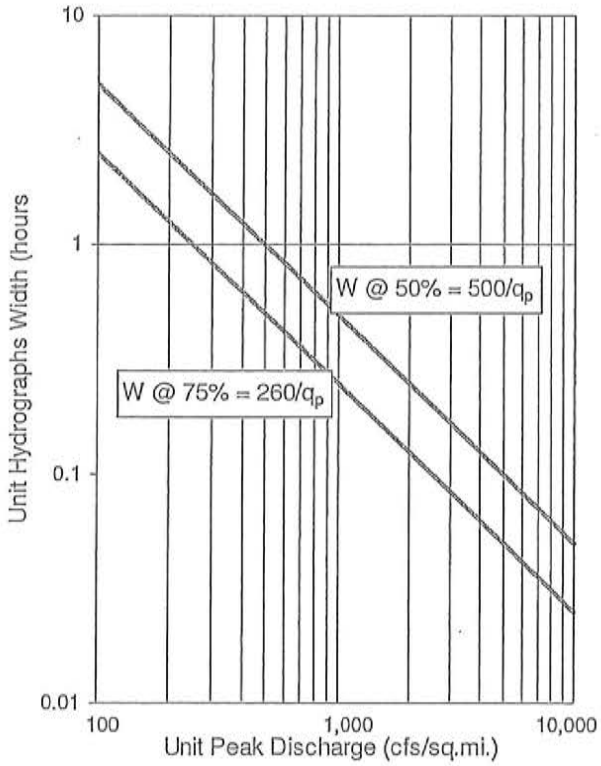


Figure 5: Unit Hydrograph Widths

Regional Analysis for Flood Peak Flows near City of Grand Junction, Colorado

prepared by
James Guo, PhD and P.E.
Tel: 303-548-9119; E-mail: James.Guo@UCDenver.edu

The master drainage plan for the Grand Junction Airport site provides the necessary information about storm water movement and magnitudes for the selected level of protection from the extreme events. The design peak flows from the tributary watersheds to the Grand Junction Airport site are simulated using the USA Corp of Army HEC-1 computer software package (HEC-1). The Snyder Unit Hydrograph method used in HEC-1 requires the pre-knowledge of the time of lag for any and all watersheds. It is suggested that the original Snyder's lag time formula be applicable to large and rural watersheds while the Colorado Unit Hydrograph Procedure (CUHP) be used for urbanized watersheds. The area-imperviousness of 10% serves as the demarcation between rural and urban watersheds. Tests on HEC-1 runs indicate that time of lag is a sensitive parameter to stormwater runoff predictions. This study provides a comparison between the HEC-1 predictions and the stream flow data available around the project site. With limited data, the comparison provides a good base to accept the selection of time of lag for the master drainage study.

SELCTION OF DATA BASE

The project site for Grand Junction Airport is located in the Mesa County, Colorado. USGS has more than 10 stream gage stations operated around the project area. For instance, the data at Stream Gage 09106200 on Lewis Wash is downloaded as:

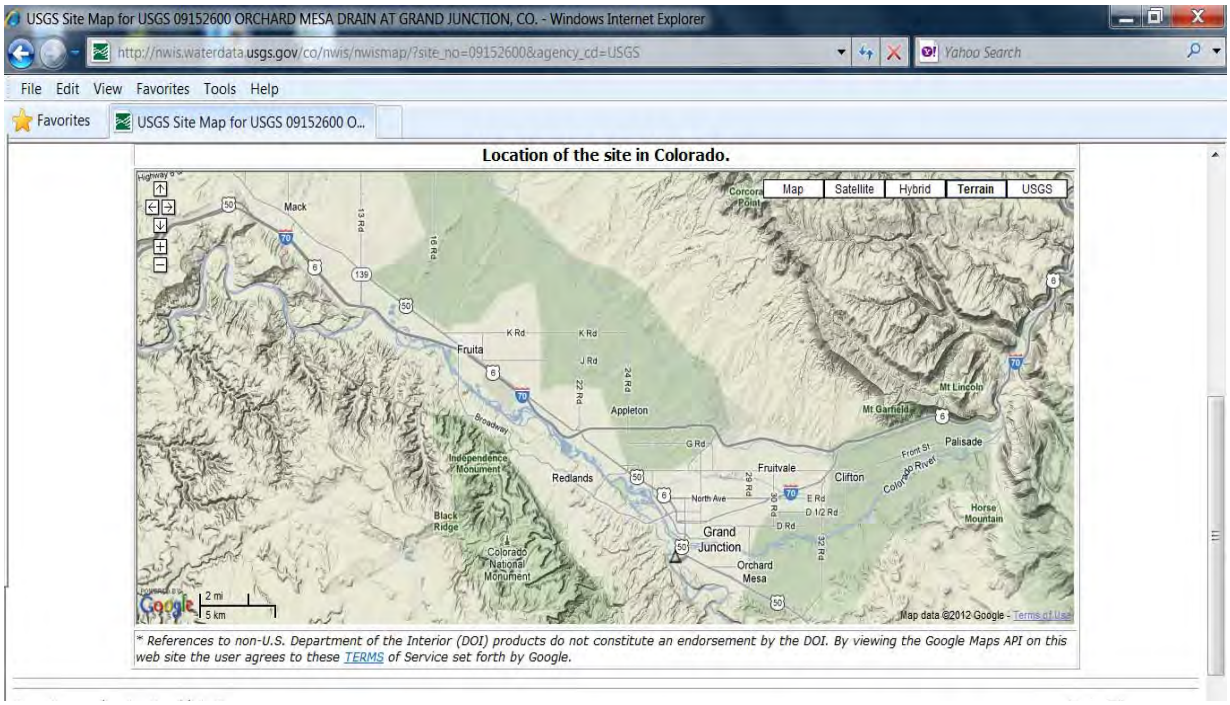


Figure 1 Map around City of Grand Junction

USGS 09106200 LEWIS WASH NEAR GRAND JUNCTION, CO.

Available data for this site | Surface-water: Peak streamflow | GO

Mesa County, Colorado
Hydrologic Unit Code 14010005
Latitude 39°03'38", Longitude 108°28'38" NAD27
Drainage area 4.72 square miles
Gage datum 4,610.00 feet above NGVD29

Output formats
Table
Graph
Tab-separated file
peakfq (watstore) format
Reselect output format

Water Year	Date	Gage Height (feet)	Stream-flow (cfs)	Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
1973	Jun. 15, 1973	2.50	33.0	1978	Sep. 07, 1978	4.17	152
1974	Jul. 18, 1974	3.68	114	1979	Aug. 20, 1979	3.78	97.0
1975	Jul. 16, 1975	2.58	36.0	2002	Aug. 06, 2002	[6]	18[1,2]
1976	Jun. 30, 1976	2.87	48.0	2003	Sep. 10, 2003	5.40	190
1977	Mar. 30, 1977	2.60[2]	32.0	2004	Nov. 05, 2003	3.13	46[E]

Table 1 Example of USGS Data Format

For this investigation, the following 4 stream gages were reviewed, screened, and analyzed for flood flow frequency analyses using the Gumbel Distribution.

USGS 09152600 ORCHARD MESA DRAIN AT GRAND JUNCTION, CO.

Mesa County, Colorado
Hydrologic Unit Code 14020005
Latitude 39°02'49", Longitude 108°34'17" NAD27
Drainage area 3.70 square miles
Gage datum 4,565.00 feet above NGVD29
Data from 1974 to 1983

Return Period	Non-Exceed	Gumbel Freq F	Peak Flow	Value of	Upper Freq F	Lower Freq F	Upper Limit	Lower Limit
Tr	p(Q<q)	Z	Qg	d	Zu	Zd	Qu	QL
year			cfs				cfs	cfs
2.00	0.50	-0.16	27.75	-0.24	0.38	-0.76	30.79	24.74
5.00	0.80	0.72	32.89	0.25	1.50	0.19	38.21	29.73
10.00	0.90	1.30	36.80	1.43	2.36	0.72	45.04	32.86
25.00	0.96	2.04	42.42	3.91	3.50	1.32	56.07	36.88
50.00	0.98	2.59	47.14	6.45	4.36	1.74	66.22	40.02
100.00	0.99	3.14	52.33	9.57	5.23	2.15	78.25	43.32

Table 2 Frequency-Flow at Station 09152600

USGS 09152000 KANNAH CREEK NEAR WHITEWATER, CO.

Mesa County, Colorado
Hydrologic Unit Code 14020005
Latitude 38°57'42", Longitude 108°13'47" NAD27
Drainage area 61.9 square miles
Gage datum 6,060.00 feet above NGVD29
Data from 1918 to 1982

Return Period Tr year	Non-Exceed p(Q<q)	Gumbel Freq F Z	Peak Flow Qg cfs	Value of d	Upper Freq F Zu	Lower Freq F Zd	Upper Limit Qu cfs	Lower Limit QL cfs
2.00	0.500	-0.164	114.97	-0.015	0.040	-0.375	151.20	86.59
5.00	0.800	0.719	376.41	0.476	0.967	0.503	524.92	281.41
10.00	0.900	1.305	825.42	1.660	1.616	1.050	1253.22	586.36
25.00	0.960	2.044	2226.13	4.136	2.455	1.721	3865.30	1443.35
50.00	0.980	2.592	4647.28	6.678	3.085	2.211	9003.54	2787.70
100.00	0.990	3.137	9649.12	9.797	3.714	2.695	20938.00	5333.43

Table 3 Frequency-Flow at Station 09152000

USGS 09106200 LEWIS WASH NEAR GRAND JUNCTION, CO.

Mesa County, Colorado
Hydrologic Unit Code 14010005
Latitude 39°03'38", Longitude 108°28'38" NAD27
Drainage area 4.72 square miles
Gage datum 4,610.00 feet above NGVD29
Data from 1974 to 2004

Return Period Tr year	Non-Exceed p(Q<q)	Gumbel Freq F Z	Peak Flow Qg cfs	Value of d	Upper Freq F Zu	Lower Freq F Zd	Upper Limit Qu cfs	Lower Limit QL cfs
2.00	0.500	-0.164	51.64	-0.244	0.376	-0.763	78.52	32.47
5.00	0.800	0.719	102.49	0.247	1.500	0.194	187.71	68.18
10.00	0.900	1.305	161.35	1.431	2.356	0.715	364.60	102.14
25.00	0.960	2.044	286.27	3.907	3.496	1.315	882.63	162.71
50.00	0.980	2.592	438.04	6.449	4.362	1.740	1727.75	226.22
100.00	0.990	3.137	668.17	9.568	5.230	2.153	3388.99	311.58

Table 4 Frequency-Flow at Station 09106200

USGS 09104500 MESA CREEK NEAR MESA, CO.

Mesa County, Colorado
Hydrologic Unit Code 14010005
Latitude 39°05'11", Longitude 108°07'34" NAD27
Drainage area 6.79 square miles
Gage datum 7,400.00 feet above NGVD29
Data from 1937 to 1960

Return Period Tr year	Non-Exceed p(Q<q)	Gumbel Freq F Z	Peak Flow Qg cfs	Value of d	Upper Freq F Zu	Lower Freq F Zd	Upper Limit Qu cfs	Lower Limit QL cfs
2.00	0.500	-0.164	37.91	-0.086	0.174	-0.523	44.25	32.18
5.00	0.800	0.719	56.77	0.405	1.157	0.372	69.33	48.43
10.00	0.900	1.305	74.16	1.589	1.869	0.904	95.96	61.75
25.00	0.960	2.044	103.96	4.065	2.802	1.541	146.98	82.64
50.00	0.980	2.592	133.57	6.607	3.507	2.002	202.83	101.99
100.00	0.990	3.137	171.28	9.726	4.212	2.453	279.95	125.35

Table 5 Frequency-Flow at Station 09104500

REGIONAL HYDROLOGIC ANALYSIS

For a specified storm such as the 100-yr event, the magnitude of stream flow is closely related to its tributary area. Often this power-function relationship can be exhibited as a straight line on a log-log graphic paper. In this study, the 100-yr peak flows are plotted with tributary areas for both predicted magnitudes from HEC-1 and from the flow-frequency analyses.

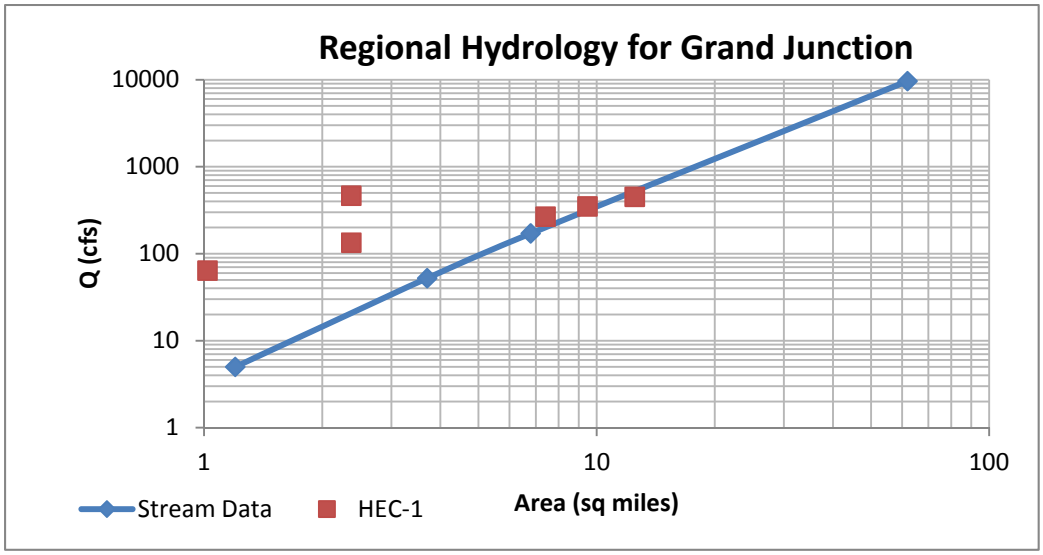


Figure 2 Peak Flows using HEC-1 and Stream Data for Grand Junction, CO

CONCLUSION

The stream flow data exhibits a straight line on the log-log scale and HEC-1 predictions scattered above the regional line. The comparison implies that the proposed method for time of lag gives a good agreement for large rural watersheds (>10 sq miles). For small urbanized watersheds, the proposed method does result in higher flows to reflect the urbanization effects. In Figure 2, watersheds less than 3 square miles are located near or within the City of Grand Junction. With limited data, this trend line is acceptable for this project site that has a mixed flood-flow hydrology between rural and urban watersheds.

706.3 Lag Time

Input data for the SCS Dimensionless Unit Hydrograph method (SCS, 1985) consists of a single parameter, T_{LAG}, which is equal to the lag (in hours) between the center of mass of rainfall excess and the peak of the unit hydrograph. For small watersheds (less than 1 square mile) in the Mesa County area, the lag time is related to the time of concentration, t_c, by the following empirical relationship:

$T_{LAG} = 0.6\ tc$ (714)

Where: T_{LAG} = The time (hours) between the center of mass of the rainfall excess and the peak of the unit hydrograph. t_c = The time of concentration (minutes, see section 703).

For large watersheds (greater than 1 square mile), the lag time (and t_c) is generally governed mostly by the concentrated flow travel time, not the initial overland flow time. In addition, as the watershed gets increasingly larger, the average flow velocity (and associated travel time) becomes more difficult to estimate. Therefore, for these watersheds, the following lag equation is recommended for use in computing T_{LAG}:

$T_{LAG} = 22.1\ K_n\ (L\ L_c / S_{0.5})_{0.33}$ (715)

Where: K_n = Manning's roughness factor for the watershed channels
L = Length of longest watercourse (miles), L_c = Watercourse length from the outflow point to a point on the channel nearest the centroid of the watershed (miles), S = Average slope of the longest watercourse (ft per mile)

This lag equation is based on the United States Bureau of Reclamation’s (USBR) analysis of the above parameters for several watersheds in the Southwest desert, Great Basin, and Colorado Plateau area (USBR, 1989). This equation was developed by converting the USBR's S-graph lag equation to a dimensionless unit hydrograph lag equation.

For watersheds 1.0 square miles in size, it is recommended that the method which results in the shortest T_{LAG} value be used to be conservative.

706.4 Roughness Factor

For consistency, recommended roughness factors, K_n, used in the lag time calculation are presented in **Table 708**. These factors are based on roughness factor analysis by the USACE (1982) and USBR (1989) as compared to the typical watershed channels found in the Mesa County area. The reader is referred to these documents for further discussion on selection of a proper roughness factor. For multiple land uses within a watershed, composite roughness factors should be determined.

Table 708 Lag Equation Roughness Factors

Land Use	Imperviousness %	K_n
Commercial, industrial, office and business	70-85	0.05
Residential		
Rural	10-15	0.08
Low density	20-25	0.07
Medium and high density	30-65	005
Irrigated grass, golf courses, parks and cemeteries	0-5	0.10
Undeveloped areas:		
Rock outcroppings		0.04
Irrigated agriculture		0.10
Rangelands:		
Grass lands		0.08
Grass and shrubs		0.09
Shrub and brush		0.10
Forest, evergreen		0.15

The initial or overland flow time, t_i, may be calculated using the following equation:

$$t_i = 1.8\ (1.1 - K)\ L_{o1/2} / S_{1/3}\ (702)$$

Where:
t_i = Initial or Overland Flow Time (min)
K = Flow Resistance Coefficient
L_o = Length of Overland Flow, (ft, 300-ft maximum)
S = Average Watershed Slope (percent)

Equation 702 was originally developed by the Federal Aviation Administration (FAA, 1970) for use with the Rational Formula method. However, the equation is also valid for computation of the initial or overland flow time for the SCS Unit Hydrograph method. The 5-year runoff coefficient, C_5, presented in **Table 702** is recommended for the flow resistance coefficient, K.

The overland flow length, L_o, is generally defined as the length over which the flow characteristics appear as sheet flow or very shallow flow in broad, grassed swales. Changes in land slope, surface characteristics, and small drainage ditches or gullies will tend to force the overland flow into a combined flow condition, which results in higher flow velocities and shorter travel times. Therefore, the initial flow time is limited to the time to travel a distance of 300 feet.

For watersheds longer than 300 feet, the travel time, t_t, must be added to the overland flow time. Travel time can be calculated using Manning's equation and the hydraulic properties of the storm drain, gutter, swale, ditch, or channel or can be approximated from Equation 703 and **Figure 701**:

$V = C_v S_{w\,0.5}$ (703)

Where:
V = Velocity, fps, S_w = watercourse slope, ft/ft, C_v = Conveyance coefficient

Table 703 Travel Time Conveyance Coefficients

Land Surface	Conveyance Coefficient C_v
Heavy meadow	2.5
Tillage/Field	5.0
Short pasture and lawns	7.0
Nearly bare ground	10
Grassed waterways	15
Paved areas and shallow swales	20

The time of concentration is then the sum of the initial flow time t_i and the travel time, t_t. The minimum recommended t_c for non-urban watersheds is 10 minutes.

Urbanized Watersheds
Overland flow in urbanized watersheds can occur from the back of the lot to the street, in parking lots, in greenbelt areas, or within park areas and can be calculated using the procedure described in Section 703. Travel time, t_t, to the first design point or inlet is often determined based on the conveyance coefficient for “Paved Areas and shallow swales”, but can be estimated using Manning's equation.

The time of concentration for the first design point in an urbanized watershed using this procedure should not exceed the time of concentration calculated using Equation 704, which was developed using rainfall/runoff data collected in urbanized regions (USDCM,1969).

$t_c = L / 180 + 10$ (704)

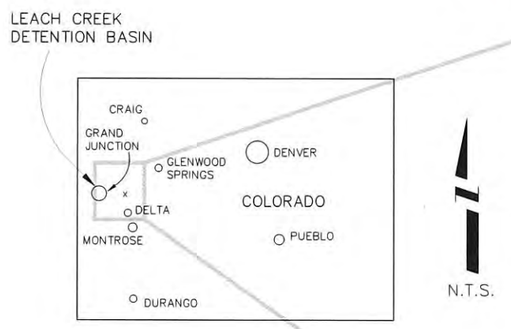
t_c = Time of Concentration at the first design point (min), L = Watershed Length (ft)

APPENDIX C – LEACH CREEK PLANS (BY OTHERS)

Leach Creek Detention Basin June 2003, City of Grand Junction
Leach Creek Detention Basin Water District 5, March 2003, City of Grand Junction

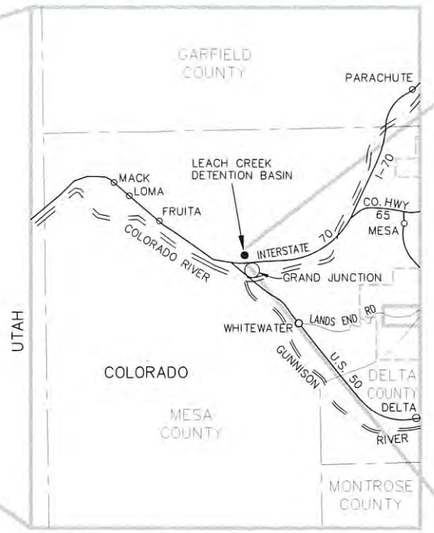
LEACH CREEK DETENTION BASIN

JUNE, 2003

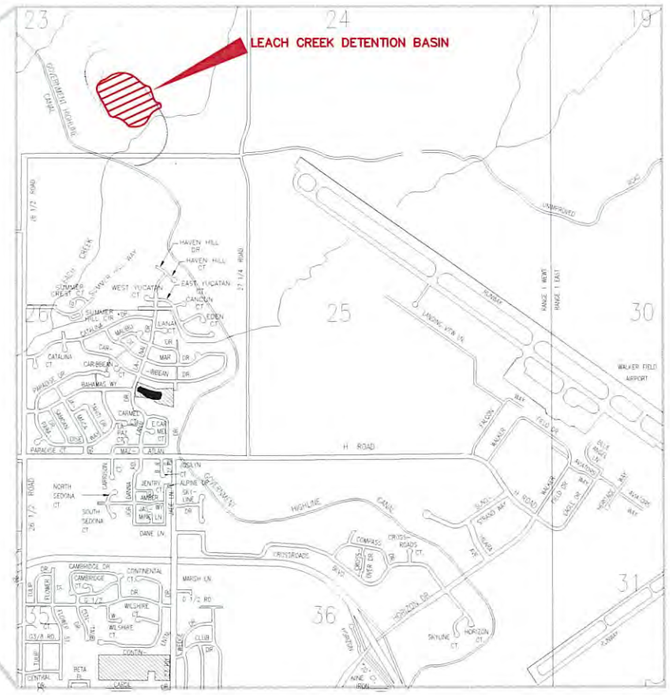


LOCATION MAP
N.T.S.

N.T.S.



REGIONAL MAP
N.T.S.



VICINITY MAP
N.T.S.

N.T.S.

1 ——— Cover Sheet

2 ——— Standard Abbreviations
Legend, and Symbols

3 ——— Summary of Approximate Quantities

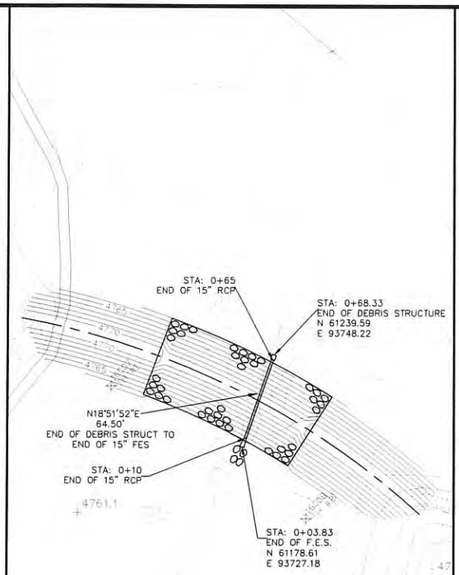
4 ——— Storm Drain and Concrete Weir Plan, Profile,
and Cross Sections (Outlet Works)

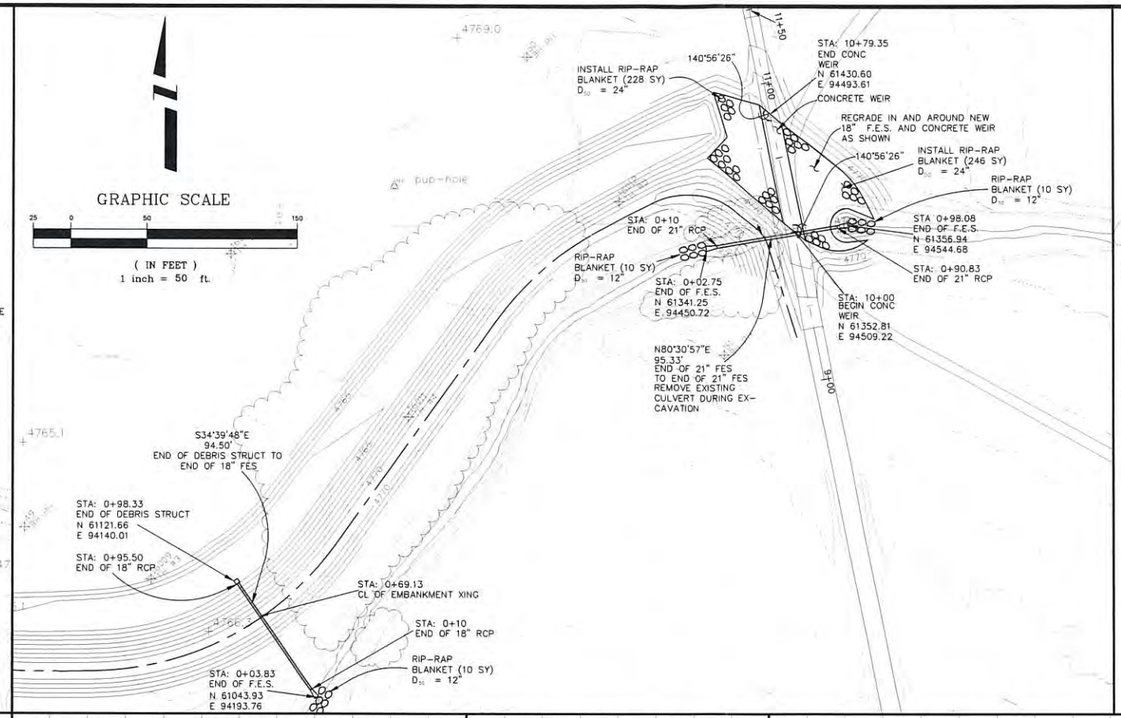
5 ——— Borrow Area, Embankment, and Spillway
Plan, Profiles, and Cross Sections

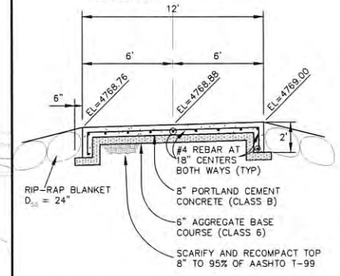
6 ——— Storm Water Management Plan

City of Grand Junction, Colorado
Department of Public Works & Utilities Engineering Division

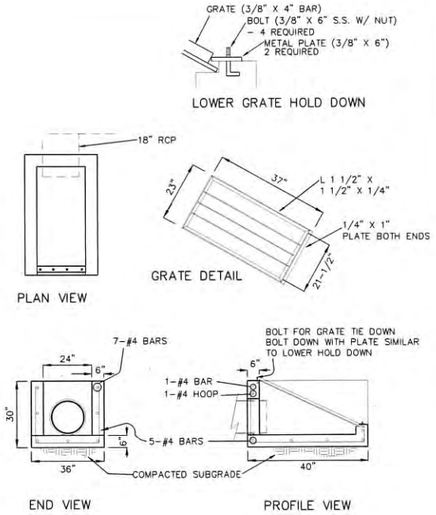
LEACH CREEK DETENTION BASIN, JUNE 2003







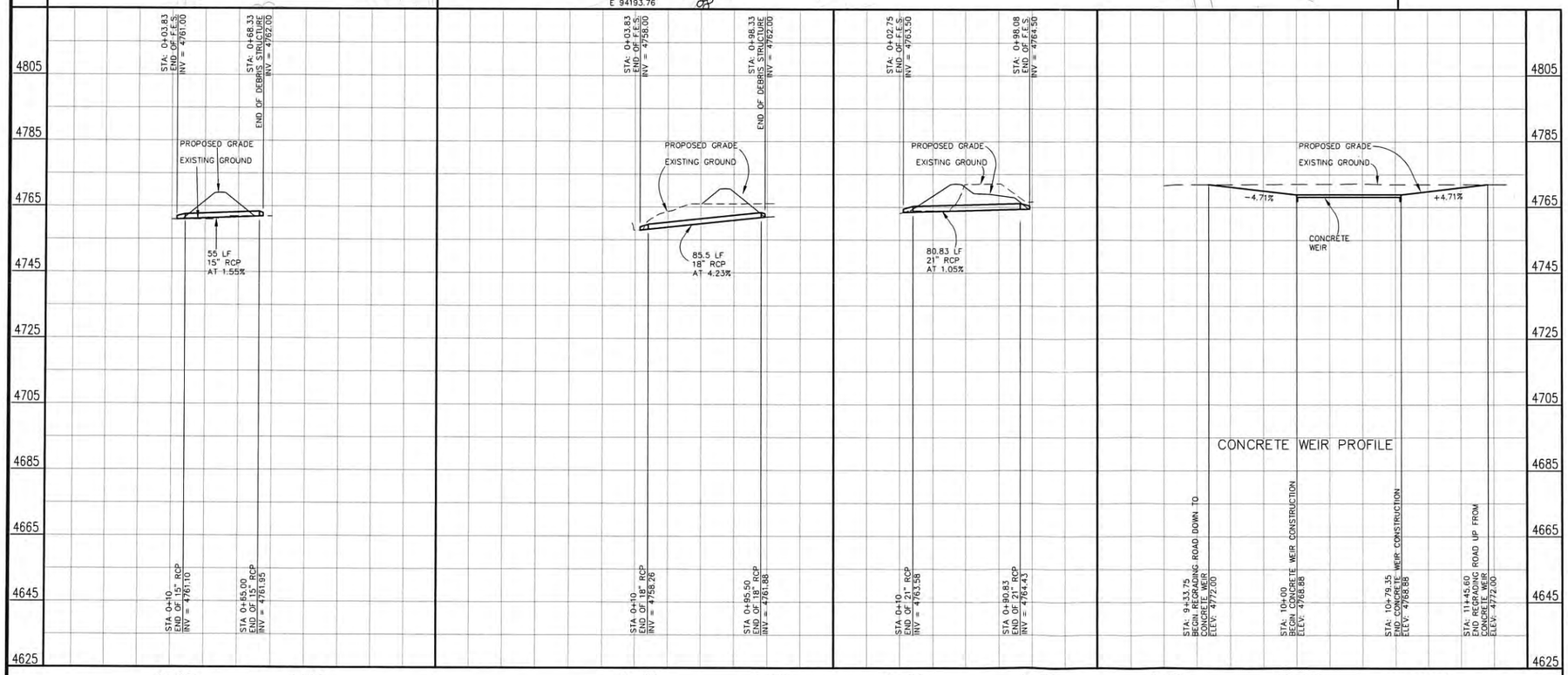
CONCRETE WEIR TYPICAL SECTION

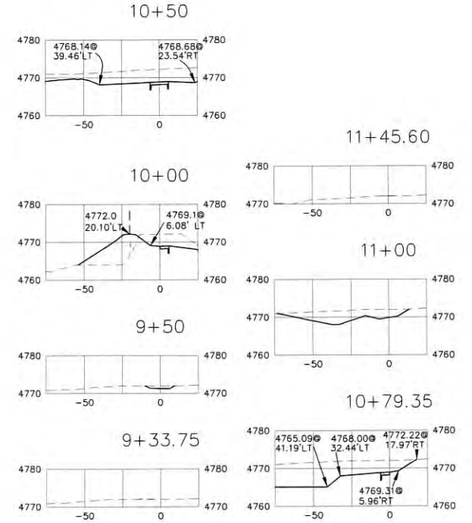


NOTES:
1. ALL CONNECTIONS SHALL BE MADE WITH 1/4" FULL LENGTH FILLET WELDS.
2. GRATE SHALL BE GALV. IN ACCORDANCE TO ASTM A 123 OR ALUMINIUM PAINT PER CDOT SECTION 708.04.
3. 1 1/2" CLEAR ON ALL REBAR
4. CONCRETE SHALL BE PORTLAND CEMENT CONCRETE (CLASS B).

TYPICAL DEBRIS STRUCTURE DETAIL

NTS





CONCRETE WEIR CROSS SECTIONS

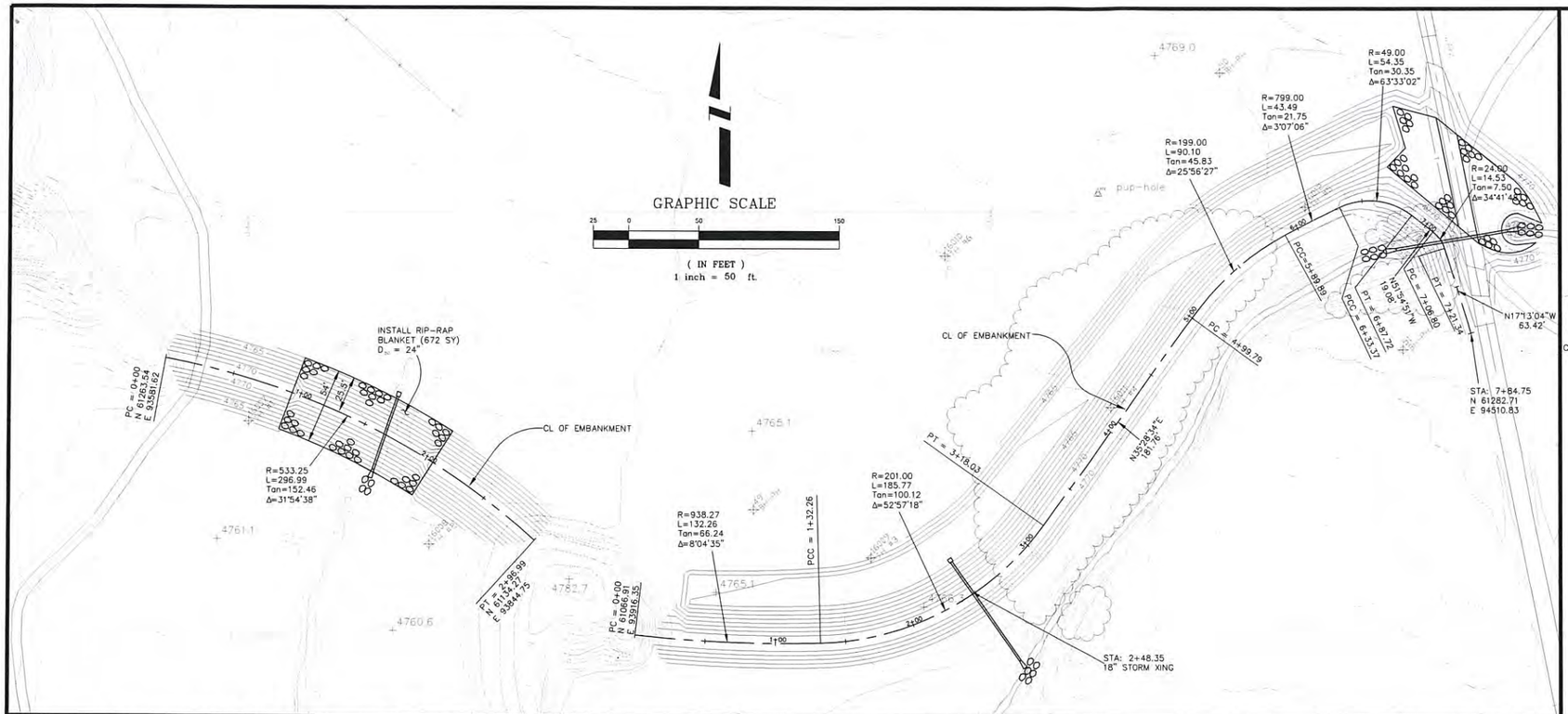
DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	
REVISION 4	

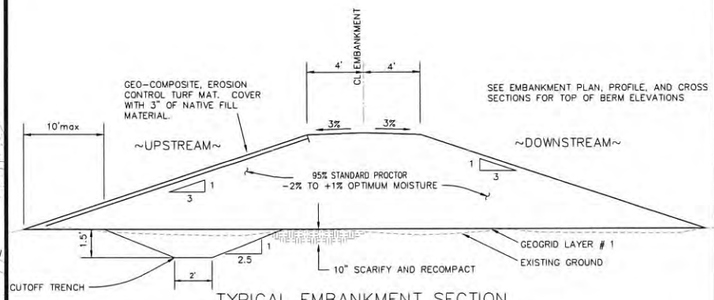
DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY DATE
APPROVED BY DATE

SCALE
PLAN HORIZ. 1"=50' PROFILE HORIZ. 1"=50'
VERT. 1"=20'

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
STORM DRAIN AND CONCRETE WEIR
PLAN, PROFILES, DETAILS, AND CROSS SECTIONS



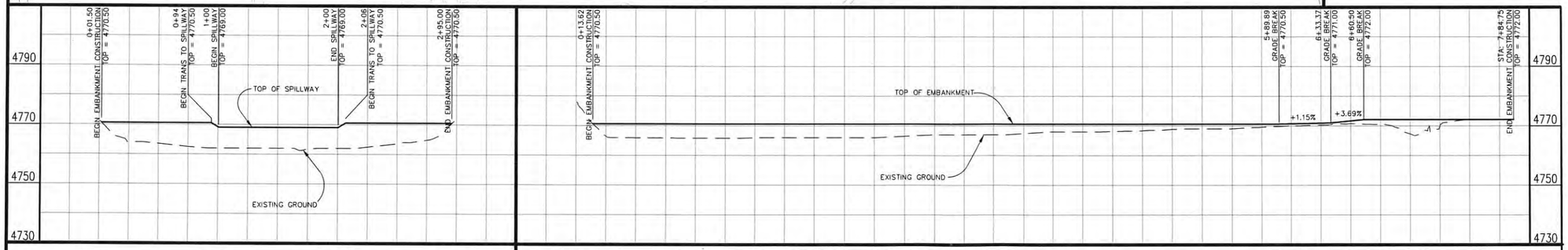


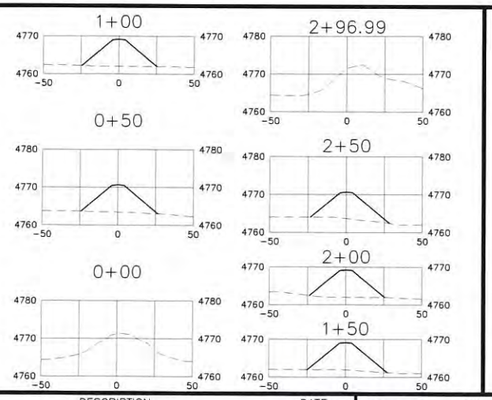
TYPICAL EMBANKMENT SECTION

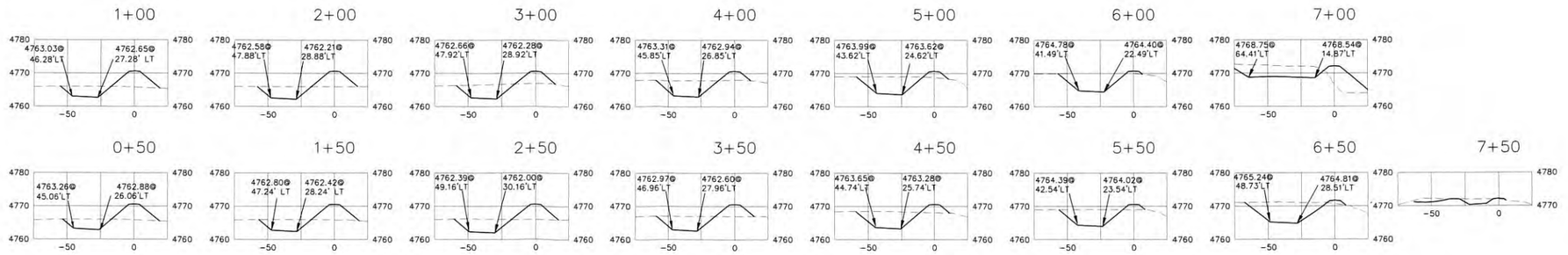
NTS

NOTES

1. Recommendations for construction of Embankment as described by the "Geotechnical Investigation, Proposed Leach Creek Detention Basin, North and West of H Road and 27 1/4 Road, South 1/2 Section No.'s 23 and 24, Township 1 North, Range 1 West, Ute Principal Meridian, Grand Junction, Co., Geotechnical Engineering Group, Job No. 871, dated January 22, 2002" shall be followed. Geotechnical Engineering Group Inc. representative shall observe and test foundation preparation fill placement for conformance with recommendations.
2. Prior to placing fill, the surface of native soils shall be stripped and all organic and deleterious material shall be completely removed.
3. Prepare subgrade by scarifying 10", moisture conditioning within 2% of optimum moisture and compacting to at least 95% of Standard Proctor (ASTM D698) maximum dry density. Subgrade preparation may be omitted where subgrade soils consist of undisturbed shale.
4. Embankment fill shall be compacted to at least 95% Standard Proctor (ASTM D698) maximum dry density and placed within 2% below and 1% above optimum moisture content.
5. Geogrid shall be Tensar BX 1200 or an equal approved by the engineer. Geogrid shall be placed in transverse direction (long grids perpendicular to the central axis of embankment). Geogrid rolls shall be at least 80 feet in length. The ends of Geogrid rolls shall be over lapped at least 5 feet. Geogrid shall be installed in accordance with the manufactures recommendations and as outlined in the Special Provisions.
6. Where the Embankment crosses existing drainages three (2) layers of geogrid reinforcement shall be installed.







DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	
REVISION 4	

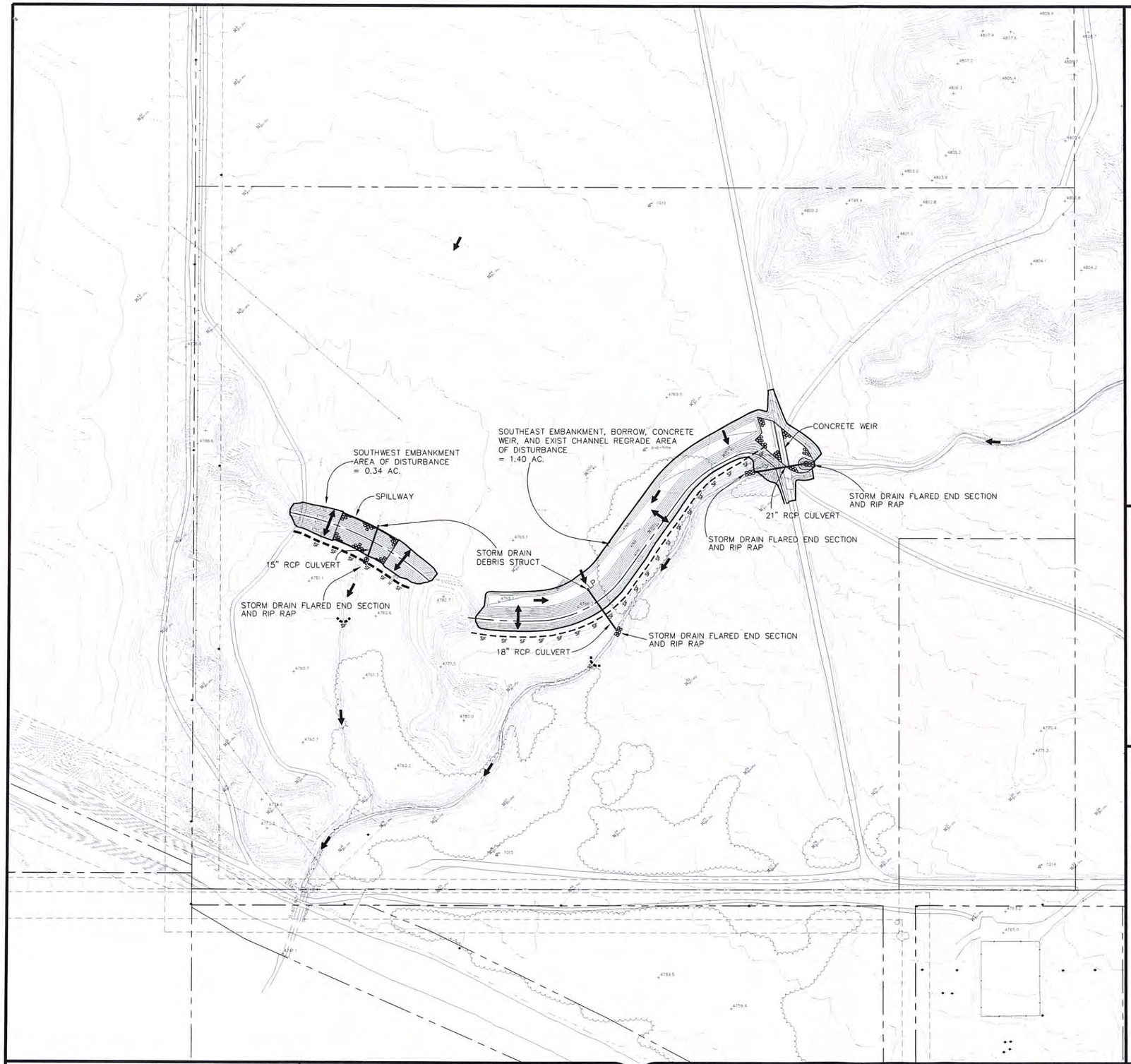
DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY DATE
APPROVED BY DATE

SCALE
PLAN HORIZ. 1"=50'
PROFILE HORIZ. 1"=50' VERT. 1"=20'

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
BORROW AREA, EMBANKMENT, AND SPILLWAY
PLAN, PROFILE, AND CROSS SECTIONS

5



PROJECT NO. 202-F35500

DRAWING STATUS:
- ● PROGRESS
- ○ BID SET
- ○ FINAL CONSTRUCTION DRAWINGS

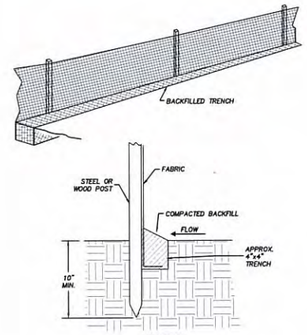
100 0 50 100 200
1 inch = 100 ft.



SECTION A-A
BALE INSTALLATION PROCEDURE



DETAIL C – CULVERT OUTLET TRAP
ANCHORED STRAW BALE (A.S.B.)



PROFILE

DETAIL B – SILT FENCE (S.F.)

LEGEND

AREAS OF DISTURBANCE (1.74 acres)

- AREAS OF DISTURBANCE BOUNDARY
- SF SILT FENCE
- A.S.B. ANCHORED STRAW BALE
- DIRECTION OF FLOW

HYDROLOGIC SOIL TYPES
SCS SOIL TYPE C – SANDY CLAY LOAM

EROSION CONTROL MEASURES

Performance Standards

The general requirements for erosion control work shall be as follows:

1. Any grading shall be conducted in such a manner so as to effectively reduce accelerated soil erosion and resulting sedimentation.
2. All grading shall be designed, constructed and completed in such a manner so that exposed area of any disturbed land shall be limited to the shortest time period.
3. Sediment caused by accelerated soil erosion shall be removed from runoff water before leaving the site.
4. Any temporary or permanent facility designed and constructed for the conveyance of water around, through, or from the graded area shall be designed to limit the water flow to a non-erosive velocity.

During Construction (Temporary Measures)

1. Anchored Straw Bales (ASB): The use of hay bales is proposed at the storm sewer outlets into channel and at all inlet locations (see Details C). Other locations are shown on the plan. Installation shall be in accordance with the detail as shown on the plans (see Detail C).
2. Silt Fence (SF) The use of silt fences is proposed at the toes of fill slopes and other areas where sediment from upstream flows may spill to existing drainage ways. Other locations are shown on the plan. Installation shall be in accordance with the detail as shown on the plans (see Detail B).

After Construction (Permanent Measures)

1. Rip-Rap: The use of rip-rap per construction drawings is proposed for the storm sewer outlets. It shall function to take the impact of the release water, thereby reducing velocities to a non-erosive rate (See plan for storm sewer outfall location).

Maintenance

1. The contractor or his designated representative shall make routine checks on all erosion control measures to determine if repairs or sediment removal is necessary.
2. After each rainfall or moderate snow melt, erosion control measures are to be checked. If repairs are needed, they shall be completed immediately.
3. Silt and sediment shall be removed when they reach a height of one-half of the barrier (silt fence or anchored straw bale).
4. When temporary measures are to be removed, any silt and sediment deposits shall be removed and spread evenly in fill areas.

General Notes

1. At all times during construction, erosion and sediment control shall be maintained by the contractor or his designated representative.
2. Erosion control system shall be installed as grading progresses.
3. Erosion bales shall be straw or hay, depending on availability.
4. Details shown are schematic only. Adjust as necessary to fit field conditions.
5. Erosion bales shall be placed to avoid runoff flowing between, around or under bales. Bales shall be anchored with 2" x 2" x 4' wooden stakes or #4 reinforcing bars, two per bale (see details for further instructions).
6. Negative impacts to downstream areas (or receiving waters) caused by the slope grading to be monitored and corrected by the contractor.
7. Construction traffic entrances shall be cleaned on a continual basis during slope grading.

DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY JLS DATE 2003
APPROVED BY ____ DATE ____

SCALE
PLAN CROSS SECTION
HORIZ. 1"=100' HORIZ. ____
VERT. ____

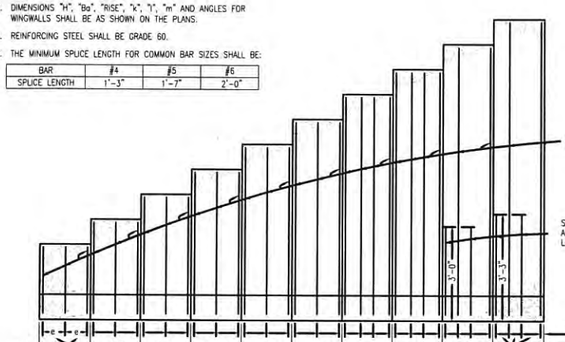
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK
STORM WATER MANAGEMENT PLAN

GENERAL NOTES

1. ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4".
2. WINGWALL FOOTINGS AND FLOOR OF BOX CULVERT SHALL BE PLACED MONOLITHICALLY.
3. DIMENSIONS "H", "Bo", "RISE", "K", "t", "m" AND ANGLES FOR WINGWALLS SHALL BE AS SHOWN ON THE PLANS.
4. REINFORCING STEEL SHALL BE GRADE 60.
5. THE MINIMUM SPLICE LENGTH FOR COMMON BAR SIZES SHALL BE:

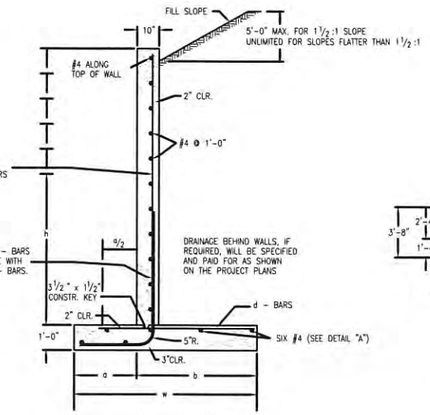
BAR	#4	#5	#6
SPLICE LENGTH	1'-3"	1'-7"	2'-0"



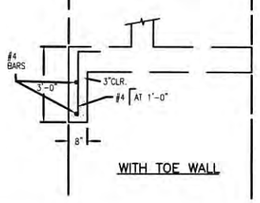
e =	1'-6"	1'-6"	1'-6"	1'-6"	1'-6"	1'-4"	1'-3"	11"	9"	7"	CTRS.
h =	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	
a =	1'-0"	1'-2"	1'-4"	1'-6"	1'-8"	1'-10"	2'-0"	2'-2"	2'-4"	2'-6"	
b =	1'-8"	2'-0"	2'-4"	2'-8"	3'-0"	3'-4"	3'-8"	4'-0"	4'-4"	4'-8"	
w =	2'-8"	3'-2"	3'-8"	4'-2"	4'-8"	5'-2"	5'-8"	6'-2"	6'-8"	7'-2"	
c & d BARS	#401'-6"	#401'-6"	#401'-6"	#401'-6"	#401'-6"	#401'-4"	#501'-3"	#5011"	#603"	#607"	CTRS.
* CONC.CU.YD./L.F.	0.161	0.210	0.259	0.308	0.358	0.407	0.457	0.506	0.556	0.604	
* REINF. LB./L.F.	8.0	9.3	10.7	12.1	14.3	16.4	23.0	28.6	41.8	54.6	

* DOES NOT INCLUDE TOE WALL QUANTITIES

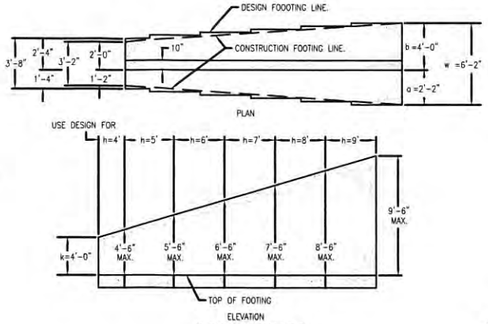
DESIGN TABLE



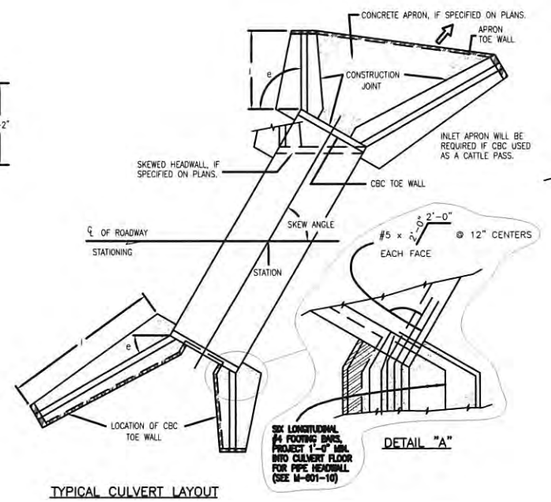
TYPICAL SECTION



WITH TOE WALL

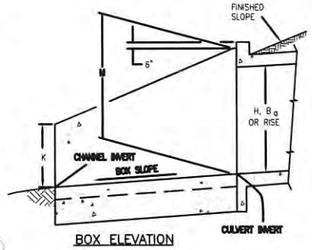


DESIGN EXAMPLE



TYPICAL CULVERT LAYOUT

DETAIL "A"



BOX ELEVATION

M = H, Bo OR RISE + (1'-4")
UNLESS OTHERWISE SHOWN ON PLANS.

DESIGN DATA:
UNIT STRESSES: f_s = 24,000 PSI
f_c = 1,200 PSI
n = 9

EQUIVALENT FLUID PRESSURE = 36 LBS./CU. FT.
MAXIMUM TOE PRESSURE = 1 TON/SQ. FT.

ALL CONSTRUCTION JOINTS SHALL BE THOROUGHLY CLEANED BEFORE CONCRETE IS POURED.

WINGWALL AND APRON CONCRETE SHALL BE:
CONCRETE CLASS B, OR D (BOX CULVERT) FOR CBC's.
CONCRETE CLASS B, OR D (WALL) FOR PIPES.

LIVE LOAD SURCHARGE HAS NOT BEEN CONSIDERED. WALLS WITHIN h/2 OF THE EDGE OF THE ROADWAY SHOULDER WILL REQUIRE A SPECIAL DESIGN IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES.

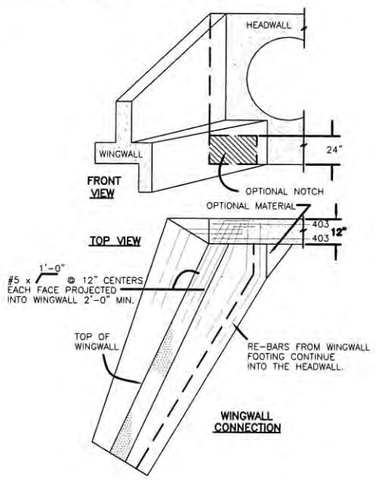
APRON REQUIRED AT INLET OF THE CBC, IF USED FOR CATTLE PASSAGE.

GENERAL NOTES

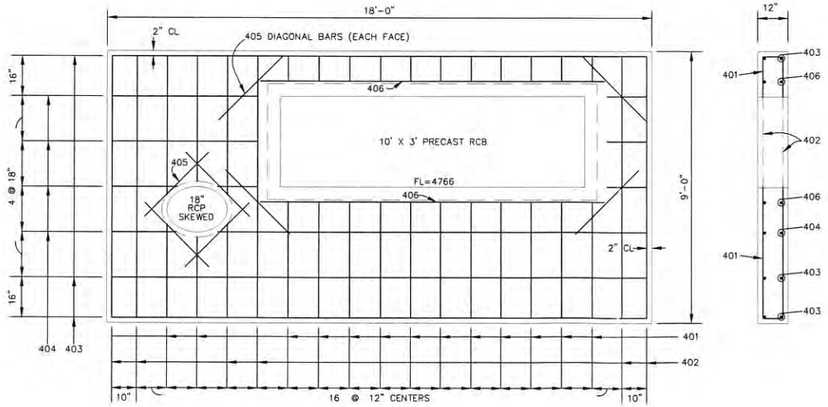
1. CONCRETE SHALL BE CLASS B.
2. HEADWALL SHALL BE PERPENDICULAR TO THE CULVERT ℄ UNLESS OTHERWISE SHOWN ON THE PLANS. TABULATED DIMENSIONS AND QUANTITIES MUST BE ADJUSTED FOR SKEWED INSTALLATIONS.
3. SEE DETAILS ABOVE FOR WINGWALL CONSTRUCTION.
4. VOLUME OCCUPIED BY PIPE HAS BEEN DEDUCTED FROM STEEL AND CONCRETE QUANTITIES.
5. EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4 ".
6. ALL BARS SHALL HAVE A 2" MINIMUM CLEARANCE.

▲ WHEN TWO OR MORE CONDUITS ARE LAID SIDE BY SIDE, THEY SHALL BE PLACED SO THAT THE ADJACENT PIPES WILL BE 1/4 INSIDE DIAMETER OR 1/2 INSIDE SPAN OR 3 FEET APART (INCLUDING WALL THICKNESS) WHICHEVER IS LESS.

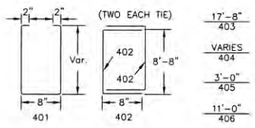
▫ ADD 0.89 x (X OR X_1) (LB.) WHEN APRON IS REQUIRED.



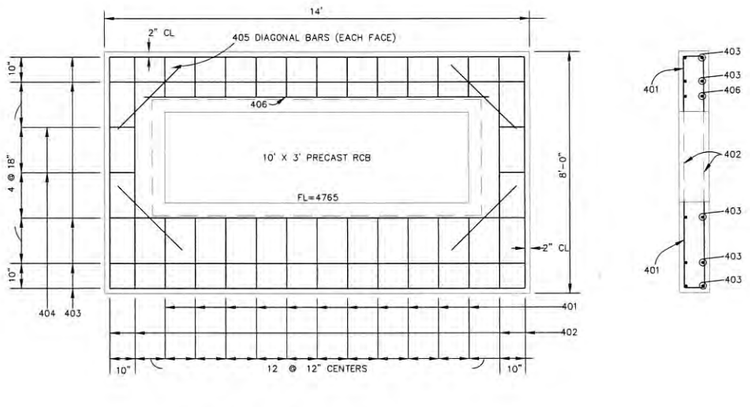
WINGWALL CONNECTION



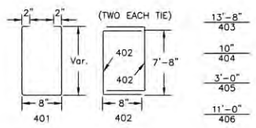
BAR LAYOUT FOR SOUTHEAST HEADWALL



BAR DIAGRAMS



BAR LAYOUT FOR NORTHWEST HEADWALL



BAR DIAGRAMS

DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	
REVISION 4	

DRAWN BY JCS DATE 2002
DESIGNED BY JLS DATE 2002
CHECKED BY DATE
APPROVED BY DATE

SCALE
NO SCALE

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
CONCRETE HEADWALL AND WINGWALL DETAILS

7

PROJECT NO. 202-F35500

SPECIFICATION DRAWINGS FOR CONSTRUCTION OF THE LEACH CREEK DETENTION BASIN WATER DIVISION 5 WATER DISTRICT ?? MESA COUNTY, COLORADO

1 – COVER SHEET
2 – STANDARD ABBREVIATIONS, LEGEND, AND SYMBOLS
3 – LOCATION, REGIONAL, AND VICINITY MAPS
4 – PROJECT AREA MAP
5 – DETENTION BASIN SITE PLAN
6 – MATERIALS INVESTIGATIONS AREA MAP
7 – GEOLOGIC SECTIONS
8 – LOGS OF TESTHOLES
9 – TYPICAL DAM CROSS SECTIONS
10 – BORROW AREA PLAN, PROFILE, AND CROSS SECTIONS
11 – DAM PLAN, PROFILE, AND CROSS SECTIONS
12 – SPILLWAY PLAN, PROFILE, AND CROSS SECTIONS
13 – OUTLET WORKS PLAN AND PROFILE
14 – BORROW AREA REMEDIATION PLAN, PROFILE, AND CROSS SECTIONS
15 – STORM WATER MANAGEMENT PLAN
16 – PROJECT DETAILS

ENGINEER CERTIFICATION

I, JAMES L SHANKS, CERTIFY THAT THESE PLANS AND ACCOMPANYING SPECIFICATIONS WERE PROVIDED BY ME OR UNDER MY DIRECT SUPERVISION.

SIGNATURE LICENSE NO. DATE

OWNER ACCEPTANCE

AS OWNER OF LEACH CREEK DETENTION BASIN WE ACKNOWLEDGE THAT THESE PLANS AND ACCOMPANYING SPECIFICATIONS HAVE BEEN REVIEWED AND ACCEPTED BY US, AND WE REQUEST CONSIDERATION FOR APPROVAL BY THE OFFICE OF THE STATE ENGINEER.

SIGNATURE TITLE DATE

STATE ENGINEER APPROVAL

APPROVED ON THE DAY OF 2003

STATE ENGINEER

BY:

DEPUTY

AS-BUILT CERTIFICATION

THESE PLANS REPRESENT THE AS-CONSTRUCTED CONDITIONS OF THE LEACH CREEK DETENTION BASIN TO THE BEST OF OUR KNOWLEDGE AND JUDGEMENT, BASE IN PART ON INFORMATION FURNISHED BY OTHERS AS OF THE DAY OF 2003.

ENGINEERS PRINTED NAME SIGNATURE

Department of Public Works & Utilities
Engineering and Technical Services Divisions
City of Grand Junction, Colorado
March 2003

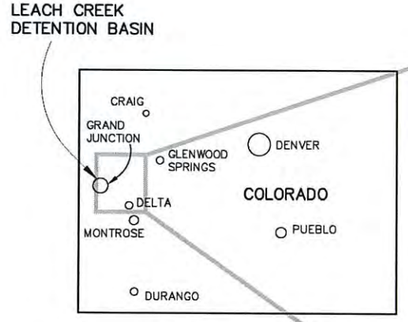
STATE ENGINEERS FILE NO.

1 of 16

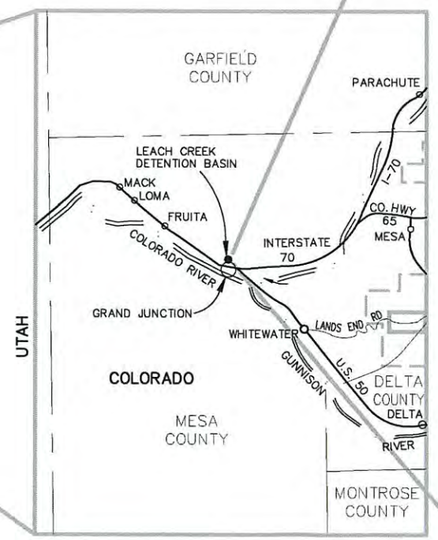
LEACH CREEK DETENTION BASIN, MARCH, 2003, Plan Set No. —

EXHIBIT 1

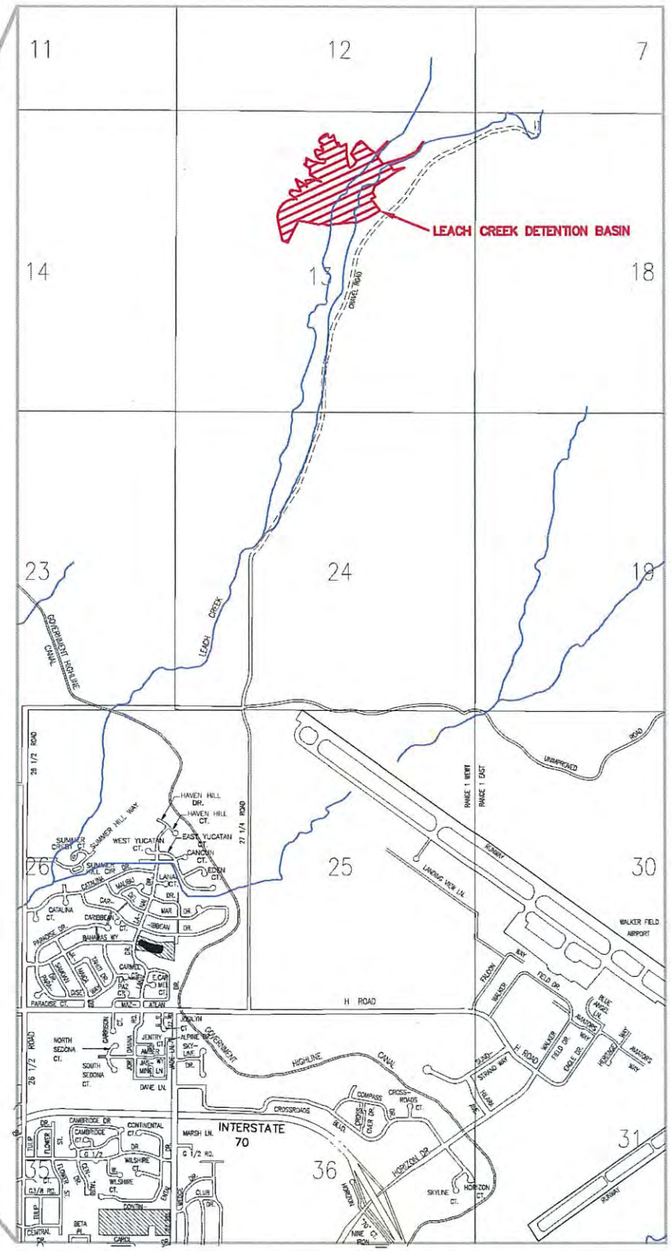
PROJECT NO. 202-F35500



LOCATION MAP
N.T.S.



REGIONAL MAP
N.T.S.



VICINITY MAP
N.T.S.

N.T.S.

DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY JLS DATE 2003
APPROVED BY DATE

SCALE
PLAN
HORIZ. NTS

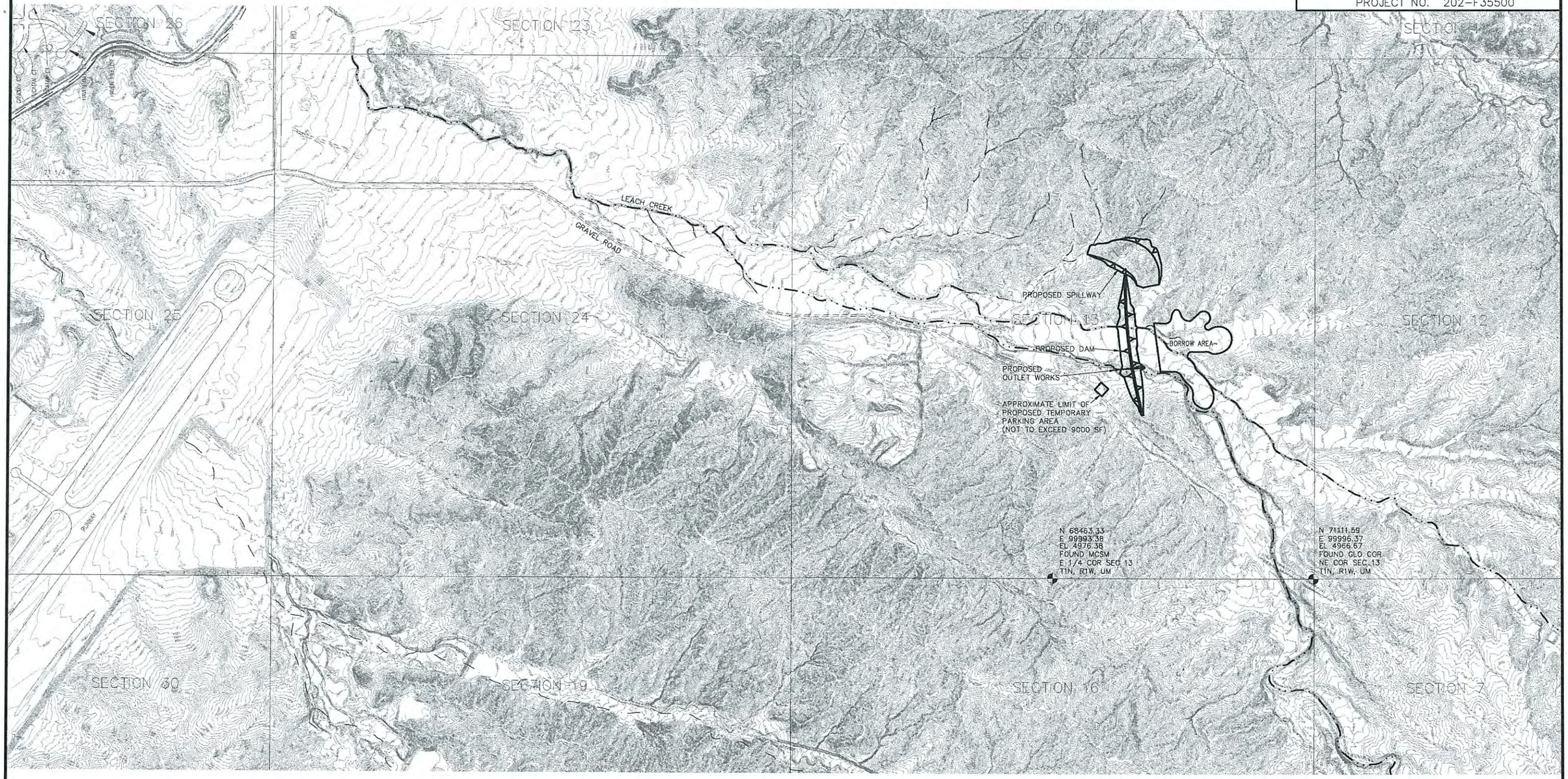
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
LOCATION, REGIONAL, AND VICINITY MAPS

STATE ENGINEERS FILE NO:

3 OF 16

PROJECT NO. 202-F35500



REFERENCE DRAWINGS

SITE PLAN ——— 5
BORROW AREA PLAN, PROFILE, AND CROSS SECTION ——— 10
DAM PLAN, PROFILE, AND CROSS SECTION ——— 11
SPILLWAY PLAN, PROFILE, AND CROSS SECTION ——— 12
OUTLET WORKS PLAN AND PROFILE ——— 13

MONUMENT TIES TO IMPROVEMENTS

TIE FROM E 1/4 COR TO STA 14+38.71 AT EAST END OF DAM CL: N 61-01-40 W 1894.57

TIE FROM STA 0+00 AT WEST END OF DAM CL TO NE COR SEC 13: N 58-16-33 E 3625.37

TIE FROM E 1/4 COR TO STA 0+00 AT SOUTH END OF SPILLWAY CL: N 83-41-02 W 3456.84

TIE FROM STA 8+67.03 AT NORTH END OF SPILLWAY CL TO NE COR SEC 13: N 60-09-36 E 3378.13

TIE FROM E 1/4 COR TO STA 0+00 AT SOUTH END OF BORROW AREA WEST ALIGNMENT CL: N 62-03-46 W 2360.98

TIE FROM STA 8+97.74 AT NORTH END OF BORROW AREA WEST ALIGNMENT CL TO NE COR SEC 13: N 71-21-32 E 2545.66

GENERAL NOTES

1. TOPOGRAPHY TAKEN FROM MESA COUNTY/CITY OF GRAND JUNCTION CIRCA 2001 2' INTERVAL CONTOURS (HORIZONTAL DATUM: NAD 83A, VERTICAL DATUM: NAVD88)
2. COORDINATES SHOWN ARE CITY OF GRAND JUNCTION LOCAL COORDINATE DEFINITION.
3. LIMITS OF PROPOSED TEMPORARY PARKING AREA IS APPROXIMATE

GRAPHIC SCALE

250 0 500 1500

(IN FEET)
1 inch = 500 ft.

DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY JLS DATE 2003
APPROVED BY ____ DATE ____

SCALE
PLAN
HORIZ. 1"= 500'

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
PROJECT AREA MAP

STATE ENGINEERS FILE NO:

4 OF 16

PROJECT NO. 202-F35500

GENERAL NOTES

1. TOPOGRAPHY TAKEN FROM MESA COUNTY/CITY OF GRAND JUNCTION CIRCA 2001 2' INTERVAL CONTOURS (DATUM: NAD 83)
2. COORDINATES SHOWN ARE CITY OF GRAND JUNCTION LOCAL COORDINATE DEFINITION.
3. FOR THE LOCATION OF TESTHOLES SEE SHEET 6

REFERENCE DRAWINGS

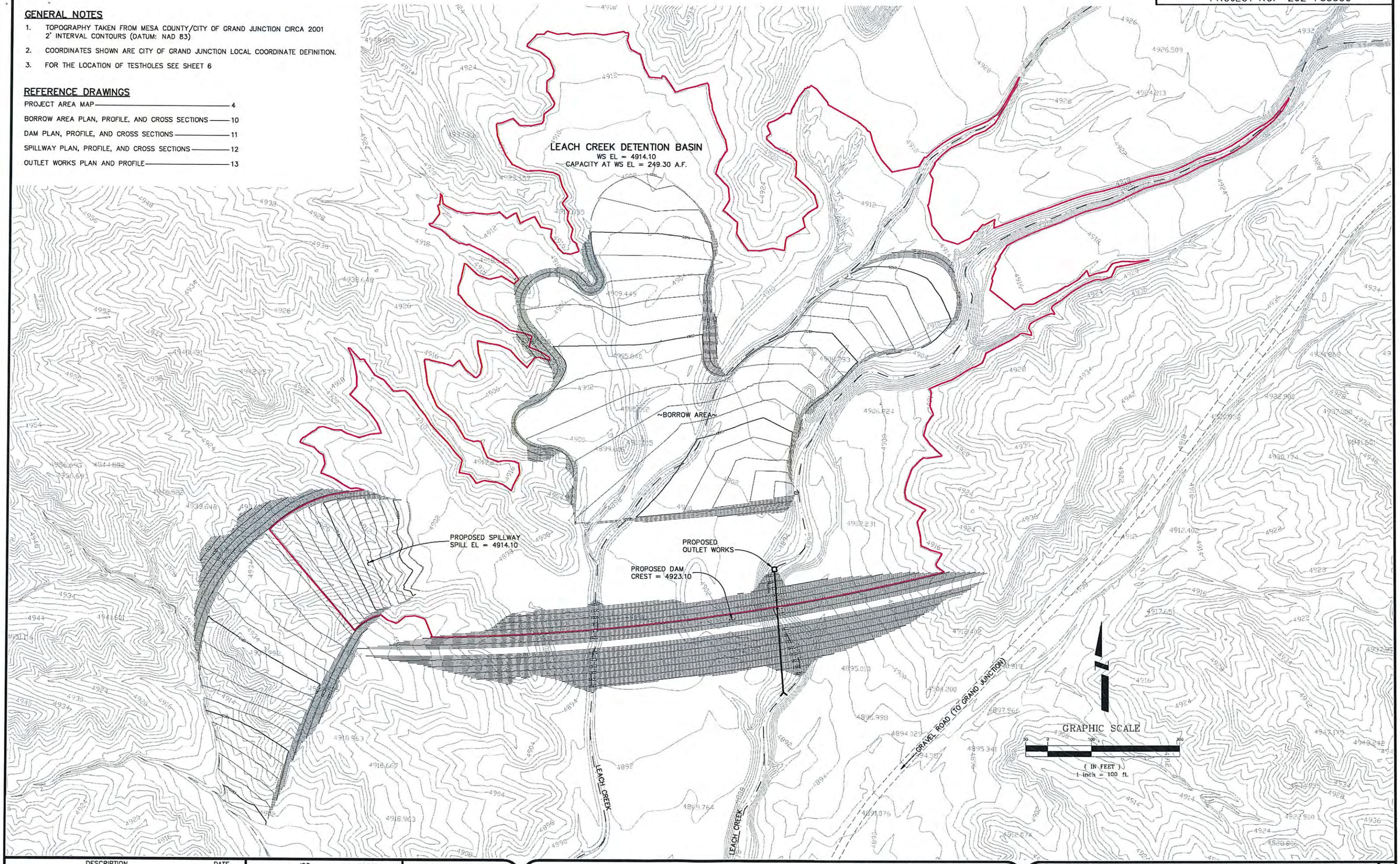
PROJECT AREA MAP ——— 4

BORROW AREA PLAN, PROFILE, AND CROSS SECTIONS ——— 10

DAM PLAN, PROFILE, AND CROSS SECTIONS ——— 11

SPILLWAY PLAN, PROFILE, AND CROSS SECTIONS ——— 12

OUTLET WORKS PLAN AND PROFILE ——— 13



DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY JLS DATE 2003
APPROVED BY ____ DATE ____

SCALE
PLAN
HORIZ. 1"=100'

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
DETENTION BASIN SITE PLAN

STATE ENGINEERS FILE NO:

5 OF 16

PROJECT NO. 202-F35500

GENERAL NOTES

1. FOR SECTIONS OF TESTHOLES SEE SHEET 7
2. FOR LOGS OF TESTHOLES SEE SHEET 8

REFERENCE DRAWINGS

PROJECT AREA MAP ——— 4
DETENTION BASIN SITE PLAN ——— 5
BORROW AREA PLAN, PROFILE, AND CROSS SECTIONS ——— 10
DAM PLAN, PROFILE, AND CROSS SECTIONS ——— 11
SPILLWAY PLAN, PROFILE, AND CROSS SECTIONS ——— 12
OUTLET WORKS PLAN AND PROFILE ——— 13

TESTHOLE LOCATION

LEACH CREEK DETENTION BASIN
WS EL = 4914.10
CAPACITY AT WS EL = 249.30 A.F.

~BORROW AREA~

PROPOSED SPILLWAY

PROPOSED DAM

PROPOSED OUTLET WORKS

TH#??
TH#2
TH#3
TH#4
TH#5
TH#6
TH#7
TH#8
TH#9
TH#10
TH#12
TH#13
TH#14
TH#15
TH#16
TH#17
TH#18
TH#19
TH#20
TH#21
TH#22
TH#24
TH#25
TH#26
TH#28
TH#30
TH#32
TH#33

GRAVEL ROAD (TO GRAND JUNCTION)

LEACH CREEK

GRAPHIC SCALE
(IN FEET)
1 inch = 100 ft.

DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY JLS DATE 2003
APPROVED BY ____ DATE ____

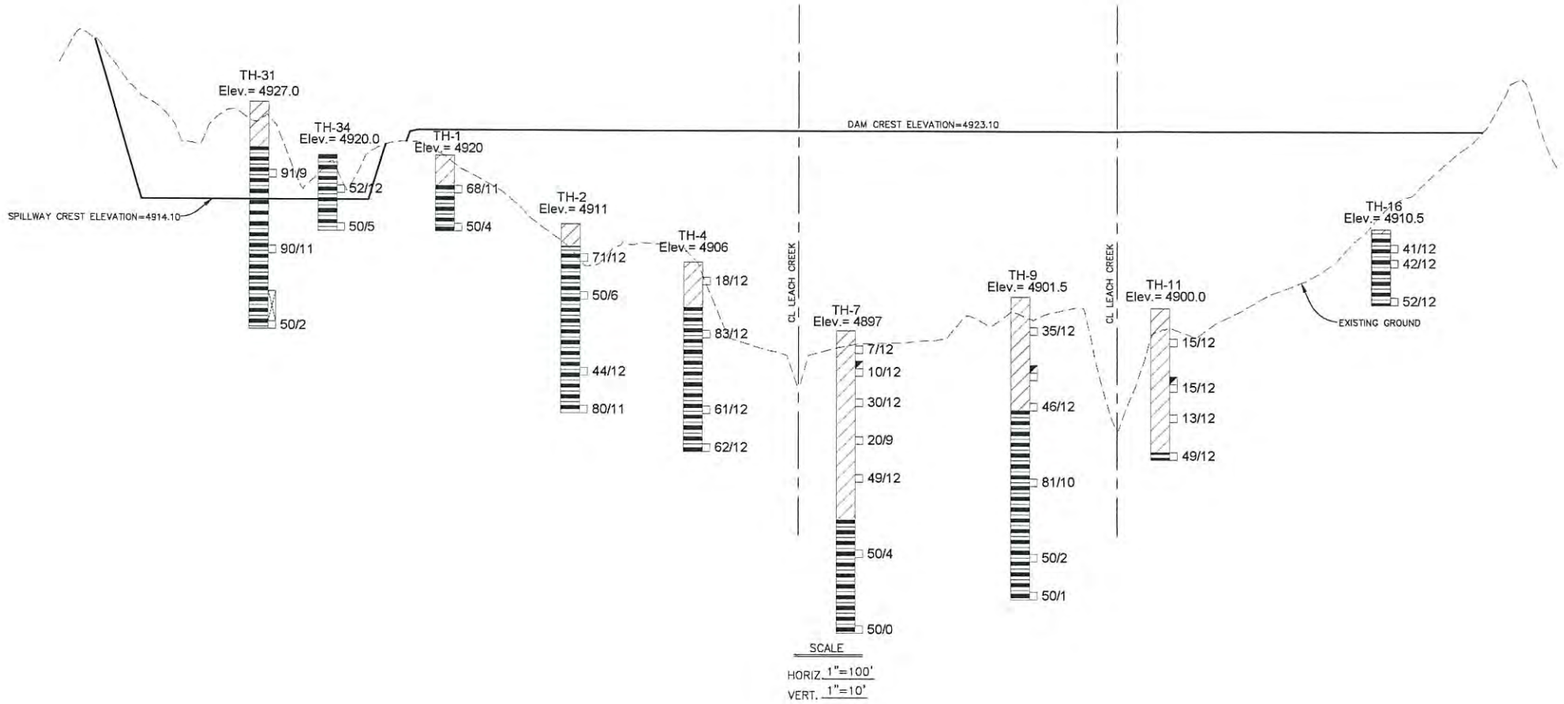
SCALE
PLAN
HORIZ. 1"=100'

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
MATERIALS INVESTIGATIONS AREA MAP

STATE ENGINEERS FILE NO:

PROJECT NO. 202-F35500



GENERAL NOTES

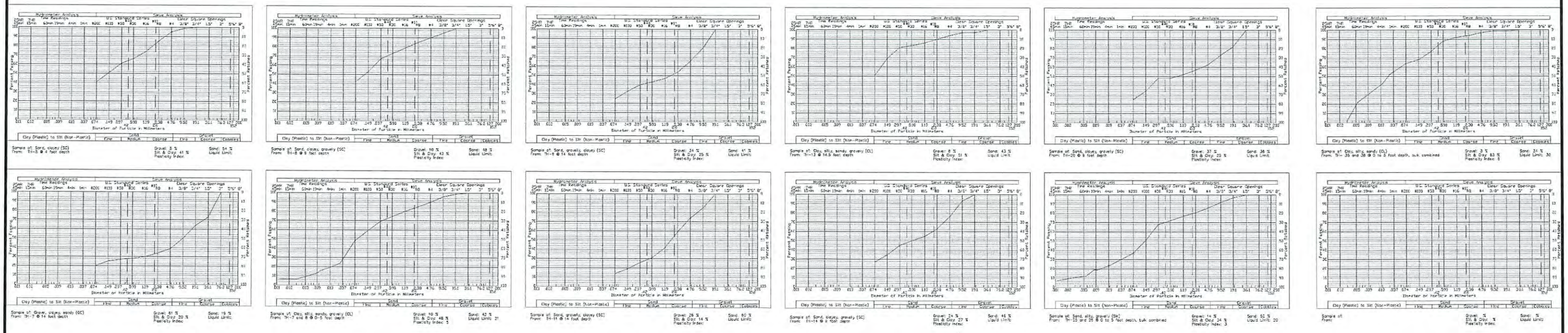
1. FOR LOCATIONS OF TESTHOLES SEE SHEET 6

REFERENCE DRAWINGS

MATERIALS INVESTIGATION AREA MAP ——— 6

Legend

- Clay, silty, sandy, with variable sandy clay, silty to clayey sand and gravelly lenses noted, soft to very stiff, dry, tan, brown (CL, SC, SM)
- Shale, clayey, medium hard to very hard, dry, brown, tan, layered, slightly fractured, sulfates noted.
- Indicates drive sample. The symbol 68/12 indicates that 68 blows of a 140 pound hammer falling 30 inches were required to drive a 2.0 inch O.D. sample barrel 12 inches.
- Indicates location of bulk sample collected from auger cuttings.
- Indicates location of shelby tube (3-inch, O.D.) type sample.



DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2004
DESIGNED BY DATE
CHECKED BY DATE
APPROVED BY DATE

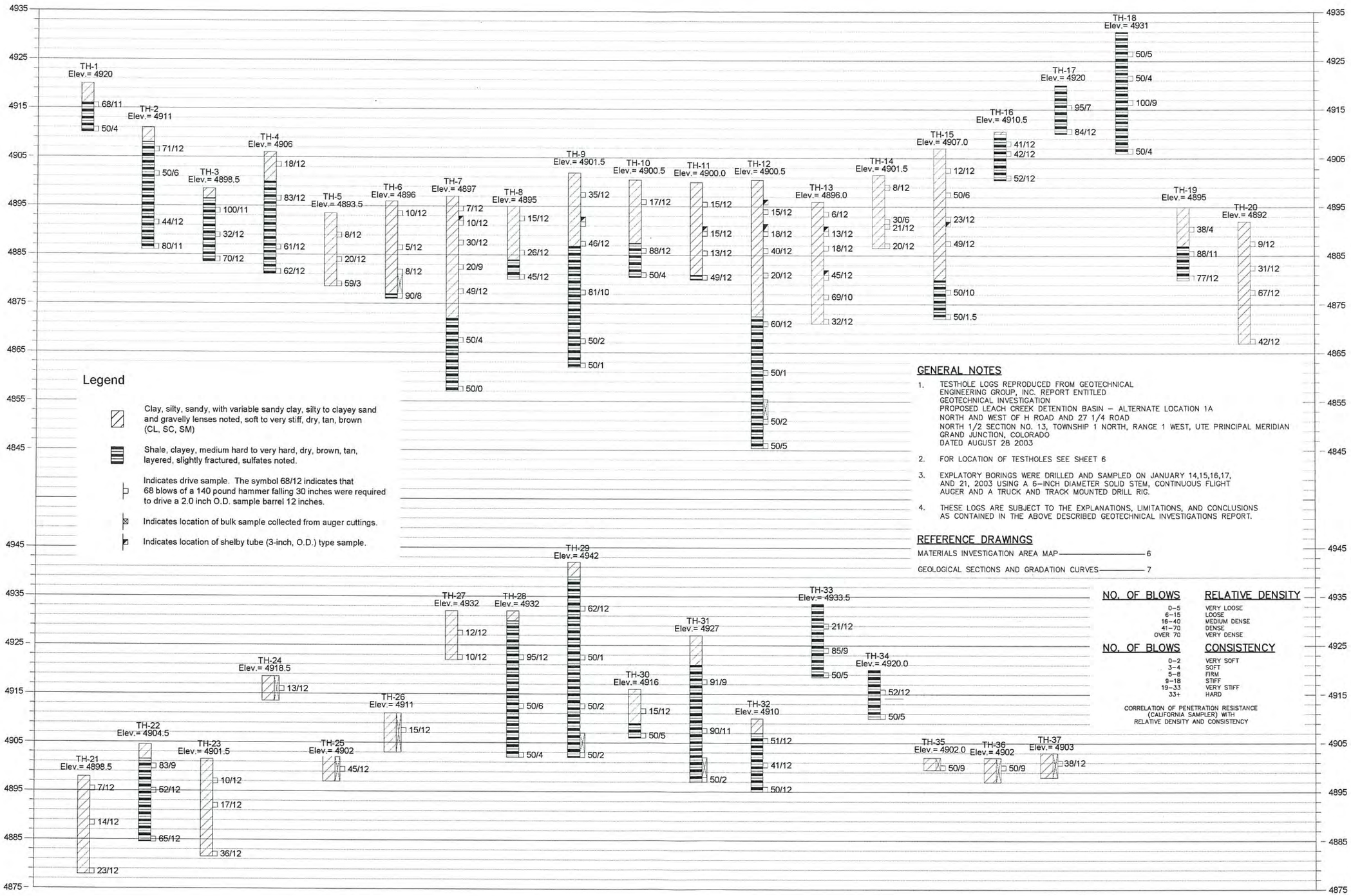
SCALE
AS SHOWN

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
GEOLOGICAL SECTIONS AND GRADATION CURVES

STATE ENGINEERS FILE NO:

7 OF 15



Legend

Clay, silty, sandy, with variable sandy clay, silty to clayey sand and gravelly lenses noted, soft to very stiff, dry, tan, brown (CL, SC, SM)

Shale, clayey, medium hard to very hard, dry, brown, tan, layered, slightly fractured, sulfates noted.

Indicates drive sample. The symbol 68/12 indicates that 68 blows of a 140 pound hammer falling 30 inches were required to drive a 2.0 inch O.D. sample barrel 12 inches.

Indicates location of bulk sample collected from auger cuttings.

Indicates location of shelby tube (3-inch, O.D.) type sample.

GENERAL NOTES

1. TESTHOLE LOGS REPRODUCED FROM GEOTECHNICAL ENGINEERING GROUP, INC. REPORT ENTITLED GEOTECHNICAL INVESTIGATION PROPOSED LEACH CREEK DETENTION BASIN – ALTERNATE LOCATION 1A NORTH AND WEST OF H ROAD AND 27 1/4 ROAD NORTH 1/2 SECTION NO. 13, TOWNSHIP 1 NORTH, RANGE 1 WEST, UTE PRINCIPAL MERIDIAN GRAND JUNCTION, COLORADO DATED AUGUST 28 2003
2. FOR LOCATION OF TESTHOLES SEE SHEET 6
3. EXPLATORY BORINGS WERE DRILLED AND SAMPLED ON JANUARY 14,15,16,17, AND 21, 2003 USING A 6-INCH DIAMETER SOLID STEM, CONTINUOUS FLIGHT AUGER AND A TRUCK AND TRACK MOUNTED DRILL RIG.
4. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS, AND CONCLUSIONS AS CONTAINED IN THE ABOVE DESCRIBED GEOTECHNICAL INVESTIGATIONS REPORT.

REFERENCE DRAWINGS

MATERIALS INVESTIGATION AREA MAP ——— 6

GEOLOGICAL SECTIONS AND GRADATION CURVES ——— 7

NO. OF BLOWS	RELATIVE DENSITY
0–5	VERY LOOSE
6–15	LOOSE
16–40	MEDIUM DENSE
41–70	DENSE
OVER 70	VERY DENSE

NO. OF BLOWS	CONSISTENCY
0–2	VERY SOFT
3–4	SOFT
5–8	FIRM
9–18	STIFF
19–33	VERY STIFF
33+	HARD

CORRELATION OF PENETRATION RESISTANCE (CALIFORNIA SAMPLER) WITH RELATIVE DENSITY AND CONSISTENCY

DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2004
DESIGNED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

SCALE AS SHOWN

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
LOGS OF TESTHOLES

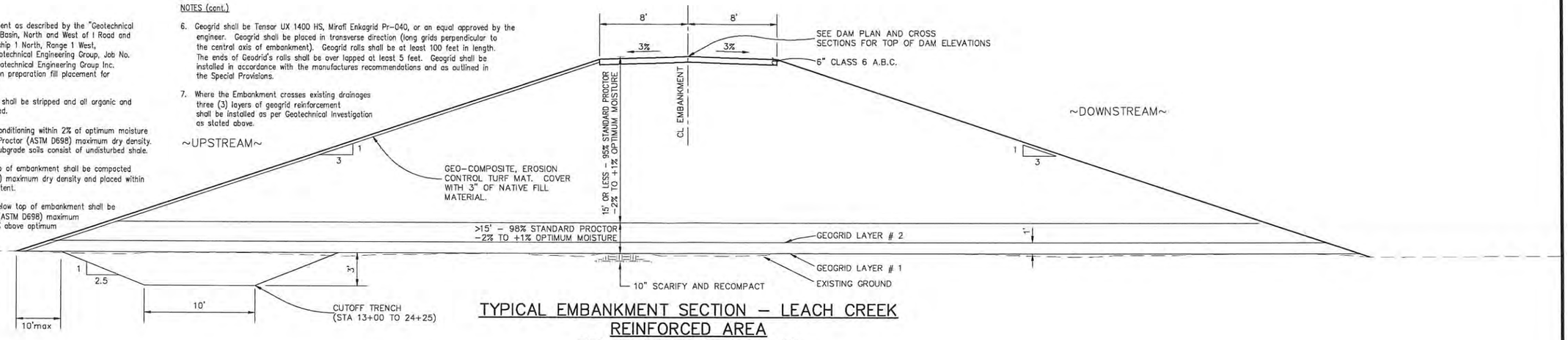
STATE ENGINEERS FILE NO:

NOTES

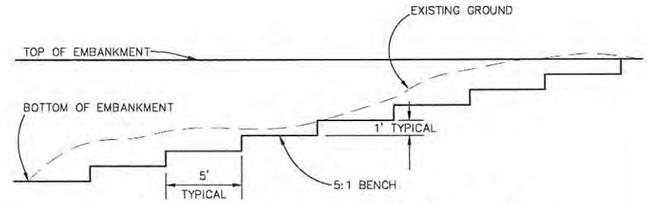
1. Recommendations for construction of Embankment as described by the "Geotechnical Investigation, Proposed Leach Creek Detention Basin, North and West of I Road and 27 1/4 Road, North 1/2 Section No 13, Township 1 North, Range 1 West, Ute Principal Meridian, Grand Junction, Co., Geotechnical Engineering Group, Job No. 871, dated March 2003" shall be followed. Geotechnical Engineering Group Inc. representative shall observe and test foundation preparation fill placement for conformance with recommendations.
2. Prior to placing fill, the surface of native soils shall be stripped and all organic and deleterious material shall be completely removed.
3. Prepare subgrade by scarifying 10", moisture conditioning within 2% of optimum moisture and compacting to at least 95% of Standard Proctor (ASTM D698) maximum dry density. Subgrade preparation may be omitted where subgrade soils consist of undisturbed shale.
4. Embankment fill placed within 15 feet of the top of embankment shall be compacted to at least 95% Standard Proctor (ASTM D698) maximum dry density and placed within 2% below and 1% above optimum moisture content.
5. Embankment fill placed greater than 15 feet below top of embankment shall be compacted to at least 98% Standard Proctor (ASTM D698) maximum dry density and placed within 2% below and 1% above optimum moisture content.

NOTES (cont.)

6. Geogrid shall be Tensar UX 1400 HS, Mirafi Enkagrid Pr-040, or an equal approved by the engineer. Geogrid shall be placed in transverse direction (long grids perpendicular to the central axis of embankment). Geogrid rolls shall be at least 100 feet in length. The ends of Geodrid's rolls shall be over lapped at least 5 feet. Geogrid shall be installed in accordance with the manufactures recommendations and as outlined in the Special Provisions.
7. Where the Embankment crosses existing drainages three (3) layers of geogrid reinforcement shall be installed as per Geotechnical Investigation as stated above.



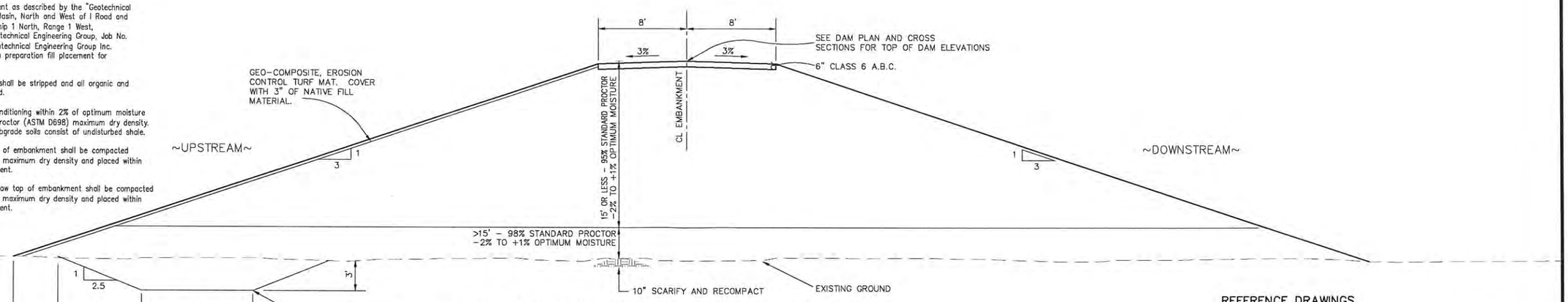
TYPICAL EMBANKMENT SECTION – LEACH CREEK
REINFORCED AREA
STA 2+00 TO STA 13+00



DETAIL TO BENCH INTO EXISTING SHALE SLOPE

NOTES

1. Recommendations for construction of Embankment as described by the "Geotechnical Investigation, Proposed Leach Creek Detention Basin, North and West of I Road and 27 1/4 Road, North 1/2 Section No 13, Township 1 North, Range 1 West, Ute Principal Meridian, Grand Junction, Co., Geotechnical Engineering Group, Job No. 871, dated March 2003" shall be followed. Geotechnical Engineering Group Inc. representative shall observe and test foundation preparation fill placement for conformance with recommendations.
2. Prior to placing fill, the surface of native soils shall be stripped and all organic and deleterious material shall be completely removed.
3. Prepare subgrade by scarifying 10", moisture conditioning within 2% of optimum moisture and compacting to at least 95% of Standard Proctor (ASTM D698) maximum dry density. Subgrade preparation may be omitted where subgrade soils consist of undisturbed shale.
4. Embankment fill placed within 15 feet of the top of embankment shall be compacted to at least 95% Standard Proctor (ASTM D698) maximum dry density and placed within 2% below and 1% above optimum moisture content.
5. Embankment fill placed greater than 15 feet below top of embankment shall be compacted to at least 98% Standard Proctor (ASTM D698) maximum dry density and placed within 2% below and 1% above optimum moisture content.



TYPICAL EMBANKMENT SECTION – LEACH CREEK
NO REINFORCEMENT AREA
STA 0+00 TO STA 2+00 & STA 13+00 TO STA 14+38.71

REFERENCE DRAWINGS

PROJECT AREA MAP — 4
DETENTION BASIN SITE PLAN — 5
MATERIALS INVESTIGATIONS AREA MAP — 6
GEOLOGICAL SECTIONS — 7
LOGS OF TESTHOLES — 8
DAM PLAN, PROFILE, AND CROSS SECTIONS — 11

DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY JLS DATE 2003
APPROVED BY DATE

SCALE 1"=5'

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
TYPICAL DAM CROSS SECTIONS

STATE ENGINEERS FILE NO:

9 OF 16

PROJECT NO. 202-F35500

GENERAL NOTES

TOPOGRAPHY TAKEN FROM MESA COUNTY/CITY OF GRAND JUNCTION CIRCA 2001
2' INTERVAL CONTOURS (DATUM: NAD 83)

COORDINATES SHOWN ARE CITY OF GRAND JUNCTION LOCAL COORDINATE DEFINITION.

FOR THE LOCATION OF TESTHOLES SEE SHEET 6

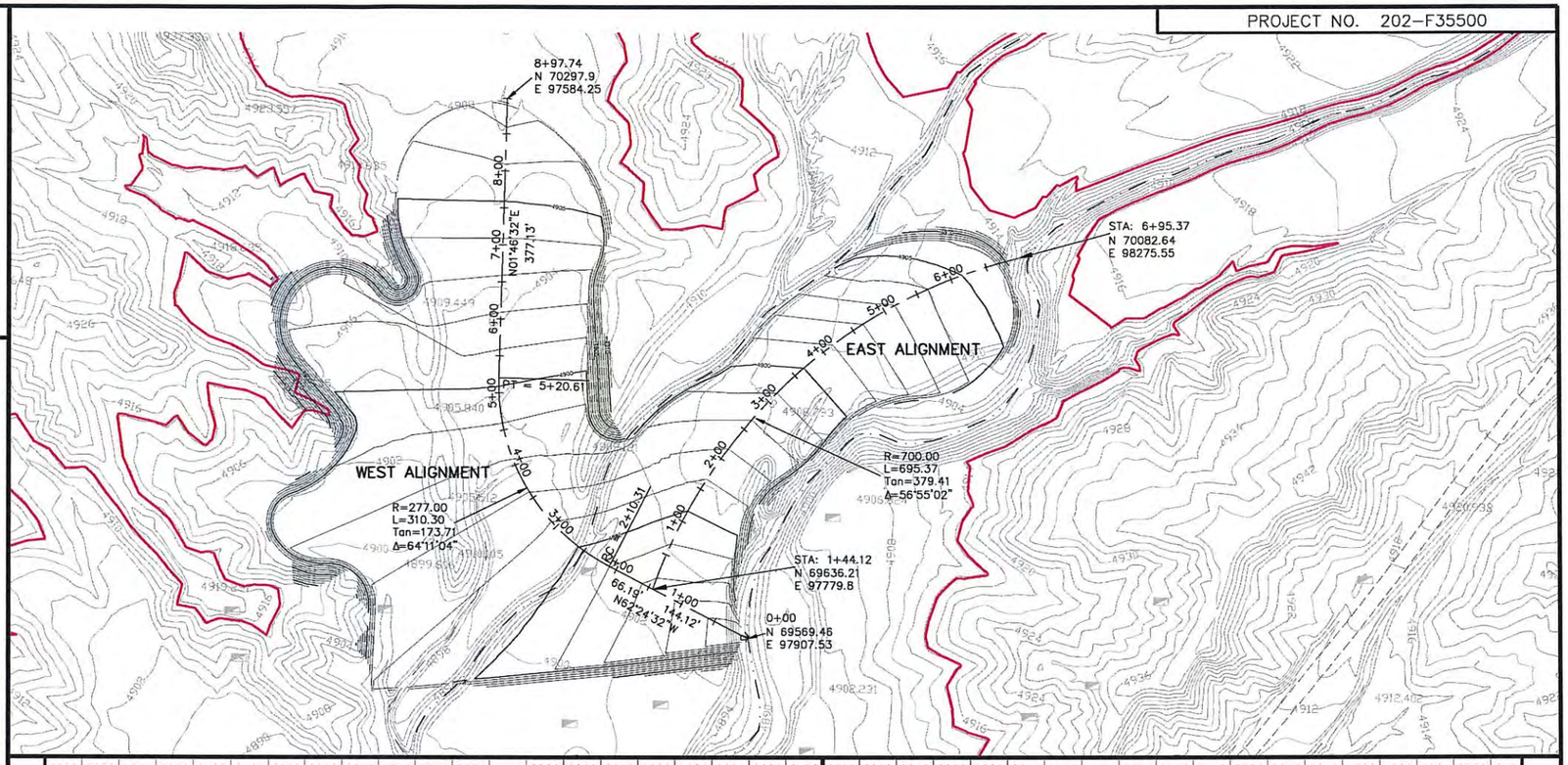
REFERENCE DRAWINGS

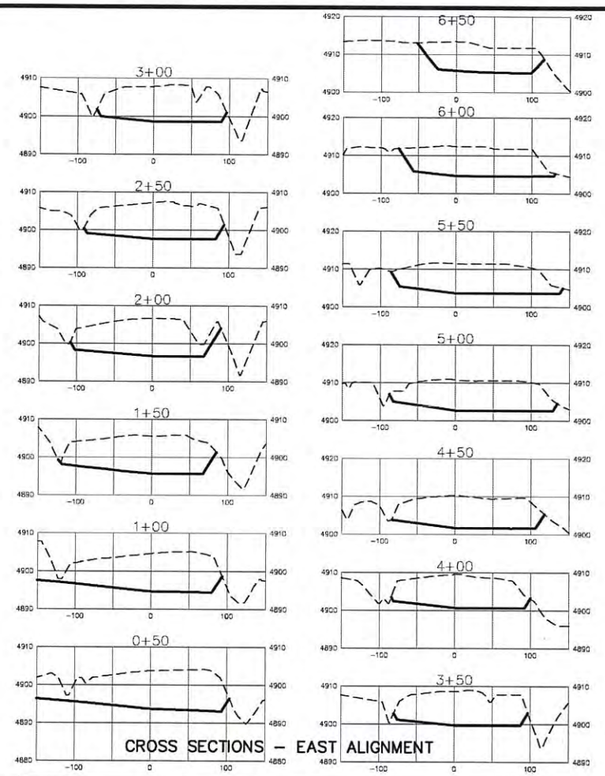
PROJECT AREA MAP — 4
DETENTION BASIN SITE PLAN — 5
MATERIALS INVESTIGATIONS AREA MAP — 6
GEOLOGICAL SECTIONS — 7
LOGS OF TESTHOLES — 8
BORROW AREA REMEDIATION PLAN, PROFILE, AND CROSS SECTIONS — 14

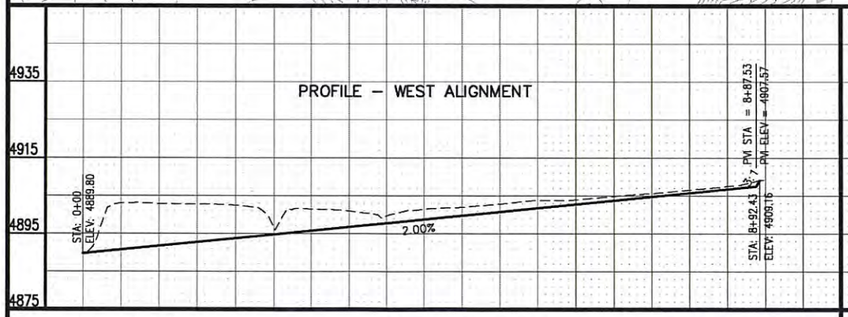
GRAPHIC SCALE

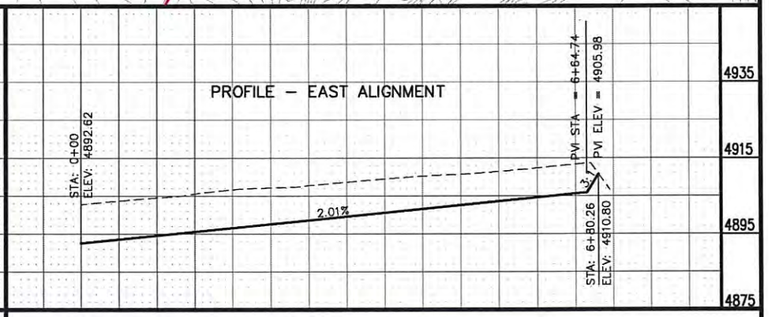
50 0 100 300

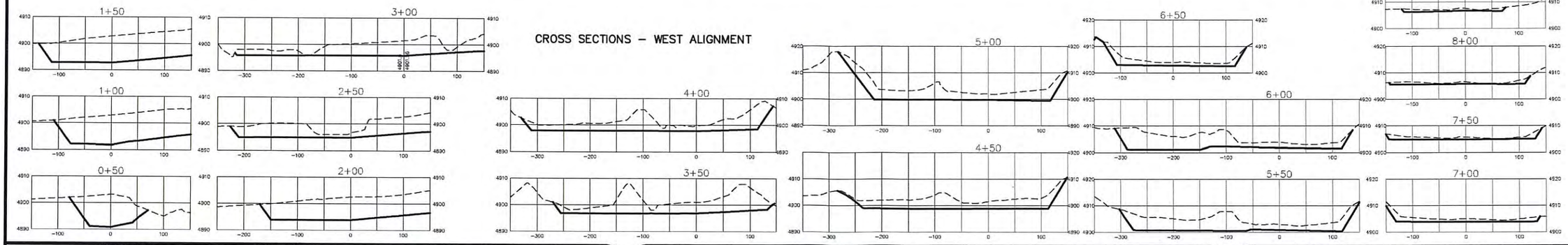
(IN FEET)
1 inch = 100 ft.











DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY JLS DATE 2003
APPROVED BY ____ DATE ____

SCALE
PLAN HORIZ. 1"=100'
PROFILE HORIZ. 1"=100'
VERT. 1"=20'

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
BORROW AREA PLAN, PROFILE, AND CROSS SECTIONS

STATE ENGINEERS FILE NO:

10 OF 16

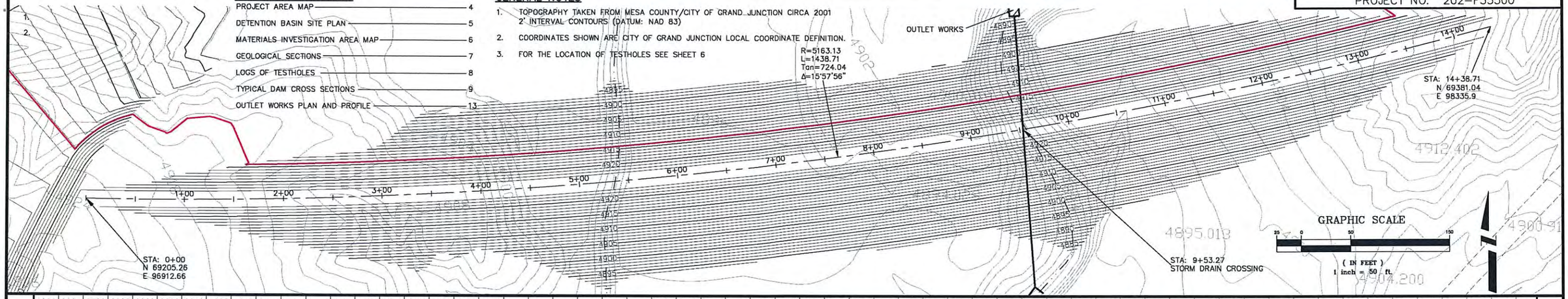
PROJECT NO. 202-F35500

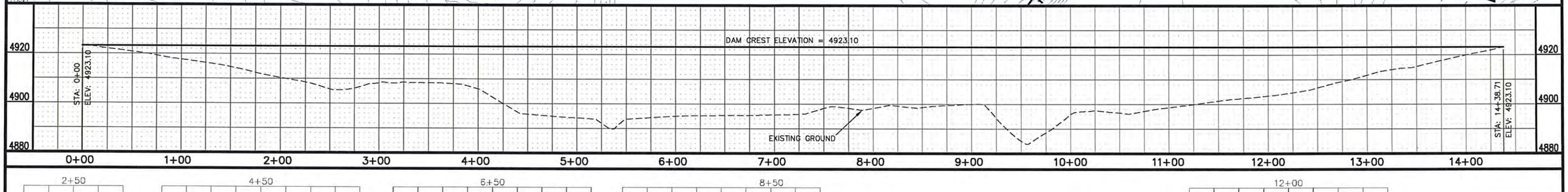
REFERENCE DRAWINGS

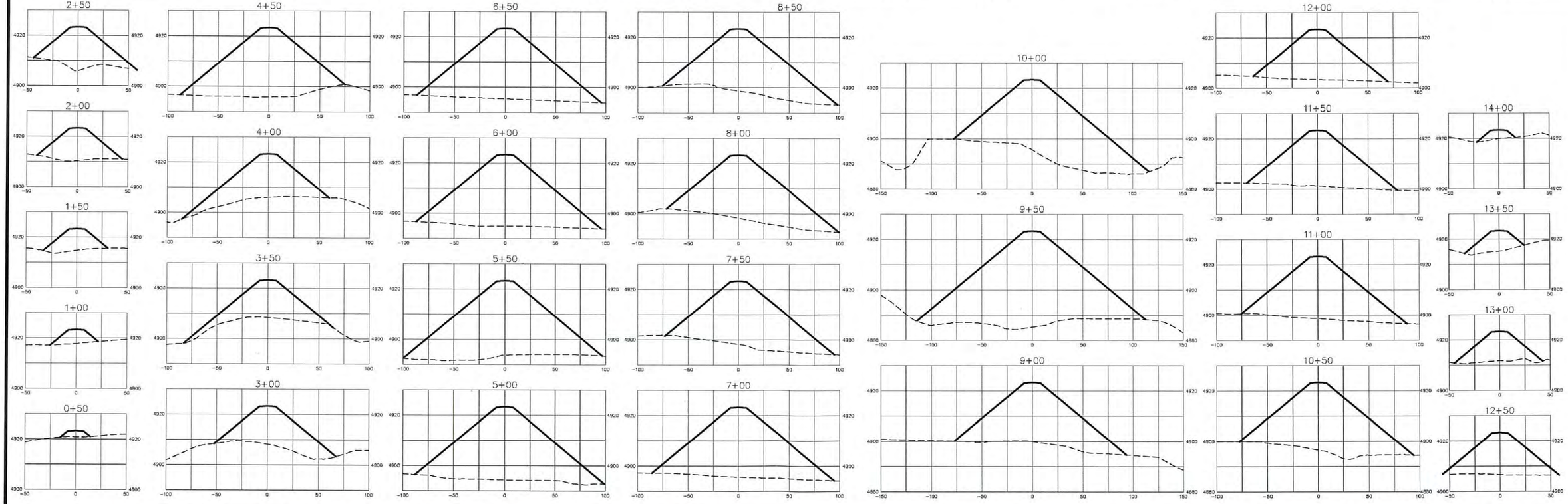
PROJECT AREA MAP — 4
DETENTION BASIN SITE PLAN — 5
MATERIALS INVESTIGATION AREA MAP — 6
GEOLOGICAL SECTIONS — 7
LOGS OF TESTHOLES — 8
TYPICAL DAM CROSS SECTIONS — 9
OUTLET WORKS PLAN AND PROFILE — 13

GENERAL NOTES

1. TOPOGRAPHY TAKEN FROM MESA COUNTY/CITY OF GRAND JUNCTION CIRCA 2001 2' INTERVAL CONTOURS (DATUM: NAD 83)
2. COORDINATES SHOWN ARE CITY OF GRAND JUNCTION LOCAL COORDINATE DEFINITION.
3. FOR THE LOCATION OF TESTHOLES SEE SHEET 6







DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY JLS DATE 2003
APPROVED BY ____ DATE ____

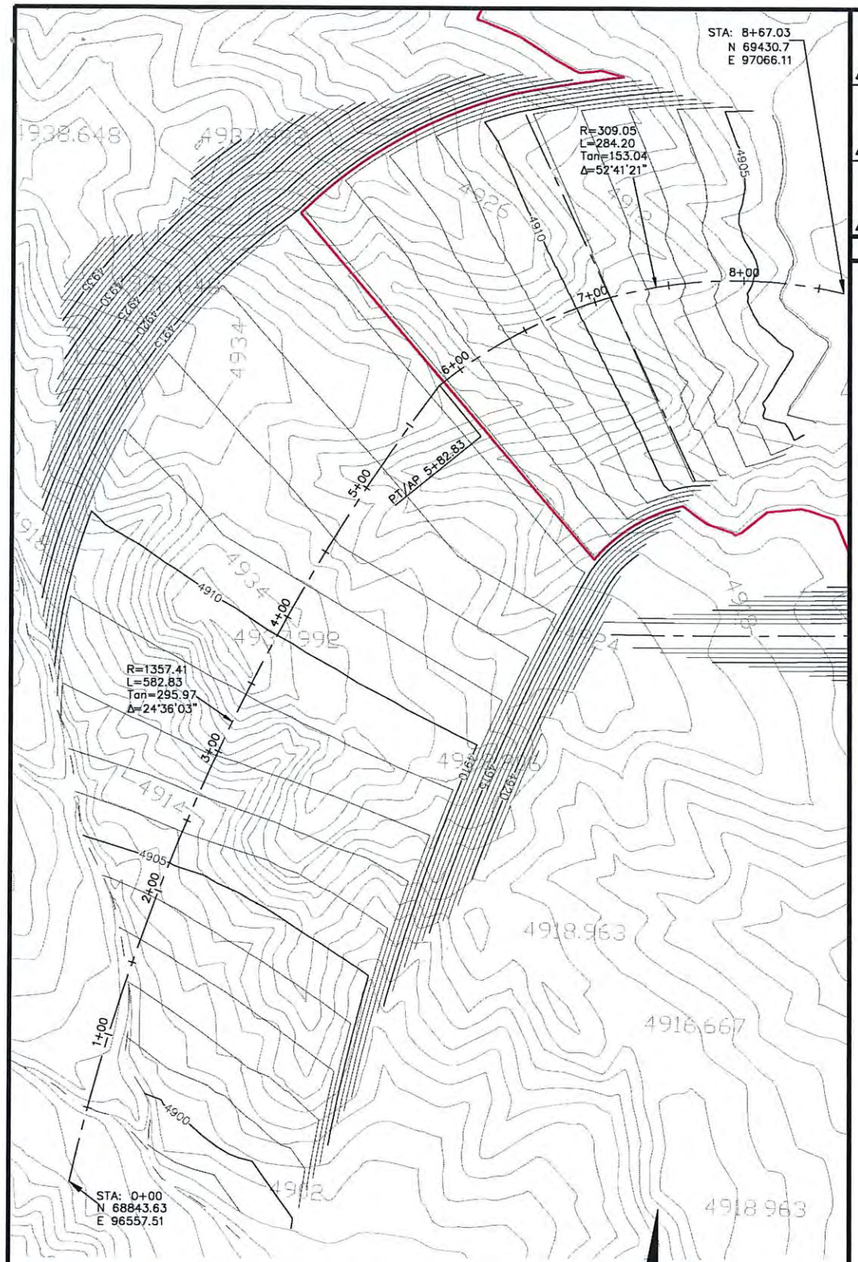
SCALE
PLAN HORIZ. 1"=50'
PROFILE HORIZ. 1"=50'
PROFILE VERT. 1"=20'

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
DAM PLAN, PROFILE, AND CROSS SECTIONS

STATE ENGINEERS FILE NO:

11 OF 16



GENERAL NOTES

1. TOPOGRAPHY TAKEN FROM MESA COUNTY/CITY OF GRAND JUNCTION CIRCA 2001 2' INTERVAL CONTOURS (DATUM: NAD 83)
2. COORDINATES SHOWN ARE CITY OF GRAND JUNCTION LOCAL COORDINATE DEFINITION.
3. FOR THE LOCATION OF TESTHOLES SEE SHEET 6

REFERENCE DRAWINGS

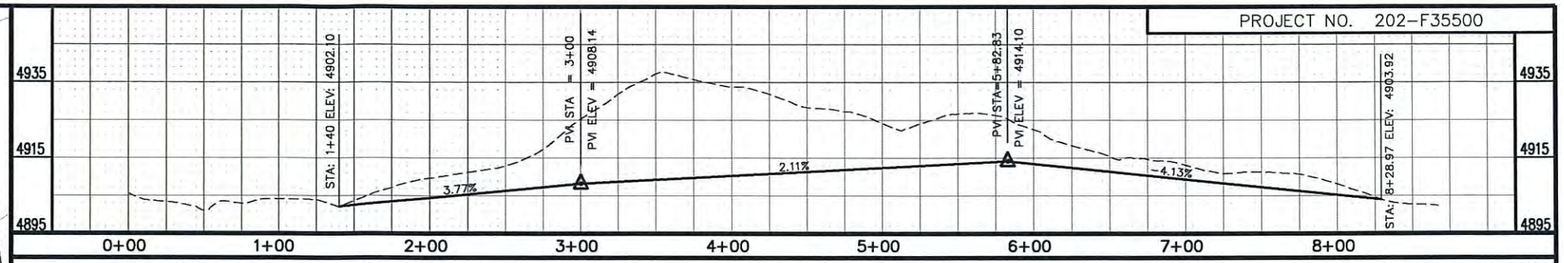
DETENTION BASIN SITE PLAN ——— 5
MATERIALS INVESTIGATION AREA MAP ——— 6
GEOLOGICAL SECTIONS ——— 7
LOGS OF TESTHOLES ——— 8

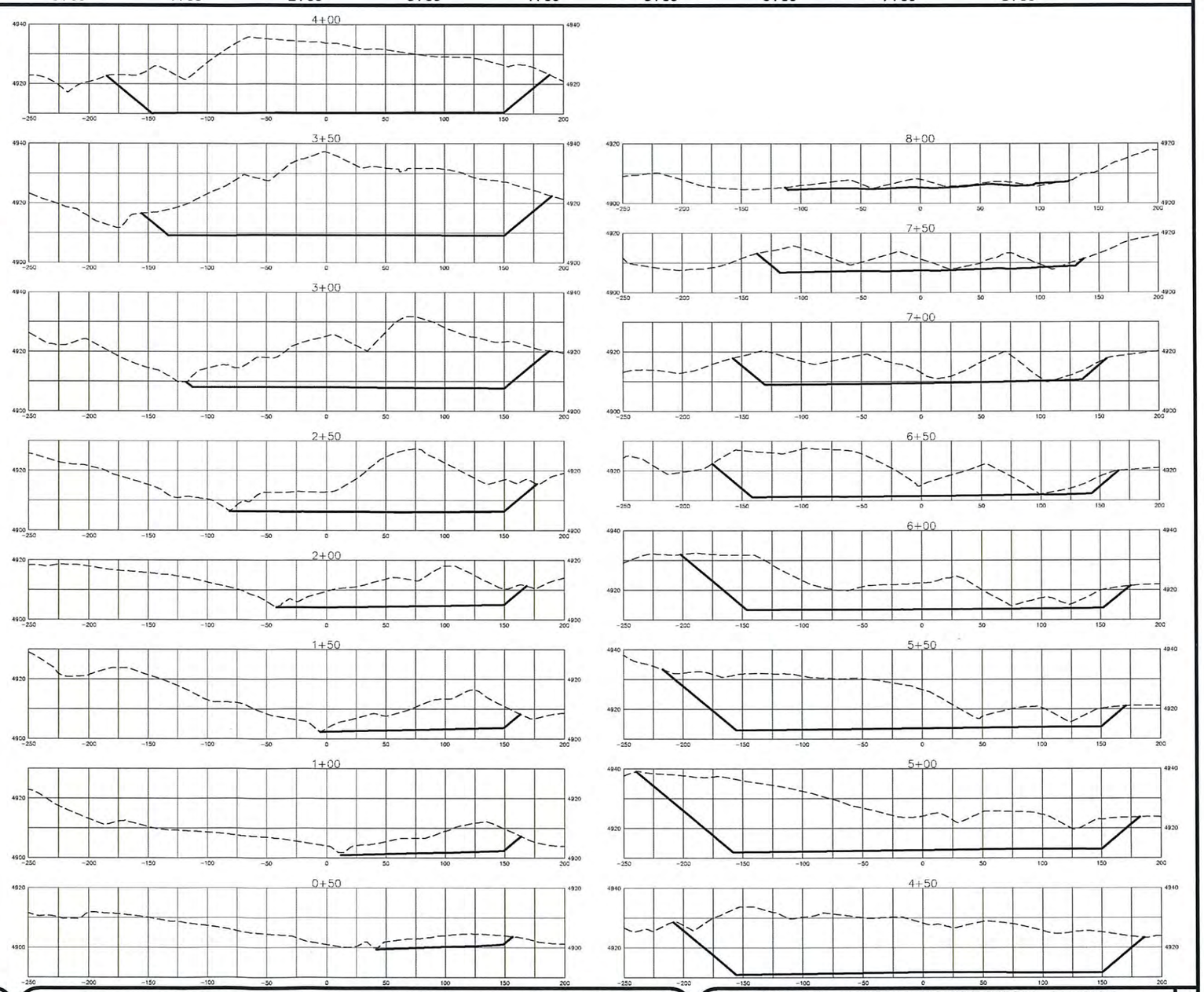
GRAPHIC SCALE

25 0 50 150

(IN FEET)
1 inch = 50 ft.

PROJECT NO. 202-F35500





DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY	JCS	DATE	2003
DESIGNED BY	JLS	DATE	2003
CHECKED BY	JLS	DATE	2003
APPROVED BY		DATE	

SCALE	PLAN	PROFILE
HORIZ.	1"=50'	1"=50'
VERT.		1"=20'

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
SPILLWAY PLAN, PROFILE, AND CROSS SECTIONS

STATE ENGINEERS FILE NO:

PROJECT NO. 202-F35500



GRAPHIC SCALE

10 0 20 40

(IN FEET)
1 inch = 20 ft

REFERENCE DRAWINGS

PROJECT AREA MAP — 4
DETENTION BASIN SITE PLAN — 5
MATERIALS INVESTIGATION AREA MAP — 6
GEOLOGICAL SECTIONS — 7
LOGS OF TESTHOLES — 8
TYPICAL DAM CROSS SECTIONS — 9
DAM PLAN, PROFILE, AND CROSS SECTIONS — 11

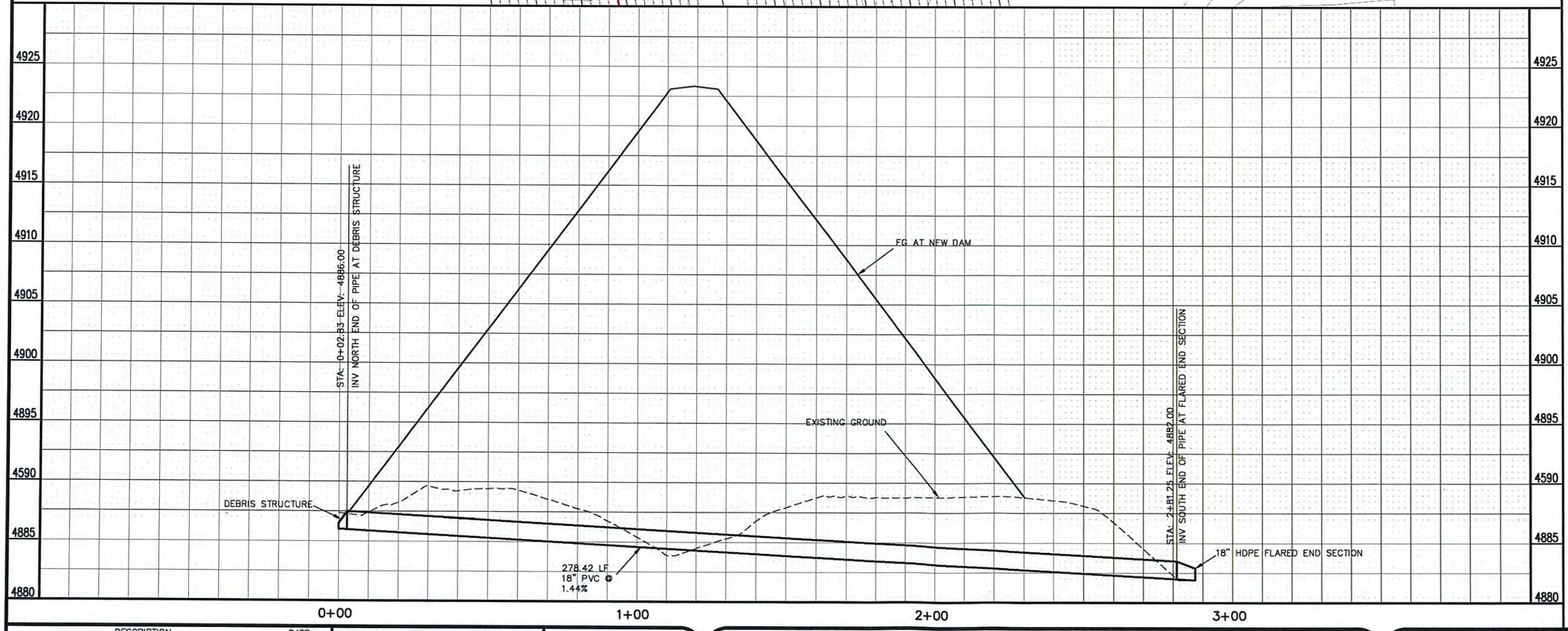
GENERAL NOTES

1 FOR ADDITIONAL INFORMATION REGARDING THE CONSTRUCTION OF THE DEBRIS STRUCTURE SEE PROJECT DETAIL SHEET 16

2 TOPOGRAPHY TAKEN FROM MESA COUNTY/CITY OF GRAND JUNCTION CIRCA 2001 2' INTERVAL CONTOURS (DATUM: NAD 83)

3 COORDINATES SHOWN ARE CITY OF GRAND JUNCTION LOCAL COORDINATE DEFINITION.

4 FOR THE LOCATION OF TESTHOLES SEE SHEET 6



DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY	JCS	DATE	2003
DESIGNED BY	JLS	DATE	2003
CHECKED BY	JLS	DATE	2003
APPROVED BY		DATE	

SCALE

PLAN		PROFILE
HORIZ.	1"=20'	HORIZ 1"=20'
		VERT. 1"=5'

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
OUTLET WORKS PLAN AND PROFILE

STATE ENGINEERS FILE NO:

13 OF 16

PROJECT NO. 202-F35500

GENERAL NOTES

1. TOPOGRAPHY TAKEN FROM MESA COUNTY/CITY OF GRAND JUNCTION CIRCA 2001 2' INTERVAL CONTOURS (DATUM: NAD 83)
2. COORDINATES SHOWN ARE CITY OF GRAND JUNCTION LOCAL COORDINATE DEFINITION.
3. FOR THE LOCATION OF TESTHOLES SEE SHEET 6

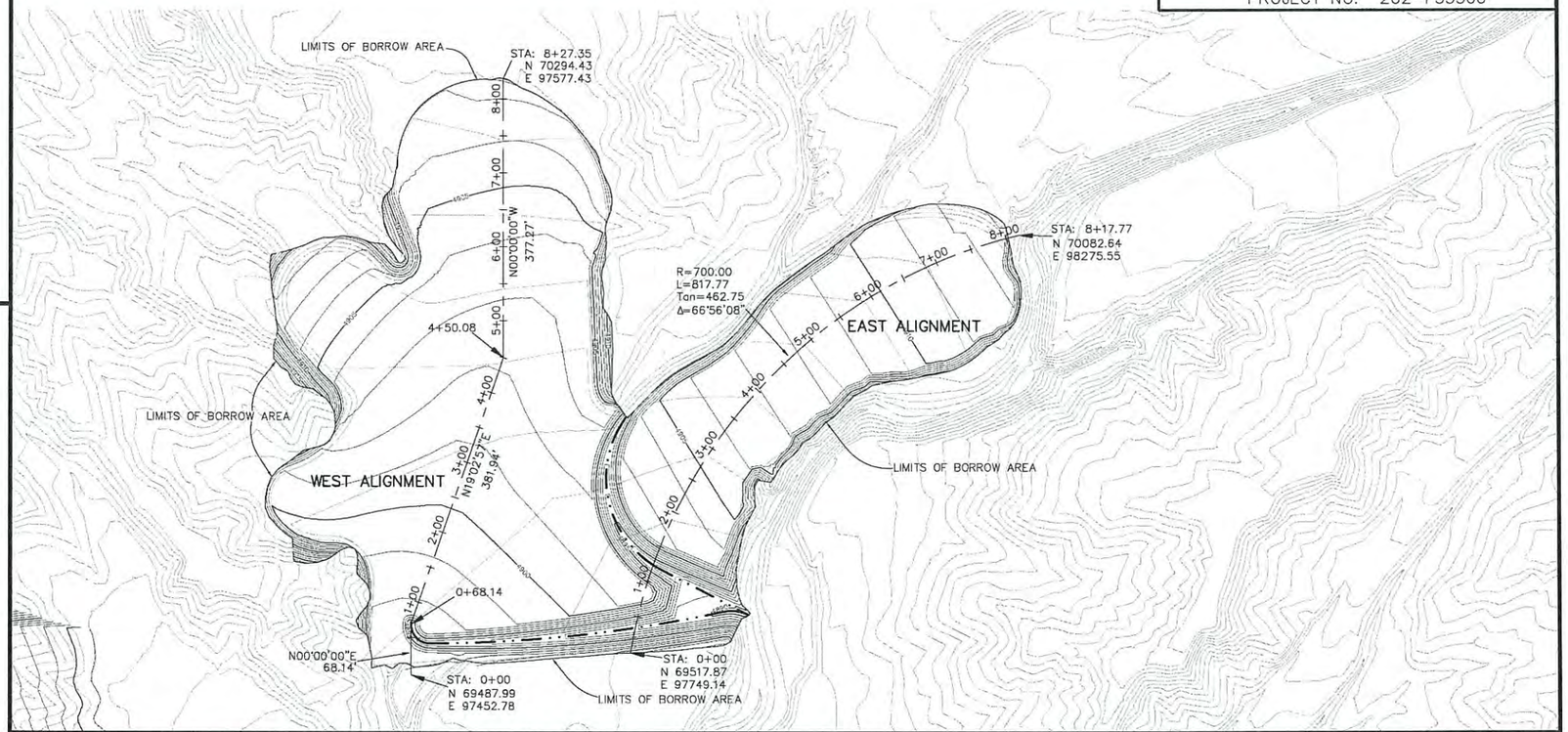
REFERENCE DRAWINGS

PROJECT AREA MAP ——— 4
DETENTION BASIN SITE PLAN ——— 5
MATERIALS INVESTIGATIONS AREA MAP ——— 6
GEOLOGICAL SECTIONS ——— 7
LOGS OF TESTHOLES ——— 8
BORROW AREA PLAN, PROFILE, AND CROSS SECTIONS ——— 10

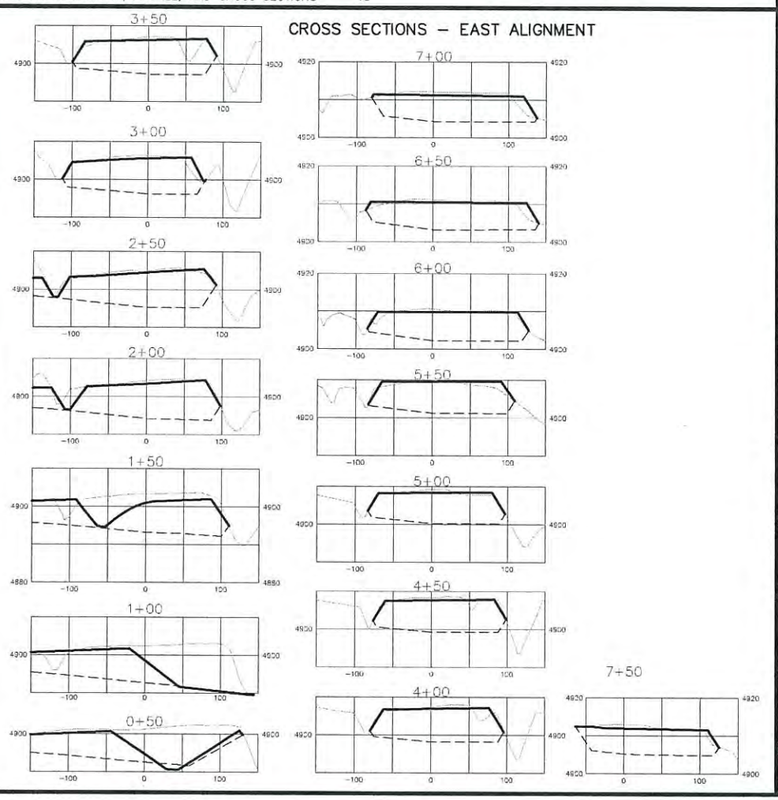
GRAPHIC SCALE

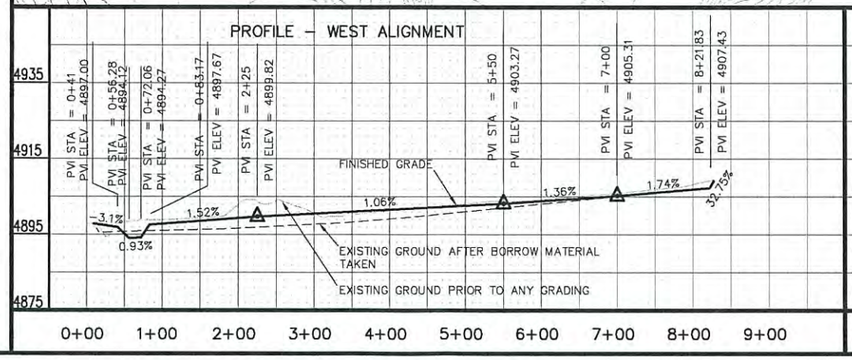
50 0 100 300

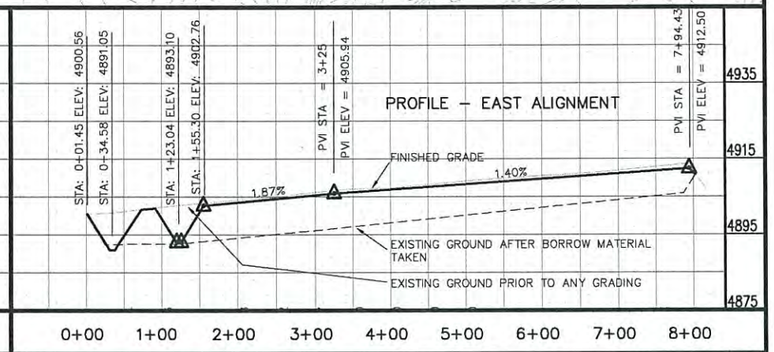
(IN FEET)
1 inch = 100 ft.



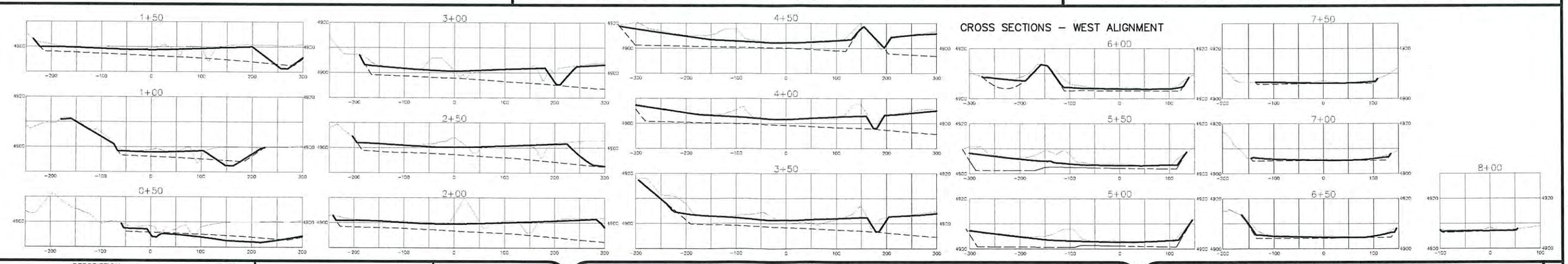
CROSS SECTIONS – EAST ALIGNMENT







CROSS SECTIONS – WEST ALIGNMENT



DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY JLS DATE 2003
APPROVED BY ____ DATE ____

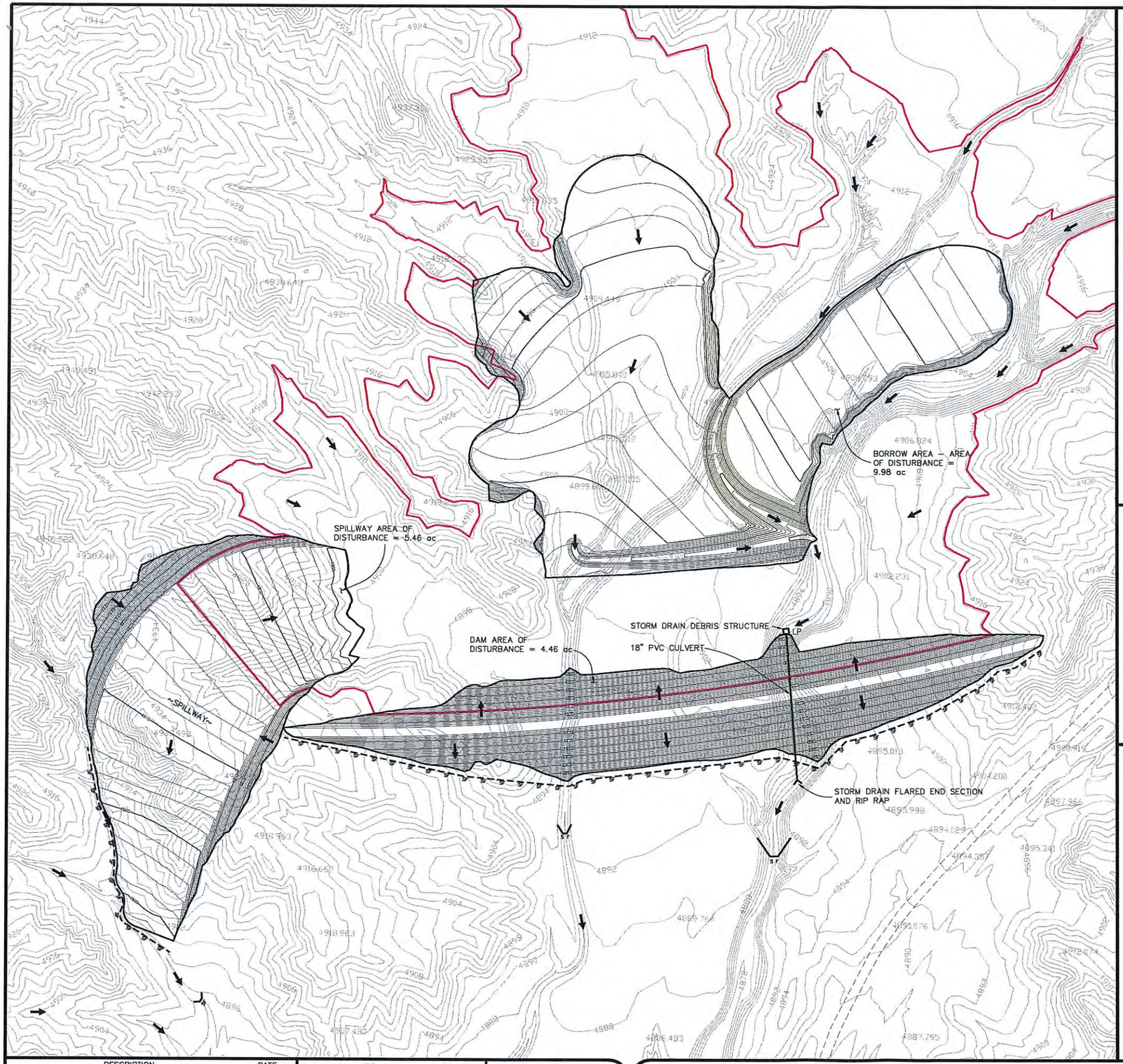
SCALE
PLAN HORIZ. 1"=100'
PROFILE HORIZ. 1"=100'
VERT. 1"=20'

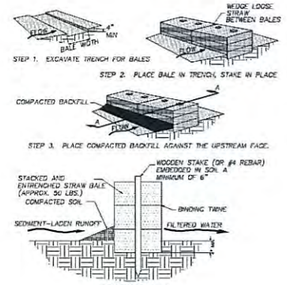
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
BORROW AREA REMEDIATION PLAN, PROFILE, AND CROSS SECTIONS

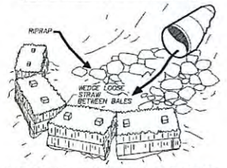
STATE ENGINEERS FILE NO:

PROJECT NO. 202-F35500

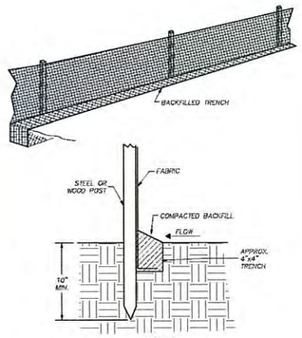




SECTION A-A
BALE INSTALLATION PROCEDURE



DETAIL C - CULVERT OUTLET TRAP
N.T.S.
ANCHORED STRAW BALE (A.S.B.)



PROFILE

DETAIL B - SILT FENCE (S.F.)
N.T.S.

LEGEND

AREAS OF DISTURBANCE (19.90 acres)

AREAS OF DISTURBANCE BOUNDARY
SF SILT FENCE
A.S.B. ANCHORED STRAW BALE
DIRECTION OF FLOW

HYDROLOGIC SOIL TYPES
SCS SOIL TYPE C - SANDY CLAY LOAM

GENERAL NOTES

1. TOPOGRAPHY TAKEN FROM MESA COUNTY/CITY OF GRAND JUNCTION CIRCA 2001 2' INTERVAL CONTOURS (DATUM: NAD 83)
2. COORDINATES SHOWN ARE CITY OF GRAND JUNCTION LOCAL COORDINATE DEFINITION.
3. FOR THE LOCATION OF TESTHOLES SEE SHEET 6

REFERENCE DRAWINGS

PROJECT AREA MAP — 4
BORROW AREA PLAN, PROFILE, AND CROSS SECTIONS — 10
DAM PLAN, PROFILE, AND CROSS SECTIONS — 11
SPILLWAY PLAN, PROFILE, AND CROSS SECTIONS — 12
OUTLET WORKS PLAN AND PROFILE — 13
BORROW AREA REMEDIATION PLAN, PROFILE, AND CROSS SECTIONS — 14

EROSION CONTROL MEASURES

Performance Standards

The general requirements for erosion control work shall be as follows:

1. Any grading shall be conducted in such a manner so as to effectively reduce accelerated soil erosion and resulting sedimentation.
2. All grading shall be designed, constructed and completed in such a manner so that exposed area of any disturbed land shall be limited to the shortest time period.
3. Sediment caused by accelerated soil erosion shall be removed from runoff water before leaving the site.
4. Any temporary or permanent facility designed and constructed for the conveyance of water around, through, or from the graded area shall be designed to limit the water flow to a non-erosive velocity.

During Construction (Temporary Measures)

1. Anchored Straw Bales (ASB): The use of hay bales is proposed at the storm sewer outlets into channel and at all inlet locations (see Details C). Other locations are shown on the plan. Installation shall be in accordance with the detail as shown on the plans (see Detail C).
2. Silt Fence (SF) The use of silt fences is proposed at the toes of fill slopes and other areas where sediment from upstream flows may spill to existing drainage ways. Other locations are shown on the plan. Installation shall be in accordance with the detail as shown on the plans (see Detail B).

After Construction (Permanent Measures)

1. Rip-Rap: The use of rip-rap per construction drawings is proposed for the storm sewer outlets. It shall function to take the impact of the release water, thereby reducing velocities to a non-erosive rate (See plan for storm sewer outfall location).

Maintenance

1. The contractor or his designated representative shall make routine checks on all erosion control measures to determine if repairs or sediment removal is necessary.
2. After each rainfall or moderate snow melt, erosion control measures are to be checked. If repairs are needed, they shall be completed immediately.
3. Silt and sediment shall be removed when they reach a height of one-half of the barrier (silt fence or anchored straw bale).
4. When temporary measures are to be removed, any silt and sediment deposits shall be removed and spread evenly in fill areas.

General Notes

1. At all times during construction, erosion and sediment control shall be maintained by the contractor or his designated representative.
2. Erosion control system shall be installed as grading progresses.
3. Erosion bales shall be straw or hay, depending on availability.
4. Details shown are schematic only. Adjust as necessary to fit field conditions.
5. Erosion bales shall be placed to avoid runoff flowing between, around or under bales. Bales shall be anchored with 2" x 2" x 4' wooden stakes or #4 reinforcing bars, two per bale (see details for further instructions).
6. Negative impacts to downstream areas (or receiving waters) caused by the slope grading to be monitored and corrected by the contractor.
7. Construction traffic entrances shall be cleaned on a continual basis during slope grading.

DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	

DRAWN BY JCS DATE 2003
DESIGNED BY JLS DATE 2003
CHECKED BY JLS DATE 2003
APPROVED BY ____ DATE ____

SCALE
PLAN HORIZ. 1"=100' VERT. ____
CROSS SECTION HORIZ. ____ VERT. ____

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING AND TECHNICAL SERVICES DIVISIONS
CITY OF GRAND JUNCTION, COLORADO

LEACH CREEK DETENTION BASIN
STORM WATER MANAGEMENT PLAN

STATE ENGINEERS FILE NO:

APPENDIX D – HYDROLOGIC CALCULATIONS

Pre-Developed Hydrologic Computations
Developed Conditions Hydrologic Computations

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

HEC-1 INPUT

KK		BA		LG					US	
Basin	Basin Description	Area (mi^2)	Area (ac)	Initial Loss (in) IA	Vol Moist Deficit DTHETA	Wetting Front Suction (in) PSIF	Hydraulic Conduct (in/hr) XKSAT	Percent Impervious (%) RTIMP	Lag Time (hr)	Peak Coef CP
RANCHMAN'S DITCH BASIN - CURRENT CONDITIONS										
DB21	Subbasin	0.1570	100.5	0.41	0.4023	1.502	0.054	2	0.318	0.253
DB21a	Subbasin	0.3827	244.9	0.41	0.4023	1.502	0.054	2	0.516	0.289
DB23b	New Subbasin	0.0581	37.2	0.06	0.0710	0.265	0.010	95	0.046	0.547
DB23c	New Subbasin	0.0822	52.6	0.06	0.0710	0.265	0.010	95	0.080	0.577
DB23d	New Subbasin	0.0188	12.0	0.04	0.0473	0.177	0.006	100	0.023	0.467
DB23e	New Subbasin	0.0764	48.9	0.04	0.0473	0.177	0.006	100	0.067	0.577
DB23a	Subbasin	0.0222	14.2	0.38	0.3787	1.414	0.051	10	0.130	0.163
DB22	Subbasin	0.2128	136.2	0.41	0.4023	1.502	0.054	2	0.410	0.265
DB24a	Subbasin	0.0209	13.4	0.27	0.2840	1.060	0.038	36	0.096	0.263
DB24	Subbasin	0.2359	151.0	0.12	0.1420	0.530	0.019	75	0.162	0.629
DB25	Subbasin	0.0239	15.3	0.27	0.2840	1.060	0.038	36	0.106	0.269
DB25a	Subbasin	0.0333	21.3	0.37	0.3550	1.325	0.048	12	0.031	0.174
R16	New Subbasin	0.1570	100.5	0.21	0.2130	0.795	0.029	51	0.076	0.479
R14a	Subbasin	0.0411	26.3	0.12	0.1420	0.530	0.019	75	0.038	0.484
LEACH CREEK BASIN - CURRENT CONDITIONS										
L11b	Subbasin	7.4130	4744.3	0.41	0.4023	1.502	0.054	2	1.654	0.451
L11au	Subbasin	1.0148	649.5	0.41	0.4023	1.502	0.054	2	1.149	0.333
L11ad	Subbasin	0.0230	14.7	0.41	0.4023	1.502	0.054	2	0.035	0.190
L10	Subbasin	1.0245	655.7	0.41	0.4023	1.502	0.054	2	1.123	0.335
L9.1	Subbasin	2.6711	1709.5	0.40	0.4023	1.502	0.054	4	1.107	0.369
L9	Subbasin	0.1647	105.4	0.39	0.3787	1.414	0.051	6	0.792	0.233
R17	Subbasin	0.1230	78.7	0.41	0.4023	1.502	0.054	2	0.169	0.244
R15	Subbasin	0.3195	204.5	0.33	0.3313	1.237	0.044	25/3	0.409	0.248
R13	Subbasin	0.0428	27.4	0.41	0.4023	1.502	0.054	2	0.179	0.208
R14	Subbasin	0.0598	38.3	0.41	0.4023	1.502	0.054	2	0.968	0.219
R5	Subbasin	0.0844	54.0	0.38	0.3787	1.414	0.051	9	0.368	0.201
CORCORAN BASIN - CURRENT CONDITIONS										
C3	New Subbasin	0.5778	369.8	0.41	0.4023	1.502	0.054	2	0.670	0.307
INDIAN WASH BASIN - CURRENT CONDITIONS										
I5	New Subbasin	0.7994	511.6	0.41	0.4023	1.502	0.054	2	0.435	0.323
I4	New Subbasin	1.2130	776.3	0.41	0.4023	1.502	0.054	2	1.184	0.344
I3	New Subbasin	3.2056	2051.6	0.41	0.4023	1.502	0.054	2	1.649	0.398
I2	New Subbasin	0.9728	622.6	0.41	0.4023	1.502	0.054	3	1.502	0.325
I1	New Subbasin	0.7563	484.0	0.41	0.4023	1.502	0.054	2	1.896	0.320
I7	New Subbasin	1.0258	656.5	0.41	0.4023	1.502	0.054	2	1.348	0.335
I6	New Subbasin	0.4513	288.8	0.40	0.4023	1.502	0.054	4	0.532	0.285
I8	New Subbasin	0.4147	265.4	0.41	0.4023	1.502	0.054	3	0.498	0.285
I9	New Subbasin	0.6808	435.7	0.41	0.4023	1.502	0.054	2	1.205	0.315

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

SOIL DATA INPUT - CURRENT CONDITIONS

Soil Hydraulic Conductivity Values from Table 706

A = 1.20
B = 0.25
C = 0.06
D = 0.04

XKSAT = alog ($\Sigma A_i \log XKSAT_i / A_T$)

Basin	Area (ac)	Hydrological Soil Group A (%)	Sub Area (ac)	B (%)	Sub Area (ac)	C (%)	Sub Area (ac)	D (%)	Sub Area (ac)	XKSAT (in./hr)	DTHETA Dry	DTHETA Normal	PSIF (in)
RANCHMAN'S DITCH BASIN													
DB21	97.22	0	0.00	0	0.00	0	0.00	100	97.22	0.040	0.25	0.15	9.50
DB21a	217.79	0	0.00	0	0.00	0	0.00	100	217.79	0.040	0.25	0.15	9.50
DB23b	37.38	0	0.00	0	0.00	0	0.00	100	37.38	0.040	0.25	0.15	9.50
DB23c	50.11	0	0.00	0	0.00	0	0.00	100	50.11	0.040	0.25	0.15	9.50
DB23d	11.07	0	0.00	0	0.00	0	0.00	100	11.07	0.040	0.25	0.15	9.50
DB23e	45.38	0	0.00	0	0.00	0	0.00	100	45.38	0.040	0.25	0.15	9.50
DB23a	12.54	0	0.00	0	0.00	0	0.00	100	12.54	0.040	0.25	0.15	9.50
DB22	142.46	0	0.00	0	0.00	0	0.00	100	142.46	0.040	0.25	0.15	9.50
DB24a	13.57	0	0.00	0	0.00	0	0.00	100	13.57	0.040	0.25	0.15	9.50
DB24	148.35	0	0.00	0	0.00	0	0.00	100	148.35	0.040	0.25	0.15	9.50
DB25	15.62	0	0.00	0	0.00	0	0.00	100	15.62	0.040	0.25	0.15	9.50
DB25a	20.22	0	0.00	0	0.00	0	0.00	100	20.22	0.040	0.25	0.15	9.50
R16	99.20	0	0.00	0	0.00	0	0.00	100	99.20	0.040	0.25	0.15	9.50
R14a	25.15	0	0.00	0	0.00	0	0.00	100	25.15	0.040	0.25	0.15	9.50
LEACH CREEK BASIN													
L11b	4744.30	0	0.00	0	0.00	0	0.00	100	4744.30	0.040	0.25	0.15	9.50
L11au	649.50	0	0.00	0	0.00	0	0.00	100	649.50	0.040	0.25	0.15	9.50
L11ad	14.70	0	0.00	0	0.00	0	0.00	100	14.70	0.040	0.25	0.15	9.50
L10	655.70	0	0.00	0	0.00	0	0.00	100	655.70	0.040	0.25	0.15	9.50
L9.1	1709.50	0	0.00	0	0.00	0	0.00	100	1709.50	0.040	0.25	0.15	9.50
L9	105.40	0	0.00	0	0.00	0	0.00	100	105.40	0.040	0.25	0.15	9.50
R17	78.70	0	0.00	0	0.00	0	0.00	100	78.70	0.040	0.25	0.15	9.50
R15	204.50	0	0.00	0	0.00	0	0.00	100	204.50	0.040	0.25	0.15	9.50
R13	27.40	0	0.00	0	0.00	0	0.00	100	27.40	0.040	0.25	0.15	9.50
R14	38.30	0	0.00	0	0.00	0	0.00	100	38.30	0.040	0.25	0.15	9.50
R5	54.00	0	0.00	0	0.00	0	0.00	100	54.00	0.040	0.25	0.15	9.50
CORCORAN BASIN													
C3	369.80	0	0.00	0	0.00	0	0.00	100	369.80	0.040	0.25	0.15	9.50
INDIAN WASH BASIN													
I5	511.60	0	0.00	0	0.00	0	0.00	100	511.60	0.040	0.25	0.15	9.50
I4	776.30	0	0.00	0	0.00	0	0.00	100	776.30	0.040	0.25	0.15	9.50
I3	2051.60	0	0.00	0	0.00	0	0.00	100	2051.60	0.040	0.25	0.15	9.50
I2	622.60	0	0.00	0	0.00	0	0.00	100	622.60	0.040	0.25	0.15	9.50
I1	484.00	0	0.00	0	0.00	0	0.00	100	484.00	0.040	0.25	0.15	9.50
I7	656.50	0	0.00	0	0.00	0	0.00	100	656.50	0.040	0.25	0.15	9.50
I6	288.80	0	0.00	0	0.00	0	0.00	100	288.80	0.040	0.25	0.15	9.50
I8	265.40	0	0.00	0	0.00	0	0.00	100	265.40	0.040	0.25	0.15	9.50
I9	435.70	0	0.00	0	0.00	0	0.00	100	435.70	0.040	0.25	0.15	9.50

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

SOIL DATA INPUT - CURRENT CONDITIONS

Surface Retention Loss Values from Table 705

Natural - Desert flat slopes = 0.35

Natural - Desert Hillslopes = 0.15

Developed - Pavement = 0.05

$IA_w = SIA_i/A_T$

RTIMP = $SRTIMP*A_i/A_T$

RTIMP PAVE = 100 %

RTIMP UNDEVELOPED = 2 %

Basin	Natural Flat (ac)	Area (%)	Natural Hill (ac)	Area (%)	Developed (ac)	Area (%)	IA_w (in)	RTIMP (%)	DTHETA Avg	VC (%)	Corr Factor	Adjusted XKSAT (in./hr)
RANCHMAN'S DITCH BASIN												
DB21	0.00	0	97.22	100	0.00	0	0.15	2	0.25	50	1.4	0.058
DB21a	130.67	60	87.12	40	0.00	0	0.27	2	0.25	50	1.4	0.058
DB23b	2.00	5	0.00	0	35.38	95	0.07	95	0.16	50	1.4	0.058
DB23c	2.51	5	0.00	0	47.60	95	0.07	95	0.16	50	1.4	0.058
DB23d	0.00	0	0.00	0	11.07	100	0.05	100	0.15	50	1.4	0.058
DB23e	0.00	0	0.00	0	45.38	100	0.05	100	0.15	50	1.4	0.058
DB23a	11.54	92	0.00	0	1.00	8	0.33	10	0.24	50	1.4	0.058
DB22	106.85	75	35.61	25	0.00	0	0.30	2	0.25	50	1.4	0.058
DB24a	8.82	65	0.00	0	4.75	35	0.25	36	0.22	50	1.4	0.058
DB24	37.09	25	0.00	0	111.26	75	0.13	75	0.18	50	1.4	0.058
DB25	10.15	65	0.00	0	5.47	35	0.24	36	0.22	50	1.4	0.058
DB25a	18.20	90	0.00	0	2.02	10	0.32	12	0.24	50	1.4	0.058
R16	49.60	50	0.00	0	49.60	50	0.20	51	0.20	50	1.4	0.058
R14a	6.29	25	0.00	0	18.86	75	0.13	75	0.18	50	1.4	0.058
LEACH CREEK BASIN												
L11b	0.00	0	4744.00	100	0.30	0	0.15	2	0.25	50	1.4	0.058
L11au	196.00	30	452.00	70	1.50	0	0.21	2	0.25	50	1.4	0.058
L11ad	14.70	100	0.00	0	0.00	0	0.35	2	0.25	50	1.4	0.058
L10	378.00	58	277.70	42	0.00	0	0.27	2	0.25	50	1.4	0.058
L9.1	174.00	10	1500.00	88	35.50	2	0.17	4	0.25	50	1.4	0.058
L9	101.00	96	0.00	0	4.40	4	0.34	6	0.25	50	1.4	0.058
R17	78.70	100	0.00	0	0.00	0	0.35	2	0.25	50	1.4	0.058
R15	165.00	81	0.00	0	39.50	19	0.29	21	0.23	50	1.4	0.058
R13	27.40	100	0.00	0	0.00	0	0.35	2	0.25	50	1.4	0.058
R14	38.30	100	0.00	0	0.00	0	0.35	2	0.25	50	1.4	0.058
R5	50.00	93	0.00	0	4.00	7	0.33	9	0.24	50	1.4	0.058
CORCORAN BASIN												
C3	269.80	73	100.00	27	0.00	0	0.30	2	0.25	50	1.4	0.058
INDIAN WASH BASIN												
I5	50.98	10	460.62	90	0.00	0	0.17	2	0.25	50	1.4	0.058
I4	566.30	73	210.00	27	0.00	0	0.30	2	0.25	50	1.4	0.058
I3	731.60	36	1320.00	64	0.00	0	0.22	2	0.25	50	1.4	0.058
I2	616.59	99	0.00	0	6.01	1	0.35	3	0.25	50	1.4	0.058
I1	484.00	100	0.00	0	0.00	0	0.35	2	0.25	50	1.4	0.058
I7	656.50	100	0.00	0	0.00	0	0.35	2	0.25	50	1.4	0.058
I6	283.77	98	0.00	0	5.03	2	0.34	4	0.25	50	1.4	0.058
I8	236.41	89	26.00	10	2.99	1	0.33	3	0.25	50	1.4	0.058
I9	400.70	92	35.00	8	0.00	0	0.33	2	0.25	50	1.4	0.058

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

SOIL DATA INPUT - CURRENT CONDITIONS

SCS Runoff Curve Number Method

	A	B	C	D	
CN Pave	98	98	98	98	IA = 0.2*[(1000/CN)-10]
CN UNDEVEL	48	67	77	83	

									From Table A1 - Table of Correspondence			
Basin	CN A	CN B	CN C	CN D	Comp CN	CB/ICON CN	CB/ICON IA	Initial Loss (in) IA	Vol Moist Deficit DTHETA	Wetting Front Suction (in) PSIF	Hydra Conduct (in/hr) XKSAT	Percent Imp (%) RTIMP
RANCHMAN'S DITCH BASIN												
DB21	0	0	0	77	77.0	87.0	0.30	0.60	0.5444	2.032	0.073	2
DB21a	0	0	0	77	77.0	87.0	0.30	0.60	0.5444	2.032	0.073	2
DB23b	0	0	0	97	97.0	79.1	0.53	0.06	0.0710	0.265	0.010	95
DB23c	0	0	0	97	97.0	79.1	0.53	0.06	0.0710	0.265	0.010	95
DB23d	0	0	0	98	98.0	79.1	0.53	0.04	0.0473	0.177	0.006	100
DB23e	0	0	0	98	98.0	79.1	0.53	0.04	0.0473	0.177	0.006	100
DB23a	0	0	0	79	78.7	77.2	0.59	0.54	0.4970	1.855	0.067	10
DB22	0	0	0	77	77.0	87.0	0.30	0.60	0.5444	2.032	0.073	2
DB24a	0	0	0	84	84.4	79.1	0.53	0.37	0.3787	1.414	0.051	36
DB24	0	0	0	93	92.8	82.0	0.44	0.16	0.1657	0.618	0.022	75
DB25	0	0	0	84	84.4	79.1	0.53	0.37	0.3787	1.414	0.051	36
DB25a	0	0	0	79	79.1	78.4	0.55	0.53	0.4970	1.855	0.067	12
R16	0	0	0	88	87.5	74.9	0.67	0.29	0.2840	1.060	0.038	51
R14a	0	0	0	93	92.8	76.9	0.60	0.16	0.1657	0.618	0.022	75
LEACH CREEK BASIN												
L11b	0	0	0	77	77.0	83.3	0.40	0.60	0.5444	2.032	0.073	2
L11au	0	0	0	77	77.0	83.3	0.40	0.60	0.5444	2.032	0.073	2
L11ad	0	0	0	77	77.0	83.3	0.40	0.60	0.5444	2.032	0.073	2
L10	0	0	0	77	77.0	82.0	0.44	0.60	0.5444	2.032	0.073	2
L9.1	0	0	0	77	77.4	85.5	0.34	0.58	0.5444	2.032	0.073	4
L9	0	0	0	78	77.8	69.0	0.90	0.57	0.5207	1.944	0.070	6
R17	0	0	0	77	77.0	87.0	0.30	0.60	0.5444	2.032	0.073	2
R15	0	0	0	81	81.0	74.1	0.70	0.47	0.4497	1.679	0.060	21
R13	0	0	0	77	77.0	76.9	0.60	0.60	0.5444	2.032	0.073	2
R14	0	0	0	77	77.0	82.0	0.44	0.60	0.5444	2.032	0.073	2
R5	0	0	0	78	78.5			0.55	0.5207	1.944	0.070	9
CORCORAN BASIN												
C3	0	48	67	77	77.0			0.60	0.5444	2.032	0.073	2
INDIAN WASH BASIN												
I5	0	48	0	77	77.0			0.60	0.5444	2.032	0.073	2
I4	0	48	0	77	77.0			0.60	0.5444	2.032	0.073	2
I3	0	48	0	77	77.0			0.60	0.5444	2.032	0.073	2
I2	0	49	0	77	77.2			0.59	0.5444	2.032	0.073	3
I1	0	49	0	77	77.2			0.59	0.5444	2.032	0.073	2
I7	0	48	0	77	77.0			0.60	0.5444	2.032	0.073	2
I6	0	49	0	77	77.4			0.58	0.5444	2.032	0.073	4
I8	0	49	0	77	77.2			0.59	0.5444	2.032	0.073	3
I9	0	48	0	77	77.0			0.60	0.5444	2.032	0.073	2

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

Snyder's Method Input

						SUH Method			
Basin	L (lf)	L (mi)	L_{ca} (lf)	L_{ca} (mi)	C_t	$T_{lag} = C_t (LxL_{ca})^{0.3}$ **(hrs)**	$T_d = T_{lag}/5.5$ (hrs)	T_{da} (hrs)	$T_{pr} = T_{lag} + 0.25(T_{da} - T_d)$ (hrs)
RANCHMAN'S DITCH BASIN - CURRENT CONDITIONS									
DB21	3333	0.6313	1163	0.2203	2.0	**1.107**	0.201	0.1667	1.098
DB21a	3656	0.6924	1035	0.1960	2.0	**1.099**	0.200	0.1667	1.090
DB23b	1894	0.3587	699	0.1324	2.0	**0.802**	0.146	0.1667	0.807
DB23c	3142	0.5951	1246	0.2360	2.0	**1.110**	0.202	0.1667	1.101
DB23d	831	0.1574	416	0.0788	2.0	**0.536**	0.097	0.1667	0.553
DB23e	2691	0.5097	1077	0.2040	2.0	**1.014**	0.184	0.1667	1.010
DB23a	1345	0.2547	558	0.1057	2.0	**0.676**	0.123	0.1667	0.687
DB22	4081	0.7729	1818	0.3443	2.0	**1.344**	0.244	0.1667	1.325
DB24a	2433	0.4608	1173	0.2222	2.0	**1.009**	0.184	0.1667	1.005
DB24	5727	1.0847	2695	0.5104	2.0	**1.675**	0.305	0.1667	1.640
DB25	2746	0.5201	1325	0.2509	2.0	**1.086**	0.197	0.1667	1.078
DB25a	528	0.1000	408	0.0773	2.0	**0.465**	0.085	0.1667	0.486
R16	2128	0.4030	1121	0.2123	2.0	**0.957**	0.174	0.1667	0.955
R14a	1475	0.2794	578	0.1095	2.0	**0.703**	0.128	0.1667	0.712
LEACH CREEK BASIN - CURRENT CONDITIONS									
L11b	29585	5.6032	15656	2.9652	2.0	**4.647**	0.845	0.1667	4.477
L11au	9530	1.8049	6329	1.1987	2.0	**2.521**	0.458	0.1667	2.448
L11ad	590	0.1117	350	0.0663	2.0	**0.459**	0.083	0.1667	0.480
L10	13149	2.4903	5726	1.0845	2.0	**2.694**	0.490	0.1667	2.614
L9.1	24604	4.6598	12022	2.2769	2.0	**4.062**	0.739	0.1667	3.919
L9	5635	1.0672	2437	0.4616	2.0	**1.617**	0.294	0.1667	1.585
R17	2311	0.4377	863	0.1634	2.0	**0.907**	0.165	0.1667	0.907
R15	3910	0.7405	2050	0.3883	2.0	**1.376**	0.250	0.1667	1.355
R13	994	0.1883	325	0.0616	2.0	**0.525**	0.095	0.1667	0.543
R14	6879	1.3028	2745	0.5199	2.0	**1.779**	0.324	0.1667	1.740
R5	2152	0.4076	1021	0.1934	2.0	**0.933**	0.170	0.1667	0.933
CORCORAN BASIN - CURRENT CONDITIONS									
C3	6679	1.2650	1938	0.3670	2.0	**1.589**	0.289	0.1667	1.558
INDIAN WASH BASIN - CURRENT CONDITIONS									
I5	10315	1.9536	5463	1.0347	2.0	**2.470**	0.449	0.1667	2.400
I4	18756	3.5523	10062	1.9057	2.0	**3.550**	0.645	0.1667	3.430
I3	29640	5.6136	15183	2.8756	2.0	**4.607**	0.838	0.1667	4.439
I2	13433	2.5441	4490	0.8504	2.0	**2.521**	0.458	0.1667	2.448
I1	14703	2.7847	5938	1.1246	2.0	**2.817**	0.512	0.1667	2.730
I7	17566	3.3269	8201	1.5532	2.0	**3.273**	0.595	0.1667	3.166
I6	3752	0.7106	1408	0.2667	2.0	**1.214**	0.221	0.1667	1.201
I8	5875	1.1127	2482	0.4701	2.0	**1.647**	0.299	0.1667	1.613
I9	10747	2.0354	4658	0.8822	2.0	**2.384**	0.433	0.1667	2.317

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

Snyder's Method Input

Basin	From CB/ICON			Imp	Delta Y	S	Fig. 2	C_t	**CUHP 2005 Equation**	P	A	$C_p = PC_tA^{0.15}$
	Imp (%)	T_{lag} (hrs)	C_p	(%)	(ft)	(ft/ft)	S- Corr (ft/ft)		**$T_{lag} = C_t (LxL_{ca}/S^{0.5})^{0.48}$ (hrs)**		(mi^2)	
RANCHMAN'S DITCH BASIN - CURRENT CONDITIONS												
DB21	1	0.1710	0.2580	2	110	0.033	0.033	0.1556	**0.1369**	2.1458	0.1570	0.2529
DB21a	1	0.2110	0.2910	2	160	0.044	0.042	0.1556	**0.1277**	2.1458	0.3827	0.2890
DB23b	75	0.1860	0.6250	95	30	0.016	0.016	0.0737	**0.0461**	11.3738	0.0581	0.5473
DB23c	73	0.1860	0.6250	95	45	0.014	0.014	0.0737	**0.0800**	11.3923	0.0822	0.5769
DB23d	62	0.1860	0.6250	100	17	0.020	0.020	0.0729	**0.0227**	11.6400	0.0188	0.4673
DB23e	75	0.1860	0.6250	100	40	0.015	0.015	0.0729	**0.0674**	11.6400	0.0764	0.5770
DB23a	1	0.0630	0.1900	10	43	0.032	0.032	0.1265	**0.0510**	2.2793	0.0222	0.1628
DB22	1	0.2030	0.2730	2	112	0.027	0.027	0.1556	**0.1961**	2.1458	0.2128	0.2647
DB24a	20	0.1500	0.1800	36	25	0.010	0.010	0.0950	**0.0961**	4.9518	0.0209	0.2634
DB24	58	0.1800	0.6230	75	85	0.015	0.015	0.0783	**0.1616**	9.9667	0.2359	0.6287
DB25	20	0.1510	0.1830	36	30	0.011	0.011	0.0950	**0.1055**	4.9532	0.0239	0.2688
DB25a	1	0.0660	0.2040	12	10	0.019	0.019	0.1228	**0.0308**	2.3599	0.0333	0.1739
R16	50	0.1190	0.4760	51	27	0.013	0.013	0.0877	**0.0764**	7.2011	0.1570	0.4786
R14a	75	0.1190	0.4790	75	30	0.020	0.020	0.0783	**0.0376**	9.9661	0.0411	0.4837
LEACH CREEK BASIN - CURRENT CONDITIONS												
L11b	0	1.5390	0.4530	2	2316	0.078	0.056	0.1556	**1.1972**	2.1458	7.4130	0.4508
L11au	0	0.7470	0.3350	2	115	0.012	0.012	0.1547	**0.6479**	2.1454	1.0148	0.3327
L11ad	0	0.0890	0.1820	2	7	0.012	0.012	0.1556	**0.0427**	2.1458	0.0230	0.1895
L10	1	0.6440	0.3420	2	285	0.022	0.022	0.1556	**0.6264**	2.1458	1.0245	0.3351
L9.1	1	1.2890	0.3980	4	520	0.021	0.021	0.1480	**1.1624**	2.1515	2.6711	0.3691
L9	8.2	0.3400	0.2380	6	85	0.015	0.015	0.1404	**0.2738**	2.1778	0.1647	0.2333
R17	1	0.1530	0.2610	2	90	0.039	0.039	0.1556	**0.0956**	2.1458	0.1230	0.2438
R15	1	0.2670	0.2860	25/3	75	0.019	0.019	#VALUE!	**#VALUE!**	#VALUE!	0.3195	#VALUE!
R13	1	0.1480	0.2130	2	10	0.010	0.010	0.1556	**0.0553**	2.1458	0.0428	0.2081
R14	5	0.3550	0.2050	2	100	0.015	0.015	0.1556	**0.3536**	2.1458	0.0598	0.2188
R5				9	20	0.009	0.009	0.1286	**0.1177**	2.2589	0.0844	0.2006
CORCORAN BASIN - CURRENT CONDITIONS												
C3				2	190	0.028	0.028	0.1556	**0.2539**	2.1458	0.5778	0.3075
INDIAN WASH BASIN - CURRENT CONDITIONS												
I5				2	1625	0.158	0.060	0.1556	**0.4285**	2.1458	0.7994	0.3228
I4				2	1850	0.099	0.059	0.1556	**0.7685**	2.1458	1.2130	0.3437
I3				2	2230	0.075	0.056	0.1556	**1.1809**	2.1458	3.2056	0.3976
I2				3	320	0.024	0.024	0.1521	**0.5391**	2.1459	0.9728	0.3250
I1				2	250	0.017	0.017	0.1556	**0.7155**	2.1458	0.7563	0.3201
I7				2	460	0.026	0.026	0.1556	**0.8217**	2.1458	1.0258	0.3351
I6				4	50	0.013	0.013	0.1492	**0.1905**	2.1492	0.4513	0.2847
I8				3	230	0.039	0.039	0.1515	**0.2418**	2.1464	0.4147	0.2849
I9				2	245	0.023	0.023	0.1556	**0.5095**	2.1458	0.6808	0.3151

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

Grand Junction= SCS Unit Hydrograph Method - Greater than 1 SQ MILE

Basin	K_n (Table 705)	L (mi)	L_c (mi)	S (ft/mi)	$T_{lag} = 22.1\ K_n\ (L*L_c/S^{0.5})^{0.33}$ **(hr)**
RANCHMAN'S DITCH BASIN - CURRENT CONDITIONS					
DB21	0.080	0.6313	0.2203	174.3	**0.3935**
DB21a	0.080	0.6924	0.1960	231.1	**0.3726**
DB23b	0.050	0.3587	0.1324	83.6	**0.1947**
DB23c	0.050	0.5951	0.2360	75.6	**0.2832**
DB23d	0.050	0.1574	0.0788	108.0	**0.1199**
DB23e	0.050	0.5097	0.2040	78.5	**0.2549**
DB23a	0.050	0.2547	0.1057	168.8	**0.1438**
DB22	0.080	0.7729	0.3443	144.9	**0.5026**
DB24a	0.050	0.4608	0.2222	54.3	**0.2695**
DB24	0.050	1.0847	0.5104	78.4	**0.4427**
DB25	0.050	0.5201	0.2509	57.7	**0.2890**
DB25a	0.080	0.1000	0.0773	100.0	**0.1662**
R16	0.050	0.4030	0.2123	67.0	**0.2453**
R14a	0.050	0.2794	0.1095	107.4	**0.1616**
LEACH CREEK BASIN - CURRENT CONDITIONS					
L11b	0.080	5.6032	2.9652	413.3	**1.6541**
L11au	0.080	1.8049	1.1987	63.7	**1.1492**
L11ad	0.080	0.1117	0.0663	62.6	**0.1770**
L10	0.080	2.4903	1.0845	114.4	**1.1225**
L9.1	0.050	4.6598	2.2769	111.6	**1.1066**
L9	0.080	1.0672	0.4616	79.6	**0.6797**
R17	0.050	0.4377	0.1634	205.6	**0.1922**
R15	0.050	0.7405	0.3883	101.3	**0.3418**
R13	0.080	0.1883	0.0616	53.1	**0.2108**
R14	0.080	1.3028	0.5199	76.8	**0.7596**
R5	0.080	0.4076	0.1934	49.1	**0.4021**
CORCORAN BASIN - CURRENT CONDITIONS					
C3	0.080	1.2650	0.3670	150.2	**0.6003**
INDIAN WASH BASIN - CURRENT CONDITIONS					
I5	0.080	1.9536	1.0347	831.8	**0.7354**
I4	0.080	3.5523	1.9057	520.8	**1.1839**
I3	0.080	5.6136	2.8756	397.2	**1.6492**
I2	0.080	2.5441	0.8504	125.8	**1.0272**
I1	0.080	2.7847	1.1246	89.8	**1.2269**
I7	0.080	3.3269	1.5532	138.3	**1.3479**
I6	0.080	0.7106	0.2667	70.4	**0.5061**
I8	0.080	1.1127	0.4701	206.7	**0.5923**
I9	0.080	2.0354	0.8822	120.4	**0.9729**

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

Grand Junction= SCS Unit Hydrograph Method - Less than 1 SQ MILE

Basin	Comp CN	K (0.0132 CN-.039)	S % (ft/ft)	$t_i=(1.8\ (1.1-K)*L_o^{1/2}/S^{1/3}$ (min) * L_o = 300 ft	V (ft/sec)	V (ft/min)	t_t = L/V (min)	$t_c = t_t + t_i$ (min)	t_c (hr)	**$T_{lag} = 0.6 * t_c$ (hr)**
RANCHMAN'S DITCH BASIN - CURRENT CONDITIONS										
DB21	77.0	0.98	3.30	2.57	1.8	108.0	30.9	33.4	0.56	**0.3343**
DB21a	77.0	0.98	4.38	2.34	1.2	72.0	50.8	53.1	0.89	**0.5311**
DB23b	97.0	1.24	1.58	3.76	2.5	150.0	12.6	16.4	0.27	**0.1639**
DB23c	97.0	1.24	1.43	3.89	2.4	144.0	21.8	25.7	0.43	**0.2571**
DB23d	98.0	1.25	2.05	3.80	2.8	168.0	4.9	8.7	0.15	**0.0874**
DB23e	98.0	1.25	1.49	4.22	2.5	150.0	17.9	22.2	0.37	**0.2216**
DB23a	78.7	1.00	3.20	2.13	1.8	108.0	12.5	14.6	0.24	**0.1458**
DB22	77.0	0.98	2.74	2.73	1.7	102.0	40.0	42.7	0.71	**0.4274**
DB24a	84.4	1.07	1.03	0.79	2.0	120.0	20.3	21.1	0.35	**0.2107**
DB24	92.8	1.19	1.48	2.33	2.7	162.0	35.4	37.7	0.63	**0.3768**
DB25	84.4	1.07	1.09	0.77	2.0	120.0	22.9	23.7	0.39	**0.2366**
DB25a	79.1	1.01	1.89	2.39	1.4	84.0	6.3	8.7	0.14	**0.0868**
R16	87.5	1.12	1.27	0.46	2.4	144.0	14.8	15.2	0.25	**0.1524**
R14a	92.8	1.19	2.03	2.10	2.0	120.0	12.3	14.4	0.24	**0.1439**
LEACH CREEK BASIN - CURRENT CONDITIONS										
L11b	77.0	0.98	7.83	1.93	2.8	168.0	176.1	178.0	2.97	**1.7803**
L11au	77.0	0.98	1.21	3.60	1.1	66.0	144.4	148.0	2.47	**1.4799**
L11ad	77.0	0.98	1.19	3.62	4.4	264.0	2.2	5.9	0.10	**0.0586**
L10	77.0	0.98	2.17	2.97	2.0	120.0	109.6	112.5	1.88	**1.1254**
L9.1	77.4	0.98	2.11	2.86	1.5	90.0	273.4	276.2	4.60	**2.7624**
L9	77.8	0.99	1.51	3.06	1.2	72.0	78.3	81.3	1.36	**0.8132**
R17	77.0	0.98	3.89	2.45	2.4	144.0	16.0	18.5	0.31	**0.1850**
R15	81.0	1.03	1.92	1.78	1.6	96.0	40.7	42.5	0.71	**0.4250**
R13	77.0	0.98	1.01	3.87	1.0	60.0	16.6	20.4	0.34	**0.2043**
R14	77.0	0.98	1.45	3.42	1.2	72.0	95.5	99.0	1.65	**0.9897**
R5	78.5	1.00	0.93	3.35	1.0	60.0	35.9	39.2	0.65	**0.3922**
CORCORAN BASIN - CURRENT CONDITIONS										
C3	77.0	0.98	2.84	2.70	1.7	101.2	66.0	68.7	1.14	**0.6870**
INDIAN WASH BASIN - CURRENT CONDITIONS										
I5	77.0	0.98	15.75	1.52	4.0	240.0	43.0	44.5	0.74	**0.4450**
I4	77.0	0.98	9.86	1.79	3.1	186.0	100.8	102.6	1.71	**1.0262**
I3	77.0	0.98	7.52	1.96	2.7	162.0	183.0	184.9	3.08	**1.8492**
I2	77.2	0.98	2.38	2.81	1.5	90.0	149.3	152.1	2.53	**1.5207**
I1	77.2	0.98	1.70	3.15	1.3	78.0	188.5	191.7	3.19	**1.9165**
I7	77.0	0.98	2.62	2.80	1.6	96.0	183.0	185.8	3.10	**1.8578**
I6	77.4	0.98	1.33	3.35	1.2	72.0	52.1	55.5	0.92	**0.5546**
I8	77.2	0.98	3.91	2.40	2.0	120.0	49.0	51.4	0.86	**0.5136**
I9	77.0	0.98	2.28	2.94	1.5	90.0	119.4	122.4	2.04	**1.2235**

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

HEC-1 INPUT

KK		BA		LG					US	
Basin	Basin Description	Area (mi^2)	Area (ac)	Initial Loss (in) IA	Vol Moist Deficit DTHETA	Wetting Front Suction (in) PSIF	Hydraulic Conduct (in/hr) XKSAT	Percent Impervious (%) RTIMP	Lag Time (hr)	Peak Coef CP
RANCHMANS DITCH BASIN - PROPOSED CONDITIONS - JUNE 2012										
DB21	Subbasin	0.1519	100.5	0.41	0.4023	1.502	0.054	3	0.314	0.245
DB21a1	Split Subbasin	0.0700	44.8	0.39	0.3787	1.414	0.051	6	0.153	0.206
DB21a2	Split Subbasin	0.0780	49.9	0.41	0.4023	1.502	0.054	3	0.144	0.221
DB21a	Split Subbasin	0.2346	150.2	0.36	0.3550	1.325	0.048	13	0.174	0.235
DB23b	Subbasin	0.0581	37.2	0.06	0.0710	0.265	0.010	95	0.046	0.547
DB23c	Subbasin	0.0822	52.6	0.06	0.0710	0.265	0.010	95	0.080	0.577
DB23d	Subbasin	0.0188	12.0	0.04	0.0473	0.177	0.006	100	0.023	0.467
DB23e	Subbasin	0.0763	48.9	0.04	0.0473	0.177	0.006	100	0.067	0.577
DB23a	Subbasin	0.0222	14.2	0.38	0.3787	1.414	0.051	10	0.131	0.163
DB22	Split Subbasin	0.0564	36.1	0.40	0.4023	1.502	0.054	5	0.123	0.203
DB22a	Split Subbasin	0.1565	100.1	0.37	0.3787	1.414	0.051	11	0.143	0.218
DB24a	Subbasin	0.0209	13.4	0.27	0.2840	1.060	0.038	36	0.096	0.263
DB24	Subbasin	0.2360	151.0	0.12	0.1420	0.530	0.019	75	0.162	0.629
DB25	Subbasin	0.0239	15.3	0.27	0.2840	1.060	0.038	36	0.105	0.269
DB25a	Subbasin	0.0332	21.3	0.37	0.3550	1.325	0.048	12	0.031	0.174
R16	Subbasin	0.1571	100.5	0.21	0.2130	0.795	0.029	51	0.076	0.479
R14a	Subbasin	0.0410	26.3	0.12	0.1420	0.530	0.019	75	0.038	0.484
R15d	Split Subbasin	0.1530	97.9	0.41	0.4023	1.502	0.054	3	0.203	0.246
R13	Subbasin	0.0428	27.4	0.41	0.4023	1.502	0.054	2	0.179	0.208
R14	Subbasin	0.0598	38.3	0.40	0.4023	1.502	0.054	2	0.963	0.219
R5	Subbasin	0.0843	54.0	0.38	0.3787	1.414	0.051	9	0.381	0.201
LEACH CREEK BASIN - PROPOSED CONDITIONS - JUNE 2012										
L11b	Subbasin	7.4130	4744.3	0.41	0.4023	1.502	0.054	2	1.654	0.451
L11au	Subbasin	1.0148	649.5	0.41	0.4023	1.502	0.054	2	1.149	0.335
L11ad	Subbasin	0.0230	14.7	0.35	0.3550	1.325	0.048	15	0.032	0.170
L10u	Subbasin	0.4357	278.9	0.41	0.4023	1.502	0.054	3	0.426	0.288
L10d1	Split Subbasin	0.0836	53.5	0.41	0.4023	1.502	0.054	3	0.158	0.225
L10d	Split Subbasin	0.5052	323.3	0.38	0.3787	1.414	0.051	8	1.308	0.268
L9.1u	Revised Subbasin	2.3743	1519.6	0.41	0.4023	1.502	0.054	2	1.436	0.377
R17	Revised Subbasin	0.1230	78.7	0.30	0.3077	1.148	0.041	27	0.097	0.274
R15u	Split Subbasin	0.1666	106.6	0.26	0.2840	1.060	0.038	37	0.177	0.372
L9.1d	Revised Subbasin	0.2968	189.9	0.06	0.0710	0.265	0.010	95	0.193	0.699
L9	Subbasin	0.1646	105.4	0.39	0.3787	1.414	0.051	6	0.774	0.232
CORCORAN BASIN - PROPOSED CONDITIONS - JUNE 2012										
C3	Subbasin	0.5779	369.8	0.41	0.4023	1.502	0.054	3	0.669	0.301
INDIAN WASH BASIN - PROPOSED CONDITIONS - JUNE 2012										
I5	Subbasin	0.7994	511.6	0.41	0.4023	1.502	0.054	2	0.439	0.323
I4	Subbasin	1.2130	776.3	0.41	0.4023	1.502	0.054	2	1.184	0.344
I3	Subbasin	3.2056	2051.6	0.41	0.4023	1.502	0.054	2	1.649	0.398
I2	Subbasin	0.9728	622.6	0.41	0.4023	1.502	0.054	3	1.460	0.325
I1	Subbasin	0.7563	484.0	0.41	0.4023	1.502	0.054	3	1.890	0.311
I7	Subbasin	1.0258	656.5	0.41	0.4023	1.502	0.054	2	1.348	0.333
I6	Subbasin	0.4513	288.8	0.40	0.4023	1.502	0.054	4	0.553	0.285
I8	Subbasin	0.4147	265.4	0.40	0.4023	1.502	0.054	4	0.503	0.280
I9	Subbasin	0.6808	435.7	0.41	0.4023	1.502	0.054	2	1.197	0.315

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

SOIL DATA INPUT - PROPOSED CONDITIONS - MAY 2012

Soil Hydraulic Conductivity Values from Table 706 $XKSAT = \text{alog}\ (SA_i \log XKSAT_i / A_T)$

A = 1.20
B = 0.25
C = 0.06
D = 0.04

Basin	Area (ac)	Hydrological Soil Group A (%)	Sub Area (ac)	B (%)	Sub Area (ac)	C (%)	Sub Area (ac)	D (%)	Sub Area (ac)	XKSAT (in./hr)	DTHETA Dry	DTHETA Normal	PSIF (in)
RANCHMAN'S DITCH BASIN													
DB21	100.48	0	0.00	0	0.00	0	0.00	100	100.48	0.040	0.25	0.15	9.50
DB21a1	44.79	0	0.00	0	0.00	0	0.00	100	44.79	0.040	0.25	0.15	9.50
DB21a2	49.91	0	0.00	0	0.00	0	0.00	100	49.91	0.040	0.25	0.15	9.50
DB21a	150.17	0	0.00	0	0.00	0	0.00	100	150.17	0.040	0.25	0.15	9.50
DB23b	37.18	0	0.00	0	0.00	0	0.00	100	37.18	0.040	0.25	0.15	9.50
DB23c	52.60	0	0.00	0	0.00	0	0.00	100	52.60	0.040	0.25	0.15	9.50
DB23d	12.02	0	0.00	0	0.00	0	0.00	100	12.02	0.040	0.25	0.15	9.50
DB23e	48.85	0	0.00	0	0.00	0	0.00	100	48.85	0.040	0.25	0.15	9.50
DB23a	14.22	0	0.00	0	0.00	0	0.00	100	14.22	0.040	0.25	0.15	9.50
DB22	36.07	0	0.00	0	0.00	0	0.00	100	36.07	0.040	0.25	0.15	9.50
DB22a	100.14	0	0.00	0	0.00	0	0.00	100	100.14	0.040	0.25	0.15	9.50
DB24a	13.38	0	0.00	0	0.00	0	0.00	100	13.38	0.040	0.25	0.15	9.50
DB24	151.02	0	0.00	0	0.00	0	0.00	100	151.02	0.040	0.25	0.15	9.50
DB25	15.29	0	0.00	0	0.00	0	0.00	100	15.29	0.040	0.25	0.15	9.50
DB25a	21.25	0	0.00	0	0.00	0	0.00	100	21.25	0.040	0.25	0.15	9.50
R16	100.52	0	0.00	0	0.00	0	0.00	100	100.52	0.040	0.25	0.15	9.50
R14a	26.26	0	0.00	0	0.00	0	0.00	100	26.26	0.040	0.25	0.15	9.50
R15d	97.93	0	0.00	0	0.00	0	0.00	100	97.93	0.040	0.25	0.15	9.50
R13	27.41	0	0.00	0	0.00	0	0.00	100	27.41	0.040	0.25	0.15	9.50
R14	38.29	0	0.00	0	0.00	0	0.00	100	38.29	0.040	0.25	0.15	9.50
R5	53.95	0	0.00	0	0.00	0	0.00	100	53.95	0.040	0.25	0.15	9.50
LEACH CREEK BASIN													
L11b	4744.32	0	0.00	0	0.00	0	0.00	100	4744.32	0.040	0.25	0.15	9.50
L11au	649.47	0	0.00	0	0.00	0	0.00	100	649.47	0.040	0.25	0.15	9.50
L11ad	14.73	0	0.00	0	0.00	0	0.00	100	14.73	0.040	0.25	0.15	9.50
L10u	278.87	0	0.00	0	0.00	0	0.00	100	278.87	0.040	0.25	0.15	9.50
L10d1	56.32	0	0.00	0	0.00	0	0.00	100	56.32	0.040	0.25	0.15	9.50
L10d	317.03	0	0.00	0	0.00	0	0.00	100	317.03	0.040	0.25	0.15	9.50
L9.1u	1519.55	0	0.00	0	0.00	0	0.00	100	1519.55	0.040	0.25	0.15	9.50
R17	78.73	0	0.00	0	0.00	0	0.00	100	78.73	0.040	0.25	0.15	9.50
R15u	106.60	0	0.00	0	0.00	0	0.00	100	106.60	0.040	0.25	0.15	9.50
L9.1d	189.92	0	0.00	0	0.00	0	0.00	100	189.92	0.040	0.25	0.15	9.50
L9	105.37	0	0.00	0	0.00	0	0.00	100	105.37	0.040	0.25	0.15	9.50
CORCORAN BASIN													
C3	369.84	0	0.00	0	0.00	0	0.00	100	369.84	0.040	0.25	0.15	9.50
INDIAN WASH BASIN													
I5	511.60	0	0.00	0	0.00	0	0.00	100	511.60	0.040	0.25	0.15	9.50
I4	776.30	0	0.00	0	0.00	0	0.00	100	776.30	0.040	0.25	0.15	9.50
I3	2051.60	0	0.00	0	0.00	0	0.00	100	2051.60	0.040	0.25	0.15	9.50
I2	622.60	0	0.00	0	0.00	0	0.00	100	622.60	0.040	0.25	0.15	9.50
I1	484.00	0	0.00	0	0.00	0	0.00	100	484.00	0.040	0.25	0.25	9.50
I7	656.50	0	0.00	0	0.00	0	0.00	100	656.50	0.040	0.25	0.15	9.50
I6	288.80	0	0.00	0	0.00	0	0.00	100	288.80	0.040	0.25	0.20	9.50
I8	265.40	0	0.00	0	0.00	0	0.00	100	265.40	0.040	0.25	0.15	9.50
I9	435.70	0	0.00	0	0.00	0	0.00	100	435.70	0.040	0.25	0.15	9.50

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

SOIL DATA INPUT - PROPOSED CONDITIONS - MAY 2012

Surface Retention Loss Values from Table 705

Natural - Desert flat slopes = 0.35

Natural - Desert Hillslopes = 0.15

Developed - Pavement = 0.05

$IA_w = SIA_i/A_T$

$RTIMP = SRTIMP*A_i/A_T$

RTIMP PAVE = 100 %

RTIMP UNDEVELOPED = 2 %

Basin	Natural Flat (ac)	Area (%)	Natural Hill (ac)	Area (%)	Developed (ac)	Area (%)	IA_w (in)	RTIMP (%)	DTHETA Avg	VC (%)	Corr Factor	Adjusted XKSAT (in./hr)
RANCHMAN'S DITCH BASIN												
DB21	0.00	0	99.35	99	1.13	1	0.15	3	0.25	50	1.4	0.058
DB21a1	0.00	0	42.99	96	1.77	4	0.15	6	0.25	50	1.4	0.058
DB21a2	16.97	34	32.29	65	0.65	1	0.22	3	0.25	50	1.4	0.058
DB21a	66.07	44	67.57	45	16.59	11	0.23	13	0.24	50	1.4	0.058
DB23b	2.00	5	0.00	0	35.18	95	0.07	95	0.15	50	1.4	0.058
DB23c	2.64	5	0.00	0	49.96	95	0.07	95	0.16	50	1.4	0.058
DB23d	0.00	0	0.00	0	12.02	100	0.05	100	0.15	50	1.4	0.058
DB23e	0.00	0	0.00	0	48.85	100	0.05	100	0.15	50	1.4	0.058
DB23a	13.09	92	0.00	0	1.13	8	0.33	10	0.24	50	1.4	0.058
DB22	10.10	28	24.89	69	1.08	3	0.20	5	0.25	50	1.4	0.058
DB22a	40.06	40	51.07	51	9.01	9	0.22	11	0.24	50	1.4	0.058
DB24a	8.70	65	0.00	0	4.68	35	0.24	36	0.22	50	1.4	0.058
DB24	37.76	25	0.00	0	113.26	75	0.13	75	0.18	50	1.4	0.058
DB25	9.94	65	0.00	0	5.35	35	0.24	36	0.22	50	1.4	0.058
DB25a	19.13	90	0.00	0	2.12	10	0.32	12	0.24	50	1.4	0.058
R16	50.26	50	0.00	0	50.26	50	0.20	51	0.20	50	1.4	0.058
R14a	6.57	25	0.00	0	19.69	75	0.13	75	0.18	50	1.4	0.058
R15d	96.95	99	0.00	0	0.98	1	0.35	3	0.25	50	1.4	0.058
R13	27.41	100	0.00	0	0.00	0	0.35	2	0.25	50	1.4	0.058
R14	38.29	100	0.00	0	0.00	0	0.35	2	0.25	50	1.4	0.058
R5	50.00	93	0.00	0	3.95	7	0.33	9	0.24	50	1.4	0.058
LEACH CREEK BASIN												
L11b	0.00	0	4744.32	100	0.00	0	0.15	2	0.25	50	1.4	0.058
L11au	194.84	30	454.63	70	0.00	0	0.21	2	0.25	50	1.4	0.058
L11ad	12.73	86	0.00	0	2.00	14	0.31	15	0.24	50	1.4	0.058
L10u	11.15	4	264.93	95	2.79	1	0.16	3	0.25	50	1.4	0.058
L10d1	6.76	12	49.00	87	0.56	1	0.17	3	0.25	50	1.4	0.058
L10d	288.50	91	9.51	3	19.02	6	0.33	8	0.24	50	1.4	0.058
L9.1u	0.00	0	1514.63	100	4.92	0	0.15	2	0.25	50	1.4	0.058
R17	58.26	74	0.00	0	20.47	26	0.27	27	0.22	50	1.4	0.058
R15u	68.00	64	0.00	0	38.60	36	0.24	37	0.21	51	1.4	0.056
L9.1d	9.00	5	0.00	0	180.01	95	0.06	95	0.16	50	1.4	0.058
L9	100.55	95	0.00	0	4.82	5	0.34	6	0.25	50	1.4	0.058
CORCORAN BASIN												
C3	266.28	72	100.00	27	3.56	1	0.29	3	0.25	50	1.4	0.058
INDIAN WASH BASIN												
I5	51.00	10	460.62	90	-0.02	0	0.17	2	0.25	50	1.4	0.058
I4	566.32	73	210.00	27	-0.02	0	0.30	2	0.25	50	1.4	0.058
I3	731.65	36	1320.00	64	-0.05	0	0.22	2	0.25	50	1.4	0.058
I2	616.59	99	0.00	0	6.01	1	0.35	3	0.25	50	1.4	0.058
I1	477.81	99	0.00	0	6.19	1	0.35	3	0.25	50	1.4	0.058
I7	654.66	100	0.00	0	1.84	0	0.35	2	0.25	50	1.4	0.058
I6	283.77	98	0.00	0	5.03	2	0.34	4	0.25	50	1.4	0.058
I8	234.51	88	26.00	10	4.89	2	0.32	4	0.25	50	1.4	0.058
I9	400.71	92	35.00	8	-0.01	0	0.33	2	0.25	50	1.4	0.058

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

SOIL DATA INPUT - PROPOSED CONDITIONS - MAY 2012

SCS Runoff Curve Number Method

	A	B	C	D	
CN Pave	98	98	98	98	IA = 0.2*[(1000/CN)-10]
CN UNDEVEL	48	67	77	83	

									From Table A1 - Table of Correspondence			
Basin	CN A	CN B	CN C	CN D	Comp CN	CB/ICON CN	CB/ICON IA	Initial Loss (in) IA	Vol Moist Deficit DTHETA	Wetting Front Suction (in) PSIF	Hydra Conduct (in/hr) XKSAT	Percent Imp (%) RTIMP
RANCHMAN'S DITCH BASIN												
DB21	0	0	0	77	77.2	87.0	0.30	0.59	0.5444	2.032	0.073	3
DB21a1	0	0	0	78	77.8			0.57	0.5207	1.944	0.070	6
DB21a2	0	0	0	77	77.2			0.59	0.5444	2.032	0.073	3
DB21a	0	0	0	79	79.3			0.52	0.4970	1.855	0.067	13
DB23b	0	0	0	97	96.9	79.1	0.53	0.06	0.0710	0.265	0.010	95
DB23c	0	0	0	97	97.0	79.1	0.53	0.06	0.0710	0.265	0.010	95
DB23d	0	0	0	98	98.0	79.1	0.53	0.04	0.0473	0.177	0.006	100
DB23e	0	0	0	98	98.0	79.1	0.53	0.04	0.0473	0.177	0.006	100
DB23a	0	0	0	79	78.7	77.2	0.59	0.54	0.4970	1.855	0.067	10
DB22	0	0	0	78	77.6			0.58	0.5207	1.944	0.070	5
DB22a	0	0	0	79	78.9			0.54	0.4970	1.855	0.067	11
DB24a	0	0	0	84	84.4	79.1	0.53	0.37	0.3787	1.414	0.051	36
DB24	0	0	0	93	92.8	82.0	0.44	0.16	0.1657	0.618	0.022	75
DB25	0	0	0	84	84.4	79.1	0.53	0.37	0.3787	1.414	0.051	36
DB25a	0	0	0	79	79.1	78.4	0.55	0.53	0.4970	1.855	0.067	12
R16	0	0	0	88	87.5	74.9	0.67	0.29	0.2840	1.060	0.038	51
R14a	0	0	0	93	92.8	76.9	0.60	0.16	0.1657	0.618	0.022	75
R15d	0	0	0	77	77.2			0.59	0.5444	2.032	0.073	3
R13	0	0	0	77	77.0	76.9	0.60	0.60	0.5444	2.032	0.073	2
R14	0	0	0	77	77.0	82.0	0.44	0.59	0.5444	2.032	0.073	2
R5	0	0	0	78	78.5			0.55	0.5207	1.944	0.070	9
LEACH CREEK BASIN												
L11b	0	0	0	77	77.0	83.3	0.40	0.60	0.5444	2.032	0.073	2
L11au	0	0	0	77	77.0	83.3	0.40	0.60	0.5444	2.032	0.073	2
L11ad	0	0	0	80	79.9	83.3	0.40	0.50	0.4734	1.767	0.063	15
L10u	0	0	0	77	77.2	82.0	0.44	0.59	0.5444	2.032	0.073	3
L10d1	0	0	0	77	77.2			0.59	0.5444	2.032	0.073	3
L10d	0	0	0	78	78.3			0.56	0.5207	1.944	0.070	8
L9.1u	0	0	0	77	77.0			0.60	0.5444	2.032	0.073	2
R17	0	0	0	82	82.5			0.43	0.4260	1.590	0.057	27
R15u	0	0	0	85	84.6			0.37	0.3550	1.325	0.048	37
L9.1d	0	0	0	97	97.0			0.06	0.0710	0.265	0.010	95
L9	0	0	0	78	78.1	69.0	0.90	0.56	0.5207	1.944	0.070	6
CORCORAN BASIN												
C3	0	0	0	77	77.2			0.59	0.5444	2.032	0.073	3
INDIAN WASH BASIN												
I5	0	0	0	77	77.0			0.60	0.5444	2.032	0.073	2
I4	0	0	0	77	77.0			0.60	0.5444	2.032	0.073	2
I3	0	0	0	77	77.0			0.60	0.5444	2.032	0.073	2
I2	0	0	0	77	77.2			0.59	0.5444	2.032	0.073	3
I1	0	0	0	77	77.2			0.59	0.5444	2.032	0.073	3
I7	0	0	0	77	77.0			0.60	0.5444	2.032	0.073	2
I6	0	0	0	77	77.4			0.58	0.5444	2.032	0.073	4
I8	0	0	0	77	77.4			0.58	0.5444	2.032	0.073	4
I9	0	0	0	77	77.0			0.60	0.5444	2.032	0.073	2

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

Snyder's Method Input

Basin	L (lf)	L (mi)	L_{ca} (lf)	L_{ca} (mi)	C_t	SUH Method $T_{lag} = C_t (LxL_{ca})^{0.3}$ (hrs)	$T_d = T_{lag}/5.5$ (hrs)	T_{da} (hrs)	$T_{pr} = T_{lag} + 0.25(T_{da} - T_d)$ (hrs)
RANCHMAN'S DITCH BASIN - PROPOSED CONDITIONS - MAY 2012									
DB21	3333	0.6313	1163	0.2203	2.0	**1.107**	0.201	0.1667	1.098
DB21a1	1979	0.3748	739	0.1400	2.0	**0.826**	0.150	0.1667	0.830
DB21a2	1678	0.3178	559	0.1059	2.0	**0.723**	0.131	0.1667	0.732
DB21a	3588	0.6795	1878	0.3557	2.0	**1.306**	0.237	0.1667	1.289
DB23b	1894	0.3587	699	0.1324	2.0	**0.802**	0.146	0.1667	0.807
DB23c	3142	0.5951	1246	0.2360	2.0	**1.110**	0.202	0.1667	1.101
DB23d	831	0.1574	416	0.0788	2.0	**0.536**	0.097	0.1667	0.553
DB23e	2691	0.5097	1077	0.2040	2.0	**1.014**	0.184	0.1667	1.010
DB23a	1345	0.2547	558	0.1057	2.0	**0.676**	0.123	0.1667	0.687
DB22	1454	0.2754	463	0.0877	2.0	**0.654**	0.119	0.1667	0.666
DB22a	3016	0.5712	1507	0.2854	2.0	**1.161**	0.211	0.1667	1.150
DB24a	2433	0.4608	1173	0.2222	2.0	**1.009**	0.184	0.1667	1.005
DB24	5727	1.0847	2695	0.5104	2.0	**1.675**	0.305	0.1667	1.640
DB25	2746	0.5201	1325	0.2509	2.0	**1.086**	0.197	0.1667	1.078
DB25a	528	0.1000	408	0.0773	2.0	**0.465**	0.085	0.1667	0.486
R16	2128	0.4030	1121	0.2123	2.0	**0.957**	0.174	0.1667	0.955
R14a	1475	0.2794	578	0.1095	2.0	**0.703**	0.128	0.1667	0.712
R15d	1862	0.3527	1445	0.2737	2.0	**0.992**	0.180	1.1667	1.238
R13	994	0.1883	325	0.0616	2.0	**0.525**	0.095	0.1667	0.543
R14	6879	1.3028	2745	0.5199	2.0	**1.779**	0.324	0.1667	1.740
R5	2152	0.4076	1021	0.1934	2.0	**0.933**	0.170	0.1667	0.933
LEACH CREEK BASIN - PROPOSED CONDITIONS - MAY 2012									
L11b	29585	5.6032	15656	2.9652	2.0	**4.647**	0.845	0.1667	4.477
L11au	9530	1.8049	6329	1.1987	2.0	**2.521**	0.458	0.1667	2.448
L11ad	590	0.1117	350	0.0663	2.0	**0.459**	0.083	0.1667	0.480
L10u	4892	0.9265	3122	0.5913	2.0	**1.670**	0.304	0.1667	1.635
L10d1	2158	0.4087	1162	0.2201	2.0	**0.971**	0.177	0.1667	0.969
L10d	8742	1.6557	3731	0.7066	2.0	**2.096**	0.381	0.1667	2.043
L9.1u	18784	3.5576	8475	1.6051	2.0	**3.373**	0.613	0.1667	3.261
R17	2339	0.4430	1604	0.3038	2.0	**1.096**	0.199	0.1667	1.088
R15u	3648	0.6909	2183	0.4134	2.0	**1.373**	0.250	1.1667	1.603
L9.1d	6168	1.1682	3815	0.7225	2.0	**1.901**	0.346	0.1667	1.856
L9	5635	1.0672	2437	0.4616	2.0	**1.617**	0.294	0.1667	1.585
CORCORAN BASIN - PROPOSED CONDITIONS - MAY 2012									
C3	6679	1.2650	1938	0.3670	2.0	**1.589**	0.289	0.1667	1.558
INDIAN WASH BASIN - PROPOSED CONDITIONS - MAY 2012									
I5	10315	1.9536	5463	1.0347	2.0	**2.470**	0.449	0.1667	2.400
I4	18756	3.5523	10062	1.9057	2.0	**3.550**	0.645	0.1667	3.430
I3	29640	5.6136	15183	2.8756	2.0	**4.607**	0.838	0.1667	4.439
I2	13433	2.5441	4490	0.8504	2.0	**2.521**	0.458	0.1667	2.448
I1	14703	2.7847	5938	1.1246	2.0	**2.817**	0.512	0.1667	2.730
I7	17566	3.3269	8201	1.5532	2.0	**3.273**	0.595	0.1667	3.166
I6	3752	0.7106	1408	0.2667	2.0	**1.214**	0.221	0.1667	1.201
I8	5875	1.1127	2482	0.4701	2.0	**1.647**	0.299	0.1667	1.613
I9	10747	2.0354	4658	0.8822	2.0	**2.384**	0.433	0.1667	2.317

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

Snyder's Method Input

Basin	From CB/ICON			Imp (%)	Delta Y (ft)	S (ft/ft)	Fig. 2 S- Corr (ft/ft)	C_t	**CUHP 2005 Equation $T_{lag} = C_t (LxL_{ca}/S^{0.5})^{0.48}$ (hrs)**	P	A (mi^2)	$C_p = PC_tA^{0.15}$
	Imp (%)	T_{lag} (hrs)	C_p									
RANCHMAN'S DITCH BASIN - PROPOSED CONDITIONS - MAY 2012												
DB21	1	0.1710	0.2580	3	110	0.033	0.033	0.1515	**0.1332**	2.1464	0.1519	0.2451
DB21a1				6	100	0.051	0.048	0.1412	**0.0711**	2.1740	0.0700	0.2060
DB21a2				3	71	0.042	0.041	0.1508	**0.0637**	2.1470	0.0780	0.2209
DB21a				13	48	0.013	0.013	0.1211	**0.1736**	2.4092	0.2346	0.2346
DB23b	75	0.1860	0.6250	95	30	0.016	0.016	0.0737	**0.0461**	11.3722	0.0581	0.5472
DB23c	73	0.1860	0.6250	95	45	0.014	0.014	0.0737	**0.0800**	11.3921	0.0822	0.5769
DB23d	62	0.1860	0.6250	100	17	0.020	0.020	0.0729	**0.0227**	11.6400	0.0188	0.4675
DB23e	75	0.1860	0.6250	100	40	0.015	0.015	0.0729	**0.0674**	11.6400	0.0763	0.5769
DB23a	1	0.0630	0.1900	10	43	0.032	0.032	0.1266	**0.0510**	2.2782	0.0222	0.1629
DB22				5	64	0.044	0.043	0.1447	**0.0515**	2.1605	0.0564	0.2030
DB22a				11	44	0.015	0.015	0.1245	**0.1428**	2.3169	0.1565	0.2183
DB24a	20	0.1500	0.1800	36	25	0.010	0.010	0.0950	**0.0961**	4.9533	0.0209	0.2634
DB24	58	0.1800	0.6230	75	85	0.015	0.015	0.0783	**0.1616**	9.9667	0.2360	0.6287
DB25	20	0.1510	0.1830	36	30	0.011	0.011	0.0950	**0.1055**	4.9559	0.0239	0.2688
DB25a	1	0.0660	0.2040	12	10	0.019	0.019	0.1228	**0.0308**	2.3591	0.0332	0.1738
R16	50	0.1190	0.4760	51	27	0.013	0.013	0.0877	**0.0764**	7.2011	0.1571	0.4786
R14a	75	0.1190	0.4790	75	30	0.020	0.020	0.0783	**0.0376**	9.9651	0.0410	0.4835
R15d				3	50	0.027	0.027	0.1519	**0.1177**	2.1460	0.1530	0.2460
R13	1	0.1480	0.2130	2	10	0.010	0.010	0.1556	**0.0553**	2.1458	0.0428	0.2081
R14	5	0.3550	0.2050	2	100	0.015	0.015	0.1556	**0.3536**	2.1458	0.0598	0.2188
R5				9	20	0.009	0.009	0.1290	**0.1180**	2.2561	0.0843	0.2008
LEACH CREEK BASIN - PROPOSED CONDITIONS - MAY 2012												
L11b	0	1.5390	0.4530	2	2316	0.078	0.056	0.1556	**1.1974**	2.1458	7.4130	0.4509
L11au	0	0.7470	0.3350	2	115	0.012	0.012	0.1556	**0.6514**	2.1458	1.0148	0.3346
L11ad	0	0.0890	0.1820	15	7	0.012	0.012	0.1171	**0.0321**	2.5503	0.0230	0.1696
L10u				3	186	0.038	0.022	0.1519	**0.2845**	2.1460	0.4357	0.2879
L10d1				3	123	0.057	0.050	0.1520	**0.0982**	2.1460	0.0836	0.2247
L10d				8	110	0.013	0.013	0.1338	**0.4090**	2.2176	0.5052	0.2678
L9.1u				2	410	0.022	0.022	0.1544	**0.8906**	2.1453	2.3743	0.3771
R17				27	51	0.022	0.022	0.1018	**0.0972**	3.6804	0.1230	0.2736
R15u				37	22	0.006	0.006	0.0944	**0.1765**	5.1529	0.1666	0.3716
L9.1d				95	83	0.013	0.013	0.0737	**0.1927**	11.3804	0.2968	0.6991
L9	8	0.3400	0.2380	6	85	0.015	0.015	0.1389	**0.2710**	2.1852	0.1646	0.2316
CORCORAN BASIN - PROPOSED CONDITIONS - MAY 2012												
C3				3	190	0.028	0.028	0.1521	**0.2482**	2.1459	0.5779	0.3006
INDIAN WASH BASIN - PROPOSED CONDITIONS - MAY 2012												
I5				2	1625	0.158	0.060	0.1556	**0.4285**	2.1458	0.7994	0.3228
I4				2	1850	0.099	0.059	0.1556	**0.7685**	2.1458	1.2130	0.3437
I3				2	2230	0.075	0.056	0.1556	**1.1810**	2.1458	3.2056	0.3976
I2				3	320	0.024	0.024	0.1521	**0.5391**	2.1459	0.9728	0.3250
I1				3	250	0.017	0.017	0.1509	**0.6941**	2.1469	0.7563	0.3107
I7				2	460	0.026	0.026	0.1546	**0.8164**	2.1454	1.0258	0.3329
I6				4	50	0.013	0.013	0.1492	**0.1905**	2.1492	0.4513	0.2847
I8				4	230	0.039	0.039	0.1489	**0.2376**	2.1498	0.4147	0.2805
I9				2	245	0.023	0.023	0.1556	**0.5096**	2.1458	0.6808	0.3152

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

Grand Junction= SCS Unit Hydrograph Method - Greater than 1 SQ MILE

Basin	K_n (Table 705)	L (mi)	L_c (mi)	S (ft/mi)	$T_{lag} = 22.1\ K_n\ (L*L_c/S^{0.5})^{0.33}$ (hr)
RANCHMAN'S DITCH BASIN - PROPOSED CONDITIONS - MAY 2012					
DB21	0.080	0.6313	0.2203	174.3	**0.3935**
DB21a1	0.080	0.3748	0.1400	266.8	**0.2659**
DB21a2	0.080	0.3178	0.1059	223.4	**0.2365**
DB21a	0.080	0.6795	0.3557	70.6	**0.5481**
DB23b	0.050	0.3587	0.1324	83.6	**0.1947**
DB23c	0.050	0.5951	0.2360	75.6	**0.2832**
DB23d	0.050	0.1574	0.0788	108.0	**0.1199**
DB23e	0.050	0.5097	0.2040	78.5	**0.2549**
DB23a	0.080	0.2547	0.1057	168.8	**0.2301**
DB22	0.080	0.2754	0.0877	232.4	**0.2106**
DB22a	0.080	0.5712	0.2854	77.0	**0.4745**
DB24a	0.050	0.4608	0.2222	54.3	**0.2695**
DB24	0.050	1.0847	0.5104	78.4	**0.4427**
DB25	0.050	0.5201	0.2509	57.7	**0.2890**
DB25a	0.080	0.1000	0.0773	100.0	**0.1662**
R16	0.050	0.4030	0.2123	67.0	**0.2453**
R14a	0.050	0.2794	0.1095	107.4	**0.1616**
R15d	0.080	0.3527	0.2737	141.8	**0.3609**
R13	0.080	0.1883	0.0616	53.1	**0.2108**
R14	0.080	1.3028	0.5199	76.8	**0.7596**
R5	0.080	0.4076	0.1934	49.1	**0.4021**
LEACH CREEK BASIN - PROPOSED CONDITIONS - MAY 2012					
L11b	0.080	5.6032	2.9652	413.3	**1.6541**
L11au	0.080	1.8049	1.1987	63.7	**1.1492**
L11ad	0.080	0.1117	0.0663	62.6	**0.1770**
L10u	0.080	0.9265	0.5913	200.8	**0.6044**
L10d1	0.080	0.4087	0.2201	300.9	**0.3114**
L10d	0.080	1.6557	0.7066	66.4	**0.9317**
L9.1u	0.080	3.5576	1.6051	115.2	**1.4355**
R17	0.050	0.4430	0.3038	115.1	**0.2605**
R15u	0.050	0.6909	0.4134	31.8	**0.4129**
L9.1d	0.050	1.1682	0.7225	71.1	**0.5171**
L9	0.080	1.0672	0.4616	79.6	**0.6797**
CORCORAN BASIN - PROPOSED CONDITIONS - MAY 2012					
C3	0.080	1.2650	0.3670	150.2	**0.6003**
INDIAN WASH BASIN - PROPOSED CONDITIONS - MAY 2012					
I5	0.080	1.9536	1.0347	831.8	**0.7354**
I4	0.080	3.5523	1.9057	520.8	**1.1839**
I3	0.080	5.6136	2.8756	397.2	**1.6492**
I2	0.080	2.5441	0.8504	125.8	**1.0272**
I1	0.080	2.7847	1.1246	89.8	**1.2269**
I7	0.080	3.3269	1.5532	138.3	**1.3479**
I6	0.080	0.7106	0.2667	70.4	**0.5061**
I8	0.080	1.1127	0.4701	206.7	**0.5923**
I9	0.080	2.0354	0.8822	120.4	**0.9729**

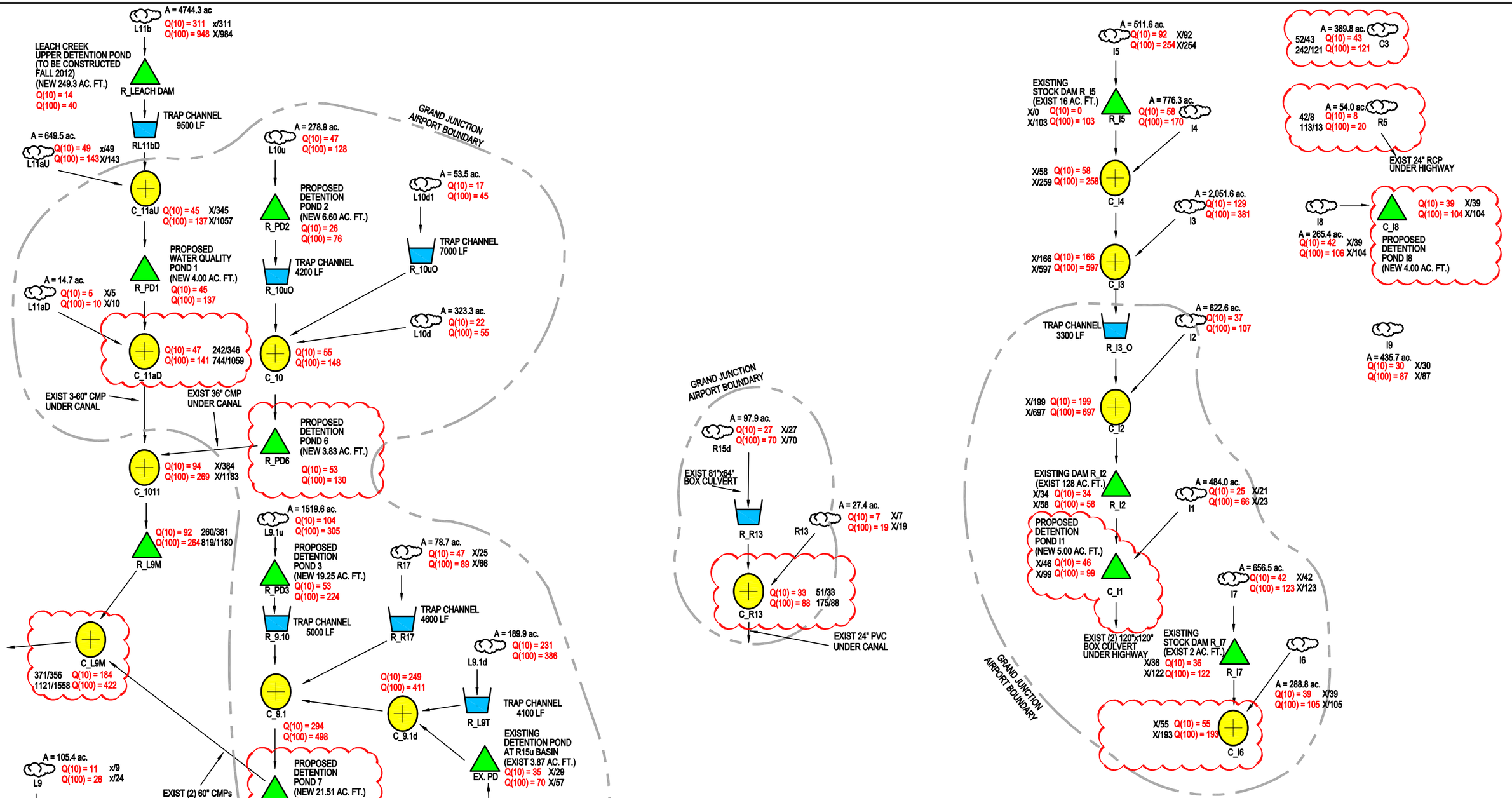
GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE

Grand Junction= SCS Unit Hydrograph Method - Less than 1 SQ MILE

Basin	Comp CN	K (0.0132 CN-.039)	S % (ft/ft)	$t_i=(1.8\ (1.1-K)*L_o^{1/2}/S^{1/3}$ (min) * L_o = 300 ft	V (ft/sec)	V (ft/min)	t_t = L/V (min)	$t_c = t_t + t_i$ (min)	t_c (hr)	**$T_{lag} = 0.6 * t_c$ (hr)**
RANCHMAN'S DITCH BASIN - PROPOSED CONDITIONS - MAY 2012										
DB21	77.2	0.98	3.30	2.51	1.8	109.0	30.6	33.1	0.55	**0.3309**
DB21a1	77.8	0.99	5.05	2.03	2.2	134.9	14.7	16.7	0.28	**0.1670**
DB21a2	77.2	0.98	4.23	2.31	2.1	123.4	13.6	15.9	0.27	**0.1591**
DB21a	79.3	1.01	1.34	2.61	1.2	72.0	49.8	52.4	0.87	**0.5244**
DB23b	96.9	1.24	1.58	3.76	2.5	150.0	12.6	16.4	0.27	**0.1638**
DB23c	97.0	1.24	1.43	3.89	2.4	144.0	21.8	25.7	0.43	**0.2571**
DB23d	98.0	1.25	2.05	3.80	2.8	168.0	4.9	8.7	0.15	**0.0874**
DB23e	98.0	1.25	1.49	4.22	2.5	150.0	17.9	22.2	0.37	**0.2216**
DB23a	78.7	1.00	3.20	2.13	1.8	107.3	12.5	14.7	0.24	**0.1466**
DB22	77.6	0.99	4.40	2.17	2.1	125.9	11.6	13.7	0.23	**0.1372**
DB22a	78.9	1.00	1.46	2.68	1.3	78.0	38.7	41.4	0.69	**0.4135**
DB24a	84.4	1.07	1.03	0.79	2.0	120.0	20.3	21.1	0.35	**0.2107**
DB24	92.8	1.19	1.48	2.33	2.7	162.0	35.4	37.7	0.63	**0.3768**
DB25	84.4	1.07	1.09	0.77	2.0	120.0	22.9	23.7	0.39	**0.2366**
DB25a	79.1	1.01	1.89	2.39	1.4	82.6	6.4	8.8	0.15	**0.0879**
R16	87.5	1.12	1.27	0.46	2.4	144.0	14.8	15.2	0.25	**0.1524**
R14a	92.8	1.19	2.03	2.10	2.8	168.0	8.8	10.9	0.18	**0.1088**
R15d	77.2	0.98	2.69	2.69	1.6	96.0	19.4	22.1	0.37	**0.2208**
R13	77.0	0.98	1.01	3.81	1.0	60.2	16.5	20.3	0.34	**0.2033**
R14	77.0	0.98	1.45	3.37	1.2	72.3	95.1	98.5	1.64	**0.9846**
R5	78.5	1.00	0.93	3.30	1.0	57.8	37.2	40.5	0.68	**0.4050**
LEACH CREEK BASIN - PROPOSED CONDITIONS - MAY 2012										
L11b	77.0	0.98	7.83	1.93	2.8	167.9	176.2	178.2	2.97	**1.7816**
L11au	77.0	0.98	1.21	3.59	1.1	65.9	144.6	148.2	2.47	**1.4818**
L11ad	79.9	1.02	1.19	2.47	1.2	72.0	8.2	10.7	0.18	**0.1066**
L10u	77.2	0.98	3.80	2.39	1.9	117.0	41.8	44.2	0.74	**0.4421**
L10d1	77.2	0.98	5.70	2.09	2.4	143.2	15.1	17.2	0.29	**0.1716**
L10d	78.3	0.99	1.26	3.06	1.1	67.3	129.9	132.9	2.22	**1.3295**
L9.1u	77.0	0.98	2.18	2.95	1.5	88.6	211.9	214.9	3.58	**2.1485**
R17	82.5	1.05	2.18	1.21	2.4	144.0	16.2	17.5	0.29	**0.1746**
R15u	84.6	1.08	0.60	0.84	1.6	96.0	38.0	38.8	0.65	**0.3884**
L9.1d	97.0	1.24	1.35	3.97	2.3	138.0	44.7	48.7	0.81	**0.4867**
L9	78.1	0.99	1.51	2.96	1.2	73.7	76.5	79.4	1.32	**0.7942**
CORCORAN BASIN - PROPOSED CONDITIONS - MAY 2012										
C3	77.2	0.98	2.84	2.64	1.7	101.2	66.0	68.6	1.14	**0.6864**
INDIAN WASH BASIN - PROPOSED CONDITIONS - MAY 2012										
I5	77.0	0.98	15.75	1.52	4.0	238.1	43.3	44.8	0.75	**0.4484**
I4	77.0	0.98	9.86	1.78	3.1	188.4	99.5	101.3	1.69	**1.0132**
I3	77.0	0.98	7.52	1.95	2.7	164.6	180.1	182.1	3.03	**1.8205**
I2	77.2	0.98	2.38	2.80	1.5	92.6	145.1	147.9	2.46	**1.4785**
I1	77.2	0.98	1.70	3.13	1.3	78.2	187.9	191.1	3.18	**1.9106**
I7	77.0	0.98	2.62	2.77	1.6	97.1	180.9	183.7	3.06	**1.8369**
I6	77.4	0.98	1.33	3.32	1.2	69.3	54.2	57.5	0.96	**0.5749**
I8	77.4	0.98	3.91	2.32	2.0	118.7	49.5	51.8	0.86	**0.5180**
I9	77.0	0.98	2.28	2.90	1.5	90.6	118.6	121.5	2.03	**1.2153**

APPENDIX E – HYDRAULIC CALCULATIONS

Graphical HEC-1 Connectivity Diagrams
HEC-1 Model 10-yr Existing Conditions
HEC-1 Model 100-yr Existing Conditions
HEC-1 Model 10-yr Proposed Conditions
HEC-1 Model 100-yr Proposed Conditions
Pond Design

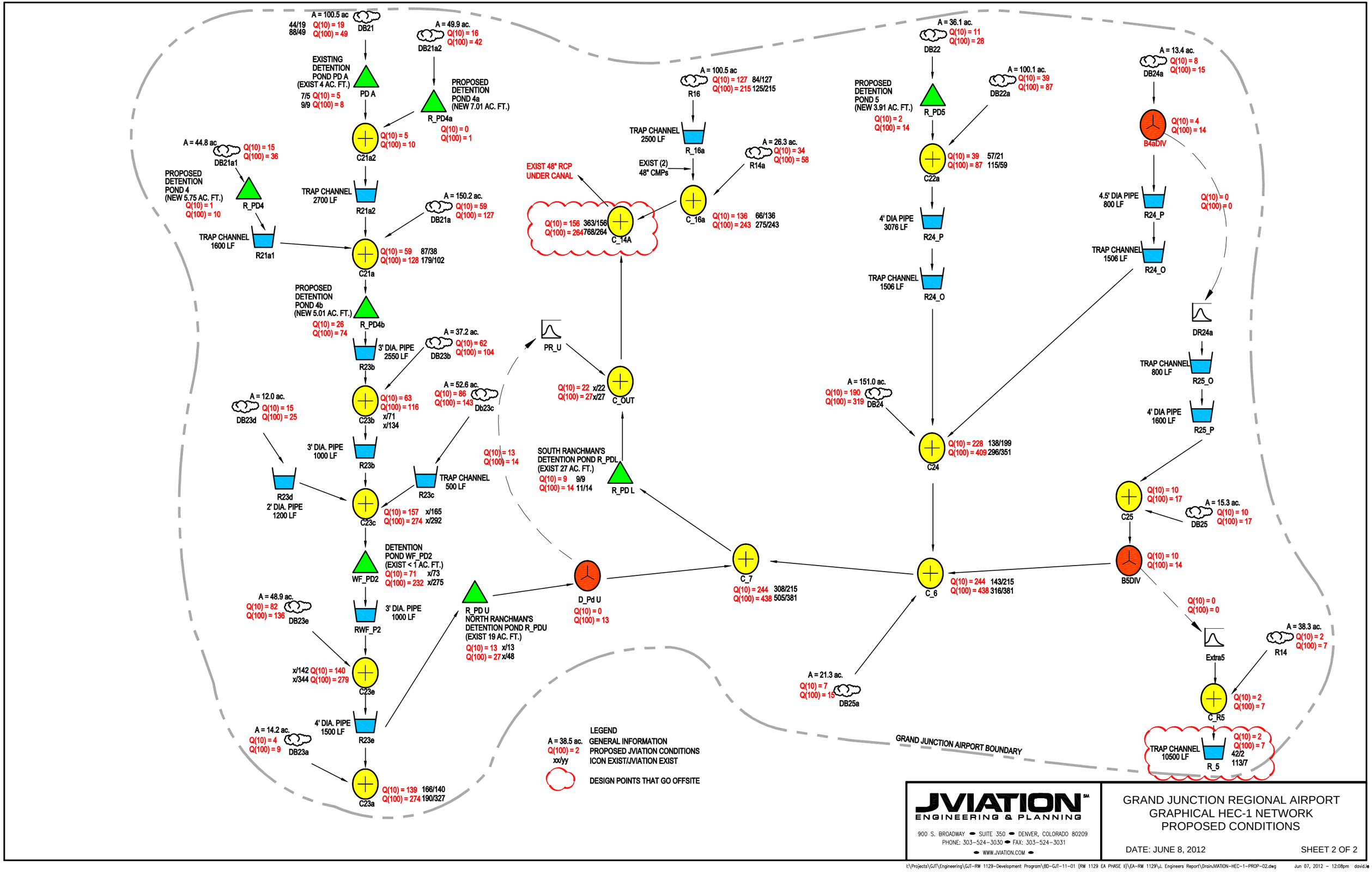


JVIATION SM
ENGINEERING & PLANNING
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

GRAND JUNCTION REGIONAL AIRPORT
GRAPHICAL HEC-1 NETWORK
PROPOSED CONDITIONS

DATE: JUNE 8, 2012

I:\Projects\GJT\Engineering\GJT-RW 1129-Development Program\BD-GJT-11-01 (RW 1129 EA PHASE II)\EA-RW 1129\J. Engineers Report\DrainJVIATION-HEC-1-PROP-01.dwg Jun 08, 2012 - 9:01am david.le



JVIATION SM
ENGINEERING & PLANNING
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

GRAND JUNCTION REGIONAL AIRPORT
GRAPHICAL HEC-1 NETWORK
PROPOSED CONDITIONS

DATE: JUNE 8, 2012

I:\Projects\GJT\Engineering\GJT-RW 1129-Development Program\BD-GJT-11-01 (RW 1129 EA PHASE II)\EA-RW 1129\J. Engineers Report\DrainJVIATION-HEC-1-PROP-02.dwg Jun 07, 2012 - 12:08pm david.le

```
1****************************************
****************************************
 *                                      *                                                *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                *    U.S. ARMY CORPS OF
ENGINEERS     *
 *               JUN   1998             *                                                *    HYDROLOGIC ENGINEERING
CENTER    *
 *            VERSION 4.1               *                                                *          609 SECOND
STREET          *
 *                                      *                                                *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   07JUN12  TIME  10:32:08  *                                                *           (916) 756-1104
        *
 *                                      *                                                *
        *
 ****************************************
****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                         *DIAGRAM
             1           ID        Grand Junction Regional Airport - Jviation - prepared June 2012
             2           ID        Existing Conditions Watershed Model  - All Soils are Type D
             3           ID        10-Year 24-Hour Storm - NRCS Type II Rainfall Distribution
             4           ID    PREC 1.00 for 0.1< area < 5.0 squire miles; use flow under ratio 1
             5           ID    PREC 0.97 for 5.0< area <12.5 square miles; use flow under ratio 2
             6           ID    When I>10, uses CHUP method for Tlag, when I<10, uses Grand Junction SCS Meth
             7           ID        ************************************************************************
 *** FREE ***
             8           IT       5       0       0     500
             9           IO       5       0       0
            10           IN       5       0      07
            11           JR    PREC     1.0    0.97

            12           KK    L11b
            13           KM   Leach Creek at Upper Pond
            14           BA  7.4130
            15           PB    1.19
            16           PC       0   0.001   0.002  0.0031  0.0041  0.0051  0.0062  0.0073  0.0083  0.0094
            17           PC  0.0105  0.0116  0.0127  0.0138   0.015  0.0161  0.0173  0.0185  0.0196  0.0208
            18           PC   0.022  0.0232  0.0244  0.0257  0.0269  0.0281  0.0294  0.0307  0.0319  0.0332
            19           PC  0.0345  0.0358  0.0371  0.0384  0.0398  0.0411  0.0425  0.0438  0.0452  0.0466
            20           PC   0.048  0.0494  0.0508  0.0523  0.0538  0.0553  0.0568  0.0583  0.0598  0.0614
            21           PC   0.063  0.0646  0.0662  0.0679  0.0696  0.0712   0.073  0.0747  0.0764  0.0782
            22           PC    0.08  0.0818  0.0836  0.0855  0.0874  0.0892  0.0912  0.0931   0.095   0.097
            23           PC   0.099   0.101   0.103  0.1051  0.1072  0.1093  0.1114  0.1135  0.1156  0.1178
            24           PC    0.12  0.1223  0.1246  0.1271  0.1296  0.1323   0.135  0.1379  0.1408  0.1439
            25           PC   0.147  0.1502  0.1534  0.1566  0.1598   0.163  0.1663  0.1697  0.1733  0.1771
            26           PC   0.181  0.1851  0.1895  0.1941  0.1989   0.204  0.2094  0.2152  0.2214   0.228
            27           PC   0.235  0.2427  0.2513  0.2609  0.2715   0.283  0.3068  0.3544  0.4308  0.5679
            28           PC   0.663   0.682  0.6986   0.713  0.7252   0.735  0.7434  0.7514  0.7588  0.7656
            29           PC   0.772   0.778  0.7836   0.789  0.7942   0.799  0.8036   0.808  0.8122  0.8162
            30           PC    0.82  0.8237  0.8273  0.8308  0.8342  0.8376  0.8409  0.8442  0.8474  0.8505
            31           PC  0.8535  0.8565  0.8594  0.8622  0.8649  0.8676  0.8702  0.8728  0.8753  0.8777
            32           PC    0.88  0.8823  0.8846  0.8868   0.889  0.8912  0.8934  0.8955  0.8976  0.8997
            33           PC  0.9018  0.9038  0.9058  0.9078  0.9098  0.9117  0.9136  0.9155  0.9174  0.9192
            34           PC   0.921  0.9228  0.9246  0.9263   0.928  0.9297  0.9314   0.933  0.9346  0.9362
            35           PC  0.9377  0.9393  0.9408  0.9423  0.9438  0.9452  0.9466   0.948  0.9494  0.9507
            36           PC   0.952  0.9533  0.9546  0.9559  0.9572  0.9584  0.9597   0.961  0.9622  0.9635
            37           PC  0.9648   0.966  0.9672  0.9685  0.9697  0.9709  0.9722  0.9734  0.9746  0.9758
            38           PC   0.977  0.9782  0.9794  0.9806  0.9818  0.9829  0.9841  0.9853  0.9864  0.9876
            39           PC  0.9888  0.9899   0.991  0.9922  0.9933  0.9944  0.9956  0.9967  0.9978  0.9989
```

```
 40          PC       1       1       1       1       1       1       1       1       1       1
 41          PC       1       1       1       1       1       1       1       1       1       1
 42          PC       1       1       1       1       1       1       1       1       1       1
 43          PC       1       1       1       1       1       1       1       1       1       1
 44          PC       1       1       1       1       1       1       1       1       1       1
 45          PC       1       1       1       1       1       1       1       1       1       1
 46          LG    0.41  0.4023   1.502   0.054     2.0
 47          US   1.654   0.451
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 48          KK  RL11bDRoute Hydrograph Through L11a
 49          RK    9500  0.0129   0.035       0    TRAP      10       6

 50          KK   L11aU
 51          KM   Subbasin L11aU
 52          BA  1.0148
 53          LG    0.41  0.4023   1.502   0.054     2.0
 54          US   1.149   0.333

 55          KK  C_11aU
 56          KM   Combine Basins L11b and L11au
 57          HC       2

 58          KK   L11aD
 59          KM   Subbasin L11aD
 60          BA  0.0230
 61          LG    0.41  0.4023   1.502   0.054     2.0
 62          US   0.035   0.190

 63          KK  C_11aD
 64          KM   Combine Hydrographs of Basin L11aU and L11aD
 65          HC       2

 66          KK     L10
 67          KM   Subbasin L10
 68          BA  1.0245
 69          LG    0.41  0.4023   1.502   0.054     2.0
 70          US   1.123   0.335

 71          KK    R_10Route Basin L10 to DP C_1011
 72          RK    5000   0.012    0.03       0    TRAP      10       4

 73          KK  C_1011
 74          KM   Combine Hydrographs of Subbasin L10 and L11
 75          HC       2

 76          KK   R_L9M
 77          KM   Route Mainstem Hydrograph Through L9
 78          RS       1    STOR       0
 79          SV       0    1.24    2.23     3.3    4.23    4.86    5.34    6.55    7.57    8.54
 80          SV    9.65   10.61   11.55   12.36   13.09  3000.0
 81          SQ       0     100     200     300     400     500     600     800    1000    1200
 82          SQ    1400    1600    1800    2000    2200    2400

 83          KK     R17
 84          KM   Subbasin R17
 85          BA  0.1230
 86          LG    0.41  0.4023   1.502   0.054     2.0
 87          US   0.169   0.244
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 88          KK   R_R17Route hydrograph through L9.1
 89          RK    4600   0.014    0.03       0    TRAP      10       4

 90          KK    R15u
 91          KM   Subbasin R15 Upper Portion
 92          BA  0.1590
 93          LG    0.33  0.3313   1.237   0.044    37.0
 94          US   0.155   0.274

 95          KK  R_EXPD
 96          KM   Existing Pond at end of Basin R15u
 97          RS       1    STOR       0
 98          SV     0.0    0.03    0.20    0.57    1.15    1.95    2.87    3.87
 99          SQ     0.0     0.0     2.7    10.3    20.6    33.1    47.6    71.3
100          SE    4790    4791    4792    4793    4794    4795    4796    4797

101          KK   R_R15Route Subbasin R15u Hydrograph Through L9.1d
102          RK    2000   0.006    0.03       0    TRAP       5     2.4

103          KK  C_1517
104          KM   Combine Hydrographs of Subbasin R15 and R17
105          HC       2

106          KK    L9.1
```

```
 107          KM   Subbasin L9.1
 108          BA  2.6711
 109          LG    0.40  0.4023   1.502   0.054     4.0
 110          US   1.107   0.369

 111          KK   C_LT9
 112          KM   Combine Hydrographs of Subbasin R15 and R17 and L9.1
 113          HC       2

 114          KK   C_L9M
 115          KM   Ultimate Outfall into Leach Creek
 116          HC       2

 117          KK      L9
 118          KM   Subbasin
 119          BA  0.1647
 120          LG    0.39  0.3787   1.414   0.051     6.0
 121          US   0.792   0.233

 122          KK  CL9L10
 123          KM   L9+L10
 124          HC       2

 125          KK      C3
 126          KM   Corcoran Wash at H Road and 25 Road
 127          BA  0.5778
 128          LG    0.41  0.4023   1.502   0.054     2.0
 129          US   0.670   0.307
```



```
      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 130          KK   Upper
 131          KM   L9+L10+C3
 132          HC       2

 133          KK    DB21
 134          KM   Subbasin
 135          BA  0.1570
 136          LG    0.41  0.4023   1.502   0.054     2.0
 137          US   0.318   0.253

 138          KK      PDA
 139          KM   Existing Pond A
 140          RS       1    STOR       0       0
 141          SV     0.0   0.001     1.8     4.7     8.9    11.6
 142          SQ     0.0     2.5     7.0     9.0    10.6    11.3
 143          SE    4915    4916    4918    4920    4922    4923

 144          KK   DB21a
 145          KM   Subbasin
 146          BA  0.3827
 147          LG    0.41  0.4023   1.502   0.054     2.0
 148          US   0.516   0.289

 149          KK    C21a
 150          KM   Combine DB Flows north of RW
 151          HC       2

 152          KK   DB23b
 153          KM   Subbasin
 154          BA  0.0581
 155          LG    0.06  0.0710   0.265   0.010    95.0
 156          US   0.046   0.547

 157          KK    C23b
 158          KM   Combine Hydrograph Basin 23b with 21a
 159          HC       2

 160          KK    R23b
 161          KM   Route Hydrograph Through Basin 23c Pipe
 162          RK    1000   0.020   0.013       0    CIRC       3

 163          KK   DB23c
 164          KM   Subbasin
 165          BA  0.0822
 166          LG    0.06  0.0710   0.265   0.010    95.0
 167          US   0.080   0.577

 168          KK    R23c
 169          KM   Route R23c Through R23c Ditch
 170          RK     500    .005   0.045       0    TRAP      10       4
```



```
      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 171          KK   DB23d
 172          KM   Subbasin
 173          BA  0.0188
```

```
 174          LG    0.04  0.0473   0.177   0.006   100.0
 175          US   0.023   0.467

 176          KK    R23d
 177          KM   Route Hydrograph Through Basin 23d Pipe
 178          RK    1200   0.005   0.015       0    CIRC       2

 179          KK    C23c
 180          KM   Combine Hydrograph Basins 23c,23d with 23b
 181          HC       3

 182          KK  WF_PD2
 183          KM   Route Hydrograph Through New Walker Field On Site Pond 2
 184          RS       1    STOR       0       0
 185          SV     0.0    0.10    0.70    1.64    3.16    5.34
 186          SQ     0.0    23.6    48.1    68.1    83.4    3000
 187          SE  4793.5    4795    4797    4799    4801    4803

 188          KK  RWF_P2
 189          KM   Route Hydrograph Through Basin 23e Pipe
 190          RK    1000   0.010   0.015       0    CIRC       3

 191          KK   DB23e
 192          KM   Subasin
 193          BA  0.0764
 194          LG    0.04  0.0473   0.177   0.006   100.0
 195          US   0.067   0.577

 196          KK    C23e
 197          KM   Combine Hydrograph Basin 23e with WF_PD2
 198          HC       2

 199          KK    R23e
 200          KM   Route Hydrograph Through Basin 23a Pipe
 201          RK    1500   0.008   0.015       0    CIRC       4

 202          KK   DB23a
 203          KM   Subbasin
 204          BA  0.0222
 205          LG    0.38  0.3787   1.414   0.051    10.0
 206          US   0.130   0.163

 207          KK    C23a
 208          KM   Combine Hydrograph Basin 23a, 23e with WF_PD2
 209          HC       2
```



```
            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 210          KK    R_PDU
 211          KM   Route Hydrograph Through Upper Airport Upper Pond
 212          RS       1    STOR       0       0
 213          SV     0.0   0.001    0.21    6.09   16.16   26.80    29.4
 214          SQ     0.0    10.8    11.4    12.4    13.3    14.2     162
 215          SE    4767 4767.01    4768    4770    4772    4774  4774.5

 216          KK    D_PdU
 217          KM   Weir Flow Into Lower Pond
 218          DT  U_Pipe
 219          DI     0.0    14.2    14.3     100    1000
 220          DQ     0.0    14.2    14.2    14.2    14.2

 221          KK    DB22
 222          KM   Subbasin
 223          BA  0.2128
 224          LG    0.41  0.4023   1.502   0.054     2.0
 225          US   0.410   0.265

 226          KK   R24_P
 227          KM   Route Hydrograph Through Basin 24 Pipe
 228          RK    3076   0.014   0.015       0    CIRC     4.5

 229          KK   R24_O
 230          KM   Route Hydrograph Through Basin 24 Overland
 231          RK    1506   0.019    0.03       0    TRAP      10      12

 232          KK   DB24a
 233          KM   Subbasin
 234          BA  0.0209
 235          LG    0.27  0.2840   1.060   0.038    36.0
 236          US   0.096   0.263

 237          KK  B4aDIV
 238          KM   Divert Basin 24a overflow
 239          DT  B4aDIV
 240          DI     0.0    14.0   100.0  1000.0
 241          DQ       0    0.01    86.0   986.0

 242          KK   R24_P
 243          KM   Route Hydrograph Through Basin 24 Pipe
```

```
 244          RK     800   0.014   0.015       0    CIRC     4.5

 245          KK   R24_O
 246          KM   Route Hydrograph Through Basin 24 Overland
 247          RK    1506   0.019    0.03       0    TRAP      10      12

 248          KK    DB24
 249          KM   Subbasin
 250          BA  0.2359
 251          LG    0.12  0.1420   0.530   0.019    75.0
 252          US   0.162   0.629
1                                      HEC-1 INPUT                                                    PAGE  7

          LINE   ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 253          KK     C24
 254          KM   Combine Hydrographs (Basin22, Basin 24a, Basin 24)
 255          HC       3

 256          KK   DR24a
 257          KM   Retrieve 24a diversion
 258          DR  B4aDIV

 259          KK   R25_O
 260          KM   Route 24a diversion through Basin 25 overland
 261          RK     800   0.015    0.03       0    TRAP      30      10

 262          KK   R25_P
 263          KM   Route 24a diversion through Basin 25 pipe
 264          RK    1600   0.013   0.015       0    CIRC       4

 265          KK    DB25
 266          KM   Subbasin
 267          BA  0.0239
 268          LG    0.27  0.2840   1.060   0.038    36.0
 269          US   0.106   0.269

 270          KK     C25
 271          KM   Combine Hydrograph with 24a diversion
 272          HC       2

 273          KK   B5DIV
 274          KM   Divert Basin 25 storm sewer overflow
 275          DT   B5DIV
 276          DI     0.0    14.0   100.0  1000.0
 277          DQ       0       0    86.0   986.0

 278          KK   DB25a
 279          KM   Subbasin
 280          BA  0.0333
 281          LG    0.37  0.3550   1.325   0.048    12.0
 282          US   0.031   0.174

 283          KK     C_6
 284          KM   Combine Basins 25a 25 24a 24 22
 285          HC       3

 286          KK     C_7
 287          KM   Combine West Ranchmans Ditch Basin
 288          HC       2

 289          KK    R_PDL
 290          KM   route Hydrograph Through Lower Airport East Pond
 291          RS       1    STOR       0       0
 292          SV     0.0    0.05    4.26   13.79   24.65    30.0
 293          SQ     0.0     5.5     7.8     9.6    11.1    14.0
 294          SE  4758.4    4760    4762    4764    4766  4766.2
1                                      HEC-1 INPUT                                                    PAGE  8

          LINE   ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 295          KK    PR_U
 296          KM   Retrieve Upper Pond Pipe Flow
 297          DR  U_Pipe

 298          KK   C_Out
 299          KM   Combine 2 Outflow Hydrographs at Canal
 300          HC       2

 301          KK     R16
 302          KM   Subbasin
 303          BA  0.1570
 304          LG    0.21  0.2130   0.795   0.029    51.0
 305          US   0.076   0.479

 306          KK   R_16a
 307          KM   Route Hydrograph through R14A overland
 308          RK    2500   0.005    0.04       0    TRAP      10      10
```

```
309          KK    R14A
310          KM   Subbasin
311          BA  0.0411
312          LG    0.12  0.1420   0.530   0.019    75.0
313          US   0.038   0.484

314          KK   C_16A
315          KM   Combine Hydrographs (R16, R14A)
316          HC       2

317          KK   C_14A
318          KM   Combine Hydrograph with Lower Pond Outfall
319          HC       2

320          KK    R15d
321          KM   Subbasin
322          BA  0.1530
323          LG    0.41  0.4023   1.502   0.054     3.0
324          US   0.203   0.246

325          KK   R_R13
326          KM   Route Hydrograph through R13
327          RS       1    STOR       0
328          RC   0.035    0.03   0.035     971    .018
329          RX    1000    1014    1022    1026    1036    1046    1050    1062
330          RY    4762    4760    4758    4756    4756    4758    4760    4762

331          KK     R13
332          KM   Subbasin
333          BA  0.0428
334          LG    0.41  0.4023   1.502   0.054     2.0
335          US   0.179   0.208
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

336          KK   C_R13
337          KM   Combine Hydrographs
338          HC       2

339          KK CMiddle
340          HC       2

341          KK    CU+M
342          HC       2

343          KK  Extra5
344          KM   Overflow released from Basin 25
345          DR   B5DIV

346          KK     R14
347          KM   Subbasin
348          BA  0.0598
349          LG    0.41  0.4023   1.502   0.054     2.0
350          US   0.968   0.219

351          KK    C_R5
352          KM   Combine Hydrographs (R14, Basin 5)
353          HC       2

354          KK     R_5
355          KM   Route Basin 5 & R14 through R5 overland
356          RK   10500   0.008    0.03       0    TRAP      10      20

357          KK      R5
358          KM   Subbasin
359          BA  0.0844
360          LG    0.38  0.3787   1.414   0.051     9.0
361          US   0.368   0.201

362          KK      I5
363          KM   Start Indian Creek Basin
364          BA  0.7994
365          LG    0.41  0.4023   1.502   0.054     2.0
366          US   0.435   0.323

367          KK    R_I5
368          KM   Route Hydrograph Through Existing Dam
369          RS       1    STOR       0       0
370          SV       0    2.24    4.65    7.24   10.01   12.95   16.08   19.41   22.92   26.63
371          SQ     0.0     0.0     0.0     0.0     0.0     0.0     0.0    93.0   263.0   483.2
372          SE    5190    5191    5192    5193    5194    5195    5196    5197    5198    5199

373          KK      I4
374          KM   Subbasin
375          BA  1.2130
376          LG    0.41  0.4023   1.502   0.054     2.0
377          US   1.184   0.344
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 378          KK    C_I4
 379          KM   Combine I5 and I4
 380          HC       2

 381          KK      I3
 382          KM   Subbasin
 383          BA  3.2056
 384          LG    0.41  0.4023   1.502   0.054     2.0
 385          US   1.649   0.398

 386          KK    C_I3
 387          KM   Combine I4 and I3
 388          HC       2

 389          KK  R_I3_O
 390          KM   Route hydrograph through I2 overland
 391          RK    3300   0.014    0.04       0    TRAP      10       5

 392          KK      I2
 393          KM   Subbasin
 394          BA  0.9728
 395          LG    0.41  0.4023   1.502   0.054     3.0
 396          US   1.502   0.325

 397          KK    C_I2
 398          KM   Combine I3 and I2
 399          HC       2

 400          KK    R_I2
 401          KM   Route Hydrograph Through Existing Dam
 402          RS       1    STOR       0       0
 403          SV       0    3.06    6.67   10.92   15.93   21.81   28.62   36.41   45.21   55.07
 404          SV   66.05   78.18   91.52  106.10  121.97  139.16  176.23  235.99  257.34  280.13
 405          SQ       0       0    13.0    18.4    22.6    26.1    29.1    31.9    34.5    36.9
 406          SQ    39.1    41.2    43.2    45.2    47.0    48.8    52.1   228.8   234.6   240.4
 407          SE    4890    4892    4894    4896    4898    4900    4902    4904    4906    4908
 408          SE    4910    4912    4914    4916    4918    4920    4924    4930    4932    4934

 409          KK      I1
 410          KM   Subbasin
 411          BA  0.7563
 412          LG    0.41  0.4023   1.502   0.052     2.0
 413          US   1.896   0.320

 414          KK    C_I1
 415          KM   Combine I2 and I1
 416          HC       2

 417          KK      I7
 418          KM   Subbasin
 419          BA  1.0258
 420          LG    0.41  0.4023   1.502   0.054     2.0
 421          US   1.348   0.335
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 422          KK    R_I7
 423          KM   Route Hydrograph Through Existing Dam
 424          RS       1    STOR       0       0
 425          SV       0    0.26    0.60    1.01    1.51    2.11    2.82    3.63    4.57    5.64
 426          SQ     0.0     0.0     0.0     0.0     0.0     0.0     0.0    62.0   175.4   322.2
 427          SE    4820    4821    4822    4823    4824    4825    4826    4827    4828    4829

 428          KK      I6
 429          KM   Subbasin
 430          BA  0.4513
 431          LG    0.40  0.4023   1.502   0.054     4.0
 432          US   0.532   0.285

 433          KK    C_I6
 434          KM   Combine I7 and I6
 435          HC       2

 436          KK      I8
 437          KM   Subbasin
 438          BA  0.4147
 439          LG    0.41  0.4023   1.502   0.054     3.0
 440          US   0.498   0.285

 441          KK      I9Subbasin
 442          BA  0.6808
 443          LG    0.41  0.4023   1.502   0.054     2.0
 444          US   1.205   0.315

 445          KK   C1819
 446          HC       2
```

```
447           KK  C16-19
448           KM   Combine 1617+I819
449           HC       2

450           KK  C15-19
451           HC       2

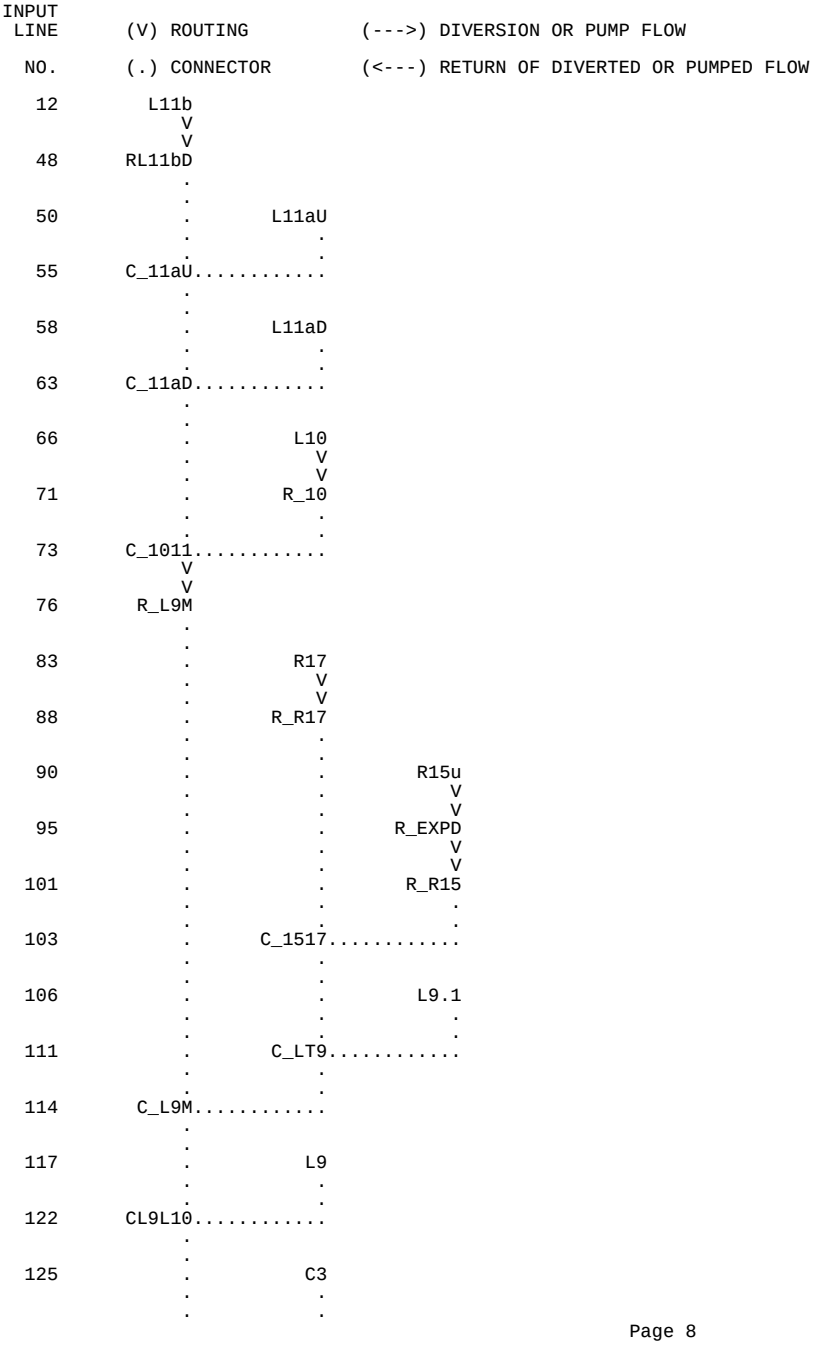
452           KK  CR5-19
453           HC       2

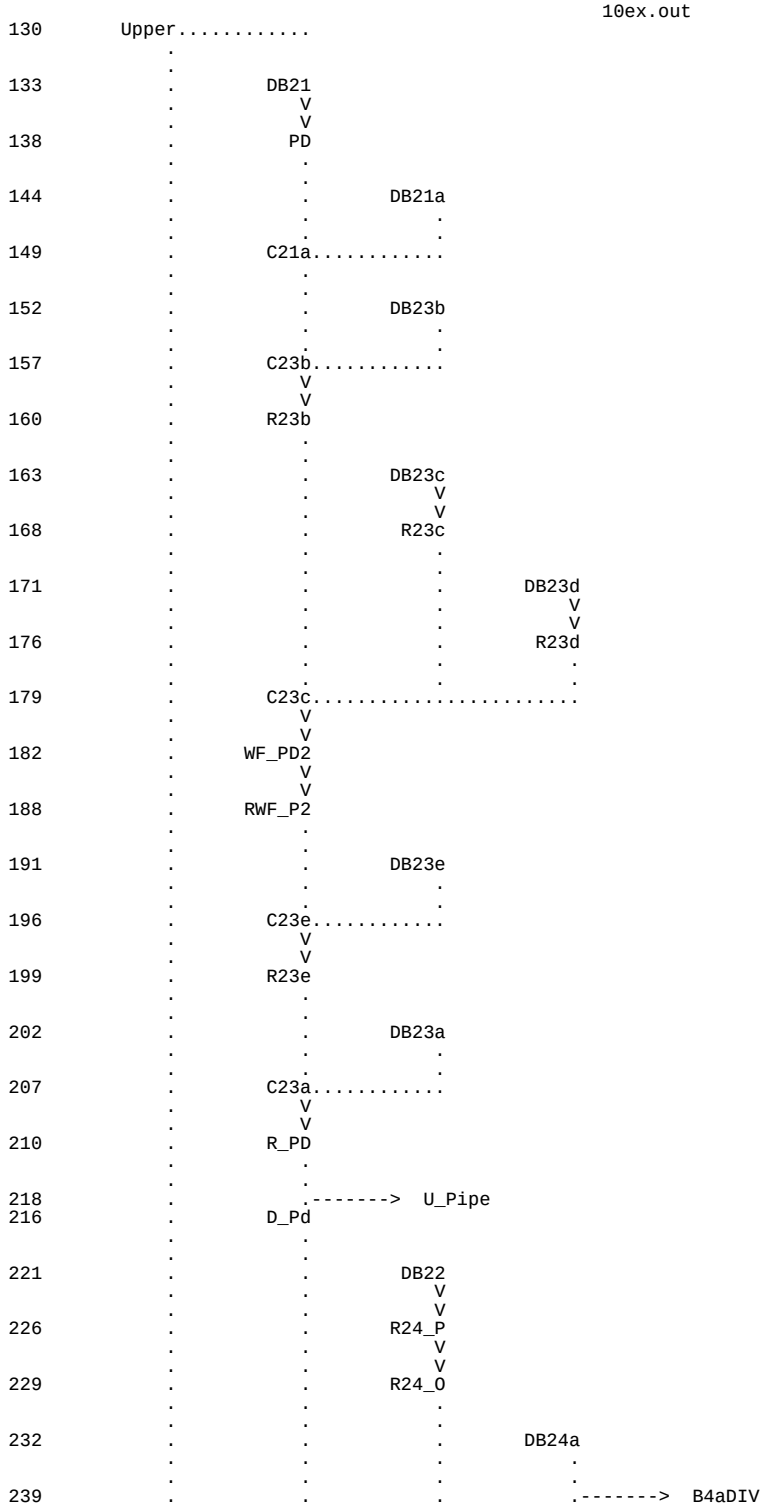
454           KK  CLower
455           KM   C14-19
456           HC       2

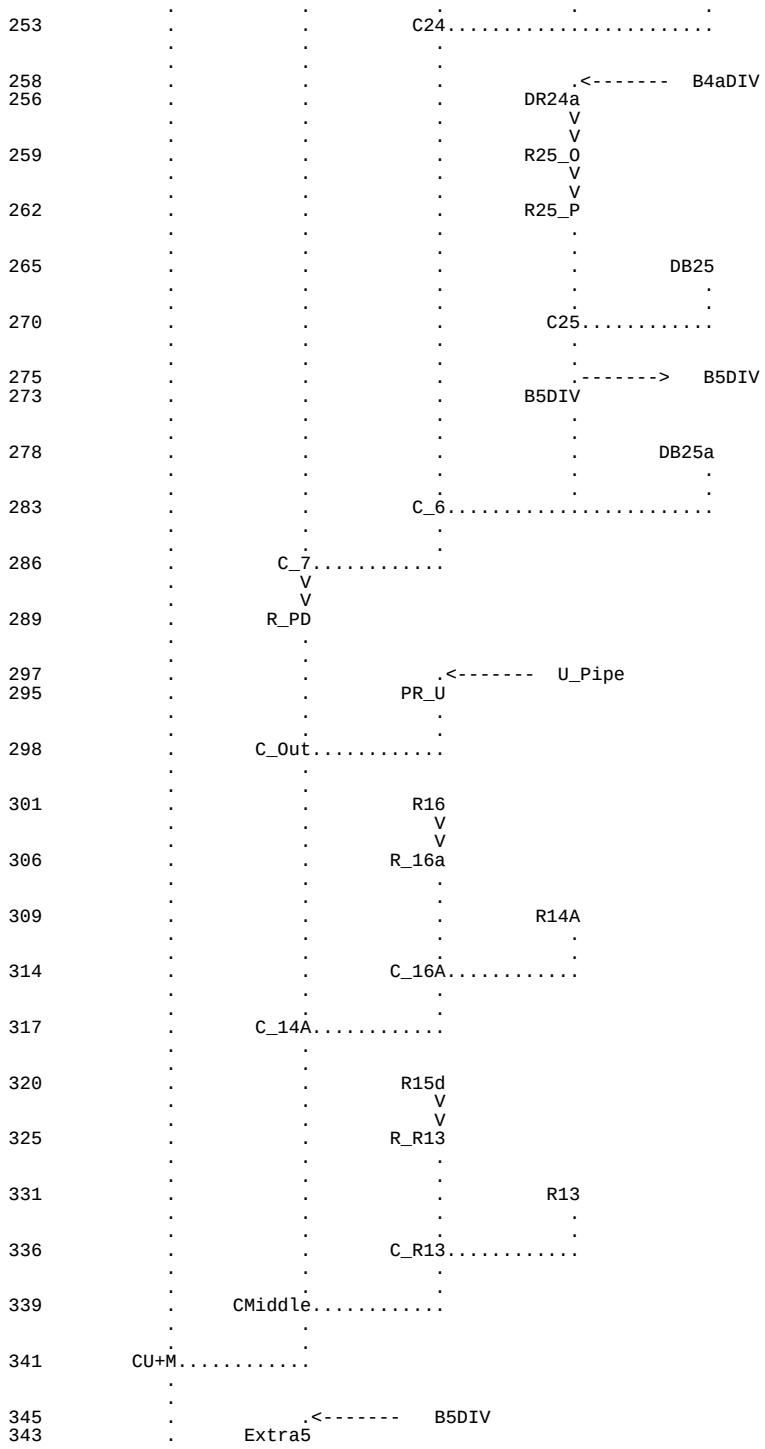
457           KK   C-All
458           HC       2
459           ZZ
```

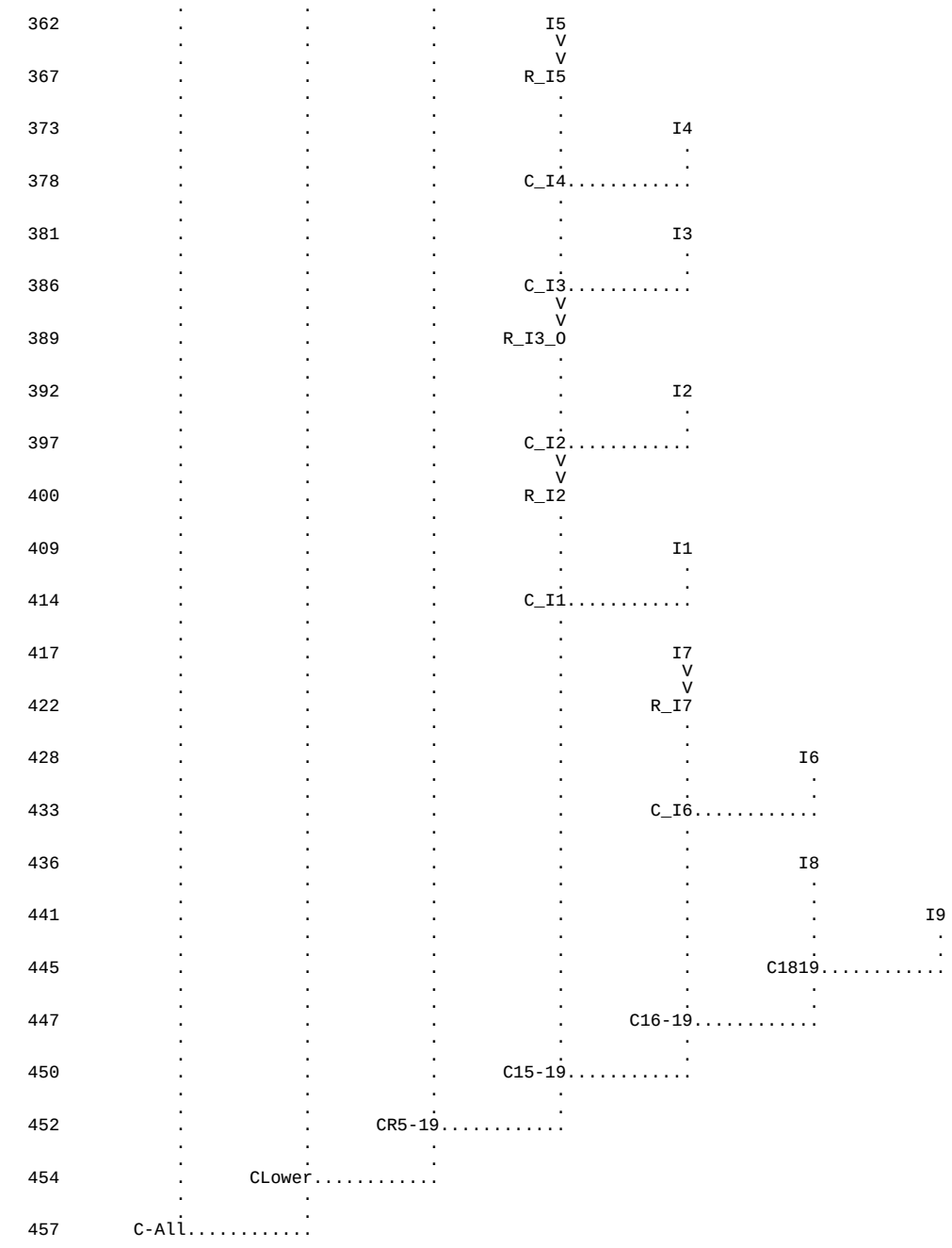
1

SCHEMATIC DIAGRAM OF STREAM NETWORK




Upper
DB21
PD
DB21a
C21a
DB23b
C23b
R23b
DB23c
R23c
DB23d
R23d
C23c
WF_PD2
RWF_P2
DB23e
C23e
R23e
DB23a
C23a
R_PD
U_Pipe
D_Pd
DB22
R24_P
R24_O
DB24a
B4aDIV
R24_P
R24_O
DB24


253 C24
258
256 DR24a
259 R25_O
262 R25_P
265 DB25
270 C25
275
273 B5DIV
278 DB25a
283 C_6
286 C_7
289 R_PD
297
295 PR_U
298 C_Out
301 R16
306 R_16a
309 R14A
314 C_16A
317 C_14A
320 R15d
325 R_R13
331 R13
336 C_R13
339 CMiddle
341 CU+M
345
343 Extra5
346 R14
351 C_R5
354 R_5
357 R5
B4aDIV
B5DIV
U_Pipe
B5DIV



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
**************************************
 *                                    *                                                    *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                    *    U.S. ARMY CORPS OF
ENGINEERS     *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING
CENTER    *
 *            VERSION 4.1               *                                                    *          609 SECOND
STREET          *
 *                                      *                                                    *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   07JUN12  TIME  10:32:08   *                                                    *           (916) 756-1104
        *
 *                                      *                                                    *
        *
 ****************************************
**************************************
```

```
                                Grand Junction Regional Airport - Jviation - prepared June 2012
                                Existing Conditions Watershed Model  - All Soils are Type D
                                10-Year 24-Hour Storm - NRCS Type II Rainfall Distribution
                               PREC 1.00 for 0.1< area < 5.0 squire miles; use flow under ratio 1
                               PREC 0.97 for 5.0< area <12.5 square miles; use flow under ratio 2
                               When I>10, uses CHUP method for Tlag, when I<10, uses Grand Junction SCS Meth
                                ************************************************************************

    9 IO          OUTPUT CONTROL VARIABLES
                        IPRNT           5  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN           5  MINUTES IN COMPUTATION INTERVAL
                        IDATE      1    0  STARTING DATE
                        ITIME        0000  STARTING TIME
                           NQ         500  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE      2    0  ENDING DATE
                       NDTIME        1735  ENDING TIME
                       ICENT          19  CENTURY MARK

                     COMPUTATION INTERVAL     .08 HOURS
                          TOTAL TIME BASE   41.58 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

      JP          MULTI-PLAN OPTION
                        NPLAN           1  NUMBER OF PLANS

      JR          MULTI-RATIO OPTION
                      RATIOS OF PRECIPITATION
                     1.00      .97
        WARNING FDKRUT FAILURE TO PRESERVE UPSTREAM HYDROGRAPH VOLUME - CHECK ROUTED HYDROGRAPH SUMQU=     .0000
SUMQT=     .0001
1

               PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                                   FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                                TIME TO PEAK IN HOURS


                                                                    RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN                      RATIO 1  RATIO 2
                                                                  1.00      .97

 HYDROGRAPH AT
+                  L11b      7.41     1   FLOW                   338.     311.
                                            TIME                  11.50    11.50

 ROUTED TO
+                 RL11bD      7.41     1   FLOW                   338.     310.
                                            TIME                  11.75    11.75

 HYDROGRAPH AT
+                  L11aU      1.01     1   FLOW                    49.      45.
                                            TIME                  11.00    11.00

  2 COMBINED AT
+                 C_11aU      8.43     1   FLOW                   376.     345.
                                            TIME                  11.75    11.75

 HYDROGRAPH AT
+                  L11aD       .02     1   FLOW                     4.       4.
                                            TIME                  10.08    10.08

  2 COMBINED AT
+                 C_11aD      8.45     1   FLOW                   376.     346.
                                            TIME                  11.75    11.75

 HYDROGRAPH AT
+                    L10      1.02     1   FLOW                    51.      47.
                                            TIME                  11.00    11.00

 ROUTED TO
+                   R_10      1.02     1   FLOW                    50.      46.
                                            TIME                  11.17    11.17

  2 COMBINED AT
```

```
+                C_1011      9.48     1   FLOW          419.      384.
                                         TIME        11.67    11.67

 ROUTED TO
+                 R_L9M      9.48     1   FLOW          417.      381.
                                         TIME        11.75    11.83

 HYDROGRAPH AT
+                   R17       .12     1   FLOW           25.       23.
                                         TIME        10.08    10.08

 ROUTED TO
+                 R_R17       .12     1   FLOW           25.       23.
                                         TIME        10.33    10.33

 HYDROGRAPH AT
+                  R15u       .16     1   FLOW           61.       58.
                                         TIME        10.08    10.08

 ROUTED TO
+                R_EXPD       .16     1   FLOW           29.       28.
                                         TIME        10.58    10.50

                                     ** PEAK STAGES IN FEET **
                                     1   STAGE     4794.66  4794.55
                                         TIME        10.58    10.50

 ROUTED TO
+                 R_R15       .16     1   FLOW           29.       28.
                                         TIME        10.67    10.67

  2 COMBINED AT
+                C_1517       .28     1   FLOW           49.       47.
                                         TIME        10.42    10.42

 HYDROGRAPH AT
+                  L9.1      2.67     1   FLOW          156.      144.
                                         TIME        11.00    11.00

  2 COMBINED AT
+                 C_LT9      2.95     1   FLOW          192.      179.
                                         TIME        10.92    10.92

  2 COMBINED AT
+                 C_L9M     12.43     1   FLOW          553.      506.
                                         TIME        11.67    11.67

 HYDROGRAPH AT
+                    L9       .16     1   FLOW            9.        9.
                                         TIME        10.67    10.67

  2 COMBINED AT
+                CL9L10     12.59     1   FLOW          560.      513.
                                         TIME        11.67    11.67

 HYDROGRAPH AT
+                    C3       .58     1   FLOW           43.       39.
                                         TIME        10.58    10.58

  2 COMBINED AT
+                 Upper     13.17     1   FLOW          584.      535.
                                         TIME        11.67    11.67

 HYDROGRAPH AT
+                  DB21       .16     1   FLOW           19.       17.
                                         TIME        10.25    10.25

 ROUTED TO
+                    PD       .16     1   FLOW            5.        5.
                                         TIME        11.75    11.67

                                     ** PEAK STAGES IN FEET **
                                     1   STAGE     4917.14  4917.02
                                         TIME        11.75    11.67

 HYDROGRAPH AT
+                 DB21a       .38     1   FLOW           34.       31.
                                         TIME        10.42    10.42

  2 COMBINED AT
+                  C21a       .54     1   FLOW           38.       35.
                                         TIME        10.42    10.42

 HYDROGRAPH AT
+                 DB23b       .06     1   FLOW           62.       60.
                                         TIME        10.00    10.00

  2 COMBINED AT
+                  C23b       .60     1   FLOW           71.       69.
                                         TIME        10.00    10.00
```

```
 ROUTED TO
+                   R23b       .60     1   FLOW          70.      67.
                                           TIME        10.00    10.00

 HYDROGRAPH AT
+                  DB23c       .08     1   FLOW          86.      83.
                                           TIME        10.00    10.00

 ROUTED TO
+                   R23c       .08     1   FLOW          82.      79.
                                           TIME        10.00    10.00

 HYDROGRAPH AT
+                  DB23d       .02     1   FLOW          15.      14.
                                           TIME        10.00    10.00

 ROUTED TO
+                   R23d       .02     1   FLOW          14.      13.
                                           TIME        10.08    10.08

  3 COMBINED AT
+                   C23c       .70     1   FLOW         165.     160.
                                           TIME        10.00    10.00

 ROUTED TO
+                 WF_PD2       .70     1   FLOW          73.      72.
                                           TIME        10.17    10.17

                                         ** PEAK STAGES IN FEET **
                                         1   STAGE     4799.66  4799.51
                                             TIME        10.17    10.17

 ROUTED TO
+                 RWF_P2       .70     1   FLOW          73.      72.
                                           TIME        10.25    10.25

 HYDROGRAPH AT
+                  DB23e       .08     1   FLOW          82.      79.
                                           TIME        10.00    10.00

  2 COMBINED AT
+                   C23e       .78     1   FLOW         142.     138.
                                           TIME        10.00    10.00

 ROUTED TO
+                   R23e       .78     1   FLOW         137.     133.
                                           TIME        10.00    10.00

 HYDROGRAPH AT
+                  DB23a       .02     1   FLOW           4.       4.
                                           TIME        10.08    10.08

  2 COMBINED AT
+                   C23a       .80     1   FLOW         140.     136.
                                           TIME        10.00    10.00

 ROUTED TO
+                    R_PD      .80     1   FLOW          13.      13.
                                           TIME        13.67    13.50

                                         ** PEAK STAGES IN FEET **
                                         1   STAGE     4771.13  4770.98
                                             TIME        13.75    13.67

 DIVERSION TO
+                 U_Pipe       .80     1   FLOW          13.      13.
                                           TIME        13.67    13.50

 HYDROGRAPH AT
+                    D_Pd      .80     1   FLOW           0.       0.
                                           TIME          .00      .00

 HYDROGRAPH AT
+                   DB22       .21     1   FLOW          21.      20.
                                           TIME        10.33    10.33

 ROUTED TO
+                  R24_P       .21     1   FLOW          21.      19.
                                           TIME        10.42    10.42

 ROUTED TO
+                  R24_O       .21     1   FLOW          21.      19.
                                           TIME        10.42    10.42

 HYDROGRAPH AT
+                  DB24a       .02     1   FLOW           8.       8.
                                           TIME        10.08    10.08

 DIVERSION TO
+                 B4aDIV       .02     1   FLOW           0.       0.
                                           TIME        10.00    10.00
```

```
 HYDROGRAPH AT
+                B4aDIV       .02     1   FLOW           8.       8.
                                          TIME        10.08    10.08

 ROUTED TO
+                 R24_P       .02     1   FLOW           8.       8.
                                          TIME        10.08    10.08

 ROUTED TO
+                 R24_O       .02     1   FLOW           8.       8.
                                          TIME        10.17    10.17

 HYDROGRAPH AT
+                  DB24       .24     1   FLOW         190.     184.
                                          TIME        10.08    10.08

  3 COMBINED AT
+                    C24       .47     1   FLOW         199.     192.
                                          TIME        10.08    10.08

 HYDROGRAPH AT
+                 DR24a       .00     1   FLOW           0.       0.
                                          TIME        10.00    10.00

 ROUTED TO
+                 R25_O       .00     1   FLOW           0.       0.
                                          TIME        10.67    10.67

 ROUTED TO
+                 R25_P       .00     1   FLOW           0.       0.
                                          TIME        10.83    10.83

 HYDROGRAPH AT
+                  DB25       .02     1   FLOW          10.       9.
                                          TIME        10.08    10.08

  2 COMBINED AT
+                    C25       .02     1   FLOW          10.       9.
                                          TIME        10.08    10.08

 DIVERSION TO
+                 B5DIV       .02     1   FLOW           0.       0.
                                          TIME          .00      .00

 HYDROGRAPH AT
+                 B5DIV       .02     1   FLOW          10.       9.
                                          TIME        10.08    10.08

 HYDROGRAPH AT
+                 DB25a       .03     1   FLOW           7.       7.
                                          TIME        10.08    10.08

  3 COMBINED AT
+                    C_6       .53     1   FLOW         215.     208.
                                          TIME        10.08    10.08

  2 COMBINED AT
+                    C_7      1.32     1   FLOW         215.     208.
                                          TIME        10.08    10.08

 ROUTED TO
+                  R_PD      1.32     1   FLOW           9.       9.
                                          TIME        13.00    12.92

                                      ** PEAK STAGES IN FEET **
                                      1   STAGE     4763.52  4763.39
                                          TIME        13.00    12.92

 HYDROGRAPH AT
+                  PR_U       .00     1   FLOW          13.      13.
                                          TIME        13.67    13.50

  2 COMBINED AT
+                C_Out      1.32     1   FLOW          22.      22.
                                          TIME        13.33    13.08

 HYDROGRAPH AT
+                    R16       .16     1   FLOW         127.     123.
                                          TIME        10.00    10.00

 ROUTED TO
+                 R_16a       .16     1   FLOW         118.     115.
                                          TIME        10.17    10.17

 HYDROGRAPH AT
+                  R14A       .04     1   FLOW          35.      33.
                                          TIME        10.00    10.00

  2 COMBINED AT
+                C_16A       .20     1   FLOW         136.     133.
```

				TIME	10.17	10.17
2 COMBINED AT						
+	C_14A	1.52	1	FLOW	156.	153.
				TIME	10.17	10.17
HYDROGRAPH AT						
+	R15d	.15	1	FLOW	27.	25.
				TIME	10.08	10.08
ROUTED TO						
+	R_R13	.15	1	FLOW	26.	24.
				TIME	10.17	10.17
			** PEAK STAGES IN FEET **			
			1	STAGE	4756.53	4756.50
				TIME	10.17	10.17
HYDROGRAPH AT						
+	R13	.04	1	FLOW	7.	7.
				TIME	10.08	10.08
2 COMBINED AT						
+	C_R13	.20	1	FLOW	33.	30.
				TIME	10.17	10.17
2 COMBINED AT						
+	CMiddle	1.72	1	FLOW	189.	183.
				TIME	10.17	10.17
2 COMBINED AT						
+	CU+M	14.89	1	FLOW	617.	567.
				TIME	11.67	11.67
HYDROGRAPH AT						
+	Extra5	.00	1	FLOW	0.	0.
				TIME	.00	.00
HYDROGRAPH AT						
+	R14	.06	1	FLOW	2.	2.
				TIME	10.83	10.83
2 COMBINED AT						
+	C_R5	.06	1	FLOW	2.	2.
				TIME	10.83	10.83
ROUTED TO						
+	R_5	.06	1	FLOW	2.	2.
				TIME	12.58	12.67
HYDROGRAPH AT						
+	R5	.08	1	FLOW	9.	8.
				TIME	10.25	10.25
HYDROGRAPH AT						
+	I5	.80	1	FLOW	93.	86.
				TIME	10.33	10.33
ROUTED TO						
+	R_I5	.80	1	FLOW	0.	0.
				TIME	.00	.00
			** PEAK STAGES IN FEET **			
			1	STAGE	5194.38	5194.08
				TIME	24.83	23.17
HYDROGRAPH AT						
+	I4	1.21	1	FLOW	58.	54.
				TIME	11.08	11.08
2 COMBINED AT						
+	C_I4	2.01	1	FLOW	58.	54.
				TIME	11.08	11.08
HYDROGRAPH AT						
+	I3	3.21	1	FLOW	129.	119.
				TIME	11.50	11.50
2 COMBINED AT						
+	C_I3	5.22	1	FLOW	181.	166.
				TIME	11.42	11.42
ROUTED TO						
+	R_I3_O	5.22	1	FLOW	181.	166.
				TIME	11.50	11.50
HYDROGRAPH AT						
+	I2	.97	1	FLOW	36.	33.
				TIME	11.33	11.33
2 COMBINED AT						

+	C_I2	6.19	1	FLOW	216.	198.
				TIME	11.50	11.50
ROUTED TO						
+	R_I2	6.19	1	FLOW	35.	34.
				TIME	17.42	17.25
			** PEAK STAGES IN FEET **			
			1	STAGE	4906.79	4905.84
				TIME	17.42	17.33
HYDROGRAPH AT						
+	I1	.76	1	FLOW	22.	20.
				TIME	11.75	11.75
2 COMBINED AT						
+	C_I1	6.95	1	FLOW	48.	46.
				TIME	12.67	12.75
HYDROGRAPH AT						
+	I7	1.03	1	FLOW	42.	39.
				TIME	11.25	11.25
ROUTED TO						
+	R_I7	1.03	1	FLOW	37.	33.
				TIME	11.75	11.83
			** PEAK STAGES IN FEET **			
			1	STAGE	4826.59	4826.53
				TIME	11.75	11.83
HYDROGRAPH AT						
+	I6	.45	1	FLOW	41.	38.
				TIME	10.42	10.42
2 COMBINED AT						
+	C_I6	1.48	1	FLOW	56.	50.
				TIME	11.67	11.75
HYDROGRAPH AT						
+	I8	.41	1	FLOW	38.	35.
				TIME	10.42	10.42
HYDROGRAPH AT						
+	I9	.68	1	FLOW	30.	27.
				TIME	11.08	11.08
2 COMBINED AT						
+	C1819	1.10	1	FLOW	56.	52.
				TIME	10.83	10.83
2 COMBINED AT						
+	C16-19	2.57	1	FLOW	99.	88.
				TIME	11.58	11.58
2 COMBINED AT						
+	C15-19	9.52	1	FLOW	143.	131.
				TIME	11.58	11.67
2 COMBINED AT						
+	CR5-19	9.60	1	FLOW	147.	135.
				TIME	11.58	11.67
2 COMBINED AT						
+	CLower	9.66	1	FLOW	147.	135.
				TIME	11.58	11.67
2 COMBINED AT						
+	C-All	24.55	1	FLOW	764.	702.
				TIME	11.67	11.67

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL			
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)

FOR PLAN = 1 RATIO= 1.00

RL11bD	MANE	4.93	337.80	704.52	.26	5.00	337.54	705.00	.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1031E+03 EXCESS= .0000E+00 OUTFLOW= .1031E+03 BASIN STORAGE= .6131E-03 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .97

RL11bD	MANE	5.00	309.81	702.58	.24	5.00	309.73	705.00	.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9505E+02 EXCESS= .0000E+00 OUTFLOW= .9495E+02 BASIN STORAGE= .7309E-03 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= 1.00

R_10	MANE	5.00	50.45	669.31	.26	5.00	50.39	670.00	.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1426E+02 EXCESS= .0000E+00 OUTFLOW= .1424E+02 BASIN STORAGE= .8116E-04 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .97

R_10	MANE	5.00	46.44	670.69	.24	5.00	46.37	670.00	.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1314E+02 EXCESS= .0000E+00 OUTFLOW= .1313E+02 BASIN STORAGE= .7828E-04 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= 1.00

R_R17	MANE	3.08	25.33	617.18	.26	5.00	24.58	620.00	.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1712E+01 EXCESS= .0000E+00 OUTFLOW= .1717E+01 BASIN STORAGE= .9798E-05 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .97

R_R17	MANE	2.63	23.30	618.74	.24	5.00	22.94	620.00	.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1578E+01 EXCESS= .0000E+00 OUTFLOW= .1582E+01 BASIN STORAGE= .9257E-05 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= 1.00

R_R15	MANE	2.60	28.80	637.53	.66	5.00	28.79	640.00	.66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5565E+01 EXCESS= .0000E+00 OUTFLOW= .5565E+01 BASIN STORAGE= .1484E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R_R15	MANE	2.61	27.53	637.27	.63	5.00	27.51	640.00	.63	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5330E+01 EXCESS= .0000E+00 OUTFLOW= .5330E+01 BASIN STORAGE= .1157E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23b	MANE	.41	70.58	600.39	.35	5.00	70.07	600.00	.35	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1116E+02 EXCESS= .0000E+00 OUTFLOW= .1116E+02 BASIN STORAGE= .1301E-11 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23b	MANE	.42	67.95	600.44	.33	5.00	67.45	600.00	.33	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1046E+02 EXCESS= .0000E+00 OUTFLOW= .1046E+02 BASIN STORAGE= .1272E-11 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23c	MANE	.92	83.87	601.46	1.18	5.00	81.51	600.00	1.18	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5156E+01 EXCESS= .0000E+00 OUTFLOW= .5161E+01 BASIN STORAGE= .4733E-07 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .97

R23c	MANE	.80	82.62	601.52	1.14	5.00	79.08	600.00	1.14	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5000E+01 EXCESS= .0000E+00 OUTFLOW= .5007E+01 BASIN STORAGE= .3527E-07 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.00

R23d	MANE	1.10	14.58	602.74	1.19	5.00	13.68	605.00	1.19	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1188E+01 EXCESS= .0000E+00 OUTFLOW= .1188E+01 BASIN STORAGE= .1528E-10 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23d	MANE	1.11	14.21	602.58	1.15	5.00	13.27	605.00	1.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1152E+01 EXCESS= .0000E+00 OUTFLOW= .1152E+01 BASIN STORAGE= .1347E-10 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

RWF_P2	MANE	.43	73.11	611.03	.47	5.00	73.03	615.00	.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1752E+02 EXCESS= .0000E+00 OUTFLOW= .1751E+02 BASIN STORAGE= .6705E-08 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

RWF_P2	MANE	.44	72.00	611.18	.45	5.00	71.80	615.00	.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1663E+02 EXCESS= .0000E+00 OUTFLOW= .1663E+02 BASIN STORAGE= .6343E-08 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23e	MANE	.65	140.37	601.37	.54	5.00	136.51	600.00	.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2237E+02 EXCESS= .0000E+00 OUTFLOW= .2237E+02 BASIN STORAGE= .1212E-07 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23e	MANE	.66	137.06	601.31	.52	5.00	132.99	600.00	.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2133E+02 EXCESS= .0000E+00 OUTFLOW= .2133E+02 BASIN STORAGE= .1286E-07 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_P	MANE	1.49	21.36	622.41	.26	5.00	21.08	625.00	.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2961E+01 EXCESS= .0000E+00 OUTFLOW= .2961E+01 BASIN STORAGE= .2237E-09 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_P	MANE	1.54	19.69	622.74	.24	5.00	19.42	625.00	.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2729E+01 EXCESS= .0000E+00 OUTFLOW= .2729E+01 BASIN STORAGE= .2236E-09 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_O	MANE	1.93	21.06	627.64	.26	5.00	21.01	625.00	.26	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2959E+01 EXCESS= .0000E+00 OUTFLOW= .2958E+01 BASIN STORAGE= .1269E-06 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_O	MANE	1.96	19.39	627.62	.24	5.00	19.30	625.00	.24	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2728E+01 EXCESS= .0000E+00 OUTFLOW= .2727E+01 BASIN STORAGE= .1053E-06 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_P	MANE	.44	8.23	605.93	.70	5.00	8.19	605.00	.70	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7807E+00 EXCESS= .0000E+00 OUTFLOW= .7807E+00 BASIN STORAGE= .3494E-12 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_P	MANE	.44	7.91	605.63	.67	5.00	7.88	605.00	.67	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7500E+00 EXCESS= .0000E+00 OUTFLOW= .7501E+00 BASIN STORAGE= .3594E-12 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_O	MANE	2.55	8.05	609.18	.70	5.00	8.02	610.00	.70	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7811E+00 EXCESS= .0000E+00 OUTFLOW= .7808E+00 BASIN STORAGE= .7196E-07 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_O	MANE	2.63	7.69	611.38	.67	5.00	7.68	610.00	.67	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7505E+00 EXCESS= .0000E+00 OUTFLOW= .7503E+00 BASIN STORAGE= .6098E-07 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R25_O MANE 5.00 .01 639.24 -1.00 5.00 .01 640.00 -1.00

FOR PLAN = 1 RATIO= .97

R25_O MANE 5.00 .01 641.91 -1.00 5.00 .01 640.00 -1.00

FOR PLAN = 1 RATIO= 1.00

R25_P MANE 2.48 .01 650.56 -1.00 5.00 .01 650.00 -1.00

FOR PLAN = 1 RATIO= .97

R25_P MANE 2.48 .01 651.27 -1.00 5.00 .01 650.00 -1.00

FOR PLAN = 1 RATIO= 1.00

R_16a MANE 3.98 117.92 610.19 .87 5.00 117.85 610.00 .87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7258E+01 EXCESS= .0000E+00 OUTFLOW= .7278E+01 BASIN STORAGE= .5513E-05 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .97

R_16a MANE 4.00 115.63 609.86 .84 5.00 114.96 610.00 .84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7002E+01 EXCESS= .0000E+00 OUTFLOW= .7039E+01 BASIN STORAGE= .6559E-05 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= 1.00

R_5 MANE 5.00 2.23 754.49 .27 5.00 2.23 755.00 .27

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8321E+00 EXCESS= .0000E+00 OUTFLOW= .8605E+00 BASIN STORAGE= .8708E-03 PERCENT ERROR= -3.5

FOR PLAN = 1 RATIO= .97

R_5 MANE 5.00 2.07 756.34 .25 5.00 2.06 760.00 .25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7668E+00 EXCESS= .0000E+00 OUTFLOW= .7964E+00 BASIN STORAGE= .8700E-03 PERCENT ERROR= -4.0

```
          FOR PLAN = 1  RATIO= 1.00

            R_I3_O  MANE         2.79    180.88    691.41       .22      5.00    180.76    690.00         .22


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6148E+02 EXCESS= .0000E+00 OUTFLOW= .6146E+02 BASIN STORAGE= .5696E-04 PERCENT
ERROR=    .0


          FOR PLAN = 1  RATIO=  .97

            R_I3_O  MANE         2.88    166.33    692.13       .20      5.00    166.25    690.00         .20


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5666E+02 EXCESS= .0000E+00 OUTFLOW= .5664E+02 BASIN STORAGE= .6720E-04 PERCENT
ERROR=    .0


1                                                  HEC-1 INPUT                                                  PAGE  1

          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 *** WARNING *** ZZ-CARD MISSING
              1
              2          ZZ
1**************************************
**************************************
 *                                    *                                                  *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                  *    U.S. ARMY CORPS OF
ENGINEERS     *
 *               JUN   1998             *                                                  *    HYDROLOGIC ENGINEERING
CENTER    *
 *             VERSION 4.1              *                                                  *          609 SECOND
STREET          *
 *                                      *                                                  *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   07JUN12  TIME  10:32:08   *                                                  *           (916) 756-1104
        *
 *                                      *                                                  *
        *
 **************************************
**************************************




 *** HEC-1 ERROR 1 *** INVALID CARD IDENTIFICATION CODE OR CARD OUT OF SEQUENCE
      CARD NO.    1

      IT          HYDROGRAPH TIME DATA
                        NMIN           5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         500  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      2    0  ENDING DATE
                      NDTIME        1735  ENDING TIME
                      ICENT           19  CENTURY MARK

                    COMPUTATION INTERVAL     .08 HOURS
                         TOTAL TIME BASE   41.58 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
                SURFACE AREA          ACRES
                TEMPERATURE           DEGREES FAHRENHEIT

                SUBBASIN RUNOFF DATA

    0 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA
```

PRECIPITATION DATA

0 PB STORM .00 BASIN TOTAL PRECIPITATION

0 PI INCREMENTAL PRECIPITATION PATTERN

0 UI INPUT UNITGRAPH, 0 ORDINATES, VOLUME = .00

***

****

HYDROGRAPH AT STATION C-All

****

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	.00	.00	.00	0.	1		2050	251	.00	.00	.00	0.
1		0005	2	.00	.00	.00	0.	1		2055	252	.00	.00	.00	0.
1		0010	3	.00	.00	.00	0.	1		2100	253	.00	.00	.00	0.
1		0015	4	.00	.00	.00	0.	1		2105	254	.00	.00	.00	0.
1		0020	5	.00	.00	.00	0.	1		2110	255	.00	.00	.00	0.
1		0025	6	.00	.00	.00	0.	1		2115	256	.00	.00	.00	0.
1		0030	7	.00	.00	.00	0.	1		2120	257	.00	.00	.00	0.
1		0035	8	.00	.00	.00	0.	1		2125	258	.00	.00	.00	0.
1		0040	9	.00	.00	.00	0.	1		2130	259	.00	.00	.00	0.
1		0045	10	.00	.00	.00	0.	1		2135	260	.00	.00	.00	0.
1		0050	11	.00	.00	.00	0.	1		2140	261	.00	.00	.00	0.
1		0055	12	.00	.00	.00	0.	1		2145	262	.00	.00	.00	0.
1		0100	13	.00	.00	.00	0.	1		2150	263	.00	.00	.00	0.
1		0105	14	.00	.00	.00	0.	1		2155	264	.00	.00	.00	0.
1		0110	15	.00	.00	.00	0.	1		2200	265	.00	.00	.00	0.
1		0115	16	.00	.00	.00	0.	1		2205	266	.00	.00	.00	0.
1		0120	17	.00	.00	.00	0.	1		2210	267	.00	.00	.00	0.
1		0125	18	.00	.00	.00	0.	1		2215	268	.00	.00	.00	0.
1		0130	19	.00	.00	.00	0.	1		2220	269	.00	.00	.00	0.
1		0135	20	.00	.00	.00	0.	1		2225	270	.00	.00	.00	0.
1		0140	21	.00	.00	.00	0.	1		2230	271	.00	.00	.00	0.
1		0145	22	.00	.00	.00	0.	1		2235	272	.00	.00	.00	0.
1		0150	23	.00	.00	.00	0.	1		2240	273	.00	.00	.00	0.
1		0155	24	.00	.00	.00	0.	1		2245	274	.00	.00	.00	0.
1		0200	25	.00	.00	.00	0.	1		2250	275	.00	.00	.00	0.
1		0205	26	.00	.00	.00	0.	1		2255	276	.00	.00	.00	0.
1		0210	27	.00	.00	.00	0.	1		2300	277	.00	.00	.00	0.
1		0215	28	.00	.00	.00	0.	1		2305	278	.00	.00	.00	0.
1		0220	29	.00	.00	.00	0.	1		2310	279	.00	.00	.00	0.
1		0225	30	.00	.00	.00	0.	1		2315	280	.00	.00	.00	0.
1		0230	31	.00	.00	.00	0.	1		2320	281	.00	.00	.00	0.
1		0235	32	.00	.00	.00	0.	1		2325	282	.00	.00	.00	0.
1		0240	33	.00	.00	.00	0.	1		2330	283	.00	.00	.00	0.

0.													
	1	0245	34	.00	.00	.00	0.	*	1	2335	284	.00	.00	.00
0.														
	1	0250	35	.00	.00	.00	0.	*	1	2340	285	.00	.00	.00
0.														
	1	0255	36	.00	.00	.00	0.	*	1	2345	286	.00	.00	.00
0.														
	1	0300	37	.00	.00	.00	0.	*	1	2350	287	.00	.00	.00
0.														
	1	0305	38	.00	.00	.00	0.	*	1	2355	288	.00	.00	.00
0.														
	1	0310	39	.00	.00	.00	0.	*	2	0000	289	.00	.00	.00
0.														
	1	0315	40	.00	.00	.00	0.	*	2	0005	290	.00	.00	.00
0.														
	1	0320	41	.00	.00	.00	0.	*	2	0010	291	.00	.00	.00
0.														
	1	0325	42	.00	.00	.00	0.	*	2	0015	292	.00	.00	.00
0.														
	1	0330	43	.00	.00	.00	0.	*	2	0020	293	.00	.00	.00
0.														
	1	0335	44	.00	.00	.00	0.	*	2	0025	294	.00	.00	.00
0.														
	1	0340	45	.00	.00	.00	0.	*	2	0030	295	.00	.00	.00
0.														
	1	0345	46	.00	.00	.00	0.	*	2	0035	296	.00	.00	.00
0.														
	1	0350	47	.00	.00	.00	0.	*	2	0040	297	.00	.00	.00
0.														
	1	0355	48	.00	.00	.00	0.	*	2	0045	298	.00	.00	.00
0.														
	1	0400	49	.00	.00	.00	0.	*	2	0050	299	.00	.00	.00
0.														
	1	0405	50	.00	.00	.00	0.	*	2	0055	300	.00	.00	.00
0.														
	1	0410	51	.00	.00	.00	0.	*	2	0100	301	.00	.00	.00
0.														
	1	0415	52	.00	.00	.00	0.	*	2	0105	302	.00	.00	.00
0.														
	1	0420	53	.00	.00	.00	0.	*	2	0110	303	.00	.00	.00
0.														
	1	0425	54	.00	.00	.00	0.	*	2	0115	304	.00	.00	.00
0.														
	1	0430	55	.00	.00	.00	0.	*	2	0120	305	.00	.00	.00
0.														
	1	0435	56	.00	.00	.00	0.	*	2	0125	306	.00	.00	.00
0.														
	1	0440	57	.00	.00	.00	0.	*	2	0130	307	.00	.00	.00
0.														
	1	0445	58	.00	.00	.00	0.	*	2	0135	308	.00	.00	.00
0.														
	1	0450	59	.00	.00	.00	0.	*	2	0140	309	.00	.00	.00
0.														
	1	0455	60	.00	.00	.00	0.	*	2	0145	310	.00	.00	.00
0.														
	1	0500	61	.00	.00	.00	0.	*	2	0150	311	.00	.00	.00
0.														
	1	0505	62	.00	.00	.00	0.	*	2	0155	312	.00	.00	.00
0.														
	1	0510	63	.00	.00	.00	0.	*	2	0200	313	.00	.00	.00
0.														
	1	0515	64	.00	.00	.00	0.	*	2	0205	314	.00	.00	.00
0.														
	1	0520	65	.00	.00	.00	0.	*	2	0210	315	.00	.00	.00
0.														
	1	0525	66	.00	.00	.00	0.	*	2	0215	316	.00	.00	.00
0.														
	1	0530	67	.00	.00	.00	0.	*	2	0220	317	.00	.00	.00
0.														
	1	0535	68	.00	.00	.00	0.	*	2	0225	318	.00	.00	.00
0.														
	1	0540	69	.00	.00	.00	0.	*	2	0230	319	.00	.00	.00
0.														
	1	0545	70	.00	.00	.00	0.	*	2	0235	320	.00	.00	.00
0.														
	1	0550	71	.00	.00	.00	0.	*	2	0240	321	.00	.00	.00
0.														
	1	0555	72	.00	.00	.00	0.	*	2	0245	322	.00	.00	.00
0.														
	1	0600	73	.00	.00	.00	0.	*	2	0250	323	.00	.00	.00
0.														
	1	0605	74	.00	.00	.00	0.	*	2	0255	324	.00	.00	.00
0.														
	1	0610	75	.00	.00	.00	0.	*	2	0300	325	.00	.00	.00
0.														
	1	0615	76	.00	.00	.00	0.	*	2	0305	326	.00	.00	.00
0.														
	1	0620	77	.00	.00	.00	0.	*	2	0310	327	.00	.00	.00
0.														
	1	0625	78	.00	.00	.00	0.	*	2	0315	328	.00	.00	.00
0.														

0.	1	0630	79	.00	.00	.00	0.	*	2	0320	329	.00	.00	.00
0.	1	0635	80	.00	.00	.00	0.	*	2	0325	330	.00	.00	.00
0.	1	0640	81	.00	.00	.00	0.	*	2	0330	331	.00	.00	.00
0.	1	0645	82	.00	.00	.00	0.	*	2	0335	332	.00	.00	.00
0.	1	0650	83	.00	.00	.00	0.	*	2	0340	333	.00	.00	.00
0.	1	0655	84	.00	.00	.00	0.	*	2	0345	334	.00	.00	.00
0.	1	0700	85	.00	.00	.00	0.	*	2	0350	335	.00	.00	.00
0.	1	0705	86	.00	.00	.00	0.	*	2	0355	336	.00	.00	.00
0.	1	0710	87	.00	.00	.00	0.	*	2	0400	337	.00	.00	.00
0.	1	0715	88	.00	.00	.00	0.	*	2	0405	338	.00	.00	.00
0.	1	0720	89	.00	.00	.00	0.	*	2	0410	339	.00	.00	.00
0.	1	0725	90	.00	.00	.00	0.	*	2	0415	340	.00	.00	.00
0.	1	0730	91	.00	.00	.00	0.	*	2	0420	341	.00	.00	.00
0.	1	0735	92	.00	.00	.00	0.	*	2	0425	342	.00	.00	.00
0.	1	0740	93	.00	.00	.00	0.	*	2	0430	343	.00	.00	.00
0.	1	0745	94	.00	.00	.00	0.	*	2	0435	344	.00	.00	.00
0.	1	0750	95	.00	.00	.00	0.	*	2	0440	345	.00	.00	.00
0.	1	0755	96	.00	.00	.00	0.	*	2	0445	346	.00	.00	.00
0.	1	0800	97	.00	.00	.00	0.	*	2	0450	347	.00	.00	.00
0.	1	0805	98	.00	.00	.00	0.	*	2	0455	348	.00	.00	.00
0.	1	0810	99	.00	.00	.00	0.	*	2	0500	349	.00	.00	.00
0.	1	0815	100	.00	.00	.00	0.	*	2	0505	350	.00	.00	.00
0.	1	0820	101	.00	.00	.00	0.	*	2	0510	351	.00	.00	.00
0.	1	0825	102	.00	.00	.00	0.	*	2	0515	352	.00	.00	.00
0.	1	0830	103	.00	.00	.00	0.	*	2	0520	353	.00	.00	.00
0.	1	0835	104	.00	.00	.00	0.	*	2	0525	354	.00	.00	.00
0.	1	0840	105	.00	.00	.00	0.	*	2	0530	355	.00	.00	.00
0.	1	0845	106	.00	.00	.00	0.	*	2	0535	356	.00	.00	.00
0.	1	0850	107	.00	.00	.00	0.	*	2	0540	357	.00	.00	.00
0.	1	0855	108	.00	.00	.00	0.	*	2	0545	358	.00	.00	.00
0.	1	0900	109	.00	.00	.00	0.	*	2	0550	359	.00	.00	.00
0.	1	0905	110	.00	.00	.00	0.	*	2	0555	360	.00	.00	.00
0.	1	0910	111	.00	.00	.00	0.	*	2	0600	361	.00	.00	.00
0.	1	0915	112	.00	.00	.00	0.	*	2	0605	362	.00	.00	.00
0.	1	0920	113	.00	.00	.00	0.	*	2	0610	363	.00	.00	.00
0.	1	0925	114	.00	.00	.00	0.	*	2	0615	364	.00	.00	.00
0.	1	0930	115	.00	.00	.00	0.	*	2	0620	365	.00	.00	.00
0.	1	0935	116	.00	.00	.00	0.	*	2	0625	366	.00	.00	.00
0.	1	0940	117	.00	.00	.00	0.	*	2	0630	367	.00	.00	.00
0.	1	0945	118	.00	.00	.00	0.	*	2	0635	368	.00	.00	.00
0.	1	0950	119	.00	-.02	.02	0.	*	2	0640	369	.00	.00	.00
0.	1	0955	120	.00	-.12	.12	0.	*	2	0645	370	.00	.00	.00
0.	1	1000	121	.00	-.08	.08	0.	*	2	0650	371	.00	.00	.00
0.	1	1005	122	.00	.00	.00	0.	*	2	0655	372	.00	.00	.00
0.	1	1010	123	.00	.00	.00	0.	*	2	0700	373	.00	.00	.00
0.	1	1015	124	.00	.00	.00	0.	*	2	0705	374	.00	.00	.00

```
0.
      1     1020  125     .00     .00     .00          0.        *        2     0710  375     .00     .00     .00
0.
      1     1025  126     .00     .00     .00          0.        *        2     0715  376     .00     .00     .00
0.
      1     1030  127     .00     .00     .00          0.        *        2     0720  377     .00     .00     .00
0.
      1     1035  128     .00     .00     .00          0.        *        2     0725  378     .00     .00     .00
0.
      1     1040  129     .00     .00     .00          0.        *        2     0730  379     .00     .00     .00
0.
      1     1045  130     .00     .00     .00          0.        *        2     0735  380     .00     .00     .00
0.
      1     1050  131     .00     .00     .00          0.        *        2     0740  381     .00     .00     .00
0.
      1     1055  132     .00     .00     .00          0.        *        2     0745  382     .00     .00     .00
0.
      1     1100  133     .00     .00     .00          0.        *        2     0750  383     .00     .00     .00
0.
      1     1105  134     .00     .00     .00          0.        *        2     0755  384     .00     .00     .00
0.
      1     1110  135     .00     .00     .00          0.        *        2     0800  385     .00     .00     .00
0.
      1     1115  136     .00     .00     .00          0.        *        2     0805  386     .00     .00     .00
0.
      1     1120  137     .00     .00     .00          0.        *        2     0810  387     .00     .00     .00
0.
      1     1125  138     .00     .00     .00          0.        *        2     0815  388     .00     .00     .00
0.
      1     1130  139     .00     .00     .00          0.        *        2     0820  389     .00     .00     .00
0.
      1     1135  140     .00     .00     .00          0.        *        2     0825  390     .00     .00     .00
0.
      1     1140  141     .00     .00     .00          0.        *        2     0830  391     .00     .00     .00
0.
      1     1145  142     .00     .00     .00          0.        *        2     0835  392     .00     .00     .00
0.
      1     1150  143     .00     .00     .00          0.        *        2     0840  393     .00     .00     .00
0.
      1     1155  144     .00     .00     .00          0.        *        2     0845  394     .00     .00     .00
0.
      1     1200  145     .00     .00     .00          0.        *        2     0850  395     .00     .00     .00
0.
      1     1205  146     .00     .00     .00          0.        *        2     0855  396     .00     .00     .00
0.
      1     1210  147     .00     .00     .00          0.        *        2     0900  397     .00     .00     .00
0.
      1     1215  148     .00     .00     .00          0.        *        2     0905  398     .00     .00     .00
0.
      1     1220  149     .00     .00     .00          0.        *        2     0910  399     .00     .00     .00
0.
      1     1225  150     .00     .00     .00          0.        *        2     0915  400     .00     .00     .00
0.
      1     1230  151     .00     .00     .00          0.        *        2     0920  401     .00     .00     .00
0.
      1     1235  152     .00     .00     .00          0.        *        2     0925  402     .00     .00     .00
0.
      1     1240  153     .00     .00     .00          0.        *        2     0930  403     .00     .00     .00
0.
      1     1245  154     .00     .00     .00          0.        *        2     0935  404     .00     .00     .00
0.
      1     1250  155     .00     .00     .00          0.        *        2     0940  405     .00     .00     .00
0.
      1     1255  156     .00     .00     .00          0.        *        2     0945  406     .00     .00     .00
0.
      1     1300  157     .00     .00     .00          0.        *        2     0950  407     .00     .00     .00
0.
      1     1305  158     .00     .00     .00          0.        *        2     0955  408     .00     .00     .00
0.
      1     1310  159     .00     .00     .00          0.        *        2     1000  409     .00     .00     .00
0.
      1     1315  160     .00     .00     .00          0.        *        2     1005  410     .00     .00     .00
0.
      1     1320  161     .00     .00     .00          0.        *        2     1010  411     .00     .00     .00
0.
      1     1325  162     .00     .00     .00          0.        *        2     1015  412     .00     .00     .00
0.
      1     1330  163     .00     .00     .00          0.        *        2     1020  413     .00     .00     .00
0.
      1     1335  164     .00     .00     .00          0.        *        2     1025  414     .00     .00     .00
0.
      1     1340  165     .00     .00     .00          0.        *        2     1030  415     .00     .00     .00
0.
      1     1345  166     .00     .00     .00          0.        *        2     1035  416     .00     .00     .00
0.
      1     1350  167     .00     .00     .00          0.        *        2     1040  417     .00     .00     .00
0.
      1     1355  168     .00     .00     .00          0.        *        2     1045  418     .00     .00     .00
0.
      1     1400  169     .00     .00     .00          0.        *        2     1050  419     .00     .00     .00
0.
```

0.	1	1405	170	.00	.00	.00	0.	*	2	1055	420	.00	.00	.00
0.	1	1410	171	.00	.00	.00	0.	*	2	1100	421	.00	.00	.00
0.	1	1415	172	.00	.00	.00	0.	*	2	1105	422	.00	.00	.00
0.	1	1420	173	.00	.00	.00	0.	*	2	1110	423	.00	.00	.00
0.	1	1425	174	.00	.00	.00	0.	*	2	1115	424	.00	.00	.00
0.	1	1430	175	.00	.00	.00	0.	*	2	1120	425	.00	.00	.00
0.	1	1435	176	.00	.00	.00	0.	*	2	1125	426	.00	.00	.00
0.	1	1440	177	.00	.00	.00	0.	*	2	1130	427	.00	.00	.00
0.	1	1445	178	.00	.00	.00	0.	*	2	1135	428	.00	.00	.00
0.	1	1450	179	.00	.00	.00	0.	*	2	1140	429	.00	.00	.00
0.	1	1455	180	.00	.00	.00	0.	*	2	1145	430	.00	.00	.00
0.	1	1500	181	.00	.00	.00	0.	*	2	1150	431	.00	.00	.00
0.	1	1505	182	.00	.00	.00	0.	*	2	1155	432	.00	.00	.00
0.	1	1510	183	.00	.00	.00	0.	*	2	1200	433	.00	.00	.00
0.	1	1515	184	.00	.00	.00	0.	*	2	1205	434	.00	.00	.00
0.	1	1520	185	.00	.00	.00	0.	*	2	1210	435	.00	.00	.00
0.	1	1525	186	.00	.00	.00	0.	*	2	1215	436	.00	.00	.00
0.	1	1530	187	.00	.00	.00	0.	*	2	1220	437	.00	.00	.00
0.	1	1535	188	.00	.00	.00	0.	*	2	1225	438	.00	.00	.00
0.	1	1540	189	.00	.00	.00	0.	*	2	1230	439	.00	.00	.00
0.	1	1545	190	.00	.00	.00	0.	*	2	1235	440	.00	.00	.00
0.	1	1550	191	.00	.00	.00	0.	*	2	1240	441	.00	.00	.00
0.	1	1555	192	.00	.00	.00	0.	*	2	1245	442	.00	.00	.00
0.	1	1600	193	.00	.00	.00	0.	*	2	1250	443	.00	.00	.00
0.	1	1605	194	.00	.00	.00	0.	*	2	1255	444	.00	.00	.00
0.	1	1610	195	.00	.00	.00	0.	*	2	1300	445	.00	.00	.00
0.	1	1615	196	.00	.00	.00	0.	*	2	1305	446	.00	.00	.00
0.	1	1620	197	.00	.00	.00	0.	*	2	1310	447	.00	.00	.00
0.	1	1625	198	.00	.00	.00	0.	*	2	1315	448	.00	.00	.00
0.	1	1630	199	.00	.00	.00	0.	*	2	1320	449	.00	.00	.00
0.	1	1635	200	.00	.00	.00	0.	*	2	1325	450	.00	.00	.00
0.	1	1640	201	.00	.00	.00	0.	*	2	1330	451	.00	.00	.00
0.	1	1645	202	.00	.00	.00	0.	*	2	1335	452	.00	.00	.00
0.	1	1650	203	.00	.00	.00	0.	*	2	1340	453	.00	.00	.00
0.	1	1655	204	.00	.00	.00	0.	*	2	1345	454	.00	.00	.00
0.	1	1700	205	.00	.00	.00	0.	*	2	1350	455	.00	.00	.00
0.	1	1705	206	.00	.00	.00	0.	*	2	1355	456	.00	.00	.00
0.	1	1710	207	.00	.00	.00	0.	*	2	1400	457	.00	.00	.00
0.	1	1715	208	.00	.00	.00	0.	*	2	1405	458	.00	.00	.00
0.	1	1720	209	.00	.00	.00	0.	*	2	1410	459	.00	.00	.00
0.	1	1725	210	.00	.00	.00	0.	*	2	1415	460	.00	.00	.00
0.	1	1730	211	.00	.00	.00	0.	*	2	1420	461	.00	.00	.00
0.	1	1735	212	.00	.00	.00	0.	*	2	1425	462	.00	.00	.00
0.	1	1740	213	.00	.00	.00	0.	*	2	1430	463	.00	.00	.00
0.	1	1745	214	.00	.00	.00	0.	*	2	1435	464	.00	.00	.00
0.	1	1750	215	.00	.00	.00	0.	*	2	1440	465	.00	.00	.00

0.														
	1	1755	216	.00	.00	.00	0.	*	2	1445	466	.00	.00	.00
0.														
	1	1800	217	.00	.00	.00	0.	*	2	1450	467	.00	.00	.00
0.														
	1	1805	218	.00	.00	.00	0.	*	2	1455	468	.00	.00	.00
0.														
	1	1810	219	.00	.00	.00	0.	*	2	1500	469	.00	.00	.00
0.														
	1	1815	220	.00	.00	.00	0.	*	2	1505	470	.00	.00	.00
0.														
	1	1820	221	.00	.00	.00	0.	*	2	1510	471	.00	.00	.00
0.														
	1	1825	222	.00	.00	.00	0.	*	2	1515	472	.00	.00	.00
0.														
	1	1830	223	.00	.00	.00	0.	*	2	1520	473	.00	.00	.00
0.														
	1	1835	224	.00	.00	.00	0.	*	2	1525	474	.00	.00	.00
0.														
	1	1840	225	.00	.00	.00	0.	*	2	1530	475	.00	.00	.00
0.														
	1	1845	226	.00	.00	.00	0.	*	2	1535	476	.00	.00	.00
0.														
	1	1850	227	.00	.00	.00	0.	*	2	1540	477	.00	.00	.00
0.														
	1	1855	228	.00	.00	.00	0.	*	2	1545	478	.00	.00	.00
0.														
	1	1900	229	.00	.00	.00	0.	*	2	1550	479	.00	.00	.00
0.														
	1	1905	230	.00	.00	.00	0.	*	2	1555	480	.00	.00	.00
0.														
	1	1910	231	.00	.00	.00	0.	*	2	1600	481	.00	.00	.00
0.														
	1	1915	232	.00	.00	.00	0.	*	2	1605	482	.00	.00	.00
0.														
	1	1920	233	.00	.00	.00	0.	*	2	1610	483	.00	.00	.00
0.														
	1	1925	234	.00	.00	.00	0.	*	2	1615	484	.00	.00	.00
0.														
	1	1930	235	.00	.00	.00	0.	*	2	1620	485	.00	.00	.00
0.														
	1	1935	236	.00	.00	.00	0.	*	2	1625	486	.00	.00	.00
0.														
	1	1940	237	.00	.00	.00	0.	*	2	1630	487	.00	.00	.00
0.														
	1	1945	238	.00	.00	.00	0.	*	2	1635	488	.00	.00	.00
0.														
	1	1950	239	.00	.00	.00	0.	*	2	1640	489	.00	.00	.00
0.														
	1	1955	240	.00	.00	.00	0.	*	2	1645	490	.00	.00	.00
0.														
	1	2000	241	.00	.00	.00	0.	*	2	1650	491	.00	.00	.00
0.														
	1	2005	242	.00	.00	.00	0.	*	2	1655	492	.00	.00	.00
0.														
	1	2010	243	.00	.00	.00	0.	*	2	1700	493	.00	.00	.00
0.														
	1	2015	244	.00	.00	.00	0.	*	2	1705	494	.00	.00	.00
0.														
	1	2020	245	.00	.00	.00	0.	*	2	1710	495	.00	.00	.00
0.														
	1	2025	246	.00	.00	.00	0.	*	2	1715	496	.00	.00	.00
0.														
	1	2030	247	.00	.00	.00	0.	*	2	1720	497	.00	.00	.00
0.														
	1	2035	248	.00	.00	.00	0.	*	2	1725	498	.00	.00	.00
0.														
	1	2040	249	.00	.00	.00	0.	*	2	1730	499	.00	.00	.00
0.														
	1	2045	250	.00	.00	.00	0.	*	2	1735	500	.00	.00	.00
0.														
								*						

****

TOTAL RAINFALL = .00, TOTAL LOSS = -.24, TOTAL EXCESS = .24

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	41.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 0.	.00		0.	0.	0.	0.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	0.	0.	0.	0.

CUMULATIVE AREA = 24.55 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND

TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT									
C-All		0.	.00	0.	0.	0.	24.55		

*** 1 ERROR(S) DETECTED BY HEC-1 ***

```
1****************************************
****************************************
 *                                      *                                                *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                *    U.S. ARMY CORPS OF
ENGINEERS     *
 *              JUN   1998              *                                                *    HYDROLOGIC ENGINEERING
CENTER    *
 *           VERSION 4.1                *                                                *          609 SECOND
STREET        *
 *                                      *                                                *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   07JUN12  TIME  10:30:45  *                                                *           (916) 756-1104
        *
 *                                      *                                                *
        *
 ****************************************
****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                         *DIAGRAM
             1           ID        Grand Junction Regional Airport - Jviation - prepared March 9 2012
             2           ID        Existing Conditions Watershed Model  - All Soils are Type D
             3           ID        100-Year 24-Hour Storm - NRCS Type II Rainfall Distribution
             4           ID    PREC 1.00 for 0.1< area < 5.0 squire miles; use flow under ratio 1
             5           ID    PREC 0.97 for 5.0< area <12.5 square miles; use flow under ratio 2
             6           ID    When I>10, uses CHUP method for Tlag, when I<10, uses Grand Junction SCS Meth
             7           ID        ************************************************************************
 *** FREE ***
             8           IT       5       0       0     500
             9           IO       5       0       0
            10           IN       5       0      07
            11           JR    PREC     1.0    0.97

            12           KK    L11b
            13           KM   Leach Creek at Upper Pond
            14           BA  7.4130
            15           PB    1.99
            16           PC       0   0.001   0.002  0.0031  0.0041  0.0051  0.0062  0.0073  0.0083  0.0094
            17           PC  0.0105  0.0116  0.0127  0.0138   0.015  0.0161  0.0173  0.0185  0.0196  0.0208
            18           PC   0.022  0.0232  0.0244  0.0257  0.0269  0.0281  0.0294  0.0307  0.0319  0.0332
            19           PC  0.0345  0.0358  0.0371  0.0384  0.0398  0.0411  0.0425  0.0438  0.0452  0.0466
            20           PC   0.048  0.0494  0.0508  0.0523  0.0538  0.0553  0.0568  0.0583  0.0598  0.0614
            21           PC   0.063  0.0646  0.0662  0.0679  0.0696  0.0712   0.073  0.0747  0.0764  0.0782
            22           PC    0.08  0.0818  0.0836  0.0855  0.0874  0.0892  0.0912  0.0931   0.095   0.097
            23           PC   0.099   0.101   0.103  0.1051  0.1072  0.1093  0.1114  0.1135  0.1156  0.1178
            24           PC    0.12  0.1223  0.1246  0.1271  0.1296  0.1323   0.135  0.1379  0.1408  0.1439
            25           PC   0.147  0.1502  0.1534  0.1566  0.1598   0.163  0.1663  0.1697  0.1733  0.1771
            26           PC   0.181  0.1851  0.1895  0.1941  0.1989   0.204  0.2094  0.2152  0.2214   0.228
            27           PC   0.235  0.2427  0.2513  0.2609  0.2715   0.283  0.3068  0.3544  0.4308  0.5679
            28           PC   0.663   0.682  0.6986   0.713  0.7252   0.735  0.7434  0.7514  0.7588  0.7656
            29           PC   0.772   0.778  0.7836   0.789  0.7942   0.799  0.8036   0.808  0.8122  0.8162
            30           PC    0.82  0.8237  0.8273  0.8308  0.8342  0.8376  0.8409  0.8442  0.8474  0.8505
            31           PC  0.8535  0.8565  0.8594  0.8622  0.8649  0.8676  0.8702  0.8728  0.8753  0.8777
            32           PC    0.88  0.8823  0.8846  0.8868   0.889  0.8912  0.8934  0.8955  0.8976  0.8997
            33           PC  0.9018  0.9038  0.9058  0.9078  0.9098  0.9117  0.9136  0.9155  0.9174  0.9192
            34           PC   0.921  0.9228  0.9246  0.9263   0.928  0.9297  0.9314   0.933  0.9346  0.9362
            35           PC  0.9377  0.9393  0.9408  0.9423  0.9438  0.9452  0.9466   0.948  0.9494  0.9507
            36           PC   0.952  0.9533  0.9546  0.9559  0.9572  0.9584  0.9597   0.961  0.9622  0.9635
            37           PC  0.9648   0.966  0.9672  0.9685  0.9697  0.9709  0.9722  0.9734  0.9746  0.9758
            38           PC   0.977  0.9782  0.9794  0.9806  0.9818  0.9829  0.9841  0.9853  0.9864  0.9876
            39           PC  0.9888  0.9899   0.991  0.9922  0.9933  0.9944  0.9956  0.9967  0.9978  0.9989
```

```
 40          PC       1       1       1       1       1       1       1       1       1       1
 41          PC       1       1       1       1       1       1       1       1       1       1
 42          PC       1       1       1       1       1       1       1       1       1       1
 43          PC       1       1       1       1       1       1       1       1       1       1
 44          PC       1       1       1       1       1       1       1       1       1       1
 45          PC       1       1       1       1       1       1       1       1       1       1
 46          LG    0.41  0.4023   1.502   0.054     2.0
 47          US   1.654   0.451
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 48          KK  RL11bDRoute Hydrograph Through L11a
 49          RK    9500  0.0129   0.035       0    TRAP      10       6

 50          KK   L11aU
 51          KM   Subbasin L11aU
 52          BA  1.0148
 53          LG    0.41  0.4023   1.502   0.054     2.0
 54          US   1.149   0.333

 55          KK  C_11aU
 56          KM   Combine Basins L11b and L11au
 57          HC       2

 58          KK   L11aD
 59          KM   Subbasin L11aD
 60          BA  0.0230
 61          LG    0.41  0.4023   1.502   0.054     2.0
 62          US   0.035   0.190

 63          KK  C_11aD
 64          KM   Combine Hydrographs of Basin L11aU and L11aD
 65          HC       2

 66          KK     L10
 67          KM   Subbasin L10
 68          BA  1.0245
 69          LG    0.41  0.4023   1.502   0.054     2.0
 70          US   1.123   0.335

 71          KK    R_10Route Basin L10 to DP C_1011
 72          RK    5000   0.012    0.03       0    TRAP      10       4

 73          KK  C_1011
 74          KM   Combine Hydrographs of Subbasin L10 and L11
 75          HC       2

 76          KK   R_L9M
 77          KM   Route Mainstem Hydrograph Through L9
 78          RS       1    STOR       0
 79          SV       0    1.24    2.23     3.3    4.23    4.86    5.34    6.55    7.57    8.54
 80          SV    9.65   10.61   11.55   12.36   13.09  3000.0
 81          SQ       0     100     200     300     400     500     600     800    1000    1200
 82          SQ    1400    1600    1800    2000    2200    2400

 83          KK     R17
 84          KM   Subbasin R17
 85          BA  0.1230
 86          LG    0.41  0.4023   1.502   0.054     2.0
 87          US   0.169   0.244
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 88          KK   R_R17Route hydrograph through L9.1
 89          RK    4600   0.014    0.03       0    TRAP      10       4

 90          KK    R15u
 91          KM   Subbasin R15 Upper Portion
 92          BA  0.1590
 93          LG    0.33  0.3313   1.237   0.044    25.0
 94          US   0.155   0.274

 95          KK  R_EXPD
 96          KM   Existing Pond at end of Basin R15u
 97          RS       1    STOR       0
 98          SV     0.0    0.03    0.20    0.57    1.15    1.95    2.87    3.87
 99          SQ     0.0     0.0     2.7    10.3    20.6    33.1    47.6    71.3
100          SE    4790    4791    4792    4793    4794    4795    4796    4797

101          KK   R_R15Route Subbasin R15u Hydrograph Through L9.1d
102          RK    2000   0.006    0.03       0    TRAP       5     2.4

103          KK  C_1517
104          KM   Combine Hydrographs of Subbasin R15 and R17
105          HC       2

106          KK    L9.1
```

```
 107          KM   Subbasin L9.1
 108          BA  2.6711
 109          LG    0.40  0.4023   1.502   0.054     4.0
 110          US   1.107   0.369

 111          KK   C_LT9
 112          KM   Combine Hydrographs of Subbasin R15 and R17 and L9.1
 113          HC       2

 114          KK   C_L9M
 115          KM   Ultimate Outfall into Leach Creek
 116          HC       2

 117          KK      L9
 118          KM   Subbasin
 119          BA  0.1647
 120          LG    0.39  0.3787   1.414   0.051     6.0
 121          US   0.792   0.233

 122          KK  CL9L10
 123          KM   L9+L10
 124          HC       2

 125          KK      C3
 126          KM   Corcoran Wash at H Road and 25 Road
 127          BA  0.5778
 128          LG    0.41  0.4023   1.502   0.054     2.0
 129          US   0.670   0.307
1                                        HEC-1 INPUT                                    PAGE  4

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 130          KK   Upper
 131          KM   L9+L10+C3
 132          HC       2

 133          KK    DB21
 134          KM   Subbasin
 135          BA  0.1570
 136          LG    0.41  0.4023   1.502   0.054     2.0
 137          US   0.318   0.253

 138          KK      PDA
 139          KM   Existing Pond A
 140          RS       1    STOR       0       0
 141          SV     0.0   0.001     1.8     4.7     8.9    11.6
 142          SQ     0.0     2.5     7.0     9.0    10.6    11.3
 143          SE    4915    4916    4918    4920    4922    4923

 144          KK   DB21a
 145          KM   Subbasin
 146          BA  0.3827
 147          LG    0.41  0.4023   1.502   0.054     2.0
 148          US   0.516   0.289

 149          KK    C21a
 150          KM   Combine DB Flows north of RW
 151          HC       2

 152          KK   DB23b
 153          KM   Subbasin
 154          BA  0.0581
 155          LG    0.06  0.0710   0.265   0.010    95.0
 156          US   0.046   0.547

 157          KK    C23b
 158          KM   Combine Hydrograph Basin 23b with 21a
 159          HC       2

 160          KK    R23b
 161          KM   Route Hydrograph Through Basin 23c Pipe
 162          RK    1000   0.020   0.013       0    CIRC       3

 163          KK   DB23c
 164          KM   Subbasin
 165          BA  0.0822
 166          LG    0.06  0.0710   0.265   0.010    95.0
 167          US   0.080   0.577

 168          KK    R23c
 169          KM   Route R23c Through R23c Ditch
 170          RK     500    .005   0.045       0    TRAP      10       4
1                                        HEC-1 INPUT                                    PAGE  5

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 171          KK   DB23d
 172          KM   Subbasin
 173          BA  0.0188
```

```
 174          LG    0.04  0.0473   0.177   0.006   100.0
 175          US   0.023   0.467

 176          KK    R23d
 177          KM   Route Hydrograph Through Basin 23d Pipe
 178          RK    1200   0.005   0.015       0    CIRC       2

 179          KK    C23c
 180          KM   Combine Hydrograph Basins 23c,23d with 23b
 181          HC       3

 182          KK  WF_PD2
 183          KM   Route Hydrograph Through New Walker Field On Site Pond 2
 184          RS       1    STOR       0       0
 185          SV     0.0    0.10    0.70    1.64    3.16    5.34
 186          SQ     0.0    23.6    48.1    68.1    83.4    3000
 187          SE  4793.5    4795    4797    4799    4801    4803

 188          KK  RWF_P2
 189          KM   Route Hydrograph Through Basin 23e Pipe
 190          RK    1000   0.010   0.015       0    CIRC       3

 191          KK   DB23e
 192          KM   Subasin
 193          BA  0.0764
 194          LG    0.04  0.0473   0.177   0.006   100.0
 195          US   0.067   0.577

 196          KK    C23e
 197          KM   Combine Hydrograph Basin 23e with WF_PD2
 198          HC       2

 199          KK    R23e
 200          KM   Route Hydrograph Through Basin 23a Pipe
 201          RK    1500   0.008   0.015       0    CIRC       4

 202          KK   DB23a
 203          KM   Subbasin
 204          BA  0.0222
 205          LG    0.38  0.3787   1.414   0.051    10.0
 206          US   0.130   0.163

 207          KK    C23a
 208          KM   Combine Hydrograph Basin 23a, 23e with WF_PD2
 209          HC       2
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 210          KK    R_PDU
 211          KM   Route Hydrograph Through Upper Airport Upper Pond
 212          RS       1    STOR       0       0
 213          SV     0.0   0.001    0.21    6.09   16.16   26.80    29.4
 214          SQ     0.0    10.8    11.4    12.4    13.3    14.2     162
 215          SE    4767 4767.01    4768    4770    4772    4774  4774.5

 216          KK    D_PdU
 217          KM   Weir Flow Into Lower Pond
 218          DT  U_Pipe
 219          DI     0.0    14.2    14.3     100    1000
 220          DQ     0.0    14.2    14.2    14.2    14.2

 221          KK    DB22
 222          KM   Subbasin
 223          BA  0.2128
 224          LG    0.41  0.4023   1.502   0.054     2.0
 225          US   0.410   0.265

 226          KK   R24_P
 227          KM   Route Hydrograph Through Basin 24 Pipe
 228          RK    3076   0.014   0.015       0    CIRC     4.5

 229          KK   R24_O
 230          KM   Route Hydrograph Through Basin 24 Overland
 231          RK    1506   0.019    0.03       0    TRAP      10      12

 232          KK   DB24a
 233          KM   Subbasin
 234          BA  0.0209
 235          LG    0.27  0.2840   1.060   0.038    36.0
 236          US   0.096   0.263

 237          KK  B4aDIV
 238          KM   Divert Basin 24a overflow
 239          DT  B4aDIV
 240          DI     0.0    14.0   100.0  1000.0
 241          DQ       0    0.01    86.0   986.0

 242          KK   R24_P
 243          KM   Route Hydrograph Through Basin 24 Pipe
```

```
 244          RK     800   0.014   0.015       0    CIRC     4.5

 245          KK   R24_O
 246          KM   Route Hydrograph Through Basin 24 Overland
 247          RK    1506   0.019    0.03       0    TRAP      10      12

 248          KK    DB24
 249          KM   Subbasin
 250          BA  0.2359
 251          LG    0.12  0.1420   0.530   0.019    75.0
 252          US   0.162   0.629
1                                    HEC-1 INPUT                                    PAGE  7

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 253          KK     C24
 254          KM   Combine Hydrographs (Basin22, Basin 24a, Basin 24)
 255          HC       3

 256          KK   DR24a
 257          KM   Retrieve 24a diversion
 258          DR  B4aDIV

 259          KK   R25_O
 260          KM   Route 24a diversion through Basin 25 overland
 261          RK     800   0.015    0.03       0    TRAP      30      10

 262          KK   R25_P
 263          KM   Route 24a diversion through Basin 25 pipe
 264          RK    1600   0.013   0.015       0    CIRC       4

 265          KK    DB25
 266          KM   Subbasin
 267          BA  0.0239
 268          LG    0.27  0.2840   1.060   0.038    36.0
 269          US   0.106   0.269

 270          KK     C25
 271          KM   Combine Hydrograph with 24a diversion
 272          HC       2

 273          KK   B5DIV
 274          KM   Divert Basin 25 storm sewer overflow
 275          DT   B5DIV
 276          DI     0.0    14.0   100.0  1000.0
 277          DQ       0       0    86.0   986.0

 278          KK   DB25a
 279          KM   Subbasin
 280          BA  0.0333
 281          LG    0.37  0.3550   1.325   0.048    12.0
 282          US   0.031   0.174

 283          KK     C_6
 284          KM   Combine Basins 25a 25 24a 24 22
 285          HC       3

 286          KK     C_7
 287          KM   Combine West Ranchmans Ditch Basin
 288          HC       2

 289          KK    R_PDL
 290          KM   route Hydrograph Through Lower Airport East Pond
 291          RS       1    STOR       0       0
 292          SV     0.0    0.05    4.26   13.79   24.65    30.0
 293          SQ     0.0     5.5     7.8     9.6    11.1    14.0
 294          SE  4758.4    4760    4762    4764    4766  4766.2
1                                    HEC-1 INPUT                                    PAGE  8

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 295          KK    PR_U
 296          KM   Retrieve Upper Pond Pipe Flow
 297          DR  U_Pipe

 298          KK   C_Out
 299          KM   Combine 2 Outflow Hydrographs at Canal
 300          HC       2

 301          KK     R16
 302          KM   Subbasin
 303          BA  0.1570
 304          LG    0.21  0.2130   0.795   0.029    51.0
 305          US   0.076   0.479

 306          KK   R_16a
 307          KM   Route Hydrograph through R14A overland
 308          RK    2500   0.005    0.04       0    TRAP      10      10
```

```
309          KK    R14A
310          KM   Subbasin
311          BA  0.0411
312          LG    0.12  0.1420   0.530   0.019    75.0
313          US   0.038   0.484

314          KK   C_16A
315          KM   Combine Hydrographs (R16, R14A)
316          HC       2

317          KK   C_14A
318          KM   Combine Hydrograph with Lower Pond Outfall
319          HC       2

320          KK    R15d
321          KM   Subbasin
322          BA  0.1530
323          LG    0.41  0.4023   1.502   0.054     3.0
324          US   0.203   0.246

325          KK   R_R13
326          KM   Route Hydrograph through R13
327          RS       1    STOR       0
328          RC   0.035    0.03   0.035     971    .018
329          RX    1000    1014    1022    1026    1036    1046    1050    1062
330          RY    4762    4760    4758    4756    4756    4758    4760    4762

331          KK     R13
332          KM   Subbasin
333          BA  0.0428
334          LG    0.41  0.4023   1.502   0.054     2.0
335          US   0.179   0.208
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

336          KK   C_R13
337          KM   Combine Hydrographs
338          HC       2

339          KK CMiddle
340          HC       2

341          KK    CU+M
342          HC       2

343          KK  Extra5
344          KM   Overflow released from Basin 25
345          DR   B5DIV

346          KK     R14
347          KM   Subbasin
348          BA  0.0598
349          LG    0.41  0.4023   1.502   0.054     2.0
350          US   0.968   0.219

351          KK    C_R5
352          KM   Combine Hydrographs (R14, Basin 5)
353          HC       2

354          KK     R_5
355          KM   Route Basin 5 & R14 through R5 overland
356          RK   10500   0.008    0.03       0    TRAP      10      20

357          KK      R5
358          KM   Subbasin
359          BA  0.0844
360          LG    0.38  0.3787   1.414   0.051     9.0
361          US   0.368   0.201

362          KK      I5
363          KM   Start Indian Creek Basin
364          BA  0.7994
365          LG    0.41  0.4023   1.502   0.054     2.0
366          US   0.435   0.323

367          KK    R_I5
368          KM   Route Hydrograph Through Existing Dam
369          RS       1    STOR       0       0
370          SV       0    2.24    4.65    7.24   10.01   12.95   16.08   19.41   22.92   26.63
371          SQ     0.0     0.0     0.0     0.0     0.0     0.0     0.0    93.0   263.0   483.2
372          SE    5190    5191    5192    5193    5194    5195    5196    5197    5198    5199

373          KK      I4
374          KM   Subbasin
375          BA  1.2130
376          LG    0.41  0.4023   1.502   0.054     2.0
377          US   1.184   0.344
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 378          KK    C_I4
 379          KM   Combine I5 and I4
 380          HC       2

 381          KK      I3
 382          KM   Subbasin
 383          BA  3.2056
 384          LG    0.41  0.4023   1.502   0.054     2.0
 385          US   1.649   0.398

 386          KK    C_I3
 387          KM   Combine I4 and I3
 388          HC       2

 389          KK  R_I3_O
 390          KM   Route hydrograph through I2 overland
 391          RK    3300   0.014    0.04       0    TRAP      10       5

 392          KK      I2
 393          KM   Subbasin
 394          BA  0.9728
 395          LG    0.41  0.4023   1.502   0.054     3.0
 396          US   1.502   0.325

 397          KK    C_I2
 398          KM   Combine I3 and I2
 399          HC       2

 400          KK    R_I2
 401          KM   Route Hydrograph Through Existing Dam
 402          RS       1    STOR       0       0
 403          SV       0    3.06    6.67   10.92   15.93   21.81   28.62   36.41   45.21   55.07
 404          SV   66.05   78.18   91.52  106.10  121.97  139.16  176.23  235.99  257.34  280.13
 405          SQ       0       0    13.0    18.4    22.6    26.1    29.1    31.9    34.5    36.9
 406          SQ    39.1    41.2    43.2    45.2    47.0    48.8    52.1   228.8   234.6   240.4
 407          SE    4890    4892    4894    4896    4898    4900    4902    4904    4906    4908
 408          SE    4910    4912    4914    4916    4918    4920    4924    4930    4932    4934

 409          KK      I1
 410          KM   Subbasin
 411          BA  0.7563
 412          LG    0.41  0.4023   1.502   0.052     2.0
 413          US   1.896   0.320

 414          KK    C_I1
 415          KM   Combine I2 and I1
 416          HC       2

 417          KK      I7
 418          KM   Subbasin
 419          BA  1.0258
 420          LG    0.41  0.4023   1.502   0.054     2.0
 421          US   1.348   0.335
1                                        HEC-1 INPUT                                        PAGE 11

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 422          KK    R_I7
 423          KM   Route Hydrograph Through Existing Dam
 424          RS       1    STOR       0       0
 425          SV       0    0.26    0.60    1.01    1.51    2.11    2.82    3.63    4.57    5.64
 426          SQ     0.0     0.0     0.0     0.0     0.0     0.0     0.0    62.0   175.4   322.2
 427          SE    4820    4821    4822    4823    4824    4825    4826    4827    4828    4829

 428          KK      I6
 429          KM   Subbasin
 430          BA  0.4513
 431          LG    0.40  0.4023   1.502   0.054     4.0
 432          US   0.532   0.285

 433          KK    C_I6
 434          KM   Combine I7 and I6
 435          HC       2

 436          KK      I8
 437          KM   Subbasin
 438          BA  0.4147
 439          LG    0.41  0.4023   1.502   0.054     3.0
 440          US   0.498   0.285

 441          KK      I9Subbasin
 442          BA  0.6808
 443          LG    0.41  0.4023   1.502   0.054     2.0
 444          US   1.205   0.315

 445          KK   C1819
 446          HC       2
```

```
447           KK  C16-19
448           KM   Combine 1617+I819
449           HC       2

450           KK  C15-19
451           HC       2

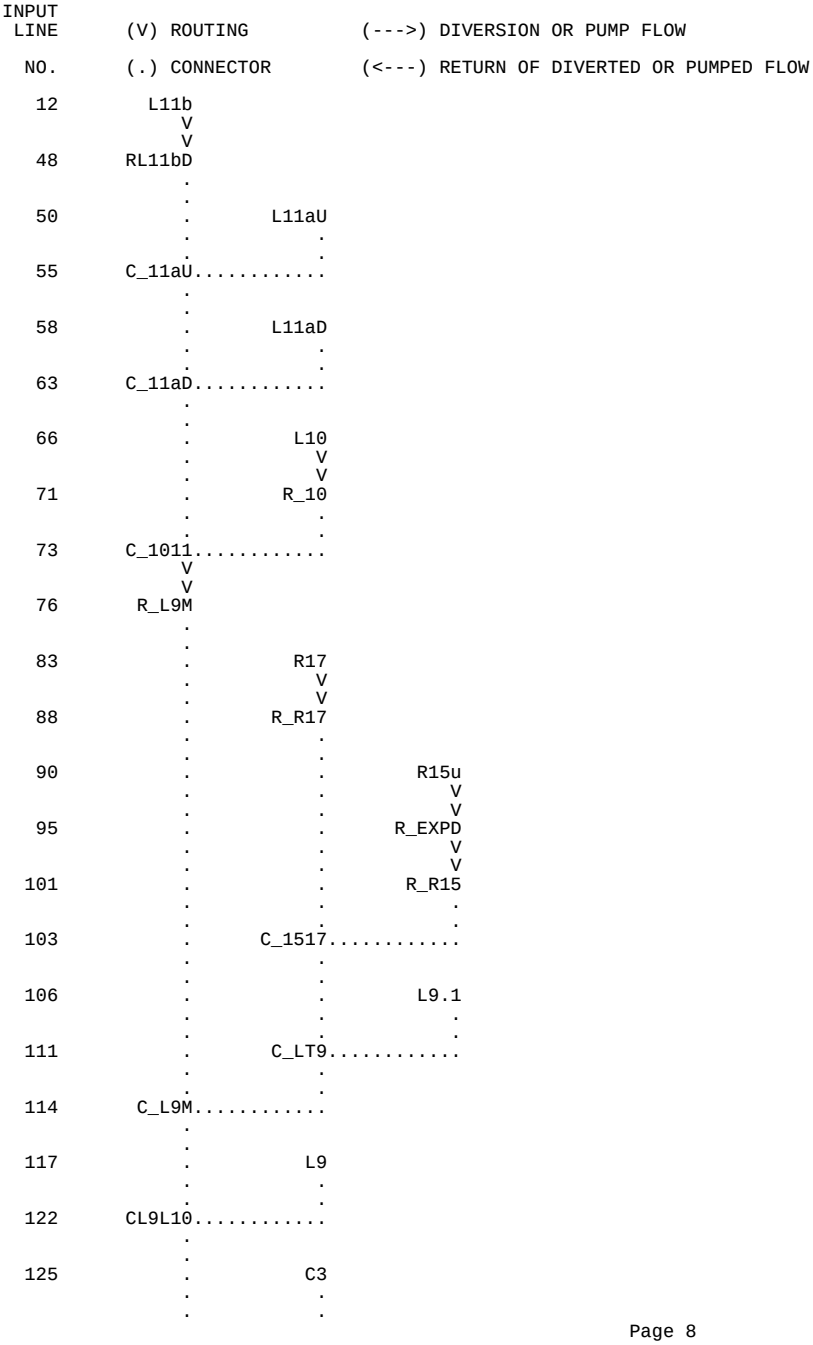
452           KK  CR5-19
453           HC       2

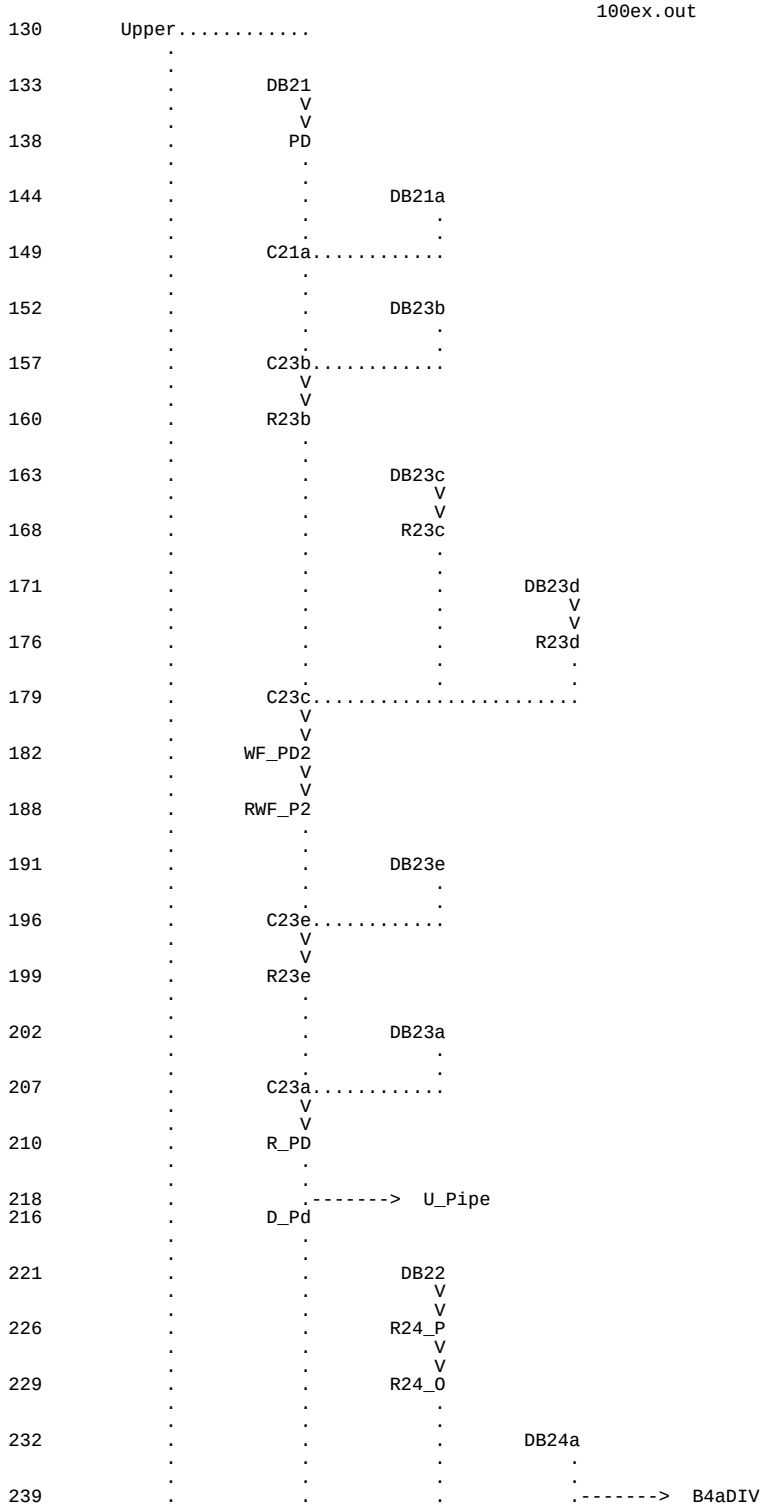
454           KK  CLower
455           KM   C14-19
456           HC       2

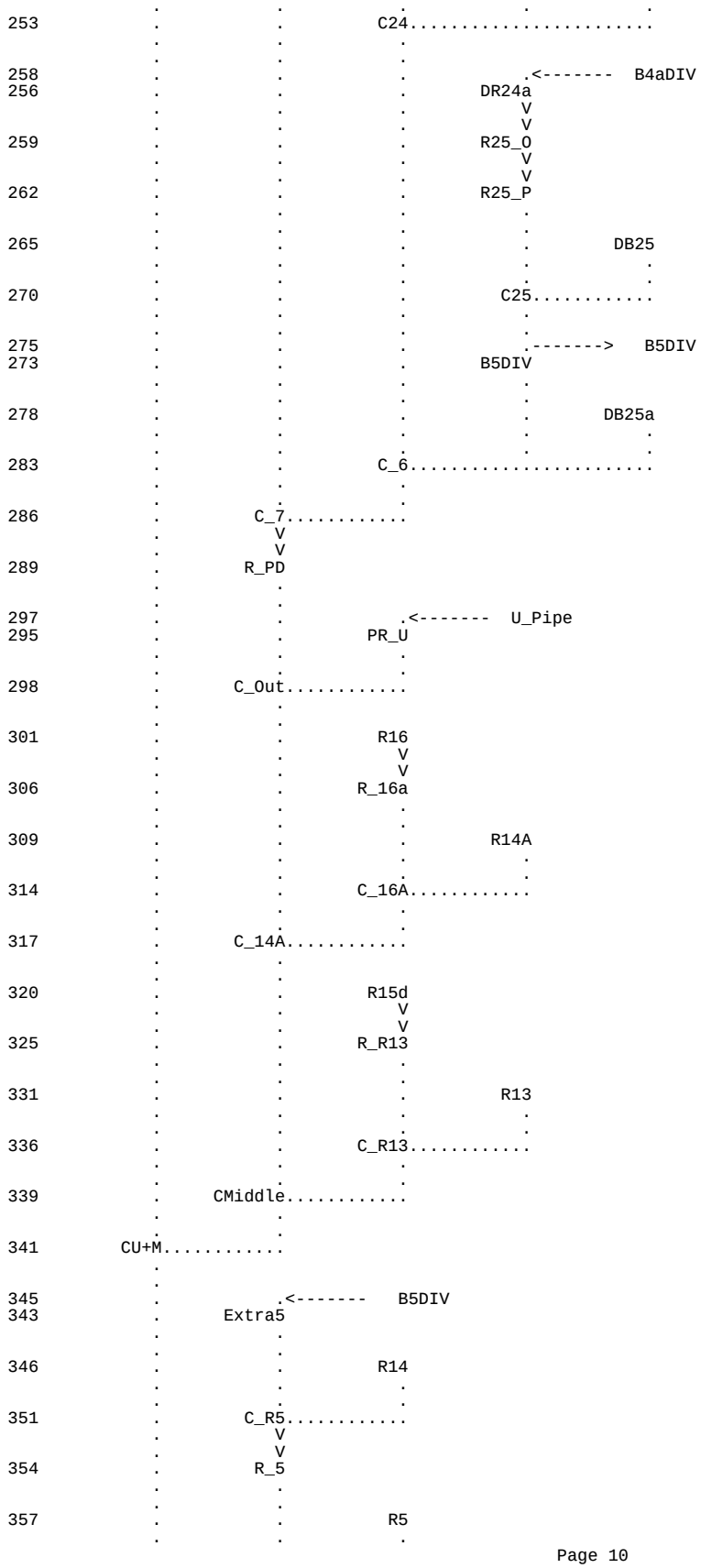
457           KK   C-All
458           HC       2
459           ZZ
```

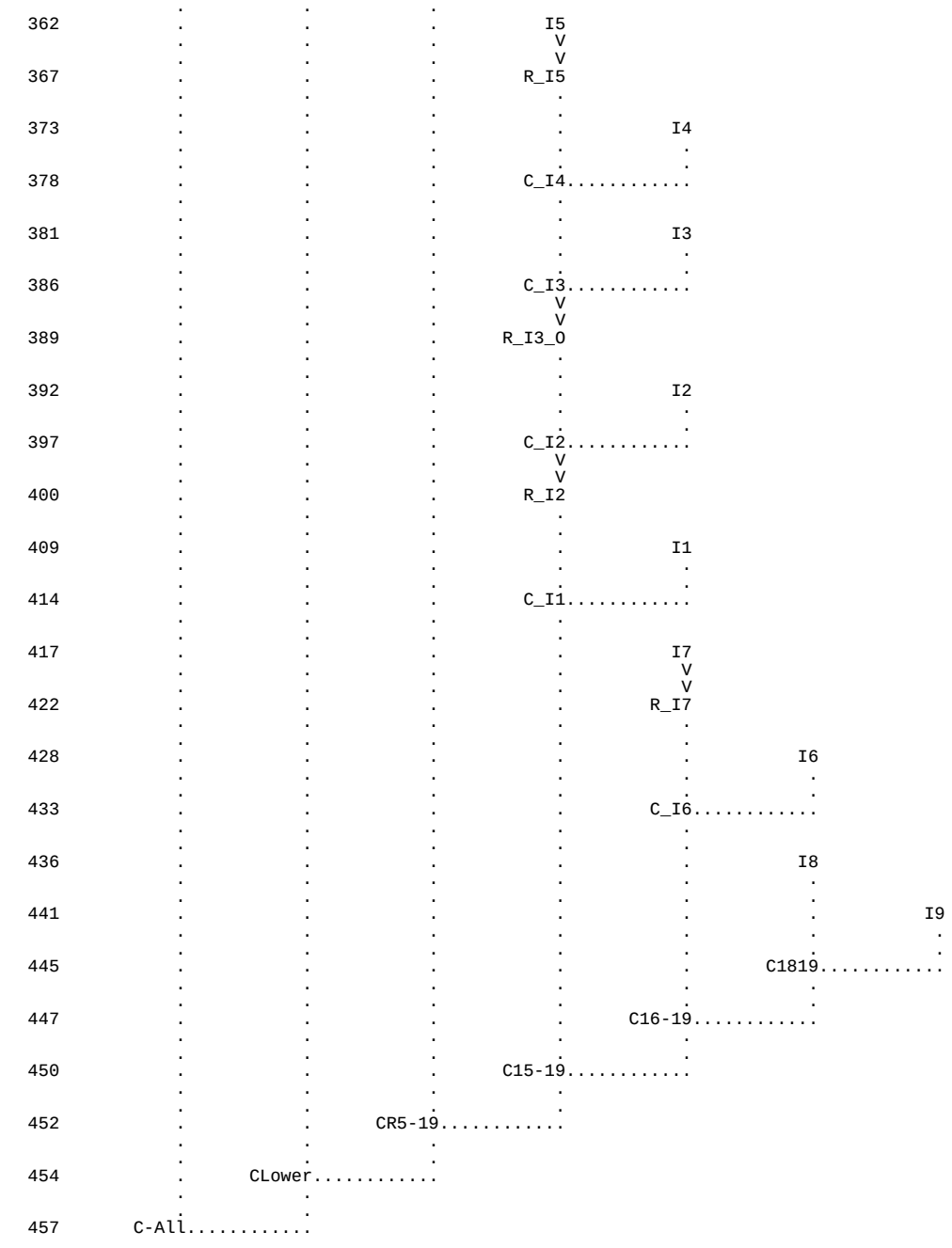
1

SCHEMATIC DIAGRAM OF STREAM NETWORK




Upper
DB21
PD
DB21a
C21a
DB23b
C23b
R23b
DB23c
R23c
DB23d
R23d
C23c
WF_PD2
RWF_P2
DB23e
C23e
R23e
DB23a
C23a
R_PD
U_Pipe
D_Pd
DB22
R24_P
R24_O
DB24a
B4aDIV
R24_P
R24_O
DB24


253 C24
258
256 DR24a
259 R25_O
262 R25_P
265 DB25
270 C25
275
273 B5DIV
278 DB25a
283 C_6
286 C_7
289 R_PD
297
295 PR_U
298 C_Out
301 R16
306 R_16a
309 R14A
314 C_16A
317 C_14A
320 R15d
325 R_R13
331 R13
336 C_R13
339 CMiddle
341 CU+M
345
343 Extra5
346 R14
351 C_R5
354 R_5
357 R5
B4aDIV
B5DIV
B5DIV
U_Pipe



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
**************************************
 *                                    *                                                    *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                    *    U.S. ARMY CORPS OF
ENGINEERS     *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING
CENTER    *
 *            VERSION 4.1               *                                                    *          609 SECOND
STREET          *
 *                                      *                                                    *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   07JUN12  TIME  10:30:45   *                                                    *           (916) 756-1104
        *
 *                                      *                                                    *
        *
 ****************************************
**************************************
```

```
                          Grand Junction Regional Airport - Jviation - prepared March 9 2012
                          Existing Conditions Watershed Model  - All Soils are Type D
                          100-Year 24-Hour Storm - NRCS Type II Rainfall Distribution
                         PREC 1.00 for 0.1< area < 5.0 squire miles; use flow under ratio 1
                         PREC 0.97 for 5.0< area <12.5 square miles; use flow under ratio 2
                         When I>10, uses CHUP method for Tlag, when I<10, uses Grand Junction SCS Meth
                          ************************************************************************

9 IO          OUTPUT CONTROL VARIABLES
                    IPRNT           5  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                     NMIN           5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1    0  STARTING DATE
                    ITIME        0000  STARTING TIME
                       NQ         500  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      2    0  ENDING DATE
                   NDTIME        1735  ENDING TIME
                    ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL     .08 HOURS
                      TOTAL TIME BASE   41.58 HOURS

       ENGLISH UNITS
            DRAINAGE AREA         SQUARE MILES
            PRECIPITATION DEPTH   INCHES
            LENGTH, ELEVATION     FEET
            FLOW                  CUBIC FEET PER SECOND
            STORAGE VOLUME        ACRE-FEET
            SURFACE AREA          ACRES
            TEMPERATURE           DEGREES FAHRENHEIT

  JP          MULTI-PLAN OPTION
                    NPLAN           1  NUMBER OF PLANS

  JR          MULTI-RATIO OPTION
                  RATIOS OF PRECIPITATION
                 1.00       .97


      *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  1


      *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT



      *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  1


      *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


      *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


      *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


      *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


      *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


      *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


      *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


      *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT
```

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 1

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1	RATIO 2
					1.00	.97
HYDROGRAPH AT						
+	L11b	7.41	1	FLOW	996.	948.
				TIME	11.50	11.50
ROUTED TO						
+	RL11bD	7.41	1	FLOW	995.	945.
				TIME	11.67	11.67
HYDROGRAPH AT						
+	L11aU	1.01	1	FLOW	142.	136.
				TIME	11.00	11.00
2 COMBINED AT						
+	C_11aU	8.43	1	FLOW	1114.	1057.
				TIME	11.58	11.58
HYDROGRAPH AT						
+	L11aD	.02	1	FLOW	11.	10.
				TIME	10.08	10.08
2 COMBINED AT						
+	C_11aD	8.45	1	FLOW	1115.	1059.
				TIME	11.58	11.58
HYDROGRAPH AT						
+	L10	1.02	1	FLOW	147.	140.
				TIME	11.00	11.00
ROUTED TO						
+	R_10	1.02	1	FLOW	146.	140.
				TIME	11.17	11.17
2 COMBINED AT						
+	C_1011	9.48	1	FLOW	1246.	1183.
				TIME	11.58	11.58
ROUTED TO						
+	R_L9M	9.48	1	FLOW	1242.	1180.
				TIME	11.67	11.67
HYDROGRAPH AT						
+	R17	.12	1	FLOW	66.	64.
				TIME	10.08	10.08
ROUTED TO						
+	R_R17	.12	1	FLOW	65.	62.
				TIME	10.25	10.25
HYDROGRAPH AT						
+	R15u	.16	1	FLOW	115.	111.
				TIME	10.08	10.08
ROUTED TO						
+	R_EXPD	.16	1	FLOW	57.	54.
				TIME	10.58	10.58
			** PEAK STAGES IN FEET **			
			1	STAGE	4796.38	4796.27
				TIME	10.58	10.58
ROUTED TO						
+	R_R15	.16	1	FLOW	56.	54.
				TIME	10.67	10.67

```
  2 COMBINED AT
+                C_1517       .28     1   FLOW         107.     102.
                                          TIME        10.33    10.33

 HYDROGRAPH AT
+                  L9.1      2.67     1   FLOW         435.     415.
                                          TIME        11.00    11.00

  2 COMBINED AT
+                 C_LT9      2.95     1   FLOW         510.     487.
                                          TIME        10.92    10.92

  2 COMBINED AT
+                 C_L9M     12.43     1   FLOW        1638.    1558.
                                          TIME        11.58    11.50

 HYDROGRAPH AT
+                    L9       .16     1   FLOW          24.      23.
                                          TIME        10.75    10.75

  2 COMBINED AT
+                CL9L10     12.59     1   FLOW        1658.    1577.
                                          TIME        11.50    11.50

 HYDROGRAPH AT
+                    C3       .58     1   FLOW         121.     115.
                                          TIME        10.58    10.58

  2 COMBINED AT
+                 Upper     13.17     1   FLOW        1736.    1652.
                                          TIME        11.50    11.50

 HYDROGRAPH AT
+                  DB21       .16     1   FLOW          51.      49.
                                          TIME        10.25    10.25

 ROUTED TO
+                    PD       .16     1   FLOW           9.       8.
                                          TIME        12.33    12.33

                                      ** PEAK STAGES IN FEET **
                                      1   STAGE     4919.56  4919.39
                                          TIME        12.33    12.33

 HYDROGRAPH AT
+                 DB21a       .38     1   FLOW          95.      91.
                                          TIME        10.42    10.42

  2 COMBINED AT
+                  C21a       .54     1   FLOW         102.      98.
                                          TIME        10.42    10.42

 HYDROGRAPH AT
+                 DB23b       .06     1   FLOW         104.     101.
                                          TIME        10.00    10.00

  2 COMBINED AT
+                  C23b       .60     1   FLOW         134.     129.
                                          TIME        10.00    10.00

 ROUTED TO
+                  R23b       .60     1   FLOW         132.     127.
                                          TIME        10.00    10.00

 HYDROGRAPH AT
+                 DB23c       .08     1   FLOW         143.     139.
                                          TIME        10.00    10.00

 ROUTED TO
+                  R23c       .08     1   FLOW         137.     133.
                                          TIME        10.00    10.00

 HYDROGRAPH AT
+                 DB23d       .02     1   FLOW          25.      24.
                                          TIME        10.00    10.00

 ROUTED TO
+                  R23d       .02     1   FLOW          23.      22.
                                          TIME        10.00    10.00

  3 COMBINED AT
+                  C23c       .70     1   FLOW         292.     282.
                                          TIME        10.00    10.00

 ROUTED TO
+                WF_PD2       .70     1   FLOW         304.     264.
                                          TIME        10.08    10.08

                                      ** PEAK STAGES IN FEET **
                                      1   STAGE     4801.15  4801.12
```

				TIME	10.08	10.08
ROUTED TO						
+	RWF_P2	.70	1	FLOW	275.	239.
				TIME	10.08	10.08
HYDROGRAPH AT						
+	DB23e	.08	1	FLOW	136.	132.
				TIME	10.00	10.00
2 COMBINED AT						
+	C23e	.78	1	FLOW	344.	306.
				TIME	10.08	10.08
ROUTED TO						
+	R23e	.78	1	FLOW	318.	286.
				TIME	10.08	10.08
HYDROGRAPH AT						
+	DB23a	.02	1	FLOW	9.	9.
				TIME	10.08	10.08
2 COMBINED AT						
+	C23a	.80	1	FLOW	327.	295.
				TIME	10.08	10.08
ROUTED TO						
+	R_PD	.80	1	FLOW	48.	36.
				TIME	13.17	13.42
			** PEAK STAGES IN FEET **			
			1	STAGE	4774.11	4774.07
				TIME	13.08	13.42
DIVERSION TO						
+	U_Pipe	.80	1	FLOW	14.	14.
				TIME	12.75	13.08
HYDROGRAPH AT						
+	D_Pd	.80	1	FLOW	34.	22.
				TIME	13.17	13.42
HYDROGRAPH AT						
+	DB22	.21	1	FLOW	59.	57.
				TIME	10.33	10.33
ROUTED TO						
+	R24_P	.21	1	FLOW	58.	56.
				TIME	10.42	10.42
ROUTED TO						
+	R24_O	.21	1	FLOW	58.	56.
				TIME	10.42	10.42
HYDROGRAPH AT						
+	DB24a	.02	1	FLOW	15.	14.
				TIME	10.08	10.08
DIVERSION TO						
+	B4aDIV	.02	1	FLOW	1.	0.
				TIME	10.08	10.08
HYDROGRAPH AT						
+	B4aDIV	.02	1	FLOW	14.	14.
				TIME	10.00	10.08
ROUTED TO						
+	R24_P	.02	1	FLOW	14.	14.
				TIME	10.08	10.08
ROUTED TO						
+	R24_O	.02	1	FLOW	14.	14.
				TIME	10.17	10.17
HYDROGRAPH AT						
+	DB24	.24	1	FLOW	319.	309.
				TIME	10.08	10.08
3 COMBINED AT						
+	C24	.47	1	FLOW	351.	340.
				TIME	10.08	10.08
HYDROGRAPH AT						
+	DR24a	.00	1	FLOW	1.	0.
				TIME	10.08	10.08
ROUTED TO						
+	R25_O	.00	1	FLOW	1.	0.
				TIME	10.25	10.25
ROUTED TO						

```
+                 R25_P       .00     1   FLOW          0.       0.
                                          TIME        10.33    10.33

 HYDROGRAPH AT
+                  DB25       .02     1   FLOW          17.      17.
                                          TIME        10.08    10.08

  2 COMBINED AT
+                    C25       .02     1   FLOW          17.      17.
                                          TIME        10.08    10.08

 DIVERSION TO
+                 B5DIV       .02     1   FLOW           3.       3.
                                          TIME        10.08    10.08

 HYDROGRAPH AT
+                 B5DIV       .02     1   FLOW          14.      14.
                                          TIME        10.00    10.00

 HYDROGRAPH AT
+                 DB25a       .03     1   FLOW          15.      15.
                                          TIME        10.08    10.08

  3 COMBINED AT
+                    C_6      .53     1   FLOW         381.     369.
                                          TIME        10.08    10.08

  2 COMBINED AT
+                    C_7     1.32     1   FLOW         381.     369.
                                          TIME        10.08    10.08

 ROUTED TO
+                  R_PD      1.32     1   FLOW          14.      13.
                                          TIME        15.25    15.25

                                      ** PEAK STAGES IN FEET **
                                      1   STAGE     4766.19  4766.10
                                          TIME        15.25    15.17

 HYDROGRAPH AT
+                  PR_U       .00     1   FLOW          14.      14.
                                          TIME        12.75    13.08

  2 COMBINED AT
+                C_Out      1.32     1   FLOW          28.      27.
                                          TIME        15.25    15.25

 HYDROGRAPH AT
+                   R16       .16     1   FLOW         215.     209.
                                          TIME        10.00    10.00

 ROUTED TO
+                R_16a       .16     1   FLOW         195.     189.
                                          TIME        10.08    10.08

 HYDROGRAPH AT
+                  R14A       .04     1   FLOW          58.      56.
                                          TIME        10.00    10.00

  2 COMBINED AT
+                C_16A       .20     1   FLOW         243.     235.
                                          TIME        10.08    10.08

  2 COMBINED AT
+                C_14A      1.52     1   FLOW         264.     256.
                                          TIME        10.08    10.08

 HYDROGRAPH AT
+                  R15d       .15     1   FLOW          70.      67.
                                          TIME        10.08    10.08

 ROUTED TO
+                R_R13       .15     1   FLOW          70.      67.
                                          TIME        10.17    10.17

                                      ** PEAK STAGES IN FEET **
                                      1   STAGE     4756.95  4756.93
                                          TIME        10.17    10.17

 HYDROGRAPH AT
+                   R13       .04     1   FLOW          19.      18.
                                          TIME        10.08    10.08

  2 COMBINED AT
+                C_R13       .20     1   FLOW          88.      84.
                                          TIME        10.17    10.17

  2 COMBINED AT
+               CMiddle      1.72     1   FLOW         347.     336.
                                          TIME        10.08    10.08
```

```
  2 COMBINED AT
+                   CU+M     14.89     1   FLOW        1792.    1706.
                                           TIME       11.50    11.50

 HYDROGRAPH AT
+                 Extra5       .00     1   FLOW           3.       3.
                                           TIME       10.08    10.08

 HYDROGRAPH AT
+                    R14       .06     1   FLOW           7.       6.
                                           TIME       10.92    10.83

  2 COMBINED AT
+                   C_R5       .06     1   FLOW           7.       6.
                                           TIME       10.92    10.83

 ROUTED TO
+                    R_5       .06     1   FLOW           6.       6.
                                           TIME       12.17    12.17

 HYDROGRAPH AT
+                     R5       .08     1   FLOW          21.      20.
                                           TIME       10.33    10.33

 HYDROGRAPH AT
+                     I5       .80     1   FLOW         256.     245.
                                           TIME       10.33    10.33

 ROUTED TO
+                   R_I5       .80     1   FLOW         104.      91.
                                           TIME       11.50    11.58

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5197.06  5196.98
                                           TIME       11.50    11.58

 HYDROGRAPH AT
+                     I4      1.21     1   FLOW         170.     162.
                                           TIME       11.08    11.08

  2 COMBINED AT
+                   C_I4      2.01     1   FLOW         259.     237.
                                           TIME       11.42    11.42

 HYDROGRAPH AT
+                     I3      3.21     1   FLOW         381.     363.
                                           TIME       11.50    11.50

  2 COMBINED AT
+                   C_I3      5.22     1   FLOW         638.     598.
                                           TIME       11.42    11.42

 ROUTED TO
+                 R_I3_O      5.22     1   FLOW         638.     598.
                                           TIME       11.50    11.50

 HYDROGRAPH AT
+                     I2       .97     1   FLOW         103.      99.
                                           TIME       11.33    11.33

  2 COMBINED AT
+                   C_I2      6.19     1   FLOW         740.     695.
                                           TIME       11.50    11.50

 ROUTED TO
+                   R_I2      6.19     1   FLOW          79.      58.
                                           TIME       18.33    19.17

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     4924.90  4924.19
                                           TIME       18.33    19.17

 HYDROGRAPH AT
+                     I1       .76     1   FLOW          64.      61.
                                           TIME       11.75    11.75

  2 COMBINED AT
+                   C_I1      6.95     1   FLOW         103.      99.
                                           TIME       11.92    11.92

 HYDROGRAPH AT
+                     I7      1.03     1   FLOW         124.     118.
                                           TIME       11.25    11.25

 ROUTED TO
+                   R_I7      1.03     1   FLOW         123.     117.
                                           TIME       11.33    11.33

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     4827.54  4827.48
                                           TIME       11.33    11.33
```

```
 HYDROGRAPH AT
+                    I6       .45     1   FLOW         109.     105.
                                          TIME        10.42    10.42

  2 COMBINED AT
+                  C_I6      1.48     1   FLOW         195.     186.
                                          TIME        11.17    11.17

 HYDROGRAPH AT
+                    I8       .41     1   FLOW         105.     101.
                                          TIME        10.42    10.42

 HYDROGRAPH AT
+                    I9       .68     1   FLOW          86.      82.
                                          TIME        11.08    11.08

  2 COMBINED AT
+                 C1819      1.10     1   FLOW         165.     158.
                                          TIME        10.83    10.83

  2 COMBINED AT
+                C16-19      2.57     1   FLOW         354.     336.
                                          TIME        11.08    11.08

  2 COMBINED AT
+                C15-19      9.52     1   FLOW         432.     412.
                                          TIME        11.17    11.17

  2 COMBINED AT
+                CR5-19      9.60     1   FLOW         447.     425.
                                          TIME        11.17    11.17

  2 COMBINED AT
+                CLower      9.66     1   FLOW         447.     425.
                                          TIME        11.17    11.17

  2 COMBINED AT
+                 C-All     24.55     1   FLOW        2224.    2116.
                                          TIME        11.42    11.42
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                 INTERPOLATED TO
                                                                               COMPUTATION INTERVAL
           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                     PEAK                                    PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO= 1.00
            RL11bD  MANE         4.87    995.53    699.67       .77      5.00    994.99    700.00         .77


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3046E+03 EXCESS= .0000E+00 OUTFLOW= .3044E+03 BASIN STORAGE= .6062E-03 PERCENT
ERROR=    .0


          FOR PLAN = 1  RATIO=  .97
            RL11bD  MANE         4.97    945.96    697.27       .73      5.00    944.78    700.00         .73


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2895E+03 EXCESS= .0000E+00 OUTFLOW= .2893E+03 BASIN STORAGE= .6089E-03 PERCENT
ERROR=    .1


          FOR PLAN = 1  RATIO= 1.00
              R_10  MANE         3.65    146.80    668.76       .77      5.00    146.49    670.00         .77
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4209E+02 EXCESS= .0000E+00 OUTFLOW= .4206E+02 BASIN STORAGE= .7060E-04 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .97

R_10	MANE	3.75	139.89	666.00	.73	5.00	139.65	670.00	.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4001E+02 EXCESS= .0000E+00 OUTFLOW= .3997E+02 BASIN STORAGE= .5518E-04 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= 1.00

R_R17	MANE	3.98	65.13	614.60	.77	5.00	64.85	615.00	.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5055E+01 EXCESS= .0000E+00 OUTFLOW= .5058E+01 BASIN STORAGE= .9392E-05 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .97

R_R17	MANE	4.10	62.70	612.80	.74	5.00	61.82	615.00	.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4805E+01 EXCESS= .0000E+00 OUTFLOW= .4836E+01 BASIN STORAGE= .8133E-05 PERCENT ERROR= -.7

FOR PLAN = 1 RATIO= 1.00

R_R15	MANE	2.18	56.56	637.57	1.15	5.00	56.46	640.00	1.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9778E+01 EXCESS= .0000E+00 OUTFLOW= .9779E+01 BASIN STORAGE= .1024E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R_R15	MANE	2.28	53.96	637.90	1.11	5.00	53.88	640.00	1.11

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9386E+01 EXCESS= .0000E+00 OUTFLOW= .9385E+01 BASIN STORAGE= .1051E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23b	MANE	.34	132.80	600.56	.89	5.00	131.53	600.00	.89

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2830E+02 EXCESS= .0000E+00 OUTFLOW= .2830E+02 BASIN STORAGE= .1292E-11 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23b	MANE	.34	128.30	600.48	.85	5.00	127.06	600.00	.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2702E+02 EXCESS= .0000E+00 OUTFLOW= .2702E+02 BASIN STORAGE= .1298E-11 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23c	MANE	.69	142.02	601.15	1.98	5.00	137.39	600.00	1.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8659E+01 EXCESS= .0000E+00 OUTFLOW= .8668E+01 BASIN STORAGE= .3470E-07 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .97

R23c	MANE	.84	135.90	601.38	1.92	5.00	133.09	600.00	1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8398E+01 EXCESS= .0000E+00 OUTFLOW= .8404E+01 BASIN STORAGE= .5142E-07 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.00

R23d	MANE	1.04	24.52	602.34	1.98	5.00	22.80	600.00	1.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1986E+01 EXCESS= .0000E+00 OUTFLOW= .1986E+01 BASIN STORAGE= .1425E-10 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23d	MANE	1.05	23.84	602.27	1.92	5.00	22.11	600.00	1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1926E+01 EXCESS= .0000E+00 OUTFLOW= .1927E+01 BASIN STORAGE= .1394E-10 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

RWF_P2	MANE	.33	299.39	605.57	1.05	5.00	274.84	605.00	1.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3897E+02 EXCESS= .0000E+00 OUTFLOW= .3897E+02 BASIN STORAGE= .6751E-08 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

RWF_P2	MANE	.34	261.29	605.75	1.00	5.00	238.84	605.00	1.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3737E+02 EXCESS= .0000E+00 OUTFLOW= .3737E+02 BASIN STORAGE= .6848E-08 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23e	MANE	.56	334.70	605.76	1.14	5.00	317.86	605.00	1.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4712E+02 EXCESS= .0000E+00 OUTFLOW= .4712E+02 BASIN STORAGE= .1221E-07 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23e	MANE	.58	298.46	605.76	1.09	5.00	285.83	605.00	1.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4526E+02 EXCESS= .0000E+00 OUTFLOW= .4526E+02 BASIN STORAGE= .1221E-07 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_P	MANE	1.20	59.10	622.23	.77	5.00	58.49	625.00	.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8743E+01 EXCESS= .0000E+00 OUTFLOW= .8744E+01 BASIN STORAGE= .1664E-09 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_P	MANE	1.20	56.60	622.45	.73	5.00	55.95	625.00	.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8310E+01 EXCESS= .0000E+00 OUTFLOW= .8311E+01 BASIN STORAGE= .1513E-09 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_O	MANE	1.62	58.41	626.25	.77	5.00	58.35	625.00	.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8742E+01 EXCESS= .0000E+00 OUTFLOW= .8742E+01 BASIN STORAGE= .1335E-06 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_O	MANE	1.61	55.88	627.34	.73	5.00	55.84	625.00	.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8309E+01 EXCESS= .0000E+00 OUTFLOW= .8308E+01 BASIN STORAGE= .1365E-06 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_P	MANE	.56	13.99	604.89	1.34	5.00	13.99	605.00	1.34	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1490E+01 EXCESS= .0000E+00 OUTFLOW= .1490E+01 BASIN STORAGE= .3512E-12 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_P	MANE	.48	13.98	605.43	1.29	5.00	13.98	605.00	1.29	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1441E+01 EXCESS= .0000E+00 OUTFLOW= .1441E+01 BASIN STORAGE= .3598E-12 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_O	MANE	2.21	13.96	609.34	1.34	5.00	13.90	610.00	1.34	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1491E+01 EXCESS= .0000E+00 OUTFLOW= .1492E+01 BASIN STORAGE= .7757E-07 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_O	MANE	2.21	13.95	609.48	1.29	5.00	13.86	610.00	1.29	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1441E+01 EXCESS= .0000E+00 OUTFLOW= .1442E+01 BASIN STORAGE= .5153E-07 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.00

R25_O	MANE	1.94	.88	613.48	-1.00	5.00	.60	615.00	-1.00	

FOR PLAN = 1 RATIO= .97

R25_O	MANE	.86	.43	616.01	-1.00	5.00	.32	615.00	-1.00	

FOR PLAN = 1 RATIO= 1.00

R25_P	MANE	1.67	.56	617.55	-1.00	5.00	.48	620.00	-1.00	

FOR PLAN = 1 RATIO= .97

R25_P	MANE	1.02	.30	620.46	-1.00	5.00	.30	620.00	-1.00

FOR PLAN = 1 RATIO= 1.00

R_16a	MANE	3.39	205.73	605.81	1.59	5.00	194.73	605.00	1.59

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1325E+02 EXCESS= .0000E+00 OUTFLOW= .1330E+02 BASIN STORAGE= .5677E-05 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .97

R_16a	MANE	3.44	195.68	605.52	1.53	5.00	188.71	605.00	1.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1279E+02 EXCESS= .0000E+00 OUTFLOW= .1285E+02 BASIN STORAGE= .6160E-05 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= 1.00

R_5	MANE	4.94	6.50	731.87	.79	5.00	6.49	730.00	.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2512E+01 EXCESS= .0000E+00 OUTFLOW= .2524E+01 BASIN STORAGE= .1020E-02 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .97

R_5	MANE	5.00	6.21	730.36	.75	5.00	6.20	730.00	.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2377E+01 EXCESS= .0000E+00 OUTFLOW= .2387E+01 BASIN STORAGE= .9839E-03 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= 1.00

R_I3_O	MANE	2.06	637.97	689.90	.71	5.00	637.95	690.00	.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1983E+03 EXCESS= .0000E+00 OUTFLOW= .1983E+03 BASIN STORAGE= .1092E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R_I3_O	MANE	2.10	597.87	690.27	.67	5.00	597.74	690.00	.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1877E+03 EXCESS= .0000E+00 OUTFLOW= .1877E+03 BASIN STORAGE= .1001E-03 PERCENT ERROR= .0

```
          LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 *** WARNING *** ZZ-CARD MISSING
             1
             2          ZZ
1**************************************
**************************************
 *                                    *                                                    *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                *    U.S. ARMY CORPS OF
ENGINEERS     *
 *               JUN   1998             *                                                *    HYDROLOGIC ENGINEERING
CENTER    *
 *            VERSION 4.1               *                                                *         609 SECOND
STREET          *
 *                                      *                                                *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   07JUN12  TIME  10:30:45   *                                                *           (916) 756-1104
          *
 *                                      *                                                *
          *
 ****************************************
**************************************




 *** HEC-1 ERROR 1 *** INVALID CARD IDENTIFICATION CODE OR CARD OUT OF SEQUENCE
      CARD NO.    1

      IT          HYDROGRAPH TIME DATA
                        NMIN           5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         500  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      2    0  ENDING DATE
                      NDTIME        1735  ENDING TIME
                      ICENT           19  CENTURY MARK

                    COMPUTATION INTERVAL     .08 HOURS
                         TOTAL TIME BASE   41.58 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
                SURFACE AREA          ACRES
                TEMPERATURE           DEGREES FAHRENHEIT

                SUBBASIN RUNOFF DATA

    0 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    0 PB                STORM         .00  BASIN TOTAL PRECIPITATION

    0 PI            INCREMENTAL PRECIPITATION PATTERN


    0 UI          INPUT UNITGRAPH,   0 ORDINATES,  VOLUME =  .00

                                                                 ***

**************************************************************************************************************************
***********

                                                HYDROGRAPH AT STATION    C-All

**************************************************************************************************************************
***********
                                                                 *
        DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q      *       DA MON HRMN  ORD    RAIN    LOSS  EXCESS
COMP Q
                                                                 *
         1     0000    1     .00     .00     .00         0.      *        1     2050  251     .00     .00     .00
  0.
         1     0005    2     .00     .00     .00         0.      *        1     2055  252     .00     .00     .00
  0.
```

1	0010	3	.00	.00	.00	0.	*	1	2100	253	.00	.00	.00
0.													
1	0015	4	.00	.00	.00	0.	*	1	2105	254	.00	.00	.00
0.													
1	0020	5	.00	.00	.00	0.	*	1	2110	255	.00	.00	.00
0.													
1	0025	6	.00	.00	.00	0.	*	1	2115	256	.00	.00	.00
0.													
1	0030	7	.00	.00	.00	0.	*	1	2120	257	.00	.00	.00
0.													
1	0035	8	.00	.00	.00	0.	*	1	2125	258	.00	.00	.00
0.													
1	0040	9	.00	.00	.00	0.	*	1	2130	259	.00	.00	.00
0.													
1	0045	10	.00	.00	.00	0.	*	1	2135	260	.00	.00	.00
0.													
1	0050	11	.00	.00	.00	0.	*	1	2140	261	.00	.00	.00
0.													
1	0055	12	.00	.00	.00	0.	*	1	2145	262	.00	.00	.00
0.													
1	0100	13	.00	.00	.00	0.	*	1	2150	263	.00	.00	.00
0.													
1	0105	14	.00	.00	.00	0.	*	1	2155	264	.00	.00	.00
0.													
1	0110	15	.00	.00	.00	0.	*	1	2200	265	.00	.00	.00
0.													
1	0115	16	.00	.00	.00	0.	*	1	2205	266	.00	.00	.00
0.													
1	0120	17	.00	.00	.00	0.	*	1	2210	267	.00	.00	.00
0.													
1	0125	18	.00	.00	.00	0.	*	1	2215	268	.00	.00	.00
0.													
1	0130	19	.00	.00	.00	0.	*	1	2220	269	.00	.00	.00
0.													
1	0135	20	.00	.00	.00	0.	*	1	2225	270	.00	.00	.00
0.													
1	0140	21	.00	.00	.00	0.	*	1	2230	271	.00	.00	.00
0.													
1	0145	22	.00	.00	.00	0.	*	1	2235	272	.00	.00	.00
0.													
1	0150	23	.00	.00	.00	0.	*	1	2240	273	.00	.00	.00
0.													
1	0155	24	.00	.00	.00	0.	*	1	2245	274	.00	.00	.00
0.													
1	0200	25	.00	.00	.00	0.	*	1	2250	275	.00	.00	.00
0.													
1	0205	26	.00	.00	.00	0.	*	1	2255	276	.00	.00	.00
0.													
1	0210	27	.00	.00	.00	0.	*	1	2300	277	.00	.00	.00
0.													
1	0215	28	.00	.00	.00	0.	*	1	2305	278	.00	.00	.00
0.													
1	0220	29	.00	.00	.00	0.	*	1	2310	279	.00	.00	.00
0.													
1	0225	30	.00	.00	.00	0.	*	1	2315	280	.00	.00	.00
0.													
1	0230	31	.00	.00	.00	0.	*	1	2320	281	.00	.00	.00
0.													
1	0235	32	.00	.00	.00	0.	*	1	2325	282	.00	.00	.00
0.													
1	0240	33	.00	.00	.00	0.	*	1	2330	283	.00	.00	.00
0.													
1	0245	34	.00	.00	.00	0.	*	1	2335	284	.00	.00	.00
0.													
1	0250	35	.00	.00	.00	0.	*	1	2340	285	.00	.00	.00
0.													
1	0255	36	.00	.00	.00	0.	*	1	2345	286	.00	.00	.00
0.													
1	0300	37	.00	.00	.00	0.	*	1	2350	287	.00	.00	.00
0.													
1	0305	38	.00	.00	.00	0.	*	1	2355	288	.00	.00	.00
0.													
1	0310	39	.00	.00	.00	0.	*	2	0000	289	.00	.00	.00
0.													
1	0315	40	.00	.00	.00	0.	*	2	0005	290	.00	.00	.00
0.													
1	0320	41	.00	.00	.00	0.	*	2	0010	291	.00	.00	.00
0.													
1	0325	42	.00	.00	.00	0.	*	2	0015	292	.00	.00	.00
0.													
1	0330	43	.00	.00	.00	0.	*	2	0020	293	.00	.00	.00
0.													
1	0335	44	.00	.00	.00	0.	*	2	0025	294	.00	.00	.00
0.													
1	0340	45	.00	.00	.00	0.	*	2	0030	295	.00	.00	.00
0.													
1	0345	46	.00	.00	.00	0.	*	2	0035	296	.00	.00	.00
0.													
1	0350	47	.00	.00	.00	0.	*	2	0040	297	.00	.00	.00
0.													
1	0355	48	.00	.00	.00	0.	*	2	0045	298	.00	.00	.00

0.													
	1	0400	49	.00	.00	.00	0.	*	2	0050	299	.00	.00	.00
0.														
	1	0405	50	.00	.00	.00	0.	*	2	0055	300	.00	.00	.00
0.														
	1	0410	51	.00	.00	.00	0.	*	2	0100	301	.00	.00	.00
0.														
	1	0415	52	.00	.00	.00	0.	*	2	0105	302	.00	.00	.00
0.														
	1	0420	53	.00	.00	.00	0.	*	2	0110	303	.00	.00	.00
0.														
	1	0425	54	.00	.00	.00	0.	*	2	0115	304	.00	.00	.00
0.														
	1	0430	55	.00	.00	.00	0.	*	2	0120	305	.00	.00	.00
0.														
	1	0435	56	.00	.00	.00	0.	*	2	0125	306	.00	.00	.00
0.														
	1	0440	57	.00	.00	.00	0.	*	2	0130	307	.00	.00	.00
0.														
	1	0445	58	.00	.00	.00	0.	*	2	0135	308	.00	.00	.00
0.														
	1	0450	59	.00	.00	.00	0.	*	2	0140	309	.00	.00	.00
0.														
	1	0455	60	.00	.00	.00	0.	*	2	0145	310	.00	.00	.00
0.														
	1	0500	61	.00	.00	.00	0.	*	2	0150	311	.00	.00	.00
0.														
	1	0505	62	.00	.00	.00	0.	*	2	0155	312	.00	.00	.00
0.														
	1	0510	63	.00	.00	.00	0.	*	2	0200	313	.00	.00	.00
0.														
	1	0515	64	.00	.00	.00	0.	*	2	0205	314	.00	.00	.00
0.														
	1	0520	65	.00	.00	.00	0.	*	2	0210	315	.00	.00	.00
0.														
	1	0525	66	.00	.00	.00	0.	*	2	0215	316	.00	.00	.00
0.														
	1	0530	67	.00	.00	.00	0.	*	2	0220	317	.00	.00	.00
0.														
	1	0535	68	.00	.00	.00	0.	*	2	0225	318	.00	.00	.00
0.														
	1	0540	69	.00	.00	.00	0.	*	2	0230	319	.00	.00	.00
0.														
	1	0545	70	.00	.00	.00	0.	*	2	0235	320	.00	.00	.00
0.														
	1	0550	71	.00	.00	.00	0.	*	2	0240	321	.00	.00	.00
0.														
	1	0555	72	.00	.00	.00	0.	*	2	0245	322	.00	.00	.00
0.														
	1	0600	73	.00	.00	.00	0.	*	2	0250	323	.00	.00	.00
0.														
	1	0605	74	.00	.00	.00	0.	*	2	0255	324	.00	.00	.00
0.														
	1	0610	75	.00	.00	.00	0.	*	2	0300	325	.00	.00	.00
0.														
	1	0615	76	.00	.00	.00	0.	*	2	0305	326	.00	.00	.00
0.														
	1	0620	77	.00	.00	.00	0.	*	2	0310	327	.00	.00	.00
0.														
	1	0625	78	.00	.00	.00	0.	*	2	0315	328	.00	.00	.00
0.														
	1	0630	79	.00	.00	.00	0.	*	2	0320	329	.00	.00	.00
0.														
	1	0635	80	.00	.00	.00	0.	*	2	0325	330	.00	.00	.00
0.														
	1	0640	81	.00	.00	.00	0.	*	2	0330	331	.00	.00	.00
0.														
	1	0645	82	.00	.00	.00	0.	*	2	0335	332	.00	.00	.00
0.														
	1	0650	83	.00	.00	.00	0.	*	2	0340	333	.00	.00	.00
0.														
	1	0655	84	.00	.00	.00	0.	*	2	0345	334	.00	.00	.00
0.														
	1	0700	85	.00	.00	.00	0.	*	2	0350	335	.00	.00	.00
0.														
	1	0705	86	.00	.00	.00	0.	*	2	0355	336	.00	.00	.00
0.														
	1	0710	87	.00	.00	.00	0.	*	2	0400	337	.00	.00	.00
0.														
	1	0715	88	.00	.00	.00	0.	*	2	0405	338	.00	.00	.00
0.														
	1	0720	89	.00	.00	.00	0.	*	2	0410	339	.00	.00	.00
0.														
	1	0725	90	.00	.00	.00	0.	*	2	0415	340	.00	.00	.00
0.														
	1	0730	91	.00	.00	.00	0.	*	2	0420	341	.00	.00	.00
0.														
	1	0735	92	.00	.00	.00	0.	*	2	0425	342	.00	.00	.00
0.														
	1	0740	93	.00	.00	.00	0.	*	2	0430	343	.00	.00	.00
0.														

1	0745	94	.00	.00	.00	0.	*	2	0435	344	.00	.00	.00
0.													
1	0750	95	.00	.00	.00	0.	*	2	0440	345	.00	.00	.00
0.													
1	0755	96	.00	.00	.00	0.	*	2	0445	346	.00	.00	.00
0.													
1	0800	97	.00	.00	.00	0.	*	2	0450	347	.00	.00	.00
0.													
1	0805	98	.00	.00	.00	0.	*	2	0455	348	.00	.00	.00
0.													
1	0810	99	.00	.00	.00	0.	*	2	0500	349	.00	.00	.00
0.													
1	0815	100	.00	.00	.00	0.	*	2	0505	350	.00	.00	.00
0.													
1	0820	101	.00	.00	.00	0.	*	2	0510	351	.00	.00	.00
0.													
1	0825	102	.00	.00	.00	0.	*	2	0515	352	.00	.00	.00
0.													
1	0830	103	.00	.00	.00	0.	*	2	0520	353	.00	.00	.00
0.													
1	0835	104	.00	.00	.00	0.	*	2	0525	354	.00	.00	.00
0.													
1	0840	105	.00	.00	.00	0.	*	2	0530	355	.00	.00	.00
0.													
1	0845	106	.00	.00	.00	0.	*	2	0535	356	.00	.00	.00
0.													
1	0850	107	.00	.00	.00	0.	*	2	0540	357	.00	.00	.00
0.													
1	0855	108	.00	.00	.00	0.	*	2	0545	358	.00	.00	.00
0.													
1	0900	109	.00	.00	.00	0.	*	2	0550	359	.00	.00	.00
0.													
1	0905	110	.00	.00	.00	0.	*	2	0555	360	.00	.00	.00
0.													
1	0910	111	.00	.00	.00	0.	*	2	0600	361	.00	.00	.00
0.													
1	0915	112	.00	.00	.00	0.	*	2	0605	362	.00	.00	.00
0.													
1	0920	113	.00	.00	.00	0.	*	2	0610	363	.00	.00	.00
0.													
1	0925	114	.00	.00	.00	0.	*	2	0615	364	.00	.00	.00
0.													
1	0930	115	.00	.00	.00	0.	*	2	0620	365	.00	.00	.00
0.													
1	0935	116	.00	.00	.00	0.	*	2	0625	366	.00	.00	.00
0.													
1	0940	117	.00	-.02	.02	0.	*	2	0630	367	.00	.00	.00
0.													
1	0945	118	.00	-.07	.07	0.	*	2	0635	368	.00	.00	.00
0.													
1	0950	119	.00	-.13	.13	0.	*	2	0640	369	.00	.00	.00
0.													
1	0955	120	.00	-.25	.25	0.	*	2	0645	370	.00	.00	.00
0.													
1	1000	121	.00	-.17	.17	0.	*	2	0650	371	.00	.00	.00
0.													
1	1005	122	.00	-.02	.02	0.	*	2	0655	372	.00	.00	.00
0.													
1	1010	123	.00	-.02	.02	0.	*	2	0700	373	.00	.00	.00
0.													
1	1015	124	.00	-.01	.01	0.	*	2	0705	374	.00	.00	.00
0.													
1	1020	125	.00	-.01	.01	0.	*	2	0710	375	.00	.00	.00
0.													
1	1025	126	.00	-.01	.01	0.	*	2	0715	376	.00	.00	.00
0.													
1	1030	127	.00	.00	.00	0.	*	2	0720	377	.00	.00	.00
0.													
1	1035	128	.00	.00	.00	0.	*	2	0725	378	.00	.00	.00
0.													
1	1040	129	.00	.00	.00	0.	*	2	0730	379	.00	.00	.00
0.													
1	1045	130	.00	.00	.00	0.	*	2	0735	380	.00	.00	.00
0.													
1	1050	131	.00	.00	.00	0.	*	2	0740	381	.00	.00	.00
0.													
1	1055	132	.00	.00	.00	0.	*	2	0745	382	.00	.00	.00
0.													
1	1100	133	.00	.00	.00	0.	*	2	0750	383	.00	.00	.00
0.													
1	1105	134	.00	.00	.00	0.	*	2	0755	384	.00	.00	.00
0.													
1	1110	135	.00	.00	.00	0.	*	2	0800	385	.00	.00	.00
0.													
1	1115	136	.00	.00	.00	0.	*	2	0805	386	.00	.00	.00
0.													
1	1120	137	.00	.00	.00	0.	*	2	0810	387	.00	.00	.00
0.													
1	1125	138	.00	.00	.00	0.	*	2	0815	388	.00	.00	.00
0.													
1	1130	139	.00	.00	.00	0.	*	2	0820	389	.00	.00	.00

```
0.
      1     1135  140     .00     .00     .00          0.        *        2     0825  390     .00     .00     .00
0.
      1     1140  141     .00     .00     .00          0.        *        2     0830  391     .00     .00     .00
0.
      1     1145  142     .00     .00     .00          0.        *        2     0835  392     .00     .00     .00
0.
      1     1150  143     .00     .00     .00          0.        *        2     0840  393     .00     .00     .00
0.
      1     1155  144     .00     .00     .00          0.        *        2     0845  394     .00     .00     .00
0.
      1     1200  145     .00     .00     .00          0.        *        2     0850  395     .00     .00     .00
0.
      1     1205  146     .00     .00     .00          0.        *        2     0855  396     .00     .00     .00
0.
      1     1210  147     .00     .00     .00          0.        *        2     0900  397     .00     .00     .00
0.
      1     1215  148     .00     .00     .00          0.        *        2     0905  398     .00     .00     .00
0.
      1     1220  149     .00     .00     .00          0.        *        2     0910  399     .00     .00     .00
0.
      1     1225  150     .00     .00     .00          0.        *        2     0915  400     .00     .00     .00
0.
      1     1230  151     .00     .00     .00          0.        *        2     0920  401     .00     .00     .00
0.
      1     1235  152     .00     .00     .00          0.        *        2     0925  402     .00     .00     .00
0.
      1     1240  153     .00     .00     .00          0.        *        2     0930  403     .00     .00     .00
0.
      1     1245  154     .00     .00     .00          0.        *        2     0935  404     .00     .00     .00
0.
      1     1250  155     .00     .00     .00          0.        *        2     0940  405     .00     .00     .00
0.
      1     1255  156     .00     .00     .00          0.        *        2     0945  406     .00     .00     .00
0.
      1     1300  157     .00     .00     .00          0.        *        2     0950  407     .00     .00     .00
0.
      1     1305  158     .00     .00     .00          0.        *        2     0955  408     .00     .00     .00
0.
      1     1310  159     .00     .00     .00          0.        *        2     1000  409     .00     .00     .00
0.
      1     1315  160     .00     .00     .00          0.        *        2     1005  410     .00     .00     .00
0.
      1     1320  161     .00     .00     .00          0.        *        2     1010  411     .00     .00     .00
0.
      1     1325  162     .00     .00     .00          0.        *        2     1015  412     .00     .00     .00
0.
      1     1330  163     .00     .00     .00          0.        *        2     1020  413     .00     .00     .00
0.
      1     1335  164     .00     .00     .00          0.        *        2     1025  414     .00     .00     .00
0.
      1     1340  165     .00     .00     .00          0.        *        2     1030  415     .00     .00     .00
0.
      1     1345  166     .00     .00     .00          0.        *        2     1035  416     .00     .00     .00
0.
      1     1350  167     .00     .00     .00          0.        *        2     1040  417     .00     .00     .00
0.
      1     1355  168     .00     .00     .00          0.        *        2     1045  418     .00     .00     .00
0.
      1     1400  169     .00     .00     .00          0.        *        2     1050  419     .00     .00     .00
0.
      1     1405  170     .00     .00     .00          0.        *        2     1055  420     .00     .00     .00
0.
      1     1410  171     .00     .00     .00          0.        *        2     1100  421     .00     .00     .00
0.
      1     1415  172     .00     .00     .00          0.        *        2     1105  422     .00     .00     .00
0.
      1     1420  173     .00     .00     .00          0.        *        2     1110  423     .00     .00     .00
0.
      1     1425  174     .00     .00     .00          0.        *        2     1115  424     .00     .00     .00
0.
      1     1430  175     .00     .00     .00          0.        *        2     1120  425     .00     .00     .00
0.
      1     1435  176     .00     .00     .00          0.        *        2     1125  426     .00     .00     .00
0.
      1     1440  177     .00     .00     .00          0.        *        2     1130  427     .00     .00     .00
0.
      1     1445  178     .00     .00     .00          0.        *        2     1135  428     .00     .00     .00
0.
      1     1450  179     .00     .00     .00          0.        *        2     1140  429     .00     .00     .00
0.
      1     1455  180     .00     .00     .00          0.        *        2     1145  430     .00     .00     .00
0.
      1     1500  181     .00     .00     .00          0.        *        2     1150  431     .00     .00     .00
0.
      1     1505  182     .00     .00     .00          0.        *        2     1155  432     .00     .00     .00
0.
      1     1510  183     .00     .00     .00          0.        *        2     1200  433     .00     .00     .00
0.
      1     1515  184     .00     .00     .00          0.        *        2     1205  434     .00     .00     .00
0.
```

1	1520	185	.00	.00	.00	0.	*	2	1210	435	.00	.00	.00
0.													
1	1525	186	.00	.00	.00	0.	*	2	1215	436	.00	.00	.00
0.													
1	1530	187	.00	.00	.00	0.	*	2	1220	437	.00	.00	.00
0.													
1	1535	188	.00	.00	.00	0.	*	2	1225	438	.00	.00	.00
0.													
1	1540	189	.00	.00	.00	0.	*	2	1230	439	.00	.00	.00
0.													
1	1545	190	.00	.00	.00	0.	*	2	1235	440	.00	.00	.00
0.													
1	1550	191	.00	.00	.00	0.	*	2	1240	441	.00	.00	.00
0.													
1	1555	192	.00	.00	.00	0.	*	2	1245	442	.00	.00	.00
0.													
1	1600	193	.00	.00	.00	0.	*	2	1250	443	.00	.00	.00
0.													
1	1605	194	.00	.00	.00	0.	*	2	1255	444	.00	.00	.00
0.													
1	1610	195	.00	.00	.00	0.	*	2	1300	445	.00	.00	.00
0.													
1	1615	196	.00	.00	.00	0.	*	2	1305	446	.00	.00	.00
0.													
1	1620	197	.00	.00	.00	0.	*	2	1310	447	.00	.00	.00
0.													
1	1625	198	.00	.00	.00	0.	*	2	1315	448	.00	.00	.00
0.													
1	1630	199	.00	.00	.00	0.	*	2	1320	449	.00	.00	.00
0.													
1	1635	200	.00	.00	.00	0.	*	2	1325	450	.00	.00	.00
0.													
1	1640	201	.00	.00	.00	0.	*	2	1330	451	.00	.00	.00
0.													
1	1645	202	.00	.00	.00	0.	*	2	1335	452	.00	.00	.00
0.													
1	1650	203	.00	.00	.00	0.	*	2	1340	453	.00	.00	.00
0.													
1	1655	204	.00	.00	.00	0.	*	2	1345	454	.00	.00	.00
0.													
1	1700	205	.00	.00	.00	0.	*	2	1350	455	.00	.00	.00
0.													
1	1705	206	.00	.00	.00	0.	*	2	1355	456	.00	.00	.00
0.													
1	1710	207	.00	.00	.00	0.	*	2	1400	457	.00	.00	.00
0.													
1	1715	208	.00	.00	.00	0.	*	2	1405	458	.00	.00	.00
0.													
1	1720	209	.00	.00	.00	0.	*	2	1410	459	.00	.00	.00
0.													
1	1725	210	.00	.00	.00	0.	*	2	1415	460	.00	.00	.00
0.													
1	1730	211	.00	.00	.00	0.	*	2	1420	461	.00	.00	.00
0.													
1	1735	212	.00	.00	.00	0.	*	2	1425	462	.00	.00	.00
0.													
1	1740	213	.00	.00	.00	0.	*	2	1430	463	.00	.00	.00
0.													
1	1745	214	.00	.00	.00	0.	*	2	1435	464	.00	.00	.00
0.													
1	1750	215	.00	.00	.00	0.	*	2	1440	465	.00	.00	.00
0.													
1	1755	216	.00	.00	.00	0.	*	2	1445	466	.00	.00	.00
0.													
1	1800	217	.00	.00	.00	0.	*	2	1450	467	.00	.00	.00
0.													
1	1805	218	.00	.00	.00	0.	*	2	1455	468	.00	.00	.00
0.													
1	1810	219	.00	.00	.00	0.	*	2	1500	469	.00	.00	.00
0.													
1	1815	220	.00	.00	.00	0.	*	2	1505	470	.00	.00	.00
0.													
1	1820	221	.00	.00	.00	0.	*	2	1510	471	.00	.00	.00
0.													
1	1825	222	.00	.00	.00	0.	*	2	1515	472	.00	.00	.00
0.													
1	1830	223	.00	.00	.00	0.	*	2	1520	473	.00	.00	.00
0.													
1	1835	224	.00	.00	.00	0.	*	2	1525	474	.00	.00	.00
0.													
1	1840	225	.00	.00	.00	0.	*	2	1530	475	.00	.00	.00
0.													
1	1845	226	.00	.00	.00	0.	*	2	1535	476	.00	.00	.00
0.													
1	1850	227	.00	.00	.00	0.	*	2	1540	477	.00	.00	.00
0.													
1	1855	228	.00	.00	.00	0.	*	2	1545	478	.00	.00	.00
0.													
1	1900	229	.00	.00	.00	0.	*	2	1550	479	.00	.00	.00
0.													
1	1905	230	.00	.00	.00	0.	*	2	1555	480	.00	.00	.00

```
 0.
        1     1910  231     .00     .00     .00         0.       *        2     1600  481     .00     .00     .00
 0.
        1     1915  232     .00     .00     .00         0.       *        2     1605  482     .00     .00     .00
 0.
        1     1920  233     .00     .00     .00         0.       *        2     1610  483     .00     .00     .00
 0.
        1     1925  234     .00     .00     .00         0.       *        2     1615  484     .00     .00     .00
 0.
        1     1930  235     .00     .00     .00         0.       *        2     1620  485     .00     .00     .00
 0.
        1     1935  236     .00     .00     .00         0.       *        2     1625  486     .00     .00     .00
 0.
        1     1940  237     .00     .00     .00         0.       *        2     1630  487     .00     .00     .00
 0.
        1     1945  238     .00     .00     .00         0.       *        2     1635  488     .00     .00     .00
 0.
        1     1950  239     .00     .00     .00         0.       *        2     1640  489     .00     .00     .00
 0.
        1     1955  240     .00     .00     .00         0.       *        2     1645  490     .00     .00     .00
 0.
        1     2000  241     .00     .00     .00         0.       *        2     1650  491     .00     .00     .00
 0.
        1     2005  242     .00     .00     .00         0.       *        2     1655  492     .00     .00     .00
 0.
        1     2010  243     .00     .00     .00         0.       *        2     1700  493     .00     .00     .00
 0.
        1     2015  244     .00     .00     .00         0.       *        2     1705  494     .00     .00     .00
 0.
        1     2020  245     .00     .00     .00         0.       *        2     1710  495     .00     .00     .00
 0.
        1     2025  246     .00     .00     .00         0.       *        2     1715  496     .00     .00     .00
 0.
        1     2030  247     .00     .00     .00         0.       *        2     1720  497     .00     .00     .00
 0.
        1     2035  248     .00     .00     .00         0.       *        2     1725  498     .00     .00     .00
 0.
        1     2040  249     .00     .00     .00         0.       *        2     1730  499     .00     .00     .00
 0.
        1     2045  250     .00     .00     .00         0.       *        2     1735  500     .00     .00     .00
 0.
                                                                 *
********************************************************************************************************************************
**********

     TOTAL RAINFALL =     .00, TOTAL LOSS =    -.74, TOTAL EXCESS =     .74

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR       72-HR     41.58-HR
+   (CFS)       (HR)
                      (CFS)
+       0.       .00                0.          0.          0.          0.
                      (INCHES)     .000        .000        .000        .000
                      (AC-FT)       0.          0.          0.          0.

                      CUMULATIVE AREA =   24.55 SQ MI

1
                                                RUNOFF SUMMARY
                                            FLOW IN CUBIC FEET PER SECOND
                                          TIME IN HOURS,  AREA IN SQUARE MILES

                                       PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM
TIME OF
         OPERATION       STATION       FLOW     PEAK                                          AREA      STAGE     MAX
STAGE
+                                                          6-HOUR     24-HOUR     72-HOUR

         HYDROGRAPH AT
+                         C-All          0.     .00           0.          0.          0.      24.55


 ***    1 ERROR(S) DETECTED BY HEC-1 ***
```

```
1****************************************
****************************************
 *                                      *                                                *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                *    U.S. ARMY CORPS OF
ENGINEERS     *
 *              JUN   1998              *                                                *    HYDROLOGIC ENGINEERING
CENTER    *
 *           VERSION 4.1                *                                                *          609 SECOND
STREET        *
 *                                      *                                                *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   06JUN12  TIME  14:18:54  *                                                *           (916) 756-1104
        *
 *                                      *                                                *
        *
 ****************************************
****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                         *DIAGRAM
              1          ID        Grand Junction Regional Airport - Jviation - prepared March 9 2012
              2          ID        Proposed Conditions Watershed Model
              3          ID        10-Year 24-Hour Storm - NRCS Type II Rainfall Distribution
              4          ID    ALL SOILS ARE TREATED AS CLASS D SOILS
              5          ID    PREC 1.00 for 0.1< area < 5.0 squire miles; use flow under ratio 1
              6          ID    PREC 0.97 for 5.0< area <12.5 square miles; use flow under ratio 2
              7          ID    When I>10, uses CHUP method for Tlag, when I<10, uses Grand Junction SCS Meth
              8          ID        ************************************************************************
 *** FREE ***
              9          IT       5       0       0     500
             10          IO       5       0       0
             11          IN       5       0      07
             12          JR    PREC     1.0    0.97

             13          KK    L11b
             14          KM   Leach Creek at Upper Pond
             15          BA  7.4130
             16          PB    1.19
             17          PC       0   0.001   0.002  0.0031  0.0041  0.0051  0.0062  0.0073  0.0083  0.0094
             18          PC  0.0105  0.0116  0.0127  0.0138   0.015  0.0161  0.0173  0.0185  0.0196  0.0208
             19          PC   0.022  0.0232  0.0244  0.0257  0.0269  0.0281  0.0294  0.0307  0.0319  0.0332
             20          PC  0.0345  0.0358  0.0371  0.0384  0.0398  0.0411  0.0425  0.0438  0.0452  0.0466
             21          PC   0.048  0.0494  0.0508  0.0523  0.0538  0.0553  0.0568  0.0583  0.0598  0.0614
             22          PC   0.063  0.0646  0.0662  0.0679  0.0696  0.0712   0.073  0.0747  0.0764  0.0782
             23          PC    0.08  0.0818  0.0836  0.0855  0.0874  0.0892  0.0912  0.0931   0.095   0.097
             24          PC   0.099   0.101   0.103  0.1051  0.1072  0.1093  0.1114  0.1135  0.1156  0.1178
             25          PC    0.12  0.1223  0.1246  0.1271  0.1296  0.1323   0.135  0.1379  0.1408  0.1439
             26          PC   0.147  0.1502  0.1534  0.1566  0.1598   0.163  0.1663  0.1697  0.1733  0.1771
             27          PC   0.181  0.1851  0.1895  0.1941  0.1989   0.204  0.2094  0.2152  0.2214   0.228
             28          PC   0.235  0.2427  0.2513  0.2609  0.2715   0.283  0.3068  0.3544  0.4308  0.5679
             29          PC   0.663   0.682  0.6986   0.713  0.7252   0.735  0.7434  0.7514  0.7588  0.7656
             30          PC   0.772   0.778  0.7836   0.789  0.7942   0.799  0.8036   0.808  0.8122  0.8162
             31          PC    0.82  0.8237  0.8273  0.8308  0.8342  0.8376  0.8409  0.8442  0.8474  0.8505
             32          PC  0.8535  0.8565  0.8594  0.8622  0.8649  0.8676  0.8702  0.8728  0.8753  0.8777
             33          PC    0.88  0.8823  0.8846  0.8868   0.889  0.8912  0.8934  0.8955  0.8976  0.8997
             34          PC  0.9018  0.9038  0.9058  0.9078  0.9098  0.9117  0.9136  0.9155  0.9174  0.9192
             35          PC   0.921  0.9228  0.9246  0.9263   0.928  0.9297  0.9314   0.933  0.9346  0.9362
             36          PC  0.9377  0.9393  0.9408  0.9423  0.9438  0.9452  0.9466   0.948  0.9494  0.9507
             37          PC   0.952  0.9533  0.9546  0.9559  0.9572  0.9584  0.9597   0.961  0.9622  0.9635
             38          PC  0.9648   0.966  0.9672  0.9685  0.9697  0.9709  0.9722  0.9734  0.9746  0.9758
             39          PC   0.977  0.9782  0.9794  0.9806  0.9818  0.9829  0.9841  0.9853  0.9864  0.9876
```

```
  40          PC  0.9888  0.9899   0.991  0.9922  0.9933  0.9944  0.9956  0.9967  0.9978  0.9989
  41          PC       1       1       1       1       1       1       1       1       1       1
  42          PC       1       1       1       1       1       1       1       1       1       1
  43          PC       1       1       1       1       1       1       1       1       1       1
  44          PC       1       1       1       1       1       1       1       1       1       1
  45          PC       1       1       1       1       1       1       1       1       1       1
  46          PC       1       1       1       1       1       1       1       1       1       1
  47          LG    0.41  0.4023   1.502   0.054     2.0
  48          US   1.654   0.451
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  49          KK  RLEACH
  50          KM   Leach Creek Dam (To be constructed in Fall 2012)
  51          RS       1    STOR       0
  52          SV       0    31.0    62.0    93.0   124.0   155.0   186.0   217.0   249.3
  53          SQ       0     5.0    10.0    15.0    20.0    40.0    40.0    40.0    40.0
  54          SE    4892    4894    4897    4900    4903    4906    4909    4911  4914.1

  55          KK  RL11bDRoute Hydrograph Through L11a
  56          RK    9500  0.0129   0.035       0    TRAP      10       6

  57          KK   L11aU
  58          KM   Subbasin at the Proposed Lower Detention Pond
  59          BA  1.0148
  60          LG    0.41  0.4023   1.502   0.054     2.0
  61          US   1.149   0.335

  62          KK  C_11aU
  63          KM   Combine Hydrographs at the Proposed Lower Detention Pond
  64          HC       2

  65          KK   R_Pd1
  66          KM   Proposed Water Quality Pond - 4.0 AC-FT per Grand Junction Requirements
  67          RS       1    STOR       0
  68          SV       0     4.0
  69          SQ       0    5000
  70          SE    4755    4756

  71          KK   L11aD
  72          KM   Subbasin Downstream of the Proposed Lower Detention Pond
  73          BA  0.0230
  74          LG    0.35  0.3550   1.325   0.048    15.0
  75          US   0.032   0.170

  76          KK  C_11aD
  77          KM   Combine Hydrographs of Basin L11aU and L11aD
  78          HC       2

  79          KK    L10u
  80          KM   Subbasin L10u
  81          BA  0.4357
  82          LG    0.41  0.4023   1.502   0.054     3.0
  83          US   0.426   0.288

  84          KK   R_Pd2
  85          KM   Proposed Pond 2
  86          RS       1    STOR       0
  87          SV     0.0    0.10    0.35    0.77    1.40    2.28    3.45    4.90    6.60
  88          SQ     0.0     0.0     0.0     6.2    17.5    32.2    49.6    69.3    94.0
  89          SE    4803    4804    4805    4806    4807    4808    4809    4810    4811
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  90          KK  R_10uORoute Detention Pond 2 to L10d
  91          RK    4200   0.012    0.03       0    TRAP      10       4

  92          KK   L10d1
  93          KM   New Subbasin L10d1
  94          BA  0.0836
  95          LG    0.41  0.4023   1.502   0.054     3.0
  96          US   0.158   0.225

  97          KK  R10d1ORoute Basin L10d1 to L10d
  98          RK    7000   0.014    0.03       0    TRAP      10       4

  99          KK    L10d
 100          KM   Revised Subbasin L10d
 101          BA  0.5052
 102          LG    0.38  0.3787   1.414   0.051     8.0
 103          US   1.308   0.268

 104          KK    C_10
 105          KM   Combine Hydrographs of Subbasin L10d, Pond 2, and Pond 3
 106          HC       3

 107          KK   R_Pd6
```

```
 108          KM   Proposed Pond 6
 109          RS       1    STOR       0
 110          SV       0    0.05    0.25    0.69    1.41    2.46    3.83
 111          SQ     0.0     0.0     6.2    34.1    78.2   130.0   130.0
 112          SE    4750    4751    4752    4753    4754    4755    4756

 113          KK  C_1011
 114          KM   Combine Hydrographs of Subbasin L10 and L11
 115          HC       2

 116          KK   R_L9M
 117          KM   Route Mainstem Hydrograph Through L9
 118          RS       1    STOR       0
 119          SV       0    1.24    2.23     3.3    4.23    4.86    5.34    6.55    7.57    8.54
 120          SV    9.65   10.61   11.55   12.36   13.09  3000.0
 121          SQ       0     100     200     300     400     500     600     800    1000    1200
 122          SQ    1400    1600    1800    2000    2200    2400

 123          KK   L9.1u
 124          KM   Revised Subbasin L9.1u
 125          BA  2.3743
 126          LG    0.41  0.4023   1.502   0.054     2.0
 127          US   1.436   0.377

 128          KK   R_PD3
 129          KM   Proposed Pond 3
 130          RS       1    STOR       0
 131          SV     0.0    1.81    3.76    5.86    8.12   10.53   13.12   15.92   18.98   24.00
 132          SQ     0.0     0.0     0.0     0.0     9.3    26.3    48.3    77.3   146.3   224.4
 133          SE    4829    4830    4831    4832    4833    4834    4835    4836    4837    4838
1                                          HEC-1 INPUT                                          PAGE  4

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 134          KK  R_9.1ORoute Pond 3 to L9.1d
 135          RK    5000   0.014    0.03       0    TRAP      10       4

 136          KK     R17
 137          KM   Revised Subbasin R17
 138          BA  0.1230
 139          LG    0.30  0.3077   1.148   0.041    27.0
 140          US   0.097   0.274

 141          KK   R_R17Route hydrograph through L.91d
 142          RK    4600   0.014    0.03       0    TRAP      10       4

 143          KK    R15u
 144          KM   Subbasin R15u
 145          BA  0.1666
 146          LG    0.26  0.2840   1.060   0.038    37.0
 147          US   0.177   0.372

 148          KK  R_EXPD
 149          KM   Existing Pond at end of Basin R15u
 150          RS       1    STOR       0
 151          SV     0.0    0.03    0.20    0.57    1.15    1.95    2.87    3.87
 152          SQ     0.0     0.0     2.7    10.3    20.6    33.1    47.6    71.3
 153          SE    4790    4791    4792    4793    4794    4795    4796    4797

 154          KK   R_R15Route Subbasin R15u Hydrograph Through L9.1d
 155          RK    2000   0.006    0.03       0    TRAP       5     2.4

 156          KK   L9.1d
 157          KM   Revised Subbasin L9.1d
 158          BA  0.2968
 159          LG    0.06  0.0710   0.265   0.010    95.0
 160          US   0.193   0.699

 161          KK   R_L9TRoute Subbasin L9.1 Hydrograph Through L9
 162          RK    4100   0.011    0.03       0    TRAP       5     2.4

 163          KK   C9.1d
 164          KM   Combine subbasin R15u and L9.1d
 165          HC       2

 166          KK   C_9.1
 167          KM   Combine subbasin Pond 4,R17 and 9.1d
 168          HC       3

 169          KK   R_PD7
 170          KM   Proposed Pond 7
 171          RS       1    STOR       0
 172          SV     0.0    0.24    1.23    3.39    6.91   11.56   16.86   22.48   28.29
 173          SQ     0.0     0.0     0.0     0.0    65.1   125.4   161.9   191.6   217.3
 174          SE    4755    4756    4757    4758    4759    4760    4761    4762    4763
1                                          HEC-1 INPUT                                          PAGE  5

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
175          KK   C_L9M
176          KM   Ultimate Outfall into Leach Creek
177          HC       2

178          KK      L9
179          KM   Subbasin
180          BA  0.1646
181          LG    0.39  0.3787   1.414   0.051    21.0
182          US   0.774   0.232

183          KK   R_WQ3
184          KM   Water Quality Pond 3 at the end of Basin L9
185          RS       1    STOR       0
186          SV     0.0    0.36
187          SQ     0.0    1000
188          SE    4766    4767

189          KK  CL9L10
190          KM   L9+L10
191          HC       2

192          KK      C3
193          KM   Corcoran Wash at H Road and 25 Road
194          BA  0.5779
195          LG    0.41  0.4023   1.502   0.054     3.0
196          US   0.669   0.301

197          KK   Upper
198          KM   L9+L10+C3
199          HC       2

200          KK    DB21
201          KM   Subbasin
202          BA  0.1519
203          LG    0.41  0.4023   1.502   0.054     3.0
204          US   0.314   0.245

205          KK      PDA
206          KM   Existing Pond A
207          RS       1    STOR       0       0
208          SV     0.0   0.001     1.8     4.7     8.9    11.6
209          SQ     0.0     2.5     7.0     9.0    10.6    11.3
210          SE    4915    4916    4918    4920    4922    4923

211          KK    21a2
212          KM   New Subbasin
213          BA  0.0780
214          LG    0.41  0.4023   1.502   0.054     3.0
215          US   0.144   0.221
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

216          KK  R_PD4A
217          KM   Proposed Pond 4A
218          RS       1    STOR       0
219          SV       0    0.21    0.63    1.42    2.72    4.57    7.01
220          SQ       0     0.0     0.0     0.0     0.0     6.3    17.5
221          SE    4891    4892    4893    4894    4895    4896    4897

222          KK   C21a2
223          KM   Combines Exisintg Pond A and Subbasin DB21a2
224          HC       2

225          KK   R21a2
226          KM   Route c21a2 Through DB21a
227          RK    2700   0.019    0.05       0    TRAP      30       6

228          KK    21a1
229          KM   New Subbasin
230          BA  0.0700
231          LG    0.39  0.3787   1.414   0.051     6.0
232          US   0.153   0.206

233          KK   R_PD4
234          KM   Proposed Pond 4
235          RS       1    STOR       0
236          SV       0    0.16    0.48    1.00    1.75    2.78    4.11    5.75
237          SQ     0.0     0.0     0.0     0.0     6.2    17.5    32.2    40.1
238          SE    4900    4901    4902    4903    4904    4905    4906    4907

239          KK   R21a1
240          KM   Route Pond 4 Through DB21a
241          RK    1600   0.041    0.05       0    TRAP      30       6

242          KK   DB21a
243          KM   Subbasin
244          BA  0.2346
245          LG    0.36  0.3550   1.325   0.048    13.0
246          US   0.174   0.235
```

```
 247          KK    C21a
 248          KM   Combine Routed Basin 21a, C21a2, and Pond 4
 249          HC       3

 250          KK  R_PD4B
 251          KM   Proposed Pond 4B
 252          RS       1    STOR       0
 253          SV       0    0.04    0.19    0.52    1.08    1.94    3.16    5.01
 254          SQ       0     0.0     0.0     0.0     3.3    17.1    36.2    77.6
 255          SE    4837    4838    4839    4840    4841    4842    4843    4844
1                                          HEC-1 INPUT                                  PAGE  7

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 256          KK    RPD1
 257          KM   Route Hydrograph Through Basin 23b Pipe
 258          RK    2550   0.014   0.015       0    CIRC       3

 259          KK   DB23b
 260          KM   Subbasin
 261          BA  0.0581
 262          LG    0.06  0.0710   0.265   0.010    95.0
 263          US   0.046   0.547

 264          KK    C23b
 265          KM   Combine Hydrograph Basin 23b with 21a
 266          HC       2

 267          KK    R23b
 268          KM   Route Hydrograph Through Basin 23c Pipe
 269          RK    1000   0.020   0.013       0    CIRC       3

 270          KK   DB23c
 271          KM   Subbasin
 272          BA  0.0822
 273          LG    0.06  0.0710   0.065   0.010    95.0
 274          US   0.080   0.577

 275          KK    R23c
 276          KM   Route R23c Through R23c Ditch
 277          RK     500    .005   0.045       0    TRAP      10       4

 278          KK   DB23d
 279          KM   Subbasin
 280          BA  0.0188
 281          LG    0.04  0.0473   0.177   0.006   100.0
 282          US   0.023   0.467

 283          KK    R23d
 284          KM   Route Hydrograph Through Basin 23d Pipe
 285          RK    1200   0.005   0.015       0    CIRC       2

 286          KK    C23c
 287          KM   Combine Hydrograph Basins 23c,23d with 23b
 288          HC       3

 289          KK  WF_PD2
 290          KM   Route Hydrograph Through New Walker Field On Site Pond 2
 291          RS       1    STOR       0       0
 292          SV     0.0    0.10    0.70    1.64    3.16    5.34
 293          SQ     0.0    23.6    48.1    68.1    83.4    3000
 294          SE  4793.5    4795    4797    4799    4801    4803
1                                          HEC-1 INPUT                                  PAGE  8

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 295          KK  RWF_P2
 296          KM   Route Hydrograph Through Basin 23e Pipe
 297          RK    1000   0.010   0.015       0    CIRC       3

 298          KK   DB23e
 299          KM   Subasin
 300          BA  0.0763
 301          LG    0.04  0.0473   0.177   0.006   100.0
 302          US   0.067   0.577

 303          KK    C23e
 304          KM   Combine Hydrograph Basin 23e with WF_PD2
 305          HC       2

 306          KK    R23e
 307          KM   Route Hydrograph Through Basin 23a Pipe
 308          RK    1500   0.008   0.015       0    CIRC       4

 309          KK   DB23a
 310          KM   Subbasin
 311          BA  0.0222
 312          LG    0.38  0.3787   1.414   0.051    10.0
```

```
 313          US   0.131   0.163

 314          KK    C23a
 315          KM   Combine Hydrograph Basin 23a, 23e with WF_PD2
 316          HC       2

 317          KK    R_PDU
 318          KM   Route Hydrograph Through Upper Airport Upper Pond
 319          RS       1    STOR       0       0
 320          SV     0.0   0.001    0.21    6.09   16.16   26.80    29.4
 321          SQ     0.0    10.8    11.4    12.4    13.3    14.2     162
 322          SE    4767 4767.01    4768    4770    4772    4774  4774.5

 323          KK    D_PdU
 324          KM   Weir Flow Into Lower Pond
 325          DT  U_Pipe
 326          DI     0.0    14.2    14.3     100    1000
 327          DQ     0.0    14.2    14.2    14.2    14.2

 328          KK    DB22
 329          KM   Subbasin
 330          BA  0.0564
 331          LG    0.40  0.4023   1.502   0.054     5.0
 332          US   0.123   0.203

 333          KK   R_PD5
 334          KM   Proposed Pond 5
 335          RS       1    STOR       0
 336          SV     0.0    0.04    0.23    0.63    1.33    2.40    3.91
 337          SQ     0.0     0.0     0.0     0.0    19.7    28.4    32.8
 338          SE    4890    4891    4892    4893    4894    4895    4896
1                                          HEC-1 INPUT                                                PAGE  9

          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 339          KK     22a
 340          KM   Subbasin
 341          BA  0.1565
 342          LG    0.37  0.3787   1.414   0.051    11.0
 343          US   0.143   0.218

 344          KK    C22a
 345          KM   Combine Hydrograph Basin 22 and 22a
 346          HC       2

 347          KK   R24_P
 348          KM   Route Hydrograph Through Basin 24 Pipe
 349          RK    3076   0.014   0.015       0    CIRC     4.5

 350          KK   R24_O
 351          KM   Route Hydrograph Through Basin 24 Overland
 352          RK    1506   0.019    0.03       0    TRAP      10      12

 353          KK   DB24a
 354          KM   Subbasin
 355          BA  0.0209
 356          LG    0.27  0.2840   1.060   0.038    36.0
 357          US   0.096   0.263

 358          KK  B4aDIV
 359          KM   Divert Basin 24a overflow
 360          DT  B4aDIV
 361          DI     0.0    14.0   100.0  1000.0
 362          DQ       0    0.01    86.0   986.0

 363          KK   R24_P
 364          KM   Route Hydrograph Through Basin 24 Pipe
 365          RK     800   0.014   0.015       0    CIRC     4.5

 366          KK   R24_O
 367          KM   Route Hydrograph Through Basin 24 Overland
 368          RK    1506   0.019    0.03       0    TRAP      10      12

 369          KK    DB24
 370          KM   Subbasin
 371          BA  0.2360
 372          LG    0.12  0.1420   0.530   0.019    75.0
 373          US   0.162   0.629

 374          KK     C24
 375          KM   Combine Hydrographs (Basin22, Basin 24a, Basin 24)
 376          HC       3

 377          KK   DR24a
 378          KM   Retrieve 24a diversion
 379          DR  B4aDIV
1                                          HEC-1 INPUT                                                PAGE 10

          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
380           KK   R25_O
381           KM   Route 24a diversion through Basin 25 overland
382           RK     800   0.015    0.03       0    TRAP      30      10

383           KK   R25_P
384           KM   Route 24a diversion through Basin 25 pipe
385           RK    1600   0.013   0.015       0    CIRC       4

386           KK    DB25
387           KM   Subbasin
388           BA  0.0239
389           LG    0.27  0.2840   1.060   0.038    36.0
390           US   0.105   0.269

391           KK     C25
392           KM   Combine Hydrograph with 24a diversion
393           HC       2

394           KK   B5DIV
395           KM   Divert Basin 25 storm sewer overflow
396           DT   B5DIV
397           DI     0.0    14.0   100.0  1000.0
398           DQ       0       0    86.0   986.0

399           KK   DB25a
400           KM   Subbasin
401           BA  0.0332
402           LG    0.37  0.3550   1.325   0.048    12.0
403           US   0.031   0.174

404           KK     C_6
405           KM   Combine Basins 25a 25 24a 24 22
406           HC       3

407           KK     C_7
408           KM   Combine all Basins
409           HC       2

410           KK    R_PDL
411           KM   route Hydrograph Through Lower Airport East Pond
412           RS       1    STOR       0       0
413           SV     0.0    0.05    4.26   13.79   24.65    30.0
414           SQ     0.0     5.5     7.8     9.6    11.1    14.0
415           SE  4758.4    4760    4762    4764    4766  4766.2

416           KK    PR_U
417           KM   Retrieve Upper Pond Pipe Flow
418           DR  U_Pipe
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

419           KK   C_Out
420           KM   Combine 2 Outflow Hydrographs at Canal
421           HC       2

422           KK     R16
423           KM   Subbasin
424           BA  0.1571
425           LG    0.21  0.2130   0.795   0.029    51.0
426           US   0.076   0.479

427           KK   R_16a
428           KM   Route Hydrograph through R14A overland
429           RK    2500   0.005    0.04       0    TRAP      10      10

430           KK    R14A
431           KM   Subbasin
432           BA  0.0410
433           LG    0.12  0.1420   0.530   0.019    75.0
434           US   0.038   0.484

435           KK   C_16A
436           KM   Combine Hydrographs (R16, R14A)
437           HC       2

438           KK   C_14A
439           KM   Combine Hydrograph with Lower Pond Outfall
440           HC       2

441           KK    R15d
442           KM   Subbasin
443           BA  0.1530
444           LG    0.41  0.4023   1.502   0.054     3.0
445           US   0.203   0.246

446           KK   R_R13
447           KM   Route Hydrograph through R13
448           RS       1    STOR       0
```

```
 449          RC   0.035    0.03   0.035     971    .018
 450          RX    1000    1014    1022    1026    1036    1046    1050    1062
 451          RY    4762    4760    4758    4756    4756    4758    4760    4762

 452          KK     R13
 453          KM   Subbasin
 454          BA  0.0428
 455          LG    0.41  0.4023   1.502   0.054     2.0
 456          US   0.179   0.208

 457          KK   C_R13
 458          KM   Combine Hydrographs
 459          HC       2
1                                      HEC-1 INPUT                                      PAGE 12

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 460          KK CMiddle
 461          HC       2

 462          KK    CU+M
 463          HC       2

 464          KK  Extra5
 465          KM   Overflow released from Basin 25
 466          DR   B5DIV

 467          KK     R14
 468          KM   Subbasin
 469          BA  0.0598
 470          LG    0.40  0.4023   1.502   0.054     2.0
 471          US   0.963   0.219

 472          KK    C_R5
 473          KM   Combine Hydrographs (R14, Basin 5)
 474          HC       2

 475          KK     R_5
 476          KM   Route Basin 5 & R14 through R5 overland
 477          RK   10500   0.008    0.03       0    TRAP      10      20

 478          KK      R5
 479          KM   Subbasin
 480          BA  0.0843
 481          LG    0.38  0.3787   1.414   0.051     9.0
 482          US   0.381   0.201

 483          KK      I5
 484          KM   Start Indian Creek Basin
 485          BA  0.7994
 486          LG    0.41  0.4023   1.502   0.054     2.0
 487          US   0.439   0.323

 488          KK    R_I5
 489          KM   Route Hydrograph Through Existing Dam
 490          RS       1    STOR       0       0
 491          SV       0    2.24    4.65    7.24   10.01   12.95   16.08   19.41   22.92   26.63
 492          SQ     0.0     0.0     0.0     0.0     0.0     0.0     0.0    93.0   263.0   483.2
 493          SE    5190    5191    5192    5193    5194    5195    5196    5197    5198    5199

 494          KK      I4
 495          KM   Subbasin
 496          BA  1.2130
 497          LG    0.41  0.4023   1.502   0.054     2.0
 498          US   1.184   0.344
1                                      HEC-1 INPUT                                      PAGE 13

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 499          KK    C_I4
 500          KM   Combine I5 and I4
 501          HC       2

 502          KK      I3
 503          KM   Subbasin
 504          BA  3.2057
 505          LG    0.41  0.4023   1.502   0.054     2.0
 506          US   1.649   0.398

 507          KK    C_I3
 508          KM   Combine I4 and I3
 509          HC       2

 510          KK  R_I3_O
 511          KM   Route hydrograph through I2 overland
 512          RK    3300   0.014    0.04       0    TRAP      10       5

 513          KK      I2
 514          KM   Subbasin
```

```
 515           BA  0.9728
 516           LG    0.41  0.4023   1.502   0.054     3.0
 517           US   1.460   0.325

 518           KK    C_I2
 519           KM   Combine I3 and I2
 520           HC       2

 521           KK    R_I2
 522           KM   Route Hydrograph Through Existing Dam
 523           RS       1    STOR        0        0
 524           SV       0    3.06    6.67    10.92    15.93    21.81    28.62    36.41    45.21    55.07
 525           SV   66.05   78.18   91.52   106.10   121.97   139.16   176.23   235.99   257.34   280.13
 526           SQ       0       0    13.0     18.4     22.6     26.1     29.1     31.9     34.5     36.9
 527           SQ    39.1    41.2    43.2     45.2     47.0     48.8     52.1    228.8    234.6    240.4
 528           SE    4890    4892    4894     4896     4898     4900     4902     4904     4906     4908
 529           SE    4910    4912    4914     4916     4918     4920     4924     4930     4932     4934

 530           KK      I1
 531           KM   Subbasin
 532           BA  0.7563
 533           LG    0.41  0.4023   1.502   0.054    12.0
 534           US   1.890   0.311

 535           KK    C_I1
 536           KM   Combine I2 and I1
 537           HC       2

 538           KK      I7
 539           KM   Subbasin
 540           BA  1.0258
 541           LG    0.41  0.4023   1.502   0.054     2.0
 542           US   1.348   0.333
```



```
          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 543           KK    R_I7
 544           KM   Route Hydrograph Through Existing Dam
 545           RS       1    STOR        0        0
 546           SV       0    0.26    0.60     1.01     1.51     2.11     2.82     3.63     4.57     5.64
 547           SQ     0.0     0.0     0.0      0.0      0.0      0.0      0.0     62.0    175.4    322.2
 548           SE    4820    4821    4822     4823     4824     4825     4826     4827     4828     4829

 549           KK      I6
 550           KM   Subbasin
 551           BA  0.4512
 552           LG    0.40  0.4023   1.502   0.054     4.0
 553           US   0.553   0.285

 554           KK    C_I6
 555           KM   Combine I7 and I6
 556           HC       2

 557           KK      I8
 558           KM   Subbasin
 559           BA  0.4147
 560           LG    0.40  0.4023   1.502   0.054    10.0
 561           US   0.503   0.280

 562           KK      I9Subbasin
 563           BA  0.6808
 564           LG    0.41  0.4023   1.502   0.054     2.0
 565           US   1.197   0.315

 566           KK   C1819
 567           HC       2

 568           KK  C16-19
 569           KM   Combine 1617+I819
 570           HC       2

 571           KK  C15-19
 572           HC       2

 573           KK  CR5-19
 574           HC       2

 575           KK  CLower
 576           KM   C14-19
 577           HC       2

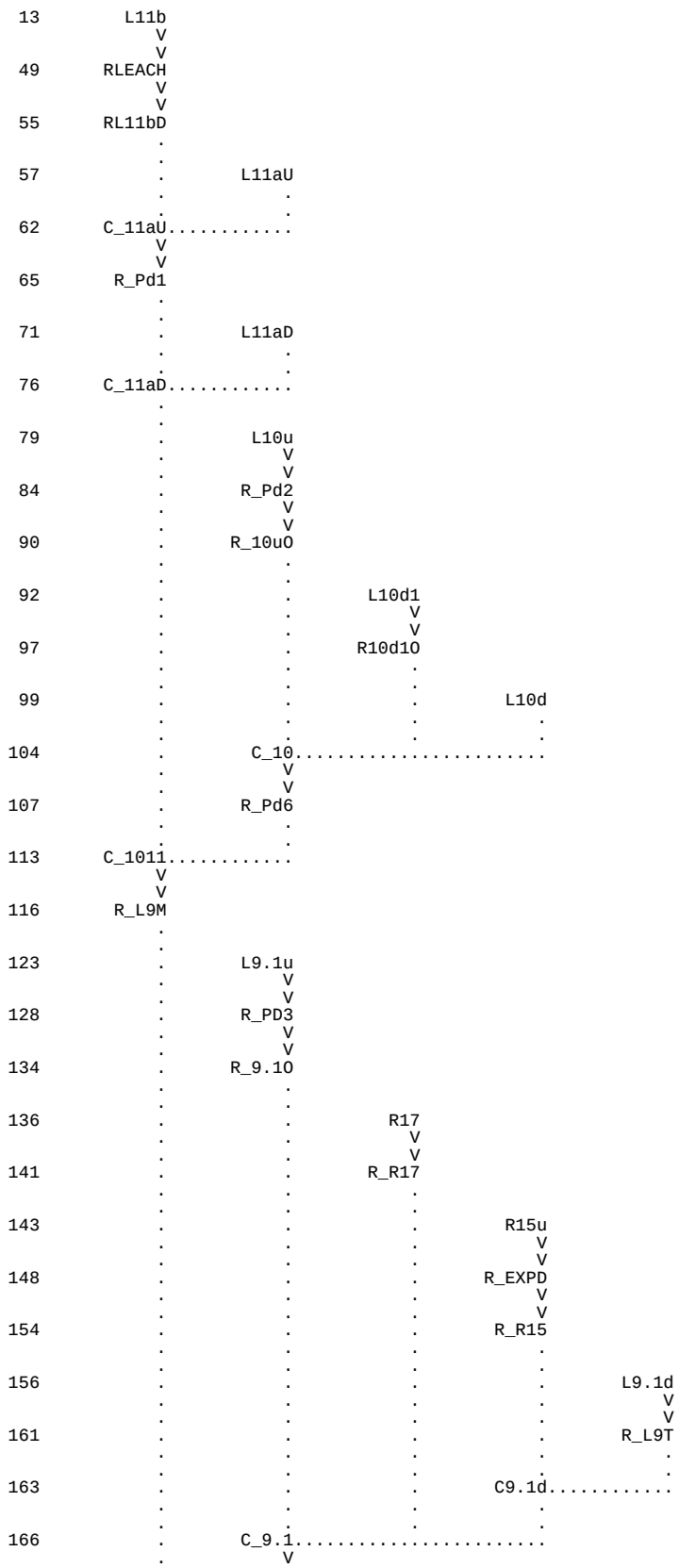
 578           KK   C-All
 579           HC       2
 580           ZZ
```

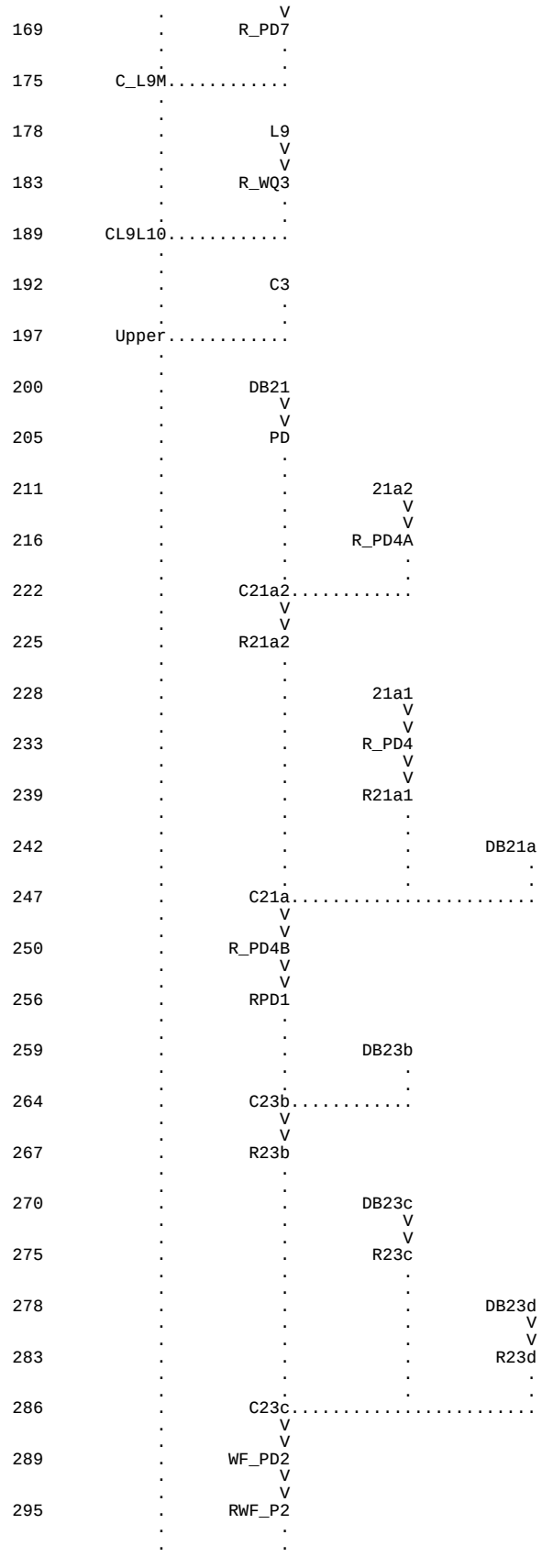
1

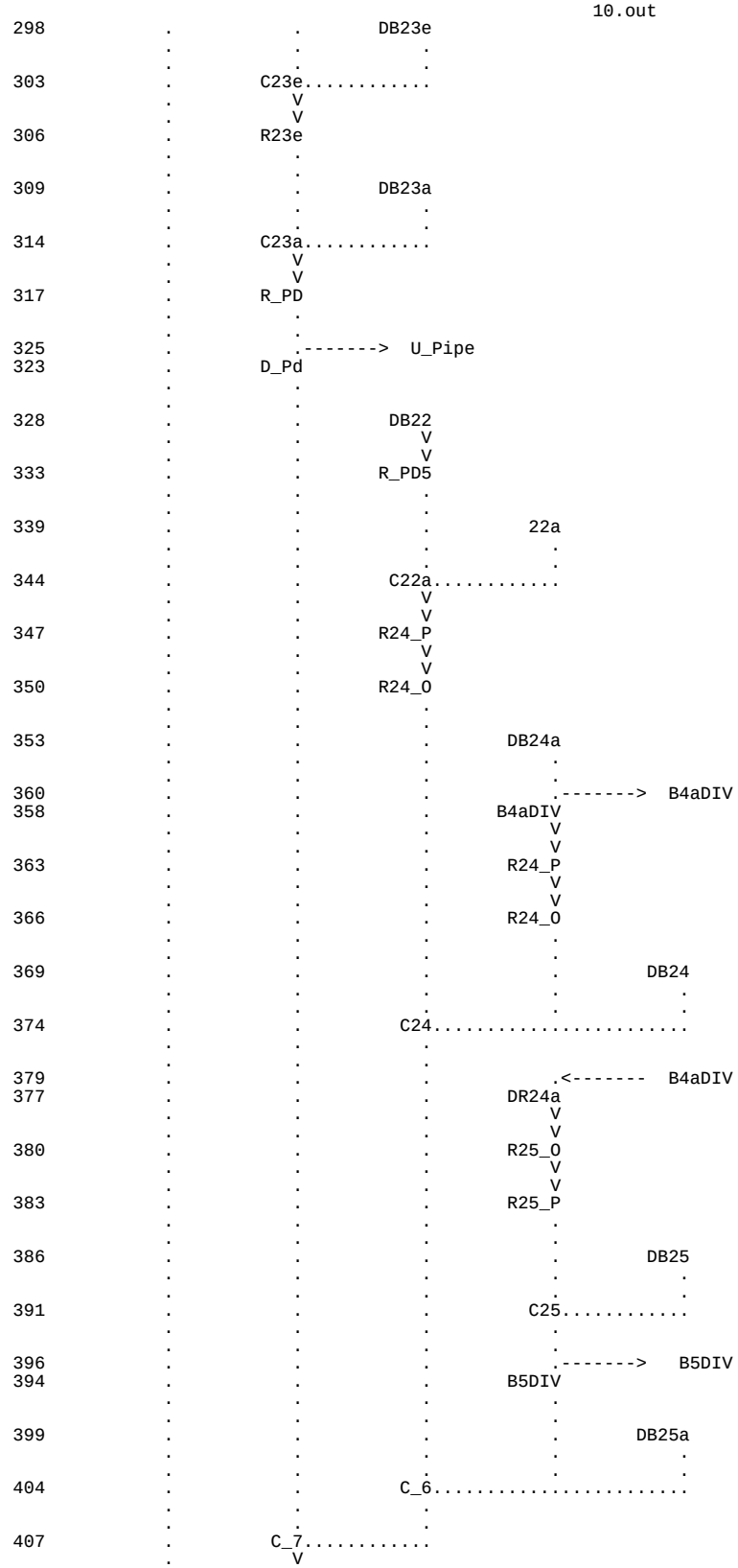
SCHEMATIC DIAGRAM OF STREAM NETWORK

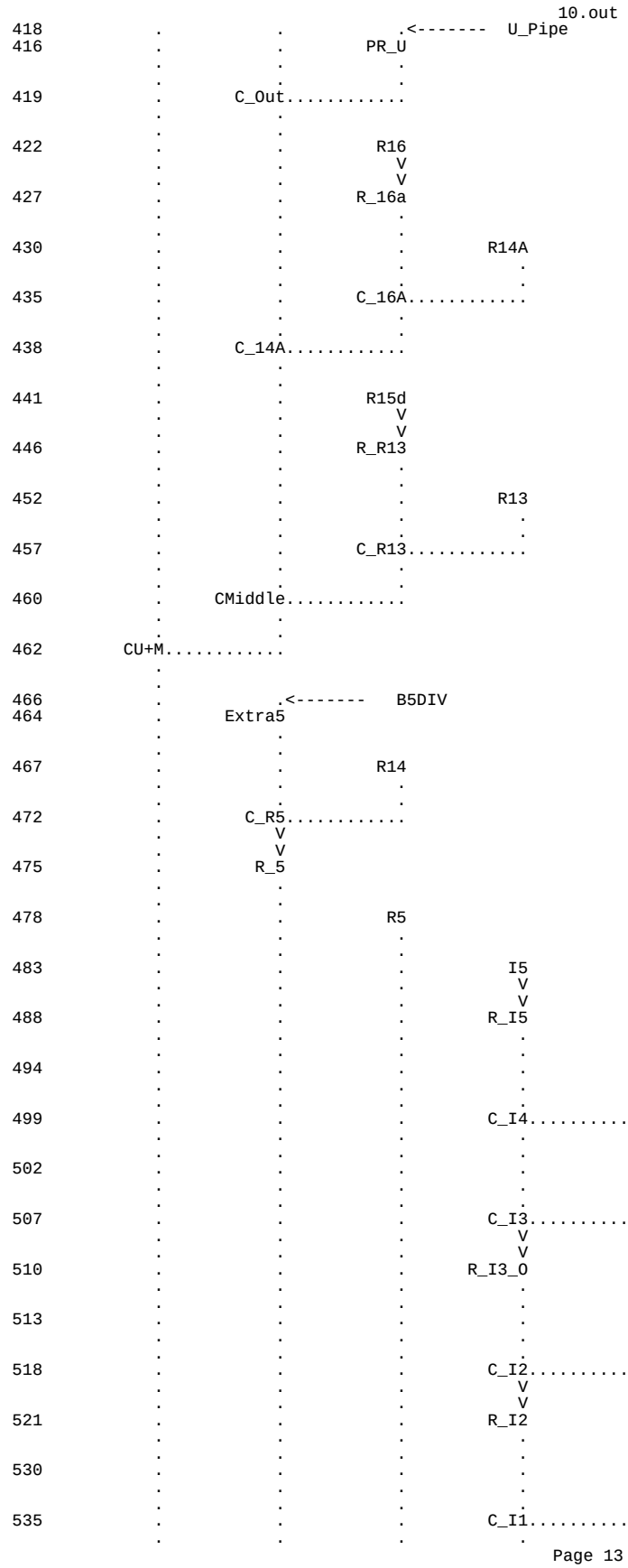
INPUT LINE (V) ROUTING (---->) DIVERSION OR PUMP FLOW

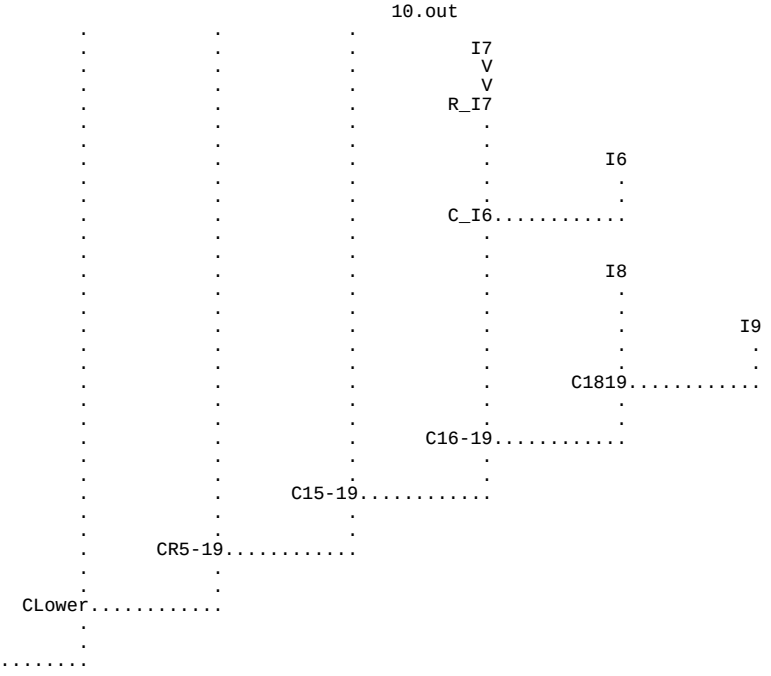
NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW




169 R_PD7
175 C_L9M
178 L9
183 R_WQ3
189 CL9L10
192 C3
197 Upper
200 DB21
205 PD
211 21a2
216 R_PD4A
222 C21a2
225 R21a2
228 21a1
233 R_PD4
239 R21a1
242 DB21a
247 C21a
250 R_PD4B
256 RPD1
259 DB23b
264 C23b
267 R23b
270 DB23c
275 R23c
278 DB23d
283 R23d
286 C23c
289 WF_PD2
295 RWF_P2


298
DB23e
303
C23e
306
R23e
309
DB23a
314
C23a
317
R_PD
325
U_Pipe
323
D_Pd
328
DB22
333
R_PD5
339
22a
344
C22a
347
R24_P
350
R24_O
353
DB24a
360
B4aDIV
358
B4aDIV
363
R24_P
366
R24_O
369
DB24
374
C24
379
B4aDIV
377
DR24a
380
R25_O
383
R25_P
386
DB25
391
C25
396
B5DIV
394
B5DIV
399
DB25a
404
C_6
407
C_7
410
R_PD


418
416
419
422
427
430
435
438
441
446
452
457
460
462
466
464
467
472
475
478
483
488
494
499
502
507
510
513
518
521
530
535
U_Pipe
PR_U
C_Out
R16
R_16a
R14A
C_16A
C_14A
R15d
R_R13
R13
C_R13
CMiddle
CU+M
B5DIV
Extra5
R14
C_R5
R_5
R5
I5
R_I5
I4
C_I4
I3
C_I3
R_I3_O
I2
C_I2
R_I2
I1
C_I1



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
**************************************
 *                                    *                                                    *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                *    U.S. ARMY CORPS OF
ENGINEERS     *
 *              JUN   1998              *                                                *    HYDROLOGIC ENGINEERING
CENTER    *
 *            VERSION 4.1               *                                                *         609 SECOND
STREET          *
 *                                      *                                                *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   06JUN12  TIME  14:18:54   *                                                *           (916) 756-1104
        *
 *                                      *                                                *
        *
 ****************************************
**************************************
```

Grand Junction Regional Airport - Jviation - prepared March 9 2012
Proposed Conditions Watershed Model
10-Year 24-Hour Storm - NRCS Type II Rainfall Distribution
ALL SOILS ARE TREATED AS CLASS D SOILS
PREC 1.00 for 0.1< area < 5.0 squire miles; use flow under ratio 1
PREC 0.97 for 5.0< area <12.5 square miles; use flow under ratio 2
When I>10, uses CHUP method for Tlag, when I<10, uses Grand Junction SCS Meth
****

```
   10 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           5  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                        NMIN           5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         500  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      2    0  ENDING DATE
                      NDTIME        1735  ENDING TIME
                      ICENT          19  CENTURY MARK

                    COMPUTATION INTERVAL      .08 HOURS
                         TOTAL TIME BASE   41.58 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
```

STORAGE VOLUME ACRE-FEET
SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00 .97

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 1

WARNING FDKRUT FAILURE TO PRESERVE UPSTREAM HYDROGRAPH VOLUME - CHECK ROUTED HYDROGRAPH SUMQU= .0000
SUMQT= .0001
1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1	RATIO 2
					1.00	.97
HYDROGRAPH AT						
+	L11b	7.41	1	FLOW	338.	311.
				TIME	11.50	11.50
ROUTED TO						
+	RLEACH	7.41	1	FLOW	15.	14.
				TIME	20.17	20.17
			** PEAK STAGES IN FEET **			
			1	STAGE	4899.84	4899.14
				TIME	20.17	20.25
ROUTED TO						
+	RL11bD	7.41	1	FLOW	15.	14.
				TIME	20.83	20.75
HYDROGRAPH AT						
+	L11aU	1.01	1	FLOW	49.	45.
				TIME	11.00	11.00
2 COMBINED AT						
+	C_11aU	8.43	1	FLOW	49.	45.
				TIME	11.00	11.00
ROUTED TO						
+	R_Pd1	8.43	1	FLOW	49.	45.
				TIME	11.00	11.00
			** PEAK STAGES IN FEET **			
			1	STAGE	4755.01	4755.01
				TIME	10.92	11.00
HYDROGRAPH AT						
+	L11aD	.02	1	FLOW	5.	5.
				TIME	10.08	10.08
2 COMBINED AT						
+	C_11aD	8.45	1	FLOW	51.	47.
				TIME	11.00	11.00
HYDROGRAPH AT						
+	L10u	.44	1	FLOW	47.	43.
				TIME	10.33	10.33
ROUTED TO						
+	R_Pd2	.44	1	FLOW	26.	24.
				TIME	11.08	11.08
			** PEAK STAGES IN FEET **			
			1	STAGE	4807.61	4807.46
				TIME	11.08	11.08
ROUTED TO						
+	R_10uO	.44	1	FLOW	26.	24.
				TIME	11.25	11.25
HYDROGRAPH AT						
+	L10d1	.08	1	FLOW	17.	16.
				TIME	10.08	10.08
ROUTED TO						
+	R10d1O	.08	1	FLOW	15.	16.
				TIME	10.58	10.50

```
 HYDROGRAPH AT
+                  L10d       .51     1   FLOW          22.      20.
                                          TIME        11.17    11.17

  3 COMBINED AT
+                  C_10      1.02     1   FLOW          55.      51.
                                          TIME        11.08    11.08

 ROUTED TO
+                 R_Pd6      1.02     1   FLOW          53.      49.
                                          TIME        11.33    11.33

                                        ** PEAK STAGES IN FEET **
                                        1   STAGE     4753.44  4753.34
                                            TIME        11.33    11.33

  2 COMBINED AT
+                C_1011      9.48     1   FLOW         102.      94.
                                          TIME        11.17    11.17

 ROUTED TO
+                 R_L9M      9.48     1   FLOW         100.      92.
                                          TIME        11.33    11.33

 HYDROGRAPH AT
+                 L9.1u      2.37     1   FLOW         104.      96.
                                          TIME        11.33    11.33

 ROUTED TO
+                 R_PD3      2.37     1   FLOW          53.      47.
                                          TIME        13.33    13.50

                                        ** PEAK STAGES IN FEET **
                                        1   STAGE     4835.18  4834.95
                                            TIME        13.33    13.50

 ROUTED TO
+                R_9.1O      2.37     1   FLOW          53.      47.
                                          TIME        13.50    13.67

 HYDROGRAPH AT
+                   R17       .12     1   FLOW          47.      45.
                                          TIME        10.08    10.08

 ROUTED TO
+                 R_R17       .12     1   FLOW          45.      44.
                                          TIME        10.17    10.17

 HYDROGRAPH AT
+                  R15u       .17     1   FLOW          79.      76.
                                          TIME        10.08    10.08

 ROUTED TO
+                R_EXPD       .17     1   FLOW          35.      34.
                                          TIME        10.50    10.50

                                        ** PEAK STAGES IN FEET **
                                        1   STAGE     4795.16  4795.06
                                            TIME        10.50    10.50

 ROUTED TO
+                 R_R15       .17     1   FLOW          35.      34.
                                          TIME        10.58    10.58

 HYDROGRAPH AT
+                 L9.1d       .30     1   FLOW         231.     224.
                                          TIME        10.08    10.08

 ROUTED TO
+                 R_L9T       .30     1   FLOW         229.     216.
                                          TIME        10.17    10.17

  2 COMBINED AT
+                 C9.1d       .46     1   FLOW         249.     236.
                                          TIME        10.17    10.17

  3 COMBINED AT
+                 C_9.1      2.96     1   FLOW         294.     280.
                                          TIME        10.17    10.17

 ROUTED TO
+                 R_PD7      2.96     1   FLOW         117.     113.
                                          TIME        10.58    10.58

                                        ** PEAK STAGES IN FEET **
                                        1   STAGE     4759.86  4759.80
                                            TIME        10.58    10.58

  2 COMBINED AT
+                 C_L9M     12.44     1   FLOW         195.     184.
```

				TIME	11.08	11.08
HYDROGRAPH AT						
+	L9	.16	1	FLOW	11.	11.
				TIME	10.67	10.67
ROUTED TO						
+	R_WQ3	.16	1	FLOW	11.	11.
				TIME	10.67	10.67
			** PEAK STAGES IN FEET **			
			1	STAGE	4766.01	4766.01
				TIME	10.58	10.67
2 COMBINED AT						
+	CL9L10	12.60	1	FLOW	205.	194.
				TIME	11.08	11.08
HYDROGRAPH AT						
+	C3	.58	1	FLOW	42.	39.
				TIME	10.58	10.58
2 COMBINED AT						
+	Upper	13.18	1	FLOW	238.	224.
				TIME	11.08	11.08
HYDROGRAPH AT						
+	DB21	.15	1	FLOW	18.	17.
				TIME	10.25	10.25
ROUTED TO						
+	PD	.15	1	FLOW	5.	5.
				TIME	11.75	11.75
			** PEAK STAGES IN FEET **			
			1	STAGE	4917.09	4916.98
				TIME	11.75	11.75
HYDROGRAPH AT						
+	21a2	.08	1	FLOW	16.	15.
				TIME	10.08	10.08
ROUTED TO						
+	R_PD4A	.08	1	FLOW	0.	0.
				TIME	.00	.00
			** PEAK STAGES IN FEET **			
			1	STAGE	4893.63	4893.52
				TIME	21.17	20.83
2 COMBINED AT						
+	C21a2	.23	1	FLOW	5.	5.
				TIME	11.75	11.75
ROUTED TO						
+	R21a2	.23	1	FLOW	5.	5.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	21a1	.07	1	FLOW	15.	14.
				TIME	10.08	10.08
ROUTED TO						
+	R_PD4	.07	1	FLOW	1.	0.
				TIME	12.25	12.67
			** PEAK STAGES IN FEET **			
			1	STAGE	4903.12	4903.07
				TIME	12.17	12.67
ROUTED TO						
+	R21a1	.07	1	FLOW	1.	0.
				TIME	12.50	13.00
HYDROGRAPH AT						
+	DB21a	.23	1	FLOW	59.	55.
				TIME	10.08	10.08
3 COMBINED AT						
+	C21a	.53	1	FLOW	59.	56.
				TIME	10.08	10.08
ROUTED TO						
+	R_PD4B	.53	1	FLOW	26.	24.
				TIME	10.83	10.83
			** PEAK STAGES IN FEET **			
			1	STAGE	4842.48	4842.39
				TIME	10.83	10.83
ROUTED TO						

+	RPD1	.53	1	FLOW	26.	24.
				TIME	10.83	10.83
HYDROGRAPH AT						
+	DB23b	.06	1	FLOW	62.	60.
				TIME	10.00	10.00
2 COMBINED AT						
+	C23b	.59	1	FLOW	63.	61.
				TIME	10.00	10.00
ROUTED TO						
+	R23b	.59	1	FLOW	62.	60.
				TIME	10.00	10.00
HYDROGRAPH AT						
+	DB23c	.08	1	FLOW	86.	83.
				TIME	10.00	10.00
ROUTED TO						
+	R23c	.08	1	FLOW	82.	79.
				TIME	10.00	10.00
HYDROGRAPH AT						
+	DB23d	.02	1	FLOW	15.	14.
				TIME	10.00	10.00
ROUTED TO						
+	R23d	.02	1	FLOW	14.	13.
				TIME	10.08	10.08
3 COMBINED AT						
+	C23c	.69	1	FLOW	157.	152.
				TIME	10.00	10.00
ROUTED TO						
+	WF_PD2	.69	1	FLOW	71.	70.
				TIME	10.17	10.17
			** PEAK STAGES IN FEET **			
			1	STAGE	4799.40	4799.27
				TIME	10.17	10.17
ROUTED TO						
+	RWF_P2	.69	1	FLOW	71.	70.
				TIME	10.17	10.17
HYDROGRAPH AT						
+	DB23e	.08	1	FLOW	81.	79.
				TIME	10.00	10.00
2 COMBINED AT						
+	C23e	.77	1	FLOW	140.	137.
				TIME	10.00	10.00
ROUTED TO						
+	R23e	.77	1	FLOW	135.	132.
				TIME	10.00	10.00
HYDROGRAPH AT						
+	DB23a	.02	1	FLOW	4.	4.
				TIME	10.08	10.08
2 COMBINED AT						
+	C23a	.79	1	FLOW	139.	135.
				TIME	10.00	10.00
ROUTED TO						
+	R_PD	.79	1	FLOW	13.	13.
				TIME	13.58	13.50
			** PEAK STAGES IN FEET **			
			1	STAGE	4770.91	4770.77
				TIME	13.75	13.58
DIVERSION TO						
+	U_Pipe	.79	1	FLOW	13.	13.
				TIME	13.58	13.50
HYDROGRAPH AT						
+	D_Pd	.79	1	FLOW	0.	0.
				TIME	.00	.00
HYDROGRAPH AT						
+	DB22	.06	1	FLOW	11.	11.
				TIME	10.08	10.08
ROUTED TO						
+	R_PD5	.06	1	FLOW	2.	1.
				TIME	11.33	11.58

** PEAK STAGES IN FEET **

			1	STAGE	4893.09	4893.07
				TIME	11.33	11.50
HYDROGRAPH AT							
+	22a	.16	1	FLOW	39.	37.
				TIME	10.08	10.08
2 COMBINED AT							
+	C22a	.21	1	FLOW	39.	37.
				TIME	10.08	10.08
ROUTED TO							
+	R24_P	.21	1	FLOW	37.	35.
				TIME	10.08	10.08
ROUTED TO							
+	R24_O	.21	1	FLOW	37.	35.
				TIME	10.17	10.17
HYDROGRAPH AT							
+	DB24a	.02	1	FLOW	8.	8.
				TIME	10.08	10.08
DIVERSION TO							
+	B4aDIV	.02	1	FLOW	0.	0.
				TIME	10.00	10.00
HYDROGRAPH AT							
+	B4aDIV	.02	1	FLOW	8.	8.
				TIME	10.08	10.08
ROUTED TO							
+	R24_P	.02	1	FLOW	8.	8.
				TIME	10.08	10.08
ROUTED TO							
+	R24_O	.02	1	FLOW	8.	8.
				TIME	10.17	10.17
HYDROGRAPH AT							
+	DB24	.24	1	FLOW	190.	184.
				TIME	10.08	10.08
3 COMBINED AT							
+	C24	.47	1	FLOW	228.	219.
				TIME	10.08	10.08
HYDROGRAPH AT							
+	DR24a	.00	1	FLOW	0.	0.
				TIME	10.00	10.00
ROUTED TO							
+	R25_O	.00	1	FLOW	0.	0.
				TIME	10.67	10.67
ROUTED TO							
+	R25_P	.00	1	FLOW	0.	0.
				TIME	10.83	10.83
HYDROGRAPH AT							
+	DB25	.02	1	FLOW	10.	9.
				TIME	10.08	10.08
2 COMBINED AT							
+	C25	.02	1	FLOW	10.	9.
				TIME	10.08	10.08
DIVERSION TO							
+	B5DIV	.02	1	FLOW	0.	0.
				TIME	.00	.00
HYDROGRAPH AT							
+	B5DIV	.02	1	FLOW	10.	9.
				TIME	10.08	10.08
HYDROGRAPH AT							
+	DB25a	.03	1	FLOW	7.	7.
				TIME	10.08	10.08
3 COMBINED AT							
+	C_6	.53	1	FLOW	244.	235.
				TIME	10.08	10.08
2 COMBINED AT							
+	C_7	1.32	1	FLOW	244.	235.
				TIME	10.08	10.08
ROUTED TO							
+	R_PD	1.32	1	FLOW	9.	9.
				TIME	12.58	12.42

** PEAK STAGES IN FEET **
1 STAGE 4763.64 4763.50
TIME 12.58 12.50

HYDROGRAPH AT
+ PR_U .00 1 FLOW 13. 13.
TIME 13.58 13.50

2 COMBINED AT
+ C_Out 1.32 1 FLOW 22. 22.
TIME 12.92 12.83

HYDROGRAPH AT
+ R16 .16 1 FLOW 127. 123.
TIME 10.00 10.00

ROUTED TO
+ R_16a .16 1 FLOW 118. 115.
TIME 10.17 10.17

HYDROGRAPH AT
+ R14A .04 1 FLOW 34. 33.
TIME 10.00 10.00

2 COMBINED AT
+ C_16A .20 1 FLOW 136. 133.
TIME 10.17 10.17

2 COMBINED AT
+ C_14A 1.52 1 FLOW 157. 153.
TIME 10.17 10.17

HYDROGRAPH AT
+ R15d .15 1 FLOW 27. 25.
TIME 10.08 10.08

ROUTED TO
+ R_R13 .15 1 FLOW 26. 24.
TIME 10.17 10.17

** PEAK STAGES IN FEET **
1 STAGE 4756.53 4756.50
TIME 10.17 10.17

HYDROGRAPH AT
+ R13 .04 1 FLOW 7. 7.
TIME 10.08 10.08

2 COMBINED AT
+ C_R13 .20 1 FLOW 33. 30.
TIME 10.17 10.17

2 COMBINED AT
+ CMiddle 1.71 1 FLOW 190. 183.
TIME 10.17 10.17

2 COMBINED AT
+ CU+M 14.89 1 FLOW 298. 287.
TIME 10.17 10.17

HYDROGRAPH AT
+ Extra5 .00 1 FLOW 0. 0.
TIME .00 .00

HYDROGRAPH AT
+ R14 .06 1 FLOW 2. 2.
TIME 10.83 10.83

2 COMBINED AT
+ C_R5 .06 1 FLOW 2. 2.
TIME 10.83 10.83

ROUTED TO
+ R_5 .06 1 FLOW 2. 2.
TIME 12.58 12.58

HYDROGRAPH AT
+ R5 .08 1 FLOW 8. 8.
TIME 10.25 10.25

HYDROGRAPH AT
+ I5 .80 1 FLOW 92. 85.
TIME 10.33 10.33

ROUTED TO
+ R_I5 .80 1 FLOW 0. 0.
TIME .00 .00

** PEAK STAGES IN FEET **
1 STAGE 5194.38 5194.08

				TIME	23.75	23.00
HYDROGRAPH AT						
+	I4	1.21	1	FLOW	58.	54.
				TIME	11.08	11.08
2 COMBINED AT						
+	C_I4	2.01	1	FLOW	58.	54.
				TIME	11.08	11.08
HYDROGRAPH AT						
+	I3	3.21	1	FLOW	129.	119.
				TIME	11.50	11.50
2 COMBINED AT						
+	C_I3	5.22	1	FLOW	181.	166.
				TIME	11.42	11.42
ROUTED TO						
+	R_I3_O	5.22	1	FLOW	181.	166.
				TIME	11.50	11.50
HYDROGRAPH AT						
+	I2	.97	1	FLOW	37.	34.
				TIME	11.33	11.33
2 COMBINED AT						
+	C_I2	6.19	1	FLOW	217.	199.
				TIME	11.50	11.50
ROUTED TO						
+	R_I2	6.19	1	FLOW	35.	34.
				TIME	17.42	17.25
			** PEAK STAGES IN FEET **			
			1	STAGE	4906.81	4905.87
				TIME	17.42	17.25
HYDROGRAPH AT						
+	I1	.76	1	FLOW	25.	24.
				TIME	11.75	11.75
2 COMBINED AT						
+	C_I1	6.95	1	FLOW	52.	49.
				TIME	12.58	12.75
HYDROGRAPH AT						
+	I7	1.03	1	FLOW	42.	39.
				TIME	11.25	11.25
ROUTED TO						
+	R_I7	1.03	1	FLOW	36.	33.
				TIME	11.75	11.83
			** PEAK STAGES IN FEET **			
			1	STAGE	4826.59	4826.53
				TIME	11.75	11.83
HYDROGRAPH AT						
+	I6	.45	1	FLOW	39.	36.
				TIME	10.42	10.42
2 COMBINED AT						
+	C_I6	1.48	1	FLOW	55.	50.
				TIME	11.67	11.75
HYDROGRAPH AT						
+	I8	.41	1	FLOW	42.	39.
				TIME	10.42	10.42
HYDROGRAPH AT						
+	I9	.68	1	FLOW	30.	27.
				TIME	11.08	11.08
2 COMBINED AT						
+	C1819	1.10	1	FLOW	60.	56.
				TIME	10.83	10.83
2 COMBINED AT						
+	C16-19	2.57	1	FLOW	102.	91.
				TIME	11.58	11.67
2 COMBINED AT						
+	C15-19	9.52	1	FLOW	149.	137.
				TIME	11.58	11.67
2 COMBINED AT						
+	CR5-19	9.60	1	FLOW	154.	141.
				TIME	11.58	11.67
2 COMBINED AT						

```
+                CLower      9.66     1   FLOW         154.      141.
                                          TIME        11.58    11.67

  2 COMBINED AT
+                 C-All     24.56     1   FLOW         410.      386.
                                          TIME        11.00    11.00
1
```

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
RL11bD	MANE	5.00	14.73	1254.21	.08	5.00	14.73	1250.00	.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3234E+02 EXCESS= .0000E+00 OUTFLOW= .3148E+02 BASIN STORAGE= .9133E+00 PERCENT ERROR= -.1

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .97									
RL11bD	MANE	5.00	13.57	1256.80	.07	5.00	13.57	1255.00	.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2980E+02 EXCESS= .0000E+00 OUTFLOW= .2896E+02 BASIN STORAGE= .8609E+00 PERCENT ERROR= -.1

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
R_10uO	MANE	4.89	26.46	673.40	.26	5.00	26.46	675.00	.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5932E+01 EXCESS= .0000E+00 OUTFLOW= .5930E+01 BASIN STORAGE= .1828E-04 PERCENT ERROR= .0

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .97									
R_10uO	MANE	5.00	24.30	677.60	.23	5.00	24.28	675.00	.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5452E+01 EXCESS= .0000E+00 OUTFLOW= .5445E+01 BASIN STORAGE= .1462E-04 PERCENT ERROR= .1

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
R10d1O	MANE	3.27	16.70	630.49	.27	5.00	15.36	635.00	.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1206E+01 EXCESS= .0000E+00 OUTFLOW= .1221E+01 BASIN STORAGE= .2823E-04 PERCENT

ERROR= -1.2

FOR PLAN = 1 RATIO= .97

R10d1O	MANE	3.35	15.76	629.32	.26	5.00	15.61	630.00	.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1114E+01 EXCESS= .0000E+00 OUTFLOW= .1149E+01 BASIN STORAGE= .3277E-04 PERCENT ERROR= -3.2

FOR PLAN = 1 RATIO= 1.00

R_9.1O	MANE	4.58	53.40	810.56	.21	5.00	53.40	810.00	.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2717E+02 EXCESS= .0000E+00 OUTFLOW= .2715E+02 BASIN STORAGE= .3124E-02 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .97

R_9.1O	MANE	4.70	47.29	816.71	.19	5.00	47.27	820.00	.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2458E+02 EXCESS= .0000E+00 OUTFLOW= .2457E+02 BASIN STORAGE= .3148E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R_R17	MANE	4.38	46.97	612.60	.61	5.00	45.31	610.00	.61

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3961E+01 EXCESS= .0000E+00 OUTFLOW= .3985E+01 BASIN STORAGE= .1102E-04 PERCENT ERROR= -.6

FOR PLAN = 1 RATIO= .97

R_R17	MANE	4.38	44.82	614.37	.58	5.00	44.18	610.00	.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3791E+01 EXCESS= .0000E+00 OUTFLOW= .3808E+01 BASIN STORAGE= .1194E-04 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= 1.00

R_R15	MANE	2.44	35.32	634.62	.71	5.00	35.31	635.00	.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6299E+01 EXCESS= .0000E+00 OUTFLOW= .6299E+01 BASIN STORAGE= .1252E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R_R15 MANE 2.47 33.98 634.46 .68 5.00 33.97 635.00 .68

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6055E+01 EXCESS= .0000E+00 OUTFLOW= .6055E+01 BASIN STORAGE= .1056E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R_L9T MANE 2.33 230.00 609.79 1.18 5.00 228.73 610.00 1.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1855E+02 EXCESS= .0000E+00 OUTFLOW= .1862E+02 BASIN STORAGE= .3556E-05 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .97

R_L9T MANE 2.42 216.32 611.02 1.14 5.00 216.00 610.00 1.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1799E+02 EXCESS= .0000E+00 OUTFLOW= .1803E+02 BASIN STORAGE= .2796E-05 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.00

R21a2 MANE 4.98 4.96 726.59 .18 5.00 4.96 725.00 .18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2194E+01 EXCESS= .0000E+00 OUTFLOW= .2200E+01 BASIN STORAGE= .3278E-04 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .97

R21a2 MANE 4.97 4.70 724.44 .17 5.00 4.70 725.00 .17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2026E+01 EXCESS= .0000E+00 OUTFLOW= .2029E+01 BASIN STORAGE= .2979E-04 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.00

R21a1 MANE 5.00 .76 751.83 .06 5.00 .76 750.00 .06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2165E+00 EXCESS= .0000E+00 OUTFLOW= .2162E+00 BASIN STORAGE= .1043E-04 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .97

R21a1 MANE 4.99 .41 780.56 .03 5.00 .41 780.00 .03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1303E+00 EXCESS= .0000E+00 OUTFLOW= .1302E+00 BASIN STORAGE= .9920E-05 PERCENT

ERROR= .1

FOR PLAN = 1 RATIO= 1.00

RPD1	MANE	1.27	26.32	652.14	.25	5.00	26.29	650.00	.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7186E+01 EXCESS= .0000E+00 OUTFLOW= .7185E+01 BASIN STORAGE= .6595E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

RPD1	MANE	1.21	24.47	652.95	.23	5.00	24.43	650.00	.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6623E+01 EXCESS= .0000E+00 OUTFLOW= .6623E+01 BASIN STORAGE= .6491E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23b	MANE	.42	62.49	600.12	.34	5.00	62.37	600.00	.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1083E+02 EXCESS= .0000E+00 OUTFLOW= .1083E+02 BASIN STORAGE= .2151E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23b	MANE	.42	60.45	600.27	.32	5.00	60.25	600.00	.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1016E+02 EXCESS= .0000E+00 OUTFLOW= .1016E+02 BASIN STORAGE= .2108E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23c	MANE	.84	84.58	601.48	1.18	5.00	81.56	600.00	1.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5163E+01 EXCESS= .0000E+00 OUTFLOW= .5169E+01 BASIN STORAGE= .3966E-07 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .97

R23c	MANE	.84	82.09	601.73	1.14	5.00	79.09	600.00	1.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5006E+01 EXCESS= .0000E+00 OUTFLOW= .5014E+01 BASIN STORAGE= .5075E-07 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.00

R23d MANE 1.10 14.58 602.74 1.19 5.00 13.68 605.00 1.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1188E+01 EXCESS= .0000E+00 OUTFLOW= .1188E+01 BASIN STORAGE= .1528E-10 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23d MANE 1.11 14.21 602.58 1.15 5.00 13.27 605.00 1.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1152E+01 EXCESS= .0000E+00 OUTFLOW= .1152E+01 BASIN STORAGE= .1347E-10 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

RWF_P2 MANE .43 71.15 610.93 .46 5.00 70.92 610.00 .46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1720E+02 EXCESS= .0000E+00 OUTFLOW= .1720E+02 BASIN STORAGE= .3343E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

RWF_P2 MANE .44 70.17 610.99 .44 5.00 69.99 610.00 .44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1633E+02 EXCESS= .0000E+00 OUTFLOW= .1633E+02 BASIN STORAGE= .3251E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23e MANE .66 139.44 601.33 .54 5.00 135.46 600.00 .54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2204E+02 EXCESS= .0000E+00 OUTFLOW= .2204E+02 BASIN STORAGE= .5513E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23e MANE .66 135.80 601.25 .51 5.00 131.96 600.00 .51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2103E+02 EXCESS= .0000E+00 OUTFLOW= .2103E+02 BASIN STORAGE= .5434E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_P MANE 1.38 38.68 607.90 .31 5.00 37.18 605.00 .31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3469E+01 EXCESS= .0000E+00 OUTFLOW= .3470E+01 BASIN STORAGE= .2782E-06 PERCENT

ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_P	MANE	1.27	36.54	607.39	.28	5.00	34.90	605.00	.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3215E+01 EXCESS= .0000E+00 OUTFLOW= .3216E+01 BASIN STORAGE= .2780E-06 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.00

R24_O	MANE	1.69	37.15	609.78	.31	5.00	37.15	610.00	.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3468E+01 EXCESS= .0000E+00 OUTFLOW= .3470E+01 BASIN STORAGE= .1062E-05 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .97

R24_O	MANE	1.75	34.88	609.78	.28	5.00	34.88	610.00	.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3212E+01 EXCESS= .0000E+00 OUTFLOW= .3211E+01 BASIN STORAGE= .1133E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_P	MANE	.44	8.23	605.93	.70	5.00	8.19	605.00	.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7807E+00 EXCESS= .0000E+00 OUTFLOW= .7807E+00 BASIN STORAGE= .3494E-12 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_P	MANE	.44	7.91	605.63	.67	5.00	7.88	605.00	.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7500E+00 EXCESS= .0000E+00 OUTFLOW= .7501E+00 BASIN STORAGE= .3594E-12 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_O	MANE	2.55	8.05	609.18	.70	5.00	8.02	610.00	.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7811E+00 EXCESS= .0000E+00 OUTFLOW= .7808E+00 BASIN STORAGE= .7196E-07 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_O	MANE	2.63	7.69	611.38	.67	5.00	7.68	610.00	.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7505E+00 EXCESS= .0000E+00 OUTFLOW= .7503E+00 BASIN STORAGE= .6098E-07 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R25_O	MANE	5.00	.01	639.24	-1.00	5.00	.01	640.00	-1.00

FOR PLAN = 1 RATIO= .97

R25_O	MANE	5.00	.01	641.91	-1.00	5.00	.01	640.00	-1.00

FOR PLAN = 1 RATIO= 1.00

R25_P	MANE	2.48	.01	650.56	-1.00	5.00	.01	650.00	-1.00

FOR PLAN = 1 RATIO= .97

R25_P	MANE	2.48	.01	651.27	-1.00	5.00	.01	650.00	-1.00

FOR PLAN = 1 RATIO= 1.00

R_16a	MANE	3.98	118.07	610.17	.87	5.00	117.99	610.00	.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7262E+01 EXCESS= .0000E+00 OUTFLOW= .7282E+01 BASIN STORAGE= .5554E-05 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .97

R_16a	MANE	4.00	115.80	609.83	.84	5.00	114.99	610.00	.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7006E+01 EXCESS= .0000E+00 OUTFLOW= .7045E+01 BASIN STORAGE= .4162E-05 PERCENT ERROR= -.6

FOR PLAN = 1 RATIO= 1.00

R_5	MANE	5.00	2.32	754.95	.28	5.00	2.32	755.00	.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8554E+00 EXCESS= .0000E+00 OUTFLOW= .8791E+00 BASIN STORAGE= .8383E-03 PERCENT ERROR= -2.9

FOR PLAN = 1 RATIO= .97

R_5	MANE	5.00	2.13	756.50	.26	5.00	2.12	755.00	.26	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7896E+00 EXCESS= .0000E+00 OUTFLOW= .8157E+00 BASIN STORAGE= .8820E-03 PERCENT ERROR= -3.4

FOR PLAN = 1 RATIO= 1.00

R_I3_O	MANE	2.79	180.88	691.41	.22	5.00	180.77	690.00	.22	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6149E+02 EXCESS= .0000E+00 OUTFLOW= .6146E+02 BASIN STORAGE= .5702E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R_I3_O	MANE	2.88	166.33	692.13	.20	5.00	166.25	690.00	.20	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5666E+02 EXCESS= .0000E+00 OUTFLOW= .5664E+02 BASIN STORAGE= .6727E-04 PERCENT ERROR= .0

*** NORMAL END OF HEC-1 ***

```
1****************************************
****************************************
 *                                      *                                                *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                *    U.S. ARMY CORPS OF
ENGINEERS     *
 *               JUN   1998             *                                                *    HYDROLOGIC ENGINEERING
CENTER    *
 *            VERSION 4.1               *                                                *          609 SECOND
STREET        *
 *                                      *                                                *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   07JUN12  TIME  10:30:51  *                                                *           (916) 756-1104
        *
 *                                      *                                                *
        *
 ****************************************
****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                         *DIAGRAM
              1          ID        Grand Junction Regional Airport - Jviation - prepared March 9 2012
              2          ID        Proposed Conditions Watershed Model
              3          ID        100-Year 24-Hour Storm - NRCS Type II Rainfall Distribution
              4          ID    ALL SOILS ARE TREATED AS CLASS D SOILS
              5          ID    PREC 1.00 for 0.1< area < 5.0 squire miles; use flow under ratio 1
              6          ID    PREC 0.97 for 5.0< area <12.5 square miles; use flow under ratio 2
              7          ID    When I>10, uses CHUP method for Tlag, when I<10, uses Grand Junction SCS Meth
              8          ID        ************************************************************************
 *** FREE ***
              9          IT       5       0       0     500
             10          IO       5       0       0
             11          IN       5       0      07
             12          JR    PREC     1.0    0.97

             13          KK    L11b
             14          KM   Leach Creek at Upper Pond
             15          BA  7.4130
             16          PB    1.99
             17          PC       0   0.001   0.002  0.0031  0.0041  0.0051  0.0062  0.0073  0.0083  0.0094
             18          PC  0.0105  0.0116  0.0127  0.0138   0.015  0.0161  0.0173  0.0185  0.0196  0.0208
             19          PC   0.022  0.0232  0.0244  0.0257  0.0269  0.0281  0.0294  0.0307  0.0319  0.0332
             20          PC  0.0345  0.0358  0.0371  0.0384  0.0398  0.0411  0.0425  0.0438  0.0452  0.0466
             21          PC   0.048  0.0494  0.0508  0.0523  0.0538  0.0553  0.0568  0.0583  0.0598  0.0614
             22          PC   0.063  0.0646  0.0662  0.0679  0.0696  0.0712   0.073  0.0747  0.0764  0.0782
             23          PC    0.08  0.0818  0.0836  0.0855  0.0874  0.0892  0.0912  0.0931   0.095   0.097
             24          PC   0.099   0.101   0.103  0.1051  0.1072  0.1093  0.1114  0.1135  0.1156  0.1178
             25          PC    0.12  0.1223  0.1246  0.1271  0.1296  0.1323   0.135  0.1379  0.1408  0.1439
             26          PC   0.147  0.1502  0.1534  0.1566  0.1598   0.163  0.1663  0.1697  0.1733  0.1771
             27          PC   0.181  0.1851  0.1895  0.1941  0.1989   0.204  0.2094  0.2152  0.2214   0.228
             28          PC   0.235  0.2427  0.2513  0.2609  0.2715   0.283  0.3068  0.3544  0.4308  0.5679
             29          PC   0.663   0.682  0.6986   0.713  0.7252   0.735  0.7434  0.7514  0.7588  0.7656
             30          PC   0.772   0.778  0.7836   0.789  0.7942   0.799  0.8036   0.808  0.8122  0.8162
             31          PC    0.82  0.8237  0.8273  0.8308  0.8342  0.8376  0.8409  0.8442  0.8474  0.8505
             32          PC  0.8535  0.8565  0.8594  0.8622  0.8649  0.8676  0.8702  0.8728  0.8753  0.8777
             33          PC    0.88  0.8823  0.8846  0.8868   0.889  0.8912  0.8934  0.8955  0.8976  0.8997
             34          PC  0.9018  0.9038  0.9058  0.9078  0.9098  0.9117  0.9136  0.9155  0.9174  0.9192
             35          PC   0.921  0.9228  0.9246  0.9263   0.928  0.9297  0.9314   0.933  0.9346  0.9362
             36          PC  0.9377  0.9393  0.9408  0.9423  0.9438  0.9452  0.9466   0.948  0.9494  0.9507
             37          PC   0.952  0.9533  0.9546  0.9559  0.9572  0.9584  0.9597   0.961  0.9622  0.9635
             38          PC  0.9648   0.966  0.9672  0.9685  0.9697  0.9709  0.9722  0.9734  0.9746  0.9758
             39          PC   0.977  0.9782  0.9794  0.9806  0.9818  0.9829  0.9841  0.9853  0.9864  0.9876
```

```
 40          PC  0.9888  0.9899   0.991  0.9922  0.9933  0.9944  0.9956  0.9967  0.9978  0.9989
 41          PC       1       1       1       1       1       1       1       1       1       1
 42          PC       1       1       1       1       1       1       1       1       1       1
 43          PC       1       1       1       1       1       1       1       1       1       1
 44          PC       1       1       1       1       1       1       1       1       1       1
 45          PC       1       1       1       1       1       1       1       1       1       1
 46          PC       1       1       1       1       1       1       1       1       1       1
 47          LG    0.41  0.4023   1.502   0.054     2.0
 48          US   1.654   0.451
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 49          KK  RLEACH
 50          KM   Leach Creek Dam (To be constructed in Fall 2012)
 51          RS       1    STOR       0
 52          SV       0    31.0    62.0    93.0   124.0   155.0   186.0   217.0   249.3
 53          SQ       0     5.0    10.0    15.0    20.0    40.0    40.0    40.0    40.0
 54          SE    4892    4894    4897    4900    4903    4906    4909    4911  4914.1

 55          KK  RL11bDRoute Hydrograph Through L11a
 56          RK    9500  0.0129   0.035       0    TRAP      10       6

 57          KK   L11aU
 58          KM   Subbasin at the Proposed Lower Detention Pond
 59          BA  1.0148
 60          LG    0.41  0.4023   1.502   0.054     2.0
 61          US   1.149   0.335

 62          KK  C_11aU
 63          KM   Combine Hydrographs at the Proposed Lower Detention Pond
 64          HC       2

 65          KK   R_Pd1
 66          KM   Proposed Water Quality Pond - 4.0 AC-FT per Grand Junction Requirements
 67          RS       1    STOR       0
 68          SV       0     4.0
 69          SQ       0    5000
 70          SE    4755    4756

 71          KK   L11aD
 72          KM   Subbasin Downstream of the Proposed Lower Detention Pond
 73          BA  0.0230
 74          LG    0.35  0.3550   1.325   0.048    15.0
 75          US   0.032   0.170

 76          KK  C_11aD
 77          KM   Combine Hydrographs of Basin L11aU and L11aD
 78          HC       2

 79          KK    L10u
 80          KM   Subbasin L10u
 81          BA  0.4357
 82          LG    0.41  0.4023   1.502   0.054     3.0
 83          US   0.426   0.288

 84          KK   R_Pd2
 85          KM   Proposed Pond 2
 86          RS       1    STOR       0
 87          SV     0.0    0.10    0.35    0.77    1.40    2.28    3.45    4.90    6.60
 88          SQ     0.0     0.0     0.0     6.2    17.5    32.2    49.6    69.3    94.0
 89          SE    4803    4804    4805    4806    4807    4808    4809    4810    4811
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 90          KK  R_10uORoute Detention Pond 2 to L10d
 91          RK    4200   0.012    0.03       0    TRAP      10       4

 92          KK   L10d1
 93          KM   New Subbasin L10d1
 94          BA  0.0836
 95          LG    0.41  0.4023   1.502   0.054     3.0
 96          US   0.158   0.225

 97          KK  R10d1ORoute Basin L10d1 to L10d
 98          RK    7000   0.014    0.03       0    TRAP      10       4

 99          KK    L10d
100          KM   Revised Subbasin L10d
101          BA  0.5052
102          LG    0.38  0.3787   1.414   0.051     8.0
103          US   1.308   0.268

104          KK    C_10
105          KM   Combine Hydrographs of Subbasin L10d, Pond 2, and Pond 3
106          HC       3

107          KK   R_Pd6
```

```
 108          KM   Proposed Pond 6
 109          RS       1    STOR       0
 110          SV       0    0.05    0.25    0.69    1.41    2.46    3.83
 111          SQ     0.0     0.0     6.2    34.1    78.2   130.0   130.0
 112          SE    4750    4751    4752    4753    4754    4755    4756

 113          KK  C_1011
 114          KM   Combine Hydrographs of Subbasin L10 and L11
 115          HC       2

 116          KK   R_L9M
 117          KM   Route Mainstem Hydrograph Through L9
 118          RS       1    STOR       0
 119          SV       0    1.24    2.23     3.3    4.23    4.86    5.34    6.55    7.57    8.54
 120          SV    9.65   10.61   11.55   12.36   13.09  3000.0
 121          SQ       0     100     200     300     400     500     600     800    1000    1200
 122          SQ    1400    1600    1800    2000    2200    2400

 123          KK   L9.1u
 124          KM   Revised Subbasin L9.1u
 125          BA  2.3743
 126          LG    0.41  0.4023   1.502   0.054     2.0
 127          US   1.436   0.377

 128          KK   R_PD3
 129          KM   Proposed Pond 3
 130          RS       1    STOR       0
 131          SV     0.0    1.81    3.76    5.86    8.12   10.53   13.12   15.92   18.98   24.00
 132          SQ     0.0     0.0     0.0     0.0     9.3    26.3    48.3    77.3   146.3   224.4
 133          SE    4829    4830    4831    4832    4833    4834    4835    4836    4837    4838
1                                          HEC-1 INPUT                                        PAGE  4

            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 134          KK  R_9.1ORoute Pond 3 to L9.1d
 135          RK    5000   0.014    0.03       0    TRAP      10       4

 136          KK     R17
 137          KM   Revised Subbasin R17
 138          BA  0.1230
 139          LG    0.30  0.3077   1.148   0.041    27.0
 140          US   0.097   0.274

 141          KK   R_R17Route hydrograph through L.91d
 142          RK    4600   0.014    0.03       0    TRAP      10       4

 143          KK    R15u
 144          KM   Subbasin R15u
 145          BA  0.1666
 146          LG    0.26  0.2840   1.060   0.038    37.0
 147          US   0.177   0.372

 148          KK  R_EXPD
 149          KM   Existing Pond at end of Basin R15u
 150          RS       1    STOR       0
 151          SV     0.0    0.03    0.20    0.57    1.15    1.95    2.87    3.87
 152          SQ     0.0     0.0     2.7    10.3    20.6    33.1    47.6    71.3
 153          SE    4790    4791    4792    4793    4794    4795    4796    4797

 154          KK   R_R15Route Subbasin R15u Hydrograph Through L9.1d
 155          RK    2000   0.006    0.03       0    TRAP       5     2.4

 156          KK   L9.1d
 157          KM   Revised Subbasin L9.1d
 158          BA  0.2968
 159          LG    0.06  0.0710   0.265   0.010    95.0
 160          US   0.193   0.699

 161          KK   R_L9TRoute Subbasin L9.1 Hydrograph Through L9
 162          RK    4100   0.011    0.03       0    TRAP       5     2.4

 163          KK   C9.1d
 164          KM   Combine subbasin R15u and L9.1d
 165          HC       2

 166          KK   C_9.1
 167          KM   Combine subbasin Pond 4,R17 and 9.1d
 168          HC       3

 169          KK   R_PD7
 170          KM   Proposed Pond 7
 171          RS       1    STOR       0
 172          SV     0.0    0.24    1.23    3.39    6.91   11.56   16.86   22.48   28.29
 173          SQ     0.0     0.0     0.0     0.0    65.1   125.4   161.9   191.6   217.3
 174          SE    4755    4756    4757    4758    4759    4760    4761    4762    4763
1                                          HEC-1 INPUT                                        PAGE  5

            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
175          KK   C_L9M
176          KM   Ultimate Outfall into Leach Creek
177          HC       2

178          KK      L9
179          KM   Subbasin
180          BA  0.1646
181          LG    0.39  0.3787   1.414   0.051    21.0
182          US   0.774   0.232

183          KK   R_WQ3
184          KM   Water Quality Pond 3 at the end of Basin L9
185          RS       1    STOR       0
186          SV     0.0    0.36
187          SQ     0.0    1000
188          SE    4766    4767

189          KK  CL9L10
190          KM   L9+L10
191          HC       2

192          KK      C3
193          KM   Corcoran Wash at H Road and 25 Road
194          BA  0.5779
195          LG    0.41  0.4023   1.502   0.054     3.0
196          US   0.669   0.301

197          KK   Upper
198          KM   L9+L10+C3
199          HC       2

200          KK    DB21
201          KM   Subbasin
202          BA  0.1519
203          LG    0.41  0.4023   1.502   0.054     3.0
204          US   0.314   0.245

205          KK      PDA
206          KM   Existing Pond A
207          RS       1    STOR       0       0
208          SV     0.0   0.001     1.8     4.7     8.9    11.6
209          SQ     0.0     2.5     7.0     9.0    10.6    11.3
210          SE    4915    4916    4918    4920    4922    4923

211          KK    21a2
212          KM   New Subbasin
213          BA  0.0780
214          LG    0.41  0.4023   1.502   0.054     3.0
215          US   0.144   0.221
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

216          KK  R_PD4A
217          KM   Proposed Pond 4A
218          RS       1    STOR       0
219          SV       0    0.21    0.63    1.42    2.72    4.57    7.01
220          SQ       0     0.0     0.0     0.0     0.0     6.3    17.5
221          SE    4891    4892    4893    4894    4895    4896    4897

222          KK   C21a2
223          KM   Combines Exisintg Pond A and Subbasin DB21a2
224          HC       2

225          KK   R21a2
226          KM   Route c21a2 Through DB21a
227          RK    2700   0.019    0.05       0    TRAP      30       6

228          KK    21a1
229          KM   New Subbasin
230          BA  0.0700
231          LG    0.39  0.3787   1.414   0.051     6.0
232          US   0.153   0.206

233          KK   R_PD4
234          KM   Proposed Pond 4
235          RS       1    STOR       0
236          SV       0    0.16    0.48    1.00    1.75    2.78    4.11    5.75
237          SQ     0.0     0.0     0.0     0.0     6.2    17.5    32.2    40.1
238          SE    4900    4901    4902    4903    4904    4905    4906    4907

239          KK   R21a1
240          KM   Route Pond 4 Through DB21a
241          RK    1600   0.041    0.05       0    TRAP      30       6

242          KK   DB21a
243          KM   Subbasin
244          BA  0.2346
245          LG    0.36  0.3550   1.325   0.048    13.0
246          US   0.174   0.235
```

```
 247          KK    C21a
 248          KM   Combine Routed Basin 21a, C21a2, and Pond 4
 249          HC       3

 250          KK  R_PD4B
 251          KM   Proposed Pond 4B
 252          RS       1    STOR       0
 253          SV       0    0.04    0.19    0.52    1.08    1.94    3.16    5.01
 254          SQ       0     0.0     0.0     0.0     3.3    17.1    36.2    77.6
 255          SE    4837    4838    4839    4840    4841    4842    4843    4844
1                                          HEC-1 INPUT                                  PAGE  7

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 256          KK    RPD1
 257          KM   Route Hydrograph Through Basin 23b Pipe
 258          RK    2550   0.014   0.015       0    CIRC       3

 259          KK   DB23b
 260          KM   Subbasin
 261          BA  0.0581
 262          LG    0.06  0.0710   0.265   0.010    95.0
 263          US   0.046   0.547

 264          KK    C23b
 265          KM   Combine Hydrograph Basin 23b with 21a
 266          HC       2

 267          KK    R23b
 268          KM   Route Hydrograph Through Basin 23c Pipe
 269          RK    1000   0.020   0.013       0    CIRC       3

 270          KK   DB23c
 271          KM   Subbasin
 272          BA  0.0822
 273          LG    0.06  0.0710   0.065   0.010    95.0
 274          US   0.080   0.577

 275          KK    R23c
 276          KM   Route R23c Through R23c Ditch
 277          RK     500    .005   0.045       0    TRAP      10       4

 278          KK   DB23d
 279          KM   Subbasin
 280          BA  0.0188
 281          LG    0.04  0.0473   0.177   0.006   100.0
 282          US   0.023   0.467

 283          KK    R23d
 284          KM   Route Hydrograph Through Basin 23d Pipe
 285          RK    1200   0.005   0.015       0    CIRC       2

 286          KK    C23c
 287          KM   Combine Hydrograph Basins 23c,23d with 23b
 288          HC       3

 289          KK  WF_PD2
 290          KM   Route Hydrograph Through New Walker Field On Site Pond 2
 291          RS       1    STOR       0       0
 292          SV     0.0    0.10    0.70    1.64    3.16    5.34
 293          SQ     0.0    23.6    48.1    68.1    83.4    3000
 294          SE  4793.5    4795    4797    4799    4801    4803
1                                          HEC-1 INPUT                                  PAGE  8

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 295          KK  RWF_P2
 296          KM   Route Hydrograph Through Basin 23e Pipe
 297          RK    1000   0.010   0.015       0    CIRC       3

 298          KK   DB23e
 299          KM   Subasin
 300          BA  0.0763
 301          LG    0.04  0.0473   0.177   0.006   100.0
 302          US   0.067   0.577

 303          KK    C23e
 304          KM   Combine Hydrograph Basin 23e with WF_PD2
 305          HC       2

 306          KK    R23e
 307          KM   Route Hydrograph Through Basin 23a Pipe
 308          RK    1500   0.008   0.015       0    CIRC       4

 309          KK   DB23a
 310          KM   Subbasin
 311          BA  0.0222
 312          LG    0.38  0.3787   1.414   0.051    10.0
```

```
 313           US   0.131   0.163

 314           KK    C23a
 315           KM   Combine Hydrograph Basin 23a, 23e with WF_PD2
 316           HC       2

 317           KK    R_PDU
 318           KM   Route Hydrograph Through Upper Airport Upper Pond
 319           RS       1    STOR       0       0
 320           SV     0.0   0.001    0.21    6.09   16.16   26.80    29.4
 321           SQ     0.0    10.8    11.4    12.4    13.3    14.2     162
 322           SE    4767 4767.01    4768    4770    4772    4774  4774.5

 323           KK    D_PdU
 324           KM   Weir Flow Into Lower Pond
 325           DT  U_Pipe
 326           DI     0.0    14.2    14.3     100    1000
 327           DQ     0.0    14.2    14.2    14.2    14.2

 328           KK    DB22
 329           KM   Subbasin
 330           BA  0.0564
 331           LG    0.40  0.4023   1.502   0.054     5.0
 332           US   0.123   0.203

 333           KK   R_PD5
 334           KM   Proposed Pond 5
 335           RS       1    STOR       0
 336           SV     0.0    0.04    0.23    0.63    1.33    2.40    3.91
 337           SQ     0.0     0.0     0.0     0.0    19.7    28.4    32.8
 338           SE    4890    4891    4892    4893    4894    4895    4896
1                                          HEC-1 INPUT                                                PAGE  9

          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 339           KK     22a
 340           KM   Subbasin
 341           BA  0.1565
 342           LG    0.37  0.3787   1.414   0.051    11.0
 343           US   0.143   0.218

 344           KK    C22a
 345           KM   Combine Hydrograph Basin 22 and 22a
 346           HC       2

 347           KK   R24_P
 348           KM   Route Hydrograph Through Basin 24 Pipe
 349           RK    3076   0.014   0.015       0    CIRC     4.5

 350           KK   R24_O
 351           KM   Route Hydrograph Through Basin 24 Overland
 352           RK    1506   0.019    0.03       0    TRAP      10      12

 353           KK   DB24a
 354           KM   Subbasin
 355           BA  0.0209
 356           LG    0.27  0.2840   1.060   0.038    36.0
 357           US   0.096   0.263

 358           KK  B4aDIV
 359           KM   Divert Basin 24a overflow
 360           DT  B4aDIV
 361           DI     0.0    14.0   100.0  1000.0
 362           DQ       0    0.01    86.0   986.0

 363           KK   R24_P
 364           KM   Route Hydrograph Through Basin 24 Pipe
 365           RK     800   0.014   0.015       0    CIRC     4.5

 366           KK   R24_O
 367           KM   Route Hydrograph Through Basin 24 Overland
 368           RK    1506   0.019    0.03       0    TRAP      10      12

 369           KK    DB24
 370           KM   Subbasin
 371           BA  0.2360
 372           LG    0.12  0.1420   0.530   0.019    75.0
 373           US   0.162   0.629

 374           KK     C24
 375           KM   Combine Hydrographs (Basin22, Basin 24a, Basin 24)
 376           HC       3

 377           KK   DR24a
 378           KM   Retrieve 24a diversion
 379           DR  B4aDIV
1                                          HEC-1 INPUT                                                PAGE 10

          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
 380          KK   R25_O
 381          KM   Route 24a diversion through Basin 25 overland
 382          RK     800   0.015    0.03       0    TRAP      30      10

 383          KK   R25_P
 384          KM   Route 24a diversion through Basin 25 pipe
 385          RK    1600   0.013   0.015       0    CIRC       4

 386          KK    DB25
 387          KM   Subbasin
 388          BA  0.0239
 389          LG    0.27  0.2840   1.060   0.038    36.0
 390          US   0.105   0.269

 391          KK     C25
 392          KM   Combine Hydrograph with 24a diversion
 393          HC       2

 394          KK   B5DIV
 395          KM   Divert Basin 25 storm sewer overflow
 396          DT   B5DIV
 397          DI     0.0    14.0   100.0  1000.0
 398          DQ       0       0    86.0   986.0

 399          KK   DB25a
 400          KM   Subbasin
 401          BA  0.0332
 402          LG    0.37  0.3550   1.325   0.048    12.0
 403          US   0.031   0.174

 404          KK     C_6
 405          KM   Combine Basins 25a 25 24a 24 22
 406          HC       3

 407          KK     C_7
 408          KM   Combine all Basins
 409          HC       2

 410          KK    R_PDL
 411          KM   route Hydrograph Through Lower Airport East Pond
 412          RS       1    STOR       0       0
 413          SV     0.0    0.05    4.26   13.79   24.65    30.0
 414          SQ     0.0     5.5     7.8     9.6    11.1    14.0
 415          SE  4758.4    4760    4762    4764    4766  4766.2

 416          KK    PR_U
 417          KM   Retrieve Upper Pond Pipe Flow
 418          DR  U_Pipe
```



```
            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 419          KK   C_Out
 420          KM   Combine 2 Outflow Hydrographs at Canal
 421          HC       2

 422          KK     R16
 423          KM   Subbasin
 424          BA  0.1571
 425          LG    0.21  0.2130   0.795   0.029    51.0
 426          US   0.076   0.479

 427          KK   R_16a
 428          KM   Route Hydrograph through R14A overland
 429          RK    2500   0.005    0.04       0    TRAP      10      10

 430          KK    R14A
 431          KM   Subbasin
 432          BA  0.0410
 433          LG    0.12  0.1420   0.530   0.019    75.0
 434          US   0.038   0.484

 435          KK   C_16A
 436          KM   Combine Hydrographs (R16, R14A)
 437          HC       2

 438          KK   C_14A
 439          KM   Combine Hydrograph with Lower Pond Outfall
 440          HC       2

 441          KK    R15d
 442          KM   Subbasin
 443          BA  0.1530
 444          LG    0.41  0.4023   1.502   0.054     3.0
 445          US   0.203   0.246

 446          KK   R_R13
 447          KM   Route Hydrograph through R13
 448          RS       1    STOR       0
```

```
 449          RC   0.035    0.03   0.035     971    .018
 450          RX    1000    1014    1022    1026    1036    1046    1050    1062
 451          RY    4762    4760    4758    4756    4756    4758    4760    4762

 452          KK     R13
 453          KM   Subbasin
 454          BA  0.0428
 455          LG    0.41  0.4023   1.502   0.054     2.0
 456          US   0.179   0.208

 457          KK   C_R13
 458          KM   Combine Hydrographs
 459          HC       2
1                                      HEC-1 INPUT                                    PAGE 12

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 460          KK CMiddle
 461          HC       2

 462          KK    CU+M
 463          HC       2

 464          KK  Extra5
 465          KM   Overflow released from Basin 25
 466          DR   B5DIV

 467          KK     R14
 468          KM   Subbasin
 469          BA  0.0598
 470          LG    0.40  0.4023   1.502   0.054     2.0
 471          US   0.963   0.219

 472          KK    C_R5
 473          KM   Combine Hydrographs (R14, Basin 5)
 474          HC       2

 475          KK     R_5
 476          KM   Route Basin 5 & R14 through R5 overland
 477          RK   10500   0.008    0.03       0    TRAP      10      20

 478          KK      R5
 479          KM   Subbasin
 480          BA  0.0843
 481          LG    0.38  0.3787   1.414   0.051     9.0
 482          US   0.381   0.201

 483          KK      I5
 484          KM   Start Indian Creek Basin
 485          BA  0.7994
 486          LG    0.41  0.4023   1.502   0.054     2.0
 487          US   0.439   0.323

 488          KK    R_I5
 489          KM   Route Hydrograph Through Existing Dam
 490          RS       1    STOR       0       0
 491          SV       0    2.24    4.65    7.24   10.01   12.95   16.08   19.41   22.92   26.63
 492          SQ     0.0     0.0     0.0     0.0     0.0     0.0     0.0    93.0   263.0   483.2
 493          SE    5190    5191    5192    5193    5194    5195    5196    5197    5198    5199

 494          KK      I4
 495          KM   Subbasin
 496          BA  1.2130
 497          LG    0.41  0.4023   1.502   0.054     2.0
 498          US   1.184   0.344
1                                      HEC-1 INPUT                                    PAGE 13

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 499          KK    C_I4
 500          KM   Combine I5 and I4
 501          HC       2

 502          KK      I3
 503          KM   Subbasin
 504          BA  3.2057
 505          LG    0.41  0.4023   1.502   0.054     2.0
 506          US   1.649   0.398

 507          KK    C_I3
 508          KM   Combine I4 and I3
 509          HC       2

 510          KK  R_I3_O
 511          KM   Route hydrograph through I2 overland
 512          RK    3300   0.014    0.04       0    TRAP      10       5

 513          KK      I2
 514          KM   Subbasin
```

```
 515           BA  0.9728
 516           LG    0.41  0.4023   1.502   0.054     3.0
 517           US   1.460   0.325

 518           KK    C_I2
 519           KM   Combine I3 and I2
 520           HC       2

 521           KK    R_I2
 522           KM   Route Hydrograph Through Existing Dam
 523           RS       1    STOR       0       0
 524           SV       0    3.06    6.67   10.92   15.93   21.81   28.62   36.41   45.21   55.07
 525           SV   66.05   78.18   91.52  106.10  121.97  139.16  176.23  235.99  257.34  280.13
 526           SQ       0       0    13.0    18.4    22.6    26.1    29.1    31.9    34.5    36.9
 527           SQ    39.1    41.2    43.2    45.2    47.0    48.8    52.1   228.8   234.6   240.4
 528           SE    4890    4892    4894    4896    4898    4900    4902    4904    4906    4908
 529           SE    4910    4912    4914    4916    4918    4920    4924    4930    4932    4934

 530           KK      I1
 531           KM   Subbasin
 532           BA  0.7563
 533           LG    0.41  0.4023   1.502   0.054    12.0
 534           US   1.890   0.311

 535           KK    C_I1
 536           KM   Combine I2 and I1
 537           HC       2

 538           KK      I7
 539           KM   Subbasin
 540           BA  1.0258
 541           LG    0.41  0.4023   1.502   0.054     2.0
 542           US   1.348   0.333
```



```
          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 543           KK    R_I7
 544           KM   Route Hydrograph Through Existing Dam
 545           RS       1    STOR       0       0
 546           SV       0    0.26    0.60    1.01    1.51    2.11    2.82    3.63    4.57    5.64
 547           SQ     0.0     0.0     0.0     0.0     0.0     0.0     0.0    62.0   175.4   322.2
 548           SE    4820    4821    4822    4823    4824    4825    4826    4827    4828    4829

 549           KK      I6
 550           KM   Subbasin
 551           BA  0.4512
 552           LG    0.40  0.4023   1.502   0.054     4.0
 553           US   0.553   0.285

 554           KK    C_I6
 555           KM   Combine I7 and I6
 556           HC       2

 557           KK      I8
 558           KM   Subbasin
 559           BA  0.4147
 560           LG    0.40  0.4023   1.502   0.054    10.0
 561           US   0.503   0.280

 562           KK      I9Subbasin
 563           BA  0.6808
 564           LG    0.41  0.4023   1.502   0.054     2.0
 565           US   1.197   0.315

 566           KK   C1819
 567           HC       2

 568           KK  C16-19
 569           KM   Combine 1617+I819
 570           HC       2

 571           KK  C15-19
 572           HC       2

 573           KK  CR5-19
 574           HC       2

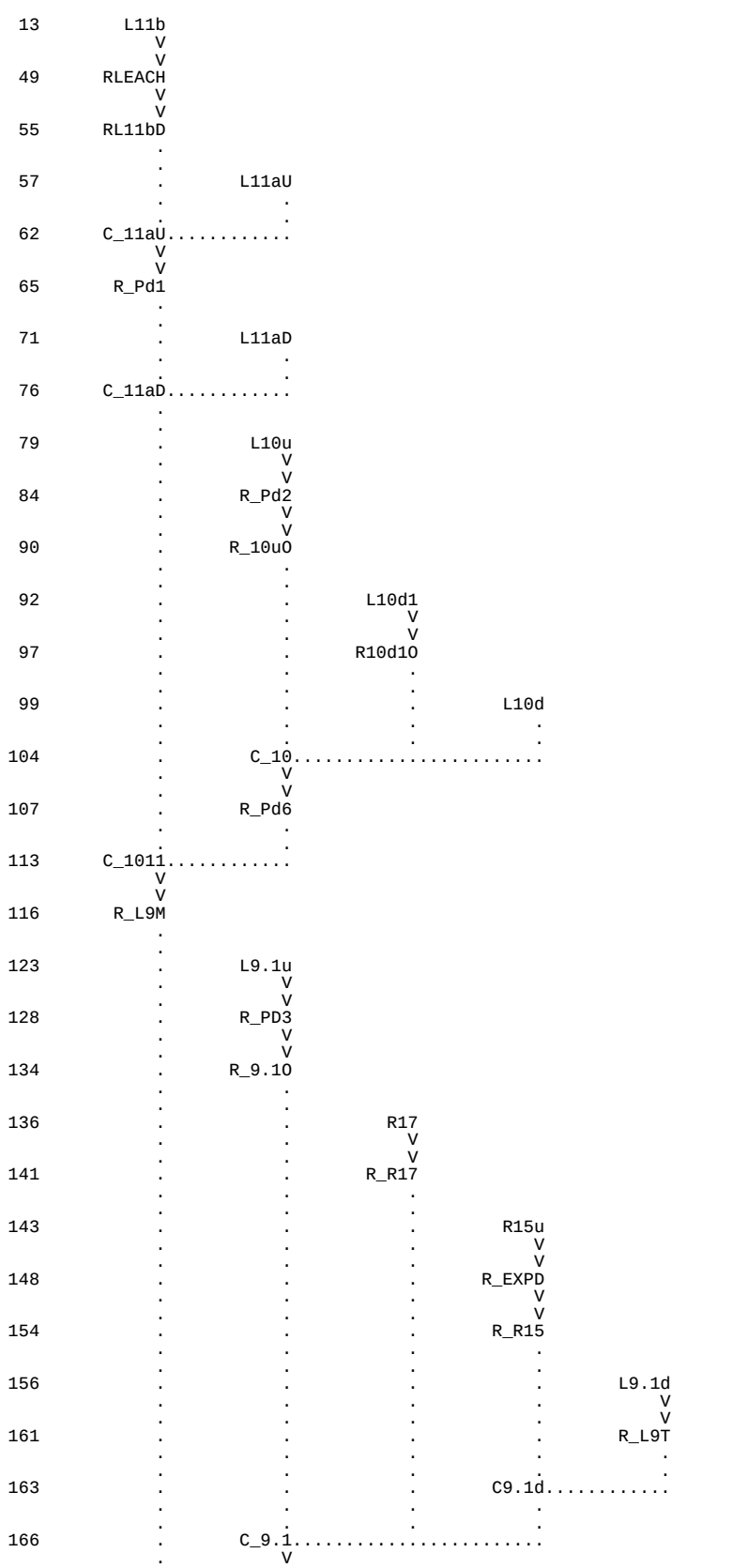
 575           KK  CLower
 576           KM   C14-19
 577           HC       2

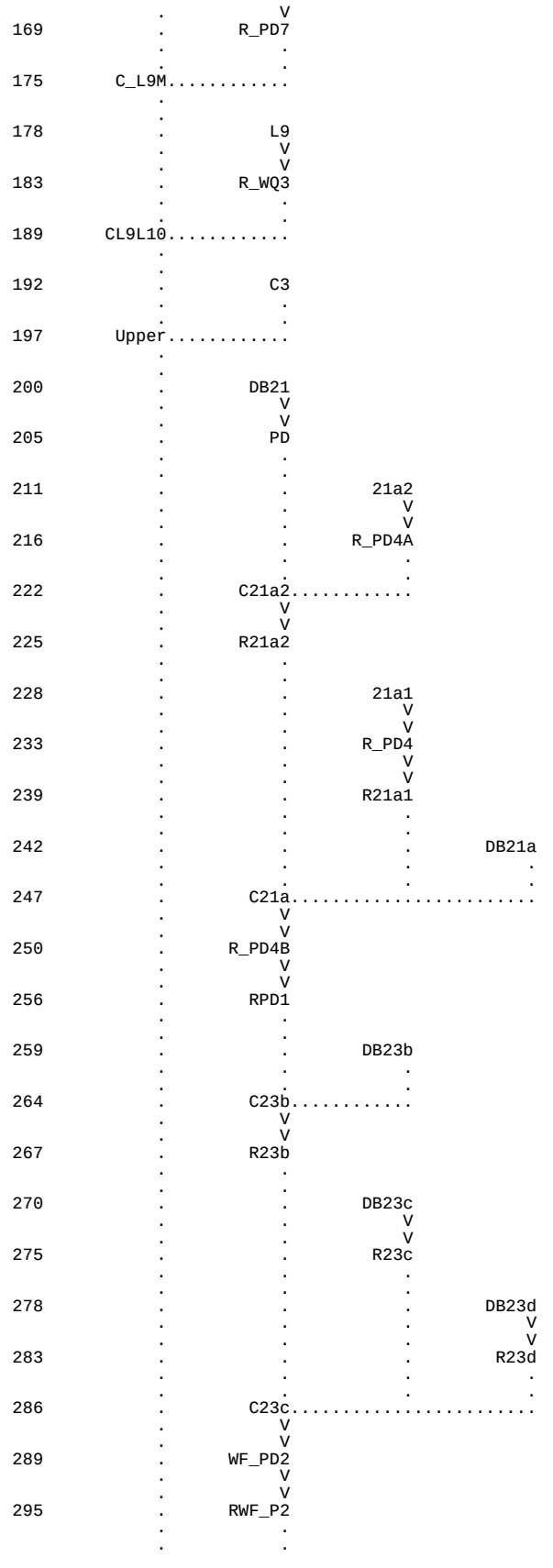
 578           KK   C-All
 579           HC       2
 580           ZZ
```

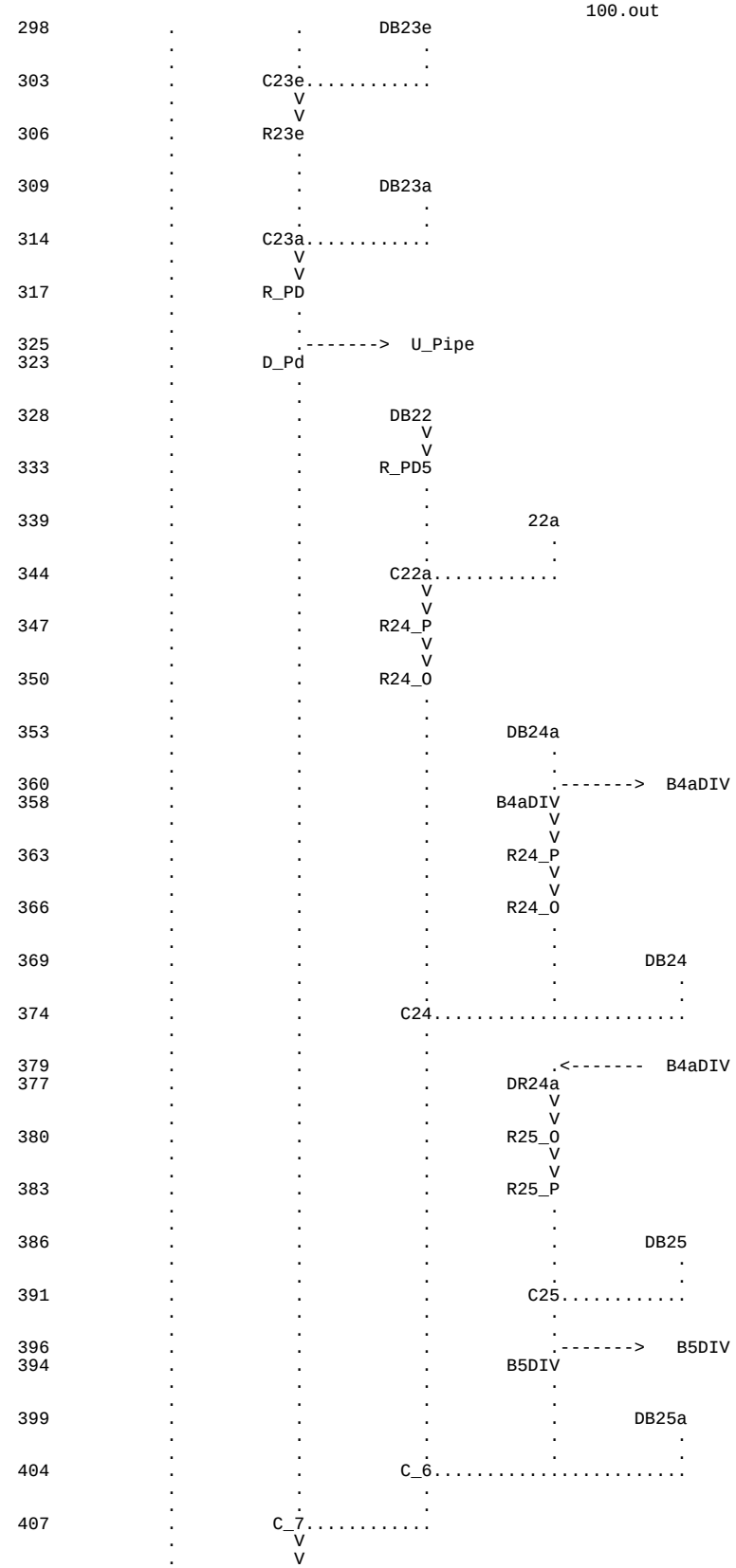
1

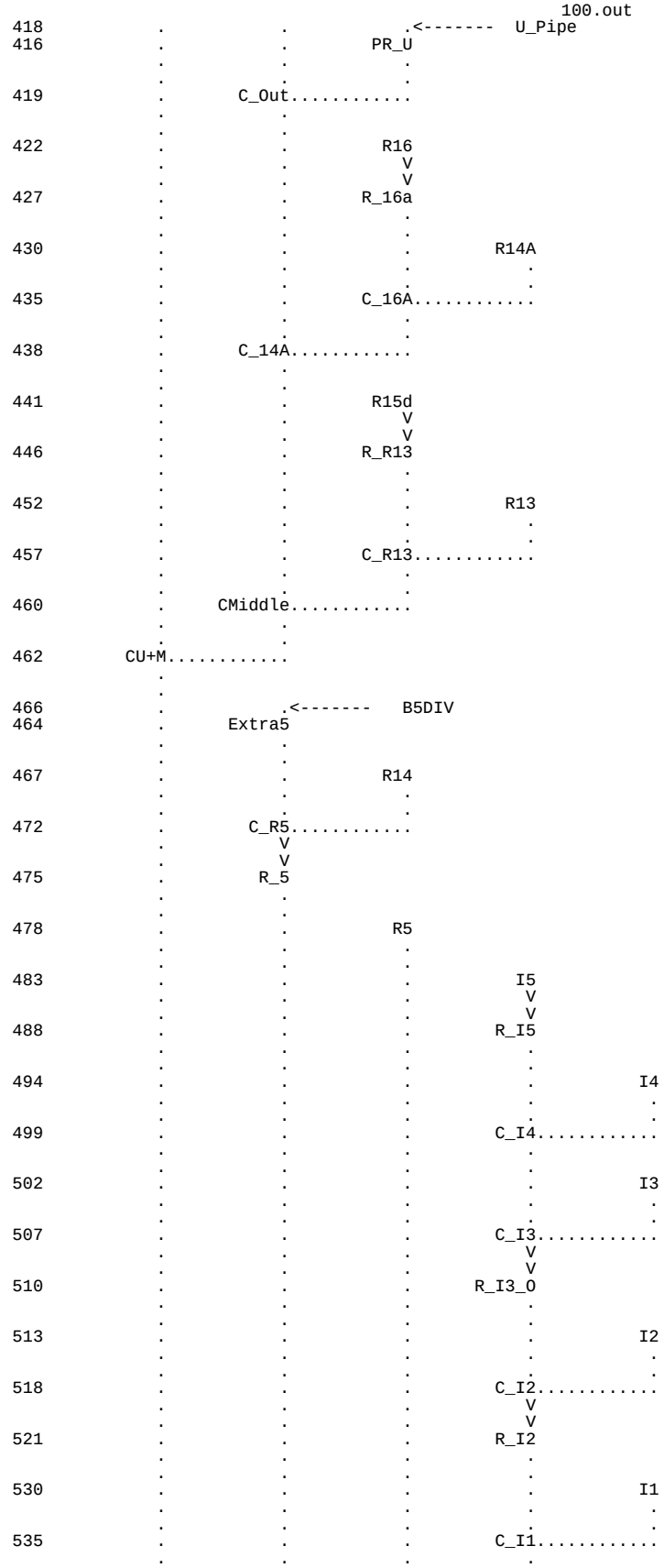
SCHEMATIC DIAGRAM OF STREAM NETWORK

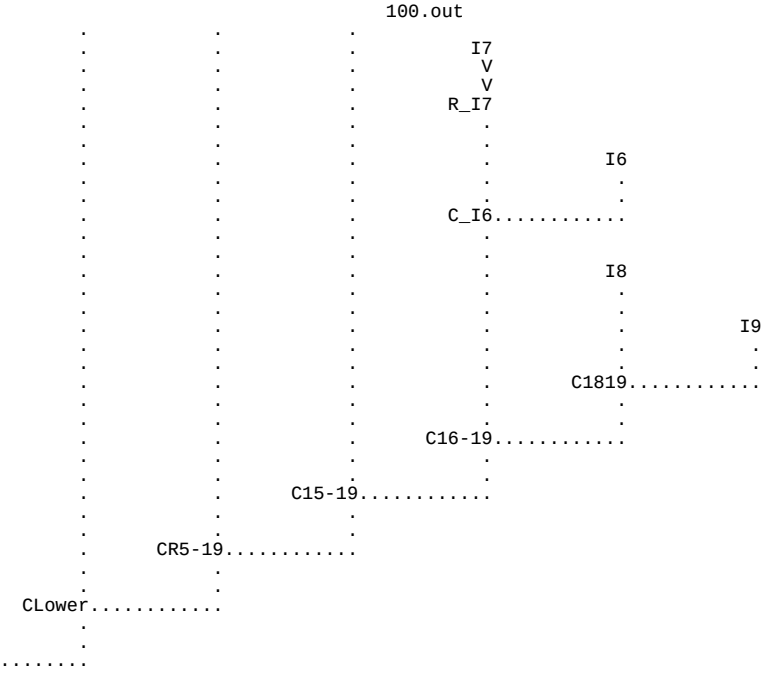
INPUT LINE (V) ROUTING (---->) DIVERSION OR PUMP FLOW


NO.
(.) CONNECTOR
(<---) RETURN OF DIVERTED OR PUMPED FLOW
13 L11b
49 RLEACH
55 RL11bD
57 L11aU
62 C_11aU
65 R_Pd1
71 L11aD
76 C_11aD
79 L10u
84 R_Pd2
90 R_10uO
92 L10d1
97 R10d1O
99 L10d
104 C_10
107 R_Pd6
113 C_1011
116 R_L9M
123 L9.1u
128 R_PD3
134 R_9.1O
136 R17
141 R_R17
143 R15u
148 R_EXPD
154 R_R15
156 L9.1d
161 R_L9T
163 C9.1d
166 C_9.1


R_PD7
C_L9M
L9
R_WQ3
CL9L10
C3
Upper
DB21
PD
21a2
R_PD4A
C21a2
R21a2
21a1
R_PD4
R21a1
DB21a
C21a
R_PD4B
RPD1
DB23b
C23b
R23b
DB23c
R23c
DB23d
R23d
C23c
WF_PD2
RWF_P2


298
DB23e
303
C23e
306
R23e
309
DB23a
314
C23a
317
R_PD
325
U_Pipe
323
D_Pd
328
DB22
333
R_PD5
339
22a
344
C22a
347
R24_P
350
R24_O
353
DB24a
360
B4aDIV
358
B4aDIV
363
R24_P
366
R24_O
369
DB24
374
C24
379
B4aDIV
377
DR24a
380
R25_O
383
R25_P
386
DB25
391
C25
396
B5DIV
394
B5DIV
399
DB25a
404
C_6
407
C_7
410
R_PD


418
416
419
422
427
430
435
438
441
446
452
457
460
462
466
464
467
472
475
478
483
488
494
499
502
507
510
513
518
521
530
535
U_Pipe
PR_U
C_Out
R16
R_16a
R14A
C_16A
C_14A
R15d
R_R13
R13
C_R13
CMiddle
CU+M
B5DIV
Extra5
R14
C_R5
R_5
R5
I5
R_I5
I4
C_I4
I3
C_I3
R_I3_O
I2
C_I2
R_I2
I1
C_I1



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1**************************************
**************************************
 *                                    *                                                    *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                *    U.S. ARMY CORPS OF
ENGINEERS     *
 *              JUN   1998              *                                                *    HYDROLOGIC ENGINEERING
CENTER    *
 *            VERSION 4.1               *                                                *         609 SECOND
STREET          *
 *                                      *                                                *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   07JUN12  TIME  10:30:51   *                                                *           (916) 756-1104
        *
 *                                      *                                                *
        *
 **************************************
**************************************
```

Grand Junction Regional Airport - Jviation - prepared March 9 2012
Proposed Conditions Watershed Model
100-Year 24-Hour Storm - NRCS Type II Rainfall Distribution
ALL SOILS ARE TREATED AS CLASS D SOILS
PREC 1.00 for 0.1< area < 5.0 squire miles; use flow under ratio 1
PREC 0.97 for 5.0< area <12.5 square miles; use flow under ratio 2
When I>10, uses CHUP method for Tlag, when I<10, uses Grand Junction SCS Meth
****

```
   10 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           5  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                        NMIN           5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         500  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      2    0  ENDING DATE
                      NDTIME        1735  ENDING TIME
                       ICENT          19  CENTURY MARK

                    COMPUTATION INTERVAL      .08 HOURS
                         TOTAL TIME BASE   41.58 HOURS

            ENGLISH UNITS
                 DRAINAGE AREA         SQUARE MILES
                 PRECIPITATION DEPTH   INCHES
                 LENGTH, ELEVATION     FEET
                 FLOW                  CUBIC FEET PER SECOND
```

STORAGE VOLUME ACRE-FEET
SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00 .97

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1	RATIO 2
					1.00	.97
HYDROGRAPH AT						
+	L11b	7.41	1	FLOW	996.	948.
				TIME	11.50	11.50
ROUTED TO						
+	RLEACH	7.41	1	FLOW	40.	40.
				TIME	12.75	12.92
			** PEAK STAGES IN FEET **			
			1	STAGE	4916.01	4914.63
				TIME	20.33	20.17
ROUTED TO						
+	RL11bD	7.41	1	FLOW	40.	40.
				TIME	13.33	13.50
HYDROGRAPH AT						
+	L11aU	1.01	1	FLOW	143.	137.
				TIME	11.00	11.00
2 COMBINED AT						
+	C_11aU	8.43	1	FLOW	143.	137.
				TIME	11.00	11.00
ROUTED TO						
+	R_Pd1	8.43	1	FLOW	143.	137.

```
                                        TIME        11.00    11.00

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     4755.03  4755.03
                                        TIME        11.00    11.00

 HYDROGRAPH AT
+                  L11aD       .02     1   FLOW          10.      10.
                                        TIME        10.08    10.08

  2 COMBINED AT
+                 C_11aD      8.45     1   FLOW         148.     141.
                                        TIME        11.00    11.00

 HYDROGRAPH AT
+                   L10u       .44     1   FLOW         128.     122.
                                        TIME        10.33    10.33

 ROUTED TO
+                  R_Pd2       .44     1   FLOW          76.      72.
                                        TIME        11.17    11.17

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     4810.26  4810.11
                                        TIME        11.17    11.17

 ROUTED TO
+                 R_10uO       .44     1   FLOW          76.      72.
                                        TIME        11.25    11.25

 HYDROGRAPH AT
+                  L10d1       .08     1   FLOW          45.      43.
                                        TIME        10.08    10.08

 ROUTED TO
+                 R10d1O       .08     1   FLOW          43.      41.
                                        TIME        10.42    10.42

 HYDROGRAPH AT
+                   L10d       .51     1   FLOW          55.      53.
                                        TIME        11.17    11.17

  3 COMBINED AT
+                  C_10      1.02     1   FLOW         148.     141.
                                        TIME        11.08    11.08

 ROUTED TO
+                  R_Pd6      1.02     1   FLOW         130.     130.
                                        TIME        11.08    11.17

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     4755.48  4755.17
                                        TIME        11.67    11.50

  2 COMBINED AT
+                 C_1011      9.48     1   FLOW         278.     269.
                                        TIME        11.00    11.08

 ROUTED TO
+                  R_L9M      9.48     1   FLOW         272.     264.
                                        TIME        11.25    11.25

 HYDROGRAPH AT
+                  L9.1u      2.37     1   FLOW         305.     291.
                                        TIME        11.25    11.25

 ROUTED TO
+                  R_PD3      2.37     1   FLOW         224.     212.
                                        TIME        12.33    12.33

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     4838.00  4837.84
                                        TIME        12.33    12.33

 ROUTED TO
+                 R_9.1O      2.37     1   FLOW         224.     212.
                                        TIME        12.42    12.42

 HYDROGRAPH AT
+                    R17       .12     1   FLOW          89.      86.
                                        TIME        10.08    10.08

 ROUTED TO
+                  R_R17       .12     1   FLOW          88.      85.
                                        TIME        10.17    10.17

 HYDROGRAPH AT
+                   R15u       .17     1   FLOW         141.     136.
                                        TIME        10.08    10.08

 ROUTED TO
```

+	R_EXPD	.17	1	FLOW	70.	67.
				TIME	10.50	10.50
			** PEAK STAGES IN FEET **			
			1	STAGE	4796.94	4796.83
				TIME	10.50	10.50
ROUTED TO						
+	R_R15	.17	1	FLOW	70.	67.
				TIME	10.58	10.58
HYDROGRAPH AT						
+	L9.1d	.30	1	FLOW	386.	374.
				TIME	10.08	10.08
ROUTED TO						
+	R_L9T	.30	1	FLOW	371.	362.
				TIME	10.17	10.17
2 COMBINED AT						
+	C9.1d	.46	1	FLOW	411.	400.
				TIME	10.17	10.17
3 COMBINED AT						
+	C_9.1	2.96	1	FLOW	498.	485.
				TIME	10.17	10.17
ROUTED TO						
+	R_PD7	2.96	1	FLOW	208.	200.
				TIME	13.58	13.50
			** PEAK STAGES IN FEET **			
			1	STAGE	4762.63	4762.31
				TIME	13.58	13.50
2 COMBINED AT						
+	C_L9M	12.44	1	FLOW	434.	422.
				TIME	11.17	11.25
HYDROGRAPH AT						
+	L9	.16	1	FLOW	26.	25.
				TIME	10.67	10.67
ROUTED TO						
+	R_WQ3	.16	1	FLOW	26.	25.
				TIME	10.67	10.67
			** PEAK STAGES IN FEET **			
			1	STAGE	4766.03	4766.03
				TIME	10.67	10.67
2 COMBINED AT						
+	CL9L10	12.60	1	FLOW	458.	444.
				TIME	11.17	11.25
HYDROGRAPH AT						
+	C3	.58	1	FLOW	119.	114.
				TIME	10.58	10.58
2 COMBINED AT						
+	Upper	13.18	1	FLOW	554.	533.
				TIME	11.08	11.08
HYDROGRAPH AT						
+	DB21	.15	1	FLOW	49.	46.
				TIME	10.25	10.25
ROUTED TO						
+	PD	.15	1	FLOW	8.	8.
				TIME	12.33	12.33
			** PEAK STAGES IN FEET **			
			1	STAGE	4919.44	4919.28
				TIME	12.42	12.33
HYDROGRAPH AT						
+	21a2	.08	1	FLOW	42.	40.
				TIME	10.08	10.08
ROUTED TO						
+	R_PD4A	.08	1	FLOW	1.	1.
				TIME	12.42	12.58
			** PEAK STAGES IN FEET **			
			1	STAGE	4895.19	4895.13
				TIME	12.33	12.58
2 COMBINED AT						
+	C21a2	.23	1	FLOW	10.	9.
				TIME	12.42	12.50

```
 ROUTED TO
+                  R21a2       .23     1   FLOW          10.       9.
                                           TIME        12.67    12.75

 HYDROGRAPH AT
+                   21a1       .07     1   FLOW          36.      35.
                                           TIME        10.08    10.08

 ROUTED TO
+                  R_PD4       .07     1   FLOW          10.       9.
                                           TIME        11.17    11.17

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     4904.30  4904.24
                                           TIME        11.17    11.17

 ROUTED TO
+                  R21a1       .07     1   FLOW          10.       9.
                                           TIME        11.25    11.25

 HYDROGRAPH AT
+                  DB21a       .23     1   FLOW         127.     123.
                                           TIME        10.08    10.08

  3 COMBINED AT
+                   C21a       .53     1   FLOW         128.     123.
                                           TIME        10.08    10.08

 ROUTED TO
+                 R_PD4B       .53     1   FLOW          74.      70.
                                           TIME        10.75    10.75

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     4843.91  4843.82
                                           TIME        10.75    10.75

 ROUTED TO
+                   RPD1       .53     1   FLOW          74.      70.
                                           TIME        10.83    10.83

 HYDROGRAPH AT
+                  DB23b       .06     1   FLOW         104.     101.
                                           TIME        10.00    10.00

  2 COMBINED AT
+                   C23b       .59     1   FLOW         116.     111.
                                           TIME        10.00    10.00

 ROUTED TO
+                   R23b       .59     1   FLOW         114.     110.
                                           TIME        10.00    10.00

 HYDROGRAPH AT
+                  DB23c       .08     1   FLOW         143.     139.
                                           TIME        10.00    10.00

 ROUTED TO
+                   R23c       .08     1   FLOW         137.     133.
                                           TIME        10.00    10.00

 HYDROGRAPH AT
+                  DB23d       .02     1   FLOW          25.      24.
                                           TIME        10.00    10.00

 ROUTED TO
+                   R23d       .02     1   FLOW          23.      22.
                                           TIME        10.00    10.00

  3 COMBINED AT
+                   C23c       .69     1   FLOW         274.     265.
                                           TIME        10.00    10.00

 ROUTED TO
+                 WF_PD2       .69     1   FLOW         232.     194.
                                           TIME        10.08    10.08

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     4801.10  4801.08
                                           TIME        10.08    10.08

 ROUTED TO
+                 RWF_P2       .69     1   FLOW         210.     177.
                                           TIME        10.08    10.08

 HYDROGRAPH AT
+                  DB23e       .08     1   FLOW         136.     132.
                                           TIME        10.00    10.00

  2 COMBINED AT
+                   C23e       .77     1   FLOW         279.     244.
                                           TIME        10.08    10.08
```

```
 ROUTED TO
+                  R23e       .77     1   FLOW          265.      236.
                                           TIME         10.08     10.08

 HYDROGRAPH AT
+                 DB23a       .02     1   FLOW            9.        9.
                                           TIME         10.08     10.08

  2 COMBINED AT
+                  C23a       .79     1   FLOW          274.      245.
                                           TIME         10.08     10.08

 ROUTED TO
+                  R_PD       .79     1   FLOW           27.       16.
                                           TIME         14.25     16.25

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE      4774.04   4774.00
                                           TIME         14.25     16.25

 DIVERSION TO
+                U_Pipe       .79     1   FLOW           14.       14.
                                           TIME         13.83     15.92

 HYDROGRAPH AT
+                  D_Pd       .79     1   FLOW           13.        1.
                                           TIME         14.25     16.25

 HYDROGRAPH AT
+                  DB22       .06     1   FLOW           28.       27.
                                           TIME         10.08     10.08

 ROUTED TO
+                 R_PD5       .06     1   FLOW           14.       13.
                                           TIME         10.67     10.67

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE      4893.71   4893.66
                                           TIME         10.67     10.67

 HYDROGRAPH AT
+                   22a       .16     1   FLOW           87.       84.
                                           TIME         10.08     10.08

  2 COMBINED AT
+                  C22a       .21     1   FLOW           87.       84.
                                           TIME         10.08     10.08

 ROUTED TO
+                 R24_P       .21     1   FLOW           85.       81.
                                           TIME         10.17     10.17

 ROUTED TO
+                 R24_O       .21     1   FLOW           85.       81.
                                           TIME         10.17     10.17

 HYDROGRAPH AT
+                 DB24a       .02     1   FLOW           15.       14.
                                           TIME         10.08     10.08

 DIVERSION TO
+                B4aDIV       .02     1   FLOW            1.        0.
                                           TIME         10.08     10.08

 HYDROGRAPH AT
+                B4aDIV       .02     1   FLOW           14.       14.
                                           TIME         10.00     10.08

 ROUTED TO
+                 R24_P       .02     1   FLOW           14.       14.
                                           TIME         10.08     10.08

 ROUTED TO
+                 R24_O       .02     1   FLOW           14.       14.
                                           TIME         10.17     10.17

 HYDROGRAPH AT
+                  DB24       .24     1   FLOW          319.      309.
                                           TIME         10.08     10.08

  3 COMBINED AT
+                   C24       .47     1   FLOW          409.      396.
                                           TIME         10.08     10.08

 HYDROGRAPH AT
+                 DR24a       .00     1   FLOW            1.        0.
                                           TIME         10.08     10.08

 ROUTED TO
+                 R25_O       .00     1   FLOW            1.        0.
```

				TIME	10.25	10.25
ROUTED TO						
+	R25_P	.00	1	FLOW	0.	0.
				TIME	10.33	10.33
HYDROGRAPH AT						
+	DB25	.02	1	FLOW	17.	17.
				TIME	10.08	10.08
2 COMBINED AT						
+	C25	.02	1	FLOW	17.	17.
				TIME	10.08	10.08
DIVERSION TO						
+	B5DIV	.02	1	FLOW	3.	3.
				TIME	10.08	10.08
HYDROGRAPH AT						
+	B5DIV	.02	1	FLOW	14.	14.
				TIME	10.00	10.00
HYDROGRAPH AT						
+	DB25a	.03	1	FLOW	15.	15.
				TIME	10.08	10.08
3 COMBINED AT						
+	C_6	.53	1	FLOW	438.	425.
				TIME	10.08	10.08
2 COMBINED AT						
+	C_7	1.32	1	FLOW	438.	425.
				TIME	10.08	10.08
ROUTED TO						
+	R_PD	1.32	1	FLOW	13.	12.
				TIME	15.25	13.25
			** PEAK STAGES IN FEET **			
			1	STAGE	4766.11	4766.05
				TIME	15.17	13.17
HYDROGRAPH AT						
+	PR_U	.00	1	FLOW	14.	14.
				TIME	13.83	15.92
2 COMBINED AT						
+	C_Out	1.32	1	FLOW	27.	26.
				TIME	15.25	13.75
HYDROGRAPH AT						
+	R16	.16	1	FLOW	215.	209.
				TIME	10.00	10.00
ROUTED TO						
+	R_16a	.16	1	FLOW	195.	189.
				TIME	10.08	10.08
HYDROGRAPH AT						
+	R14A	.04	1	FLOW	58.	56.
				TIME	10.00	10.00
2 COMBINED AT						
+	C_16A	.20	1	FLOW	243.	235.
				TIME	10.08	10.08
2 COMBINED AT						
+	C_14A	1.52	1	FLOW	264.	256.
				TIME	10.08	10.08
HYDROGRAPH AT						
+	R15d	.15	1	FLOW	70.	67.
				TIME	10.08	10.08
ROUTED TO						
+	R_R13	.15	1	FLOW	70.	67.
				TIME	10.17	10.17
			** PEAK STAGES IN FEET **			
			1	STAGE	4756.95	4756.93
				TIME	10.17	10.17
HYDROGRAPH AT						
+	R13	.04	1	FLOW	19.	18.
				TIME	10.08	10.08
2 COMBINED AT						
+	C_R13	.20	1	FLOW	88.	84.
				TIME	10.17	10.17
2 COMBINED AT						

+	CMiddle	1.71	1	FLOW	348.	337.
				TIME	10.08	10.08
2 COMBINED AT						
+	CU+M	14.89	1	FLOW	630.	607.
				TIME	11.00	11.00
HYDROGRAPH AT						
+	Extra5	.00	1	FLOW	3.	3.
				TIME	10.08	10.08
HYDROGRAPH AT						
+	R14	.06	1	FLOW	7.	6.
				TIME	10.83	10.83
2 COMBINED AT						
+	C_R5	.06	1	FLOW	7.	6.
				TIME	10.83	10.83
ROUTED TO						
+	R_5	.06	1	FLOW	7.	6.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	R5	.08	1	FLOW	20.	19.
				TIME	10.33	10.33
HYDROGRAPH AT						
+	I5	.80	1	FLOW	254.	243.
				TIME	10.33	10.33
ROUTED TO						
+	R_I5	.80	1	FLOW	103.	90.
				TIME	11.50	11.58
			** PEAK STAGES IN FEET **			
			1	STAGE	5197.06	5196.97
				TIME	11.50	11.58
HYDROGRAPH AT						
+	I4	1.21	1	FLOW	170.	162.
				TIME	11.08	11.08
2 COMBINED AT						
+	C_I4	2.01	1	FLOW	258.	236.
				TIME	11.42	11.42
HYDROGRAPH AT						
+	I3	3.21	1	FLOW	381.	363.
				TIME	11.50	11.50
2 COMBINED AT						
+	C_I3	5.22	1	FLOW	637.	597.
				TIME	11.42	11.42
ROUTED TO						
+	R_I3_O	5.22	1	FLOW	637.	597.
				TIME	11.50	11.50
HYDROGRAPH AT						
+	I2	.97	1	FLOW	107.	102.
				TIME	11.33	11.33
2 COMBINED AT						
+	C_I2	6.19	1	FLOW	742.	697.
				TIME	11.50	11.50
ROUTED TO						
+	R_I2	6.19	1	FLOW	79.	58.
				TIME	18.25	19.08
			** PEAK STAGES IN FEET **			
			1	STAGE	4924.92	4924.21
				TIME	18.25	19.08
HYDROGRAPH AT						
+	I1	.76	1	FLOW	66.	63.
				TIME	11.75	11.75
2 COMBINED AT						
+	C_I1	6.95	1	FLOW	106.	102.
				TIME	11.92	11.92
HYDROGRAPH AT						
+	I7	1.03	1	FLOW	123.	118.
				TIME	11.25	11.25
ROUTED TO						
+	R_I7	1.03	1	FLOW	122.	116.
				TIME	11.33	11.33

```
                                   ** PEAK STAGES IN FEET **
                                   1   STAGE     4827.53  4827.48
                                       TIME        11.33    11.33

 HYDROGRAPH AT
+                    I6       .45     1   FLOW         105.     101.
                                          TIME        10.42    10.42

  2 COMBINED AT
+                  C_I6      1.48     1   FLOW         193.     184.
                                          TIME        11.17    11.17

 HYDROGRAPH AT
+                    I8       .41     1   FLOW         106.     102.
                                          TIME        10.42    10.42

 HYDROGRAPH AT
+                    I9       .68     1   FLOW          87.      83.
                                          TIME        11.08    11.08

  2 COMBINED AT
+                 C1819      1.10     1   FLOW         169.     161.
                                          TIME        10.83    10.83

  2 COMBINED AT
+                C16-19      2.57     1   FLOW         355.     337.
                                          TIME        11.08    11.08

  2 COMBINED AT
+                C15-19      9.52     1   FLOW         436.     416.
                                          TIME        11.17    11.17

  2 COMBINED AT
+                CR5-19      9.60     1   FLOW         450.     429.
                                          TIME        11.17    11.17

  2 COMBINED AT
+                CLower      9.66     1   FLOW         450.     429.
                                          TIME        11.17    11.17

  2 COMBINED AT
+                 C-All     24.56     1   FLOW        1077.    1032.
                                          TIME        11.08    11.08
1
                                       SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

                                           (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

                                                                                    INTERPOLATED TO

                                                                                 COMPUTATION INTERVAL

           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME

                                                     PEAK                                     PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)


          FOR PLAN = 1  RATIO= 1.00

            RL11bD  MANE         4.94     40.00    797.54       .24      5.00     40.00    800.00         .24


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .9834E+02 EXCESS= .0000E+00 OUTFLOW= .9614E+02 BASIN STORAGE= .2204E+01 PERCENT
ERROR=    .0


          FOR PLAN = 1  RATIO=  .97

            RL11bD  MANE         4.94     40.00    805.65       .24      5.00     40.00    810.00         .24


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .9806E+02 EXCESS= .0000E+00 OUTFLOW= .9605E+02 BASIN STORAGE= .2204E+01 PERCENT
ERROR=   -.2
```

FOR PLAN = 1 RATIO= 1.00

R_10uO	MANE	3.75	75.63	677.03	.77	5.00	75.58	675.00	.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1784E+02 EXCESS= .0000E+00 OUTFLOW= .1783E+02 BASIN STORAGE= .1862E-04 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .97

R_10uO	MANE	3.79	71.97	677.99	.73	5.00	71.95	675.00	.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1695E+02 EXCESS= .0000E+00 OUTFLOW= .1693E+02 BASIN STORAGE= .1512E-04 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= 1.00

R10d1O	MANE	4.06	43.62	623.09	.79	5.00	42.57	625.00	.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3491E+01 EXCESS= .0000E+00 OUTFLOW= .3523E+01 BASIN STORAGE= .3196E-04 PERCENT ERROR= -.9

FOR PLAN = 1 RATIO= .97

R10d1O	MANE	4.04	41.39	620.14	.75	5.00	40.90	625.00	.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3320E+01 EXCESS= .0000E+00 OUTFLOW= .3348E+01 BASIN STORAGE= .3299E-04 PERCENT ERROR= -.8

FOR PLAN = 1 RATIO= 1.00

R_9.1O	MANE	3.00	224.29	746.10	.72	5.00	224.20	745.00	.72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9168E+02 EXCESS= .0000E+00 OUTFLOW= .9164E+02 BASIN STORAGE= .4853E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R_9.1O	MANE	3.07	212.19	745.38	.69	5.00	212.15	745.00	.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8685E+02 EXCESS= .0000E+00 OUTFLOW= .8681E+02 BASIN STORAGE= .5020E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R_R17	MANE	3.73	87.66	609.40	1.22	5.00	87.64	610.00	1.22

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7978E+01 EXCESS= .0000E+00 OUTFLOW= .7981E+01 BASIN STORAGE= .1308E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R_R17	MANE	3.67	85.44	610.83	1.17	5.00	84.86	610.00	1.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7662E+01 EXCESS= .0000E+00 OUTFLOW= .7682E+01 BASIN STORAGE= .1329E-04 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= 1.00

R_R15	MANE	2.03	69.84	633.41	1.36	5.00	69.67	635.00	1.36

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1206E+02 EXCESS= .0000E+00 OUTFLOW= .1206E+02 BASIN STORAGE= .1237E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R_R15	MANE	2.03	67.13	633.64	1.31	5.00	66.95	635.00	1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1161E+02 EXCESS= .0000E+00 OUTFLOW= .1161E+02 BASIN STORAGE= .1409E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R_L9T	MANE	2.18	375.81	608.55	1.97	5.00	371.35	610.00	1.97

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3116E+02 EXCESS= .0000E+00 OUTFLOW= .3119E+02 BASIN STORAGE= .4181E-05 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .97

R_L9T	MANE	2.14	362.29	608.19	1.91	5.00	362.24	610.00	1.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3022E+02 EXCESS= .0000E+00 OUTFLOW= .3027E+02 BASIN STORAGE= .4616E-05 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.00

R21a2	MANE	5.09	9.65	761.27	.56	5.00	9.65	760.00	.56

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6883E+01 EXCESS= .0000E+00 OUTFLOW= .6885E+01 BASIN STORAGE= .5294E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R21a2	MANE	5.13	9.10	764.18	.52	5.00	9.10	765.00	.52	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6408E+01 EXCESS= .0000E+00 OUTFLOW= .6411E+01 BASIN STORAGE= .4318E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.00

R21a1	MANE	3.12	9.63	675.72	.59	5.00	9.62	675.00	.59	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2193E+01 EXCESS= .0000E+00 OUTFLOW= .2191E+01 BASIN STORAGE= .9602E-05 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .97

R21a1	MANE	3.20	8.88	677.60	.55	5.00	8.88	675.00	.55	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2041E+01 EXCESS= .0000E+00 OUTFLOW= .2039E+01 BASIN STORAGE= .8668E-05 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= 1.00

RPD1	MANE	.96	73.86	646.75	.73	5.00	73.78	650.00	.73	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2080E+02 EXCESS= .0000E+00 OUTFLOW= .2080E+02 BASIN STORAGE= .6633E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

RPD1	MANE	1.03	70.28	647.24	.69	5.00	70.20	650.00	.69	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1964E+02 EXCESS= .0000E+00 OUTFLOW= .1964E+02 BASIN STORAGE= .5678E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23b	MANE	.34	114.80	600.39	.85	5.00	113.99	600.00	.85	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2693E+02 EXCESS= .0000E+00 OUTFLOW= .2692E+02 BASIN STORAGE= .2075E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23b	MANE	.34	110.41	600.48	.81	5.00	109.78	600.00	.81	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2557E+02 EXCESS= .0000E+00 OUTFLOW= .2557E+02 BASIN STORAGE= .1794E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23c	MANE	.69	141.89	601.11	1.98	5.00	137.39	600.00	1.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8666E+01 EXCESS= .0000E+00 OUTFLOW= .8675E+01 BASIN STORAGE= .4634E-07 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .97

R23c	MANE	.69	137.98	601.45	1.92	5.00	133.22	600.00	1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8404E+01 EXCESS= .0000E+00 OUTFLOW= .8415E+01 BASIN STORAGE= .5597E-07 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.00

R23d	MANE	1.04	24.52	602.34	1.98	5.00	22.80	600.00	1.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1986E+01 EXCESS= .0000E+00 OUTFLOW= .1986E+01 BASIN STORAGE= .1425E-10 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23d	MANE	1.05	23.84	602.27	1.92	5.00	22.11	600.00	1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1926E+01 EXCESS= .0000E+00 OUTFLOW= .1927E+01 BASIN STORAGE= .1394E-10 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

RWF_P2	MANE	.50	224.14	605.80	1.02	5.00	209.91	605.00	1.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3761E+02 EXCESS= .0000E+00 OUTFLOW= .3760E+02 BASIN STORAGE= .3175E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

RWF_P2	MANE	.51	189.22	606.11	.97	5.00	176.95	605.00	.97

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3593E+02 EXCESS= .0000E+00 OUTFLOW= .3593E+02 BASIN STORAGE= .2717E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R23e	MANE	.56	275.71	606.16	1.11	5.00	264.93	605.00	1.11

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4572E+02 EXCESS= .0000E+00 OUTFLOW= .4572E+02 BASIN STORAGE= .5136E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R23e	MANE	.57	241.12	606.22	1.07	5.00	235.91	605.00	1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4380E+02 EXCESS= .0000E+00 OUTFLOW= .4380E+02 BASIN STORAGE= .4408E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_P	MANE	1.06	87.03	607.53	.84	5.00	85.20	610.00	.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9528E+01 EXCESS= .0000E+00 OUTFLOW= .9531E+01 BASIN STORAGE= .2782E-06 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_P	MANE	1.13	83.64	607.50	.80	5.00	81.48	610.00	.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9062E+01 EXCESS= .0000E+00 OUTFLOW= .9064E+01 BASIN STORAGE= .2782E-06 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_O	MANE	1.38	85.11	612.43	.84	5.00	84.89	610.00	.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9530E+01 EXCESS= .0000E+00 OUTFLOW= .9532E+01 BASIN STORAGE= .1062E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_O	MANE	1.39	81.43	611.14	.80	5.00	81.39	610.00	.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9066E+01 EXCESS= .0000E+00 OUTFLOW= .9067E+01 BASIN STORAGE= .1062E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_P	MANE	.56	13.99	604.89	1.34	5.00	13.99	605.00	1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1490E+01 EXCESS= .0000E+00 OUTFLOW= .1490E+01 BASIN STORAGE= .3512E-12 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_P	MANE	.48	13.98	605.43	1.29	5.00	13.98	605.00	1.29	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1441E+01 EXCESS= .0000E+00 OUTFLOW= .1441E+01 BASIN STORAGE= .3598E-12 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

R24_O	MANE	2.21	13.96	609.34	1.34	5.00	13.90	610.00	1.34	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1491E+01 EXCESS= .0000E+00 OUTFLOW= .1492E+01 BASIN STORAGE= .7757E-07 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R24_O	MANE	2.21	13.95	609.48	1.29	5.00	13.86	610.00	1.29	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1441E+01 EXCESS= .0000E+00 OUTFLOW= .1442E+01 BASIN STORAGE= .5153E-07 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.00

R25_O	MANE	1.94	.88	613.48	-1.00	5.00	.60	615.00	-1.00	

FOR PLAN = 1 RATIO= .97

R25_O	MANE	.86	.43	616.01	-1.00	5.00	.32	615.00	-1.00	

FOR PLAN = 1 RATIO= 1.00

R25_P	MANE	1.67	.56	617.55	-1.00	5.00	.48	620.00	-1.00	

FOR PLAN = 1 RATIO= .97

R25_P	MANE	1.02	.30	620.46	-1.00	5.00	.30	620.00	-1.00	

FOR PLAN = 1 RATIO= 1.00

R_16a	MANE	3.39	205.51	605.78	1.59	5.00	194.92	605.00	1.59

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1326E+02 EXCESS= .0000E+00 OUTFLOW= .1331E+02 BASIN STORAGE= .5732E-05 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .97

R_16a	MANE	3.44	195.44	605.49	1.54	5.00	188.93	605.00	1.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1280E+02 EXCESS= .0000E+00 OUTFLOW= .1286E+02 BASIN STORAGE= .6219E-05 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= 1.00

R_5	MANE	5.00	6.58	731.20	.80	5.00	6.57	730.00	.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2528E+01 EXCESS= .0000E+00 OUTFLOW= .2553E+01 BASIN STORAGE= .1072E-02 PERCENT ERROR= -1.0

FOR PLAN = 1 RATIO= .97

R_5	MANE	5.00	6.28	729.81	.75	5.00	6.28	730.00	.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2393E+01 EXCESS= .0000E+00 OUTFLOW= .2404E+01 BASIN STORAGE= .1008E-02 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= 1.00

R_I3_O	MANE	2.06	637.00	689.93	.71	5.00	636.99	690.00	.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1983E+03 EXCESS= .0000E+00 OUTFLOW= .1983E+03 BASIN STORAGE= .1073E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

R_I3_O	MANE	2.10	597.21	690.32	.67	5.00	597.05	690.00	.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1877E+03 EXCESS= .0000E+00 OUTFLOW= .1877E+03 BASIN STORAGE= .9917E-04 PERCENT ERROR= .0

*** NORMAL END OF HEC-1 ***

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE
Pond 1

Top of Embankment Elev = 4763.0

10yr Weir

Inv Elev = 4756.5

10 yr Weir Length (ft) = 3

100yr Weir

Inv Elev = 4757.00

Outlet Box Width (ft) = 18

Outlet Box Depth (ft) = 3

Top of Structure Angle = 0

Inv Elev = 4755.0

Springline Elev = 4758.0

	Dim. (in)	Size (ft)	Area (ft^2)	Alpha
				3.1416
Outlet Pipes	60	5.00	19.635	
Adj Area	3	pipes	58.905	

*pipe downstrea = 3-60" CMP @ 3%

*pipe @ 80% capacity

	Stage (Elev)	WS Area	Incr Vol	Cumm Stor (cf)	Stor (ac-ft)	10 yr weir	100 yr weir length	100 yr weir box	Outlet Pipe Orf Control	Total Q (cfs)	Control*
	4755.0	1400									
	4756.0	20400	9048	9048	4.00	0.0	0.0	0.0	0.0	0.0	p
	4757.0	58100	37642	46690	4.00	3.3	24.0	0.0	5000.0	5000.0	w
	4758.0	109000	82227	128917	4.00	3.3	24.0	74.4	5000.0	5000.0	w
	4759.0	175700	141029	269946	4.00	3.3	24.0	210.4	5000.0	5000.0	w
	4760.0	249800	211666	481613	4.00	3.3	24.0	386.6	5000.0	5000.0	w
	4761.0	309000	278876	760489	4.00	3.3	24.0	595.2	5000.0	5000.0	w
	4762.0	351800	330169	1090657	4.00	3.3	24.0	831.8	5000.0	5000.0	w
	4763.0	393900	372652	1463309	4.00	3.3	24.0	1093.5	5000.0	5000.0	w

* - w = weir control; p = orifice control

10 yr wsel 4758.08

100 yr wsel 4761.47

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE
Pond 2

Top of Embankment Elev = 4811.0

10yr Weir

Inv Elev = 4805

10 yr Weir Length (ft) = 2

100yr Weir

Inv Elev = 4810.00

Outlet Box Width (ft) = 3

Outlet Box Depth (ft) = 3

Top of Structure Angle = 0

Inv Elev = 4803.0

Springline Elev = 4804.5

	Dim. (in)	Size (ft)	Area (ft^2)	Alpha
				3.1416
Outlet Pipes	36	3.00	7.069	
Adj Area	1	pipes	7.069	

	Stage (Elev)	WS Area	Incr Vol	Cumm Stor (cf)	Stor (ac-ft)	10 yr weir	100 yr weir length	100 yr weir box	Outlet Pipe Orf Control	Total Q (cfs)	Control*
	4803.0	1800									
	4804.0	7500	4325	4325	0.10	0.0	0.0	0.0	0.0	0.0	p
	4805.0	14500	10809	15134	0.35	0.0	0.0	0.0	26.1	0.0	w
	4806.0	22600	18401	33535	0.77	6.2	0.0	0.0	45.2	6.2	w
	4807.0	32500	27401	60936	1.40	17.5	0.0	0.0	58.3	17.5	w
	4808.0	44600	38391	99326	2.28	32.2	0.0	0.0	69.0	32.2	w
	4809.0	57400	50866	150192	3.45	49.6	0.0	0.0	78.2	49.6	w
	4810.0	69000	63111	213303	4.90	69.3	9.0	0.0	86.5	69.3	w
	4811.0	79400	74139	287442	6.60	69.3	9.0	27.9	94.0	94.0	p

* - w = weir control; p = orifice control

10 yr wsel	4807.12
100 yr wsel	4809.89

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE
Pond 3

Top of Embankment Elev =	4839.0			**Inv Elev =**	4829.0			
	10yr Weir		**100yr Weir**	**Springline Elev =**	4831.0			
Inv Elev =	4832	Inv Elev =	4835.50		**Dim. (in)**	**Size (ft)**	**Area (ft^2)**	**Alpha**
10 yr Weir Length (ft) =	2	Outlet Box Width (ft) =	9					3.1416
		Outlet Box Depth (ft) =	3	**Outlet Pipes**	48	4.00	12.566	
		Top of Structure Angle =	0	**Adj Area**	2	pipes	25.133	

	Stage (Elev)	WS Area	Incr Vol	Cumm Stor (cf)	Stor (ac-ft)	10 yr weir	100 yr weir length	100 yr weir box	Outlet Pipe Orf Control	Total Q (cfs)	Control*
	4829.0	75600									
	4830.0	81900	78729	78729	1.81	0.0	0.0	0.0	0.0	0.0	p
	4831.0	88300	85080	163809	3.76	0.0	0.0	0.0	0.0	0.0	p
	4832.0	94900	91580	255389	5.86	0.0	0.0	0.0	131.1	0.0	w
	4833.0	101600	98231	353620	8.12	6.2	0.0	0.0	185.4	6.2	w
	4834.0	108500	105031	458651	10.53	17.5	0.0	0.0	227.1	17.5	w
	4835.0	116900	112674	571325	13.12	32.2	0.0	0.0	262.2	32.2	w
	4836.0	127100	121964	693290	15.92	40.6	15.0	16.4	293.1	57.0	w
	4837.0	140200	133596	826886	18.98	40.6	15.0	85.4	321.1	126.0	w
	4838.0	156800	148423	975309	22.39	40.6	15.0	183.8	346.9	224.4	w

* - w = weir control; p = orifice control

10 yr wsel	4833.94
100 yr wsel	4836.98

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE
Pond 4

Top of Embankment Elev = 4907.0

Inv Elev = 4900.0

Springline Elev = 4901.0

10yr Weir

Inv Elev = 4903

10 yr Weir Length (ft) = 2

100yr Weir

Inv Elev = 4906.00

Outlet Box Width (ft) = 3

Outlet Box Depth (ft) = 3

Top of Structure Angle = 0

	Dim. (in)	Size (ft)	Area (ft^2)	Alpha
				3.1416
Outlet Pipes	24	2.00	3.142	
Adj Area	1	pipes	3.142	

	Stage (Elev)	WS Area	Incr Vol	Cumm Stor (cf)	Stor (ac-ft)	10 yr weir	100 yr weir length	100 yr weir box	Outlet Pipe Orf Control	Total Q (cfs)	Control*
	4900.0	4300									
	4901.0	9900	6908	6908	0.16	0.0	0.0	0.0	0.0	0.0	p
	4902.0	18200	13841	20749	0.48	0.0	0.0	0.0	16.4	0.0	w
	4903.0	27700	22784	43534	1.00	0.0	0.0	0.0	23.2	0.0	w
	4904.0	38400	32905	76438	1.75	6.2	0.0	0.0	28.4	6.2	w
	4905.0	51400	44742	121181	2.78	17.5	0.0	0.0	32.8	17.5	w
	4906.0	64300	57730	178910	4.11	32.2	9.0	0.0	36.6	32.2	w
	4907.0	78900	71476	250386	5.75	32.2	9.0	27.9	40.1	40.1	p

* - w = weir control; p = orifice control

10 yr wsel 4903.12

100 yr wsel 4904.3

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE
Pond 4a

Top of Embankment Elev = 4897.0

Inv Elev = 4891.0

Springline Elev = 4892.0

10yr Weir		**100yr Weir**	
Inv Elev =	4895	Inv Elev =	4897.00
10 yr Weir Length (ft) =	2	Outlet Box Width (ft) =	3
		Outlet Box Depth (ft) =	3
		Top of Structure Angle =	0

	Dim. (in)	**Size (ft)**	**Area (ft^2)**	**Alpha**
				3.1416
Outlet Pipes	24	2.00	3.142	
Adj Area	1	pipes	3.142	

	Stage (Elev)	WS Area	Incr Vol	Cumm Stor (cf)	Stor (ac-ft)	10 yr weir	100 yr weir length	100 yr weir box	Outlet Pipe Orf Control	Total Q (cfs)	Control*
	4891.0	6100									
	4892.0	13000	9335	9335	0.21	0.0	0.0	0.0	0.0	0.0	p
	4893.0	23900	18176	27511	0.63	0.0	0.0	0.0	16.4	0.0	w
	4894.0	45700	34216	61727	1.42	0.0	0.0	0.0	23.2	0.0	w
	4895.0	68700	56811	118538	2.72	0.0	0.0	0.0	28.4	0.0	w
	4896.0	93000	80544	199082	4.57	6.2	0.0	0.0	32.8	6.2	w
	4897.0	120500	106454	305535	7.01	17.5	9.0	0.0	36.6	17.5	w

* - w = weir control; p = orifice control

10 yr wsel	4893.63
100 yr wsel	4895.19

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE
Pond 4b

Top of Embankment Elev = 4844.0

Inv Elev = 4837.0

Springline Elev = 4838.5

10yr Weir

Inv Elev = 4840.5

10 yr Weir Length (ft) = 3

100yr Weir

Inv Elev = 4842.50

Outlet Box Width (ft) = 3

Outlet Box Depth (ft) = 3

Top of Structure Angle = 0

	Dim. (in)	**Size (ft)**	**Area (ft^2)**	**Alpha**
				3.1416
Outlet Pipes	36	3.00	7.069	
Adj Area	1	pipes	7.069	

	Stage (Elev)	WS Area	Incr Vol	Cumm Stor (cf)	Stor (ac-ft)	10 yr weir	100 yr weir length	100 yr weir box	Outlet Pipe Orf Control	Total Q (cfs)	Control*
	4837.0	500									
	4838.0	3700	1853	1853	0.04	0.0	0.0	0.0	0.0	0.0	p
	4839.0	9800	6507	8361	0.19	0.0	0.0	0.0	26.1	0.0	w
	4840.0	19000	14149	22509	0.52	0.0	0.0	0.0	45.2	0.0	w
	4841.0	30500	24524	47033	1.08	3.3	0.0	0.0	58.3	3.3	w
	4842.0	44500	37280	84314	1.94	17.1	0.0	0.0	69.0	17.1	w
	4843.0	63000	53483	137796	3.16	26.3	9.0	9.9	78.2	36.2	w
	4844.0	87200	195872	218381	5.01	26.3	9.0	51.3	86.5	77.6	w

* - w = weir control; p = orifice control

10 yr wsel 4842.48

100 yr wsel 4843.91

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE
Pond 5

Top of Embankment Elev =	4896.0			**Inv Elev =**	4891.0			
	10yr Weir		**100yr Weir**	**Springline Elev =**	4892.0			
Inv Elev =	4893	Inv Elev =	4893.50		**Dim. (in)**	**Size (ft)**	**Area (ft^2)**	**Alpha**
10 yr Weir Length (ft) =	2	Outlet Box Width (ft) =	3					3.1416
		Outlet Box Depth (ft) =	6	**Outlet Pipes**	24	2.00	3.142	
		Top of Structure Angle =	0	**Adj Area**	1	pipes	3.142	

	Stage (Elev)	WS Area	Incr Vol	Cumm Stor (cf)	Stor (ac-ft)	10 yr weir	100 yr weir length	100 yr weir box	Outlet Pipe Orf Control	Total Q (cfs)	Control*
	4890.0	200									
	4891.0	4400	1846	1846	0.04	0.0	0.0	0.0	0.0	0.0	p
	4892.0	12400	8062	9908	0.23	0.0	0.0	0.0	0.0	0.0	p
	4893.0	23400	17611	27520	0.63	0.0	0.0	0.0	16.4	0.0	w
	4894.0	38400	30592	58112	1.33	2.2	15.0	16.4	23.2	18.6	w
	4895.0	55300	46594	104705	2.40	2.2	15.0	85.4	28.4	28.4	p
	4896.0	76300	65519	170224	3.91	2.2	15.0	183.8	32.8	32.8	p

* - w = weir control; p = orifice control

10 yr wsel	4893.09
100 yr wsel	4893.71

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE
Pond 6

Top of Embankment Elev = 4762.0

Inv Elev = 4750.0

Springline Elev = 4751.5

10yr Weir

Inv Elev = 4751

10 yr Weir Length (ft) = 2

100yr Weir

Inv Elev = 4752.00

Outlet Box Width (ft) = 3

Outlet Box Depth (ft) = 3

Top of Structure Angle = 0

	Dim. (in)	Size (ft)	Area (ft^2)	Alpha
				3.1416
Outlet Pipes	36	3.00	7.069	
Adj Area	1	pipes	7.069	

*pipe downstrea = 36" CMP @ 10% Max flow = 130 cfs

*pipe @ 80% capacity

	Stage (Elev)	WS Area	Incr Vol	Cumm Stor (cf)	Stor (ac-ft)	10 yr weir	100 yr weir length	100 yr weir box	Outlet Pipe Orf Control	Total Q (cfs)	Control*
	4750.0	200									
	4751.0	4800	1993	1993	0.05	0.0	0.0	0.0	130.0	0.0	w
	4752.0	13700	8870	10863	0.25	6.2	9.0	0.0	130.0	6.2	w
	4753.0	25000	19069	29932	0.69	6.2	9.0	27.9	130.0	34.1	w
	4754.0	38600	31555	61487	1.41	6.2	9.0	78.9	130.0	85.1	w
	4755.0	52900	45563	107049	2.46	6.2	9.0	145.0	130.0	130.0	p
	4756.0	66900	59763	166813	3.83	6.2	9.0	223.2	130.0	130.0	p

* - w = weir control; p = orifice control

10 yr wsel 4753.13

100 yr wsel 4754.94

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE
Pond 7

Top of Embankment Elev = 4763.0

Inv Elev = 4756.0

Springline Elev = 4758.5

10yr Weir		**100yr Weir**	
Inv Elev =	4757	Inv Elev =	4758.00
10 yr Weir Length (ft) =	6	Outlet Box Width (ft) =	9
		Outlet Box Depth (ft) =	3
		Top of Structure Angle =	0

	Dim. (in)	**Size (ft)**	**Area (ft^2)**	**Alpha**
				3.1416
Outlet Pipes	60	5.00	19.635	
Adj Area	1	pipes	19.635	

	Stage (Elev)	WS Area	Incr Vol	Cumm Stor (cf)	Stor (ac-ft)	10 yr weir	100 yr weir length	100 yr weir box	Outlet Pipe Orf Control	Total Q (cfs)	Control*
	4755.0	1600									
	4756.0	23200	10298	10298	0.24	0.0	0.0	0.0	0.0	0.0	p
	4757.0	67300	43338	53636	1.23	0.0	0.0	0.0	0.0	0.0	p
	4758.0	123900	94172	147807	3.39	18.6	15.0	0.0	0.0	0.0	p
	4759.0	184400	153151	300958	6.91	18.6	15.0	46.5	72.4	65.1	w
	4760.0	221000	202424	503382	11.56	18.6	15.0	131.5	125.4	125.4	p
	4761.0	240800	230829	734212	16.86	18.6	15.0	241.6	161.9	161.9	p
	4762.0	248900	244839	979050	22.48	18.6	15.0	372.0	191.6	191.6	p
	4763.0	257681	253278	1232328	28.29	18.6	15.0	519.9	217.3	217.3	p

* - w = weir control; p = orifice control

10 yr wsel 4759

100 yr wsel 4759.94

APPENDIX F - MAPS

Drainage Maps

SUMMARY OF DRAINAGE FLOWS

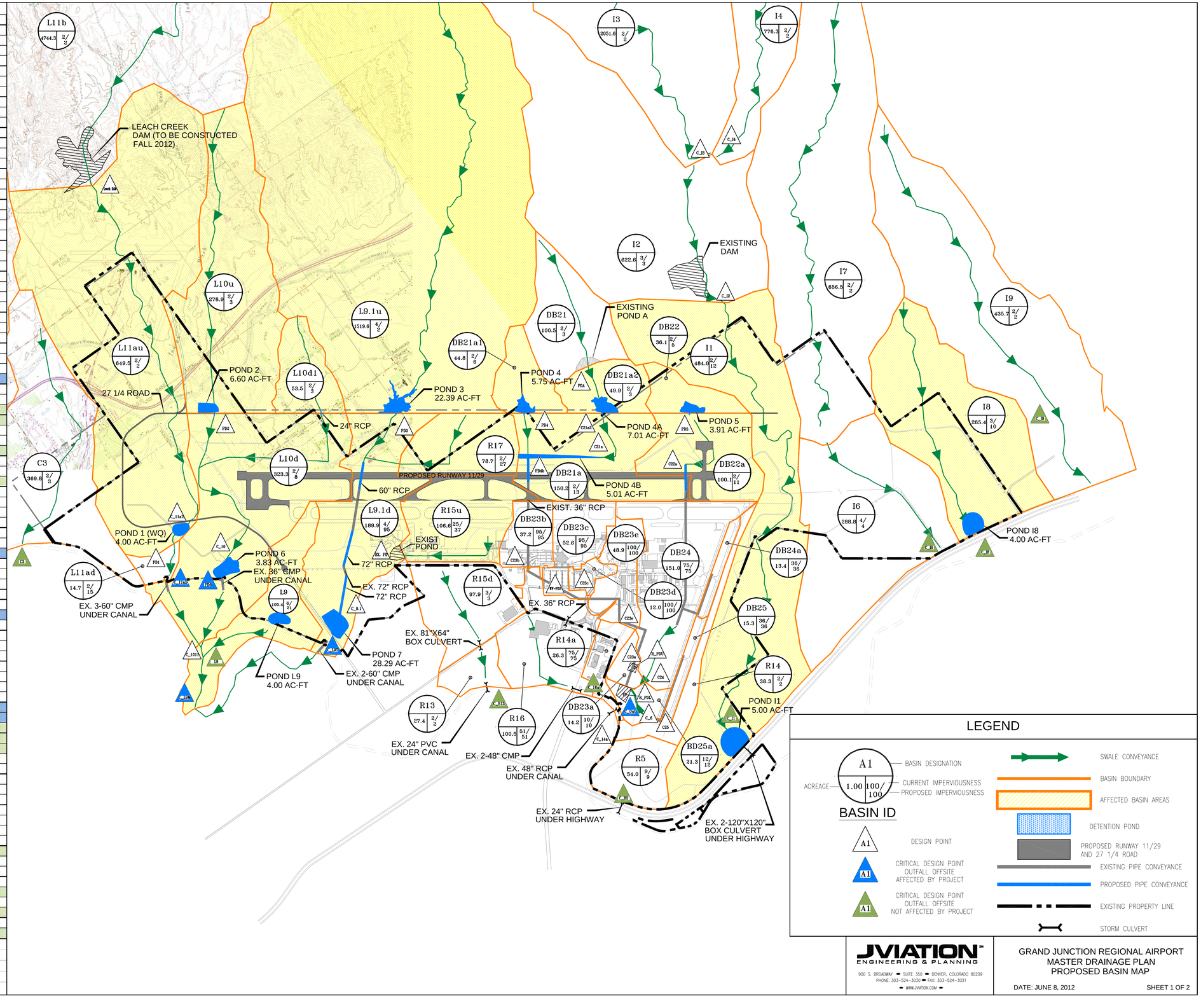
Basin	Design Point	Area (Acres)	Jviation Current Conditions 10-Year (cfs)	Jviation Current Conditions 100-Year (cfs)	Jviation Proposed Conditions 10-Year (cfs)	Jviation Proposed Conditions 100-Year (cfs)
DB21		100.5	19	51	18	49
	PDA		5	9	5	8
DB21a2		49.9	*	*	16	42
			*	*	5	10
DB21a1		44.8	*	*	15	36
	PD4		*	*	1	10
DB21a		150.2	34	95	59	127
	C21a		38	102	59	128
	PD4b		*	*	26	74
DB23b		37.2	62	104	62	104
	C23b		71	134	63	116
DB23c		52.6	86	143	86	143
DB23d		12.0	15	25	15	25
	C23c		165	292	157	274
	WF_PD2		73	275	71	232
DB23e		48.9	82	136	82	136
	C23e		142	344	140	279
DB23a		14.2	4	9	4	9
	C23a		140	327	139	274
	R_PD U		13	48	13	27
DB22		36.1	*	*	11	28
	PD5		*	*	2	14
DB22a		100.1	21	134	39	87
	C22a		21	59	39	87
DB24a		13.4	8	15	8	15
DB24		151.0	190	319	190	319
	C24		199	351	228	409
DB25		15.3	10	17	10	17
	C25		10	17	10	17
DB25a		21.3	7	15	7	15
	C_6		215	381	244	438
	C_7		215	381	244	438
	R_PD_L		9	14	9	14
	C_Out		22	27	22	27
R16		100.5	127	215	127	215
R14a		26.3	35	58	34	58
	C_16a		136	243	136	243
	C_14a		156	264	156	264
R15d		97.9	27	70	27	70
R13		27.4	7	19	7	19
	C_R13		33	88	33	88
R14		38.3	2	3	2	7
	C_R5		2	7	2	7
R5		54.0	2	7	2	7
L11b		4744.3	311	948	311	948
	Leach DAM		*	*	14	40
L11au		649.5	49	143	49	143
	C_L11au		345	1,057	45	137
	PD1		*	*	45	137
L11ad		14.7	5	10	5	10
	C_11ad		346	1,059	47	141
L10u		278.9	*	*	47	128
	PD2		*	*	26	76
L10d1		53.5	*	*	17	45
L10d		323.3	51	147	22	55
	C_10		51	147	55	148
	PD6		*	*	53	130
	C_1011		384	1,183	94	269
L9.1u		1519.6	*	*	104	305
	PD3		*	*	53	224
R17		78.7	25	66	47	89
R15u		106.6	61	115	79	141
	EX_Pd		29	57	35	70
L9.1d		189.9	*	*	231	386
	C_9.1		192	510	294	498
	C_L9T		192	510	117	208
	C_L9M		506	1,558	184	422
L9		105.4	0	0	11	26
C3		369.8	43	121	42	119
I5		511.6	92	254	92	254
	R_I5		0	103	0	103
I4		776.3	58	170	58	170
	C_I4		58	259	58	259
I3		2051.6	129	381	129	381
	C_I3		166	597	166	597
I2		622.6	37	107	37	107
	C_I2		199	697	199	697
I1		484.0	21	23	25	66
	C_I1		46	99	46	99
I7		656.5	42	123	42	123
	R_I7		36	122	36	122
I6		288.8	39	109	39	109
	C_I6		55	193	55	193
I8		265.4	39	104	42	106
	C_I8		39	104	42	104
I9		435.7	30	87	30	87
	C_I9		30	87	30	87

Basin areas that have been affected with proposed project

Critical flows-Basins affected by project (flows leaving airport property)

Critical flows (flows leaving airport property)

*NOTE: SEE SHEET 2 OF 2 FOR COMMENTS/JUSTIFICATION ON FLOWRATE CHANGES



LEGEND

- A1 — BASIN DESIGNATION
- ACREAGE: 1.00
- 100/100 — CURRENT IMPERVIOUSNESS / PROPOSED IMPERVIOUSNESS
- BASIN ID
- A1 — DESIGN POINT
- A1 — CRITICAL DESIGN POINT OUTFALL OFFSITE AFFECTED BY PROJECT
- A1 — CRITICAL DESIGN POINT OUTFALL OFFSITE NOT AFFECTED BY PROJECT
- SWALE CONVEYANCE
- BASIN BOUNDARY
- AFFECTED BASIN AREAS
- DETENTION POND
- PROPOSED RUNWAY 11/29 AND 27 1/4 ROAD
- EXISTING PIPE CONVEYANCE
- PROPOSED PIPE CONVEYANCE
- EXISTING PROPERTY LINE
- STORM CULVERT

JVIATION™ ENGINEERING & PLANNING
900 S. BROADWAY ➧ SUITE 350 ➧ DENVER, COLORADO 80209
PHONE: 303-524-3030 ➧ FAX: 303-524-3031
➧ WWW.JVIATION.COM ➧

GRAND JUNCTION REGIONAL AIRPORT MASTER DRAINAGE PLAN PROPOSED BASIN MAP

DATE: JUNE 8, 2012

DETAILED SUMMARY OF DRAINAGE FLOWS

Basin	Design Point	Area (Acres)	ICON Current Conditions 10-Year (cfs)	ICON Current Conditions 100-Year (cfs)	Jviation Current Conditions 10-Year (cfs)	Jviation Current Conditions 100-Year (cfs)	Jviation Proposed Conditions 10-Year (cfs)	Jviation Proposed Conditions 100-Year (cfs)	Comments
DB21		100.5	44	88	19	51	18	49	
	PDA		7	9	5	9	5	8	Existing pond
DB21a2		49.9	*	*	*	*	16	42	In Proposed Pond 4a
	C21a2		*	*	*	*	5	10	Out Proposed Pond 4a / Crossing future 27 1/4 Road
DB21a1		44.8	*	*	*	*	15	36	In Proposed Pond 4
	PD4		*	*	*	*	1	10	Out Proposed Pond 4 / Crossing future 27 1/4 Road
DB21a		150.2	*	*	34	95	59	127	
	C21a		87	179	38	102	59	128	In Proposed Pond 4b
	PD4b		*	*	*	*	26	74	Out Proposed Pond 4b north of future Runway 11/29
DB23b		37.2	*	*	62	104	62	104	
	C23b		*	*	71	134	63	116	
DB23c		52.6	*	*	86	143	86	143	
DB23d		12.0	*	*	15	25	15	25	
	C23c		*	*	165	292	157	274	
	WF_PD2		*	*	73	275	71	232	Existing Water Quality Pond
DB23e		48.9	*	*	82	136	82	136	
	C23e		*	*	142	344	140	279	
DB23a		14.2	*	*	4	9	4	9	
	C23a		166	190	140	327	139	274	
	R_PD U		*	*	13	48	13	27	Existing Upper detention pond
DB22		36.1	*	*	*	*	11	28	In Proposed Pond 5
	PD5		*	*	*	*	2	14	Out Proposed Pond 5 / Crossing future 27 1/4 Road
DB22a		100.1	*	*	21	134	39	87	
	C22a		57	115	21	59	39	87	
DB24a		13.4	3	8	8	15	8	15	
DB24		151.0	*	*	190	319	190	319	
	C24		138	296	199	351	228	409	
DB25		15.3	*	*	10	17	10	17	
	C25		*	*	10	17	10	17	
DB25a		21.3	*	*	7	15	7	15	
	C_6		143	316	215	381	244	438	
	C_7		308	505	215	381	244	438	
	R_PD_L		9	11	9	14	9	14	
	C_Out		*	*	22	27	22	27	Existing Outlet Structure to be modified to add WQ elements
R16		100.5	84	125	127	215	127	215	
R14a		26.3	*	*	35	58	34	58	
	C_16a		66	275	136	243	136	243	Did not account for new ponds by others- flow rate is conservative
	C_14a		363	768	156	264	156	264	Flows leave site at existing flow rate
R15d		97.9	*	*	27	70	27	70	Removed Basin R15u from this basin - see below
R13		27.4	*	*	7	19	7	19	
	C_R13		51	175	33	88	33	88	Flows leave site at existing flow rate
R14		38.3	*	*	2	3	2	7	
	C_R5		42	113	2	7	2	7	
R5		54.0	42	113	2	7	2	7	Flows leave site at existing flow rate
L11b		4744.3	*	*	311	948	311	948	
	Leach DAM		*	*	*	*	14	40	Dam to be constructed Fall 2012- Outflow of 100 yr is 40 cfs
L11au		649.5	*	*	49	143	49	143	
	C_L11au		*	*	345	1,057	45	137	In Proposed Pond 1 - Water Quality Only
	PD1		*	*	*	*	45	137	Out Proposed Pond 1 - Water Quality Only
L11ad		14.7	*	*	5	10	5	10	
	C_11ad		242	744	346	1,059	47	141	Flows from Pond 1 and basin L11ad
L10u		278.9	*	*	*	*	47	128	In Proposed Pond 2
	PD2		*	*	*	*	26	76	Out Proposed Pond 2/ Crossing future 27 1/4 Road
L10d1		53.5	*	*	*	*	17	45	
L10d		323.3	*	*	51	147	22	55	
	C_10		*	*	51	147	55	148	In Proposed Pond 6
	PD6		*	*	*	*	53	130	Out Proposed Pond 6
	C_1011		*	*	384	1,183	94	269	
L9.1u		1519.6	*	*	*	*	104	305	In Proposed Pond 3
	PD3		*	*	*	*	53	224	Out Proposed Pond 3 / Crossing future 27 1/4 Road
R17		78.7	*	*	25	66	47	89	
R15u		106.6	*	*	61	115	79	141	Removed Basin R15d from this basin - see above
	EX. Pd		*	*	29	57	35	70	Out of existing pond west of Landing View Lane
L9.1d		189.9	*	*	*	*	231	386	
	C_9.1		*	*	192	510	294	498	In Proposed Pond 7
	C_L9T		165	423	192	510	117	208	Out Proposed Pond 7 release 208 cfs per request of City
	C_L9M		371	1,121	506	1,558	184	422	Ultimate Outfall of Leach Creek Basin
L9		105.4					11	26	In Proposed Pond L9
	C_L9		2	15	9	24	9	24	Out of Proposed Pond L9
C3		369.8	52	242	43	121	42	119	Offsite unaffected basin
I5		511.6	*	*	92	254	92	254	
	R_I5		*	*	0	103	0	103	
I4		776.3	*	*	58	170	58	170	
	C_I4		*	*	58	259	58	259	
I3		2051.6	*	*	129	381	129	381	
	C_I3		*	*	166	597	166	597	
I2		622.6	*	*	37	107	37	107	
	C_I2		*	*	199	697	199	697	
I1		484.0	*	*	21	23	25	66	In Proposed Pond I1
	C_I1		*	*	46	99	46	99	Out of Proposed Pond I1
I7		656.5	*	*	42	123	42	123	
	R_I7		*	*	36	122	36	122	
I6		288.8	*	*	39	109	39	109	
	C_I6		*	*	55	193	55	193	
I8		265.4	*	*	39	104	42	106	In Proposed Pond I8
	C_I8		*	*	39	104	42	104	Out of Proposed Pond I8
I9		435.7	*	*	30	87	30	87	
	C_I9		*	*	30	87	30	87	

Basin areas that have been affected with proposed project

Critical flow s-Basins affected by project (flow s leaving airport property)

Critical flow s (flow s leaving airport property)

*NOTE: SEE SHEET 1 OF 2 FOR BASIN MAP

JVIATION™
ENGINEERING & PLANNING
900 S. BROADWAY ➡ SUITE 350 ➡ DENVER, COLORADO 80209
PHONE: 303-524-3030 ➡ FAX: 303-524-3031
➡ WWW.JVIATION.COM ➡

GRAND JUNCTION REGIONAL AIRPORT
MASTER DRAINAGE PLAN
DETAILED SUMMARY OF
DRAINAGE FLOWS

DATE: JUNE 8, 2012

APPENDIX F

Pavement Design Forms & Supporting Documentation

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section NewFlexib~01 in Job GJTEA1.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is New Flexible.
Design Life = 20 years.
A design has not been completed for this section.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	P-401/ P-403 HMA Surface	5.00	200,000	0.35	0
2	P-401/ P-403 St (flex)	7.04	400,000	0.35	0
3	P-209 Cr Ag	20.58	50,469	0.35	0
4	Subgrade	0.00	8,100	0.35	0

Total thickness to the top of the subgrade = 32.62 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	RegionalJet-200	47,450	2,462	4.70
2	RegionalJet-700	72,500	224	6.00
3	MD83	161,000	246	6.80
4	B757-200	256,000	500	5.00
5	Dual Whl-45	42,328	718	10.00
6	Sngl Whl-30	36,300	1,900	-5.00
7	Sngl Whl-15	16,000	3,737	1.60
8	Sngl Whl-3	3,000	11,053	1.00
9	Sngl Whl-10	10,000	2,395	1.00
10	Gulfstream-G-V	90,900	4,606	1.60
11	Dual Tan-400	342,000	100	0.00
12	F-15C	68,000	2,307	0.00
13	B737-600	146,000	52	3.00
14	B707-320C	322,500	400	0.00

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	RegionalJet-200	0.00	0.00	0.00
2	RegionalJet-700	0.00	0.00	0.00
3	MD83	0.00	0.00	0.00
4	B757-200	0.00	0.00	0.00
5	Dual Whl-45	0.00	0.00	0.00
6	Sngl Whl-30	0.00	0.00	0.00
7	Sngl Whl-15	0.00	0.00	0.00
8	Sngl Whl-3	0.00	0.00	0.00
9	Sngl Whl-10	0.00	0.00	0.00
10	Gulfstream-G-V	0.00	0.00	0.00
11	Dual Tan-400	0.00	0.00	0.00
12	F-15C	0.00	0.00	0.00
13	B737-600	0.00	0.00	0.00
14	B707-320C	0.00	0.00	0.00

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section NewFlexib~01 in Job GJTEA1.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is New Flexible. Asphalt CDF was not computed.
Design Life = 20 years.
A design for this section was completed on 02/20/12 at 14:21:39.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	P-401/ P-403 HMA Surface	5.00	200,000	0.35	0
2	P-401/ P-403 St (flex)	7.04	400,000	0.35	0
3	P-209 Cr Ag	20.58	50,469	0.35	0
4	Subgrade	0.00	8,100	0.35	0

Total thickness to the top of the subgrade = 32.62 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	RegionalJet-200	47,450	2,462	4.70
2	RegionalJet-700	72,500	224	6.00
3	MD83	161,000	246	6.80
4	B757-200	256,000	500	5.00
5	Dual Whl-45	42,328	718	10.00
6	Sngl Whl-30	36,300	1,900	-5.00
7	Sngl Whl-15	16,000	3,737	1.60
8	Sngl Whl-3	3,000	11,053	1.00
9	Sngl Whl-10	10,000	2,395	1.00
10	Gulfstream-G-V	90,900	4,606	1.60
11	Dual Tan-400	342,000	100	0.00
12	F-15C	68,000	2,307	0.00
13	B737-600	146,000	52	3.00
14	B707-320C	322,500	400	0.00

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	RegionalJet-200	0.00	0.00	1.67
2	RegionalJet-700	0.00	0.00	1.43
3	MD83	0.03	0.06	1.30
4	B757-200	0.12	0.14	0.71
5	Dual Whl-45	0.00	0.00	1.59
6	Sngl Whl-30	0.00	0.00	1.85
7	Sngl Whl-15	0.00	0.00	1.99
8	Sngl Whl-3	0.00	0.00	2.22
9	Sngl Whl-10	0.00	0.00	2.06
10	Gulfstream-G-V	0.00	0.00	1.48
11	Dual Tan-400	0.43	0.43	0.64
12	F-15C	0.00	0.00	1.99
13	B737-600	0.00	0.00	1.24
14	B707-320C	0.42	0.44	0.62

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section NewFlexib~02 in Job GJTEA1.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is New Flexible. Asphalt CDF was not computed.
Design Life = 20 years.
A design for this section was completed on 02/20/12 at 10:00:11.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	P-401/ P-403 HMA Surface	5.00	200,000	0.35	0
2	P-401/ P-403 St (flex)	7.00	400,000	0.35	0
3	P-304 CTB	6.05	500,000	0.20	0
4	Subgrade	0.00	8,100	0.35	0

Total thickness to the top of the subgrade = 18.05 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	RegionalJet-200	47,450	2,462	4.70
2	RegionalJet-700	72,500	224	6.00
3	MD83	161,000	246	6.80
4	B757-200	256,000	500	5.00
5	Dual Whl-45	42,328	718	10.00
6	Sngl Whl-30	36,300	1,900	-5.00
7	Sngl Whl-15	16,000	3,737	1.60
8	Sngl Whl-3	3,000	11,053	1.00
9	Sngl Whl-10	10,000	2,395	1.00
10	Gulfstream-G-V	90,900	4,606	1.60
11	Dual Tan-400	342,000	100	0.00
12	F-15C	68,000	2,307	0.00
13	B737-600	146,000	52	3.00
14	B707-320C	322,500	400	0.00

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	RegionalJet-200	0.00	0.00	2.21
2	RegionalJet-700	0.00	0.00	1.75
3	MD83	0.05	0.08	1.51
4	B757-200	0.11	0.13	0.78
5	Dual Whl-45	0.00	0.00	2.04
6	Sngl Whl-30	0.00	0.00	2.62
7	Sngl Whl-15	0.00	0.00	2.94
8	Sngl Whl-3	0.00	0.00	3.55
9	Sngl Whl-10	0.00	0.00	3.12
10	Gulfstream-G-V	0.00	0.00	1.83
11	Dual Tan-400	0.38	0.38	0.73
12	F-15C	0.00	0.00	2.94
13	B737-600	0.00	0.00	1.52
14	B707-320C	0.47	0.50	0.74

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section NewFlexibful in Job GJTEA1.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is New Flexible. Asphalt CDF was not computed.
Design Life = 20 years.
A design for this section was completed on 02/17/12 at 12:43:27.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	P-401/ P-403 HMA Surface	5.00	200,000	0.35	0
2	P-401/ P-403 St (flex)	13.50	400,000	0.35	0
3	Subgrade	0.00	8,100	0.35	0

Total thickness to the top of the subgrade = 18.50 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	RegionalJet-200	47,450	2,462	4.70
2	RegionalJet-700	72,500	224	6.00
3	MD83	161,000	246	6.80
4	B757-200	256,000	500	5.00
5	Dual Whl-45	42,328	718	10.00
6	Sngl Whl-30	36,300	1,900	-5.00
7	Sngl Whl-15	16,000	3,737	1.60
8	Sngl Whl-3	3,000	11,053	1.00
9	Sngl Whl-10	10,000	2,395	1.00
10	Gulfstream-G-V	90,900	4,606	1.60
11	Dual Tan-400	342,000	100	0.00
12	F-15C	68,000	2,307	0.00
13	B737-600	146,000	52	3.00
14	B707-320C	322,500	400	0.00

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	RegionalJet-200	0.00	0.00	2.19
2	RegionalJet-700	0.00	0.00	1.73
3	MD83	0.05	0.08	1.50
4	B757-200	0.11	0.13	0.77
5	Dual Whl-45	0.00	0.00	2.02
6	Sngl Whl-30	0.00	0.00	2.58
7	Sngl Whl-15	0.00	0.00	2.90
8	Sngl Whl-3	0.00	0.00	3.48
9	Sngl Whl-10	0.00	0.00	3.07
10	Gulfstream-G-V	0.00	0.00	1.81
11	Dual Tan-400	0.38	0.38	0.73
12	F-15C	0.00	0.00	2.90
13	B737-600	0.00	0.00	1.50
14	B707-320C	0.47	0.50	0.73

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section NewRigid01 in Job GJTEA1.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is New Rigid.
Design Life = 20 years.
A design for this section was completed on 02/20/12 at 14:39:30.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	PCC Surface	15.49	4,000,000	0.15	650
2	P-306 Econocrete	8.00	700,000	0.20	0
3	P-209 Cr Ag	6.00	22,551	0.35	0
4	Subgrade	0.00	8,041	0.40	0

Total thickness to the top of the subgrade = 29.49 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	RegionalJet-200	47,450	2,462	4.70
2	RegionalJet-700	72,500	224	6.00
3	MD83	161,000	246	6.80
4	B757-200	256,000	500	5.00
5	Dual Whl-45	42,328	718	10.00
6	Sngl Whl-30	36,300	1,900	-5.00
7	Sngl Whl-15	16,000	3,737	1.60
8	Sngl Whl-3	3,000	11,053	1.00
9	Sngl Whl-10	10,000	2,395	1.00
10	Gulfstream-G-V	90,900	4,606	1.60
11	Dual Tan-400	342,000	100	0.00
12	F-15C	68,000	2,307	0.00
13	B737-600	146,000	52	3.00
14	B707-320C	322,500	400	0.00

Additional Airplane Information

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	RegionalJet-200	0.00	0.00	5.48
2	RegionalJet-700	0.00	0.00	4.71
3	MD83	0.29	0.40	3.42
4	B757-200	0.03	0.05	3.90
5	Dual Whl-45	0.00	0.00	5.30
6	Sngl Whl-30	0.00	0.00	3.12
7	Sngl Whl-15	0.00	0.00	4.40
8	Sngl Whl-3	0.00	0.00	9.82
9	Sngl Whl-10	0.00	0.00	5.39
10	Gulfstream-G-V	0.00	0.00	4.23
11	Dual Tan-400	0.46	0.46	3.19
12	F-15C	0.00	0.00	4.40
13	B737-600	0.01	0.01	3.68
14	B707-320C	0.21	0.26	3.40

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section shoulderflex in Job GJTEA1.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The section does not have a design life of 20 years. This constitutes a deviation from standards and requires FAA approval.
The aircraft list contains only one aircraft. Please see the introduction to the Help File for a discussion on using FAArfield to make single aircraft comparisons.
The structure is New Flexible. Asphalt CDF was not computed.
Design Life = 10 years.
A design for this section was completed on 02/17/12 at 12:45:17.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	P-401/ P-403 HMA Surface	6.00	200,000	0.35	0
2	P-209 Cr Ag	12.42	35,357	0.35	0
3	Subgrade	0.00	8,100	0.35	0

Total thickness to the top of the subgrade = 18.42 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	Dual Tan-400	342,000	1	0.00

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Dual Tan-400	1.00	1.00	0.73

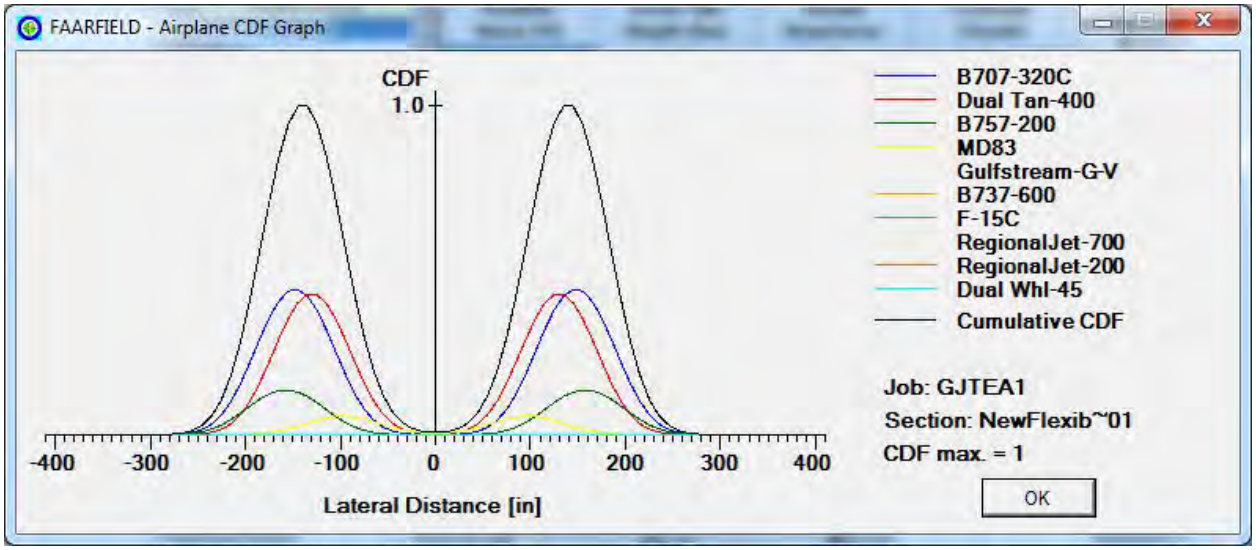


Figure 4: FAARFIELD CDF graph, Pavement Section A

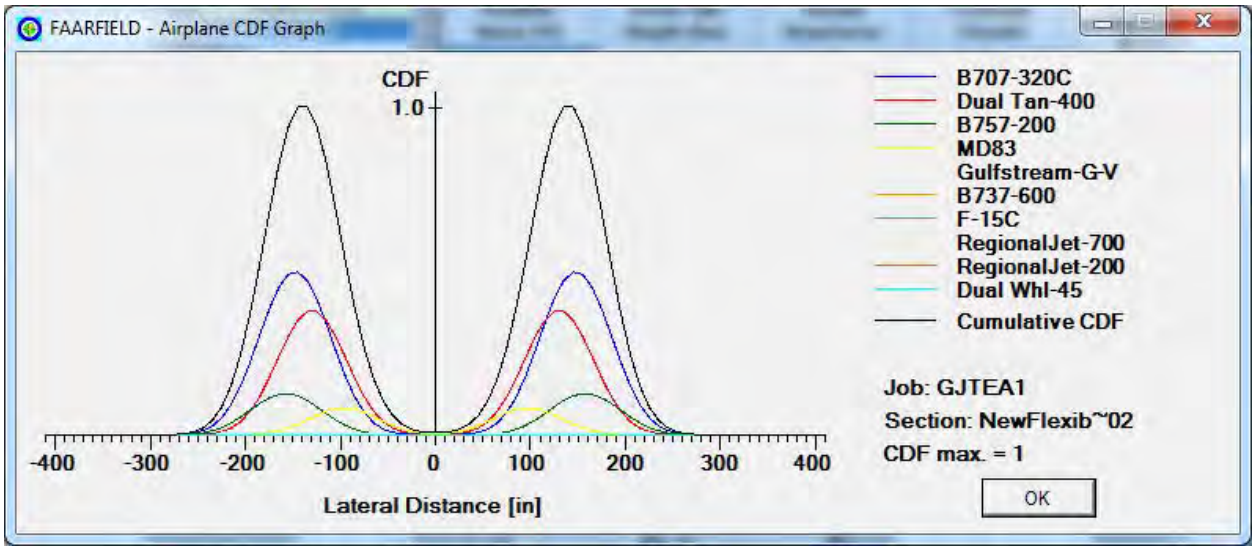


Figure 5: FAARFIELD CDF graph, Pavement Section B

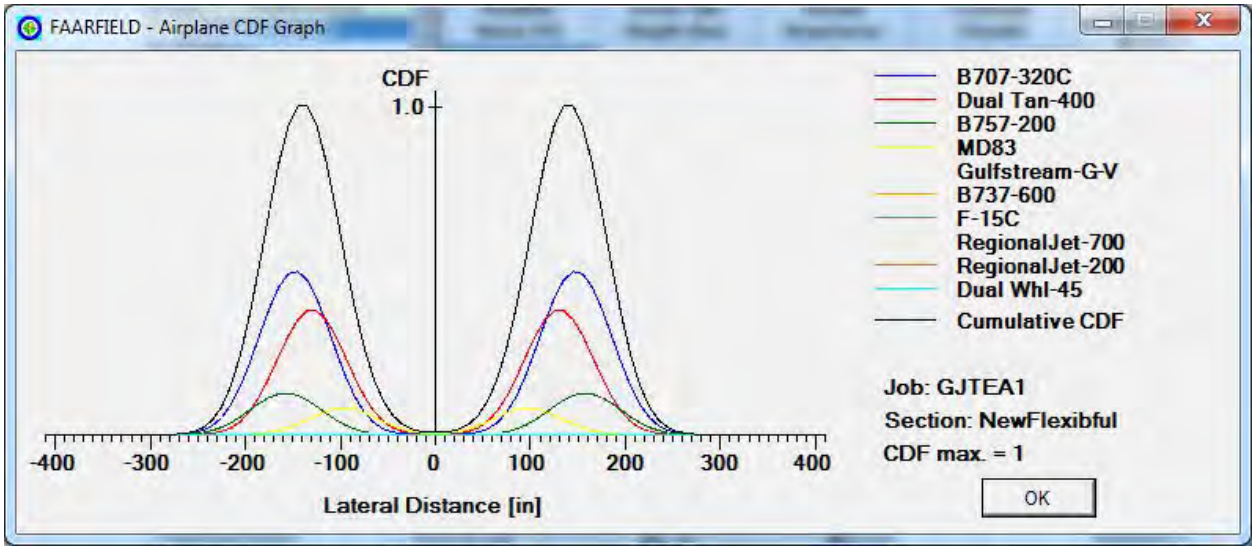


Figure 6: FAARFIELD CDF graph, Pavement Section C

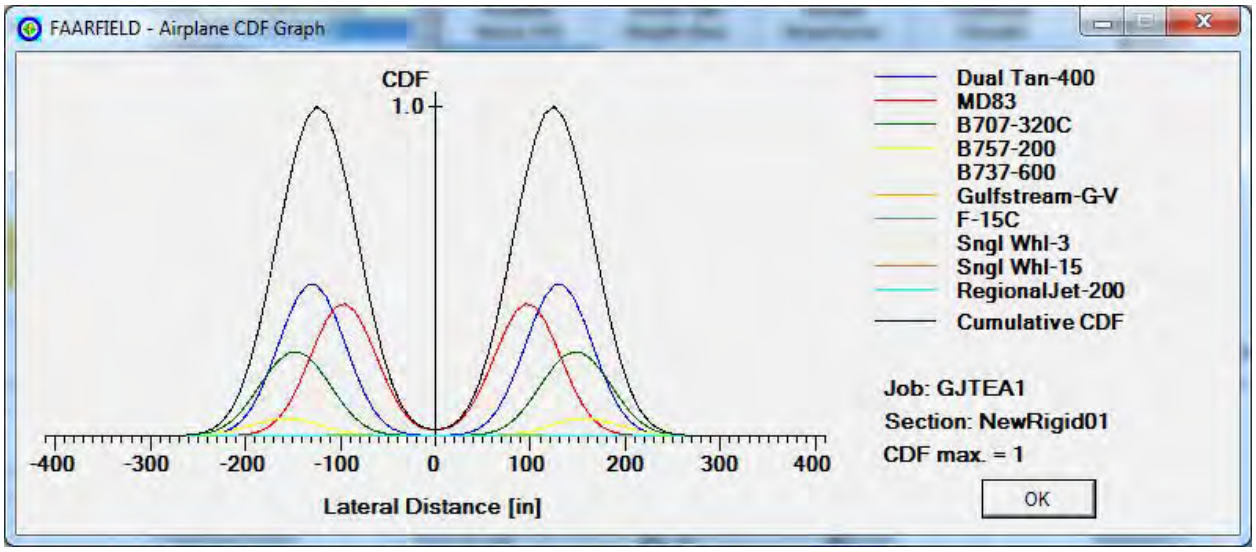


Figure 7: FAARFIELD CDF graph, Pavement Section D

ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 8

DOT 4(F) EVALUATION

US Department of Transportation
Federal Aviation Administration

DOT Section 4(f) Evaluation for the Grand Junction Regional Airport Grand Junction, Colorado

May 2014

This Department of Transportation Section 4(f) Evaluation (also referred to as a Section 303 Evaluation) is submitted for review pursuant to the following public law requirements: Section 102(2)(c) of the National Environmental Policy Act of 1969; 49 USC 47106; Section 303 of 49 USC Code, Subtitle I; Section 106 of the National Historic Preservation Act of 1966.

For Further Information:

Kandice Krull
Environmental Protection Specialist
Federal Aviation Administration
Denver Airports District Office
26805 E. 68th Avenue, Suite 224
Denver, CO 80249-6361

Grand Junction Regional Airport DOT Section 4(f) Evaluation

TABLE OF CONTENTS

Section 1 - INTRODUCTION **1-1**
- 1.1 Section 4(f) Feasible and Prudent Requirements 1-1
- 1.2 Description of Airport and Surrounding Land Uses
- 1.3 Purpose and Need 1-3

Section 2 – IDENTIFICATION OF DOT SECTION 4(f) RESOURCES **2-1**
- 2.1 Parks/Recreation/Wildlife Refuge Resources 2-1
- 2.2 Historic Resources 2-3

Section 3 - ALTERNATIVE ANALYSIS **3-1**
- 3.1 Methodology for Determination of DOT Section 4(f) Resource Impacts 3-1
- 3.2 Alternatives 3-2
- 3.3 Description of DOT Section 4(f) Resources Impacts and Measures to Minimize Harm 3-7

Section 4 – COORDINATION **4-1**
- 4.1 Coordination with Owners of DOT Section 4(f) Resources 4-1
- 4.2 Coordination with Recreational Users 4-1
- 4.3 State Historic Preservation Office (SHPO) Consultation 4-1

Section 5 - FINDING **5-1**

1. INTRODUCTION

Section 4(f) was initially codified in Title 49 of United States Code (USC) § 1653(f) (Section 4(f) of the USDOT Act of 1966). In 1983, § 1653(f) was reworded and recodified as Title 49 USC § 303, but still commonly referred to as Section 4(f). Congress amended Section 4(f) in 2005 when it enacted the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users. Section 4(f):

> Prohibits the use of land of significant publicly owned public parks, recreation areas, wildlife and waterfowl refuges, and land of a historic site for transportation projects unless the Administration determines that there is no feasible and prudent avoidance alternatives and that all possible planning to minimize harm has occurred.

The Federal Aviation Administration (FAA) is considering actions requested by the Grand Junction Regional Airport Authority to correct the non-standard conditions related to runway gradients, taxiway gradients, and the Runway Visibility Zone (RVZ); to enhance the capacity and operational safety of the runway/taxiway system; to protect the Airport from incompatible land uses; to correct a runway intersection; and to protect the Airport's instrument approaches.

This DOT Section 4(f) Evaluation (Evaluation) was prepared as an appendix to the Environmental Assessment (EA). This Evaluation consists of:

- **Section 1** – Introduction – Provides the regulatory context for the evaluation and the purpose and need for the proposed project;
- **Section 2** – Determination of DOT Section 4(f) Applicability – Examines the lands in the airport vicinity relative to DOT Section 4(f) and identifies those resources that the FAA determined to be potentially subject to DOT Section 4(f);
- **Section 3** – Alternative Analysis – Identifies possible alternatives to avoid or minimize impacts to Section 4(f) resources. .
- **Section 4** – Coordination – Summarizes the efforts made to coordinate with agencies and parties owning DOT Section 4(f) Lands on the potential effects of the proposed projects.
- **Section 5** – FAA DOT Section 4(f) Finding

1.1 DOT SECTION 4(F) FEASIBLE AND PRUDENT REQUIREMENTS

Programs or projects requiring the use of Section 4(f) lands will not be approved by the FAA unless there is no prudent and feasible alternative to the use of such land, and such programs and projects include all possible planning to minimize harm resulting from the use. The term "feasible"[1] refers to sound engineering principals, while the term "prudent"[1] refers to rationale judgment. According to FAA Order 5050.4B, a project may be possible (feasible), but not prudent when one considers safety, policy, environmental, social, or economic consequences. The following factors are to be used to decide if an alternative is prudent[1]:

- Does it meet the project's purpose and need?
- Does it cause extraordinary safety or operational problems?

[1] FAA Order 5050.4B, *National Environmental Policy Act Implementing Instructions for Airport Actions*. Page 10-10

- Are there unique problems or truly unusual factors present with the alternative?
- Does it cause unacceptable and severe adverse social, economic, or environmental impacts?
- Does it cause extraordinary community disruptions?
- Does it cause additional construction, maintenance, or operational costs of an extraordinary magnitude?
- Does it result in accumulation of factors that collectively, rather than individually, have adverse impacts that present unique problems or reach extraordinary magnitudes?

The FAA must clearly explain why any alternative is rejected as not being prudent and feasible if the project results in the use of 4(f) protected lands.

1.2 EXISTING AIRPORT ENVIRONS

The Grand Junction Regional Airport (Airport) is located on the northern edge of the City of Grand Junction. Grand Junction is perhaps best known for its proximity to year-round outdoor recreation areas, such as ski resorts, hiking trails, fishing, golf courses, horseback riding trails, mountain bike trails, camping facilities, etc. Other nearby attractions include: the Colorado National Monument, the McInnis Canyons National Conservation Area, the Grand Mesa National Forest and the Uncompahgre National Forest, as well as many local vineyards and wineries in what is known as Colorado Wine Country.

The Airport encompasses 2,357 acres and is located approximately four miles northeast of downtown Grand Junction. Airport property in the City's zoning and development code is zoned Public Airport District, which is a nonresidential zoning district. Areas to the south and west of the Airport consist of both residential and nonresidential land uses. Some of the nonresidential land uses include light commercial, industrial/office park and open or planned development areas. Areas to the north and east of the Airport are outside of the corporate city limit boundary and are owned by the Bureau of Land Management (BLM).

1.3 PURPOSE AND NEED

Council on Environmental Quality (CEQ) Regulations implementing the National Environmental Policy Act (NEPA) require that a NEPA document specify the underlying purpose and need to which an agency is responding in proposing alternatives (40 C.F.R. §1502.13).

The need, or the problem, is existing non-standard runway gradients, taxiway gradients, runway intersections, and the RVZ. Thus, the purpose of the project is to achieve FAA standards which are established to ensure aviation safety.

While the airfield at the Airport was built to meet FAA standards, over time, the FAA has improved/updated the standards to increase safety. As a result of these changes, several airfield components do not meet current FAA design standards including:

- Runway 11/29 Transverse Gradient. Portions of the runway exceed the maximum recommended design standard of 1.5%.

- Runway 11/29 Longitudinal Gradient. A portion of the runway near the approach end of Runway 29 exceeds the maximum recommended design standard of 0.8% gradient. Also, portions of the center 4,500 feet of the runway exceed the maximum recommended design standard of 1.5%.

- Runway 11/29 Connecting Taxiway Gradient. A number of the connecting taxiways between Runway 11/29 and parallel Taxiway "A" exceed the maximum recommended design standard gradient of 1.5%.
- Runway 11/29 and Runway 4/22 RVZ. Numerous structures obstruct the line of sight between the runway mid-points. The Runway Visibility Zone is an area formed by imaginary lines connecting the two runways' visibility points. The visibility points are any two points five feet above the runway centerline that are mutually visible for the entire runway length. According to FAA design standards there should be a clear line of sight between these runway points.
- Runway 11/29 and Runway 4/22 Intersection. This runway intersection increases the potential for runway incursions.

2. IDENTIFYING DOT SECTION 4(f) RESOURCES

DOT Section 4(f) lands are defined as "any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance or land from an historic site of national, state, or local significance."[2] To identify probable DOT Section 4(f) resources, published recreation/refuge plans were reviewed and coordination was conducted with the primary owner of public lands (the Bureau of Land Management - BLM) in the Airport environs. In addition, a review of sites on or eligible for the National Register of Historic Place (NRHP) was conducted. **Figure 2-1** shows the locations of the DOT Section 4(f) resources.

2.1 Parks/Recreational/Refuge Resources

Publicly owned land is considered to be a park, recreation area, or wildlife and waterfowl refuge when the land has been officially designated as such by a federal, state or local agency and one its major purposes is for a park, recreation area, or wildlife and waterfowl refuge. The Department of Interior's 2003 guidance, *Handbook on Departmental Review of Section 4(f) Evaluations,* notes that "Lands under the jurisdiction of the Bureau of Land Management that are administered for recreation, cultural, and wildlife purposes" are considered Section 4(f) resources. The only potential DOT 4(f) lands located within close proximity of the Airport that have the potential to be affected by the proposed improvements include:

- BLM Grand Junction Planning Area: The Grand Junction Planning Area (Planning Area) is located in the extreme west-central portion of Colorado and consists of over 2 million acres of federal and private lands, national forest, national park, and state lands. This Planning Area consists of 1.2 million acres of land administered by the BLM, considered public lands. The City of Grand Junction (with the Airport located on the northern edge of the City) is roughly in the center of the Planning Area. The Airport is located in Mesa County which hosts about 1.2 million of the 2 million acres of the Planning Area, nearly 1 million acres of which are public lands administered by BLM.

  Use in the area includes a) casual (including recreation-oriented use and hunting), b) competitive use (running races, motorcycle races, bicycle races, etc.) and c) training (annual BLM ATV and motorcycle safety training, 4x4 driver safety training, and wild land firefighter training). The BLM notes that off-road vehicle (ORV) use is the single largest recreational use of public land in the Grand Junction Planning Area. **Figure 2-1** shows the locations of off-road trails as identified in late 2011 by users of this recreational resource. Relatively mild winters enable nearly year-round opportunity for ORVs. In addition, many back roads and trails in the remainder of the resource area provide extensive vehicle use and access opportunities. Local access roads (27 ¼ Rd. and 29 Rd.) provide the primary access points to a very popular ORV riding area. There are some tailgating and camping activities in the 27 ¼ Road area, and there was fairly heavy tailgating and camping activity on airport property at the 29 Road access prior to the fencing of that property. In spring and fall it is not unusual to have 30 to 50 campers along 27 ¼ Road, fewer out at 29 Road outside of airport property. **Table 2-1** (from the 1985 RMP) shows visitor use by activity.

[2] 23 U.S.C. 138 *Preservation of Parklands.*

Figure 2-1 Insert 4f graphic

Table 2-1. *Off-Road Vehicle Use in the Grand Junction Resource Area*

Vehicle type	Visitor Use	
	Within the Grand Valley	Outside the Grand Valley[3]
Motorcycle	60,300	5,000
4-Wheel Drive	21,300	2,000

Source 1985 Grand Junction Resource Area Resource Management Plan, BLM, Table 3-13

BLM provided data from traffic counters located at 27 ¼ Road and 29 Road. These traffic counters were not installed for this project, but they do give some indication of the level of use for the area. It is also important to note that these counters register all traffic on 27 ¼ Road, not just recreational land users. In 2010, annual visitation was estimated at 135,000 at 27 ¼ Rd. and 131,000 at 29 Rd. BLM estimates this number by first dividing the raw traffic count by two (to account for in and out traffic), then multiplying the number by a factor of 2.5. In other words, it is estimated that each vehicle contains approximately 2.5 people. The busiest months for use are typically April, May, September, and October when there may be as many as 12,000 to 14,000 visitors per month at each entry road location. Users estimate that about 60-75% of the users are local, about 20-25% from other locations in Colorado, and 5-15% outside of Colorado.

- Paradise Hills Park – is located 1 mile west of the Airport. This park is a 7 acre neighborhood park that consists of open space, playground, park shelter and picnic tables, basketball hoops, and horseshoe pits. Though a Section 4(f) resource, the park is not considered further in this DOT Section 4(f) Evaluation given its distance from the Airport. This park is outside of the study area and will not be impacted (directly or indirectly) by construction at the Airport.

2.2 Historic Sites

To identify potential historic sites, a review was conducted of properties on or eligible for the NRHP during the Intensive-Level Historic Resources Inventory and Class III Archaeological Inventory in June of 2011. This inventory identified four potential historic sites and nine isolated finds (Little Book Cliff Railway, Historic Dam, Theodore J. Broemser Homestead, and the Walker Airport calibration pads). According to Section 4(f) requirements, an historic site is significant only if the site is listed on or eligible for listing on the NRHP. Only one of the historic sites was found to be eligible for listing on the NRHP (the Little Book Cliff Railway). Please refer to Appendix 12 of the EA for more information on the survey and resources identified as not eligible for listing on the NRHP.

Little Book Cliff Railway: Part of the rail bed of the Little Book Cliff Railway is located on the BLM land northwest of the Airport. This rail company was a narrow gauge railroad that operated from 1889 to 1925 in Colorado. The company was formed by William Carpenter and other prominent Grand Junction businessmen to haul coal from Book Cliff mines to Grand Junction, about an 11-mile distance. Over its history, it also provided transportation for area residents for recreational purposes. The railroad and its associated coal mines had an important impact upon the development of early Grand Junction and its environs, providing the growing community with a consistent supply of heating fuel at competitive prices for thirty-five years.

[3] The Grand Valley is generally defined as the greater Grand Junction Metropolitan Statistical Area consisting of the City of Grand Junction, the City of Fruita, the Town of Collbran, the Town of Debeque, the Town of Palisade and the unincorporated areas of Mesa County.

Abandonment and dismantlement following closure of the railway's coal mines in the mid-1920s left little behind but the bed of the line. The cultural inspection found no visibly remaining tracks, ties, tie plates, spikes, trestles, signage, ballast or other features normally associated with a rail line. Features that indicate a railway once ran through the area are limited to the bed, one cut, and scatterings of cinders along the line. The route and alignment of the railway remain evident today largely because it is used for off highway vehicle recreational purposes.

The Little Book Cliff Railway was found to be eligible for listing on the NRHP. Therefore, the railway also is considered a Section 4(f) resource. Given its location, the railway could be impacted by the proposed project and will be considered in this evaluation.

3. ALTERNATIVE ANALYSIS

This section describes the methodology used for determining impacts to Section 4(f) resources and provides details on the alternatives considered including potential impacts. Methods to minimize or mitigate impacts to the identified preferred alternative are also included.

3.1 METHODOLOGY FOR DETERMINATION IMPACTS

Each DOT Section 4(f) resource was evaluated for potential impacts associated with each of the alternatives considered. The potential impact criteria evaluated for each site included direct impacts and constructive use impacts.

3.1.1 Direct Impacts/Physical Use

Direct impacts, or physical "use", refer to physical taking/acquisition of a Section 4(f) resource for incorporation into a transportation project. In determining direct impacts, each proposed alternative was evaluated to determine if land acquisition would impact one of the identified Section 4(f) resources.

3.1.2 Indirect Impacts/Constructive Use

"Use" within the context of Section 4(f) includes not only actual physical taking of such resources, but also indirect impacts as well. Indirect impacts may rise to the level of a "use" termed "constructive use" if due to the proximity of the project, the activities, features, or attributes of the site's vital functions are substantially impaired. The definition of constructive use adopted for this study is based on FAA Order 1050.1E Appendix A, Paragraph 6.2f:

> Substantial impairment occurs only when the activities, features, or attributes of the resource that contribute to its significance or enjoyment are substantially diminished. A project which respects a park's territorial integrity may still, by means of noise, air pollution, or otherwise, dissipate its aesthetic value, harm its wildlife, defoliate its vegetation, and take it in every practical sense. For section 4(f) purposes, the impairment must be substantial. With respect to aircraft noise, for example, the noise must be at levels high enough to have negative consequences of a substantial nature that amount to a taking of a park or portion of a park for transportation purposes.

In determining indirect impacts, each proposed alternative was evaluated to determine if construction and/or land acquisition would indirectly impact a Section 4(f) resource.

3.2 ALTERNATIVES

An Airport Master Plan Update (Master Plan) is a development plan for an airport. The Master Plan for the Airport not only considered options to address the existing standard issues but also identified future projects that are needed to either enhance capacity or increase the safety of the airfield layout. The ALP and Master Plan were evaluated in determining the preferred alternative to make sure the chosen alternative does not conflict with future development plans.

The Master Plan and the EA considered and evaluated various development alternatives. The only alternative evaluated in these documents that avoids impacts to Section 4(f) resources is the No Action Alternative. Two additional alternatives that potentially avoid impacts to Section 4(f) resources were developed for this evaluation. These two alternatives, in addition to the No Action Alternative and Proposed Action Alternative from the EA, are described below.

Development to the south was eliminated from consideration given the location of the crosswind runway. Shifting the runway to the southeast would not resolve the intersecting runway issue nor would it correct all of the non-standard issues. Offsetting the runway with a shift to the southeast would result in the runway being in the Runway Protection Zone (RPZ)/approach to the crosswind runway, which are safety concerns. For these reasons, alternatives to the south were not considered.

- No Action Alternative: The No Action Alternative consists of limited maintenance to keep the runway and taxiway systems operational and would not impact the identified Section 4(f) resources. However, the No Action Alternative would not address the purpose and need as it would not correct the existing non-standard conditions. While this alternative does not meet the purpose and need, NEPA requires its consideration and it is carried forward for evaluation in the EA but will not be carried forward for consideration in this evaluation.

- DOT Section 4(f) Alternative 1: Reconstruction of Runway 11/29 in Place with 700-foot Shift to the Northwest: This alternative reconstructs the runway in its current position with a 700-foot shift to the northwest to separate the intersecting runways (**Figure 3-1**). This alternative would not correct all of the non-standard conditions. The longitudinal gradient for exit taxiway A-7 would not meet FAA design standards. The runway at this intersection would have to be raised by at least 2 feet in order to fix the longitudinal grades in the eastern quarter-end of the runway. Bringing this connector to standards is not possible due to the proximity of Taxiway A to the General Aviation (GA) ramp. The runway/taxiway separation could impede construction of proposed future development identified in the ALP and Master Plan Update.

  Though this alternative avoids Section 4(f) impacts, it does not meet the purpose and need because it will not correct all of the deficiencies and it does not meet FAA standards. Therefore, it was found not to be prudent and was eliminated from further consideration.

Figure 3-1 DOT Section 4(f) Alternative 1: Reconstruction of Runway 11/29 in Place with 700-foot Shift to the Northwest

- DOT Section 4(f) Alternative 2: Offset and Shift Runway 11/29 North with 400-foot Runway/Taxiway Separation: This alternative offsets the runway 400 feet north of its present location (**Figure 3-2**). The existing runway would serve as the parallel taxiway with a runway/taxiway separation of 400 feet.

  The runway/taxiway separation of 400 feet could impede construction of proposed future development identified in the ALP and Master Plan Update.

  Construction of this alternative, as with all of the alternatives, will be dependent on funding and it is expected that funding will be spread over multiple years due to the limited funding available. The Airport will lose their precision approach during periods of construction due to signal interruptions by construction equipment to the glide scope. The glide slope signal is used to establish and maintain the aircraft's descent rate until visual contact confirms the runway alignment and location. The glide slope is a crucial component of a precision approach. Deactivating the glide slope during construction effectively terminates the precision approach.

  In addition to the deactivation of the glide slope, construction of the new runway will result in obstructions for the existing runway. There are several surfaces surrounding an airport that are protected for the safe operation of the airport, including approach, primary, transitional, conical and horizontal surfaces. Federal Aviation Regulation (FAR) Part 77 establishes standards and notification requirements for objects affecting navigable airspace. Construction equipment will penetrate both the primary and transitional surfaces, which will potentially limit or restrict air carrier and cargo operations. In addition, to meet FAA runway design standards, the eastern quarter-end of the runway will be higher than the existing runway gradient and penetrate the primary surface of the existing runway resulting in increased instrument approach minimums. Scheduled air carrier and cargo operations would potentially be limited or not able to operate due to Part 77 penetrations and the deactivation of the glide slope (and precision approach).

  This alternative would impact BLM property (just under one acre of acquisition) and the historic railroad grade. Following construction, this alternative would technically meet the purpose and need by correcting all non-standard conditions; however, the alternative would not meet FAA design standards during construction, which will greatly reduce (if not eliminate) air carrier and cargo operations during the extended construction period. Consequently this alternative was found not to be prudent and was not considered further.

Figure 3-2 DOT Section 4(f) Alternative 2:
Offset and Shift Runway 11/29 North with 400-foot Runway/Taxiway Separation

- Proposed Action Alternative: Offset and Shift Runway 11/29 North with 600 Runway/Taxiway Separation: This alternative would construct a new runway approximately 637.5 feet to the northeast of the existing runway centerline (**Figure 3-3**). Upon the completion of the new runway, the existing Runway 11/29 would be converted to a parallel taxiway for the new runway. The additional 37.5 feet is necessary to allow the parallel taxiway to be constructed on the existing runway's quarter crown. The new runway and connector taxiways would meet all FAA design standards.

  The runway/taxiway separation of 600 feet will allow construction of proposed future development identified in the ALP and Master Plan Update.

  The funding, and therefore the construction, of this alternative will be take place over multiple years, similar to the previous alternative. However, the new runway will be outside of the various Part 77 surfaces for the existing runway. Therefore, operations will continue as normal during construction and construction will not impact the utility of the Airport.

  This alternative was found to be the only prudent and feasible alternative that fully meets the purpose and need while limiting impacts to the Airport during construction. This alternative would impact BLM property and the historic railroad grade. This alternative would require the transfer of approximately 188 acres of BLM land to the Airport Authority. This alternative was selected as the preferred alternative.

Figure 3-3 Proposed Action Alternative:
Offset and Shift Runway 11/29 North with 600-foot Runway/Taxiway Separation

3.3 DESCRIPTION OF DOT SECTION 4(f) RESOURCES IMPACTS AND MEASURES TO MINIMIZE HARM

3.4.1 BLM Lands

Direct Impacts/Acquisition: The preferred alternative will require acquisition of BLM property to complete the project. Four different land transfer alternatives were considered in Chapter 2 of the EA. Land Transfer Alternative 2 included the transfer of land in accordance with a 1991 MOU between the BLM and Airport Authority that recognized the future need of BLM lands for airport purposes (2,163 acres). This was then reduced to 720 acres by identifying the lands needed in Aliquot Parcels (Land Transfer Alternative 3). This was further reduced to 188 acres utilizing a straight line acquisition scheme (Land Transfer Alternative 4).

Approximately 80 acres of the 188 acre total (shown as parcel A on **Figure 2-1**) would be required for the RPZ and relocated 27 ¼ Road. Public access would continue on approximately 77 acres of this 80 acre parcel; approximately 3 acres would be fenced. The relocation of 27 ¼ Road would be undertaken to maintain access to BLM lands. The 108 acres in parcel B (shown on **Figure 2-1**) would be required for the relocated runway, perimeter service road, security fence, and storm water detention ponds.

The land that would be acquired is part of the Grand Valley ORV Area and is used for off-road vehicle recreational activities. The quantity of land to be acquired is minimal in comparison to the amount of acres available for ORV activities (over 11,000 acres). Recreational activities can be absorbed by the remaining lands.

Consultation between FAA and BLM, as well as public lands users, confirmed that the use of the Section 4(f) property would not create a significant effect given the amount of land being acquired compared to the amount of land that will still be available for recreational uses. In addressing the loss of available recreational land, the recreation users suggested that as mitigation, the Airport Authority improve the vehicle staging area which would enhance the overall value of the remaining large recreation area.

Indirect Effects/Constructive Use: No project-related constructive use effects would occur to the BLM Lands.

Proposed Mitigation: In addition to minimizing harm through reducing the quantity of land transferred to the Airport, the Airport Authority is evaluating additional mitigation strategies to address the loss of recreational land. In discussions with the users of the off highway vehicle areas, users noted the need for maintained access to off road vehicle areas, as well as the need for parking, staging, and preparation for off highway vehicle uses. These improvements would help to enhance the remaining recreation area and make the area more useable for users. The Airport Authority is proposing to provide access/staging improvements in exchange for the land transfer. Mitigation will be accomplished in accordance with BLM and FAA requirements. Before the FAA issues its environmental finding on the proposed project, a MOA outlining this proposed mitigation will be approved by the FAA, the BLM and the Airport Authority.

3.4.2 Little Book Cliff Railway

Direct Impacts/Acquisition: Approximately 850 linear feet of the mile long segment of the railway would be within the acquisition area associated with the new runway. While the runway would not be sited near the railway line, the new security fence and perimeter service roadway that would parallel the runway would bisect/cross the railway. While 850 linear feet of the railway path would be within the airport fence line, only 15 to 20 feet would be physically altered by this proposed project.

Indirect Effects/Constructive Use: Public access would be lost to a portion of the historic railway, as noted above. No indirect effects would be expected.

Proposed Mitigation: BLM and the Colorado Office of Historic Preservation have developed and signed a Memorandum of Agreement (MOA) to address the adverse effects of the acquisition and to identify measures that can be taken to minimize harm. The FAA was a concurring part to the MOA. This MOA is included in the EA in Appendix 12. BLM has proposed to conduct a Level II photo-documentation of the portion of the railway that would be impacted as mitigation for the impact as explained in the MOA. The Level II documentation process under the Colorado Office of Historic Preservation guidance will include a full descriptive and historical narrative about the site, measured drawings, and medium format black and white photography. This approach recognizes that the site will likely be permanently destroyed, and thus the information collected in this Level II documentation will provide important information on the resource for use by scholars, researchers, preservationists, architects, engineers, and others interested in preserving and understanding historic properties, in accordance with the Secretary of Interior's standards and guidelines.

4. COORDINATION

The Airport Authority, FAA, and the BLM implemented a comprehensive and proactive public involvement and agency coordination program for the EA process. Staff of the Airport Authority met with users of the BLM lands to identify their concerns and potential mitigation options. Coordination for the project is ongoing and includes scoping, meetings, and agency coordination.

4.1 COORDINATION WITH OWNERS OF SECTION 4(F) RESOURCES

Regular meetings occurred between the staff of the FAA, the BLM, and the Airport Authority. Because both the FAA and the BLM have federal actions that are subject to NEPA, the BLM became a cooperating agency to the preparation of the EA. DOT 4(f) is only applicable to decisions of the Department of Transportation. Therefore, BLM is not required to prepare a Section 4(f) Evaluation. However, because BLM is responsible for managing the lands adjacent to the Airport that would be acquired/transferred to the Airport Authority, the BLM has been an important part of the FAA's process of complying with DOT Section 4(f).

Meetings between the FAA and BLM on this project are noted in **Table 4-1**.

4.2 COORDINATION WITH RECREATION USERS

In addition to coordinating with BLM, the Airport Authority also met with users of the recreational lands. The purpose of the meetings were to 1) identify when and where recreational activities occur on the lands adjacent to the Airport, 2) discuss airport development needs, and 3) identify ways to minimize harm to the current and planned recreational activities. These discussions are summarized in **Table 4-2** as well as the dates of the meetings.

4.3 STATE HISTORIC PRESERVATION OFFICE (SHPO) CONSULTATION

The BLM took the lead in SHPO Consultation for this project and the process is documented in Appendix 12 of the EA. The SHPO concurred with all eligibility determinations and proposed mitigation for the project as outlined in the MOA.

TABLE 4-1
COORDINATION ACTIVITIES BETWEEN FAA, BLM, & AIRPORT AUTHORITY

Coordination Date	Coordination Purpose	Attendees
January 15, 2008	Discussion of land transfer options, RMP process and NEPA requirements of both FAA and BLM	BLM, Airport Authority, Consultant Team
August 5, 2008	Discussion of land transfer options, RMP process and NEPA requirements of both FAA and BLM	BLM, Airport Authority, Consultant Team
July 22, 2009	Discussion of combined EA/RMP Amendment process, phases, schedule and timeline	BLM, FAA, Airport Authority, Consultant Team
October 27, 2009	Meeting to execute MOU between BLM, Airport Authority and Consultant	BLM, Airport Authority, Consultant Team
January 8, 2011	Discussion of scoping process, scoping notices and scoping meeting dates	BLM, Airport Authority, Consultant Team
February 15, 2011	Discussion of need for FAA/BLM Letter of Intent (LOI). FAA signed LOI on April 4, 2011.	BLM, FAA, Airport Authority, Consultant Team
April 27, 2011	Official Joint Project Scoping Meeting	BLM, FAA, Airport Authority, Consultant Team
August 17, 2011	Geotechnical update, discussion of alternatives and schedule	BLM, Airport Authority, Consultant Team
September 19, 2011	Discussion of DOT 4(f) requirements, alternatives and schedule	BLM, Airport Authority, Consultant Team
November 21, 2011	Conference call to discuss BLM comments on Working Paper 1 and initial discussion of an alternative that minimizes the amount of land to be transferred.	BLM, Airport Authority, Consultant Team
February 15, 2012	Discussion of minimization alternative and straight line transfer. Also discussion of boundary survey requirements for straight line transfer.	FAA, Airport Authority, Consultant Team
May 18, 2012	FAA and BLM sign letters concurring on a preferred alternative for the land transfer request.	BLM, FAA, Airport Authority, Consultant Team

TABLE 4-2
COORDINATION ACTIVITIES WITH RECREATIONAL USERS

Meeting Date	Meeting Purpose	Attendees
October 19, 2011	Brief the Western Slope ATV Association of the project and discuss mitigation.	BLM, Western Slope ATV Association, Consultant Team
June 20, 2012	Update the Western Slope ATV Association on the new minimization alternative.	BLM, Western Slope ATV Association, Consultant Team

5. FINDING

After careful and thorough consideration, the FAA determined that there are no feasible and prudent alternatives to the use of Section 4(f) resources. As demonstrated in Section 3 of this evaluation, other alternatives considered would either fail to meet the purpose and need or result in extraordinary impacts during construction. The Proposed Action includes minimized impacts to Section 4(f) resources by limiting the amount of land being acquired. Less than one percent of the entire 11,000 acre Grand Valley OHV area would be acquired. In addition, the Proposed Action includes mitigation to help enhance the recreational use of the remaining land.

Based upon the above considerations, there is no feasible and prudent alternative to the use of BLM land, which includes a portion of the Little Book Cliff Railway, and the Proposed Action includes all possible planning to minimize harm resulting from such use.

ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 9

MINERAL RESOURCE POTENTIAL REPORT

Form 3980-1
(July 1984)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
State of Colorado

MINERAL REPORT

Approximately 190 Acre BLM Property
to be Transferred to the
Airport Authority

LANDS INVOLVED

S1/2NE1/4, Sec. 23
SE1/4, Sec. 24
Township 1 North, Range 1 West

Lot 4; Sec. 19
Lot 1, S1/2NE1/4, NE1/4NW1/4, Sec. 30
Township 1 North, Range 1 East
Ute Principal Meridian
Mesa County, Colorado

Prepared By: _____
(Signature)

BLM GJFO Geologist
(Title)

7/17/12
(Date)

Technical Approval:

_____
John Morrone (Signature)

Geologist, 1990 Program Colorado Level
(Title)

7/18/2012
(Date)

Management Acknowledgement:

_____
(Signature)

FM
(Title)

7/25/12
(Date)

TABLE OF CONTENTS

Conclusions and Recommendations 1

Introduction 1

Lands Involved 1

Land Status 1

Geologic Setting 3

Sitel Geology and Site Conditions 3

Mineral History 6

- Locatable minerals: 6
- Leasable Minerals 6
  - Oil and Gas: 6
  - Coal: 7
- Salable Minerals 7
  - Sand and Gravel: 7
  - Decorative Stone and Moss rock: 7
  - Clay 7

References 9

LIST OF FIGURES AND PHOTOS

Figure 1. Location Map 2
Figure 2. Surface Ownership Map 4
Figure 3. Surface Geology Map 5
Photos 1-6 8

Conclusions and Recommendations

Drilling for natural gas produced out of the Dakota Sandstone in the subsurface represents the only currently known possible mineral resource to be recovered from property lands. This potential for commercial operations of natural gas is considered low due to the formation producing from irregular intervals where stratigraphic traps are present, but since there are two oil and gas leases with one shut-in gas well on and adjacent to the 110 acre parcel the BLM must retain the mineral estate for oil and gas. No mining claims have been staked on the property at the time of this site investigation and no mineral leases are held in the area. There are no sources of decorative rock or mineral materials on site. Clay is abundant, but similar clays are found throughout the Grand Valley. Since there is low potential for any type of solid mineral development, the federal solid mineral estate should be conveyed with the surface estate.

Introduction

Under the Airport and Airway Improvement Act of September 3, 1982, the Grand Junction Airport Authority (Airport Authority), in cooperation with the Federal Aviation Administration (FAA), has proposed a land title transfer of approximately 190 acres from the BLM to the Airport Authority. The 190 acres are separated into two different parcels adjacent to the existing Airport Authority land (see figures 1, 2 and 3). The purpose of the planned runway relocation is to attain compliance with the FAA design standards by correcting deficiencies related to runway and taxiway gradients and to eliminate intersecting runways at the airport. The need for the proposed runway relocation is to increase safety at the airport.

Lands Involved

The subject property is located immediately north of the city of Grand Junction, Colorado and west of Mount Garfield in the Book Cliffs (see figure 1). Undeveloped BLM land borders the north, east and northwest sides of the subject site. These adjacent BLM lands are managed as the Grand Valley Off Highway Vehicle Area for motorized cross-country recreation (see figures 1, 2, and 3).

Land Status

The subject property is federal ownership in surface and mineral estate. No mining claims exist on the property. Two oil and gas leases exist on and adjacent to the 110 acre parcel (see figure 3). No mineral materials disposal permit exists on the property.

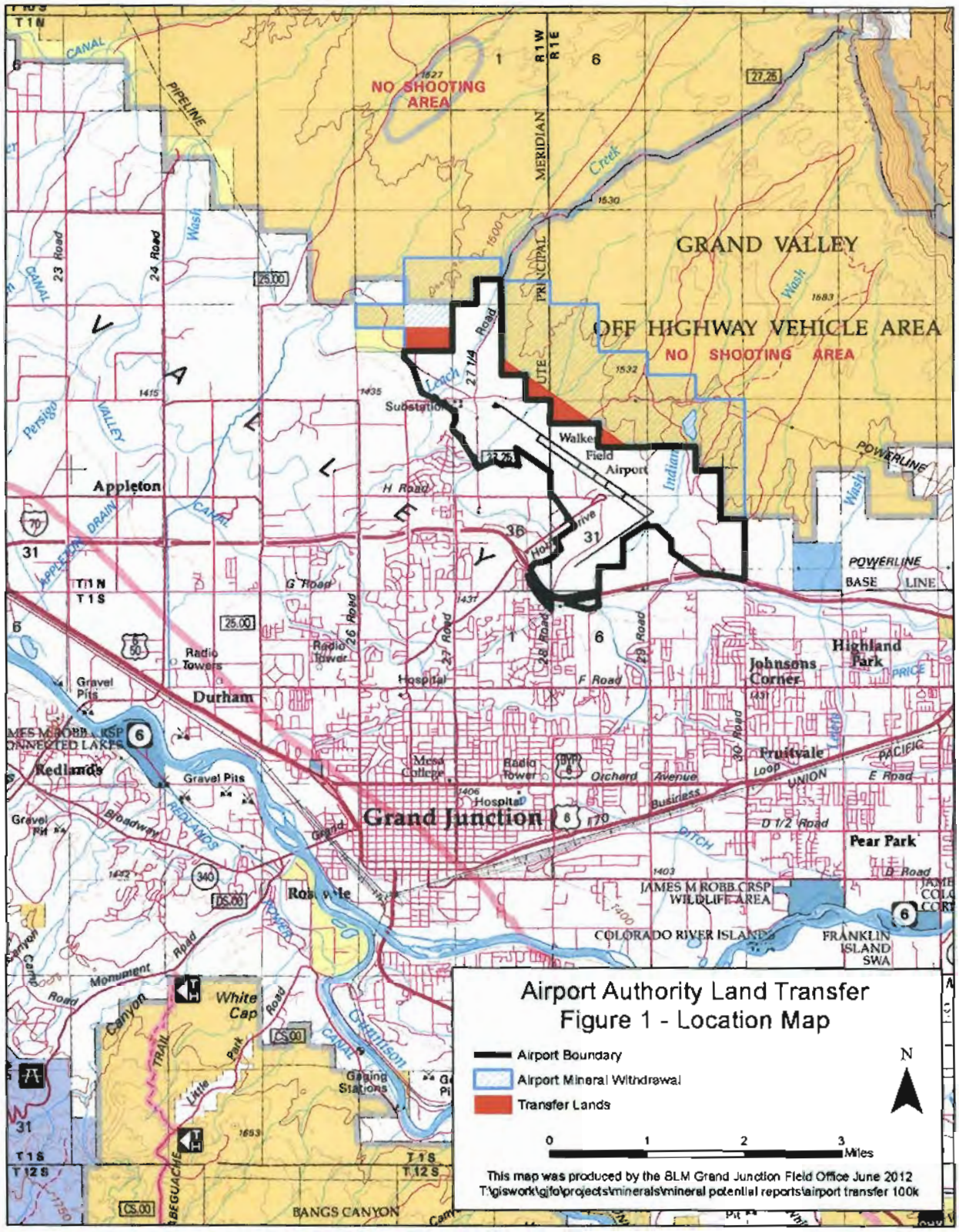


Figure 1. General Location Map

Geologic Setting

The property lies in the northern portion of the Grand Valley in western Colorado near the confluence of the Colorado and Gunnison Rivers. The valley is underlain by Cretaceous age Mancos shale overlain with Quaternary age alluvium, colluvium and terrace gravels. The Book Cliffs immediately to the north and east are composed of Mancos Shale slopes capped by Upper Cretaceous age sedimentary rocks, predominantly sandstone, of the Mesa Verde Group dipping gently to the northeast.

Site Geology and Site Conditions

One geologic unit covers the property surface, the Cretaceous age Mancos Shale (see figure 3). The Mancos Shale is a thick, widespread carbonaceous marine shale with occasional sandstone and limestone interbeds. Bentonite beds of altered volcanic ash are also common in the Mancos Shale. Throughout the two offered parcels, the upper portion of the Mancos Shale is exposed, and consists of a dark gray to bluish gray fissile shale that is easily weathered and eroded into badland slope topography. Pelecypod fossils are known to be found in places where the bedrock is exposed, though no fossils were identified on the property. No bentonite beds were identified, though the soil overlying the Mancos Shale was found to have a "popcorn" texture in places, which is indicative of the presence of bentonite. The Mancos Shale is known to contain significant quantities of bentonite and other expansive clays. Exposures of the uppermost Mancos Shale are up to 100 feet thick on the property. The formation as a whole is as much as nearly 4,000 feet thick in the Grand Valley, and dips gently (~7°) to the northeast (see figure 3).

There were no major structural features noted on the property. No faults or folds were noted within or projected onto the property boundaries on the geologic map of the area, nor were faults or folds identified during the field survey. Fractures were infrequent where Mancos Shale bedrock was exposed. Vegetation on the property was generally sparse, and consisted of low, desert type shrubs and forbs. Photos one through six document site conditions during an onsite visit the morning of July 12, 2012.

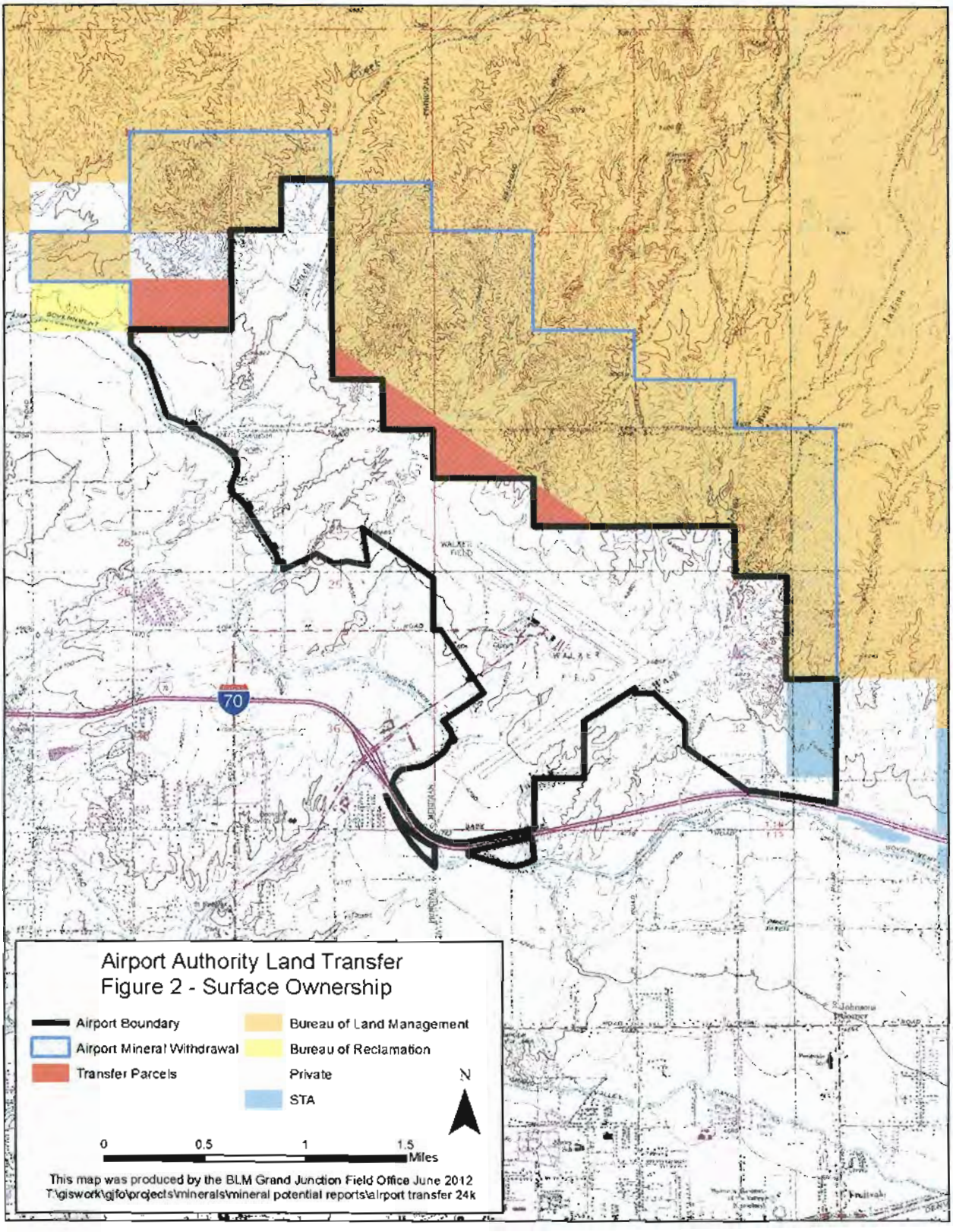


Figure 2. Surface Ownership

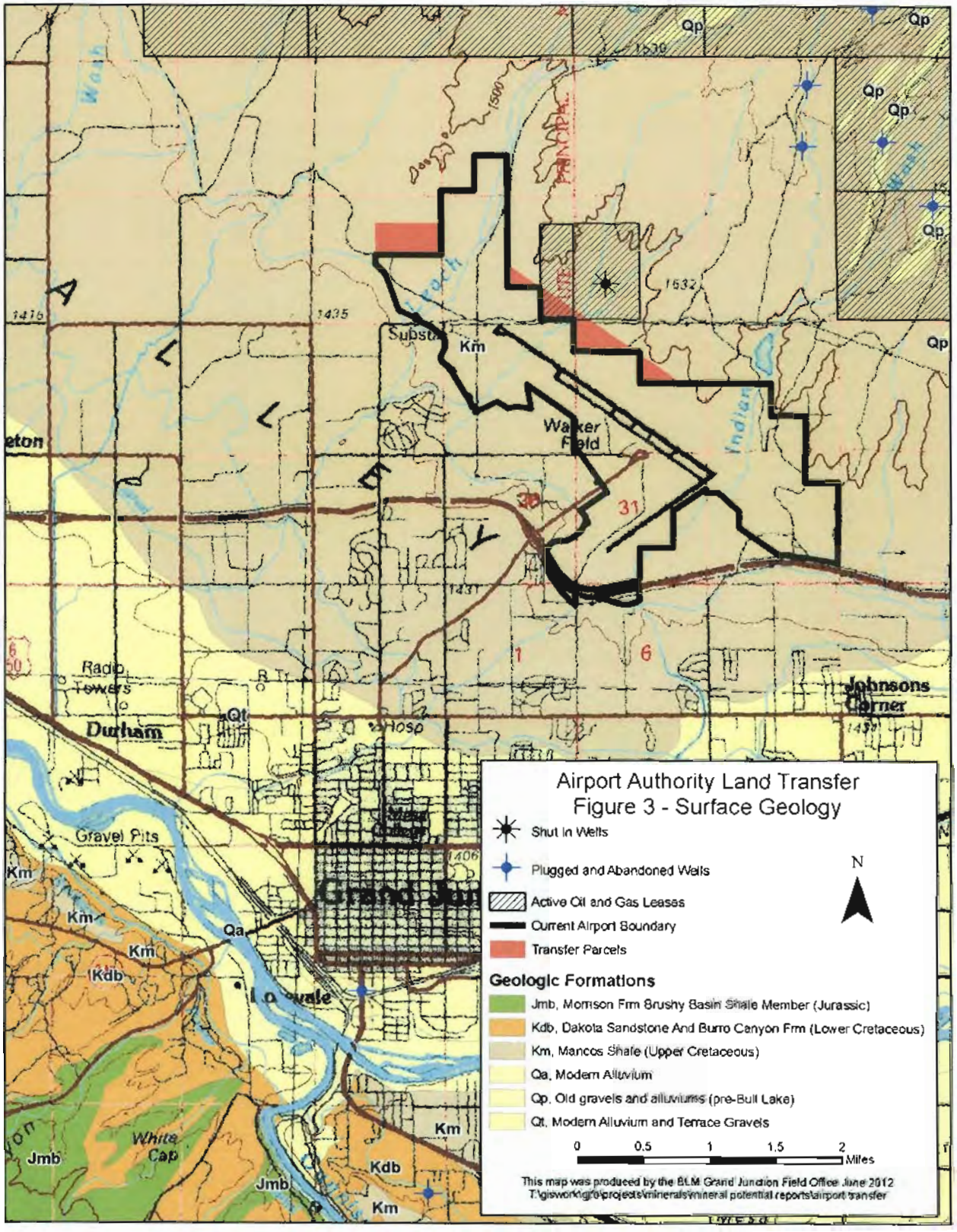


Figure 3. Surface Geology

Mineral History

Locatable minerals:

No valuable locatable minerals were found in the general area. A LR2000 land and minerals records search on June 20, 2012 revealed no active mining claims on the property. There was about a 50 acre inactive mining claim block in the eastern portion of the 110 acre parcel that had been located in the 1980's. This was most likely in response to a belief that gold could be extracted from the Mancos Shale. No gold production ever occurred in this region from the Mancos Shale. No mining permits have been issued in the area. Both of the parcels were withdrawn from mineral entry in January of 1994, but the withdrawal expires in January of 2014. In the region uranium and vanadium have been found in the sandstones of the Salt Wash Member of the Morrison Formation, which is not exposed on or around the property. Subsurface development of uranium from this unit is not considered likely due to the unit being located too deep (>3,000') beneath the property as to be economically viable.

Leasable Minerals

Oil and Gas:

A LR2000 energy records search on June 20, 2012 revealed two oil/gas leases on and adjacent to the 110 acre parcel (see figure 3). Some oil and gas activities near the Grand Valley produce from a sandstone unit within the Mancos Shale known as the "Mancos B Formation." The Mancos B is a natural gas-bearing, thinly interbedded and interlaminated very fine to fine-grained sandstone, siltstone, and claystone that is stratigraphically located within the middle part of the Mancos Shale and up to 1,220 feet thick (Hettinger and Kirschbaum, 2002). Minor oil deposits have been recovered from the Mancos B in the Douglas Creek Arch area of western Colorado and eastern Utah. The Mancos B is not exposed at the surface on the property, and its approximate depth from the top of the terraces is unknown, although it is likely less than 500 feet. Due to its proximity to the surface, which would not permit the generation of gas and would promote its migration, the likelihood of oil or natural gas development from the Mancos B on the property is considered possible, but not likely. It could be a stratigraphic trap target, however.

Approximately 15 miles east and southeast of Grand Junction, Fram Operating, LLC (Fram) has proposed a major five-year drilling program that would exploit gas resources that may be present within an area known as the Whitewater Unit. This drilling program is intending to recover natural gas primarily from the Dakota Sandstone, while also attempting to recover natural gas from the Morrison Formation and Entrada Sandstone at depths of up to 4,500 and 5,000 feet.

The oil and natural gas contained within the Dakota Sandstone, Morrison Formation, and Entrada Sandstone are constrained by stratigraphic, rather than structural traps. As such, there is the possibility that exploratory drilling within these units can migrate outside of the Whitewater Unit, as the deposits may have a more widespread distribution in the largely flat-lying reservoir rocks. This includes the potential for future drilling to take place within the subject property boundary, as these formations are present in the subsurface. Production from the Dakota Sandstone is limited, sporadic and irregular, however, and though it is possible that drilling could take place on the property in the future, it is not considered likely. In addition, potential oil and gas exploration and development from these units could be directionally drilled from outside the property boundary. No producing wells have been found in the near vicinity of the property.

Coal:

A LR2000 energy records search on June 20, 2012 revealed no coal leases on the property. Coal is not present near the surface in the general vicinity of the property. Coal and coalbed methane are exploited from the Mesaverde Group (Iles and Williams Fork Formations) in the surrounding area, but the Mesaverde Group is not present on the property.

Salable Minerals

Sand and Gravel:

No sand and gravel deposits exist on the property.

Decorative Stone and Moss rock:

No decorative stone or moss rock was found on the property.

Clay:

There is abundant clay, possibly some bentonitic clays, but the same types of clay can be found throughout the Grand Valley where the Mancos Shale is exposed. There is no record of clay production from these offered parcels.



Photo 1: Looking north at northeast corner of 80 acre BLM parcel.



Photo 2: Looking west at 80 acre BLM parcel.



Photo 3: Looking south from the middle of the 80 acre BLM parcel.



Photo 4: Looking east from the middle of the 80 acre BLM parcel.



Photo 5: Looking southeast from the northwest part of the 110 acre BLM parcel.



Photo 6: Looking northwest from southeast part of the 110 acre BLM parcel.

References

1. BLM GIS geology coverage June 20, 2012.

2. Hettinger, R.D. and Kirschbaum, M.A., 2002, Stratigraphy of the Upper Cretaceous Mancos Shale (Upper Part) and Mesaverde Group in the Southern Part of the Uinta and Piceance Basins, Utah and Colorado, USGS Geologic Investigations Series I-2764.

3. LR2000 Serial Register Pages Report for mining claims and oil and gas leases, June 20, 2012.

ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 10

PHASE I ENVIRONMENTAL SITE ASSESSMENT

PHASE I ENVIRONMENTAL SITE ASSESSMENT GRAND JUNCTION REGIONAL AIRPORT EXPANSION GRAND JUNCTION, COLORADO

August 31, 2012

Prepared for:

Mead and Hunt, Incorporated
1743 Wazee Street, Suite 400
Denver, CO 81505

Prepared by:

Walsh Environmental Scientists and Engineers, LLC

Table of Contents

Section **Page**

Executive Summary 1

1 Introduction 1-1

2 Site Description 2-1

2.1 Site Location and Description 2-1
2.2 Physical Setting 2-4
2.2.1 Topography 2-4
2.2.2 Regional and Site Geology 2-4
2.2.3 Hydrogeology 2-4

3 Historical Records Review 3-1

3.1 Aerial Photograph Review 3-1
3.2 Historic USGS Topographic Maps 3-2
3.3 Sanborn Fire Insurance Rate Maps 3-2
3.4 City Directories 3-3

4 Evironmental Records Radius Search 4-1

4.1.1 Comprehensive Environmental Response, Compensation, and Liability Act Sites 4-1
4.1.2 Resource Conservation and Recovery Act Sites 4-1
4.1.3 Emergency Response Notification System 4-2
4.1.4 Additional Federal Databases 4-2
4.2 State and Local Records 4-2
4.2.1 State and Tribal Equivalent NPL List 4-2
4.2.2 Solid Waste Disposal Facilities 4-3
4.2.3 Leaking Aboveground/Underground Storage Tanks 4-3
4.2.4 Aboveground Storage and Underground Storage Tanks 4-3
4.2.5 Additional State Databases 4-3

5 Site Inspection and Interviews 5-1

5.1 Site 5-1
5.2 Surrounding Properties 5-3
5.3 Interviews 5-3

Table of Contents (Cont.)

Section **Page**

5.3.1 Property Owner 5-3

6 Conclusions 6-1

7 Qualifications and Limitations 7-1

8 References 8-1

Appendix

A Environmental Records Search (EDR)

B Aerial Photograph Maps

C Photographs from Site Inspection

D Owner and End-User Questionnaires

E ESA Preparer's Qualifications

List of Tables and Figures

Tables **Page**

Table 2-1 Mesa County Assessor Information 2-1

Table 3-1. Review of Historical Aerial Photographs 3-1

Table 3-2. Review of Historical Topographic Maps 3-2

Table 4-1.2 RCRA Facilities in Site Vicinity 4-2

Table 4-2.3 LUST/TRUST/LAST in Site Vicinity 4-3

Figures **Page**

Figure 2.1 Site Overview Map 2-2

Figure 2.2 Site Location Map 2-3

List of Acronyms

ACM	Asbestos-Containing Material
ASTs	Aboveground Storage Tanks
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CES	Compressor Elements Services
CESQG	Conditionally Exempt Small-Quantity Generator
CORRACTS	Corrective Actions
EPA	Environmental Protection Agency
ERNS	Emergency Response Notification System
ESA	Environmental Site Assessment
FINDS	Facility Index System
GJRA	Grand Junction Regional Airport
GJRAA	Grand Junction Regional Airport Authority
IPA	Isopropyl Alcohol
LQGs	Large Quantity Generators
LUSTs	Leaking Underground Storage Tanks
MSDS	Material Safety Data Sheets
NFR	No Further Remediation
NFRAP	No Further Remedial Action Planned
NIOSH	National Institute of Safety and Health
NPL	National Priorities List
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
RCRA	Resource Conservation and Recovery Act
REC	Recognized Environmental Condition

SITE	Approximately 190 non-contiguous acres of land within portions of Mesa County Parcels 2701-113-00-914 and 2705-154-00-914 to the north and northeast of Grand Junction Regional Airport property in north Grand Junction, Colorado.
SVOCs	Semivolatile Organic Compounds
SQG	Small Quantity Generator
TSDF	Treatment, Storage, and Disposal Facilities
UST	Underground Storage Tank
VCUP	Voluntary Cleanup
VEC	Vapor Encroachment Condition
VOCs	Volatile Organic Compounds
WALSH	Walsh Environmental Scientists and Engineers, LLC

Executive Summary

This report presents the findings of a Phase I Environmental Site Assessment (ESA) conducted at the proposed Grand Junction Regional Airport Expansion of approximately 190 acres (Mesa County parcel numbers 2701-113-00-914 and 2705-154-00-914). Parcel number 2701-113-00-914 occupies the south half of the northeast quarter of Section 23, Township 1 north, Range 1 West of the Ute Principal Meridian. Parcel number 2705-154-00-914 occupies portions of the southeast quarter of Section 24, portions of the northwest and northeast quarters of Section 30, Township 1 north, Range 1 East of the Ute Principal Meridian. Walsh Environmental Scientists and Engineers, LLC (WALSH) conducted this ESA for Mead and Hunt, Incorporated on behalf of the Grand Junction Regional Airport Authority. WALSH has performed this Phase I ESA in conformance with the scope and limitations of ASTM Practice E 1527-05. The objective of this assessment is to provide information regarding the environmental condition of the Site prior to title transfer.

Prior Environmental Studies

There had been no previous Phase I ESA studies found that were completed for this Site. An Initial Assessment Report was prepared by the Bureau of Land Management's Grand Junction Field Office in December 2011. That assessment report was for approximately 721 acres, of which the Site was included. The initial assessment identified no recognized environmental conditions related to the area of interest except for *de minimus* conditions located to the north (up gradient) of the Site.

Data Gaps

The ASTM 2005 Standard requires that significant data gaps that affect the Environmental Professional's ability to identify recognized environmental conditions are reported. The Site is non-contiguous; however, the property in which it currently is situated is contiguous. Historical records were available for the Site going back to 1937. The largest gap in subsequent coverage is approximately 21 years (1973-1994). The Site appearance and use appears to remain vacant during all periods; therefore, no data gaps were identified that were considered to be inherently significant or would affect WALSH's ability to identify recognized environmental conditions related to the Site.

Recognized Environmental Conditions

This assessment has revealed no evidence of recognized environmental conditions in connection with the Site.

Non-Scope Considerations

Small piles of landscaping debris and trash are located throughout the west half of the Site. Visual inspection during the Site inspection did not reveal potentially hazardous materials in the debris piles. .

1 Introduction

This report presents the findings of a Phase I Environmental Site Assessment (ESA) conducted for undeveloped land located adjacent to the north of Grand Junction Regional Airport Authority (GJRAA) properties in Grand Junction, Colorado. The Mesa County Assessor's parcel numbers associated with this site are 2701-113-00-914 and 2705-154-00-914. Parcel number 2701-113-00-914 occupies the south half of the northeast quarter of Section 23, Township 1 north, Range 1 West of the Ute Principal Meridian. Parcel number 2705-154-00-914 occupies portions of the southeast quarter of Section 24, portions of the northwest and northeast quarters of Section 30, Township 1 north, Range 1 East of the Ute Principal Meridian. Walsh Environmental Scientists and Engineers, LLC (WALSH), an Ecology and Environment (E & E) company conducted this ESA for Mead and Hunt, Incorporated on behalf of the GJRAA. The objective of this assessment is to provide information regarding the environmental condition of the site prior to transaction.

The purpose of a Phase I ESA is to identify recognized environmental conditions (RECs) affecting the subject property in a real estate transaction. ASTM Standard E 1527-05 defines RECs as "the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, ground water, or surface water of the property." Recognized environmental conditions do not include *de minimis* conditions. ASTM Standard E 1527-05 defines *de minimis* conditions as "conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies."

This ESA consisted of a review of available local, county, state, and federal documents; examination of historical aerial photographs, topographic maps, city directories, and fire insurance maps; interviews; and a visual inspection of the site. It was conducted in accordance with American Society for Testing and Materials (ASTM) Standard E1527-05, *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process* (ASTM 2005).

2 Site Description

2.1 Site Location and Description

The Site consists of approximately 190 acres of non-contiguous undeveloped land located adjacent to GJRAA properties in Grand Junction, Colorado (Figures 1 and 2). The Mesa County Assessor's parcel numbers associated with the Site are 2701-113-00-914 and 2705-154-00-914. Parcel number 2701-113-00-914 occupies the south half of the northeast quarter of Section 23, Township 1 north, Range 1 West of the Ute Principal Meridian. Parcel number 2705-154-00-914 occupies portions of the southeast quarter of Section 24, portions of the northwest and northeast quarters of Section 30, Township 1 north, Range 1 East of the Ute Principal Meridian. A survey plat and legal description for the Site were not available at the time of this report.

This Site has been further divided in to five separate zones to clarify locations and descriptions. The compilation of Zones A through Zone E is depicted in Figure 2.2 of this report.

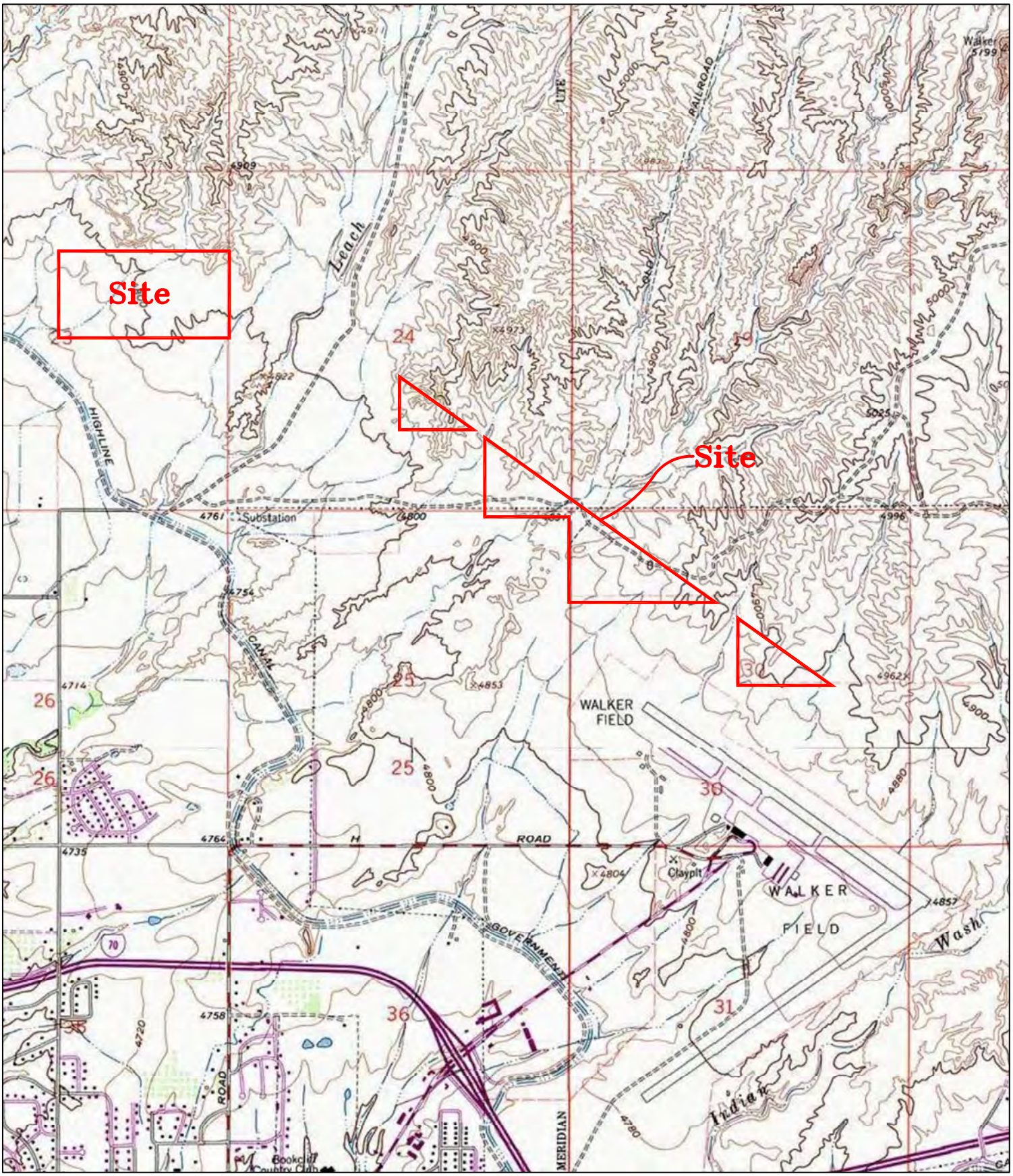
The Site consists of vacant undeveloped land. Additional observations made during the visual inspections of the Site are discussed in Sections 5.1 and 5.2 of this report.

The following information was obtained from the Mesa County Tax Assessor's office:

Table 2-1 Mesa County Assessor Information

Parcel Number	Property Address	Size (Acres)	Current Owners	Improvements, (Structures, Size, Date of Construction)
2701-113-00-914*	None Listed	113-Site* (7,676.3 Total)	Bureau of Land Management	None Listed
2705-154-00-914*	None Listed	76.8-Site* (17,815 Total)	Bureau of Land Management	None Listed

Note: * - The Site only occupies portions of these parcels.



Explanation

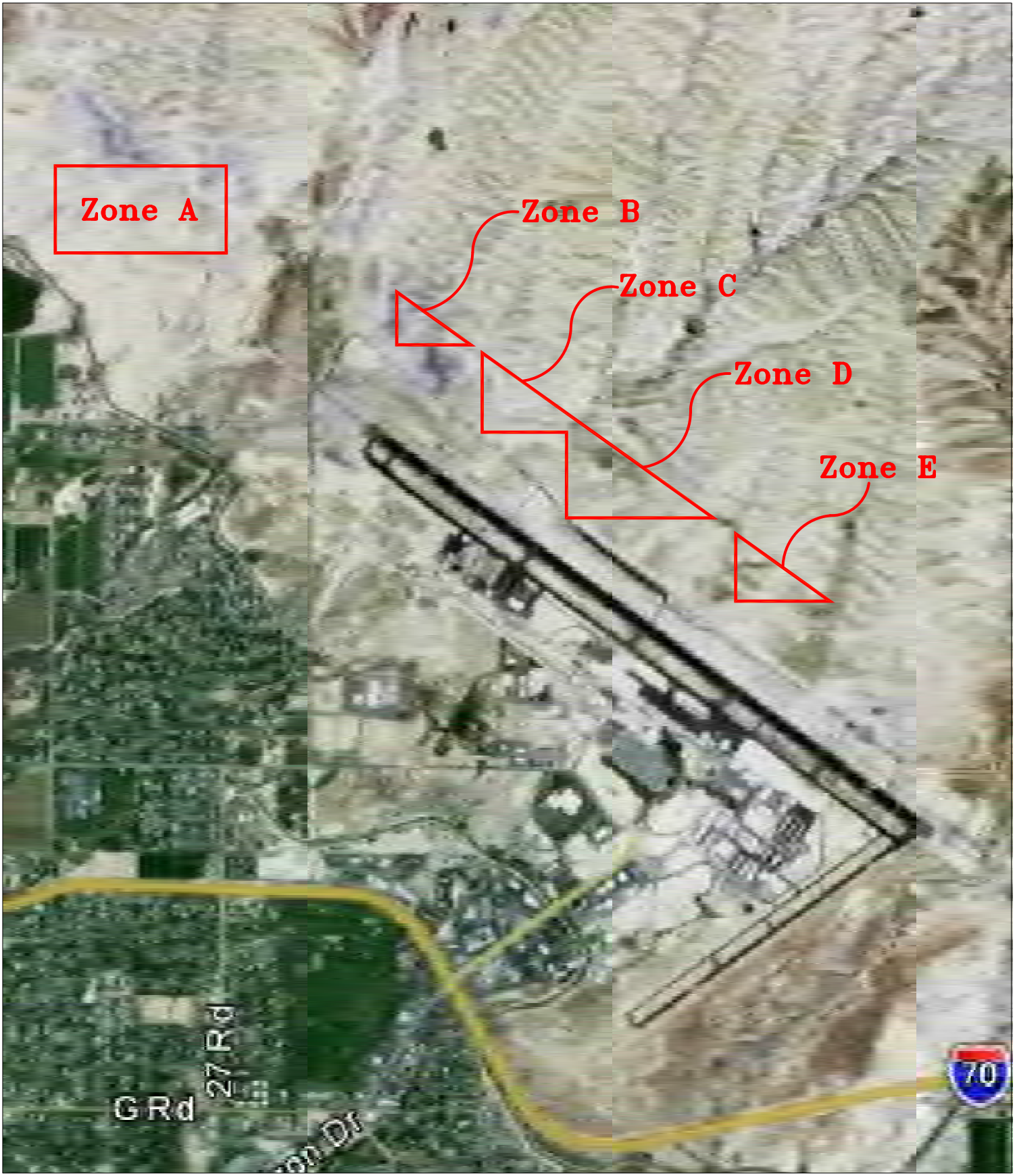
Map Source:
USGS Grand Junction, Colorado Quadrangle
7.5 Minute Series Topograhpic Maps
Printed 1962, Photorevised 1973

Walsh
Environmental Scientists and Engineers, LLC

Vicinity Map
Grand Junction Regional Airport
Grand Junction, Colorado

0 2000
Approximate Scale (Feet)

WA-001760-0001-10	Date 08/12	Figure 1



Explanation

Map Source:
Google Earth© 2011

Walsh
Environmental Scientists and Engineers, LLC

Aerial Map
Grand Junction Regional Airport
Grand Junction, Colorado

0 2000
Approximate Scale (Feet)

WA-001773-0001-10	Date 08/12	Figure 2

2.2 Physical Setting

2.2.1 Topography

The Site lies within the USGS Grand Junction and Corcoran Point, Colorado topographic quadrangles at an elevation of approximately 4,760 to 4,920 feet above mean sea level. The topography in the vicinity of the Site is moderately flat to hilly sloping generally to the southwest.

2.2.2 Regional and Site Geology

The Site is located within the Grand Valley geomorphic province. The Grand Valley is located north of the Uncompahgre Plateau and south of the Piceance Basin (Tweto, 1979). The Uncompahgre Plateau is an uplift of primarily Mesozoic sedimentary bedrock forming an anticline that plunges northward into the Grand Valley. The Piceance Basin is composed of relatively flat-lying Tertiary Uintah, Green River, and Wasatch Formations. These formations contain sandstones, siltstones, and shales including oil-bearing shales. Bedrock within the Grand Valley is predominantly the Cretaceous Mancos Shale, a dark-gray to black soft shale with intermittent thin sandstone beds. The upper portion of the Mancos shale grades into the cliff-forming Cretaceous Mount Garfield Formation and Sego Sandstone which grade into the Cretaceous Hunter Canyon Formation north of the Grand Valley (Cashion, 1973). The Mancos Shale overlies the Burro Canyon formation, composed of sandstone and conglomerate.

2.2.3 Hydrogeology

Stormwater travels via unnamed drainages which discharge to Leach Creek Wash to the west and Indian Wash to the east. These drainages eventually discharge into the Colorado River.

Groundwater in the vicinity, if present, is likely to flow perpendicularly to surface contours, or towards the southwest. Actual groundwater flow at the Site has not been determined in the study area, and is likely to vary depending on the season and other factors.

3 Historical Records Review

3.1 Aerial Photograph Review

Available historical aerial photographs were obtained from Mesa County GIS; findings are summarized in Table 3-1. The aerial photographs can be reviewed in Appendix B.

Table 3-1. Review of Historical Aerial Photographs

Year	Site	Surrounding Area
1937	The Site is shown as vacant.	Government Highline Canal is visible to the southwest of the site.
1954	No significant changes noted.	Minor development of agricultural land has occured to the southwest of the Site, north of Government Highline Canal. A water tank is visible north of Zone A.
1966	No significant changes noted.	Paved airport runway and small terminal structures are visible south of Zones D and E. A drainage ditch runs diagonally northwest to southeast; adjacent to the south of Zones C, D, and E along the runway. Agricultural land is visible to the southwest of site and to the north of Government Highline Canal near Zone A. A large detention pond is visible north of Zone E.
1994	No significant changes noted.	The Runway adjacent to the south was extended to the northwest. The airport terminal appears to have expanded to the south. The south portion of Bookcliff Landfill is visible approximately ¾ of a mile to the north of Zone B.
1997	Undeveloped roads visible throughout Zone A.	Small additions of the runway are visible between Zones A and B. A small commercial building is visible approximately ¼ mile south of Zone B. Residential structures are visible to the south of Zone Adjacent to the Government Highline Canal.
2001	No significant changes noted.	An additional commercial building is visible approximately ¼ mile to the south of Zone B. Residential structures are located west of Zone B on the south side of the Government Highline Canal.
2003	No significant changes noted.	Commercial building, roadways and paved parking lots were developed approximately ¼ mile to the south of Zone D and E. A small runway extends from the end of the runway to the southeast south of Zone E.

Table 3-1. Review of Historical Aerial Photographs

Year	Site	Surrounding Area
2005	No significant changes noted.	No significant changes noted.
2006	No significant changes noted.	Further development of commercial buildings, paved lots, and paved road-ways to the southwest of Zone B.
2007	No significant changes noted.	No significant changes noted.

Review of aerial photographs indicated the presence of the Bookcliff Landfill to the north of Zone B; however, it unlikely to have had any environmental impact to the Site due to its location, size, and distance from the Site.

3.2 Historic USGS Topographic Maps

USGS topographic maps held by WALSH and/or obtained from Environmental Database Resources (EDR) were reviewed. The Site is located within the Grand Junction and Corcoran Point, Colorado quadrangles. The quadrangles were originally printed in 1962 and the Grand Junction quadrangle was photo revised in 1973. Figure 1 uses these USGS maps for a base. The historic topographic maps are located in Appendix C and Table 3-2 summarizes the findings of the reviewed maps.

Table 3-2. Review of Historical Topographic Maps

Year	Site	Surrounding Area
1962	The Site is shown as vacant undeveloped land With some unimproved roads and overhead powerlines are visible crossing the Site from east to west near the south extent of Zone C. An old railroad grade is shown near the north end of Zone D.	The airport runway is shown to the southeast of the Site (south of Zones D and E). Undeveloped roads are located near the center of the Site extending outward to the north. An old railroad grade extends to the north from Zone D.
1973	No significant changes noted.	Horizon Drive is visible to the southwest of the Site. Various structures are visible to the south and west of the Site that appear to be associated with the airport.

Review of topographic maps did not indicate the presence of any structures or land uses on the Site or neighboring properties that are thought to have potentially impacted the environmental condition of the Site.

3.3 Sanborn Fire Insurance Rate Maps

Historic Sanborn Fire Insurance Maps were reviewed by EDR which reported that the regional Sanborn maps did not include coverage of the Site or surrounding area. Lack of coverage indicates that the area was not likely located within the historically developed limits of Grand Junction.

3.4 City Directories

There is no physical address associated with the Site. There is no city directory or listings related to the Site.

4 Environmental Records Radius Search

A search of pertinent agency environmental records was obtained from EDR. This search focused on records pertaining to properties lying within a one-mile radius of the site, depending on the database. A copy of the database report is included in Appendix A. Databases used standard ASTM search radii plus one half mile to account for the Site's larger size. The findings are summarized in the following sections.

4.1 Federal Records

4.1.1 Comprehensive Environmental Response, Compensation, and Liability Act Sites

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides a system for prioritizing existing areas of known contamination for remediation. The United States Environmental Protection Agency (EPA) ranks the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) sites according to risk, based on the Hazard Ranking System score. Higher risk sites are placed on the National Priorities List (NPL) and are then considered Superfund sites. Sites that are evaluated by the EPA and determined to require no further action are classified as No Further Remedial Action Planned (NFRAP).

There are no CERCLIS sites listed within the search radius of the Site.

4.1.2 Resource Conservation and Recovery Act Sites

The RCRA Hazardous Waste Notifiers List is an inventory of hazardous waste management facilities including generators, transporters, and treatment, storage, and disposal facilities (TSDFs). Hazardous waste generators are further classified as large quantity generators (LQGs), small quantity generators (SQGs), or conditionally exempt small quantity generators (CESQGs). LQGs generate more than 1,000 kilograms (2,205 pounds) of hazardous waste per month. SQGs generate 100 kilograms (220 pounds) to 1,000 kilograms per month, and conditionally exempt small quantity generators generate less than 100 kilograms of hazardous waste per month. Corrective Actions (CORRACTS) sites are RCRA-regulated sites

where releases have occurred and have had agency-mandated investigation and/or clean-ups implemented.

RCRA-regulated sites identified in the Site vicinity are as follows:

Table 4-1.2 RCRA Facilities in Site Vicinity

EDR ID#	Database	Facility Name Address	Distance/ Direction From Site (miles)	Comments
E27	CORRACTS LQG	West Star Aviation, Inc. 796 Heritage Way	0.862/SSE	D002 – pH<2 D006 – Cadmium D007 – Chromium D008 – Lead
B11	SQG	Twin Otter Airborne Research 2780 Landing View Lane	0.424/S	D002 – pH<2 D018 – Benzene D039 – Tetrachloroethylene

Based on the distance and down-gradient position, these facilities are not expected to pose an environmental risk for the Site.

4.1.3 Emergency Response Notification System

Spill reports received by the EPA regarding hazardous materials incidents are maintained in an on-line database called the Emergency Response Notification System (ERNS). When a reportable quantity of a hazardous substance is released, the National Response Center must be notified within 24 hours, and these reports are also included in ERNS. The search distance for this database is the target property. WALSH searched the ERNS database for incidents that may have occurred at the Site.

No incidents have been recorded at the site.

4.1.4 Additional Federal Databases

Additional Federal databases not required by ASTM were queried for the regulatory database report. See the EDR report in Appendix A for a complete list and discussion of these sources.

4.2 State and Local Records

4.2.1 State and Tribal Equivalent NPL List

Colorado State does not have a list that is equivalent to the Federal NPL list. However, CDPHE maintains a list of sites that have undergone or are currently undergoing a Voluntary Cleanup (VCUP).

There are no VCUP sites listed within one half mile of the Site.

4.2.2 Solid Waste Disposal Facilities

State and county databases were reviewed for landfills, transfer stations, and other solid waste handling facilities. Bookcliff Landfill was not locatable on EDR provided records. See section 4.2.5

4.2.3 Leaking Aboveground/Underground Storage Tanks

The Leaking Underground/Aboveground Storage Tank (LUST/LAST) database contains records of storage tank incidents. The data comes from the Colorado Division of Oil and Public Safety.

Table 4-2.3 LUST/TRUST/LAST in Site Vicinity

#	Database	Facility Name, Address	Distance/Direction From Site (miles)	Comments
sadfB13	LAST	Timberline Aviation, LLC 2780 Landing View Lane	0.424/S	Event ID: 3099 Status: Closed Date: 12/13/2004

Based on the topographic gradient, distance and the closed status of this facility, it is not expected to pose an environmental risk to the Site.

4.2.4 Aboveground Storage and Underground Storage Tanks

Registered aboveground storage tank (AST) and underground storage tank (UST) information was obtained from EDR. USTs are regulated under Subtitle 1 of RCRA. The database was searched for registered ASTs and USTs within one mile of the Site. No registered AST's or UST's where found on this Site or adjoining properties at this time.

4.2.5 Additional State Databases

Additional state databases not required by ASTM were queried for the regulatory database report. See the EDR report in Appendix A for a complete list and discussion of these sources.

CDPHE records were searched for active and closed landfill locations within one mile. One historic landfill was identified in this list; it is the "Bookcliff Landfill" located approximately one-half mile north of the Site (Zone B). This landfill is listed as being between 10 and 50 acres with an unknown hazard and identified as being closed. The Site inspection with Mr. Kraus also confirmed the location of the Bookcliff Landfill (see Section 5).

5 Site Inspection and Interviews

5.1 Site

WALSH performed a visual inspection of the Site on August 13, 2012. Photographs taken during the Site inspection are included in Appendix D. The Site was inspected by vehicle and on foot. The weather conditions were mild (cloudy skies, moderate temperature, and a breeze) during the inspection. The Site was bound on the south along the boundary of GJRAA properties by a barbwire fence. Survey markers were found at all of the Site's corners.

Zone A is located in the northwest portion of the Site and west of 27 ¼ Road. This portion of the Site is comprised of 80 acres of relatively flat native ground that slopes moderately to the southwest. Signs of mud-flow are present in the southwest interior portion of Zone A. Overhead power lines run northwest to southeast through the south-central part of Zone A. No associated transformers were identified on these overhead lines. Various unmaintained roads run throughout Zone A.

Zone B is located north of the GJRA's northwest runway and east of 27 ¼ Road. This portion of the Site is hilly with drainage being to the west, south, and east via unnamed drainages. Many unimproved roads cross the Site. Landscaping debris and pieces of scrap metal are located near the north end of Zone B.

Zone C is located near the central portion of the Site. This portion of the Site consists of moderately hilly terrain that predominantly drains to the west and south. Several unimproved roads are located along the northeast boundary of this Zone.

Zone D is located in the east-central portion of the Site and is crossed by a deep ravine in its northwest corner. An old railroad grade is visible approximately 100 feet east of the ravine. Unimproved roads in this Zone are primarily limited to the northwest corner and the north and south boundaries.

Zone E is located on the southeast end of the Site. This portion of the Site is relatively unused except for unimproved roads near the north and south boundaries of the Site.

Utilities at the Site are limited to overhead lines along the south-central property boundary of Zone A. No indications of buried utilities were identified during the inspection.

The visual inspection did not reveal evidence of any improper hazardous substance or petroleum product use or disposal on the Site. No fill pipes, and no pits, ponds, or lagoons associated with waste treatment were observed on the Site. No significantly stained or discolored soil or unusual odors were noted during the inspection of the Site. Although there were small piles of dumped debris and trash throughout much of the Site, none of it would be expected to require regulated cleanup efforts or to contain hazardous materials or waste.

5.2 Surrounding Properties

The Site is located in a largely undeveloped area with GJRAA-owned properties located adjacent to the south of the Site. All land located adjacent to the north and northwest of the Site are undeveloped lands belonging to the BLM.

5.3 Interviews

5.3.1 Property Owner

An ASTM-type questionnaire was completed by Mr. Alan Kraus, Hazardous Material Program Coordinator for the Bureau of Land Management (BLM) Grand Junction Field Office. He was also interviewed during the Site inspection on August 13, 2012. A copy of the completed questionnaire is included in Appendix E of this report. This questionnaire was submitted in order to obtain information about current and historic activities at the Site. According to Mr. Kraus, he has managed the hazardous materials for the BLM for the Grand Junction Field office for over 20years. He indicated the Site has not seen any development. Mr. Kraus did point out that an abandoned motor was cleaned up and a small oil leak occurred north and up gradient of Zone C. Additionally Mr. Kraus identified the Little Bookcliff Railroad grade in Zone D, and the location of the Bookcliff Landfill north of Zone B. Mr. Kraus stated that the landfill had caught fire several years ago through a crack in its soil cap, but that it was put out by the Grand Junction Fire Department and re-capped with local clay-containing soil. He was unaware of the origin of the fire.

To the best of Mr. Kraus's knowledge, the Site has not been used for industrial purposes, and he has no knowledge of environmental concerns associated with the Site. Additionally, Mr. Kraus conducted an individual Initial Assessment Report for the transfer (disposal) of Bureau of Land Management administrated land concluding that, "The Initial Assessment has not revealed any evidence of hazardous substances, petroleum products, or Recognized Environmental Conditions" on the Site.

5.3.2 End User

Ms. Amy Jordan, representing Grand Junction Regional Airport, answered questions related to previous environmental investigations and assessments conducted at the Site. Ms. Jordan was unaware of any documents or environmental concerns associated with the Site, and she has not performed a search of environmental liens against the Site.

6 Conclusions

This report presents the findings of a Phase I Environmental Site Assessment (ESA) conducted at the proposed Grand Junction Regional Airport Expansion of approximately 190 acres (Mesa County parcel numbers 2701-113-00-914 and 2705-154-00-914). Parcel number 2701-113-00-914 occupies the south half of the northeast quarter of Section 23, Township 1 north, Range 1 West of the Ute Principal Meridian. Parcel number 2705-154-00-914 occupies portions of the southeast quarter of Section 24, portions of the northwest and northeast quarters of Section 30, Township 1 north, Range 1 East of the Ute Principal Meridian. Walsh Environmental Scientists and Engineers, LLC (WALSH) conducted this ESA for Mead and Hunt, Incorporated on behalf of the Grand Junction Regional Airport Authority. WALSH has performed this Phase I ESA in conformance with the scope and limitations of ASTM Practice E 1527-05. The objective of this assessment is to provide information regarding the environmental condition of the Site prior to title transfer.

Prior Environmental Studies

There had been no previous Phase I ESA studies found that were completed for this Site. An Initial Assessment Report was prepared by the Bureau of Land Management's Grand Junction Field Office in December 2011. That assessment report was for approximately 721 acres, of which the Site was included. The initial assessment identified no recognized environmental conditions related to the area of interest except for *de minimus* conditions located to the north (up gradient) of the Site.

Data Gaps

The ASTM 2005 Standard requires that significant data gaps that affect the Environmental Professional's ability to identify recognized environmental conditions are reported. The Site is non-contiguous; however, the property in which it currently is situated is contiguous. Historical records were available for the Site going back to 1937. The largest gap in subsequent coverage is approximately 21 years (1973-1994). The Site appearance and use appears to remain vacant during all periods; therefore, no data gaps were identified that were considered to be inherently significant or would affect WALSH's ability to identify recognized environmental conditions related to the Site.

Recognized Environmental Conditions

This assessment has revealed no evidence of recognized environmental conditions in connection with the Site.

Non-Scope Considerations

Small piles of landscaping debris and trash are located throughout the west half of the Site. Visual inspection during the Site inspection did not reveal potentially hazardous materials in the debris piles.

7 Qualifications and Limitations

I declare that, to the best of my professional knowledge and belief, I meet the definition of Environmental Professional as defined in Section 312.10 of 40 CFR 312 and we have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject property. I have developed and performed all the appropriate inquiries in conformance with the standards and practices set forth in 40 CFR Part 312.

WALSH conducted this Phase I ESA in accordance with the guidelines set forth by ASTM. The qualifications of the personnel preparing this assessment are included in Appendix F. The sources of information obtained to perform this assessment include documents, oral statements, and other information from parties outside of Walsh's control. WALSH cannot guarantee the accuracy of the information.

WALSH's conclusions for this Phase I ESA are based on information provided by available public records, discussions with selected individuals associated with the Site and government agencies, and the general site conditions determined by a visual inspection. Environmental legislation passed in the 1970s and 1980s initiated the current practice of maintaining environmental records and facility inspection reports. Prior to the 1970s, activities may have adversely impacted the area without having been documented by government agencies. However, there is also no guarantee that the current record-keeping requirements are adhered to by all facilities.

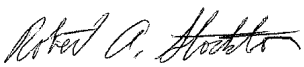
This assessment was limited and it did **not** include:

- Evaluation on non-scope issues as defined in ASTM E1527-05 including asbestos-containing building materials; radon; lead-based paint; lead in drinking water; wetlands; regulatory compliance; asbestos in soil; cultural and historic resources; industrial hygiene; health and safety; ecological resources; endangered species; indoor air quality; biological agents; mold; and vapor intrusion.
- Collection, testing, or chemical analysis of any samples of soil, groundwater, surface water, wastewater, building materials or other material that

was or could have been on-site, except those specifically mentioned in this report.

- Interviews, except as specifically noted in this report, with past owners, tenants, employees, neighboring landowners or Government agencies regarding past site use, waste generation and disposal practices (including disposal at remote sites), or manufacturing processes that may have contributed to environmental contamination at the Site.
- Evaluation of the potential risks associated with identified concerns from records searches with incomplete addresses location listings, or sites where no records were available for review.

If additional information concerning the Site environmental conditions becomes available, the conclusions presented in this report will not be considered valid unless this information is reviewed and the conclusions and recommendations of this report are modified and approved in writing by WALSH. It is possible that additional reports or investigations could alter the conclusions of this assessment. This report was prepared for the use of our client(s) and authorized agents only.

Prepared by: 

Robert A. Stockton, Environmental Professional

8 References

American Society for Testing and Materials (ASTM). 2005. *Standard Practice for ESAs: Phase I ESA Process.* Designation: E 1527-05.

EDR. 2012. EDR Historical Topographic Map Report. *Walker Field Expansion, Grand Junction, CO, 81506.*

EDR. 2012. The EDR-City Directory Image Report. *Walker Field Expansion, Grand Junction, CO, 81506.*

EDR. 2012. The EDR Radius Map™ Report with GeoCheck®. *Walker Field Expansion, Grand Junction, CO, 81506.*

Cashion, W. B. 1973. *Geologic and Structure Map of the Grand Junction Quadrangle, Colorado and Utah.* U.S. Geological Survey Map I-736.

Lohman, S. W. 1963. *Geologic Map of the Grand Junction Area, Colorado.* Miscellaneous Investigations Map I-404, U.S. Geological Survey.

Mesa County Tax Assessor's Website, 2012, http://www.imap.mesacounty.us/assessor_lookup/

City of Grand Junction Website, 2012, *arcgisfs.ci.grandjct.co.us/gis_map_external/index.html?map=citymap*

Tweto, Ogden. 1979. *Geologic Map of Colorado.*

U. S. Geological Society. 1973. *Grand Junction, Colorado Quadrangle.*

U. S. Natural Resource Conservation Service. 2006. *Soil Survey of the Grand Junction Area, Colorado.* http://www.soils.usda.gov/survey/

Whitney, J. W. 1981. *Surficial Geologic Map of the Grand Junction 1^0 X 2^0 Quadrangle, Colorado and Utah.* U.S. Geological Survey Map I-1289.

A Environmental Records Search (EDR Radius Report

Walker Field Expansion
2828 Walker Field Drive
Grand Junction, CO 81506

Inquiry Number: 3365127.2s
July 11, 2012

EDR Summary Radius Map Report

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

SECTION	PAGE
Executive Summary	ES1
Overview Map	2
Detail Map	3
Map Findings Summary	4
Map Findings	7
Orphan Summary	55
Government Records Searched/Data Currency Tracking	GR-1

GEOCHECK ADDENDUM

Physical Setting Source Addendum	A-1
Physical Setting Source Summary	A-2
Physical Setting Source Map	A-7
Physical Setting Source Map Findings	A-8
Physical Setting Source Records Searched	A-10

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, Inc. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. **NO WARRANTY EXPRESSED OR IMPLIED, IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, INC. SPECIFICALLY DISCLAIMS THE MAKING OF ANY SUCH WARRANTIES, INCLUDING WITHOUT LIMITATION, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, INC. BE LIABLE TO ANYONE, WHETHER ARISING OUT OF ERRORS OR OMISSIONS, NEGLIGENCE, ACCIDENT OR ANY OTHER CAUSE, FOR ANY LOSS OF DAMAGE, INCLUDING, WITHOUT LIMITATION, SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES. ANY LIABILITY ON THE PART OF ENVIRONMENTAL DATA RESOURCES, INC. IS STRICTLY LIMITED TO A REFUND OF THE AMOUNT PAID FOR THIS REPORT.** Purchaser accepts this Report "AS IS". Any analyses, estimates, ratings, environmental risk levels or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only a Phase I Environmental Site Assessment performed by an environmental professional can provide information regarding the environmental risk for any property. Additionally, the information provided in this Report is not to be construed as legal advice.

Copyright 2012 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, Inc. or its affiliates. All other trademarks used herein are the property of their respective owners.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-05) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

2828 WALKER FIELD DRIVE
GRAND JUNCTION, CO 81506

COORDINATES

Latitude (North):	39.1359000 - 39° 8' 9.24''
Longitude (West):	108.5347000 - 108° 32' 4.92''
Universal Tranverse Mercator:	Zone 12
UTM X (Meters):	713084.7
UTM Y (Meters):	4334544.0
Elevation:	4833 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property:	TP
Source:	USGS 7.5 min quad index

AERIAL PHOTOGRAPHY IN THIS REPORT

Photo Year:	2009
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
2828 WALKER FIELD DRIVE
GRAND JUNCTION, CO 81506

Click on Map ID to see full detail.

MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft.) DIRECTION
A1	GRAND JUNCTION REGIO	2828 WALKER FIELD DR	AST		TP
A2	HALCO PATCHING & SEA	2828 WALKER FIELD DR	FINDS		TP
A3	WEST STAR AVIATION I	2828 WALKER FIELD DR	UST		TP
A4	TSA-GRAND JUNCTION-W	2828 WALKER FIELD DR	RCRA-CESQG		TP
A5	BUDGET RENT A CAR	2828 WALKER FIELD DR	LUST		TP
A6	TSA-GRAND JUNCTION-W	2828 WALKER FIELD DR	FINDS		TP
B7	GRAND JUNCTION AIR C	2774 LANDING VIEW LN	RCRA-NonGen, FINDS	Lower	2150, South
B8		2774 LANDING VIEW LA	CO ERNS	Lower	2150, South
B9		2780 LANDING VIEW LA	HMIRS	Lower	2239, South
B10	TIMBERLINE AVIATION	2780 LANDING VIEW LN	AST	Lower	2239, South
B11	TWIN OTTER AIRBORNE	2780 LANDING VIEW LN	RCRA-SQG, FINDS	Lower	2239, South
B12	TIMBERLINE AVIATION	2780 LANDING VIEW LA	FINDS	Lower	2239, South
B13	TIMBERLINE AVIATION	2780 LANDING VIEW LN	LAST	Lower	2239, South
B14		2780 LANDING VIEW LA	ERNS	Lower	2239, South
C15	WEST STAR FUEL FARM	2800 LANDING VIEW LN	AST	Lower	2676, South
C16	WEST STAR FUEL FARM	2800 LANDING VIEW LN	LAST	Lower	2676, South
C17	MESA AIRLINES	2810 LANDING VIEW LN	RCRA-CESQG	Lower	2824, South
C18	HERTZ SERVICE CTR	2812 LANDING VIEW LN	AST	Lower	2849, South
C19	RETRIEVER AIR FREIGH	2814 LANDING VIEW LN	AST	Lower	2875, South
D20	GRAND JUNCTION FSS	GRAND JUNCTION AIRPO	UST	Higher	3186, SSE
D21	US FAA GRAND JUNCTIO	OLD TERMINAL BLDG WA	RCRA-NonGen, FINDS	Higher	3187, SSE
D22	CONTINENTAL GRAND JU	WALKER FIELD	RCRA-NonGen, FINDS	Higher	3187, SSE
23	DANA MOTORS	WALKER FIELD	AST	Higher	3317, SSE
24	SCHWANS HOME SERVICE	838 NORTH CREST DR	AST	Lower	3734, South
25	3D SYSTEMS - GRAND J	805 FALCON WAY	RCRA-CESQG, FINDS	Lower	3903, South
E26	WEST STAR AVIATION I	796 HERITAGE WAY	LUST TRUST, LAST, CO ERNS, AIRS	Lower	4550, SSE
E27	WEST STAR AVIATION I	796 HERITAGE WAY	CORRACTS, RCRA-LQG, FINDS, LUST	Lower	4550, SSE

EXECUTIVE SUMMARY

TARGET PROPERTY SEARCH RESULTS

The target property was identified in the following records. For more information on this property see page 7 of the attached EDR Radius Map report:

Site	Database(s)	EPA ID
GRAND JUNCTION REGIO 2828 WALKER FIELD DR GRAND JUNCTION, CO 81506	AST	N/A
HALCO PATCHING & SEA 2828 WALKER FIELD DR GRAND JUNCTION, CO 81506	FINDS	N/A
WEST STAR AVIATION I 2828 WALKER FIELD DR GRAND JUNCTION, CO 81506	UST	N/A
TSA-GRAND JUNCTION-W 2828 WALKER FIELD DR GRAND JUNCTION, CO 81506	RCRA-CESQG	COR000208884
BUDGET RENT A CAR 2828 WALKER FIELD DR GRAND JUNCTION, CO 81503	LUST Status: Closed Status: Closed	N/A
TSA-GRAND JUNCTION-W 2828 WALKER FIELD DR GRAND JUNCTION, CO 81506	FINDS	N/A

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified in the following databases.

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

STANDARD ENVIRONMENTAL RECORDS

Federal RCRA CORRACTS facilities list

CORRACTS: A review of the CORRACTS list, as provided by EDR, and dated 08/19/2011 has revealed that there is 1 CORRACTS site within approximately 1.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
WEST STAR AVIATION I	***796 HERITAGE WAY***	***SSE 1/2 - 1 (0.862 mi.)***	***E27***	***11***

Federal RCRA generators list

RCRA-SQG: A review of the RCRA-SQG list, as provided by EDR, and dated 03/15/2012 has revealed that there is 1 RCRA-SQG site within approximately 0.75 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
TWIN OTTER AIRBORNE	***2780 LANDING VIEW LN***	***S 1/4 - 1/2 (0.424 mi.)***	***B11***	***8***

RCRA-CESQG: A review of the RCRA-CESQG list, as provided by EDR, and dated 03/15/2012 has revealed that there are 2 RCRA-CESQG sites within approximately 0.75 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
MESA AIRLINES	2810 LANDING VIEW LN	S 1/2 - 1 (0.535 mi.)	C17	9
3D SYSTEMS - GRAND J	***805 FALCON WAY***	***S 1/2 - 1 (0.739 mi.)***	***25***	***11***

Federal ERNS list

ERNS: A review of the ERNS list, as provided by EDR, and dated 04/02/2012 has revealed that there is 1 ERNS site within approximately 0.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
Not reported	2780 LANDING VIEW LA	S 1/4 - 1/2 (0.424 mi.)	B14	9

State and tribal leaking storage tank lists

LUST: A review of the LUST list, as provided by EDR, and dated 03/27/2012 has revealed that there is 1 LUST site within approximately 1 mile of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
WEST STAR AVIATION I	***796 HERITAGE WAY***	***SSE 1/2 - 1 (0.862 mi.)***	***E27***	***11***
Status: Closed				

EXECUTIVE SUMMARY

LUST TRUST: A review of the LUST TRUST list, as provided by EDR, and dated 03/19/2012 has revealed that there is 1 LUST TRUST site within approximately 1 mile of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
WEST STAR AVIATION I	***796 HERITAGE WAY***	***SSE 1/2 - 1 (0.862 mi.)***	***E26***	***11***

LAST: A review of the LAST list, as provided by EDR, and dated 03/27/2012 has revealed that there are 3 LAST sites within approximately 1 mile of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
TIMBERLINE AVIATION	2780 LANDING VIEW LN	S 1/4 - 1/2 (0.424 mi.)	B13	9
WEST STAR FUEL FARM	2800 LANDING VIEW LN	S 1/2 - 1 (0.507 mi.)	C16	9
WEST STAR AVIATION I	***796 HERITAGE WAY***	***SSE 1/2 - 1 (0.862 mi.)***	***E26***	***11***

State and tribal registered storage tank lists

UST: A review of the UST list, as provided by EDR, and dated 03/27/2012 has revealed that there is 1 UST site within approximately 0.75 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
GRAND JUNCTION FSS	GRAND JUNCTION AIRPO	SSE 1/2 - 1 (0.603 mi.)	D20	10

AST: A review of the AST list, as provided by EDR, and dated 03/27/2012 has revealed that there are 6 AST sites within approximately 0.75 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
DANA MOTORS	WALKER FIELD	SSE 1/2 - 1 (0.628 mi.)	23	10

Lower Elevation	Address	Direction / Distance	Map ID	Page
TIMBERLINE AVIATION	2780 LANDING VIEW LN	S 1/4 - 1/2 (0.424 mi.)	B10	8
WEST STAR FUEL FARM	2800 LANDING VIEW LN	S 1/2 - 1 (0.507 mi.)	C15	9
HERTZ SERVICE CTR	2812 LANDING VIEW LN	S 1/2 - 1 (0.540 mi.)	C18	10
RETRIEVER AIR FREIGH	2814 LANDING VIEW LN	S 1/2 - 1 (0.545 mi.)	C19	10
SCHWANS HOME SERVICE	838 NORTH CREST DR	S 1/2 - 1 (0.707 mi.)	24	11

ADDITIONAL ENVIRONMENTAL RECORDS

Records of Emergency Release Reports

HMIRS: A review of the HMIRS list, as provided by EDR, and dated 04/01/2012 has revealed that there

is 1 HMIRS site within approximately 0.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
Not reported	2780 LANDING VIEW LA	S 1/4 - 1/2 (0.424 mi.)	B9	8

CO ERNS: A review of the CO ERNS list, as provided by EDR, and dated 04/09/2012 has revealed that there is 1 CO ERNS site within approximately 0.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
Not reported	2774 LANDING VIEW LA	S 1/4 - 1/2 (0.407 mi.)	B8	8

Other Ascertainable Records

RCRA-NonGen: A review of the RCRA-NonGen list, as provided by EDR, and dated 03/15/2012 has revealed that there are 3 RCRA-NonGen sites within approximately 0.75 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
US FAA GRAND JUNCTIO	***OLD TERMINAL BLDG WA***	***SSE 1/2 - 1 (0.604 mi.)***	***D21***	***10***
CONTINENTAL GRAND JU	***WALKER FIELD***	***SSE 1/2 - 1 (0.604 mi.)***	***D22***	***10***

Lower Elevation	Address	Direction / Distance	Map ID	Page
GRAND JUNCTION AIR C	***2774 LANDING VIEW LN***	***S 1/4 - 1/2 (0.407 mi.)***	***B7***	***8***

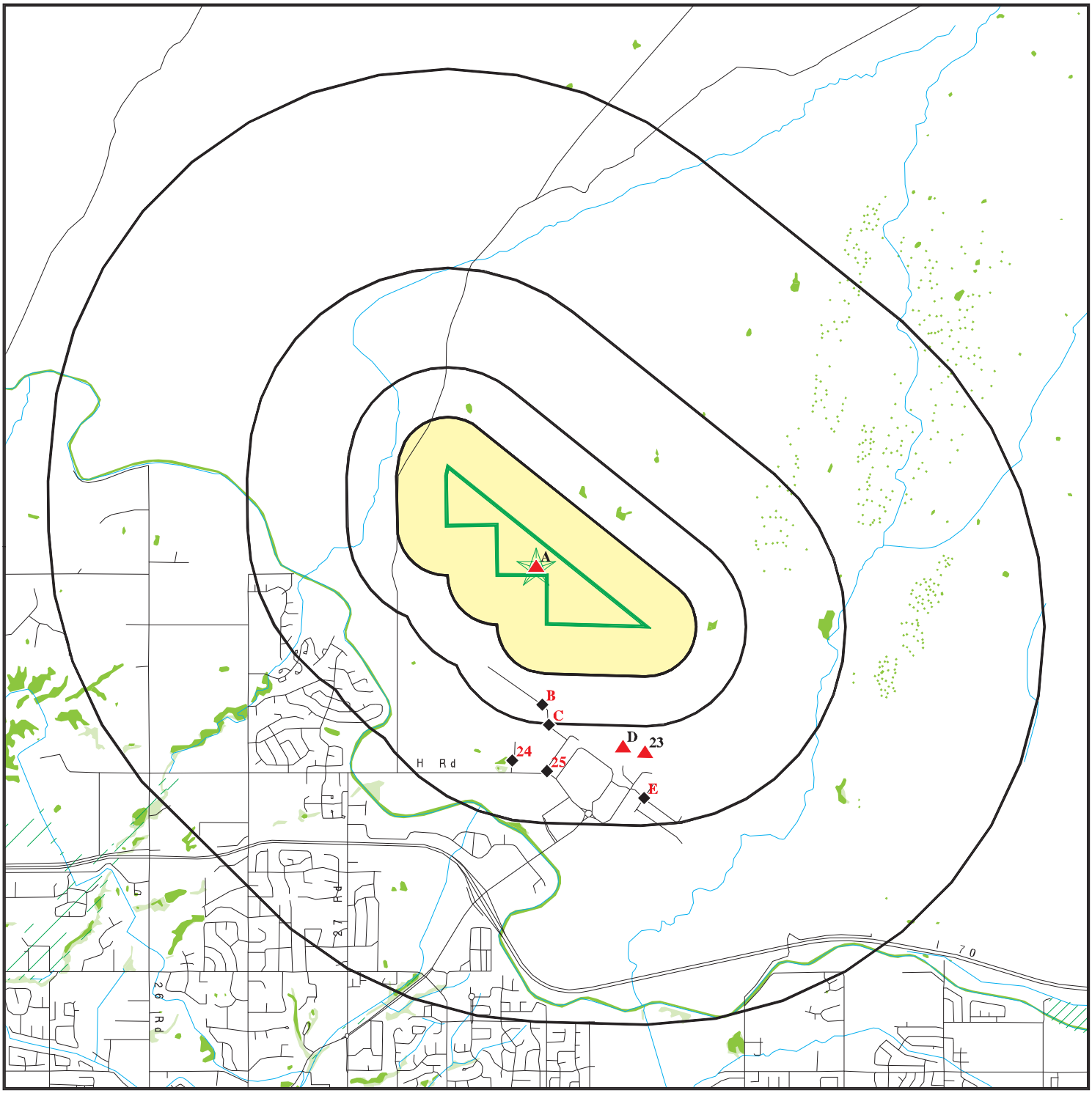
FINDS: A review of the FINDS list, as provided by EDR, and dated 10/23/2011 has revealed that there are 3 FINDS sites within approximately 0.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
GRAND JUNCTION AIR C	***2774 LANDING VIEW LN***	***S 1/4 - 1/2 (0.407 mi.)***	***B7***	***8***
TWIN OTTER AIRBORNE	***2780 LANDING VIEW LN***	***S 1/4 - 1/2 (0.424 mi.)***	***B11***	***8***
TIMBERLINE AVIATION	2780 LANDING VIEW LA	S 1/4 - 1/2 (0.424 mi.)	B12	9

Count: 12 records. ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
GRAND JUNCTION	S104300913		2222ND & HWY 6		LUST TRUST, LAST, CO ERNS, AIRS
GRAND JUNCTION	S111433717		2475TH & HWY 6		ASBESTOS
GRAND JUNCTION	S107764041		2508TH & HWY 6		ASBESTOS
GRAND JUNCTION	S111321249		2589TH & HWY 6		ASBESTOS
GRAND JUNCTION	S108670732		2659 HWY 50		ASBESTOS
GRAND JUNCTION	1012056331	730 HIGHWAY 50 104	730 HIGHWAY 50 104		US CDL
GRAND JUNCTION	S111704894		12 ST AND BOOKCLIFF DR		CO ERNS, NPDES
GRAND JUNCTION	S108127987	WEST STAR AVIATION - WALKER FIELD	2870 AVIATION WAY	81506	AIRS
GRAND JUNCTION	1014683522	WEST STAR AVIATION - WALKER FIELD	2870 AVIATION WAY	81506	FINDS
GRAND JUNCTION	S110293160	PARKWAY SANITARY SEWER INTERCEPTOR	RIVERSIDE PKWY BTWN HWY 50TH &		NPDES
GRAND JUNCTION	S110492728		640 S USHY 50		ASBESTOS
GRAND JUNCTION	1014680747	WEST STAR AVIATION INC - WALKER FI	807 WALKER FLD	81506	FINDS

OVERVIEW MAP - 3365127.2s



Target Property

Sites at elevations higher than or equal to the target property

Sites at elevations lower than the target property

Manufactured Gas Plants

National Priority List Sites

Dept. Defense Sites

Indian Reservations BIA

Oil & Gas pipelines from USGS

100-year flood zone

500-year flood zone

National Wetland Inventory

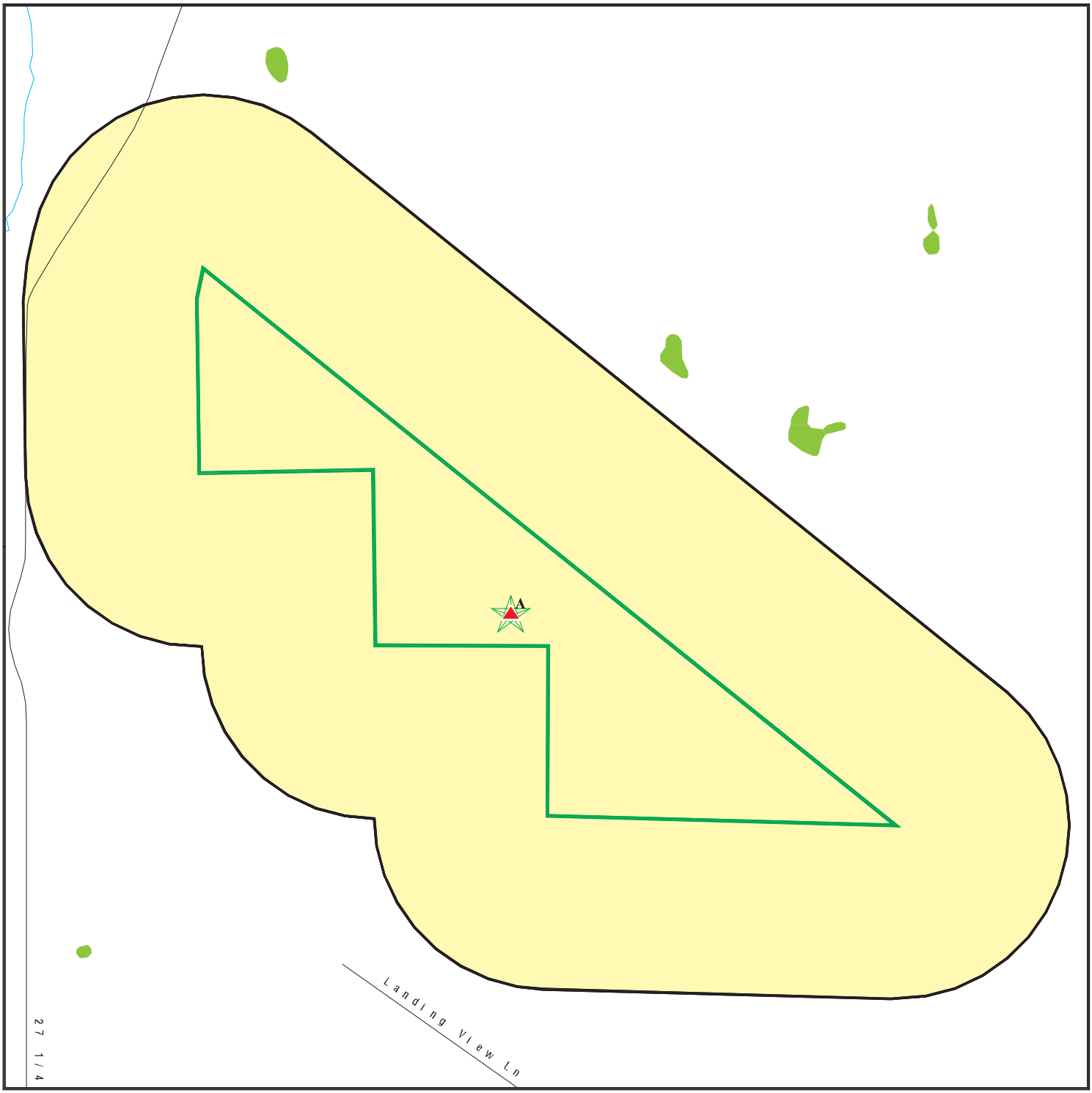
State Wetlands

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Walker Field Expansion	CLIENT: Walsh Environmental
ADDRESS: 2828 Walker Field Drive Grand Junction CO 81506	CONTACT: Bob Stockton
LAT/LONG: 39.1359 / 108.5347	INQUIRY #: 3365127.2s DATE: July 11, 2012 6:32 pm

Copyright © 2012 EDR, Inc. © 2010 Tele Atlas Rel. 07/2009.

DETAIL MAP - 3365127.2s



0 1/8 1/4 1/2 Miles

- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines from USGS
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME:	Walker Field Expansion	CLIENT:	Walsh Environmental
ADDRESS:	2828 Walker Field Drive Grand Junction CO 81506	CONTACT:	Bob Stockton
LAT/LONG:	39.1359 / 108.5347	INQUIRY #:	3365127.2s
		DATE:	July 11, 2012 6:33 pm

Copyright © 2012 EDR, Inc. © 2010 Tele Atlas Rel. 07/2009.

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Federal NPL site list								
NPL	1.500		0	0	0	0	0	0
Proposed NPL	1.500		0	0	0	0	0	0
NPL LIENS	0.500		0	0	0	NR	NR	0
Federal Delisted NPL site list								
Delisted NPL	1.500		0	0	0	0	0	0
Federal CERCLIS list								
CERCLIS	1.000		0	0	0	0	NR	0
FEDERAL FACILITY	1.500		0	0	0	0	0	0
Federal CERCLIS NFRAP site List								
CERC-NFRAP	1.000		0	0	0	0	NR	0
Federal RCRA CORRACTS facilities list								
CORRACTS	1.500		0	0	0	1	0	1
Federal RCRA non-CORRACTS TSD facilities list								
RCRA-TSDF	1.000		0	0	0	0	NR	0
Federal RCRA generators list								
RCRA-LQG	0.750		0	0	0	0	NR	0
RCRA-SQG	0.750		0	0	1	0	NR	1
RCRA-CESQG	0.750	1	0	0	0	2	NR	3
Federal institutional controls / engineering controls registries								
US ENG CONTROLS	1.000		0	0	0	0	NR	0
US INST CONTROL	1.000		0	0	0	0	NR	0
Federal ERNS list								
ERNS	0.500		0	0	1	NR	NR	1
State- and tribal - equivalent CERCLIS								
SHWS	N/A		N/A	N/A	N/A	N/A	N/A	N/A
State and tribal landfill and/or solid waste disposal site lists								
SWF/LF	1.000		0	0	0	0	NR	0
State and tribal leaking storage tank lists								
LUST	1.000	1	0	0	0	1	NR	2
LUST TRUST	1.000		0	0	0	1	NR	1
LAST	1.000		0	0	1	2	NR	3
INDIAN LUST	1.000		0	0	0	0	NR	0
State and tribal registered storage tank lists								
UST	0.750	1	0	0	0	1	NR	2

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
AST	0.750	1	0	0	1	5	NR	7
INDIAN UST	0.750		0	0	0	0	NR	0
FEMA UST	0.750		0	0	0	0	NR	0
State and tribal institutional control / engineering control registries								
AUL	1.000		0	0	0	0	NR	0
State and tribal voluntary cleanup sites								
INDIAN VCP	1.000		0	0	0	0	NR	0
VCP	1.000		0	0	0	0	NR	0
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS	1.000		0	0	0	0	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
DEBRIS REGION 9	1.000		0	0	0	0	NR	0
ODI	1.000		0	0	0	0	NR	0
SWRCY	1.000		0	0	0	0	NR	0
HIST LF	1.000		0	0	0	0	NR	0
INDIAN ODI	1.000		0	0	0	0	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
US CDL	0.500		0	0	0	NR	NR	0
CDL	0.500		0	0	0	NR	NR	0
US HIST CDL	0.500		0	0	0	NR	NR	0
Local Land Records								
LIENS 2	0.500		0	0	0	NR	NR	0
LUCIS	1.000		0	0	0	0	NR	0
Records of Emergency Release Reports								
HMIRS	0.500		0	0	1	NR	NR	1
CO ERNS	0.500		0	0	1	NR	NR	1
Other Ascertainable Records								
RCRA-NonGen	0.750		0	0	1	2	NR	3
DOT OPS	0.500		0	0	0	NR	NR	0
DOD	1.500		0	0	0	0	0	0
FUDS	1.500		0	0	0	0	0	0
CONSENT	1.500		0	0	0	0	0	0
ROD	1.500		0	0	0	0	0	0
UMTRA	1.000		0	0	0	0	NR	0
MINES	0.750		0	0	0	0	NR	0
TRIS	0.500		0	0	0	NR	NR	0
TSCA	0.500		0	0	0	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
FTTS	0.500		0	0	0	NR	NR	0
HIST FTTS	0.500		0	0	0	NR	NR	0
SSTS	0.500		0	0	0	NR	NR	0
ICIS	0.500		0	0	0	NR	NR	0
PADS	0.500		0	0	0	NR	NR	0
MLTS	0.500		0	0	0	NR	NR	0
RADINFO	0.500		0	0	0	NR	NR	0
FINDS	0.500	2	0	0	3	NR	NR	5
RAATS	0.500		0	0	0	NR	NR	0
METHANE SITE	0.500		0	0	0	NR	NR	0
Methane Investigation	0.500		0	0	0	NR	NR	0
DRYCLEANERS	0.750		0	0	0	0	NR	0
NPDES	0.500		0	0	0	NR	NR	0
AIRS	0.500		0	0	0	NR	NR	0
UMTRA	1.000		0	0	0	0	NR	0
ASBESTOS	0.500		0	0	0	NR	NR	0
INDIAN RESERV	1.500		0	0	0	0	0	0
SCRD DRYCLEANERS	1.000		0	0	0	0	NR	0
FINANCIAL ASSURANCE	0.500		0	0	0	NR	NR	0
COAL ASH DOE	0.500		0	0	0	NR	NR	0
2020 COR ACTION	0.750		0	0	0	0	NR	0
PRP	0.500		0	0	0	NR	NR	0
EPA WATCH LIST	0.500		0	0	0	NR	NR	0
US FIN ASSUR	0.500		0	0	0	NR	NR	0
COAL ASH EPA	1.000		0	0	0	0	NR	0
PCB TRANSFORMER	0.500		0	0	0	NR	NR	0
EDR PROPRIETARY RECORDS								
EDR Proprietary Records								
Manufactured Gas Plants	1.500		0	0	0	0	0	0

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

N/A = This State does not maintain a SHWS list. See the Federal CERCLIS list.

A1
Target
Property

GRAND JUNCTION REGIONAL AIRPORT
2828 WALKER FIELD DR
GRAND JUNCTION, CO 81506

AST

A100319541
N/A

Actual:
4833 ft.

Click here for full text details

A2
Target
Property

HALCO PATCHING & SEALING INC
2828 WALKER FIELD DR
GRAND JUNCTION, CO 81506

FINDS

1012080512
N/A

Actual:
4833 ft.

Click here for full text details

A3
Target
Property

WEST STAR AVIATION INC
2828 WALKER FIELD DR
GRAND JUNCTION, CO 81506

UST

U003124031
N/A

Actual:
4833 ft.

Click here for full text details

A4
Target
Property

TSA-GRAND JUNCTION-WALKER FIELD AIRPORT
2828 WALKER FIELD DR STE 209
GRAND JUNCTION, CO 81506

RCRA-CESQG

1007569256
COR000208884

Actual:
4833 ft.

Click here for full text details

A5
Target
Property

BUDGET RENT A CAR
2828 WALKER FIELD DR
GRAND JUNCTION, CO 81503

LUST

S107554915
N/A

Actual:
4833 ft.

Click here for full text details

LUST
Status: Closed
Status: Closed

A6
Target
Property

TSA-GRAND JUNCTION-WALKER FIELD AIRPORT
2828 WALKER FIELD DR STE 209
GRAND JUNCTION, CO 81506

FINDS **1007730168**
N/A

Actual:
4833 ft.

Click here for full text details

B7
South
1/4-1/2
0.407 mi.
2150 ft.

Relative:
Lower

GRAND JUNCTION AIR CENTER
2774 LANDING VIEW LN
GRAND JUNCTION, CO 81506

RCRA-NonGen **1004680052**
FINDS **COR000005157**

Click here for full text details

B8
South
1/4-1/2
0.407 mi.
2150 ft.

Relative:
Lower

2774 LANDING VIEW LANE
GRAND JUNCTION, CO

CO ERNS **S106482972**
N/A

Click here for full text details

B9
South
1/4-1/2
0.424 mi.
2239 ft.

Relative:
Lower

2780 LANDING VIEW LANE
GRAND JUNCTION, CO

HMIRS **9998101156**
N/A

Click here for full text details

B10
South
1/4-1/2
0.424 mi.
2239 ft.

Relative:
Lower

TIMBERLINE AVIATION LLC
2780 LANDING VIEW LN
GRAND JUNCTION, CO 81506

AST **A100184874**
N/A

Click here for full text details

B11
South
1/4-1/2
0.424 mi.
2239 ft.

Relative:
Lower

TWIN OTTER AIRBORNE RESEARCH
2780 LANDING VIEW LN
GRAND JUNCTION, CO 81506

RCRA-SQG **1001115699**
FINDS **COR000005991**

Click here for full text details

B12
South
1/4-1/2
0.424 mi.
2239 ft.

Relative:
Lower

TIMBERLINE AVIATION
2780 LANDING VIEW LANE
GRAND JUNCTION, CO 81506

Click here for full text details

FINDS **1006798655**
N/A

B13
South
1/4-1/2
0.424 mi.
2239 ft.

Relative:
Lower

TIMBERLINE AVIATION LLC
2780 LANDING VIEW LN
GRAND JUNCTION, CO 81506

Click here for full text details

LAST **S107556207**
N/A

B14
South
1/4-1/2
0.424 mi.
2239 ft.

Relative:
Lower

2780 LANDING VIEW LANE
GRAND JUNCTION, CO 81506

Click here for full text details

ERNS **984592270**
N/A

C15
South
1/2-1
0.507 mi.
2676 ft.

Relative:
Lower

WEST STAR FUEL FARM
2800 LANDING VIEW LN
GRAND JUNCTION, CO 81506

Click here for full text details

AST **S105684392**
N/A

C16
South
1/2-1
0.507 mi.
2676 ft.

Relative:
Lower

WEST STAR FUEL FARM
2800 LANDING VIEW LN
GRAND JUNCTION, CO 81506

Click here for full text details

LAST **S107556374**
N/A

C17
South
1/2-1
0.535 mi.
2824 ft.

Relative:
Lower

MESA AIRLINES
2810 LANDING VIEW LN
GRAND JUNCTION, CO 81506

Click here for full text details

RCRA-CESQG **1000820686**
COD983794611

Map ID / Direction / Distance / Elevation	Site	Database(s)	EDR ID Number / EPA ID Number
C18 **South** **1/2-1** **0.540 mi.** **2849 ft.** **Relative: Lower**	**HERTZ SERVICE CTR** **2812 LANDING VIEW LN** **GRAND JUNCTION, CO 81506** **Click here for full text details**	**AST**	**A100138378** **N/A**
C19 **South** **1/2-1** **0.545 mi.** **2875 ft.** **Relative: Lower**	**RETRIEVER AIR FREIGHT** **2814 LANDING VIEW LN** **GRAND JUNCTION, CO 81501** **Click here for full text details**	**AST**	**S106437596** **N/A**
D20 **SSE** **1/2-1** **0.603 mi.** **3186 ft.** **Relative: Higher**	**GRAND JUNCTION FSS** **GRAND JUNCTION AIRPORT** **GRAND JUNCTION, CO 81505** **Click here for full text details**	**UST**	**U003122262** **N/A**
D21 **SSE** **1/2-1** **0.604 mi.** **3187 ft.** **Relative: Higher**	**US FAA GRAND JUNCTION SECTOR FLD OFC 1** **OLD TERMINAL BLDG WALKER FLD** **GRAND JUNCTION, CO 81506** **Click here for full text details**	**RCRA-NonGen** **FINDS**	**1000227631** **CO1690590079**
D22 **SSE** **1/2-1** **0.604 mi.** **3187 ft.** **Relative: Higher**	**CONTINENTAL GRAND JUNCTION** **WALKER FIELD** **GRAND JUNCTION, CO 81506** **Click here for full text details**	**RCRA-NonGen** **FINDS**	**1000698236** **COT090010406**
23 **SSE** **1/2-1** **0.628 mi.** **3317 ft.** **Relative: Higher**	**DANA MOTORS** **WALKER FIELD** **GRAND JUNCTION, CO 81501** **Click here for full text details**	**AST**	**A100138348** **N/A**

Map ID / Direction / Distance / Elevation	Site	Database(s)	EDR ID Number / EPA ID Number
24 **South** **1/2-1** **0.707 mi.** **3734 ft.** **Relative:** **Lower**	**SCHWANS HOME SERVICE** **838 NORTH CREST DR** **GRAND JUNCTION, CO 81506** **Click here for full text details**	**AST**	**A100301306** **N/A**
25 **South** **1/2-1** **0.739 mi.** **3903 ft.** **Relative:** **Lower**	**3D SYSTEMS - GRAND JUNCTION** **805 FALCON WAY** **GRAND JUNCTION, CO 81506** **Click here for full text details**	**RCRA-CESQG** **FINDS**	**1004680120** **COR000006734**
E26 **SSE** **1/2-1** **0.862 mi.** **4550 ft.** **Relative:** **Lower**	**WEST STAR AVIATION INC** **796 HERITAGE WAY** **GRAND JUNCTION, CO 81502** **Click here for full text details**	**LUST TRUST** **LAST** **CO ERNS** **AIRS**	**S104299630** **N/A**
E27 **SSE** **1/2-1** **0.862 mi.** **4550 ft.** **Relative:** **Lower**	**WEST STAR AVIATION INC** **796 HERITAGE WAY** **GRAND JUNCTION, CO 81506** **Click here for full text details** **LUST** Status: Closed	**CORRACTS** **RCRA-LQG** **FINDS** **LUST**	**1000393987** **COD160887741**

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

St	Acronym	Full Name	Government Agency	Gov Date	Arvl. Date	Active Date
CO	AIRS	Permitted Facility & Emissions Listing	Department of Public Health & Environment	03/13/2012	03/14/2012	03/30/2012
CO	ASBESTOS	Asbestos Abatement & Demolition Projects	Department of Public Health & Environment	12/31/2011	02/14/2012	03/06/2012
CO	AST	Aboveground Tank List	Department of Labor and Employment, Oil Inspe	03/27/2012	03/28/2012	05/01/2012
CO	AUL	Environmental Real Covenants List	Department of Public Health & Environment	04/09/2012	04/10/2012	05/01/2012
CO	CDL	Meth Lab Locations	Department of Public Health and Environment	04/09/2012	04/09/2012	05/01/2012
CO	CO ERNS	Spills Database	Department of Public Health and Environmental	04/09/2012	04/09/2012	05/01/2012
CO	DRYCLEANERS	Drycleaner Facilities	Department of Public Health & Environment	03/13/2012	03/15/2012	03/30/2012
CO	FINANCIAL ASSURANCE 1	Financial Assurance Information Listing	Department of Public Health & Environment	04/12/2012	04/16/2012	05/01/2012
CO	FINANCIAL ASSURANCE 2	Financial Assurance Information Listing	Department of Public Health & Environment	04/12/2012	04/16/2012	05/01/2012
CO	HISTORICAL LANDFILL	Historical Landfill List	Department of Public Health & Environment	01/31/1993	04/24/1994	05/30/1994
CO	LAST	Leaking Aboveground Storage Tank Listing	Department of Labor & Employment	03/27/2012	03/28/2012	05/01/2012
CO	LUST	Leaking Underground Storage Tank List	Department of Labor and Employment, Oil Inspe	03/27/2012	03/28/2012	05/01/2012
CO	METHANE INVESTIGATION	Methane Gas & Swamp Findings	Department of Health	03/15/1979	02/13/1995	04/04/1995
CO	METHANE SITE	Methane Site Investigations - Jefferson County 1980	Jefferson County Health Department	12/31/1980	02/13/1995	04/04/1995
CO	NPDES	Permitted Facility Listing	Department of Public Health & Environment	05/07/2012	05/08/2012	06/08/2012
CO	SHWS	This state does not maintain a SHWS list. See the Federal CE	Department of Public Health & Environment			
CO	SWF/LF	Solid Waste Sites & Facilities	Department of Public Health & Environment	06/30/2011	08/23/2011	09/28/2011
CO	SWRCY	Registered Recyclers Listing	Department of Public Health & Environment	03/20/2012	03/21/2012	05/01/2012
CO	TRUST	Lust Trust Sites	Department of Labor and Employment, Oil Inspe	03/19/2012	03/21/2012	05/01/2012
CO	UMTRA	Uranium Mill Tailings Sites	Department of Public Health & Environment	11/23/2004	03/21/2007	05/02/2007
CO	UST	Underground Storage Tank Database	Department of Labor and Employment, Oil Inspe	03/27/2012	03/28/2012	05/01/2012
CO	VCP	Voluntary Cleanup & Redevelopment Act Application Tracking R	Department of Public Health and Environmental	01/09/2012	01/25/2012	03/06/2012
US	2020 COR ACTION	2020 Corrective Action Program List	Environmental Protection Agency	11/11/2011	05/18/2012	05/25/2012
US	BRS	Biennial Reporting System	EPA/NTIS	12/31/2009	03/01/2011	05/02/2011
US	CERCLIS	Comprehensive Environmental Response, Compensation, and Liab	EPA	12/27/2011	02/27/2012	03/12/2012
US	CERCLIS-NFRAP	CERCLIS No Further Remedial Action Planned	EPA	12/28/2011	02/27/2012	03/12/2012
US	COAL ASH DOE	Sleam-Electric Plan Operation Data	Department of Energy	12/31/2005	08/07/2009	10/22/2009
US	COAL ASH EPA	Coal Combustion Residues Surface Impoundments List	Environmental Protection Agency	08/17/2010	01/03/2011	03/21/2011
US	CONSENT	Superfund (CERCLA) Consent Decrees	Department of Justice, Consent Decree Library	12/01/2011	01/25/2012	03/01/2012
US	CORRACTS	Corrective Action Report	EPA	08/19/2011	08/31/2011	01/10/2012
US	DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations	EPA, Region 9	01/12/2009	05/07/2009	09/21/2009
US	DELISTED NPL	National Priority List Deletions	EPA	03/30/2012	04/05/2012	05/15/2012
US	DOD	Department of Defense Sites	USGS	12/31/2005	11/10/2006	01/11/2007
US	DOT OPS	Incident and Accident Data	Department of Transporation, Office of Pipeli	07/29/2011	08/09/2011	11/11/2011
US	EPA WATCH LIST	EPA WATCH LIST	Environmental Protection Agency	03/31/2012	05/17/2012	06/14/2012
US	ERNS	Emergency Response Notification System	National Response Center, United States Coast	04/02/2012	04/03/2012	06/14/2012
US	FEDERAL FACILITY	Federal Facility Site Information listing	Environmental Protection Agency	12/10/2010	01/11/2011	02/16/2011
US	FEDLAND	Federal and Indian Lands	U.S. Geological Survey	12/31/2005	02/06/2006	01/11/2007
US	FEMA UST	Underground Storage Tank Listing	FEMA	01/01/2010	02/16/2010	04/12/2010
US	FINDS	Facility Index System/Facility Registry System	EPA	10/23/2011	12/13/2011	03/01/2012
US	FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fu	EPA/Office of Prevention, Pesticides and Toxi	04/09/2009	04/16/2009	05/11/2009
US	FTTS INSP	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fu	EPA	04/09/2009	04/16/2009	05/11/2009
US	FUDS	Formerly Used Defense Sites	U.S. Army Corps of Engineers	12/31/2009	08/12/2010	12/02/2010
US	HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing	Environmental Protection Agency	10/19/2006	03/01/2007	04/10/2007
US	HIST FTTS INSP	FIFRA/TSCA Tracking System Inspection & Enforcement Case Lis	Environmental Protection Agency	10/19/2006	03/01/2007	04/10/2007
US	HMIRS	Hazardous Materials Information Reporting System	U.S. Department of Transportation	04/01/2012	04/03/2012	06/14/2012
US	ICIS	Integrated Compliance Information System	Environmental Protection Agency	07/20/2011	11/10/2011	01/10/2012

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

St	Acronym	Full Name	Government Agency	Gov Date	Arvl. Date	Active Date
US	INDIAN LUST R1	Leaking Underground Storage Tanks on Indian Land	EPA Region 1	04/12/2012	05/09/2012	07/10/2012
US	INDIAN LUST R10	Leaking Underground Storage Tanks on Indian Land	EPA Region 10	05/07/2012	05/08/2012	07/10/2012
US	INDIAN LUST R4	Leaking Underground Storage Tanks on Indian Land	EPA Region 4	12/14/2011	12/15/2011	01/10/2012
US	INDIAN LUST R6	Leaking Underground Storage Tanks on Indian Land	EPA Region 6	09/12/2011	09/13/2011	11/11/2011
US	INDIAN LUST R7	Leaking Underground Storage Tanks on Indian Land	EPA Region 7	02/07/2012	02/17/2012	05/15/2012
US	INDIAN LUST R8	Leaking Underground Storage Tanks on Indian Land	EPA Region 8	08/18/2011	08/19/2011	09/13/2011
US	INDIAN LUST R9	Leaking Underground Storage Tanks on Indian Land	Environmental Protection Agency	02/14/2012	02/17/2012	05/15/2012
US	INDIAN ODI	Report on the Status of Open Dumps on Indian Lands	Environmental Protection Agency	12/31/1998	12/03/2007	01/24/2008
US	INDIAN RESERV	Indian Reservations	USGS	12/31/2005	12/08/2006	01/11/2007
US	INDIAN UST R1	Underground Storage Tanks on Indian Land	EPA, Region 1	10/01/2011	11/01/2011	11/11/2011
US	INDIAN UST R10	Underground Storage Tanks on Indian Land	EPA Region 10	02/01/2012	02/02/2012	05/15/2012
US	INDIAN UST R4	Underground Storage Tanks on Indian Land	EPA Region 4	12/14/2011	12/15/2011	01/10/2012
US	INDIAN UST R5	Underground Storage Tanks on Indian Land	EPA Region 5	02/28/2012	02/29/2012	05/15/2012
US	INDIAN UST R6	Underground Storage Tanks on Indian Land	EPA Region 6	05/10/2011	05/11/2011	06/14/2011
US	INDIAN UST R7	Underground Storage Tanks on Indian Land	EPA Region 7	02/07/2012	02/17/2012	05/15/2012
US	INDIAN UST R8	Underground Storage Tanks on Indian Land	EPA Region 8	08/18/2011	08/19/2011	09/13/2011
US	INDIAN UST R9	Underground Storage Tanks on Indian Land	EPA Region 9	11/28/2011	11/29/2011	01/10/2012
US	INDIAN VCP R1	Voluntary Cleanup Priority Listing	EPA, Region 1	02/17/2012	04/03/2012	05/15/2012
US	INDIAN VCP R7	Voluntary Cleanup Priority Lisitng	EPA, Region 7	03/20/2008	04/22/2008	05/19/2008
US	LIENS 2	CERCLA Lien Information	Environmental Protection Agency	02/16/2012	03/26/2012	06/14/2012
US	LUCIS	Land Use Control Information System	Department of the Navy	12/09/2005	12/11/2006	01/11/2007
US	MINES	Mines Master Index File	Department of Labor, Mine Safety and Health A	08/18/2011	09/08/2011	09/29/2011
US	MLTS	Material Licensing Tracking System	Nuclear Regulatory Commission	06/21/2011	07/15/2011	09/13/2011
US	Manufactured Gas Plants	EDR Proprietary Manufactured Gas Plants	EDR, Inc.			
US	NPL	National Priority List	EPA	05/08/2012	05/10/2012	05/15/2012
US	NPL LIENS	Federal Superfund Liens	EPA	10/15/1991	02/02/1994	03/30/1994
US	ODI	Open Dump Inventory	Environmental Protection Agency	06/30/1985	08/09/2004	09/17/2004
US	PADS	PCB Activity Database System	EPA	11/01/2010	11/10/2010	02/16/2011
US	PCB TRANSFORMER	PCB Transformer Registration Database	Environmental Protection Agency	02/01/2011	10/19/2011	01/10/2012
US	PRP	Potentially Responsible Parties	EPA	02/27/2012	04/04/2012	05/15/2012
US	Proposed NPL	Proposed National Priority List Sites	EPA	03/30/2012	04/05/2012	05/15/2012
US	RAATS	RCRA Administrative Action Tracking System	EPA	04/17/1995	07/03/1995	08/07/1995
US	RADINFO	Radiation Information Database	Environmental Protection Agency	01/10/2012	01/12/2012	03/01/2012
US	RCRA-CESQG	RCRA - Conditionally Exempt Small Quantity Generators	Environmental Protection Agency	03/15/2012	04/04/2012	05/15/2012
US	RCRA-LQG	RCRA - Large Quantity Generators	Environmental Protection Agency	03/15/2012	04/04/2012	05/15/2012
US	RCRA-NonGen	RCRA - Non Generators	Environmental Protection Agency	03/15/2012	04/04/2012	05/15/2012
US	RCRA-SQG	RCRA - Small Quantity Generators	Environmental Protection Agency	03/15/2012	04/04/2012	05/15/2012
US	RCRA-TSDF	RCRA - Treatment, Storage and Disposal	Environmental Protection Agency	03/15/2012	04/04/2012	05/15/2012
US	ROD	Records Of Decision	EPA	02/27/2012	03/14/2012	06/14/2012
US	SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing	Environmental Protection Agency	03/07/2011	03/09/2011	05/02/2011
US	SSTS	Section 7 Tracking Systems	EPA	12/31/2009	12/10/2010	02/25/2011
US	TRIS	Toxic Chemical Release Inventory System	EPA	12/31/2009	09/01/2011	01/10/2012
US	TSCA	Toxic Substances Control Act	EPA	12/31/2006	09/29/2010	12/02/2010
US	UMTRA	Uranium Mill Tailings Sites	Department of Energy	09/14/2010	10/07/2011	03/01/2012
US	US BROWNFIELDS	A Listing of Brownfields Sites	Environmental Protection Agency	06/27/2011	06/27/2011	09/13/2011
US	US CDL	Clandestine Drug Labs	Drug Enforcement Administration	02/02/2012	03/13/2012	06/14/2012
US	US ENG CONTROLS	Engineering Controls Sites List	Environmental Protection Agency	12/30/2011	12/30/2011	01/10/2012

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

St	Acronym	Full Name	Government Agency	Gov Date	Arvl. Date	Active Date
US	US FIN ASSUR	Financial Assurance Information	Environmental Protection Agency	05/24/2012	06/05/2012	06/14/2012
US	US HIST CDL	National Clandestine Laboratory Register	Drug Enforcement Administration	09/01/2007	11/19/2008	03/30/2009
US	US INST CONTROL	Sites with Institutional Controls	Environmental Protection Agency	12/30/2011	12/30/2011	01/10/2012
CT	CT MANIFEST	Hazardous Waste Manifest Data	Department of Energy & Environmental Protecti	05/21/2012	05/22/2012	05/31/2012
NY	NY MANIFEST	Facility and Manifest Data	Department of Environmental Conservation	05/01/2012	05/09/2012	06/14/2012
PA	PA MANIFEST	Manifest Information	Department of Environmental Protection	12/31/2010	04/27/2012	06/05/2012
WI	WI MANIFEST	Manifest Information	Department of Natural Resources	12/31/2010	08/19/2011	09/15/2011
US	Oil/Gas Pipelines	GeoData Digital Line Graphs from 1:100,000-Scale Maps	USGS			
US	Electric Power Lines	Electric Power Transmission Line Data	Rextag Strategies Corp.			
US	AHA Hospitals	Sensitive Receptor: AHA Hospitals	American Hospital Association, Inc.			
US	Medical Centers	Sensitive Receptor: Medical Centers	Centers for Medicare & Medicaid Services			
US	Nursing Homes	Sensitive Receptor: Nursing Homes	National Institutes of Health			
US	Public Schools	Sensitive Receptor: Public Schools	National Center for Education Statistics			
US	Private Schools	Sensitive Receptor: Private Schools	National Center for Education Statistics			
CO	Daycare Centers	Sensitive Receptor: Daycare Listing	Department of Human Services			
US	Flood Zones	100-year and 500-year flood zones	Emergency Management Agency (FEMA)			
US	NWI	National Wetlands Inventory	U.S. Fish and Wildlife Service			
CO	State Wetlands	Riparian Vegetation Data	Division of Wildlife			
US	USGS 7.5' Topographic Map	Scanned Digital USGS 7.5' Topographic Map (DRG)	USGS			

STREET AND ADDRESS INFORMATION

© 2010 Tele Atlas North America, Inc. All rights reserved. This material is proprietary and the subject of copyright protection and other intellectual property rights owned by or licensed to Tele Atlas North America, Inc. The use of this material is subject to the terms of a license agreement. You will be held liable for any unauthorized copying or disclosure of this material.

GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

WALKER FIELD EXPANSION
2828 WALKER FIELD DRIVE
GRAND JUNCTION, CO 81506

TARGET PROPERTY COORDINATES

Latitude (North):	39.1359 - 39° 8' 9.24''
Longitude (West):	108.5347 - 108° 32' 4.92''
Universal Tranverse Mercator:	Zone 12
UTM X (Meters):	713084.7
UTM Y (Meters):	4334544.0
Elevation:	4833 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	39108-B5 CORCORAN POINT, CO
Most Recent Revision:	1973

EDR's GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principal investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

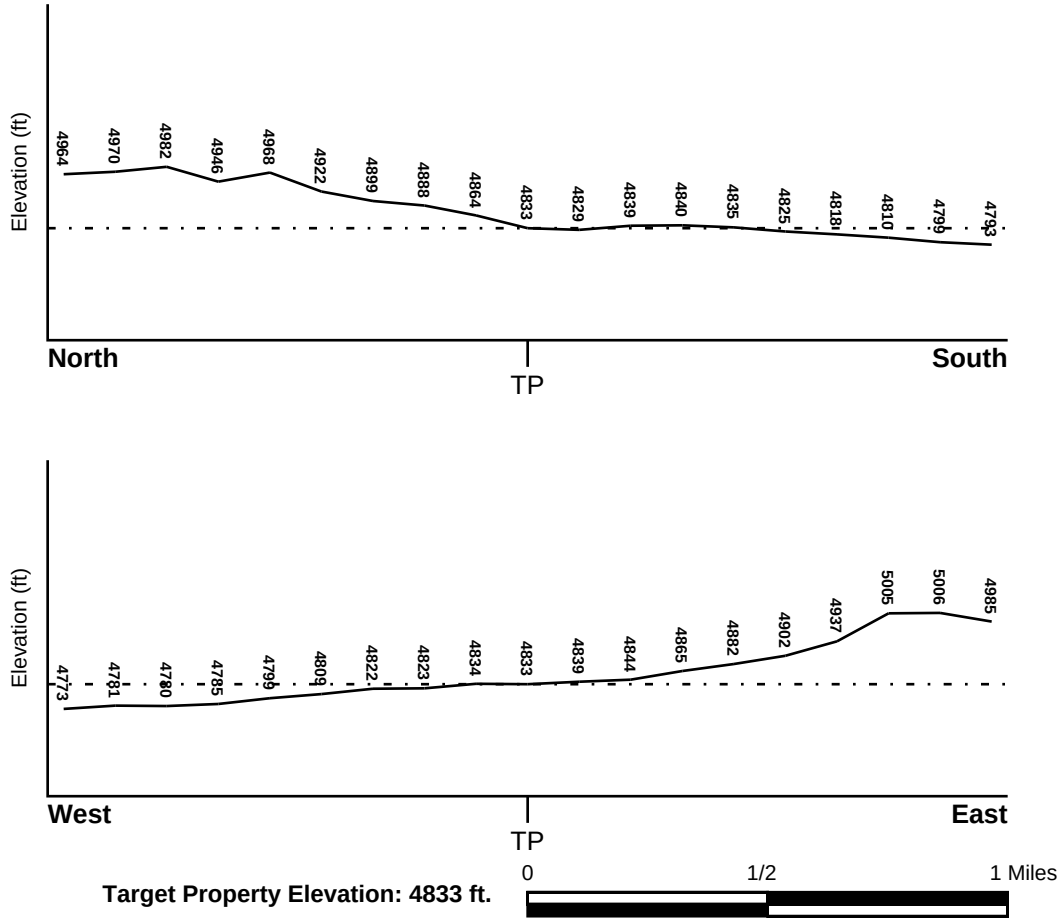
TOPOGRAPHIC INFORMATION

Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General SSW

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES



Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Target Property County	FEMA Flood Electronic Data
MESA, CO	YES - refer to the Overview Map and Detail Map

Flood Plain Panel at Target Property: 08077C - FEMA DFIRM Flood data

Additional Panels in search area: Not Reported

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
CORCORAN POINT	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

Era:	Mesozoic
System:	Cretaceous
Series:	Austin and Eagle Ford Groups
Code:	uK2 *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Stratified Sequence

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps. The following information is based on Soil Conservation Service STATSGO data.

Soil Component Name:	CHIPETA
Soil Surface Texture:	silty clay loam
Hydrologic Group:	Class D - Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.
Soil Drainage Class:	Well drained. Soils have intermediate water holding capacity. Depth to water table is more than 6 feet.

Hydric Status: Soil does not meet the requirements for a hydric soil.

Corrosion Potential - Uncoated Steel:	HIGH
Depth to Bedrock Min:	> 5 inches
Depth to Bedrock Max:	> 20 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification			
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil	Permeability Rate (in/hr)	Soil Reaction (pH)
1	0 inches	5 inches	silty clay loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), Lean Clay	Max: 0.60 Min: 0.20	Max: 8.40 Min: 7.40
2	5 inches	17 inches	silty clay loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), Lean Clay	Max: 0.20 Min: 0.06	Max: 9.00 Min: 7.40
3	17 inches	21 inches	weathered bedrock	Not reported	Not reported	Max: 0.06 Min: 0.00	Max: 0.00 Min: 0.00

OTHER SOIL TYPES IN AREA

Based on Soil Conservation Service STATSGO data, the following additional subordinant soil types may appear within the general area of target property.

Soil Surface Textures: weathered bedrock
gravelly - loam
loam

Surficial Soil Types: weathered bedrock
gravelly - loam
loam

Shallow Soil Types: No Other Soil Types

Deeper Soil Types: unweathered bedrock
very gravelly - sand
gravelly - sandy loam
silty clay loam

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No PWS System Found		

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

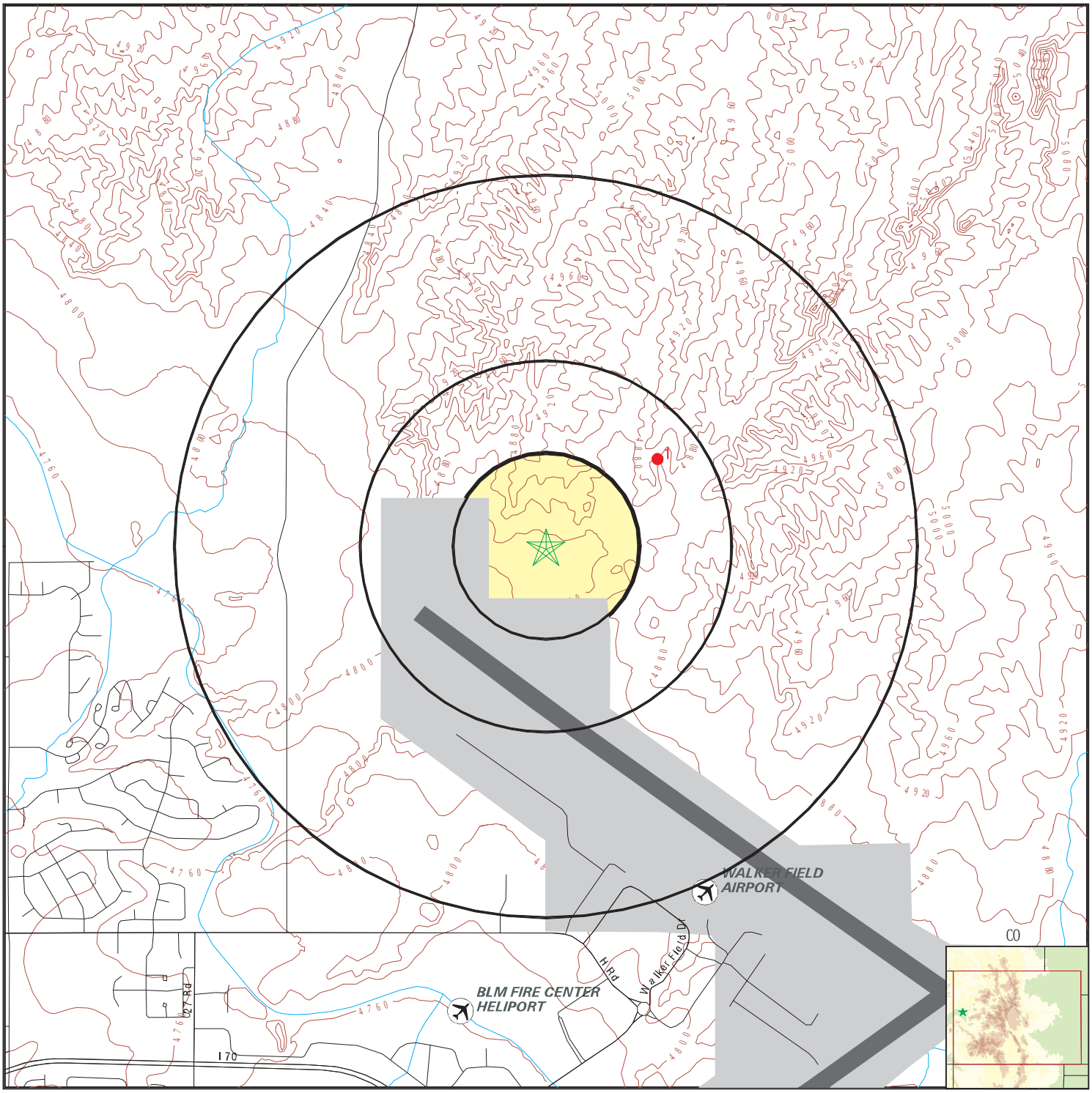
MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

OTHER STATE DATABASE INFORMATION

STATE OIL/GAS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
1	COOG90000016651	1/4 - 1/2 Mile NE

PHYSICAL SETTING SOURCE MAP - 3365127.2s



- County Boundary
- Major Roads
- Contour Lines
- Airports
- Earthquake epicenter, Richter 5 or greater
- Water Wells
- Public Water Supply Wells
- Cluster of Multiple Icons
- Groundwater Flow Direction
- Indeterminate Groundwater Flow at Location
- Groundwater Flow Varies at Location
- Oil, gas or related wells

SITE NAME:	Walker Field Expansion	CLIENT:	Walsh Environmental
ADDRESS:	2828 Walker Field Drive Grand Junction CO 81506	CONTACT:	Bob Stockton
LAT/LONG:	39.1359 / 108.5347	INQUIRY #:	3365127.2s
		DATE:	July 11, 2012 6:33 pm

Copyright © 2012 EDR, Inc. © 2010 Tele Atlas Rel. 07/2009.

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Map ID Direction Distance Elevation		Database	EDR ID Number
1 **NE** **1/4 - 1/2 Mile**	**Click here for full text details**	**OIL_GAS**	**COOG90000016651**

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

State Database: CO Radon

Radon Test Results

Zip	Total Sites	Avg	% sites<=4 pCi/L	% sites>4&<10 pCi/L	% sites>=10&<20 pCi/L	% sites>20 pCi/L
81506	9	3.19	77.78	22.22	0.00	0.00

Federal EPA Radon Zone for MESA County: 1

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for Zip Code: 81506

Number of sites tested: 7

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	2.786 pCi/L	86%	14%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	5.500 pCi/L	0%	100%	0%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

Scanned Digital USGS 7.5' Topographic Map (DRG)
Source: United States Geologic Survey
A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey topographic map. The map images are made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator (UTM) projection.

HYDROLOGIC INFORMATION

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 2003 & 2011 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Riparian Vegetation Data
Source: Division of Wildlife
Telephone: 970-416-3360

HYDROGEOLOGIC INFORMATION

AQUIFLOW^{R} Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Services, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

Colorado GIS Well Database
Source: Office of State Engineer, Division of Water Resources
Telephone: 303-866-3581
The GIS Well database includes all wells that the Division of Water Resources permits.

OTHER STATE DATABASE INFORMATION

Oil and Gas Well Locations
Source: Department of Natural Resources
Telephone: 303-894-2100

RADON

State Database: CO Radon
Source: Department of Public Health & Environment
Telephone: 303-692-3090
Radon Study in Colorado

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

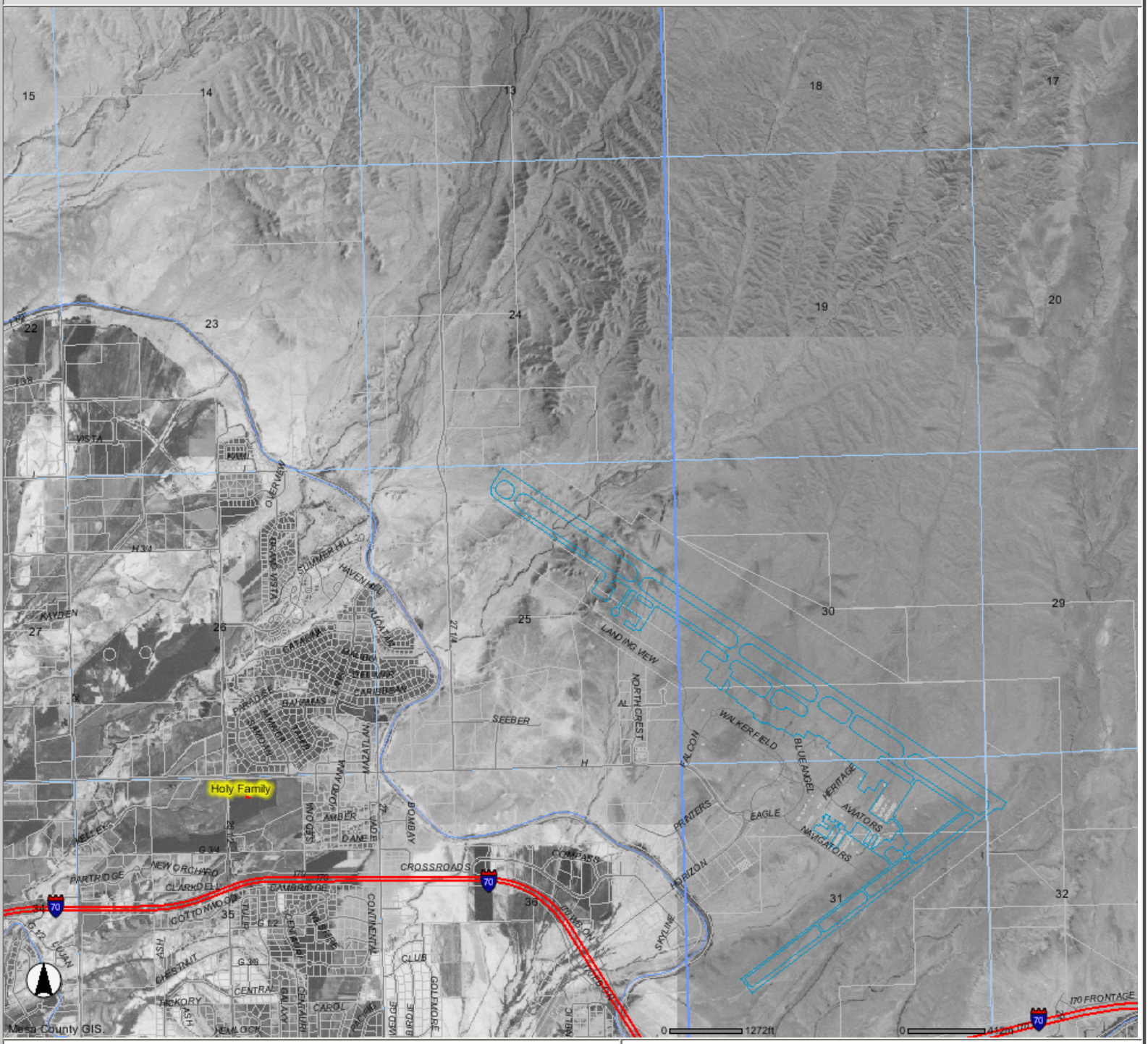
PHYSICAL SETTING SOURCE RECORDS SEARCHED

STREET AND ADDRESS INFORMATION

© 2010 Tele Atlas North America, Inc. All rights reserved. This material is proprietary and the subject of copyright protection and other intellectual property rights owned by or licensed to Tele Atlas North America, Inc. The use of this material is subject to the terms of a license agreement. You will be held liable for any unauthorized copying or disclosure of this material.

B Arial Photograph Maps

1937



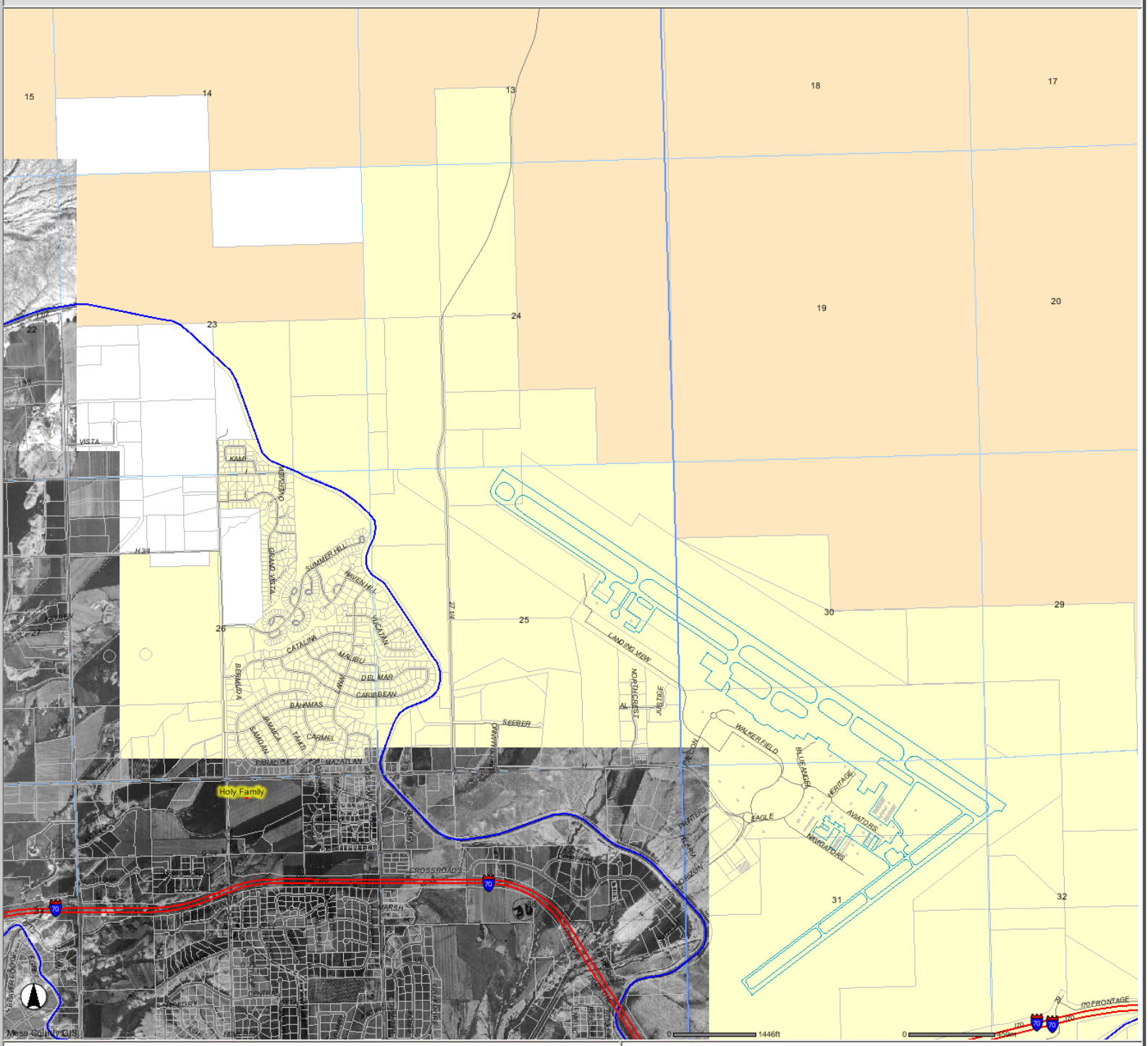
Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest

1954



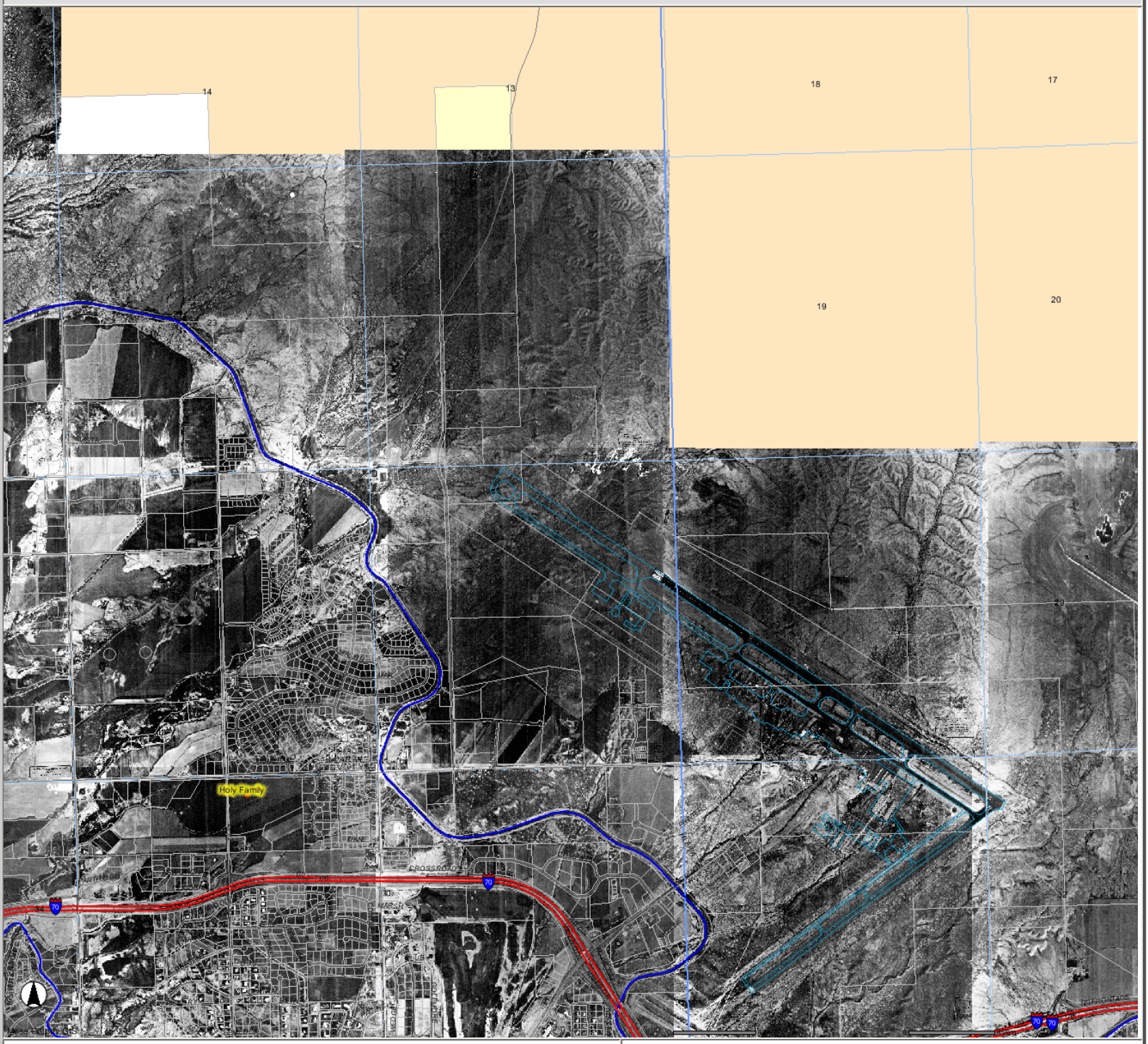
Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest

1966



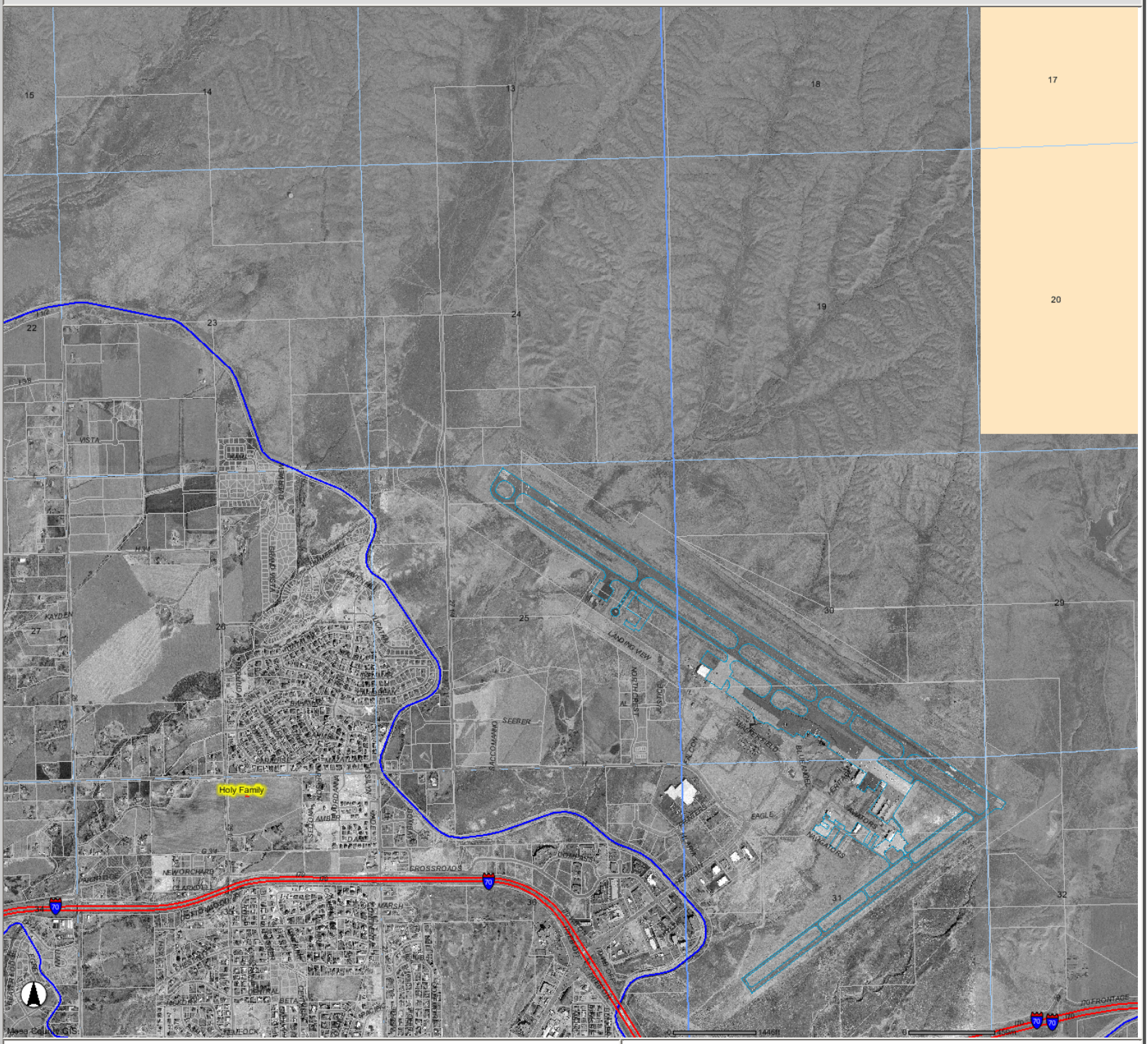
Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest

1994



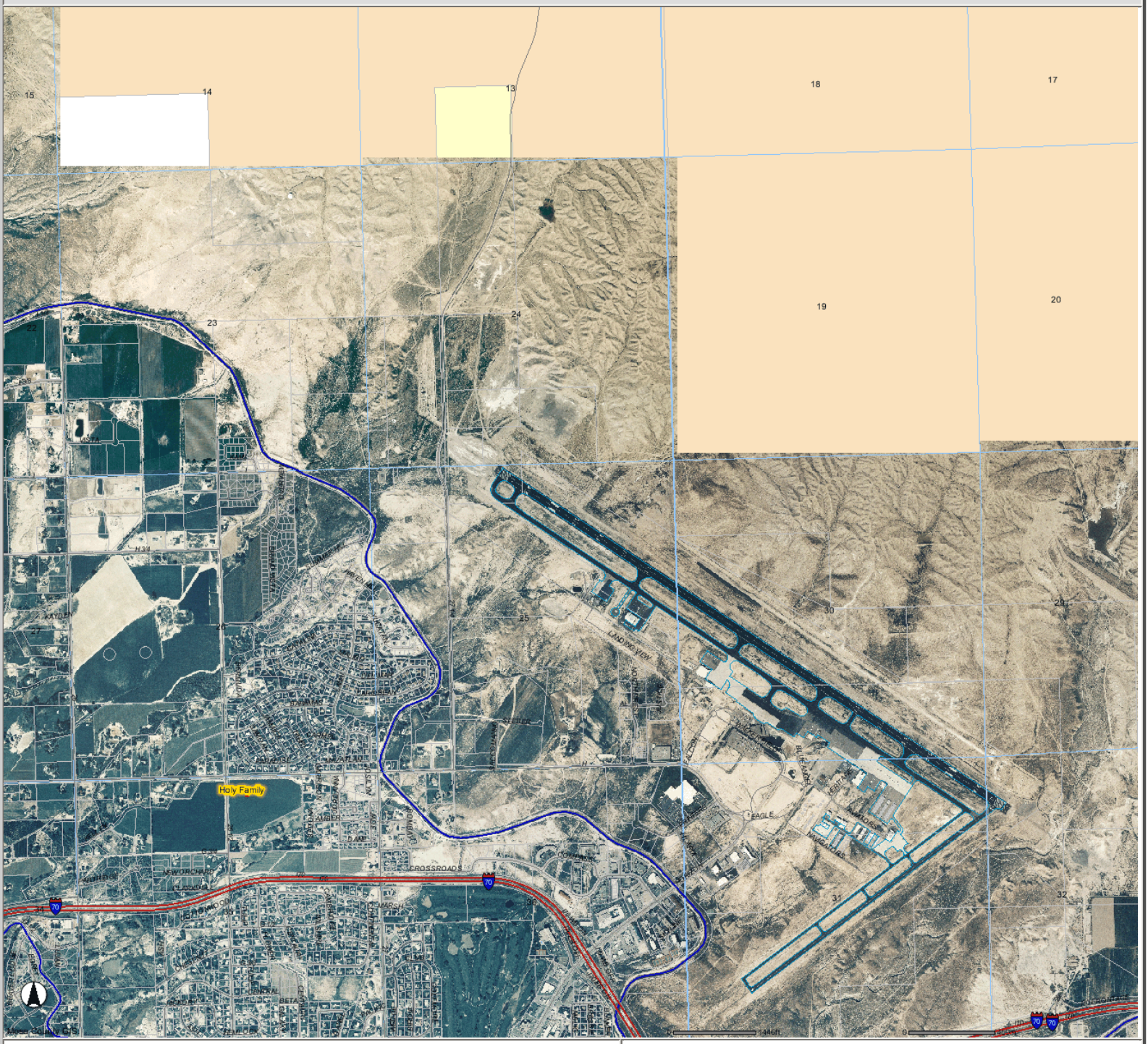
Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest

1997



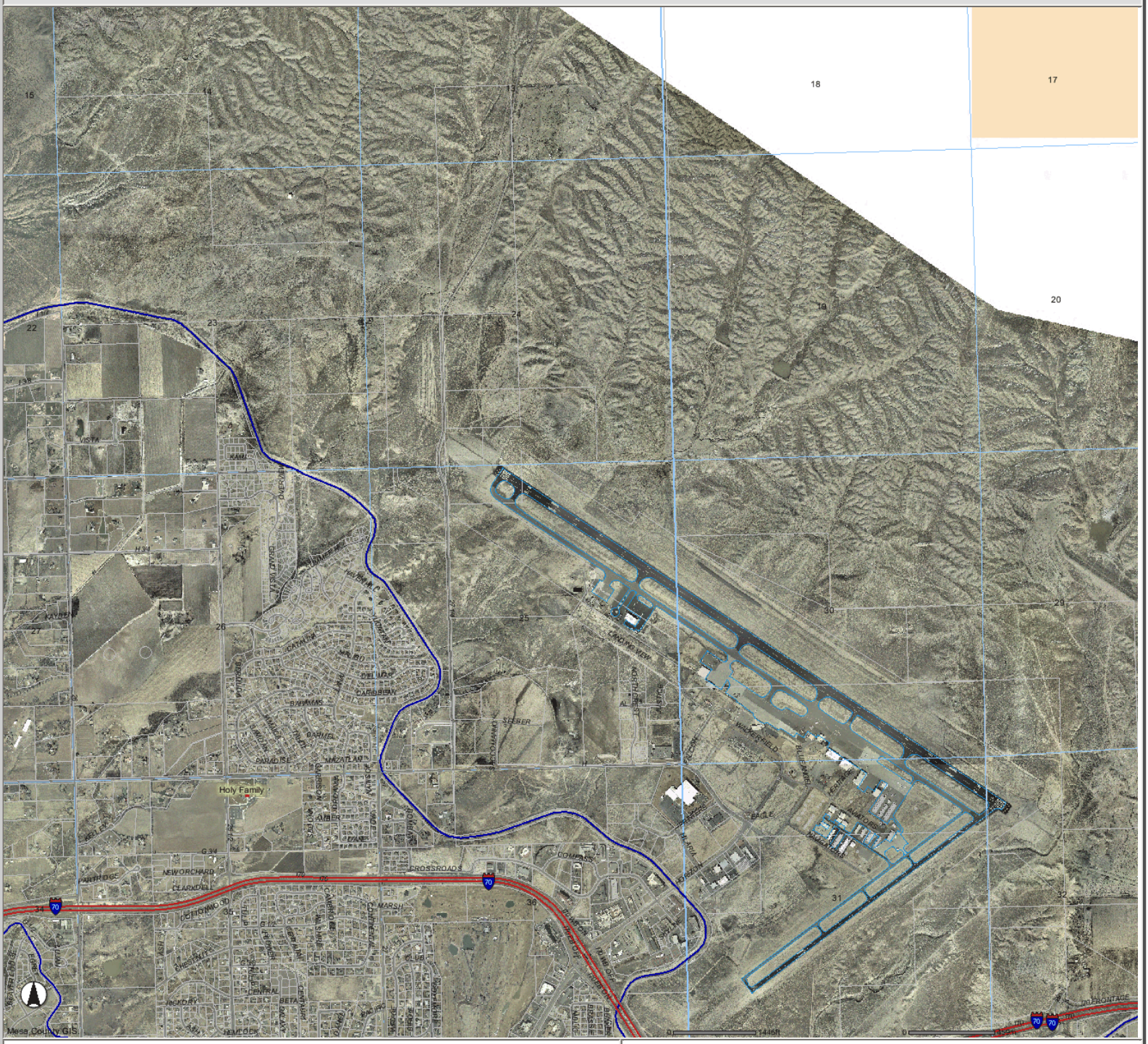
Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest

2001



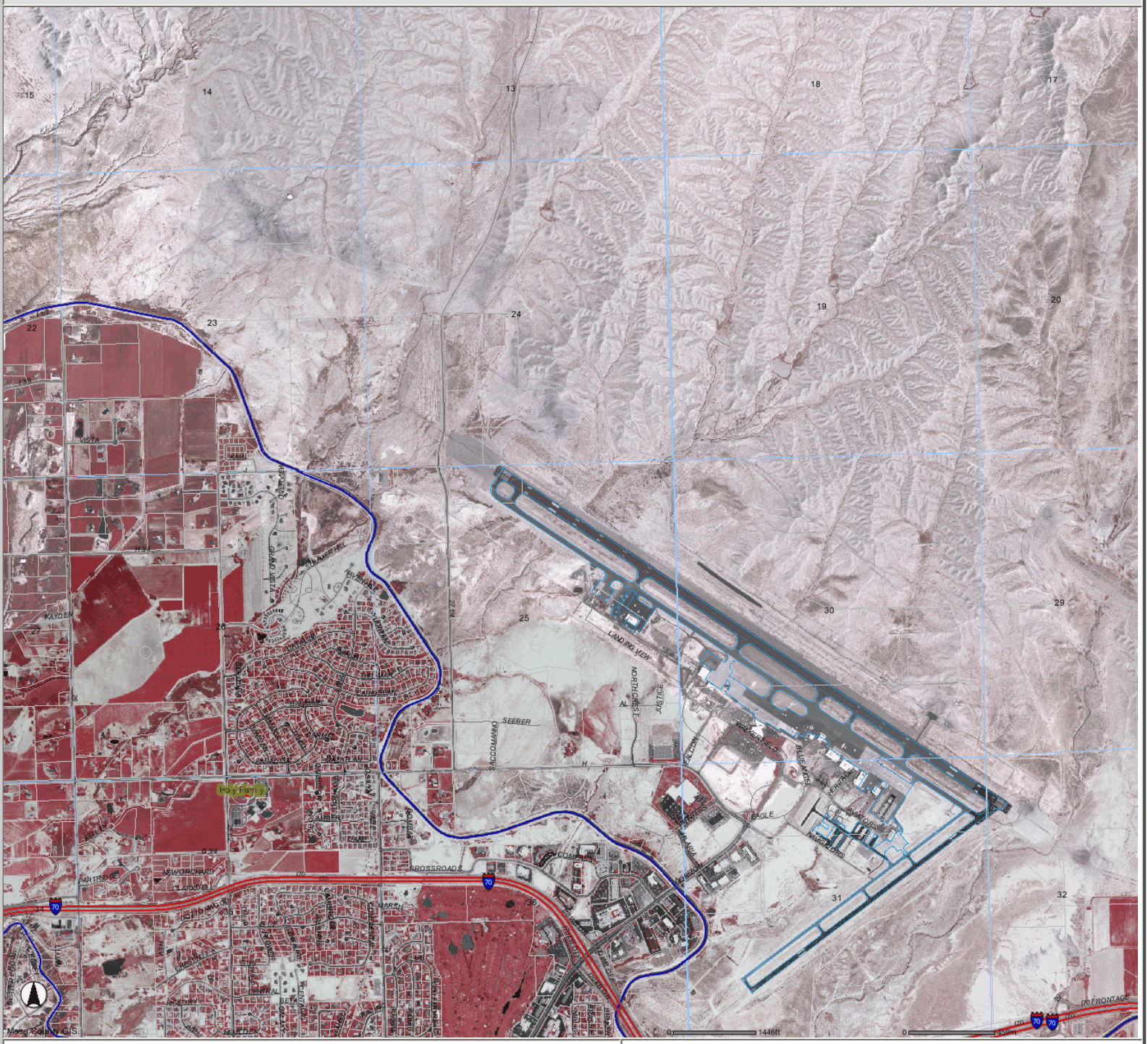
Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest

2003



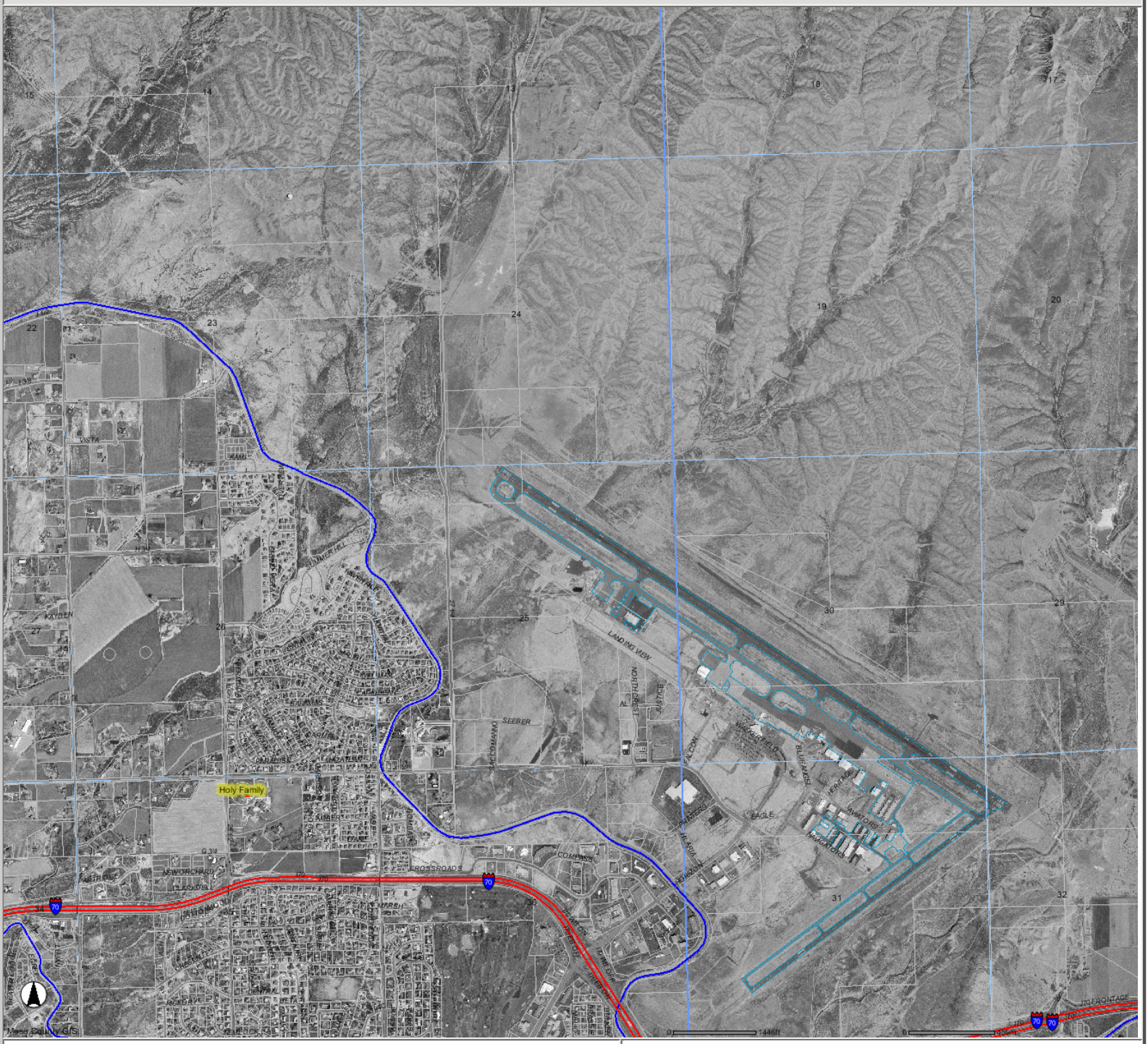
Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest

2005



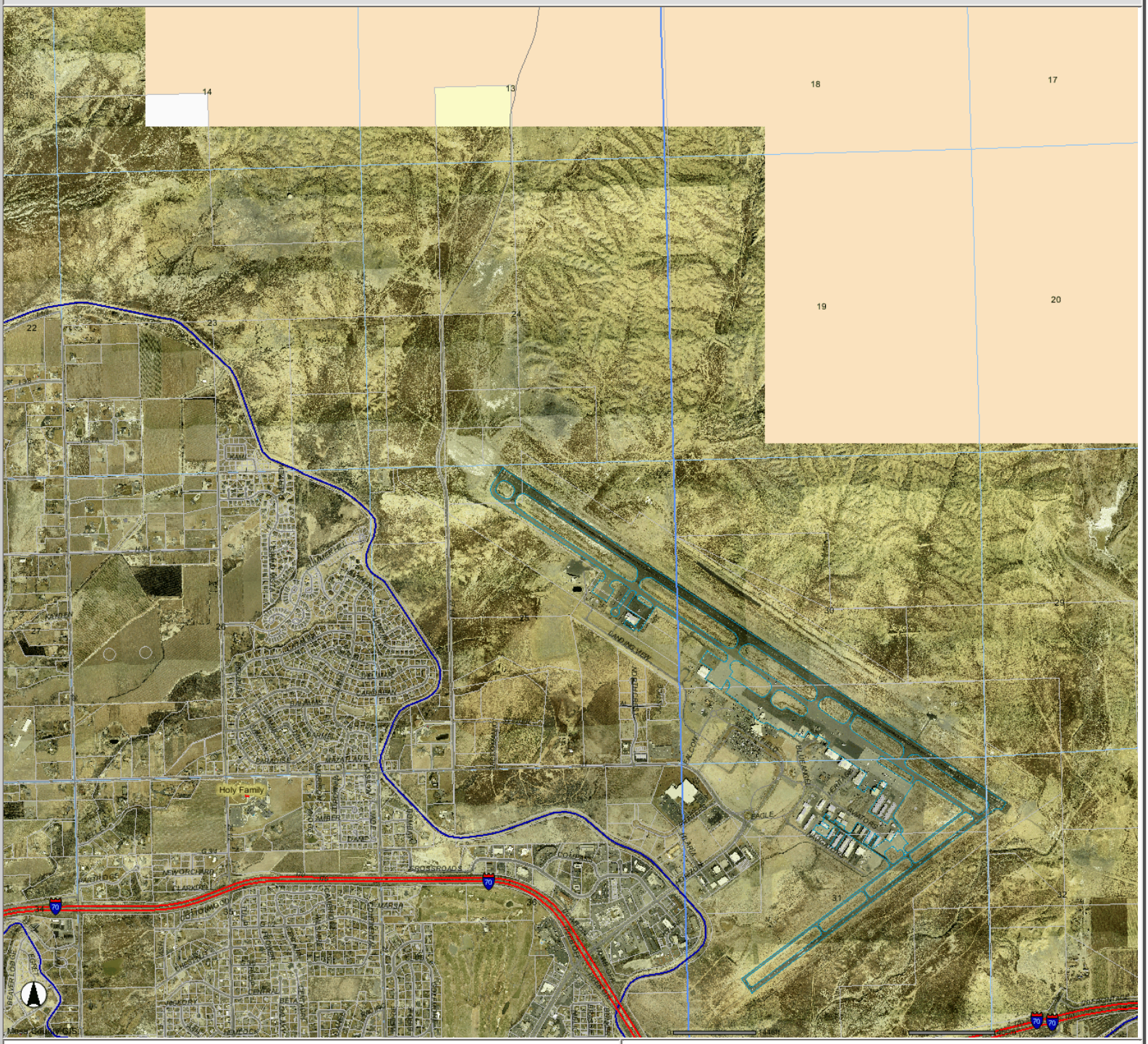
Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest

2006



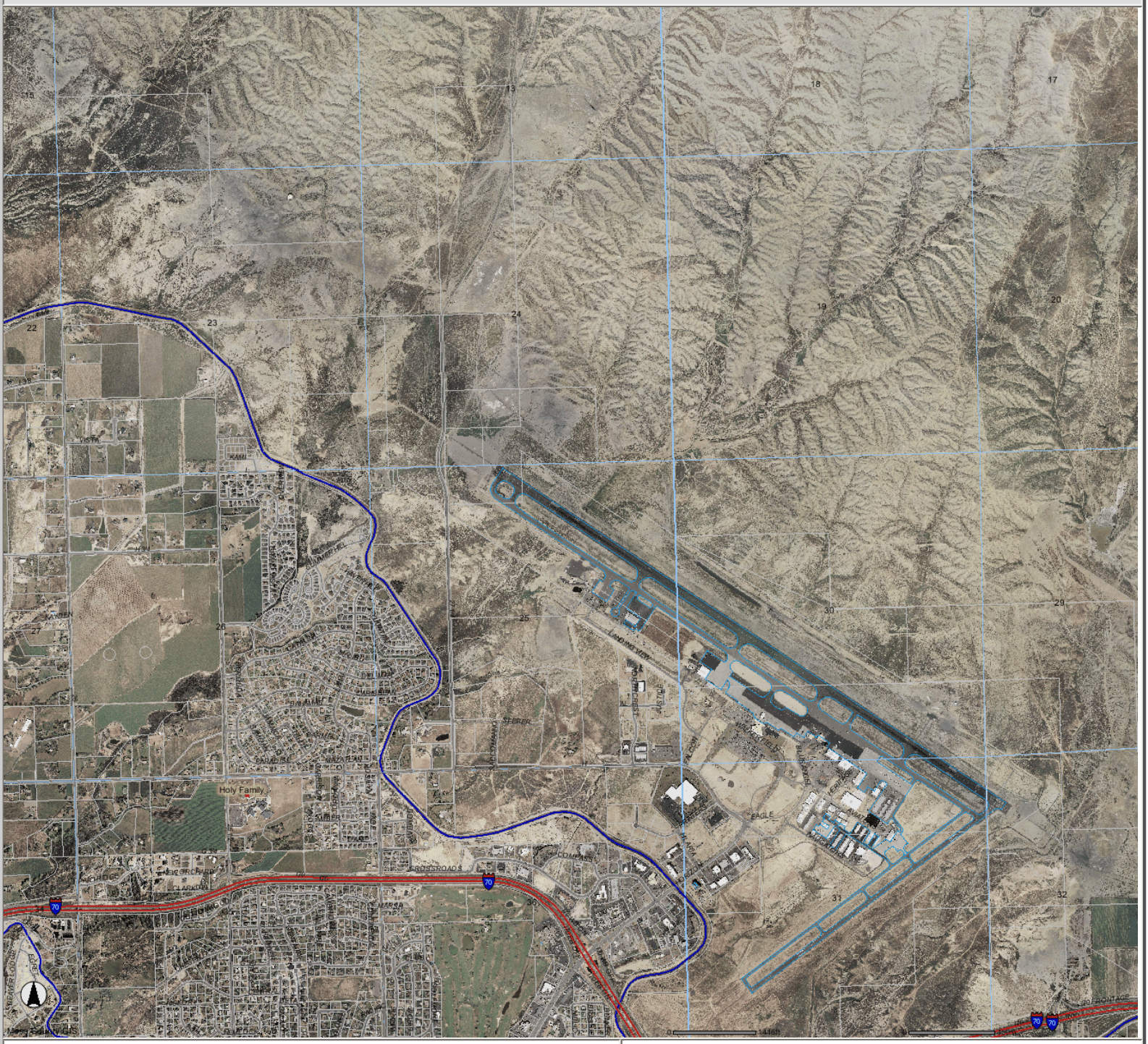
Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest

2007



Mesa County GIS
544 Rood Ave.
Grand Junction, CO 81501

DISCLAIMER : The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

LEGEND

- Hospitals
- Police Stations
- Fire Stations
- Schools
- State Highways
- Roads
- Lakes
- Canals
- Colorado National Monument
- BLM Special Areas
- Black Ridge Canyons
- COLORADO CANYONS NATIONAL CONSERVATION AREA
- BLM
- National Forest

C Photographs from Site Inspection



View of Zone A from the south property boundary to the north. Ute Water storage tank in the background north of Zone A.



View of Zone A from the northwest property boundary looking to the southeast. Over-head power lines cross the central portion of Zone A.



View from the south-east corner of Zone B looking south towards GJRA.



View from the south-east corner of Zone B looking southeast towards Zone C.



View from the south side of Zone C looking west.



View to the south boundary of Zone D looking south towards the GJRA.



View from the north-west corner of Zone D. Abandoned railroad grade crosses the photo's left side.



View from Zone E north proposed property boundary looking south with flagged survey stake at bottom of the photograph.

D Owner and End-User Questionnaires

Walsh Environmental Scientists and Engineers, LLC
Preassessment Questionnaire

Directions: The person(s) responding to this questionnaire should have sufficient knowledge of the property and environmental conditions at the property to understand the purpose of the questionnaire. Answers should be given to the best of the person responding's actual knowledge of the site. If the *occupant* of the property is different than the *owner*, a separate questionnaire should be completed by each.

1 INTRODUCTION

Please write legibly and use ink.

(a) Name of preparer Alan Kraus

(b) Title Hazardous Material Program Coordinator

(c) Phone number 970-640-3943

(d) Date 13 August 2012

(e) Length of time in current position 18 years

(f) Length of time at facility 22 years

(g) Facility location 2815 H Rd Grand Junction, CO 81506

2 RECORD REVIEW

Please indicate whether any of the documents listed below are available for the property.

	Yes	No	Unknown
(a) Environmental Site Assessment Report	~	(~)	~
(b) Environmental Audit Report	(~)	~	~
(c) Environmental Permits	~	~	~
—solid waste disposal	~	(~)	~
—air emission	~	(~)	~
—hazardous waste treatment, storage, or disposal	~	(~)	~
—waste water discharge permits	~	(~)	~

	Yes	No	Unknown
—NPDES permits	~	(~)	~
—other _____	~	~	~
(d) Petroleum or Hazardous Substance Tank Registration Forms Tank Closure Reports	~	(~)	~
(e) Material Safety Data Sheets (MSDS)	~	(~)	~
(f) SARA Title III, Community Right to Know (RTK) Reporting Forms	~	(~)	~
(g) Site Safety Plans (or other Business Plan)	~	(~)	~
(h) Preparedness and Prevention Plans	~	(~)	~
(i) Spill Prevention and Countermeasure (SPCC) Plans	~	(~)	~
(j) Hydrogeologic Reports	~	~	~
(k) Hazardous Waste Generator Notices	~	(~)	~
(l) Hazardous Waste Manifests	~	(~)	~
(m) Geotechnical Reports	~	(~)	~
(n) Environmental Inspection Reports	~	(~)	~
(o) Any records indicating Presence or Absence of PCBs in Transformers, Capacitors, or Hydraulic Equipment	~	(~)	~
(p) Plant/Facility layout and Topographic Maps	~	(~)	~
(q) Sewer Maps/Diagrams	~	(~)	~
(r) Wetland/Historic Preservation Area Maps	~	(~)	~
(s) Historical Aerial Photographs	(~)	~	~
(t) Process/Flow Descriptions or Diagrams	~	(~)	~

Note: Copies of the above documents should be made available to E & E at the time of the site visit.

3 FACILITY DESCRIPTION

	Yes	No	Unknown
(a) Are you aware of any pending threatened or past litigation relevant to the release of hazardous substances or petroleum products in, on, or from the property?	~	X	~
(b) Are you aware of any pending threatened or past administrative proceeding relevant to hazardous substances or petroleum products in, on, or from the property?	~	X	~
(c) Are you aware of any notices from any governmental entity regarding any possible violation of environmental laws or possible liability relating to hazardous substances or petroleum products at the property?	~	X	~
(d) Are there currently or have there ever been any damaged or discarded automotive/industrial batteries; pesticides; paints; or other chemicals/industrial containers of >5 gal (19 L) in volume or 50 gal (190 L) in aggregate, stored on, or used at the property?	~	X	~
(e) Has dirt fill ever been brought on the property? Little Brokcliff Railway Grade	X	~	~
(f) Are there or were there ever any pits ponds or lagoons located on the property which were used for waste treatment or disposal?	~	X	~
(g) Is there currently or was there previously any stained soil on the property? None in recent past.	~	~	X
(h) Are there currently or have there been any registered or unregistered (above or underground) storage tanks located on the property?	~	X	~
(i) Are there currently any flooring, drains, or walls located within the facility that are stained by substances other than water or are emitting foul or toxic odors?	~	X	~
(j) If the property is serviced by a private well, have contaminants ever been identified in the well in excess of applicable regulatory guidelines?	~	X	~

	Yes	No	Unknown
(k) Does the property discharge waste water other than storm water on or adjacent to the property, into a sanitary sewer system?	~	X	~
(l) Are you aware of the presence or likely presence of any hazardous substance or petroleum product on the property that could cause or contribute to a release into the ground, groundwater, or surface water at the property?	~	X	~

4 CERTIFICATION

Preparer represents that to the best of preparer's knowledge the above statements and facts are true and correct and, to the best of the preparer's actual knowledge, no material facts have been withheld or misstated.

Signature Alan E Kraus for Bureau of Land Management

Date 13 August 2012

Walsh
Environmental Scientists and Engineers

URGENT AND CONFIDENTIAL - FAX BACK TO (970) 241-4312
USER QUESTIONNAIRE FOR PHASE I ESAs

AS REQUIRED BY NEW ASTM STANDARD E1527-05

Site Name: Grand Junction Regional Airport Address: 800 Eagle Drive, Grand Jct, CO 81506

The person who will use the Phase I should provide the following information. Please fill in this form to the best of your ability, explaining any Yes answers on a separate sheet of paper. Without these answers, our report would have to note that the Phase One is incomplete, and your Landowner Liability Protections could be at risk. We need these answers before we conduct the site visit.

1. **Environmental Cleanup Liens.** ASTM requires the User to check for environmental liens that may be filed or recorded against the subject property under federal, tribal, state or local law. In Colorado, such liens might be listed in the "exceptions to coverage" in the property's title insurance commitment or policy. Failure to check for these liens could put your Landowner Liability Protections at risk.

   Have you checked for these environmental cleanup liens? I don't Know ☐ Yes ☐ No

   Are you aware of any such liens against the subject property? ☐ Yes ☐ No

2. **Activity and Use Limitations (AULs).** These include engineering controls (e.g., slurry walls, caps) and land use restrictions or institutional controls (e.g., deed restrictions, covenants) that may be in place at the site or filed under federal, tribal, state or local law. In Colorado, the title commitment or policy might also list AULs.

   Are you aware of any possible AULs involving the subject site? I don't Know ☐ Yes ☐ No

3. **Specialized Knowledge.** This involves personal knowledge or experience related to the subject property or nearby properties. For example, if you are involved in the same line of business as the current or former occupants of the property or an adjoining property, you would probably know of any chemicals, oil, degreasers, gasoline, or other hazardous substances commonly used in that type of business.

   Do you have any specialized knowledge that might indicate the past or present use of such substances on the subject or nearby properties? I don't Know ☐ Yes ☐ No

4. **Fair Market Value (FMV).** A purchase price significantly below FMV may indicate an environmental problem. Please note that this question does not require an appraisal of the property. If the price is significantly below FMV, the User should consider whether it might be because contamination may be present at the property.

   Is the purchase price significantly below fair market value? I don't Know ☐ Yes ☐ No

5. **Obvious Indicators.** This involves past or present spills, stains, releases, cleanups, etc. on or near the site.

   Do you know of any obvious indicators of possible contamination on or near the site? I don't Know ☐ Yes ☐ No

6. **Common Knowledge.** Please use a separate sheet if necessary.

   a. Describe the past uses of the property: I don't Know

   b. Describe any specific chemicals that may have been present at the property: I don't Know

   c. Describe any other information that may help us identify possible contamination: I don't Know

I have no Knowledge of any of the above information.

User Name: Amy Jordan **Company:** Grand Junction Regional Airpor

Signature: Amy Jordan **Date:** 8/23/2012 **# of separate sheets attached:** 0

Explain Yes answers on a separate sheet.

E ESA Preparers Qualifications

Robert Stockton

Project Manager, Environmental Scientist

KEY EXPERTISE

- ✓ REMEDIATION SYSTEMS INSTALLATION
- ✓ SOIL, GROUND-WATER INVESTIGATIONS AND REMEDIATION
- ✓ DATA COLLECTION AND INTERPRETATION
- ✓ ENVIRONMENTAL SITE ASSESSMENTS
- ✓ ASBESTOS INSPECTIONS
- ✓ SURVEYING AND MAPPING
- ✓ ENVIRONMENTAL MONITORING
- ✓ HEALTH AND SAFETY MONITORING
- ✓ FIELD DOCUMENTATION AND INSTRUMENTATION
- ✓ HAZARDOUS WASTE PROFILING AND MANIFESTING
- ✓ HISTORICAL RECORD SEARCHES
- ✓ VOLUNTARY CLEANUP AND REDEVELOPMENT

EDUCATION AND CERTIFICATIONS

- ✓ B.S., ENVIRONMENTAL RESTORATION AND HAZARDOUS WASTE MANAGEMENT, MESA STATE COLLEGE, 2000
- ✓ OSHA HEALTH AND SAFETY TRAINING
- ✓ CERTIFIED ASBESTOS INSPECTOR, AHERA AND COLORADO

Experience Summary

Mr. Stockton has eleven years of experience as an environmental consultant. He performs all phases of environmental site investigations, remediation, and waste disposal. He has installed remediation wells and systems for the clean-up of petroleum products. In addition, he has provided subcontractor oversight for the completion of various remediation and monitoring projects. Mr. Stockton has supervised and managed environmental, health, and safety issues during petroleum remediation projects and hazardous spills. Mr. Stockton's primary responsibility at Walsh is performing Phase I and Phase II Environmental Site Assessments.

Project Experience

Environmental Site Remediations

Mr. Stockton has installed and maintained an air sparging and soil vapor extraction system for the remediation of petroleum contaminated soil and groundwater at two high profile locations. He also assists with the maintenance and operation of other soil and groundwater remediation systems at other petroleum contaminated sites. Mr. Stockton has extensive background in monitoring, reporting, and remediating

Environmental Site Investigations

Mr. Stockton has performed over one-hundred Phase I Environmental Site Investigations and dozens of remediation projects, including obtaining groundwater, air, surface water, wastewater, soil, and waste samples.

Disposal Monitoring

Mr. Stockton has supervised and managed the environmental, health, and safety issues during hazardous spill and remediation projects. Successful completion of the projects required that Mr. Stockton determine sampling methods, transportation methods, and determine proper testing and disposal practices for potentially-hazardous wastes. Work done with on-site disposal monitoring includes projects done for Black Mountain Disposal and projects for On-Site Disposal in Rangely.

Environmental Health and Safety Monitoring

Mr. Stockton has implemented the environmental health and safety monitoring for the Xcel Energy facility in Cameo, and has done safety design plans for many other companies.

Employment History

Environmental Scientist, Walsh, 2000 to present.
Office Depot, June 1998 to January 2000.
Sprint Express, 1993 to 1998.
US Army, 1987 to 1993.

ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 11

NATIONWIDE PERMIT APPLICATION AND PRE-CONSTRUCTION NOTICE

Bio-Environs
114 N Boulevard Ste. 202
Gunnison, Co. 81230
970.641.8749
tim.bioenvirons@gmail.com

September 27, 2012

Nathan Green
U.S. Army Corps of Engineers
400 Rood Ave, Room 224
Grand Junction, CO 81501

From: Bio-Environs

Dear Mr. Green:

On behalf of Grand Junction Regional Airport, Bio-Environs is seeking authorization under NWP #14 and #39 for the construction of roads and grading associated with runway improvements, and NWP#43 for the construction of detention features. This letter serves in part as a pre-construction notification for proposed impacts to preliminary jurisdictional water features associated with the expansion of the existing airport runway area and associated features including the relocation of 27 ¼ road to the west of its current location, the construction of an airport perimeter road to the north of the proposed runway and the construction of 6 detention ponds, 3 water quality features and culverts to accommodate changes in drainage patterns associated with the relocated runway. The road relocation, perimeter road and detention features will impact portions of ephemeral drainages that generally flow from the north to the south through Bureau of Land Management (BLM) land and airport property. The Grand Junction Regional Airport is located 3.5 miles northeast of downtown Grand Junction, Co. within:

Mesa County, Colorado
Section 30, the SW ¼ SE ¼ Section 31 and the NW ¼ Section 32, T 1N R 1E
PM Ute 1880
Lat 39˚ 7’ 17.10” N, Long 108˚ 31’ 27.43” W NAD83
Elevation: Approximately 4850’
(Figures 1 and 2)

A delineation was completed and verified by the USACE in 2010 (Case # SPK 2010-00845) as part of an Environmental Assessment of airport expansion that is being conducted by the Grand Junction Regional Airport. The delineation was conducted within the 2010 Project Area boundaries and includes both existing airport property and the proposed BLM land transfer parcels. Although no jurisdictional wetlands were found within the project area, two named ephemeral

drainages and eleven unnamed ephemeral drainages are identified in the 2010 report (Figure 2). In our professional opinion, three of the identified features could be considered non-regulated waterways due to current ground conditions and a lack of hydrologic connection to Traditionally Navigable Waters of the US, however; all thirteen of the ephemeral (non-relatively permanent) drainages are identified as preliminarily jurisdictional water features in the report to meet the requirements of a "Preliminary Jurisdictional Determination" by the USACE. Originally the Airport was planning to request the transfer of approximately 720 acres of BLM lands in association with the proposed runway relocation (2010 Project Area, Figure 2). Since that time the original 720 acre parcel transfer has been reduced to approximately 190 acres during the first phase of the EA process (2012 Project Area, Figure 3). As a result impacts associated with the 2010 Project Area boundary have been reduced substantially, and therefore, impacts have been avoided and minimized through the EA process and the establishment of the reduced 2012 Project Area.

The Grand Junction Regional Airport Authority seeks authorization under NWP #14, NWP #39 and NWP #43 for impacts to approximately 0.38 surface acre and 7475 linear feet of "waters of the U.S." which includes 1240 linear feet of unregulated water features identified in the 2010 wetland delineation and wetland map (Table 1, Figure 2, Table 2, Figure 3). The existing airport property is comprised of the airport facilities and associated development, along with less developed land to the west of the airport facilities. Outside of the airport facilities, the less developed areas have been subject to various forms of excavation and grading associated with airport operations and drainage features. To the north and west the BLM dispersal parcels that are included in the Project Area are entirely within an Off Highway Vehicle (OHV) area. This land is extremely degraded by extensive OHV use throughout the parcels with many of the drainage features and ridge tops being used as travel routes through the adobe badland habitat. The use of the drainage features as OHV travel routes makes the identification of drainage channels and the OHWM difficult in some locations.

Table 1. Linear Footage, Width and Depth of Waters of the US within the Original 2010 Project Area (Taken from the 2010 wetland delineation, Bio-Environs).

Water of the US	NWI classification; Jurisdictional Status	Linear Feet Within APE	Avg. Width at OHWM (ft)	Avg. Depth at OHWM (in)
Leach Creek	Riverine, intermittent, streambed, seasonally flooded; Intermittent -RPW jurisdictional	7,200	2.0.	3.0
Indian Wash	Riverine, intermittent, streambed, seasonally flooded; Intermittent -RPW jurisdictional	1,800	4-6	4.0

E-1	OHWM present; –Non-RPW – jurisdictional	886	1.0	1.0
E-2	OHWM present; –Non-RPW – jurisdictional	3,872	2.0	4.0
E-3 North	OHWM present; –Non-RPW – jurisdictional	5,571	5.0	1.5
E-3 South	OHWM present; –Non-RPW – jurisdictional	3,237	2.5	6.0
E-4	OHWM present; –Non-RPW – jurisdictional	3,655	1.5	2.0
E-5	OHWM present; –Non-RPW – jurisdictional	2,216	1.5	2.0
E-6	OHWM present; –Non-RPW – jurisdictional	4,266	2.0	2.0
E-7	OHWM present; –Non-RPW – jurisdictional	1,253	2.0	2.0
E-8	OHWM present; –Non-RPW – jurisdictional	1,066	2.0	2.0
WF-1	Jurisdictional-Preliminary Determination	694		
WF-2	Jurisdictional- Preliminary Determination	550		
WF-3	Jurisdictional_ Preliminary Determination	1,456		
Total		**28,914**	**N/A**	**N/A**

All of the identified drainages are in poor condition and are generally comprised of arroyos that have cut deeply into the highly erodible adobe badland habitat. They form as a result of precipitation events and geological position. There is no subsurface or shallow ground water present under these drainages. They typically support bare banks at places where the banks are at right angles to the drainage bottom or a combination of greasewood (*Sarcobatus vermiculatus*) and rabbitbrush (*Chysothamnus nauseosus*) on the bank slopes to the drainage bottom. Remnants of last year's tumbleweed growth were present in all drainages at the time of investigation. Also, many if not all of the drainages were crossed by OHV tracks, and these crossings included establishment of OHV trails down the banks, through the drainage and then up the other bank (Photographs 1 and 2). In some cases the bottom of the larger drainages are used as active OHV routes. At least four dams have been placed within the drainages, and all but one remains intact. The dams are associated with a grassed flatland supporting a few tamarisk shrubs (*Tamarix ramosissima*), greasewood and rabbitbrush. Drainage detention features can be found in various areas throughout the airport property.

Within the 2012 Project Area, approximately 7475 linear feet (this total includes 1240 linear feet of a linear water feature [WF-3] that does not connect to other waters) and approximately 0.38 surface acres of ephemeral drainage would be impacted as a result of the development of 1) detention features, 2) an airport perimeter road that is included in the detention feature configuration at drainage crossings, and 3) grading associated with the construction of the proposed runway relocation and improvements within the current Project Area (Table 2, Figure 3). In total, approximately 0.014 surface acre and 230 linear feet of ephemeral drainage will be impacted by the relocation of 27 ¼ road and the perimeter road crossing of Indian Wash (NWP #14), approximately 0.20 surface acres and 3970 linear feet of ephemeral drainage will be impacted by grading associated with the runway improvements (NWP #39) and approximately 0.17 surface acres and 3275 linear feet of ephemeral drainage will be impacted by the construction of detention features that include the proposed perimeter road (NWP #43). Approximately 198.0 cubic yards of earthen fill will be placed below OHWM in associated with the proposed impacts (Table 2).

Table 2. Proposed impacts to drainages that exist within the current 2012 Project Area.

Water of the US	Linear Feet Within Current PROJECT AREA	Proposed Impacts to Drainage Feature - Road and/ or Grading (LF)	Proposed Impacts to Drainage Feature- Detention Feature (LF)	Avg. Width at OHWM (ft)	Avg. Depth at OHWM (in)	Area of Impact -Road or Grading (Acres)	Area of Impact - Detention Feature (Acres)	Approximate Proposed Fill Below OHWM (Cubic Yards)
Leach Creek	4,770	190	260	2.0	3.0	0.009 ac	0.01	8.3
Indian Wash	2640	40	0.0	4-6	4.0	0.005	0.0	2.4
E-1	890	0.0	0.0	1.0	1.0	0.0	0.0	0.0
E-2	1,760	400	320	2.0	4.0	0.02	0.0	9.7
E-3 North	2,900	1,000	620	5.0	1.5	0.1	0.08	77.3
E-3 South	3,340	950	400	2.5	6.0	0.05	0.02	63.0
E-4	3,655	0	300	1.5	2.0	0.005	0.01	4.0
E-5	200	0.0	200	1.5	2.0	0.0	0.007	2.7
E-6	2,520	780	425	2.0	2.0	0.03	0.02	22.3
E-7	1,293	0.0	450	2.0	2.0	0.0	0.02	8.0
E-8	1,066	0.0	0.0	2.0	2.0	0.0	0.0	0.0
WF-1	694	0.0	0.0	N/A	N/A	0.0	0.0	0.0
WF-2	550	0.0	0.0	N/A	N/A	0.0	0.0	0.0
WF-3	1536	840	300	N/A	N/A	0.0	0.0	0.0
Total	**27,814**	**4200**	**3275**			**0.21 ac**	**0.17**	**198.0**

As presented in the figures section, Sheets 1-12 provided by Jviation (the Airport's current engineering firm), the design features associated with road crossings, and creating water detention and water quality improvements allow for continued movement of water from the surrounding landscape through the project area to ditches that eventually flow to the Colorado River. Water will still continue to flow through the drainages during storm events, but will be detained to slow flows, decrease erosion downstream and improve water quality. Drainages with steep banks also support habitat for birds and mammals as they can nest within cavities formed along the drainages' sides. Vegetation will be removed or occasionally inundated within the proposed detention features.

Table 3 provides a list detailing the Jviation design sheet number, the feature such as grading, road crossing or detention or water quality feature, the specific waters of the US that are impacted and the mitigation action as a result of construction. All detention features will have energy dissipation below the culverted outlet to reduce erosion in the drainage. Natural bottom culverts will be used for the 27 ¼ Road crossing of Leach Creek (Sheet 10) and for the perimeter road crossing of Indian Wash. These two drainages are identified as intermittent features on NWI maps, but are truly ephemeral in nature because the source of water in these drainages is from storm events and not from a rise in seasonal groundwater table.

Please refer to the individual design sheets (Sheets 1-12) for review of the plan and cross-section views for each impact area.

Table 3. Design sheet number, impact area and mitigation design action.

Sheet #	Feature	Impact Area	Mitigation Action
1	Pond 1, 27 ¼ Road	Leach Creek	Energy dissipation below outlet structure
2	Pond 2	No mapped drainage – no impact	Energy dissipation below outlet structure
3	Pond 3, perimeter road	E-3, E-4, E-5	Energy dissipation below outlet structure
4	Pond 4, perimeter road	E-6	Energy dissipation below outlet structure
5	Pond 4a, perimeter road	WF-3	Energy dissipation below outlet structure
6	Pond 4b	E-6	
7	Pond 5	No mapped drainage – no impact	Energy dissipation below outlet structure
8	Pond 6, 27 ¼ Road	E-7	Energy dissipation below outlet structure
9	Pond 7	E-3	Energy dissipation below outlet structure
10	Rd crossing 27 ¼ Road	Leach Creek	Natural bottom culvert
11	Rd crossing- Perimeter Road	Indian Wash	Natural bottom culvert
12	Grading - general	Leach Creek, E-3, E-6	Not applicable

Additional Mitigation Ephemeral drainages serve to move water off the landscape during storm events. They are susceptible to severe erosion depending on the intensity and duration of the storm and therefore, they are very dynamic. While placing culverts in them or constructing detention features may constitute an impact according to the Clean Water Act, the impact is negligible to aquatic organisms since permanent waters are not present. Impacts may accrue to mammals and birds that use the drainages for cover, food, roosting and nesting.

However, given the very dynamic nature of the ephemeral drainages and the intense recreational use in the area, minimal impacts will accrue to the existing mammals, birds and other organisms using the area. Regardless, it is important to note that in the adobe badland habitat, water movement through the landscape is an important driver in overall landscape development as well as in microhabitat development, which is important to seed germination and soil crust development, both of which stabilize soil. With this in mind and in addition to the engineering mitigation actions, the Grand Junction Regional Airport proposes to improve the microhabitat in portions of 3 drainages within the Project Area. These include Leach Creek (4530 LF), Indian Wash (2650 LF) (Photograph 3) and portions of ephemeral drainage E-3 north (1250 LF) (Photograph 4) (Figure

4). Mitigation will include use of vertical mulching on the slopes of the existing drainages at existing OHV crossings or severely degraded streambank locations.

Vertical mulching includes “planting” dead woody material in a vertical position and placing native rock in strategic locations in order to catch debris that is carried down during storm events. The accumulation of material behind the vertical mulch and rock will allow for microhabitat development suitable for plant growth on the drainage banks (Figure 5). Though direct seeding and planting is desirable in many restoration situations under moister conditions, this kind of restoration would not work nor would it be sustainable due to the dynamic nature of these drainages and the lack of precipitation in this desert region. Therefore, mitigation is directed towards microhabitat development and soil stabilization. In addition, Leach Creek and Indian Wash present opportunities for mitigation. OHV crossings can be obliterated and the areas of greatest impact remediated through vertical mulching. These areas will be fenced out from further recreational use. Figure 6 represents FEMA mapping in the Grand Junction Regional Airport area.

Figure 5 shows that vertical mulching and rock placement along the drainage slopes will occur at existing OHV crossings or severely degraded streambank locations. Vertical mulching consists of “planting” dead shrub material in an upright position and placing rock material on the slopes; 4 to 8 shrubs or rock clusters will be placed at remediated OHV crossings and along severely degraded slopes of the drainages. In total, improvements will encompass 7475 linear feet of drainage in an effort to minimize impacts to 7475 linear feet of ephemeral drainage and water feature (WF-3).

Additional mitigation for impacts to ephemeral drainages in the project area will be provided through the fencing off of the entire reach of Leach Creek that exists within the Project Area. This approximately 4770 LF reach of Leach Creek is currently subject to intense use by the public and OHV enthusiasts, but will be included inside the restricted airport perimeter upon completion of the proposed expansion and will not include public access. Termination of public access to this feature will greatly decrease the continued degradation and human induced alteration of the drainage course.

Off-site, supplementary mitigation to flooding flows in the Leach Creek drainage will be addressed in a proposal by the BLM to construct a detention basin on the Leach Creek drainage. The feature is planned upstream of the airport reach of Leach Creek. Storm water that originates in the Leach Creek basin runs through residential and commercial areas in Grand Junction has caused flooding and severe property damage. The proposed detention basin will mitigate any extreme flooding events and the impact to the drainage and the areas that exist downstream.

The results of the EA that is being conducted in association with the proposed runway improvements addresses whether endangered or threatened species are impacted by the project. The EA for this project is currently being finalized and could be submitted upon completion. Currently, field surveys conducted as part of the EA found that no Threatened and Endangered species exist within the project area. However, comments from the USFWS service preliminarily identify the existence of four federally listed fishes which exist off-site in the Upper Colorado River that could be affected by water depletions to the Upper Colorado River Basin that result from project actions. Cumulative water depletions from the Colorado River Basin are considered likely to jeopardize the continued existence of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker and result in the destruction or adverse modification of their critical habitat. Under the proposed Drainage Plan, all water that could flow within the ephemeral drainages will still be directed towards the Colorado River, and water temporally captured in detention features or water quality features will eventually flow to the Colorado River, except for very minor depletions in the form of evaporation from the detention features. Based on Jviation's design of the detention features, any water that is detained in the proposed detention features will be released within approximately 40 hours of a storm event and inundate the pond basins for a very short duration with little evaporation taking place. The detention features were designed per the Grand Junction Stormwater Management Manual for 10-year (1.12 inch) and 100-year (2.01 inches) storm events. If water remains in the detention features for only 40 hours, evaporation is minimal – approximately 0.26 ac- ft/year based on a simple calculation using the Thornwaite method (Dunne and Leopold, 1978). Therefore, calculated total annual evaporation from detention features is less than 100 ac-ft. In July 2008, BLM prepared a Programmatic Biological Assessment (PBA) that addresses water depleting activities in the Colorado River Basin. In response to BLM's PBA, the FWS issued a Programmatic Biological Opinion (PBO)(#ES/GJ-6-CO-08-F-0010) on February 25, 2009, which determined that water depletions from the Colorado River Basin resulting from BLM actions described in the PBO are not likely to jeopardize the continued existence of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker or result in the destruction or adverse modification of their critical habitat. The PBO addresses internal and external BLM projects including impoundments, diversions, water wells, pipelines, and spring developments. The FWS determined that projects that fit under the umbrella of the PBA would avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletion impacts to the Upper Colorado River Basin if they deplete relatively small amounts of water (less than 100 AF) and BLM makes a one-time contribution to the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program) in the amount equal to the average annual acre-feet depleted by each project. The PBO instructed BLM to make an annual payment to the National Fish and Wildlife Foundation (NFWF) to cover all BLM authorized actions that result in water depletions. The proposed detention ponds for the airport will deplete 0.26 acre-feet annually. This project has been entered into

the Grand Junction Field Office water depletion log which will be submitted to the Colorado State Office at the end of the Fiscal Year. The CSO is responsible for paying depletion fees based on the annual statewide total (BLM Grand Junction Field Office, Personal communication, Heidi Plank, 9/21/12).

An *Intensive Level Historical Resources Inventory* and *Class 111 Archeological Inventory* (attached separately) was conducted as Part of the EA.

A USACE PCN checklist providing additional information regarding general and regional conditions where applicable to this PCN Letter is included in Appendix A.

On behalf of Grand Junction Regional Airport we are submitting a 1:1 mitigation ratio for impacts to the ephemeral drainages that are associated with the proposed runway expansion project.

We are also requesting a written waiver to exceed the 300 linear foot limitation of impacts to streambed associated with NWP #39 and NWP # 43 as there will be minimal adverse affects to the conveyance of surface waters and the ecological services provided by the identified drainages. No wetlands will be impacted by the proposed runway improvements.

Again, please consider authorization of this project and the associated mitigation under Nationwide #14, #39 and #43.

Should you have questions, please contact me at your convenience.

Sincerely,

Tim Lapello
Bio-Environs

PHOTOGRAPHS
Grand Junction Regional Airport
Pre-construction Notification





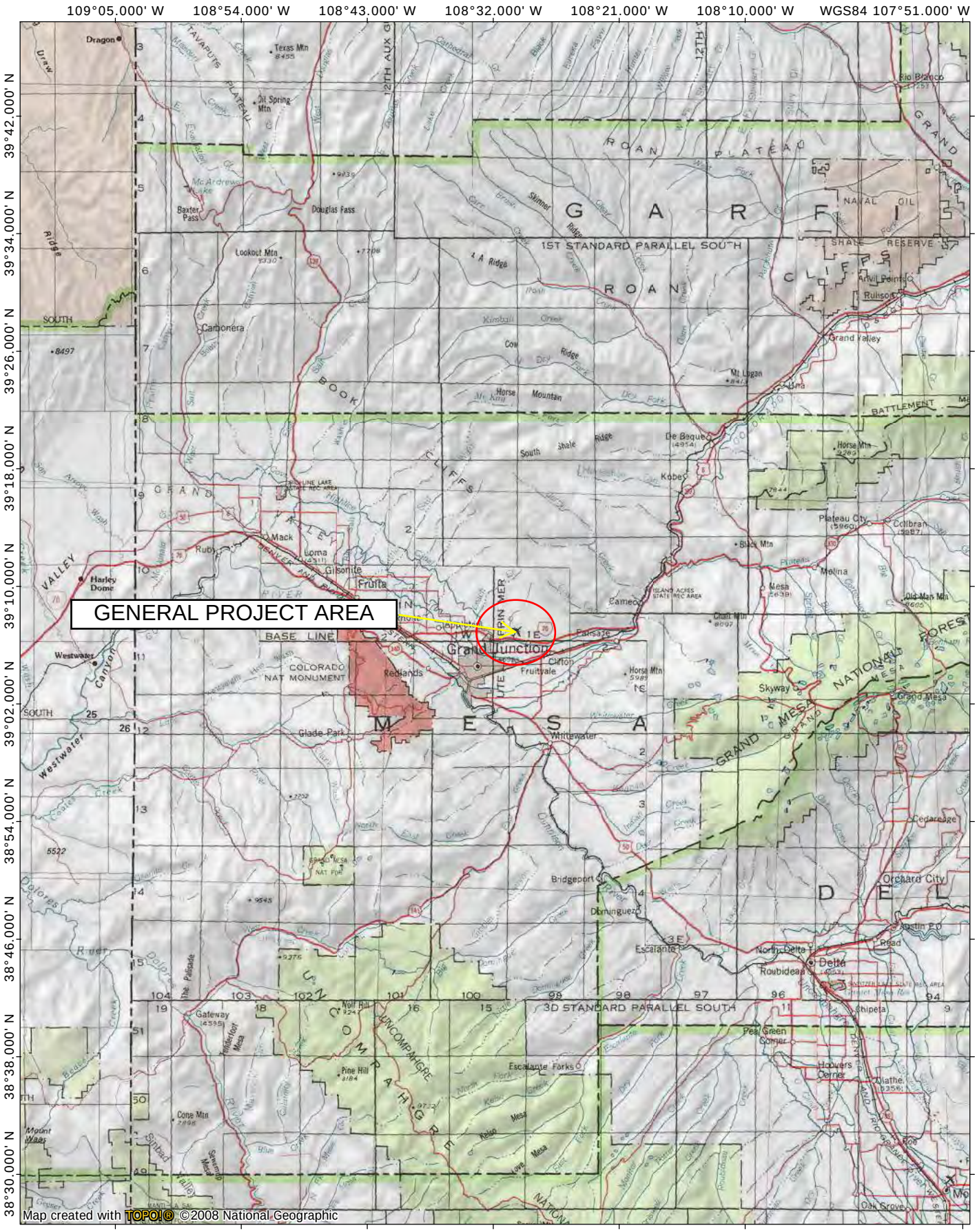
Photographs 1 and 2. Photographs taken looking north and south of degraded areas of Leach Creek that exist on airport property. These areas provide obvious opportunities for mitigation.



Photographs 3 and 4. Photographs taken looking south and north respectively of Indian Wash and E-3 north near proposed detention feature. Portions of These degraded drainages also provide obvious opportunities for mitigation.

FIGURES
Grand Junction Regional Airport
Pre-construction Notification

FIGURE 1. GENERAL LOCATION OF PROJECT AREA, GRAND JUNCTION REGIONAL AIRPORT



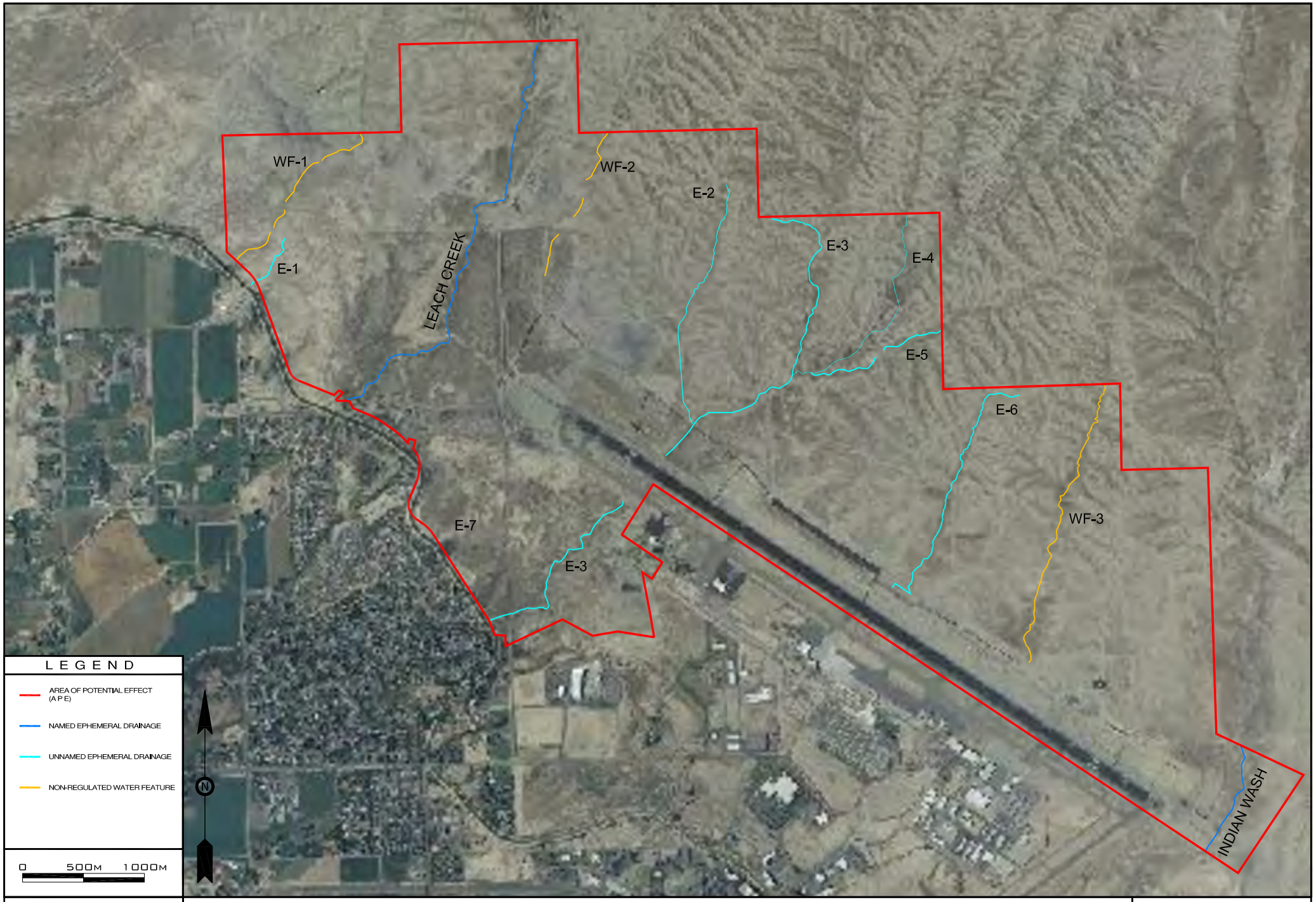


FIG. 2

PROPOSED GRAND JUNCTION REGIONAL AIRPORT EXPANSION

GRAND JUNCTION REGIONAL AIRPORT

GRAND JUNCTION, COLORADO

BIO-ENVIRONS
Environmental Consulting
114 North Boulevard
Gunnison, Colorado 81230
(970) 641-8749
bioenvirons@gunnison.com

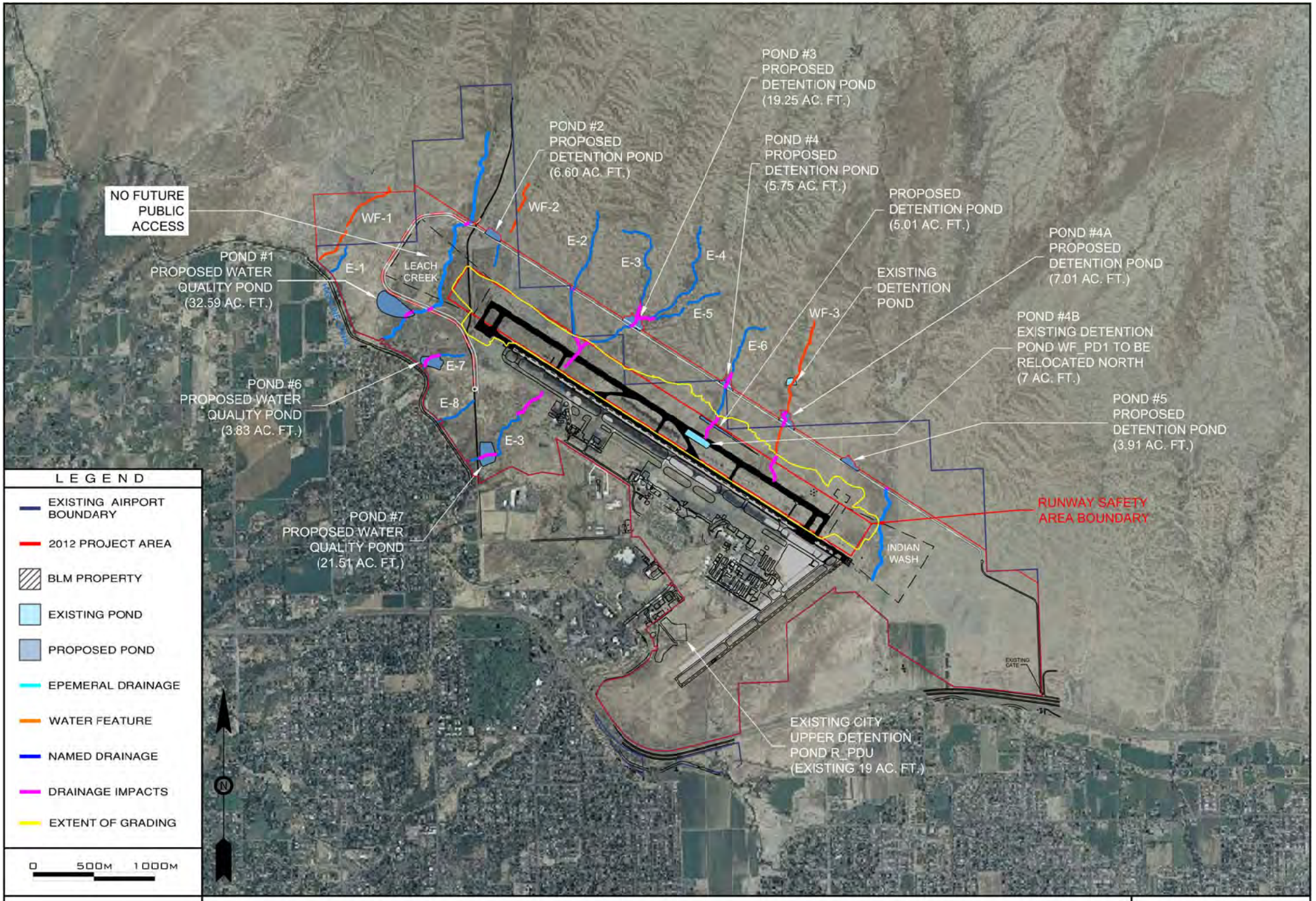


FIG. 3

PROPOSED IMPACTS TO "WATERS OF THE U.S."-GRADED

GRAND JUNCTION REGIONAL AIRPORT

GRAND JUNCTION, COLORADO

BIO-ENVIRONS
ENVIRONMENTAL CONSULTING
114 NORTH BOULEVARD
GUNNISON, COLORADO 81230
(970) 641-8749
BIOENVIRONS@GUNNISON.COM

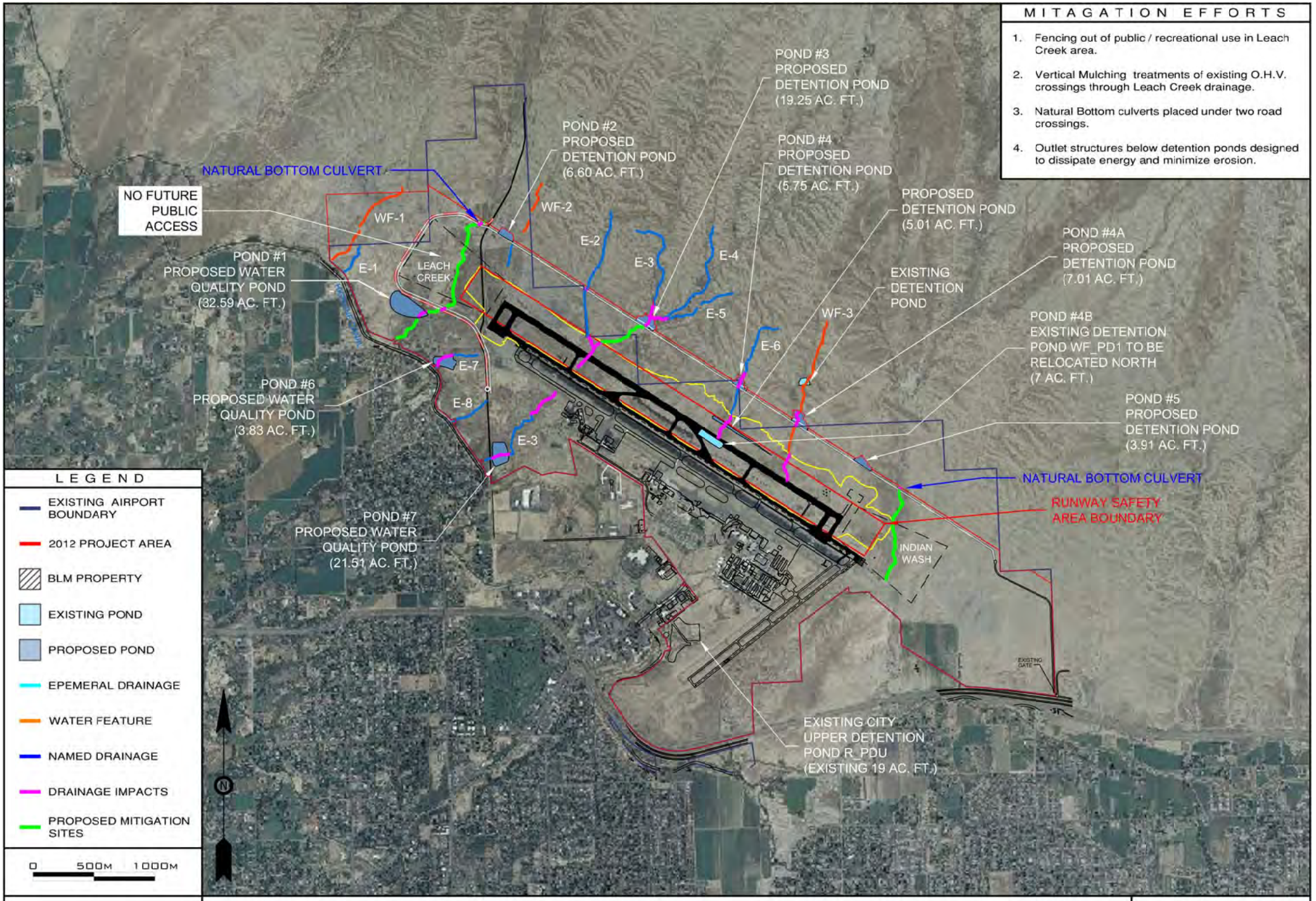


Fig. 4

'WATERS OF THE U.S.' - MITIGATION MAP

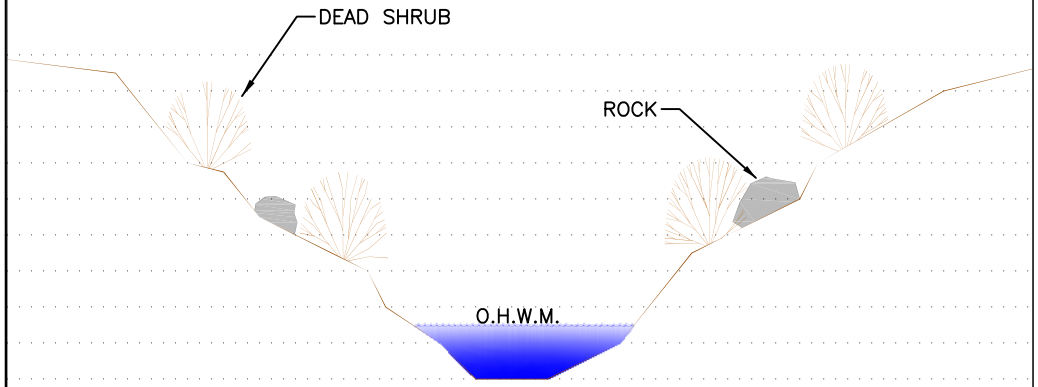
GRAND JUNCTION REGIONAL AIRPORT

GRAND JUNCTION, COLORADO

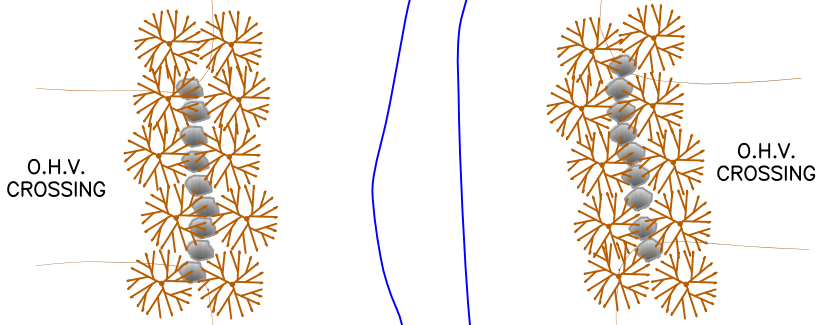
BIO-ENVIRONS
ENVIRONMENTAL CONSULTING
114 NORTH BOULEVARD
GUNNISON, COLORADO 81230
(970) 641-8749
BIOENVIRONS@GUNNISON.COM







TYPICAL CROSS SECTION



PLAN VIEW

FIG. 5

PROPOSED MITIGATION - VERTICAL MULCHING

GRAND JUNCTION REGIONAL AIRPORT

GRAND JUNCTION, COLORADO

BIO-ENVIRONS
ENVIRONMENTAL CONSULTING
114 NORTH BOULEVARD
GUNNISON, COLORADO 81230
(970) 641-8749
BIOENVIRONS@GUNNISON.COM

Figure 6. Fema Floodplain, Grand Junction Regional Airport

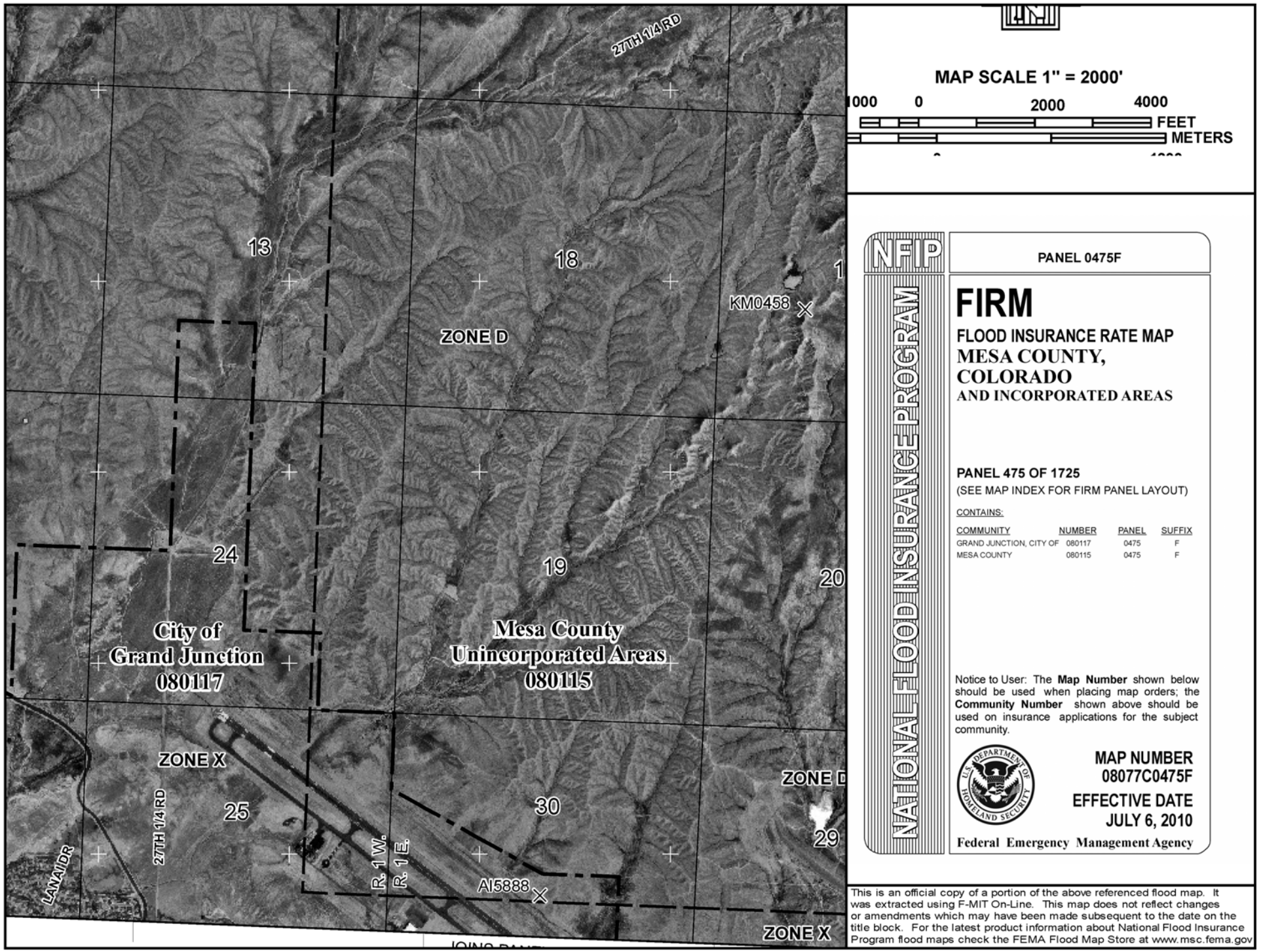
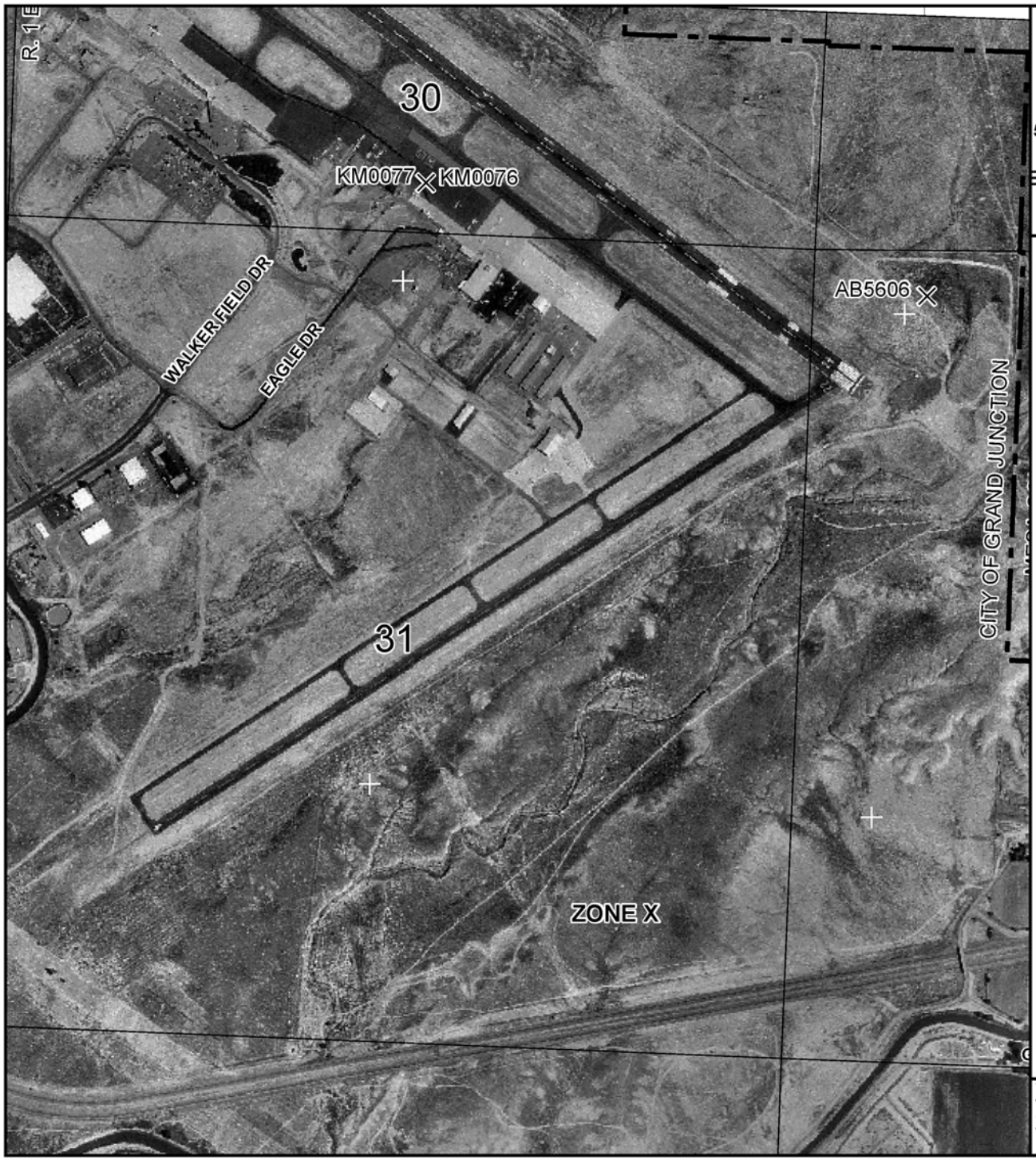


Figure 6. Continued



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0810F

FIRM

FLOOD INSURANCE RATE MAP

MESA COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 810 OF 1725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GRAND JUNCTION, CITY OF	080117	0810	F
MESA COUNTY	080115	0810	F

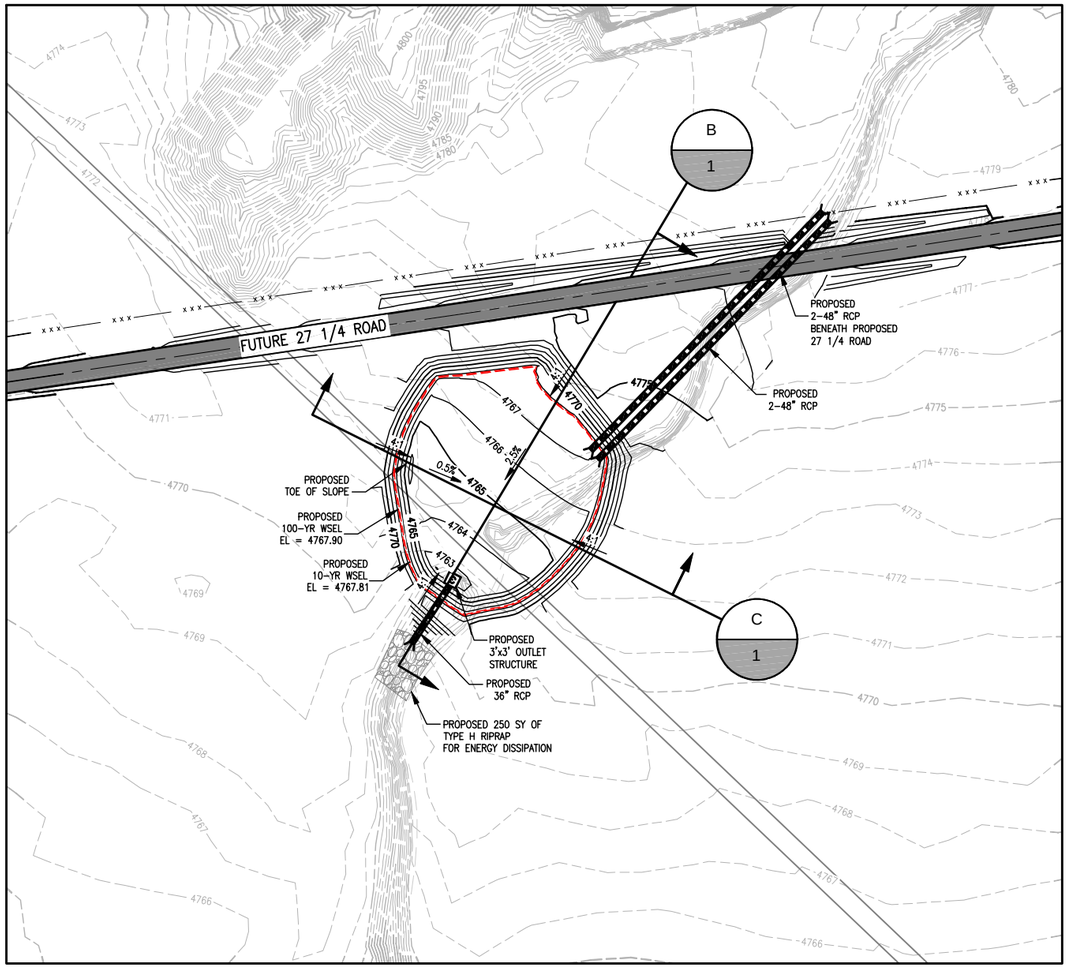
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08077C0810F

EFFECTIVE DATE
JULY 6, 2010

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

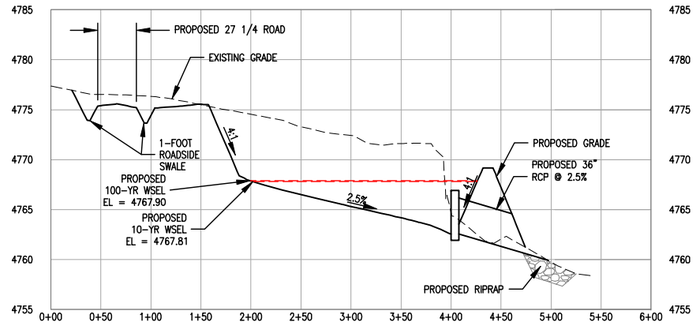


A 1 PROPOSED POND 1 – (WATER QUALITY ONLY– 4.00 ACRE-FEET)
PLAN VIEW

HYDRAULIC CHARACTERISTICS		
	10 YEAR EVENT	100 YEAR EVENT
FLOW INTO POND	45 CFS	137 CFS
FLOW OUT OF POND	45 CFS	137 CFS

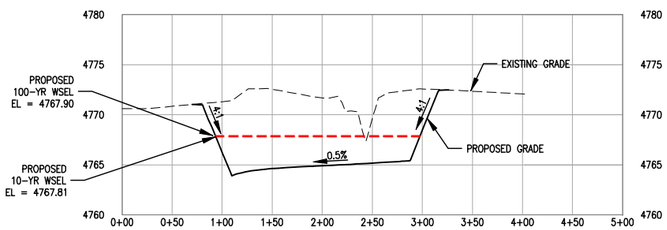
EARTHWORK QUANTITIES	
CUT	11,900 CY
FILL	1,300 CY

NOTE: EARTHWORK IS DEFINED AS THE VOLUME OF SOIL THAT IS REQUIRED TO BE FILLED/CUT TO REACH A FINAL ELEVATION FROM EXISTING CONDITIONS.



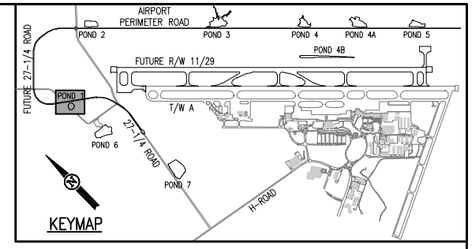
NOTE: WSEL = WATER SURFACE ELEVATION

B 1 PROPOSED POND 1 – SECTION B
PROFILE VIEW



NOTE: WSEL = WATER SURFACE ELEVATION

C 1 PROPOSED POND 1 – SECTION C
PROFILE VIEW



PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

GRAPHIC SCALE
75 0 75 150
(IN FEET)

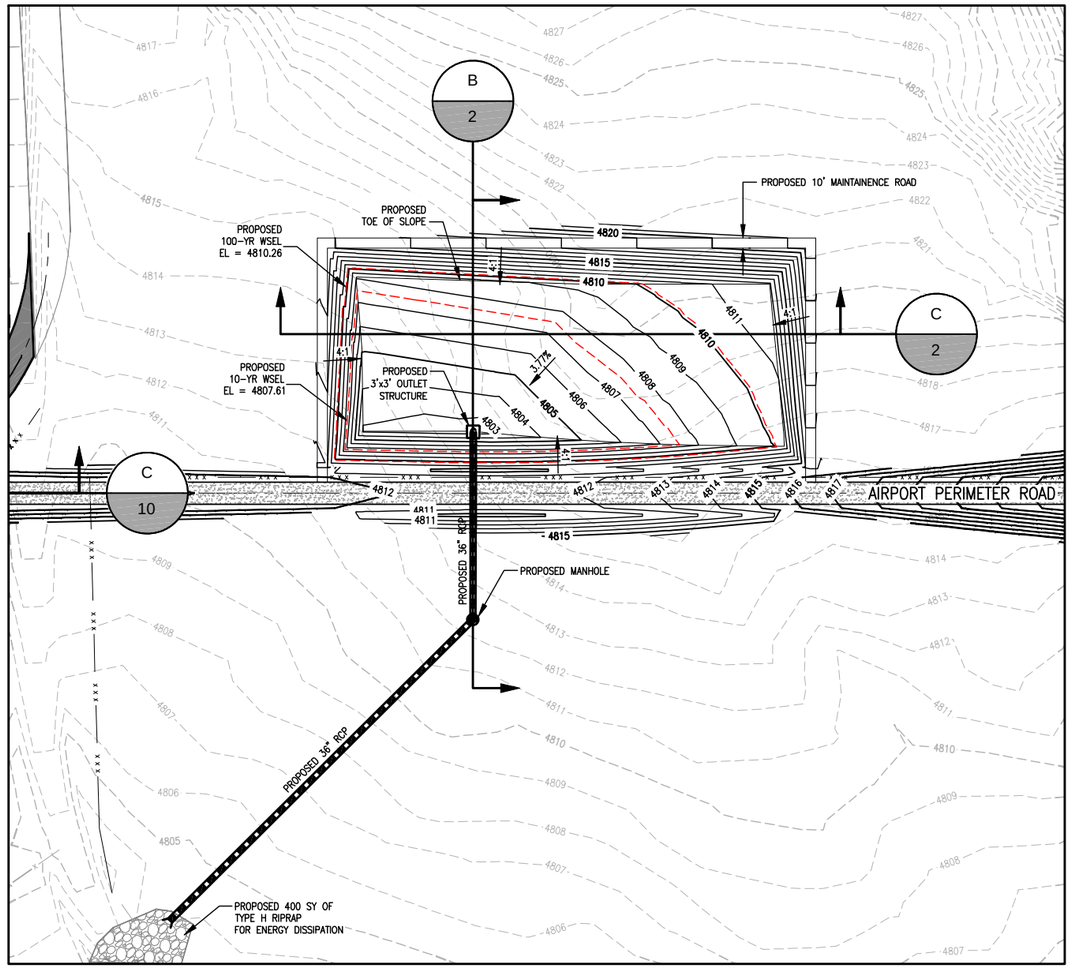
GRAND JUNCTION REGIONAL AIRPORT

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

POND 1 - DETAILS (25% DESIGN) ENVIRONMENTAL ASSESSMENT

DATE: JULY 26, 2012

J:\Projects\GJT\C40\GJT-RW 11?9-DPBD-GJT-11-01\EA-RW 11?9\EXHIBITS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:46am dovid.le

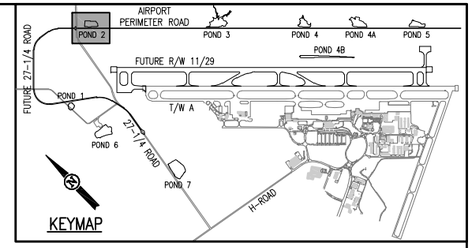


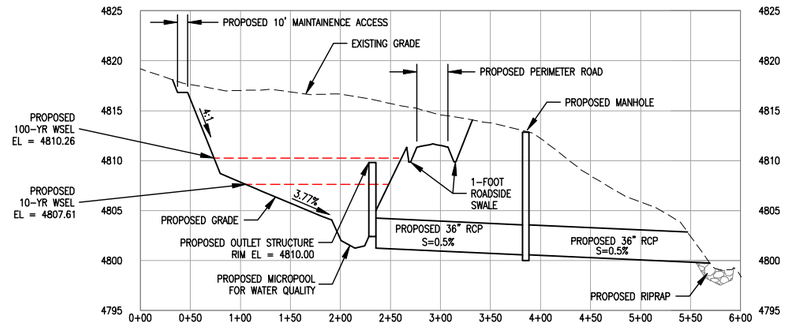
A 2 — PROPOSED POND 2 – (STORAGE OF 6.60 ACRE-FEET)
PLAN VIEW

HYDRAULIC CHARACTERISTICS		
	10 YEAR EVENT	100 YEAR EVENT
FLOW INTO POND	47 CFS	128 CFS
FLOW OUT OF POND	26 CFS	76 CFS

EARTHWORK QUANTITIES	
CUT	36,500 CY
FILL	50 CY

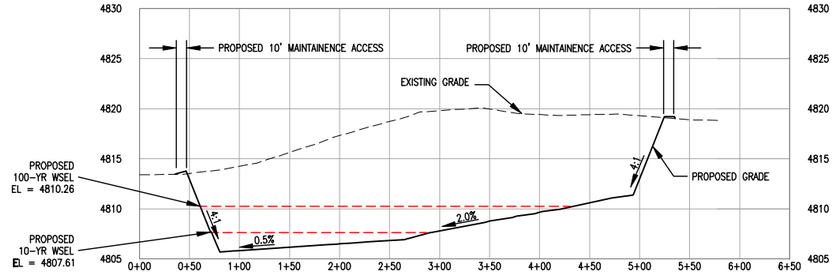
NOTE: EARTHWORK IS DEFINED AS THE VOLUME OF SOIL THAT IS REQUIRED TO BE FILLED/CUT TO REACH A FINAL ELEVATION FROM EXISTING CONDITIONS.





NOTE: WSEL = WATER SURFACE ELEVATION

B 2 — PROPOSED POND 2 – SECTION B
PROFILE VIEW



NOTE: WSEL = WATER SURFACE ELEVATION

C 2 — PROPOSED POND 2 – SECTION C
PROFILE VIEW

GRAND JUNCTION REGIONAL AIRPORT

PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

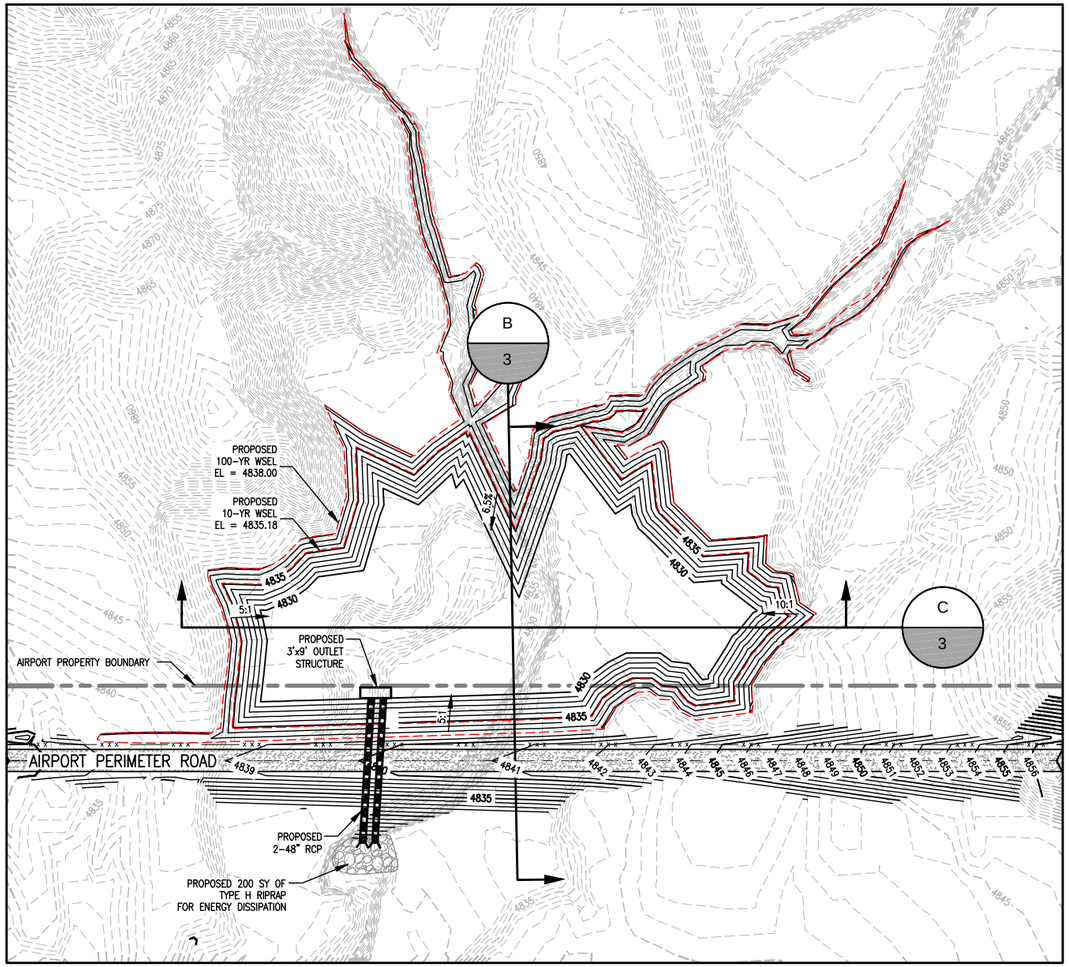
GRAPHIC SCALE
75 0 75 150
(IN FEET)

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

POND 2 - DETAILS
(25% DESIGN)
ENVIRONMENTAL ASSESSMENT

DATE: JULY 26, 2012

J:\Projects\GJT\CAD\GJT-RW 11?9-DPBB-GJT-11-01\EA-RW 11?9\DWGBITS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:46am dovick



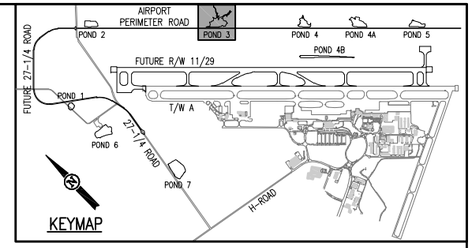
A
3

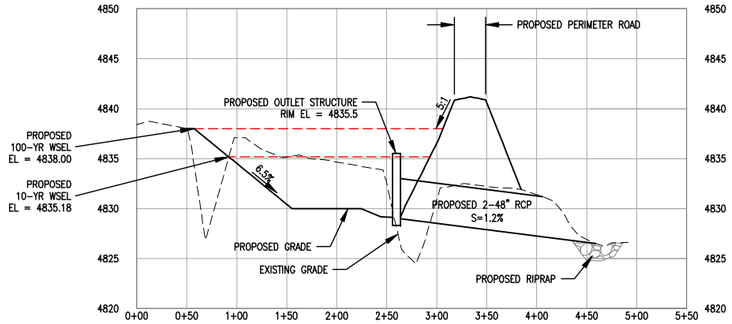
PROPOSED POND 3 – (STORAGE OF 22.39 ACRE-FEET)
PLAN VIEW

HYDRAULIC CHARACTERISTICS		
	10 YEAR EVENT	100 YEAR EVENT
FLOW INTO POND	104 CFS	305 CFS
FLOW OUT OF POND	53 CFS	224 CFS

EARTHWORK QUANTITIES	
CUT	19,650 CY
FILL	5,350 CY

NOTE: EARTHWORK IS DEFINED AS THE VOLUME OF SOIL THAT IS REQUIRED TO BE FILLED/CUT TO REACH A FINAL ELEVATION FROM EXISTING CONDITIONS.

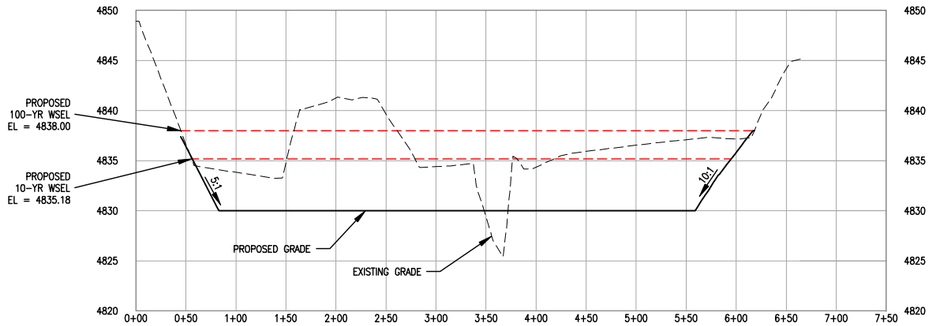




NOTE: WSEL = WATER SURFACE ELEVATION

B
3

PROPOSED POND 3 – SECTION B
PROFILE VIEW



NOTE: WSEL = WATER SURFACE ELEVATION

C
3

PROPOSED POND 3 – SECTION C
PROFILE VIEW

GRAND JUNCTION REGIONAL AIRPORT

PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

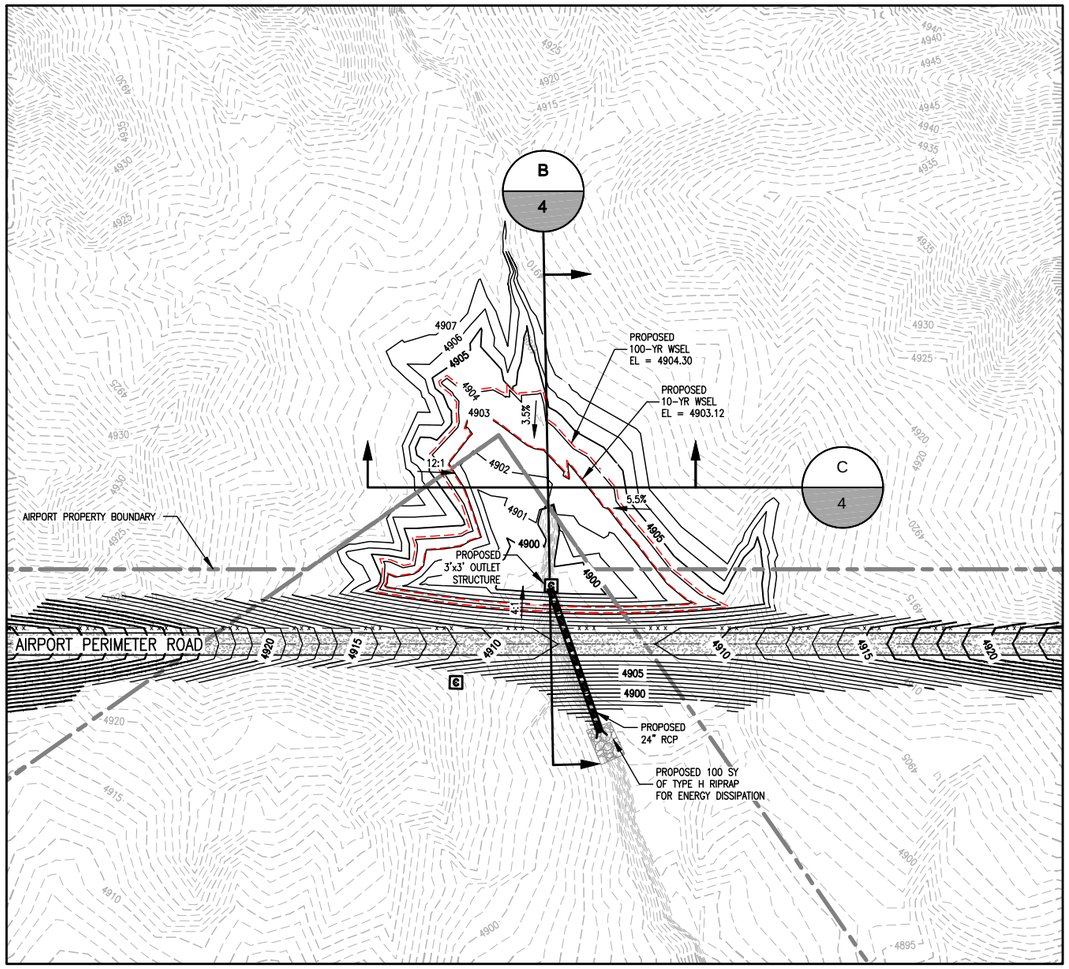
GRAPHIC SCALE
75 0 75 150
(IN FEET)

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

POND 3 - DETAILS
(25% DESIGN)
ENVIRONMENTAL ASSESSMENT

DATE: JULY 26, 2012

J:\Projects\GJT\CAD\GJT-RW 11?9-9?\BG-GJT-11-01\EA-RW 11?9\EXHIBITS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:47am dandi.le



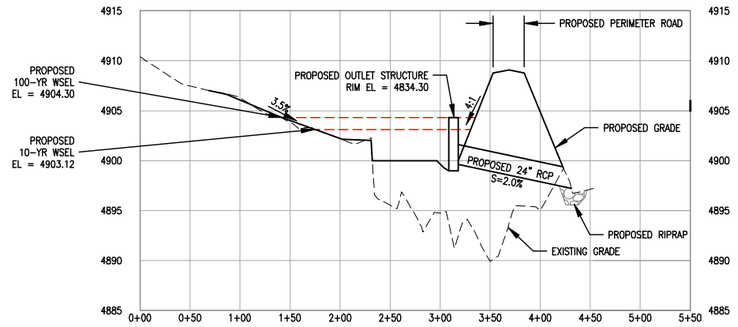
A
4

PROPOSED POND 4 – (STORAGE OF 5.75 ACRE-FEET)
PLAN VIEW

HYDRAULIC CHARACTERISTICS		
	10 YEAR EVENT	100 YEAR EVENT
FLOW INTO POND	15 CFS	36 CFS
FLOW OUT OF POND	1 CFS	10 CFS

EARTHWORK QUANTITIES	
CUT	50 CY
FILL	9,250 CY

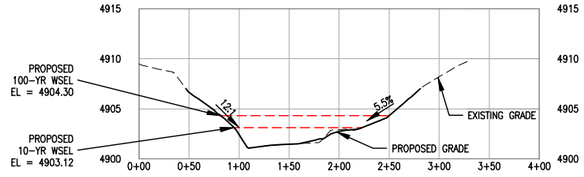
NOTE: EARTHWORK IS DEFINED AS THE VOLUME OF SOIL THAT IS REQUIRED TO BE FILLED/CUT TO REACH A FINAL ELEVATION FROM EXISTING CONDITIONS.



NOTE: WSEL = WATER SURFACE ELEVATION

B
4

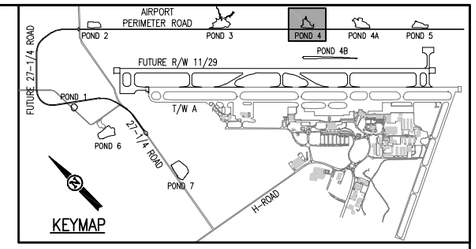
PROPOSED POND 4 – SECTION B
PROFILE VIEW



NOTE: WSEL = WATER SURFACE ELEVATION

C
4

PROPOSED POND 4 – SECTION C
PROFILE VIEW



GRAND JUNCTION REGIONAL AIRPORT

PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

GRAPHIC SCALE
75 0 75 150
(IN FEET)

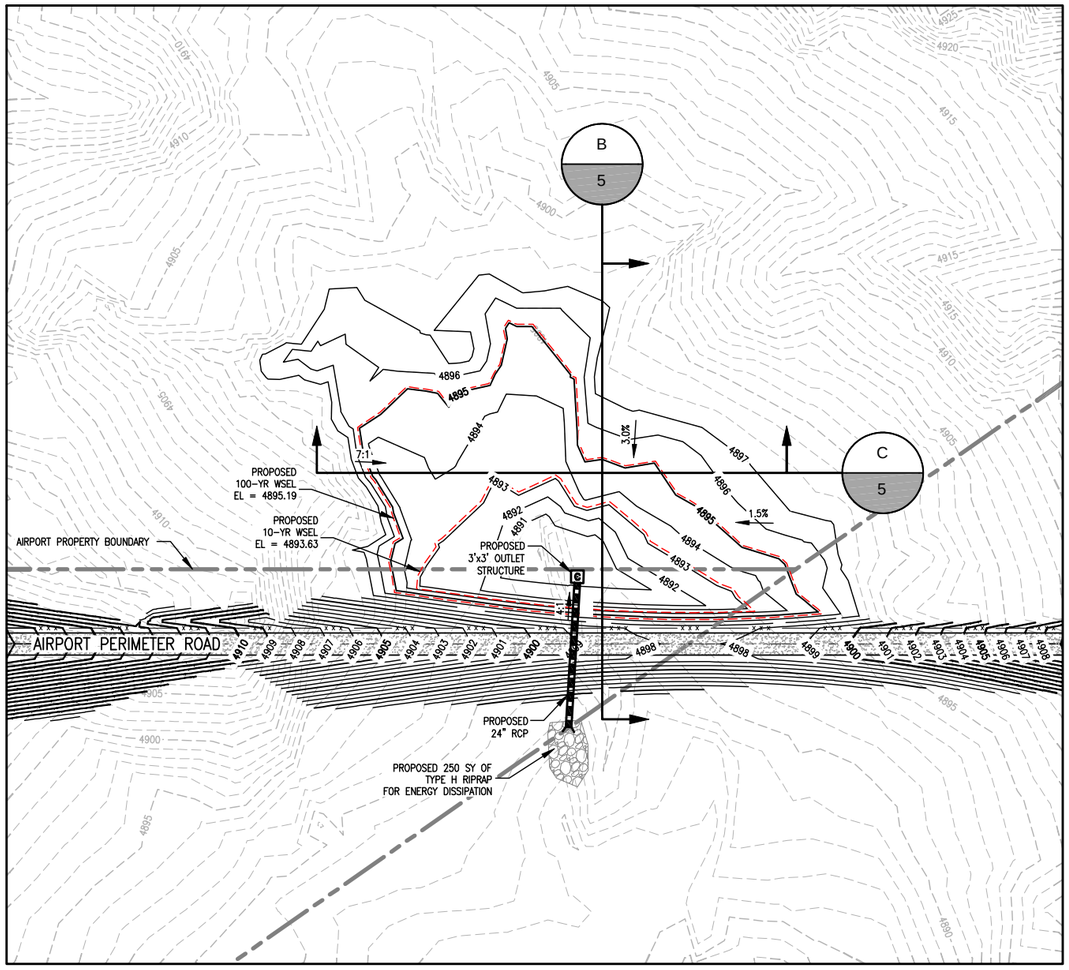
N

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

POND 4 - DETAILS
(25% DESIGN)
ENVIRONMENTAL ASSESSMENT

DATE: JULY 26, 2012

J:\Projects\GJT\CAD\GJT-RW 11?9-RPR\80-GJT-11-01\EA-RW 11?9\DWGS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:47am dvick.le



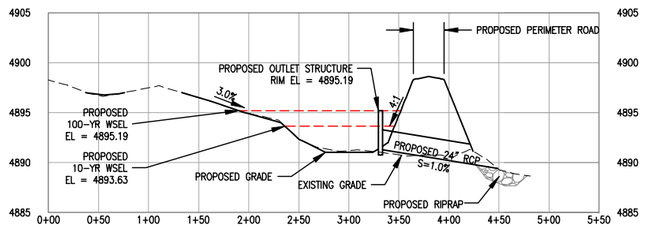
A
5

PROPOSED POND 4A – (STORAGE OF 7.01 ACRE-FEET)
PLAN VIEW

HYDRAULIC CHARACTERISTICS		
	10 YEAR EVENT	100 YEAR EVENT
FLOW INTO POND	16 CFS	42 CFS
FLOW OUT OF POND	0 CFS	1 CFS

EARTHWORK QUANTITIES	
CUT	250 CY
FILL	9,300 CY

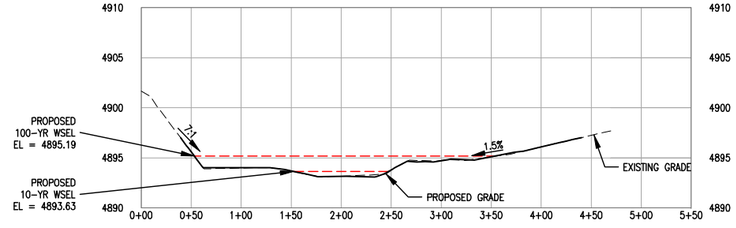
NOTE: EARTHWORK IS DEFINED AS THE VOLUME OF SOIL THAT IS REQUIRED TO BE FILLED/CUT TO REACH A FINAL ELEVATION FROM EXISTING CONDITIONS.



NOTE: WSEL = WATER SURFACE ELEVATION

B
5

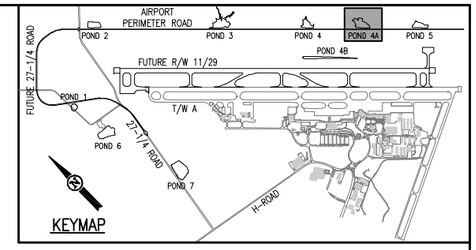
PROPOSED POND 4A – SECTION B
PROFILE VIEW



NOTE: WSEL = WATER SURFACE ELEVATION

C
5

PROPOSED POND 4A – SECTION C
PROFILE VIEW



GRAND JUNCTION REGIONAL AIRPORT

PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

GRAPHIC SCALE
75 0 75 150
(IN FEET)

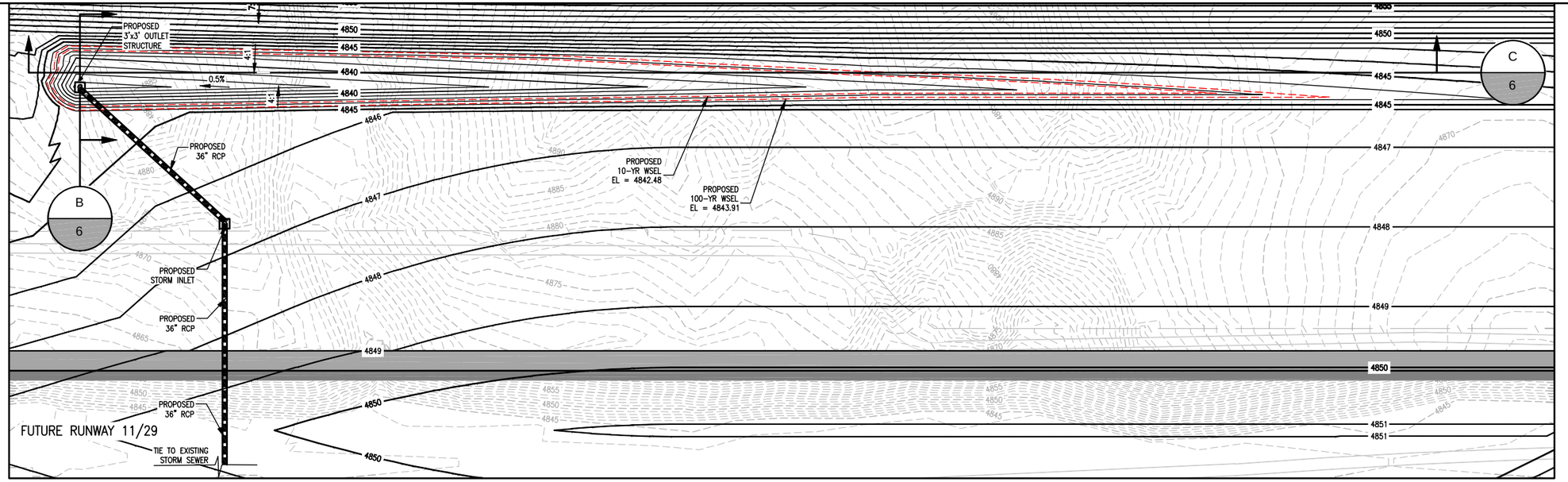
N

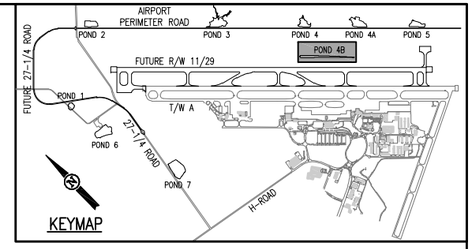
JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

POND 4A - DETAILS
(25% DESIGN)
ENVIRONMENTAL ASSESSMENT

DATE: JULY 26, 2012

J:\Projects\GJT\040\GJT-RW 11?9-9P\80-GJT-11-01\EA-RW 11?9\EXHIBITS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:48am dvaclav





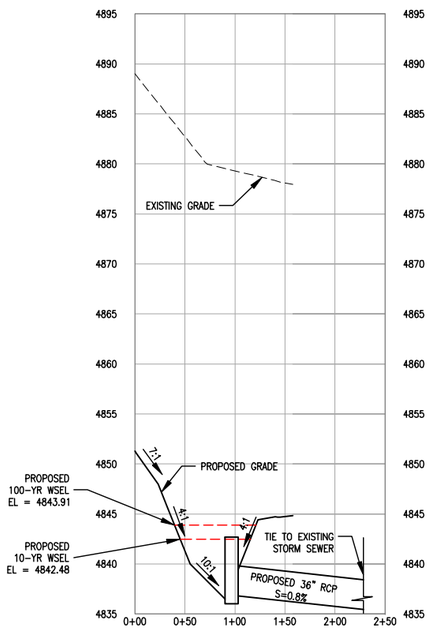
A
6

PROPOSED POND 4B (STORAGE OF 5.01 ACRE-FEET) PLAN VIEW

HYDRAULIC CHARACTERISTICS		
	10 YEAR EVENT	100 YEAR EVENT
FLOW INTO POND	59 CFS	128 CFS
FLOW OUT OF POND	26 CFS	74 CFS

EARTHWORK QUANTITIES	
CUT	250,950 CY
FILL	0 CY

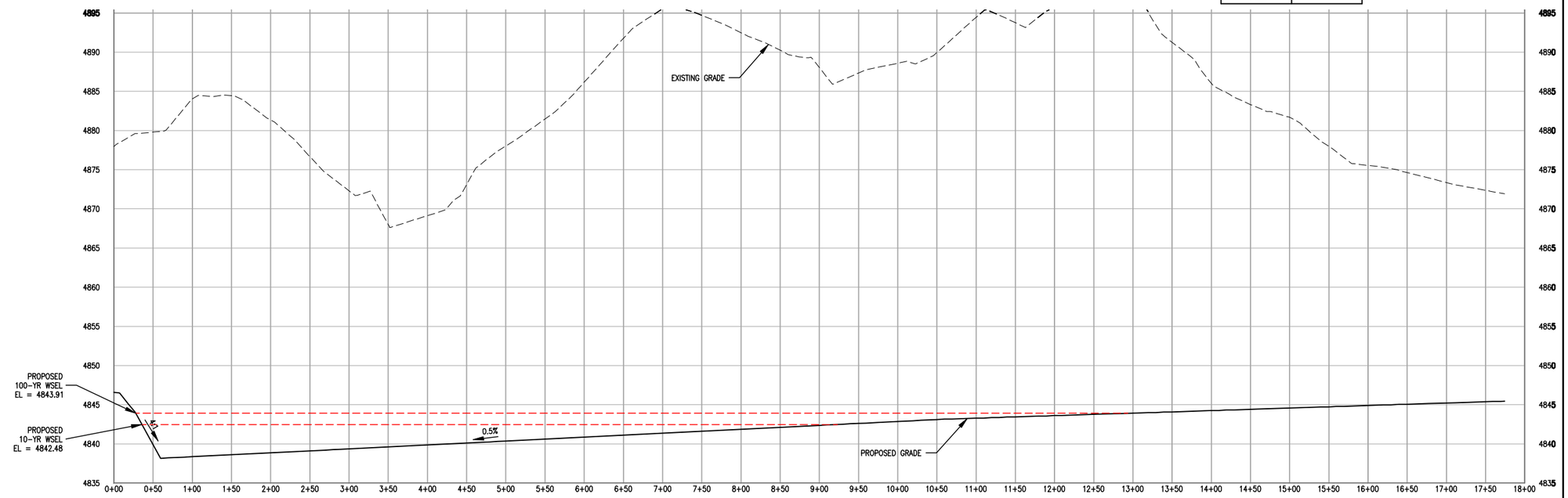
NOTE: EARTHWORK IS DEFINED AS THE VOLUME OF SOIL THAT IS REQUIRED TO BE FILLED/CUT TO REACH A FINAL ELEVATION FROM EXISTING CONDITIONS.



NOTE: WSEL = WATER SURFACE ELEVATION

B
6

PROPOSED POND 4B – SECTION B PROFILE VIEW



NOTE: WSEL = WATER SURFACE ELEVATION

C
6

PROPOSED POND 4B – SECTION C PROFILE VIEW

GRAND JUNCTION REGIONAL AIRPORT

PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

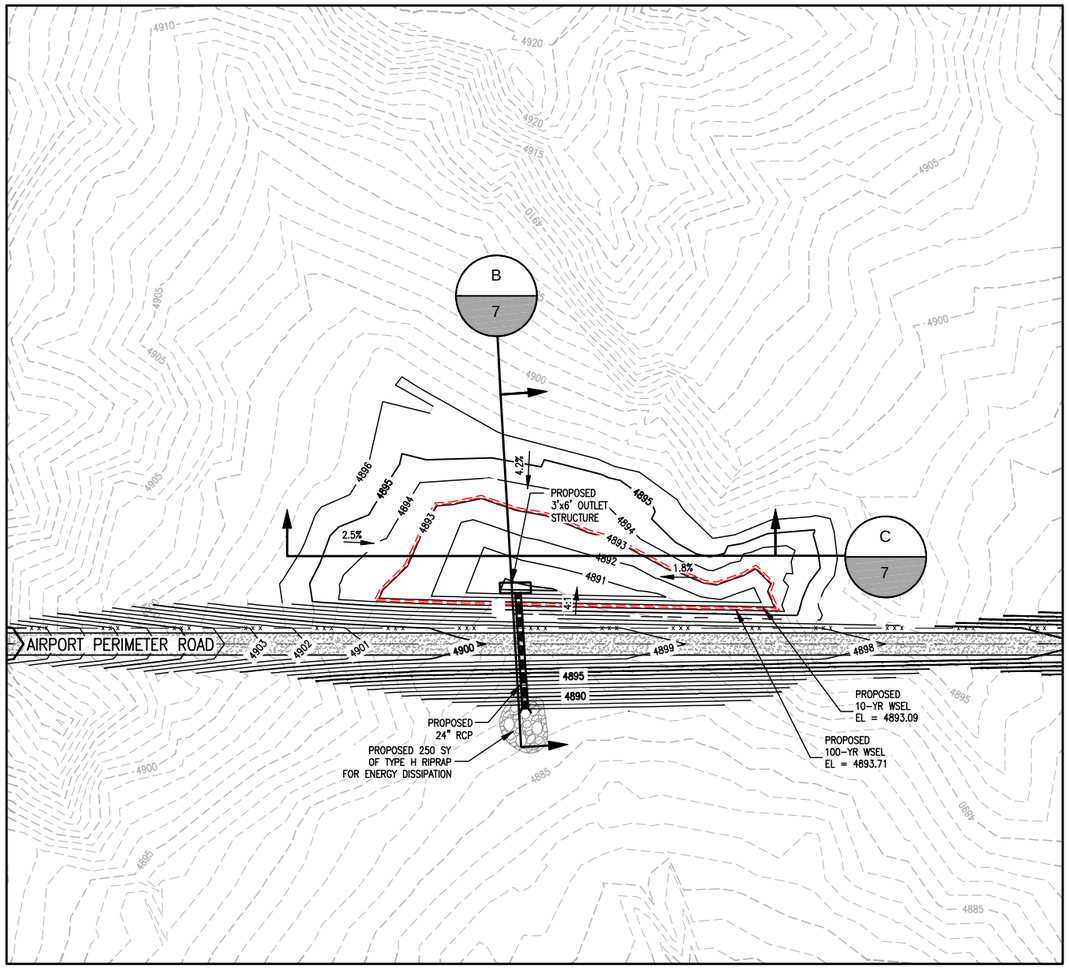
GRAPHIC SCALE
75 0 75 150
(IN FEET)

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

POND 4B - DETAILS (25% DESIGN) ENVIRONMENTAL ASSESSMENT

DATE: JULY 26, 2012

J:\Projects\GJT\CAD\GJT-RW 11?9-SP\6b-GJT-11-01\EA-RW 11?9\EXHIBITS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:48am david.le

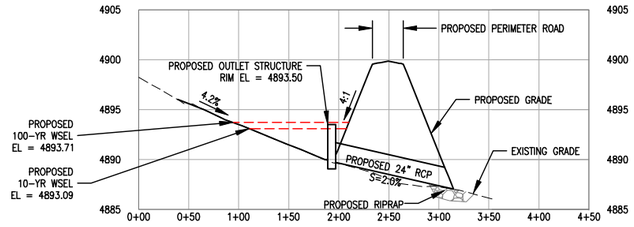


A / 7 — PROPOSED POND 5 – (STORAGE OF 3.91 ACRE-FEET)
PLAN VIEW

HYDRAULIC CHARACTERISTICS		
	10 YEAR EVENT	100 YEAR EVENT
FLOW INTO POND	11 CFS	28 CFS
FLOW OUT OF POND	2 CFS	14 CFS

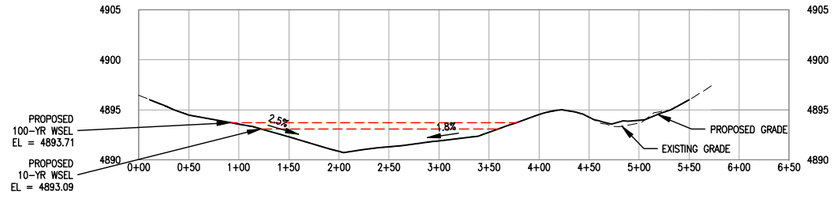
EARTHWORK QUANTITIES	
CUT	50 CY
FILL	10,500 CY

NOTE: EARTHWORK IS DEFINED AS THE VOLUME OF SOIL THAT IS REQUIRED TO BE FILLED/CUT TO REACH A FINAL ELEVATION FROM EXISTING CONDITIONS.



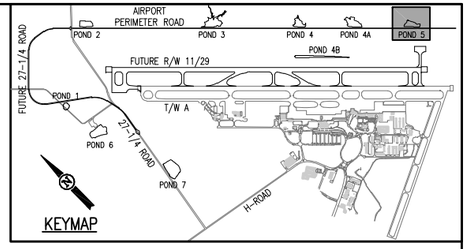
NOTE: WSEL = WATER SURFACE ELEVATION

B / 7 — PROPOSED POND 5 – SECTION B
PROFILE VIEW



NOTE: WSEL = WATER SURFACE ELEVATION

C / 7 — PROPOSED POND 5 – SECTION C
PROFILE VIEW



GRAND JUNCTION REGIONAL AIRPORT

PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

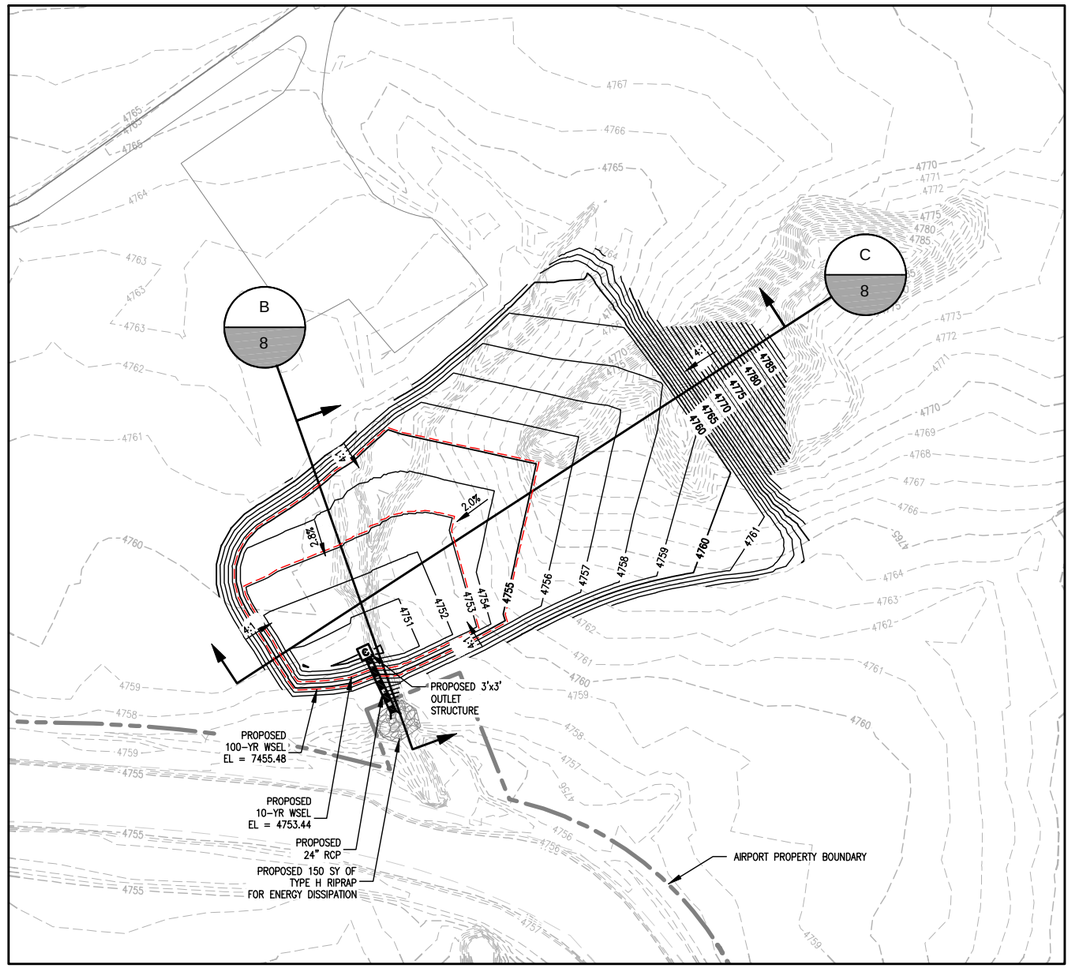
GRAPHIC SCALE
75 0 75 150
(IN FEET)

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

POND 5 - DETAILS (25% DESIGN) ENVIRONMENTAL ASSESSMENT

DATE: JULY 26, 2012

J:\Projects\GJT\CAD\GJT-RW 11?9-DPI\BD-GJT-11-01\EA-RW 11?9\DWG\TS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:48am david.le

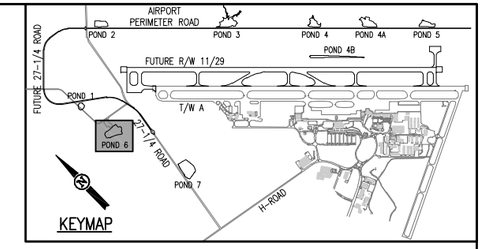


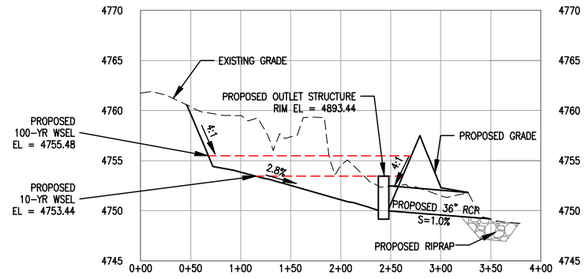
A / 8 — PROPOSED POND 6 – (STORAGE OF 3.83 ACRE-FEET)
PLAN VIEW

HYDRAULIC CHARACTERISTICS		
	10 YEAR EVENT	100 YEAR EVENT
FLOW INTO POND	55 CFS	148 CFS
FLOW OUT OF POND	53 CFS	130 CFS

EARTHWORK QUANTITIES	
CUT	42,500 CY
FILL	50 CY

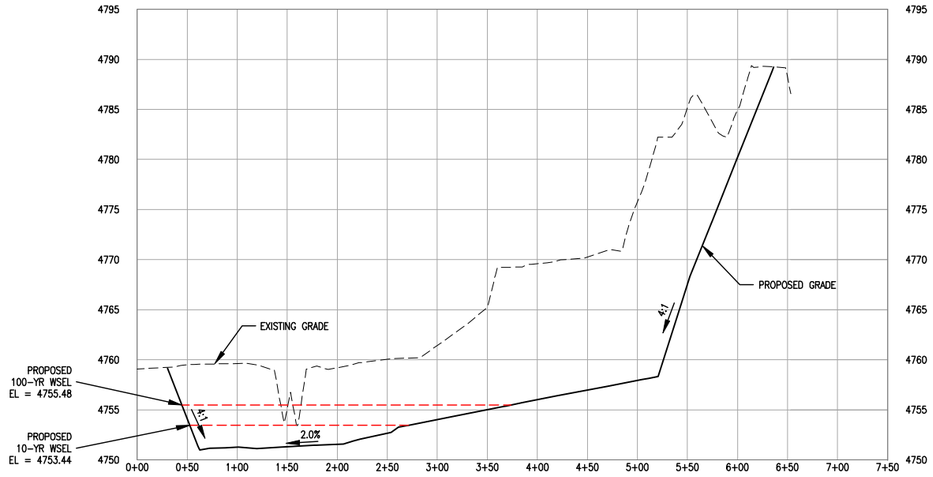
NOTE: EARTHWORK IS DEFINED AS THE VOLUME OF SOIL THAT IS REQUIRED TO BE FILLED/CUT TO REACH A FINAL ELEVATION FROM EXISTING CONDITIONS.





NOTE: WSEL = WATER SURFACE ELEVATION

B / 8 — PROPOSED POND 6 – SECTION B
PROFILE VIEW



NOTE: WSEL = WATER SURFACE ELEVATION

C / 8 — PROPOSED POND 6 – SECTION C
PROFILE VIEW

GRAND JUNCTION REGIONAL AIRPORT

PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

GRAPHIC SCALE
75 0 75 150
(IN FEET)

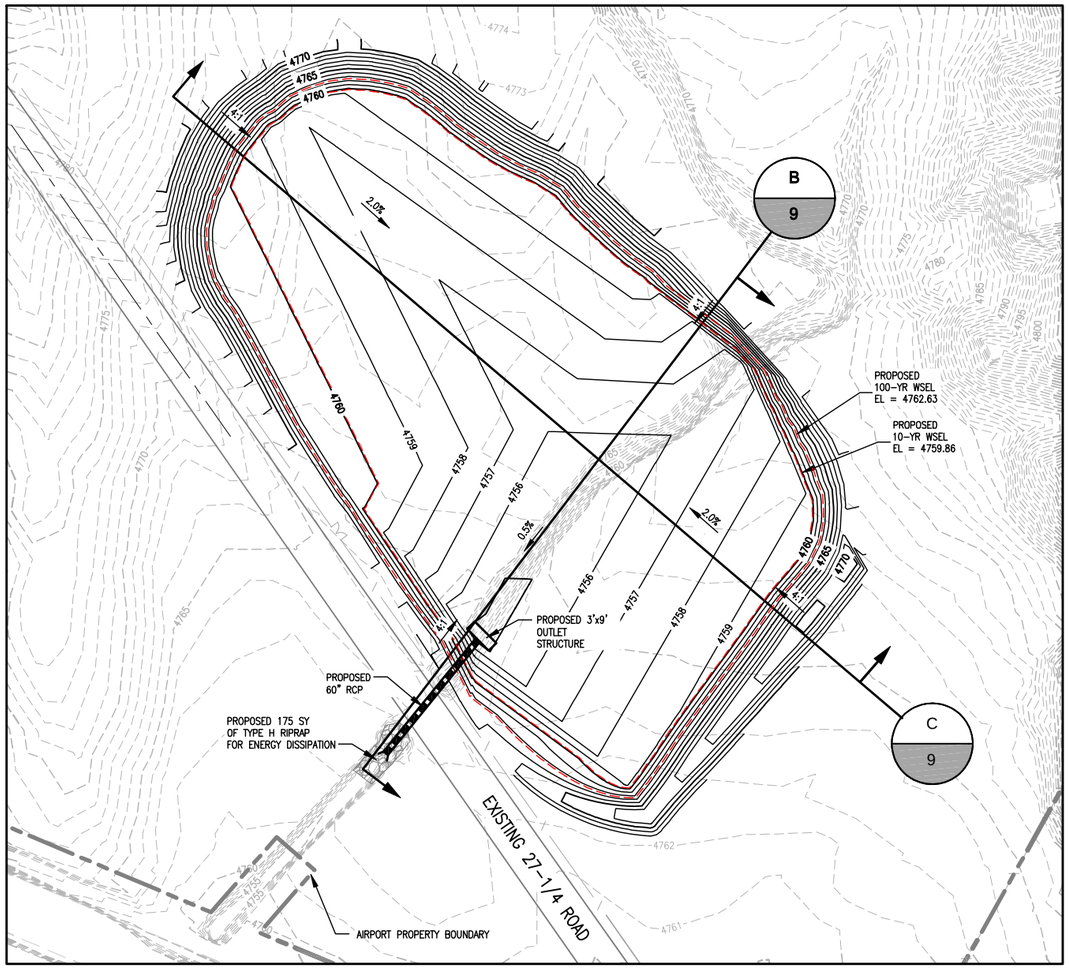
N

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

POND 6 - DETAILS (25% DESIGN) ENVIRONMENTAL ASSESSMENT

DATE: JULY 26, 2012

I:\Projects\GJT\CAD\GJT-RW 11-29-GPA 86-GJT-11-01\EA-RW 11\29\EXHIBITS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:49am davidk

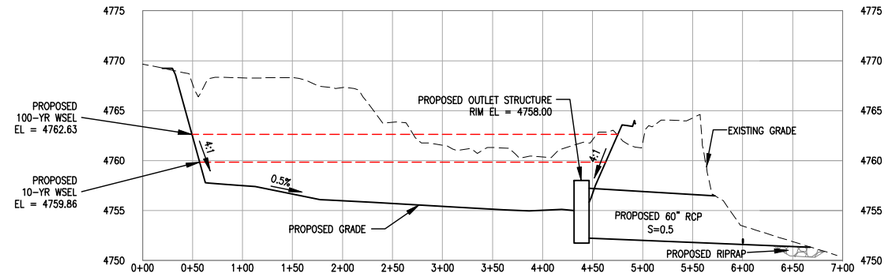


A 9 — PROPOSED POND 7 – (STORAGE OF 28.29 ACRE-FEET)
PLAN VIEW

HYDRAULIC CHARACTERISTICS		
	10 YEAR EVENT	100 YEAR EVENT
FLOW INTO POND	294 CFS	498 CFS
FLOW OUT OF POND	117 CFS	208 CFS

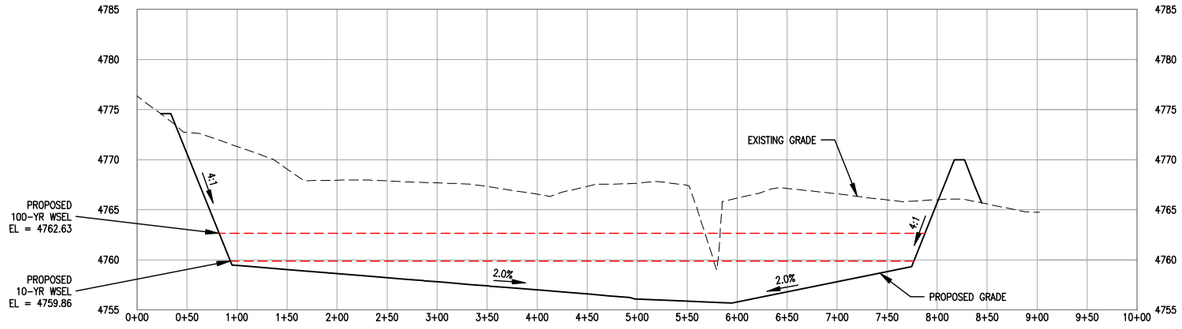
EARTHWORK QUANTITIES	
CUT	87,200 CY
FILL	2,000 CY

NOTE: EARTHWORK IS DEFINED AS THE VOLUME OF SOIL THAT IS REQUIRED TO BE FILLED/CUT TO REACH A FINAL ELEVATION FROM EXISTING CONDITIONS.



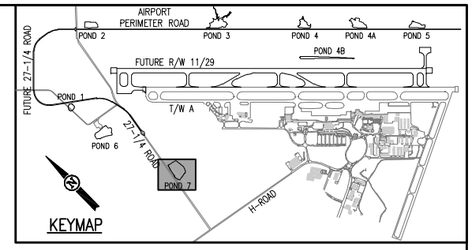
NOTE: WSEL = WATER SURFACE ELEVATION

B 9 — PROPOSED POND 7 – SECTION B
PROFILE VIEW



NOTE: WSEL = WATER SURFACE ELEVATION

C 9 — PROPOSED POND 7 – SECTION C
PROFILE VIEW



GRAND JUNCTION REGIONAL AIRPORT

PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

GRAPHIC SCALE
75 0 75 150
(IN FEET)

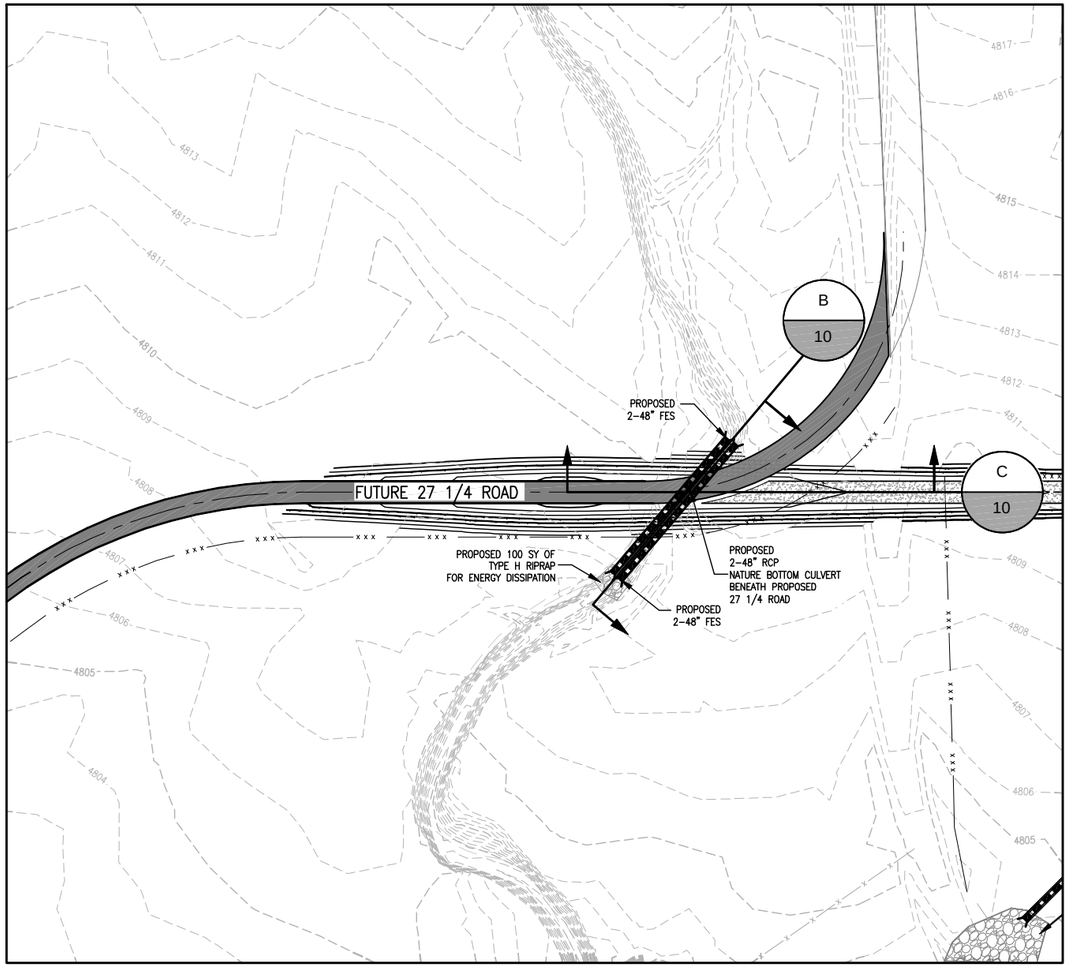
N

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

POND 7 - DETAILS
(25% DESIGN)
ENVIRONMENTAL ASSESSMENT

DATE: JULY 26, 2012

J:\Projects\GJT\CAD\GJT-RW 11\29-SP\BG-GJT-11-01\EA-RW 11\29\EXHIBITS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:49am dandle



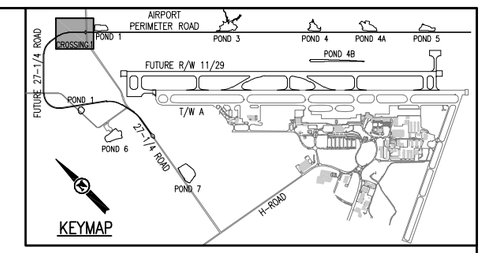
A
10

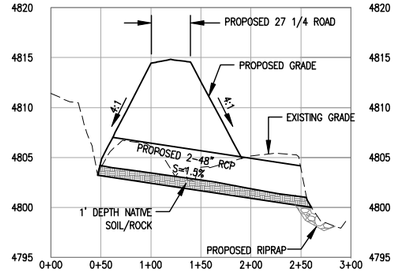
CROSSING #1
PLAN VIEW

HYDRAULIC CHARACTERISTICS		
	10 YEAR EVENT	100 YEAR EVENT
FLOW INTO PIPE	30 CFS	55 CFS
FLOW OUT OF PIPE	30 CFS	55 CFS

EARTHWORK QUANTITIES	
CUT	0 CY
FILL	1,300 CY

NOTE: EARTHWORK IS DEFINED AS THE VOLUME OF SOIL THAT IS REQUIRED TO BE FILLED/CUT TO REACH A FINAL ELEVATION FROM EXISTING CONDITIONS.

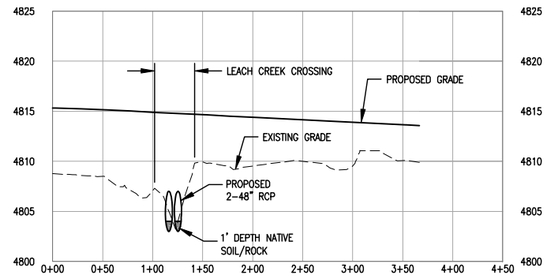




NOTE: WSEL = WATER SURFACE ELEVATION

B
10

CROSSING #1 – SECTION B
PROFILE VIEW



NOTE: WSEL = WATER SURFACE ELEVATION

C
10

CROSSING #1 – SECTION C
PROFILE VIEW

GRAND JUNCTION REGIONAL AIRPORT

PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

GRAPHIC SCALE
75 0 75 150
(IN FEET)

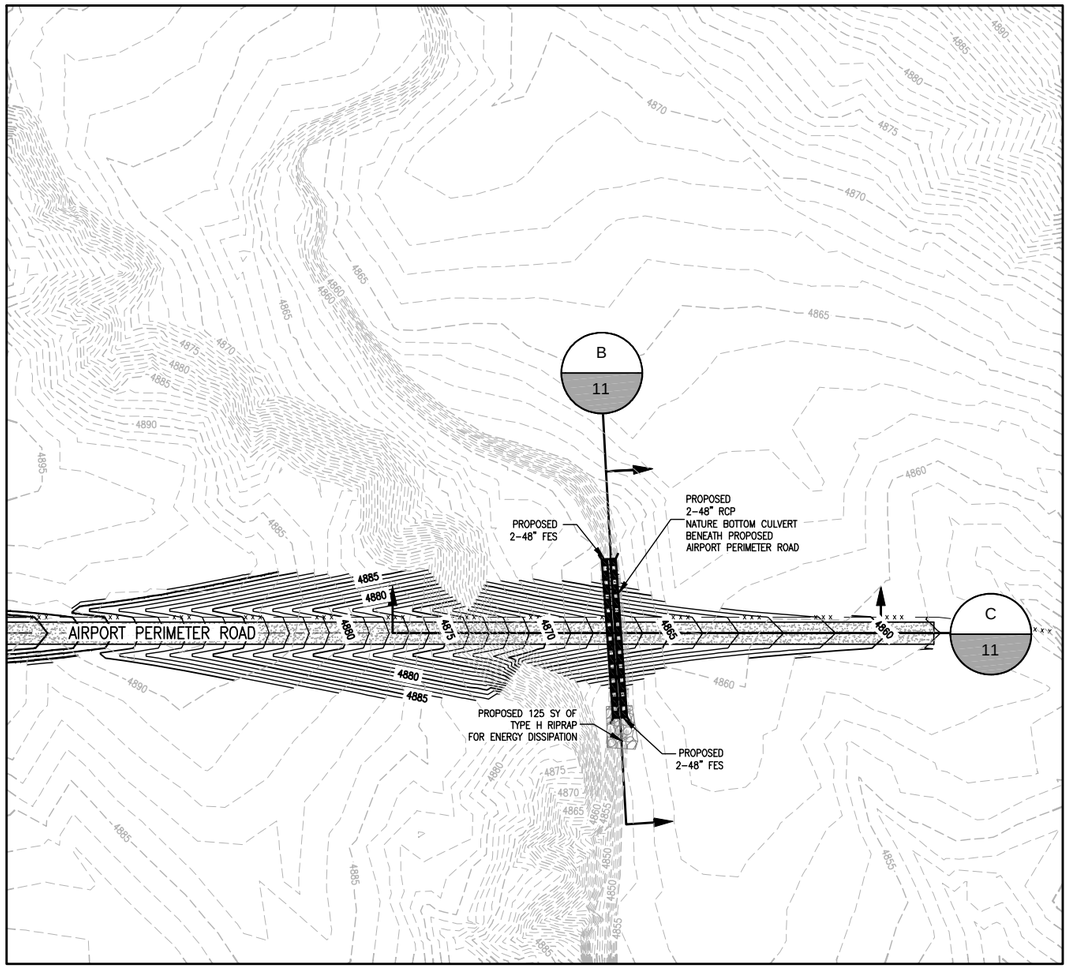
N

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

CROSSING #1 - DETAILS
(25% DESIGN)
ENVIRONMENTAL ASSESSMENT

DATE: JULY 26, 2012

J:\Projects\GJT\CAD\GJT-RW 11?9-9?\B0-GJT-11-01\EA-RW 11?9\EXHIBITS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:50am dandrle

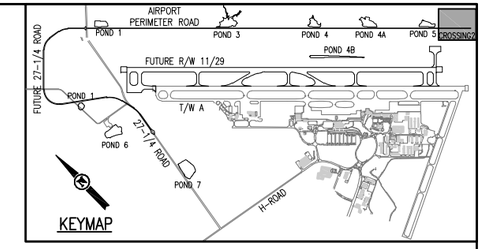


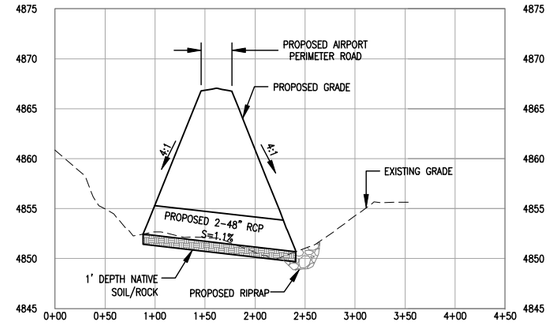
A
11
CROSSING #2
PLAN VIEW

HYDRAULIC CHARACTERISTICS		
	10 YEAR EVENT	100 YEAR EVENT
FLOW INTO PIPE	199 CFS	697 CFS
FLOW OUT OF PIPE	199 CFS	697 CFS

EARTHWORK QUANTITIES	
CUT	0 CY
FILL	2,300 CY

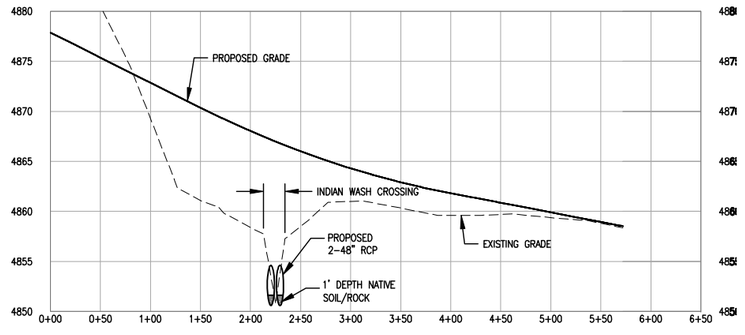
NOTE: EARTHWORK IS DEFINED AS THE VOLUME OF SOIL THAT IS REQUIRED TO BE FILLED/CUT TO REACH A FINAL ELEVATION FROM EXISTING CONDITIONS.





NOTE: WSEL = WATER SURFACE ELEVATION

B
11
CROSSING #2 – SECTION B
PROFILE VIEW



NOTE: WSEL = WATER SURFACE ELEVATION

C
11
CROSSING #2 – SECTION C
PROFILE VIEW

GRAND JUNCTION REGIONAL AIRPORT

PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

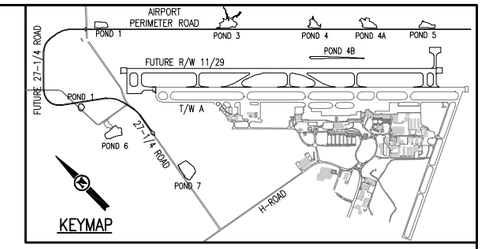
GRAPHIC SCALE
75 0 75 150
(IN FEET)

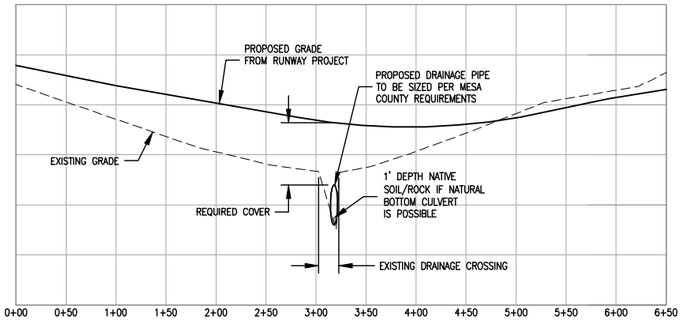
JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

CROSSING #2 - DETAILS (25% DESIGN) ENVIRONMENTAL ASSESSMENT

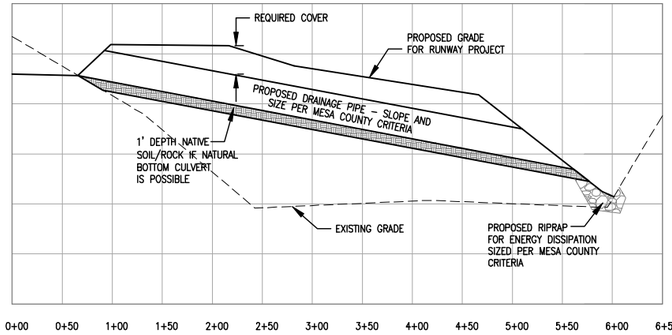
DATE: JULY 26, 2012

J:\Projects\GJT\CAD\GJT-RW 11?9-DPI\BD-GJT-11-01\EA-RW 11?9\DWGS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:50am david.le





A
12
TYPICAL SECTION
PROFILE



B
12
TYPICAL SECTION
PROFILE

GRAND JUNCTION REGIONAL AIRPORT

PROFILE
HORIZ: 1" = 150'
VERT: 1" = 15'

GRAPHIC SCALE
75 0 75 150
(IN FEET)

N

JVIATION
900 S. BROADWAY • SUITE 350 • DENVER, COLORADO 80209
PHONE: 303-524-3030 • FAX: 303-524-3031
• WWW.JVIATION.COM •

TYPICAL DETAILS FOR RUNWAY GRADING CROSSING DRAINAGE FEATURES

DATE: JULY 26, 2012

J:\Projects\GJT\CAD\GJT-RW 1129-GPD&D-GJT-11-01\EA-RW 1129\EXHIBITS\POND-Cross Sections\GJT-EA-Pond Cross Sections.dwg Jul 26, 2012 - 11:50am dandle

APPENDIX A
USACE Nationwide Permit Pre-Construction Notification Form (Pages 5, 8-13)

Dredge Volume: Indicate in CUBIC YARDS the quantity of material to be dredged or used as fill:

Indicate type(s) of material proposed to be discharged in waters of the United States:

For proposed discharges of dredged material into waters of the U.S. (including beach nourishment), please attach[2] a proposed Sampling and Analysis Plan (SAP) prepared according to Inland Testing Manual (ITM) guidelines (including Tier I information, if available).

[2]or mail copy separately if applying electronically

Is any portion of the work already complete? ☐ YES ☐ NO
If yes, describe the work:

Box 7 Intended NWP number (1st)[3]:
Intended NWP number (2nd):
Intended NWP number (3rd):

[3] Enter the intended permit type(s). See NWP regulations for permit types and qualification information (http://www.usace.army.mil/inet/functions/cw/cecwo/reg/nationwide_permits.htm).

Box 8 Authority:
Is Section 10 of the Rivers and Harbors Act applicable?: ☐ YES ☐ NO

Is Section 404 of the Clean Water Act applicable?: ☐ YES ☐ NO

Box 9 Is the discharge of fill or dredged material for which Section 10/404 authorization is sought part of a larger plan of development?: ☐ YES ☐ NO

If discharge of fill or dredged material is part of development, name and proposed schedule for that larger development (start-up, duration, and completion dates):

Location of larger development (If discharge of fill or dredged material is part of a plan of development, a map of suitable quality and detail of the entire project site should be included):

Total area in acres of entire project area (including larger plan of development, where applicable):

Box 10 Threatened or Endangered Species

Please list any federally-listed (or proposed) threatened or endangered species or critical habitat within the project area (use scientific names (e.g., Genus species), if known):

a. Gila cypha
b. Xyauchen texanus
c. Ptychocheilus Lucius
d.
e. Gila elegans
f.

Have surveys, using U.S. Fish and Wildlife Service/NOAA Fisheries protocols, been conducted?

☒ Yes, Report attached (or mail copy separately if applying electronically) ☐ No

If a federally-listed species would be impacted, please provide a description and a biological evaluation.

☐ Yes, Report attached (or mail copy separately if applying electronically) ☒ Not attached

Has the USFWS/NOAA Fisheries issued a Biological Opinion?

☒ Yes, Attached (or mail copy separately if applying electronically) ☐ No

If yes, list date Opinion was issued (m/d/yyyy): 2/25/2009

Has Section 7 consultation been initiated by another federal agency?

☒ Yes, Initiation letter attached (or mail copy separately if applying electronically) ☐ No

Has Section 10 consultation been initiated for the proposed project?

☐ Yes, Initiation letter attached (or mail copy separately if applying electronically) ☒ No

Box 11 Historic properties and cultural resources:

Please list any historic properties listed (or eligible to be listed) on the National Register of Historic Places:

a. Historic Railroad Grade
b.
c.
d.
e.
f.

Are any cultural resources of any type known to exist on-site?

☐ Yes ☒ No

Has an archaeological records search been conducted?

☒ Yes, Report attached (or mail copy separately if applying electronically) ☐ No

Has a archaeological pedestrian survey been conducted for the site?

☒ Yes, Report attached (or mail copy separately if applying electronically) ☐ No

Has a Section 106 MOA been signed by another federal agency and the SHPO?

☐ Yes, Attached (or mail copy separately if applying electronically) ☒ No

If yes, list date MOA was signed (m/d/yyyy):

Has Section 106 consultation been initiated by another federal agency?

☐ Yes, Initiation letter attached (or mail copy separately if applying electronically) ☒ No

Box 12 Measures taken to avoid and minimize impacts to waters of the United States (if any)**:**

Include multiple copies of Box 13 for separate sites.

Box 13 Proposed Compensatory Mitigation (site __ of __) related to fill/excavation and dredge activities. Indicate in ACRES and LINEAR FEET (where appropriate) the total quantity of waters of the United States proposed to be created, restored, enhanced and/or preserved for purposes of providing compensatory mitigation. Indicate water body type (wetland, riparian streambed, unvegetated streambed, lake, ocean, other) or non-jurisdictional (uplands[5]). Indicate mitigation type (on- or off-site by applicant, mitigation bank, in-lieu fee program):

Water Body Type	Created	Restored	Enhanced	Preserved	Mitigation type
Example: wetland			-	-	
Example: riparian stream	-	-		-	
Totals:					

[5] For uplands, please indicate if designed as an upland buffer.

If no mitigation is proposed, provide detailed explanation of why no mitigation would be necessary:

See attached PCN letter for box 13 details

Has a draft/conceptual mitigation plan been prepared in accordance with the Army Corps of Engineers District guidelines? ☒ Yes, Attached (or mail copy separately if applying electronically) ☐ No

Mitigation site Latitude & Longitude (D/M/S, DD, or UTM):	USGS Quadrangle map name:
Assessors Parcel Number:	Section, Township, Range:

Other location descriptions, if known:

Directions to the mitigation location:

Box 14 Water Quality Certification (see instructions)**:**
Applying for certification? ☐ Yes, Attached (or mail copy separately if applying electronically) ☐ No

Certification issued? ☐ Yes, Attached (or mail copy separately if applying electronically) ☐ No

Exempt? ☒ Yes ☐ No
If exempt, state why: NWP certification Agency concurrence? ☐ Yes, Attached ☐ No

Box 15 Coastal Zone Management Act (see instructions)**:**
Is the project located within the Coastal Zone? ☐ Yes ☒ No

If yes, applying for a coastal commission-approved Coastal Development Permit?
☐ Yes, Attached (or mail copy separately if applying electronically) ☐ No

If no, applying for separate CZMA-consistency certification?
☐ Yes, Attached (or mail copy separately if applying electronically) ☐ No

Permit/Consistency issued? ☐ Yes, Attached (or mail copy separately if applying electronically) ☐ No

Exempt? ☐ Yes ☐ No
If exempt, state why:

Box 16 List of other certifications or approvals/denials received from other federal, state, or local agencies for work described in this application:

Agency	Type Approval[4]	Identification No.	Date Applied	Date Approved	Date Denied

[4] Would include but is not restricted to zoning, building, and flood plain permits

NWP General Conditions (GC) checklist:

1. **Navigation:**

   Project would be in compliance with GC? ☒ Yes ☐ No

   Cannot navigate ephemeral drainages i.e. not applicable

2. **Aquatic Life Movements:**

   Project would be in compliance with GC? ☒ Yes ☐ No

   No aquatic life present in ephemeral drainages. This is a xeric environment.

3. **Spawning Areas:**

   Spawning areas present? ☐ Yes ☒ No

   Project would be in compliance with GC? ☒ Yes ☐ No

   No spawning in ephemeral drainages

4. **Migratory Bird Breeding Areas:**

   Migratory bird breeding areas present? ☒ Yes ☐ No

   Project would be in compliance with GC? ☒ Yes ☐ No

   Loggerhead shrike nest located outside of project area not within project area; construction would avoid breeding season for migratory birds.

5. **Shellfish Beds:**

   Shellfish beds present? ☐ Yes ☒ No

   Project would be in compliance with GC? ☒ Yes ☐ No

   No shellfish beds present in ephemeral drainages

6. **Suitable Material:**

   Project would be in compliance with GC? ☒ Yes ☐ No

   Clean fill and natural bottom culverts will be used to build project features.

7. **Water Supply Intakes:**

   Project would be in compliance with GC? ☒ Yes ☐ No

   Not applicable

8. **Adverse Effects From Impoundments:**

   Project would be in compliance with GC? ☒ Yes ☐ No

   Outlet structures designed to reduce erosion through energy dissapation; natural bottom culverts will be installed.

9. **Management of Water Flows:**

   Project would be in compliance with GC? ☒ Yes ☐ No

   Detention features and culverts designed to carry expected high flows in ephemeral drainages. Jviation designed features as provided in Master Drainage Report May 5, 2009.

10. **Fills Within 100-Year Floodplains:**

    Project would be within 100-year floodplains? ☐ Yes ☒ No

    If yes, project would be in compliance with GC? ☐ Yes ☐ No

    Not applicable, project is in Zone X, see Figure 6 in PCN

Revised November 9, 2011. For the most recent version of this form, visit your Corps District's Regulatory website.

11. Equipment:

Project would be in compliance with GC? ☒ Yes ☐ No

No wetlands or mudflats are present, therefore mats will be required.

12. Soil Erosion and Sediment Controls:

Project would be in compliance with GC? ☒ Yes ☐ No

Project construction will adhere to BMPs including but not limited to adequate silt fence installation and maintenance; use of 4:1 slopes and slope stabilization.

13. Removal of Temporary Fills:

Project would be in compliance with GC? ☒ Yes ☐ No

not applicable

14. Proper Maintenance:

Project would be in compliance with GC? ☒ Yes ☐ No

Airport will maintain detention features and natural bottom culverts and proposed mitigation.

15. Wild and Scenic Rivers:

Project would be within a National Wild and Scenic River System (including proposed system)?

☐ Yes ☒ No

Project would be in compliance with GC? ☐ Yes ☐ No

not applicable

16. Tribal Rights:

Project would be in compliance with GC? ☒ Yes ☐ No

No tribal property within vicinity of project

17. Endangered Species: see Box 10 above.

18. Historic Properties: see Box 11 above.

19. Designated Critical Waters (***check those that apply***)

Includes:

1) ☐ N0AA-designated marine sanctuaries,

2) ☐ National Estuarine Research Reserves,

3) ☐ State natural heritage sites,

4) ☐ Officially designated waters

Applicant is aware of the restrictions a) and b) below? ☒ Yes ☐ No

a) NWP 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, and 50: No NWP can be authorized.

b) NWP 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38: Notification is required.

20. Mitigation: see Box 13 above.

21. Water Quality (401 Certification): see Box 14 above.

22. Coastal Zone Permit: see Box 15 above.

23. Regional and Case-By-Case Conditions:

Complete the Regional Conditions checklist below.

Project would be in compliance with any Case-by-case conditions? ☒ Yes ☐ No

24. Use of Multiple Nationwide Permits:

Applicant is aware that if total proposed acreage of impact exceeds acreage limit of NWP with highest specified acreage, no NWP can be issued? ☒ Yes ☐ No

25. Transfer of Nationwide Permit Verifications:

Applicant is aware of this permit transfer requirement? ☒ Yes ☐ No

26. Compliance Certification:

Applicant is aware of this post-construction requirement? ☒ Yes ☐ No

27. Pre-Construction Notification:

If a PCN is required, the PCN includes: **(*check those that apply*)**

☒ Delineation of wetlands and other waters of the U.S.

☒ If project results in the loss of greater than 1/10 acre of wetlands, a compensatory mitigation plan or statement describing how the mitigation requirement will be satisfied

☒ For non-Federal applicants, a list of threatened or endangered species or designated critical habitat that might be affected by the proposed work

☒ For Federal applicants, documentation demonstrating compliance with the Endangered Species Act

☒ For non-Federal applicants, a list of historic properties listed on, or determined eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places that may be affected by the proposed work; or a vicinity map indicating the location of the historic property

☐ For Federal applicants, documentation demonstrating compliance with the National Historic Preservation Act

28. Single and Complete Project:

Project would be in compliance with GC? ☒ Yes ☐ No

NWP Regional Conditions (RC) checklist:

II. Sacramento District (SPK) in Colorado:

SPK Regional conditions to be applied **only in Colorado in the Sacramento District:**

a. Are utility line and/or road activities crossing perennial water or special aquatic sites located within the Colorado Basin proposed under NWPs 12 and/or 14? ☐ Yes ☒ No

If yes, notification pursuant to General Condition 27 is required using either the South Pacific Division Preconstruction Notification (PCN) Checklist or a completed application form (ENG Form 4345). In addition, the PCN shall include:

1. A written statement explaining how the activity has been designed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States;
2. Drawings, including plan and cross-section views, clearly depicting the location, size and dimensions of the proposed activity. The drawings shall contain a title block, legend and scale, amount (in cubic yards) and size (in acreage) of fill in Corps jurisdiction, including both permanent and temporary fills/structures. The ordinary high water mark or, if tidal waters, the high tide line should be shown (in feet), based on National Geodetic Vertical Datum (NGVD) or other appropriate referenced elevation; and

3. Pre-project color photographs of the project site taken from designated locations documented on the plan drawing.

b. Are bank stabilization activities proposed under NWP 13 within streams which average less than 20 feet across (measured between the ordinary high water marks) and require placement of greater than ¼ cubic yard of suitable fill material per running foot below the plane of the ordinary high water mark? ☐ Yes ☒ No

If yes, notification pursuant to General Condition 27 (as described above) is required.

c. Is the activity proposed under NWP 27? ☐ Yes ☒ No

1. Does the activity include a fishery enhancement component? ☐ Yes ☒ No

If yes, notification pursuant to General Condition 27 (as described above) is required. The Corps will send the PCN to the Colorado Parks and Wildlife (CPW) (formerly Colorado Division of Wildlife) for review. In accordance with General Condition 27, CPW will have 10 days from the receipt of Corps notification to indicate that they will be commenting on the proposed project. CPW will then have an additional 15 days after the initial 10-day period to provide those comments. If CPW raises concerns, the applicant may either modify their plan, in coordination with CPW, or apply for a standard individual permit.

2. Does the activity involve the length of a stream? ☐ Yes ☒ No

If yes, the post-project stream sinuosity will not be significantly reduced, unless it is demonstrated that the reduction in sinuosity is consistent with the natural morphological evolution of the stream (sinuosity is the ratio of stream length to project reach length).

3. Does the activity involve a structure? ☒ Yes ☐ No

If yes, the structure will allow the upstream and downstream passage of aquatic organisms, including fish native to the reach, as well as recreational water craft or other navigational activities, unless specifically waived in writing by the District Engineer. The use of grout and/or concrete in building structures is not authorized by NWP 27.

4. Does the activity involve construction of a water park (i.e., kayak courses) or flood control project? ☐ Yes ☒ No

If yes, the construction of water parks and flood control projects are not authorized by NWP 27.

d. Is the activity proposed under NWPs 29 and/or 39? ☒ Yes ☐ No

If yes, notification pursuant to General Condition 27 (as described above) is required. A copy of the existing FEMA/locally-approved floodplain map must be submitted with the PCN. When reviewing proposed developments, the Corps will utilize the most accurate and reliable FEMA/locally-approved pre-project floodplain mapping, not post-project floodplain mapping based on a CLOMR or LOMR. However, the Corps will accept revisions to existing floodplain mapping if the revisions resolve inaccuracies in the original floodplain mapping and if the revisions accurately reflect pre-project conditions.

e. Will the activity involve the removal of temporary fills? ☐ Yes ☒ No

If yes, General Condition 13 (Removal of Temporary Fills) is amended by adding the following: When temporary fills are placed in wetlands in Colorado, a horizontal marker (i.e. fabric, certified weed-free straw, etc.) must be used to delineate the existing ground elevation of wetlands that will be temporarily filled during construction.

f. Will the activity occur within a spawning area? ☐ Yes ☒ No

If yes, General Condition 3 (Spawning Areas) is amended by adding the following: In Colorado, all Designated Critical Resource Waters (see Enclosure 1) are considered important spawning areas. Therefore, in accordance with General Condition 19 (Designated Critical Resource Waters), the discharge of dredged or fill material is not authorized by the following NWPs in these waters: NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, and 50. In addition, in accordance with General Condition 27, notification (as described above) is required for the use of the following NWPs in these waters: NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38..

g. Will the activity use broken concrete as fill material? ☐ Yes ☒ No

If yes, notification pursuant to General Condition 27 (as described above) is required. Permittees must demonstrate that soft engineering methods utilizing native or non-manmade materials are not practicable (with respect to cost, existing technology, and logistics), before broken concrete is allowed as suitable fill. Use of broken concrete with exposed rebar is prohibited in perennial waters and special aquatic sites.

h. Will the activity involve work with heavy equipment in perennial or intermittent waters of the United States?
☐ Yes ☒ No

If yes, General Condition 11 (Equipment) is amended by adding the following condition: If heavy equipment is used for the subject project that was previously working in another stream, river, lake, pond, or wetland within 10 days of initiating work, one of the following procedures is necessary to prevent the spread of New Zealand Mud Snails and other aquatic hitchhikers:

1. Remove all mud and debris from equipment (tracks, turrets, buckets, drags, teeth, etc.) and keep the equipment dry for 10 days; or
2. Remove all mud and debris from equipment (tracks, turrets, buckets, drags, teeth, etc.) and spray/soak equipment with either a 1:1 solution of Formula 409 Household Cleaner and water, or a solution of Sparquat 256 (5 ounces Sparquat per gallon of water). Treated equipment must be kept moist for at least 10 minutes; or
3. Remove all mud and debris from equipment (tracks, turrets, buckets, drags, teeth, etc.) and spray/soak equipment with water greater than 120 degrees F for at least 10 minutes.

i. Is the activity located with a fen and/or a wetland adjacent to a fen? ☐ Yes ☒ No

If yes, all NWPs except 3, 6, 20, 27, 32, 38, and 47, are revoked. For NWPs 3, 20, 27, and 38, notification pursuant to General Condition 27 (as described above) is required and the permittee may not begin the activity until the Corps determines the adverse environmental effects are minimal. A fen is defined as:

Fen soils (histosols) are normally saturated throughout the growing season, although they may not be during drought conditions. The primary source of hydrology for fens is groundwater. Histosols are defined in accordance with the U.S. Department of Agriculture, Natural Resources Conservation Service publications on Keys to Soil Taxonomy and Field Indicators of Hydric Soils in the United States (http://soils.usda.gov/technical/classification/taxonomy).

j. Is the activity proposed within 100 feet of the point of groundwater discharge of a natural spring?
☐ Yes ☒ No

If yes, all NWPs, except NWP 47, require notification pursuant to General Condition 27 (as described above). A spring source is defined as any location where ground water emanates from a point in the ground. For purposes of this condition, springs do not include seeps or other discharges which lack a defined channel.

Additional Information Regarding Minimization of Impacts and Compliance with Existing General Conditions:

ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 12

SHPO CONSULTATION AND MEMORANDUM OF AGREEMENT

JUL 2 0 2011

United States Department of the Interior
Bureau of Land Management
Grand Junction Field Office
2815 H Road
Grand Junction CO 81506
http://www.blm.gov/co/st/en/fo/gjfo.html

CONCURRENCE LETTER

In Reply Refer To:
8100 (LLCONO3000)

Mr. Edward Nichols
State Historic Preservation Officer
Colorado Historical Society
1300 Broadway
Denver, CO 80203

County: Mesa
Cultural Resources Project Number: BLM GJFO CRIR 18210-01
NEPA Number: CO-130-0078-EA
SHPO Number: ME.LM.R695
Project Name: Grand Junction Regional Airport and Bureau of Land Management Proposed Land Exchange

The following undertaking is located in the Ute PM, T. 1 N., R. 1 E., Sections 19, 29, 30, 31, 32 and Ute PM, T. 1 N., R. 1 W., Sections 13, 23, 24, 25, and 26 in Mesa County. This undertaking: ___ is a non-routine interstate and/or interagency project or program; ___ directly affects a National Register eligible or listed property; ___ has been determined by BLM, the SHPO or the Council to be highly controversial; ___ is one of the following: a land exchange, land sale, Recreation and Public Purpose lease, or transfer; ___ has been analyzed by a BLM staff person with limited experience or lacking appropriate expertise; **X is one which we wish to bring to your attention.**

The Bureau of Land Management (BLM), has received a Class III Cultural Resource Inventory completed by Tatanka Historical Associates (Tatanka) and Metcalf Archaeological Consultants (Metcalf) on behalf of the Grand Junction Regional Authority. The survey has been completed in preparation for an anticipated land transfer from the BLM Grand Junction Field Office (GJFO) to the Grand Junction Regional Airport Authority to provide for expansion of the Grand Junction Airport. Currently, the environmental analysis documents are being prepared by the Federal Aviation Administration (FAA) and should be presented to the BLM in Fall 2011. Currently there is no undertaking until the proposed action is submitted to the BLM.

Tatanka and Metcalf conducted a Class III Cultural Resource Inventory on a total of 1780.5 acres on both BLM GJFO land and private property belonging to the airport (753 acres of BLM and 1027.5 private acres) in the Summer of 2010. The survey resulted in the recordation of three new historic properties (two sites (5ME17676 and 5ME17686) and an additional segment of an existing linear site (5ME768.4)) and nine isolated finds (5ME17677-5ME17685). The historic sites included a historic homestead (5ME17676), a historic dam (5ME17686), and the railroad bed of the Little Book Cliff Railway (5ME768.4). The isolated finds include eight historic trash scatter and 1 prehistoric artifact. Additionally, it is important to note that when the survey initially occurred, Tatanka and Metcalf included site 5ME11856 within the project boundaries. After further GIS work it was determined that this property is outside of the likely Area of Potential Effect and the site was removed from the project. Tatanka will provide your office with the updated form for that site for your reference separately.

Of the three historic sites recorded during this inventory, two sites (5ME17676 and 5ME17686) are recommended **not eligible** to the National Register of Historic Places (NRHP). The remaining site, the Little Book Cliff Railway (5ME768.4) is recommended as **eligible** for the NRHP. All nine isolated finds (5ME17677-5ME17685) were determined at the field level to be **not eligible**.

The enclosed report and site forms/isolated forms document the results of the Class III inventory for the previously proposed project on both federal and non-federal lands. As there is currently no proposed undertaking, we would like to consult with your office on eligibility, but not effect for the Grand Junction Regional Airport Proposed Land Transfer. When an undertaking is proposed (likely in Fall 2011) we will consult with your office on determination of effect and further steps to be taken.

The final positive findings report and the site forms discussing the findings and cultural resource determinations are enclosed. The BLM requests your concurrence on the determinations of eligibility for those properties recorded by *the Grand Junction Regional Airport & Bureau of Land Management Acreage: Intensive-Level Historic Resources Inventory and Class III Archaeological Inventory, Mesa County, Colorado*. Please review the enclosed documentation and send us your comments within ten working days. If you have any questions or comments, please don't hesitate to contact archaeologist Alissa Leavitt-Reynolds at 970-244-3035 or aleavitt@blm.gov

BUREAU OF LAND MANAGEMENT, GRAND JUNCTION FIELD OFFICE

Alissa Leavitt-Reynolds 7/15/2011

BY FIELD OFFICE ARCHAEOLOGIST DATE

/S/ Catherine Robertson JUL 19 2011

BY MANAGER DATE

Enclosures:

1) *Grand Junction Regional Airport & Bureau of Land Management Acreage: Intensive-Level Historic Resources Inventory and Class III Archaeological Inventory, Mesa County Colorado* (BLM GJFO CRIR 18210-01) (Sladek and Kintz 2011) and associated forms.
2) CDs of shapefiles, maps and PDFs of sites and report for above report.



HISTORY Colorado

July 29, 2011

Alissa Leavitt-Reynolds
Field Office Archaeologist
Bureau of Land Management
Grand Junction Field Office
2815 H Road
Grand Junction, CO 81506

Re: Grand Junction Regional Airport and Bureau of Land Management Land Exchange (GJFO CRIR 18210-01) (CHS #60050)

Dear Ms. Leavitt-Reynolds:

Thank you for your correspondence dated July 20, 2011 (received by our office on July 27, 2011) and the documentation provided for the subject project.

Following our review of the documentation provided, we concur with your determination that linear segment 5ME768.4 supports the eligibility of the larger linear resource of which it is a part. We concur that sites 5ME17676 and 5ME17686 are **not eligible** for the National Register of Historic Places (NRHP). Finally we concur that isolated finds 5ME17677, 5ME17678, 5ME17679, 5ME17680, 5ME17681, 5ME17682, 5ME17683, 5ME17684, and 5ME17685 are **not eligible** for the NRHP. Should the undertaking resume, we look forward to further consultation on project effect.

Thank you for the opportunity to comment. If we may be of further assistance, please contact Mark Tobias, Section 106 Compliance Manager, at (303) 866-4674 or mark.tobias@chs.state.co.us.

Sincerely,

for Edward C. Nichols
State Historic Preservation Officer
ECN/MAT

RECEIVED
BUREAU OF LAND MGMT.
GRAND JCT., CO
2011 AUG -3 PM 2:34

United States Department of the Interior
Bureau of Land Management
Grand Junction Field Office
2815 H Road
Grand Junction CO 81506
http://www.blm.gov/co/st/en/fo/gjfo.html

CONCURRENCE LETTER

In Reply Refer To:
8100 (LLCONO3000)
SEP 2 0 2012

Mr. Edward Nichols
State Historic Preservation Officer
Colorado Historical Society
1200 Broadway
Denver, CO 80203

County: Mesa
Cultural Resources Project Number: BLM GJFO CRIR 18210-01
NEPA Number: Pending
SHPO Number: ME.LM.R695 (sent previously)
Project Name: Proposed Transfer of Public Land to the Grand Junction Regional Airport Authority

The following undertaking is located in the Ute PM, T. 1 N., R. 1 E., Sections 19, 29, 30, 31, 32 and Ute PM, T. 1 N., R. 1 W., Sections 13, 23, 24, 25, and 26 in Mesa County. This undertaking; ___ is a non-routine interstate and/or interagency project or program; ___ directly affects a National Register eligible or listed property; ___ has been determined by BLM, the SHPO or the Council to be highly controversial; **_X_ is one of the following: a land exchange, land sale, Recreation and Public Purpose lease, or transfer**; ___ has been analyzed by a BLM staff person with limited experience or lacking appropriate expertise; **_X_ is one which we wish to bring to your attention.**

The Bureau of Land Management (BLM), has consulted with your office on the eligibility determinations for the cultural resources involved in the Grand Junction Regional Airport Land Transfer (CHS #60050) and would like to begin consultation on project effect. Earlier, in 2011, we sent your office a Class III Cultural Resource Inventory completed by Tatanka Historical Associates (Tatanka) and Metcalf Archaeological Consultants (Metcalf) on behalf of the Grand Junction Regional Airport Authority. The survey was completed in preparation for an anticipated land transfer from the BLM Grand Junction Field Office (GJFO) to the Grand Junction Regional Airport Authority to provide for expansion of the Grand Junction Airport. Currently, the environmental analysis documents are being prepared by the Federal Aviation Administration (FAA) and should be presented to the BLM in Fall 2012.

In the previously sent document, Tatanka and Metcalf conducted a Class III Cultural Resource Inventory on a total of 1780.5 acres on both BLM GJFO land and private property belonging to the airport (753 acres of BLM and 1027.5 private acres) in the Summer of 2010. The survey resulted in the recordation of three new historic properties (two sites (5ME17676 and 5ME17686 (both determined to be not eligible) and an additional segment of an existing linear site (5ME768.4 – determined eligible and supporting)) and nine isolated finds (5ME17677-5ME17685 – not eligible). The historic sites included a historic homestead (5ME17676), a historic dam (5ME17686), and the railroad bed of the Little Book Cliff Railway (5ME768.4). Your office concurred with our eligibility recommendations in July of 2011.

Since then the project boundaries have been modified from the original plan and now the Grand Junction Airport Authority is requesting a transfer of 190 acres of Federal Lands managed by the Grand Junction BLM. They are requesting this transfer in order to meet current Federal Aviation Administration (FAA) design standards and to eliminate intersecting runways at the Airport. Additionally, the Grand Junction Airport Authority is applying for Right of Way (ROW) grants for retention ponds just outside of the transfer area.

Of the previously mentioned cultural resources, about one quarter of the total length of 5ME768.4, the Little Book Cliff Railway, would fall within the land to be transferred and possibly in an area of a proposed retention pond. For security purposes, the Airport plans to install a perimeter fence and an access road that will cross and impact the Little Book Cliff Railway. Because of the nature of the land transfer and the proposed boundary fence, it is anticipated that an adverse effect will occur to 5ME768.4. Additionally, if the land transfer occurs, the FAA would continue consulting with your office for any future projects, and it is anticipated that the railroad would be impacted by additional runway expansion projects that may take place at a later date.

The BLM would like to begin further discussions on mitigation measures for this undertaking and would like to propose a Level II documentation of the portion of the Little Book Cliff Railway grade that would be impacted by the land transfer. We expect that continued consultation would result in a Memorandum of Understanding (MOU) between our offices and other applicable parties (the FAA) in order to mitigate the adverse effect to the Little Book Cliff Railway segment 5ME768.4 that would be impacted by this project. If you have any questions or comments please contact archaeologist Alissa Leavitt-Reynolds at 970-244-3035 or at aleavitt@blm.gov

BUREAU OF LAND MANAGEMENT, GRAND JUNCTION FIELD OFFICE

Alissa Leavitt-Reynolds 9/19/12

BY FIELD OFFICE ARCHAEOLOGIST DATE

/S/ Catherine Robertson SEP 2 0 2012

BY MANAGER DATE

Enclosures:

1) 2 Maps of Project showing land to be transferred and affected site.
2) Photo of the historic grade at the proposed fence and road location.

HISTORY Colorado

September 28, 2012

Catherine Robertson
Manager
Bureau of Land Management
Grand Junction Field Office
2815 H Road
Grand Junction, Colorado 81506

Re: Proposed Transfer of Public Land to the Grand Junction Regional Airport Authority (GJFO CRIR 18210-01) (CHS #60050)

Dear Ms. Robertson:

Thank you for your correspondence dated September 20, 2012 (received by our office on September 24, 2012) regarding the subject undertaking.

Following our review of the documentation provided, we concur that the proposed transference of a portion of the National Register eligible Little Book Cliff Railway (site 5ME768) out of "Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure the long-term preservation of the property's historic significance" does constitute an adverse effect pursuant to 36 CFR 800.5(a)(2)(vii).

We find the proposed mitigation satisfactory and look forward to developing a Memorandum of Agreement between all applicable parties, including the Federal Aviation Administration, to mitigate the effect of this undertaking on historic properties. Please note that as stipulated in 36 CFR 800.6, the lead agency official shall notify the Advisory Council on Historic Preservation of the adverse effect so that the Council may indicate whether it wishes to participate in the consultation to resolve the adverse effect.

We do request that BLM provide our office with an electronic copy of this agreement document as this will enable us to provide comments electronically and ultimately expedite consultation. This document may be sent directly to the e-mail address below.

Thank you for the opportunity to comment. We look forward to continued consultation on the subject project. If we may be of further assistance, please contact Mark Tobias, Section 106 Compliance Manager at (303) 866-4674 or mark.tobias@state.co.us.

Sincerely,

Edward C. Nichols
State Historic Preservation Officer
ECN/MAT

MEMORANDUM OF AGREEMENT

BETWEEN THE BUREAU OF LAND MANAGEMENT AND

THE COLORADO STATE HISTORIC PRESERVATION OFFICER

REGARDING THE GRAND JUNCTION REGIONAL AIRPORT AUTHORITY LAND

TRANSFER IN MESA COUNTY, COLORADO

WHEREAS, the Bureau of Land Management – Grand Junction Field Office (BLM) plans to transfer itself of 188 acres of public lands that it holds in the Grand Junction Field Office to the Grand Junction Regional Airport Authority (Airport) for airport development and safety improvements. Project pursuant to Federal Land Policy and Management Act (FLPMA) Public Law 94–579 of 1976; Section 516 of the Airport and Airway Improvement Act of 1982 (49 U.S.C. 2215); and federal regulations at 43 C.F.R Subpart 2640.

WHEREAS, the BLM has defined the undertaking's area of potential effect (APE) as the 188 acres to be transferred to the Airport, and a possible recreation staging area on BLM land to be built as a part of the Federal Aviation Administration's (FAA) mitigation for impacts to recreation opportunities that will occur because of the transfer; and

WHEREAS, the segment of the Little Book Cliff Railway (5ME768.4) that is located within the acreage to be transferred was determined to support the National Register of Historic Places eligibility for the Little Book Cliff Railway of which it is a part; and

WHEREAS, the BLM has determined, in consultation with the Colorado State Historic Preservation Officer (SHPO), that the undertaking will have an adverse effect on site 5ME768, which is eligible for listing in the National Register of Historic Places; and

WHEREAS, the BLM has consulted with the SHPO following guidance regarding cultural resources pursuant to the *"Programmatic Agreement Among the Bureau of Land Management, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Manner in which Bureau of Land Management will Meet Its Responsibilities Under the National Historic Preservation Act"*; *State Protocol Agreement Between the Colorado State Director of the Bureau of Land Management and the State Historic Preservation Office Regarding the Manner in Which the BLM will meets its Responsibilities Under the National Programmatic Agreement Among the Bureau of Land Management, The Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Offices* (hereinafter Colorado Protocol); and

NOW, THEREFORE, the BLM and the SHPO agree that the undertaking shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on site 5ME768.

STIPULATIONS

The BLM shall ensure that the following measures are carried out:

I. DOCUMENTATION

Level II Photo Documentation in accordance with the guidance found in "Historic Resource Documentation, Standards for Level I, II, and III Documentation" (Office of Archaeology and Historic Preservation Publication 1595, October 2007) shall be completed for the portion of the Little Book Cliff Railway (site 5ME768) located within the area to be transferred. The SHPO will receive a copy of the report following the completion of fieldwork.

II. DURATION

This MOA will be null and void if its terms are not carried out within five (5) years from the date of its execution. Prior to such time, the BLM may consult with the other signatories to reconsider the terms of the MOA and amend it in accordance with Stipulation VII below.

III. POST-REVIEW DISCOVERIES

In the unlikely event that additional historic properties are discovered, the BLM shall contact the SHPO for further consultation.

IV. MONITORING AND REPORTING

One year following the execution of this MOA until it expires or is terminated, the BLM shall provide all parties to this MOA a summary report detailing work undertaken pursuant to its terms by September 30th. Such report shall include any scheduling changes proposed, any problems encountered, and any disputes and objections received in the BLM's efforts to carry out the terms of this MOA.

V. DISPUTE RESOLUTION

Should any signatory to this MOA object at any time to any actions proposed or the manner in which the terms of this MOA are implemented, the BLM shall consult with such party to resolve the objection. If the BLM determines that such objection cannot be resolved, the BLM will:

A. Forward all documentation relevant to the dispute, including the BLM's proposed resolution, to the Advisory Council on Historic Preservation (ACHP). The ACHP shall provide the BLM with its advice on the resolution of the objection within thirty (30) days of receiving adequate documentation. Prior to reaching a final decision on the dispute, the BLM shall prepare a written response that takes into account any timely advice or comments regarding the dispute from the ACHP, signatories and concurring parties, and provide them with a copy of this written response. The BLM will then proceed according to its final decision.

B. If the ACHP does not provide its advice regarding the dispute within the thirty (30) day time period, the BLM may make a final decision on the dispute and proceed accordingly. Prior to reaching such a final decision, the BLM shall prepare a written response that takes into account any timely comments regarding the dispute from the signatories and concurring parties to the MOA, and provide them and the ACHP with a copy of such written response.

C. It is the BLM's responsibility to carry out all other actions subject to the terms of this MOA that are not the subject of the dispute remain unchanged.

VI. AMENDMENTS

This MOA may be amended when such an amendment is agreed to in writing by all signatories. The amendment will be effective on the date a copy signed by all of the signatories is filed with the ACHP.

VII. TERMINATION

If any signatory to this MOA determines that its terms will not or cannot be carried out, that party shall immediately consult with the other parties to attempt to develop an amendment per Stipulation VI, above. If within thirty (30) days an amendment cannot be reached, any signatory may terminate the MOA upon written notification to the other signatories.

Once the MOA is terminated, and prior to work continuing on the undertaking, the BLM must either (a) execute an MOA pursuant to 36 C.F.R § 800.6 or (b) request, take into account, and respond to the comments of the ACHP under 36 C.F.R § 800.7. The BLM shall notify the signatories as to the course of action it will pursue.

Execution of this MOA by the BLM and the SHPO is in accordance with the Colorado Protocol Stipulation VIII(C)(2)(A)(1) and therefore is in compliance with 36 CFR 800.6(b)1(iv) and 36 CFR 800.6(c). It is considered an agreement with the ACHP for the purposes of Section 110(1) of NHPA and that the BLM has taken into account the effects of the undertaking on historic properties. The BLM will submit the fully executed MOA to the ACHP.

In witness whereof, the parties to this MOA through their duly authorized representatives have executed this MOA on the dates set out below, and certify that they have read, understood, and agreed to the terms and conditions of this MOA as set forth herein.

The effective date of this MOA is the date signed by the last signatory below.

SIGNATORIES:

Bureau of Land Management

Katie A Stevens Date 3/5/13
Katie Stevens, Grand Junction Field Manager

Colorado State Historic Preservation Office

Richard H Williams (Deputy SHPO) Date March 12, 2013
Mr. Edward Nichols, State Historic Preservation Officer

CONCURRING PARTIES:

Federal Aviation Administration

_____ Date 4.12.2013
Mr. John Bauer, Manager, Denver Airports District Office Manager

Grand Junction Regional Airport

_____ Date 4.29.2013
Mr. Rex A. Tippetts, Director of Aviation

United States Department of the Interior

Bureau of Land Management
Grand Junction Field Office
2815 H Road
Grand Junction, Colorado 81506
www.co.blm.gov/gjra/gjra.html

CONCURRENCE LETTER

In Reply Refer to:
8100 (LLCON03000)

AUG - 5 2013

Mr. Edward Nichols
State Historic Preservation Officer
Colorado Historical Society
1200 Broadway
Denver, CO 80203

County: Mesa
Cultural Resources Project Number: BLM GJFO CRIR 18213-01
NEPA Number: CO-130-2013-0020-EA
SHPO Report Number: ME.LM.R846

Project Name: Fulfillment of MOA between the BLM Grand Junction Field Office and the Colorado SHPO Regarding the Grand Junction Regional Airport Authority Land Transfer in Mesa County, Colorado – Level II Documentation of the Little Book Cliff Railway (CHS#60050).

This undertaking is located in Ute PM, T. 1 N., R. 1 E., Section 30

As part of the upcoming proposed Airport Land Transfer between the Bureau of Land Management (BLM) Grand Junction Field Office (GJFO) and the Grand Junction Regional Airport Authority, the BLM, in consultation with the Colorado State Historic Preservation Officer (SHPO) determined that the land transfer would have an adverse effect on the portion of the Little Book Cliff Railway (site 5ME.768.4) that is within the transfer area. To mitigate impacts to a portion of 5ME.768.4, the BLM and SHPO agreed to Level II Photo Documentation of the portion of the site that will be transferred to the Grand Junction Regional Airport Authority.

In May 2013, BLM Colorado Permitted firm, Tatanka Historical Associates, Inc., visited the site to complete medium-format black and white photography and to take field measurements of the rail bed segment. All of these materials have been prepared and printed in archival-stable format

to comply with the guidelines found in OAHP Publication #1595, entitled, "Historic Resource Documentation."

It is the BLM's opinion that this Level II documentation of the portion of the Little Book Cliff Railway (5ME.768.4) that will be transferred outside of the BLM ownership fulfills the MOA between our offices and completes consultation for Section 106 of the National Historic Preservation Act for this land transfer. We request your confirmation that the stipulations of the MOA between our offices have been fulfilled and are now completed for this project.

Please review the enclosed Level II documentation report (BLM GJFO CRIR 18213-01/ME.LM.R846) and send us your comments within ten working days. If you have any questions or concerns, please contact either myself at 970-244-3010 or kasteven@blm.gov or archaeologist, Alissa Leavitt-Reynolds at 970-244-3035 or aleavitt@blm.gov.

BUREAU OF LAND MANAGEMENT, GRAND JUNCTION FIELD OFFICE

Alissa Leavitt-Reynolds 8/1/2013

BY FIELD OFFICE ARCHAEOLOGIST DATE
Alissa Leavitt-Reynolds

Katie A Stevens 8/2/2013

BY MANAGER DATE
Katie Stevens

Enclosures:

1) Little Book Cliff Railway, Level II Documentation (BLM CRIR 18213-01/ME.LM.R846).

2) Data CD with report and photos in PDF form; Medium-format negatives.

CC: 1) Mr. John Bauer, Federal Aviation Administration, Denver Airports District Office Manager (with enclosure #1).

2) Mr. Rex A. Tippetts, Grand Junction Regional Airport, Director of Aviation, (without enclosures).

3) Mr. Ryan Hayes, Senior Airport and Environmental Planner, Barnard Dunkelberg Company (without enclosures) (electronic).

HISTORY Colorado

RECEIVED
BUREAU OF LAND MGMT.
GRAND JCT., CO
2013 AUG 12 PM 2:54

August 8, 2013

Katie A. Stevens
Field Manager
Bureau of Land Management
Grand Junction Field Office
2815 H Road
Grand Junction, Colorado 81506

Re: Fulfillment of MOA between the BLM Grand Junction Field Office and the Colorado SHPO Regarding the Grand Junction Regional Airport Authority Land Transfer in Mesa County, Colorado – Level II Documentation of the Little Book Cliffs Railway (BLM GJFO CRIR 18213-01) (CHS #60050)

Dear Ms. Stevens:

Thank you for your correspondence dated August 5, 2013 (received by our office on August 7, 2013) submitted pursuant to the *Memorandum of Agreement Between the Bureau of Land Management and the Colorado State Historic Preservation Officer Regarding the Walker Field Grand Junction Airport Land Transfer in Mesa County, Colorado.*

We find the report entitled *Little Book Cliffs Railway, Level II Documentation, Grand Junction, Colorado* and the attendant documentation satisfactory. As such, we concur that the documentation stipulation of the above referenced MOA has been fulfilled and completed.

Thank you for the opportunity to comment. If we may be of further assistance, please contact Mark Tobias, Section 106 Compliance Manager, at (303) 866-4674 or mark.tobias@state.co.us.

Sincerely,

for Edward C. Nichols
State Historic Preservation Officer
ECN/MAT

ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 13

USFWS CONSULTATION

UTM 4/25/11

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
764 Horizon Drive, Building B
Grand Junction, Colorado 81506-3946

IN REPLY REFER TO:
ES/CO: BLM/GJFO/GJRegionalAirport
TAILS 65413-2011-CPA-0009

RECEIVED
BUREAU OF LAND MGMT.
GRAND JCT., CO
2011 APR 20 PM 5:01

April 21, 2011

Memorandum

To: Field Manager, Bureau of Land Management, Grand Junction Field Office, Grand Junction, Colorado

From: Western Colorado Supervisor, Fish and Wildlife Service, Ecological Services, Grand Junction, Colorado Allan R. Pfister

Subject: Comments on Proposed Land Transfer to Grand Junction Regional Airport Authority

The U.S. Fish and Wildlife Service (Service) received your March 21, 2011, request for comments regarding the proposed project near Grand Junction, Colorado. The proposed action includes transferring title to 720 acres of land administered by the Bureau of Land Management (BLM), Grand Junction Field Office (GJFO), to the Grand Junction Regional Airport Authority (Airport) for an airport improvement project. BLM is preparing an Environmental Assessment (EA) to assess the environmental effects of the proposed land transfer, as well as an amendment to the BLM GJFO Resource Management Plan to identify the requested lands as suitable for disposal to the Airport.

The Airport has requested the proposed land transfer as part of a plan to correct deficiencies in runway and taxiway gradients associated with the primary runway and to eliminate intersecting runways to improve safety. The proposed land transfer would allow a new replacement primary runway to be built 650 feet north of the existing runway, making it possible for the Airport to stay open during construction. Other project activities include relocation of portions of roads; construction of detention ponds, water quality ponds and culverts; installation/relocation of navigational aids, visual aids, and runway lighting; installation/relocation of taxiway lighting; construction of airport perimeter fencing; removal of existing sections of pavement no longer required; and relocation of the aircraft maintenance run-up area.

The Service's primary concern with any project is avoidance of impacts to threatened, endangered and candidate species, as well as species-at-risk and their habitats within the project area. To assist with planning, we provide the following list of federally listed threatened, endangered, and proposed species, and potential candidates for future listing that could be impacted by the proposed project.

Common Name	Scientific Name	Status
Yellow-billed cuckoo	*Coccyzus americanus*	C
Canada lynx	*Lynx canadensis*	T
Humpback chub*	*Gila cypha*	E
Colorado pikeminnow*	*Ptychocheilus lucius*	E
Bonytail chub*	*Gila elegans*	E
Razorback sucker*	*Xyrauchen texanus*	E
Greenback cutthroat trout #	*Oncorhynchus clarki stomias*	T
Colorado hookless cactus	*Sclerocactus glaucus*	T
DeBeque phacelia	*Phacelia submuitica*	P

T = federally listed threatened, E = federally listed endangered, C = federal candidate species, P = federally proposed as threatened

* Water depletions in the Upper Colorado River Basin may affect the species and/ or critical habitat in downstream reaches in other states.
# Recent genetic tests identified cutthroat population as GB lineage; therefore, consultation is an interim measure until genetic and taxonomic issues are resolved.

We compiled the list above from an inventory for Mesa County, Colorado, and therefore it may be that some or all of the species do not presently occupy or use the proposed project area, and/or that habitats for these species do not exist within the project area. We included the four federally-listed fishes on the list in the event that project actions cause water depletions to the Upper Colorado River Basin, or affect listed species and/or off-site habitat, including critical habitat, in downstream reaches.

Based on our records, cacti identified as *Sclerocactus parviflorus* (Devil's claw cactus) occur in the vicinity of the project area. Comparative deoxyribonucleic acid (DNA) sequences (Porter et al. 2000) infer common ancestry between *S. parviflorus* and *Sclerocactus glaucus* (Colorado hookless cactus) (*S. glaucus*), and introgression may occur between the two species. Consequently, there are uncertainties regarding the taxonomic distinction between these species, based on current morphological and genetic data. This issue is currently being researched by the Denver Botanic Gardens, and study results are forthcoming (DBG 2009). Also, the Service intends to collect *S. glaucus* samples from the project vicinity for further genetic testing. Please be aware that, depending on this and future research related to *Sclerocactus*, proposed and ongoing Federal activities may be subject to further review under the Endangered Species Act, possibly including reinitiation of Section 7 consultation. As with any proposal involving disposal or exchange of public lands which support threatened or endangered species, or their habitats, or other trust resources, the Service strongly recommends retaining lands in Federal ownership, or otherwise ensuring protection of those species through other means if lands cannot be retained.

Migratory birds, raptors and eagles: Please be apprised of the potential application of the Migratory Bird Treaty Act (MBTA) of 1918, as amended, 16 U.S.C. 703 et seq., and the Bald Eagle Protection Act (BEPA) of 1940, as amended, 16 U.S.C. 688 et seq., to your project. The MBTA does not require intent to be proven and does not allow for "take," except as permitted by regulations. Section 703 of the MBTA provides: "Unless and except as permitted by regulations

. . . it shall be unlawful at any time, by any means or in any manner, to... take, capture, kill, attempt to take, capture, or kill, possess . . . any migratory bird, any part, nest, or eggs of any such bird ... "

The BEPA prohibits knowingly taking, or taking with wanton disregard for the consequences of an activity, any bald or golden eagles or their body parts, nests, or eggs, which includes collection, molestation, disturbance, or killing activities.

One or more candidate species potentially occur within the project area. Federal candidates for official listing as threatened or endangered have no legal protection under the Endangered Species Act of 1973, as amended. However, it is within the spirit of the Act to consider project impacts to these species.

Based on the information provided, we would like to point out that it appears that Section 7 consultation may be appropriate in this case. The BLM must evaluate the effects of the action, including the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). In this case it would be the responsibility of the Bureau of Land Management, Grand Junction Field Office, to complete consultation with the Service on effects to listed species prior to granting the land transfer, if listed species or their habitat may be affected in or near the project area.

The Service looks forward to commenting further on this project. If the Service can be of further assistance, please contact Charlie Sharp (970) 243-2778, extension 18, or charles_sharp@fws.gov.

LITERATURE CITED

DBG. 2009. Proposal for funding submitted by the Denver Botanic Gardens and the University of Northern Colorado, "A genetic investigation of *Sclerocactus glaucus* (Colorado hookless cactus): Genetic diversity and taxonomic relations in western Colorado. Denver, Colorado. 8 pp.

Porter JM, MS Kinnery, and KD Heil. 2000. Relationships between *Sclerocactus* and *Toumeya* (Cactaceae) based on chloroplast trnL-trnF sequences. Haseltonia 7:8-23.

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Northwest Colorado District
2815 H Road
Grand Junction, Colorado 81506

TAKE PRIDE IN AMERICA

FEB 26 2013

2800 (CO-130)
BA/ Grand Junction Regional Airport land transfer

Memorandum

To: Patty Schrader Gelatt, U.S. Fish & Wildlife Service

From: for Field Manager Wayne Hirt

Subject: Biological Assessment of the Grand Junction Regional Airport Land Transfer from the Grand Junction Field Office, BLM

The Bureau of Land Management Grand Junction Field (BLM-GJFO) has prepared the enclosed Biological Assessment (BA) for submittal to the U.S. Fish and Wildlife Service (FWS), Western Colorado Ecological Services Field Office, Grand Junction, Colorado. The purpose of the BA is to evaluate effects of the Proposed Action – transfer of 188 acres of BLM land to the Grand Junction Regional Airport in sufficient detail to determine effects on federally listed endangered and threatened species and designated critical habitat.

The Federal Aviation Administration (FAA) and Bureau of Land Management (BLM) are working jointly with the Grand Junction Regional Airport on a project which includes 1) the transfer of BLM lands that will become airport property, 2) the relocation of the primary airport runway, and 3) creation of 3 water quality ponds and 6 detention pond features on ephemeral drainages.

For reasons explained in the BA, the Proposed Action would have "No Effect" on four listed species that could occur within Mesa counties: Yellow-billed cuckoo (Coccyzus americanus), Canada lynx (Lynx canadensis), greenback cutthroat trout (Onchorynchus clarki stomias), and DeBeque phacelia (Phacelia submutica).

The Proposed Action would withdraw an average of .26 acre-feet of water per year. Because there would be water depletions associated with the land transfer and airport expansion, a determination of "May Affect, Likely to Adversely Affect" was made for the four endangered fish – Colorado pikeminnow (Ptychocheilus lucius), razorback sucker (Xyrauchen texanus), humpback chub (Gila cypha), and bonytail (G. elegans) and the species' critical habitat in the Colorado River.

Colorado hookless cactus (Sclerocactus glaucus) is present within 1,300 feet of the project area. While no direct effects to the cactus is anticipated, indirect impacts associated with on-going livestock grazing and recreational use of public land resulted in a determination of "May Affect, Not Likely to Adversely

Affect" for the Colorado hookless cactus. Critical habitat for Colorado hookless cactus has not been designated or proposed.

The water depletions are covered by the FWS 2009 Programmatic Biological Opinion (PBO) regarding the Colorado River endangered fishes. Water depletions will be reported under the annual reporting provisions of the PBO. BLM requests concurrence with the determinations that, other than water depletions, effects by the Proposed Action may affect but would not likely adversely affect Colorado hookless cactus.

Please contact Anna Lincoln, Ecologist with the Grand Junction Field Office (970-244-3019) with any questions regarding this request, or the proposed project.

Attachments:
Biological Assessment
Biological Survey

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
764 Horizon Drive, Building B
Grand Junction, Colorado 81506-3946

IN REPLY REFER TO:
ES/CO: BLM/GJFO
TAILS 06E24100-2013-I-0077

March 22, 2013

Memorandum

To: Field Manager, Bureau of Land Management, Grand Junction Field Office, Grand Junction, Colorado

From: Western Colorado Supervisor, Fish and Wildlife Service, Ecological Services, Grand Junction, Colorado

Subject: BLM Land Transfer to Grand Junction Regional Airport Authority

The U.S. Fish and Wildlife Service (Service) received your February 26, 2013 request for informal Endangered Species Act, section 7 consultation for the proposed transfer of 188 acres of BLM land to the Grand Junction Regional Airport

The proposed action includes transferring title to 188 acres of land administered by the Bureau of Land Management (BLM), Grand Junction Field Office (GJFO), to the Grand Junction Regional Airport Authority (Airport) for an airport improvement project. The Airport has requested the proposed land transfer as part of a plan to correct deficiencies in runway and taxiway gradients associated with the primary runway and to eliminate intersecting runways to improve safety. The proposed land transfer would allow a new replacement primary runway to be built 650 feet north of the existing runway, making it possible for the Airport to stay open during construction. Other project activities include relocation of portions of roads; construction of detention ponds, water quality ponds and culverts; installation/relocation of navigational aids, visual aids, and runway lighting; installation/relocation of taxiway lighting; construction of airport perimeter fencing; removal of existing sections of pavement no longer required; and relocation of the aircraft maintenance run-up area. The proposed action would withdraw an average of 0.26 acre-feet of water per year.

The BLM determined that the proposed action may affect, is likely to adversely affect the four Colorado River endangered fish, including the bonytail (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), and razorback sucker (*Xyrauchen texanus*), and their critical habitats, due to water depletions. The water depletions are addressed by the USFWS 2009 Programmatic Biological Opinion (PBO)

regarding the Colorado River endangered fish. Water depletions will be reported under the annual reporting provisions of the PBO.

We concur with your determination that the transfer of 188 acres of BLM land to the Grand Junction Regional Airport may affect but is not likely to adversely affect the *Sclerocactus glaucus* (Colorado hookless cactus). Our concurrence is based on the following information provided in the February 2013 Biological Assessment (BA) provided by the BLM.

- No Colorado hookless cacti were found during surveys within the BLM proposed transfer property. Cacti were located approximately 1,300 feet (396 m) to the north of proposed transfer property on BLM lands that are historically and currently subject to livestock grazing and OHV use. The proposed transfer will not concentrate livestock grazing or OHV use around the cactus occurrences to any measureable level on BLM land to the north of the proposed transfer area.

- There is no anticipated direct effect to the cactus by construction and use of the detention ponds, construction of the security fence and perimeter road, and the relocation of 27 ¼ Road, as the action area is more than 1,000 feet (304 m) from the closest known cactus.

This concludes Section 7 consultation for the proposed project. As provided in 50 CFR §402.16, re-initiation of consultation is required if: 1) new information reveals effects of the agency action that may impact listed species or critical habitat in a manner or to an extent not previously considered, 2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not previously considered, or 3) a new species is listed or critical habitat designated that may be affected by the action.

Thank you for your interest in conserving threatened and endangered species. If we can be of further assistance, please contact Ellen Mayo (970) 243-2778, extension 14, or ellen_mayo@fws.gov.

EMayo:BLMGJFOLandTransfertoGJAirportCL.docx:032113:KM

ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Appendix 14

EA DRAINAGE ANALYSIS

EA DRAINAGE ANALYSIS FOR PROPOSED RUNWAY 11/29

Grand Junction Regional Airport

Grand Junction, Colorado

Sponsored By:

Grand Junction Regional Airport Authority
Federal Aviation Administration

May 2012

JVIATION®

900 S. Broadway, Suite 350
Denver, CO 80209

Main 303.524.3030
Fax 303.524.3031

JVIATION.COM

ENGINEER'S STATEMENT

I hereby certify that this Drainage Analysis for the Environmental Assessment of the Proposed Runway 11/29 was prepared by me (or under my direct supervision) in accordance with the provisions of the *Stormwater Management Manual*. I understand that the City of Grand Junction does not and will not assume liability for drainage facilities analyzed by others.

_____

David M. Le, PE
State of Colorado No. 43827
(Affix Seal)

TABLE OF CONTENTS

	Pages
GENERAL LOCATION AND DESCRIPTION	
A. Location	1
B. Description of Property	1
MAJOR DRAINAGE BASINS AND SUB-BASINS	
A. Proposed Drainage System Description	1
B. Drainage Facility Maintenance	4
DRAINAGE DESIGN CRITERIA	
A. Regulations	5
B. Development Criteria Reference and Constraints	6
C. Hydrologic Criteria	6
D. Hydraulic Criteria	7
E. Water Quality Requirements	7
F. Variance from Criteria	7
DRAINAGE FACILTY DESIGN	
A. General Concept	8
B. Specific Details	8
CONCLUSION	
A. Compliance with Manual	9
B. Drainage Concept	9
C. Water Quality	9
D. Areas in Flood Hazard Zone	9
REFERENCES	9
APPENDIX A	
Vicinity Map	
Flood Insurance Rate Map	
Excerpts from Stormwater Management Manual	
NRCS Web Soil Survey Data	
Excerpt from AC 150/5200-33B	
SCS Method Reference Data	
Water Quality Capture Volume Criteria	

APPENDIX B

Leach Creek Detention Basin June 2003, City of Grand Junction
Leach Creek Detention Basin Water District 5, March 2003, City of Grand Junction

APPENDIX C

HEC-1 Input Data Proposed Conditions
Graphical HEC-1 Connectivity Diagrams
HEC-1 Model 10-yr Proposed Conditions
HEC-1 Model 100-yr Proposed Conditions
Pond Design

APPENDIX D

Drainage Maps

GENERAL LOCATION AND DESCRIPTION

A. Location

This project is located at the Grand Junction Regional Airport (see Vicinity Map in Appendix A). The project is located northeast of the City of Grand Junction, Colorado in Mesa County, north of Interstate 70 (I-70), approximately one mile along Horizon Drive. The airport is bordered by Bureau of Land Management (BLM) property to the north and east, I-70 and the Government Highline Canal to the south, and Road 27 ¼ to the west.

The area studied in this report includes land in Sections 24 and 25 of Township 1 North, Range 1 West of the UTE Meridian and Sections 19, 29, 30, and 32 of Township 1 North, Range 1 East of the UTE Meridian.

B. Description of Property

The property is made up of Commercial and General Aviation areas that utilize the airport for business. The land consists of runways, taxiways, aprons, parking lots, buildings, roadway networks, and utility infrastructure to serve the operations at the airport.

The airport is planning on relocating Runway 11/29 and 27 ¼ Road to the north. Because these pavement sections will be built, detention and water quality ponds will have to be constructed to meet Grand Junction stormwater requirements. This analysis will determine necessary locations and sizes of the proposed detention and water quality ponds.

MAJOR DRAINAGE BASIN AND SUB-BASINS

A. Proposed Drainage System Description

The approved Environmental Assessment (EA) Drainage Analysis for Proposed Runway 11/29, by Jviation, October 2011, has divided the site into four major basins: 1) Ranchman's Ditch, 2) Leach Creek, 3) Corcoran Wash, and 4) Indian Wash. This analysis will study portions of the same four major basins.

RANCHMAN'S CREEK

Ranchman's Creek is subdivided into twenty-one subbasins and is the main basin that conveys flows through the airport. Major changes to the previous drainage report (Jviation 2009) are the revisions to all drainage subbasin areas, imperviousness of all subbasins, and dividing subbasins DB21a and DB22.

Based on updated topography data, all subbasin areas were re-evaluated to more accurately delineate each basin. Subbasin DB21a was divided into three subbasins (DB21a, DB21a1, and DB21a2) and subbasin DB22 was divided into two subbasins (DB022 and DB22a) to incorporate the proposed relocation of Runway 11/29.

Subbasin DB21 is north of Runway 11/29 and is comprised of 100.5 acres that conveys flows to an existing detention pond (Pond A). Flows from Pond A are conveyed into Subbasin DB21a2. Subbasin DB21a2 is comprised of 49.9 acres which convey flows to proposed Pond 4a. Subbasin DB21a1 is comprised of 44.8 acres which convey flows to proposed Pond 4. Both Pond 4 and 4a are directly north of the relocated 27 ¼ Road and outfall into subbasin DB21a. Subbasin DB21a is comprised of 150.2 acres and includes a portion of relocated Runway 11/29. Overland flows in subbasin DB21a are conveyed into proposed Pond 4b. The outfall of Pond 4b is an existing 36" RCP pipe. The remaining subbasins downstream to subbasin DB21a include DB23b, DB23c, DB23d, DB23e and DB23a, remain unchanged, and flows eventually enter the existing city's upper detention pond (R_PDU).

Subbasin DB22 is north of the relocated 27 ¼ Road and is comprised of 36.1 acres. Overland flows of subbasin DB22 are conveyed into proposed Pond 5. The outfall of Pond 5 is a 24" RCP pipe which crosses 27 ¼ Road and enters subbasin DB22a. Subbasin DB22a is comprised of 100.1 acres and outfalls into an existing 36" RCP pipe. The remaining subbasins downstream to subbasin DB22a include DB24a, DB24, DB25 and DB25a, remain unchanged, and flows eventually enter the existing city's upper detention pond (R_PDU). Flows from detention pond R_PDU enter the existing city's lower detention pond (R_PDL), where flows outfall offsite with a 48" RCP pipe.

Subbasin R16 is comprised of 100.5 acres which conveys flows into subbasin R14a through 2-48" CMPs beneath Horizon Road. Subbasin R14a consist of 26.3 acres of parking lot uses and buildings with outfall offsite with an existing 48" RCP pipe.

Subbasin R15d is comprised of 97.9 acres of undeveloped openspace. Flows from subbasin R15d enter subbasin R13 with an existing 81"x64" box culvert beneath H Road. Subbasin R13 is comprised of 27.4 acres and outfalls offsite with an existing 24" polyvinyl chloride (PVC) pipe.

Subbasin R14 is comprised of 38.3 acres of undeveloped land that conveys flows into subbasin R5. Subbasin R5 consists of 54.0 acres of undeveloped land and outfalls offsite with a 24" RCP pipe beneath I-70.

In previous drainage reports, subbasin R17 was tributary to the Ranchman's Creek Basin, but proposed overlot grading for the relocation of Runway 11/29 now shows subbasin R17 tributary to the Leach Creek Basin.

All subbasins within the Ranchman's Creek Basin have been analyzed for the airport's ultimate buildout. All water quality and detention features have been sized for the change of imperviousness for the ultimate conditions of the Airport.

The four subbasins that outfall offsite are DB25a (Pond R_PDL), R14a, R13, and R5.

LEACH CREEK

Leach Creek is subdivided into eleven subbasins and conveys flows along the west side of the proposed runway. Leach Creek also includes flows along the relocated 27 ¼ Road.

All subbasin areas were re-evaluated to more accurately delineate each basin based on updated topography data. Subbasin L10d was divided into two subbasins (L10d and L10d1) to incorporate the proposed relocation of 27 ¼ Road.

Subbasin L11b is comprised of 4744.3 acres of undeveloped land and conveys flows to a large upper city pond that is planned to be constructed fall of 2012. Flows then enter subbasin L11au which is comprised of 649.5 acres, which include undeveloped land and a majority of relocated 27 ¼ Road. Overland flows in subbasin L11au are conveyed into proposed Pond 1. Currently, Pond 1's design is not completed. The City of Grand Junction would like to continue investigated the allowed release rate of Pond 1 due to the construction of the upper Leach Creak Dam and current drainage issues downstream of Pond 1. Flows from Pond 1 enter subbasin L11ad, which consist of 14.7 acres of undeveloped land. Subbasin L11ad is unchanged with this project. In this basin, flows outfall offsite with 3-60" CMPs.

Subbasin L10u is comprised of 278.9 acres of undeveloped land. Flows from subbasin L10u are conveyed into Pond 2, which outfall into subbasin L10d. Subbasin L10d1 is comprised of 53.5 acres and outfall into subbasin L10d with a proposed 36" RCP pipe beneath the relocated 27 ¼ Road. Subbasin L10d is comprised of 323.3 acres of the western portion of the relocated runway and a portion of 27 ¼ Road. Flows from subbasin L10d are conveyed into Pond 6, which outfalls offsite with a 36" RCP pipe.

Subbasin L9.1u is comprised of 1519.6 acres of undeveloped land. Flows from subbasin L9.1u are conveyed into Pond 3 which outfall into subbasin L9.1d. Subbasin R17 was added to the Leach Creek Basin due to the proposed grading. Subbasin R17 consists of 78.7 acres of undeveloped land that conveys its flows into subbasin L9.1d. Subbasin R15u was also added to the Leach Creek Basin due to a site visit that made it apparent that Subbasin R15u was tributary to the Leach Creek Basin. Subbasin R15u consists of 106.6 acres of proposed taxiways, apron and access roads. At the downstream end of Subbasin R15u, an existing detention pond exist which outfall into Subbain L9.1d. Subbasin L9.1d is comprised of 189.9 acres of runway, taxiway, apron, and undeveloped land. A portion of the subbasin will convey flows downstream with a 72" RCP pipe. Flows from this subbasin will be conveyed to Pond 7, which will outfall offsite with 2-60" RCP pipes.

Subbasin L9 is comprised of 105.4 acres and includes the airport's undeveloped property which is part of a residential subdivision. Subbasin L9 is unchanged with this project.

All subbasins within the Leach Creek Basin have been analyzed for the airport's ultimate buildout. All water quality and detention features have been sized for the change of imperviousness for the ultimate conditions of the Airport.

The four subbasins that outfall offsite are L11ad, L10d, L9.1d, and L9.

CORCORAN WASH

Corcoran Wash consists of one basin, C3, and convey flows west of the airport's property. This basin is not affected by the proposed relocation of Runway 11/29 or 27 ¼ Road.

INDIAN WASH

Indian Wash is subdivided into nine subbasins and conveys flows around the east side of Runway 11/29. Although on airport property, this basin is not affected by the proposed relocation of Runway 11/29 or 27 ¼ Road.

This report does not modify the hydrology of this basin and did not consider the ultimate buildout of this basin.

According to the master plan for the airport, there will be hangar development as well as potential land improvements to this basin in the future. Several detention and water quality elements will need to be built per Grand Junction regulations once these land improvements occur.

The four subbasins that outfall offsite are I1, I6, I8, and I9.

B. Drainage Facility Maintenance

Drainage facility maintenance for all detention and water quality ponds on the property of the Grand Junction Regional Airport will be the responsibility of the airport.

DRAINAGE DESIGN CRITERIA

A. Regulations

The regulation for analysis for this study was the City of Grand Junction Stormwater Management Manual (ref. 2). Additional guidance was provided by the Urban Storm Drainage – Criteria Manual (ref. 1).

There are several methods used to determine the values used with HEC-1 for the characteristic of each basin: the SCS Curve Number Method, the Green Ampt Method, and the Snyder Method. These methods were computed in the analysis of this report. According to the City of Grand Junction Stormwater Management Manual, "Typical values for the Green-Ampt parameters were obtained from the *Drainage Manual for Maricopa County Hydrology* (Maricopa County 2003 (draft))." This procedure was also calculated for this report.

The final procedure used to determine the input values for HEC-1 is described below:

Each subdivision was divided into separate areas by soil type (see web soil survey in Appendix A). A Curve Number (CN) was then derived based on the soil type and imperviousness of each basin. The Initial Loss (IA) was then determined using the SCS Method.

The SCS Method uses a CN value calculated directly from the Imperviousness and soil type:

$$S = (1{,}000/CN)-10$$

$$IA = 0.2*S$$

$$Q = (P-IA)^2/((P-IA)+S)$$

The values for precipitation losses, Volume Moisture Deficit (DTHETA), Wetting Front Suction (PSIF) and Hydraulic Conductivity (XKSAT) were selected from Table A1 – Table of Correspondence (see Appendix A), based on the Curve Number (CN).

In regards to the Snyder Method (specifically the CUHP) that was used to determine lag time (Tlag) and the coefficient related to peak rate of runoff (Cp), Jviation's 2009 Drainage Report (ref. 6) and Icon's Drainage Report (ref. 5) used the following equations to calculate lag time.

$$T_{lag} = C_t\,(LxL_{ca}/S^{0.5})^{0.48}$$

$$C_p = PC_tA^{0.15}$$

In this report, it is proposed that the Snyder Method (CUHP equations) is only appropriate to urban areas. There are several basins for this project that are considered rural areas, and the Snyder Method (CUHP equations) do not properly characterize flows for these basins. To address this issue, the Grand Junction Stormwater Management Manual directed the lag time to be calculated using the Snyder Method (USBR equations – Mesa County). The following are the equations used for rural areas:

If basins are less than 1 square mile:

$T_{lag} = 22.1K_n(LxL_{ca}/S^{0.5})^{0.33}$

If basins are greater than 1 square mile:

$T_{lag} = 0.6T_c$

To determine the threshold of what is considered rural or urban, a study was completed by Dr. James Guo (ref. 7) to analyze the Snyder Method (USBR-Mesa County) against stream gages in Grand Junction. It was determined by the study that an imperviousness of 10% for a basin is a good threshold. Therefore, in basin areas where the imperviousness is less than 10%, Snyder Method (USBR – Mesa County) equations were used, and where imperviousness is greater than 10%, Snyder Method (CUHP) equations were used.

A table with the final input values used with the HEC-1 model, along with Dr. Guo's study, can be found in Appendix B.

B. Development Criteria References and Constraints

The development of the Grand Junction Regional Airport will be based on the proposed plan created for the FAA and the City of Grand Junction. The goal of this study is to provide the framework needed to guide future airport development that will cost-effectively satisfy aviation demands, while considering potential environmental and socioeconomic impacts.

C. Hydrologic Criteria

Rainfall intensities are obtained from the City of Grand Junction Stormwater Management Manual, Table 602 – Point Rainfall Values for the Leach Creek/Horizon Drive Watershed. The Depth Area Curves (Figure 614, Appendix A) were utilized with the 24-Hour Storm, NRCS Type II Rainfall Distribution to generate rainfall depths and runoff. The two design storms analyzed in this study are the 10-year and 100-year design storms.

The soil types for the airport and the off-site tributary areas are made up of Type B, Type C, and Type D soils (see web soil survey in Appendix A).

D. Hydraulic Criteria

The existing storm sewer system was verified using AutoCAD Civil 3D Land Desktop. Pipe flow calculations were calculated using the Manning Formula shown below:

$$V = (1/n)*R^{2/3}*S^{1/2}$$

Where:
V = mean flow rate (ft/s)
R = hydraulic radius (ft)
S = slope of hydraulic gradeline (ft/ft)
n = Manning's roughness coefficient

E. Water Quality Requirements

The proposed drainage facilities were analyzed using the City of Grand Junction Stormwater Management Manual procedures and best management practices (BMP).

Each water quality pond is sized for ultimate conditions imperviousness. The following table outlines the water quality pond sizes for each subbasin:

	Basins Included	Cumulative Area (acres)	Weighted I (%)	Required WQ Volume
Pond 1	L11au, L11b	5393.8	2.0	4.0 AC-FT
Pond 6	L10d, L10d1, L10u	655.7	5.4	1.3 AC-FT
Pond 7	L9.1d, R17, R15u, L9.1u	1894.8	14.6	8.5 AC-FT

F. Variance from Criteria

In discussions with the City of Grand Junction Development Engineer, Rick Dorris, PE, CFM, it was determined to use the Green-Ampt and SCS Curve Number Method. This is a variance from the Maricopa Method as stated in the Stormwater Management Manual.

DRAINAGE FACILITY DESIGN

A. General Concept

All proposed water quality ponds will be sized to accommodate the ultimate conditions. The nine proposed detention ponds are analyzed for the 10-year and 100-year detention volumes.

Pond Names	Volume 100-yr
Pond 1	Not Designed
Pond 2	6.60 AC-FT
Pond 3	19.25 AC-FT
Pond 4	5.75 AC-FT
Pond 4a	7.01 AC-FT
Pond 4b	5.01 AC-FT
Pond 5	3.91 AC-FT
Pond 6	3.83 AC-FT
Pond 7	21.51 AC-FT

Pond 1 has not been designed yet. Due to the construction of the Leach Creek Dam set to begin in the fall of 2012 and the current drainage issues downstream (offsite) of the Airport, the City of Grand Junction would like the further investigate the release rate of Pond 1. Without Pond 1's detention, there will be 92 cfs during the 100-year storm event at the outfall of Pond 1.

B. Specific Details

The proposed ponds are analyzed for the 10-year and 100-year detention volumes, which are controlled by an outlet structure to minimize impacts to downstream structures. The proposed detention ponds are analyzed to handle the flows generated from all development within these basins, per the Master Plan. All eight designed ponds have been sized for the ultimate conditions.

The Grand Junction Regional Airport will be in charge of maintaining the detention ponds and outlet structures. Regular maintenance and debris removal will be mandatory to ensure the functionality of the outlet structures. The detention ponds are an Extended Detention Basin-Sedimentation facility, which follows the design criteria for Best Management Practices of volume 3 of the *Urban Drainage & Flood Control District* (revised June 2001) (Ref. 1).

Detention ponds 2, 3, 4, 4a, and 5 are located upstream of their respective lower basins and are therefore oversized to ensure that adequate release from the overall subbasin is lower than current flow rates. At the downstream end of the system, Ponds 1, 6, and 7 release at a lower rate than current conditions, as specified in previous drainage reports.

HEC input and output data is provided in Appendix B. For specific reference to detention ponds in HEC data, please contact Jviation.

CONCLUSION

A. Compliance with Manual

This analysis is prepared in accordance with the procedures and concepts outlined in the City of Grand Junction Stormwater Management Manual (ref. 2) as well as the Urban Storm Drainage – Criteria Manual (ref. 1). Hydraulic Criteria, as defined in the Stormwater Management Manual, is adhered to and only the variance described above is requested.

B. Drainage Concept

All proposed water quality ponds will be sized to accommodate the ultimate conditions.

The proposed 10-year and 100-year detention and water quality ponds will minimize the flow's impact downstream.

C. Water Quality

Water quality capture volume has been included in all detention ponds sizing, as required.

D. Areas in Flood Hazard Zone

From the Flood Insurance Rate Map, Community Panel Number 080117 0001 0009, revised July 15, 1992, the entire airport lies in Zone X. Zone X is determined to be outside of the 500-year flood plain.

REFERENCES

1. *Urban Storm Drainage – Criteria Manual,* (revised June 2002) – Prepared by the Urban Drainage and Flood Control District, Denver, CO
2. *City of Grand Junction Stormwater Management Manual,* (December 31, 2007) – Prepared by WRC Engineering, Inc.
3. *FAA AC 150/5320-5C Surface Drainage Design,* (August 01, 2006) – Prepared by U.S. Department of Transportation, Federal Aviation Administration
4. *FAA AC 150/5200-33B Hazardous Wildlife Attractants on or Near Airports,* (August 28, 2007) – Prepared by U.S. Department of Transportation, Federal Aviation Administration
5. *Ranchman's Ditch (Horizon Drive Channel), Leach Creek, & North Leach Creek Conditional Letter of Map Revision (CLOMR)* (October 2004) – Prepared by Icon Engineering
6. *EA Drainage Analysis for Proposed Runway 11/29* (October 20, 2009) – Prepared by Jviation, Inc.
7. *Regional Analysis for Flood Peak Flows* (March 10, 2012) – Prepared By Dr. James Guo

GRAND JUNCTION REGIONAL AIRPORT

ENVIRONMENTAL ASSESSMENT/

RMP AMENDMENT FOR PROPOSED LAND TRANSFER

AND RUNWAY PROJECT

ORIGINAL

PUBLIC HEARING

Grand Junction Regional Airport

Airport Terminal Building, 2nd Floor

2828 Walker Field Drive

Grand Junction, Colorado 81506

July 21, 2015

Reported by: Candice F. Flowers, CSR

(Grand Junction Regional Airport Environmental Assessment Public Hearing opened at 3:05 p.m.)

- - -

RYAN HAYES: Thank you all for coming this afternoon, especially those of you who have already heard this before. But this is the public hearing for the Grand Junction Regional Airport environmental assessment to transfer BLM land to the airport and relocate the primary runway.

I'm Ryan Hayes with formerly Barnard Dunkelberg, which is now a Mead & Hunt company. We are the third-party contractors preparing this environmental assessment on behalf of the airport as well as the FAA and the BLM.

The agenda for the presentation looks like this: I will walk through what the current project looks like, talk a little bit about why we do environmental documentation for an airport project, go over the project purpose and need, talk about a typical EA process, explain a little bit the environmental consequences that were reviewed in the impact analysis that was done as well as some proposed mitigation measures, and then we will close with comments and questions.

So the current project is to relocate the

primary runway, Runway 11/29, at the Grand Junction Regional Airport approximately 637 feet to the north and the west and turn the existing runway into the parallel taxiway when the new runway is fully constructed.

Some of the connected actions to this project involve the transfer of BLM land. Approximately 188 acres of BLM land is needed to complete the project as well as the relocation of 27 1/4 outside of what's called the runway protection zone, which is this yellow trapezoid area off the end of the runway.

The reason we do this environmental document for an airport project is it's required under the National Environmental Policy Act of 1969, which requires any project that involves a major federal action to be reviewed environmentally.

There are three kinds of NEPA documents: An environmental impact statement for the most impactful projects, categorical exclusions for the least environmental impactful projects, and this is kind of the middle of the road environmental impact. This is an environmental assessment.

FAA orders basically say that an EA prepares a review of the potential environmental

impacts, both positive and negative. So it's not just negative impacts but it's also potential positive impacts of the project, and analyzes alternatives. The BLM and the FAA then use the environmental document to make decisions on the project and either issue a finding of no significant impact, if the impacts are not significant, or recommend the preparation of an environmental impact statement if it is determined that the impacts are significant.

The other thing the EA does is it compares alternatives and discloses mitigation measures. I will steal a line from Rick, since he's here, that he uses all the time. An EA is the easiest thing to do in the world. All you have to do is tell the truth. And, really, all we're doing is disclosing the potential environmental impacts of the project. It's very much a disclosure document.

The document allows informed decisions to be made. And in this particular case, the EA is unique in that we're meeting the needs of two federal agencies, both the BLM involved in the transfer of the land as well as the FAA's environmental requirements through NEPA.

The first chapter of the document is

entitled "Purpose and Need" where we explain the purpose and need for both the runway project and then separately the purpose and need for the land transfer.

So the purpose of the runway project is to enhance safety. The need or the problem being fixed is essentially meeting FAA design standards. So the current runway does not meet a number of FAA design standards and design criteria. By building a new runway, the runway will be fully compliant with FAA design standards.

On the BLM side, the purpose and need for the land transfer is to meet the need of correcting the nonstandard conditions by transferring the land to the airport that it needs for airport purposes.

The BLM's role in this process is, one, to amend their resource management plan, and this is their old resource management plan from 1987 that does not identify this land as for disposal to the airport. So the BLM will use this document to both make an environmental determination as well as amend their resource management plan. And the BLM also reviews the environmental documentation and eventually will respond to the request for the transfer of land. So that's their role in this

process.

And the process looks like this: We start with the scoping process, which was done four years ago for this project. Then we prepare the purpose and need chapter. We look at alternatives. Then we prepare the affected environment and then do the environmental analysis, which is called the environmental consequences chapter. Then we propose any mitigation that might be necessary. We have the public hearing, which is where we are today. Following the public hearing and the response to any comments that we get during the public hearing, we submit the document to the FAA and the BLM and allow them to use the document to make their decisions.

This next graphic illustrates the amount of land that the BLM and the airport have always had in a memorandum of understanding, that when this land is needed for airport purposes, the BLM will make it available. This is the pink area on this graphic. This is about 2,100 -- a little bit more than 2,100 acres. That amount of land was reduced during the airport's master plan process in 2010 to what's currently shown on this map, which is about 720 acres.

So that previous amount of BLM land was

what was considered necessary to build a second parallel runway, parallel to Runway 11/29. The master plan determined that that parallel runway is so far out in the future, it will likely never need to be built based on the forecast. And in order to build this new runway immediately adjacent to the existing runway, you only need 720 acres.

Then through the environmental process, we reduced that acreage even further. And the reason that we reduced that acreage even further was because it was recognized that this land has some recreational value and that the BLM has this land open to recreational use, and there's a lot of local organizations and individuals that take advantage of the recreational opportunity that this land involves.

And so as part of the environmental process, we went through an alternatives analysis to look at how -- what is the minimum number of acres that we can do this project and minimize the impact on recreational users. So the current proposed project recommends the transfer of 188 acres. So we have gone from -- as illustrated in this line, in the MOU, we had 2,100 acres, then we have gone down to 720 acres in the master plan, and now in the

environmental assessment in the current project, we are down to 188 acres of BLM land that needs to be transferred to the airport to complete the project.

This next slide is a list of all the environmental consequences that were considered in the document. Some of these are analyzed in much more detail than others, depending on the potential for impact.

Some of the potential impacts that were identified in the process were some fish and wildlife impacts. The initial amount of land that we surveyed was the 720 acres from the master plan. There was a few endangered species in that 720 acres, but when we went down to the 188 acres, we eliminated those impacts.

But there were still considered some impacts to some endangered fish in the Colorado River based on the proposed drainage in the project that would essentially have a depletion of water to the Colorado River. So we had to analyze those impacts; we had to quantify them. But essentially they are mitigated through BLM Programmatic Biological Assessment that's already in place.

We had some historic resource impacts, most notably an historic railroad grade that went

basically from airport property to the north towards the Bookcliffs that was a mining railroad grade, and then eventually it became a tourist attraction for a number of years. There's no longer a railroad there, but the grade is still there.

The mitigation for that historic impact to basically allow us to impact the railroad grade was we had to go through what's called a photo documentation process, where someone comes out and photographs the grade, writes a report about its historic significance, and that's considered by the State Historic Preservation Officer as an appropriate level of mitigation for that resource.

Additional impacts that I mentioned before are the recreational land. This is known as a DOT Section 4(f) impact. And, again, that impact, as I said, was minimized by reducing the amount of acreage in the proposed action from 720 to 188. It's being further minimized by the airport committing to building a staging area or parking area somewhere along 27 1/4 Road for the users of the recreational land. So by reducing the amount of acreage and by committing to building a staging area, we feel like we have adequately mitigated that impact to recreational land as part of the project.

The last impact category there is "Waters of the U.S." There's a number of ephemeral drainages that cross airport property that carry water, particularly during storm events. These are considered -- because they have a nexus to the Colorado River, these are considered waters of the U.S. So we have to apply to the Army Corps of Engineers for a permit to impact these drainages.

And the mitigation is essentially that we -- primarily that we maintain the flow under the runway. But there's some additional construction practices, such as vertical mulching and natural bottom culverts, that will be included in the permit application to the Corps that show that we are adequately mitigating the impact to waters of the U.S.

So that is the whole project. And, again, the purpose of the hearing is to take comments. Public comments can be given to our court reporter and they can also be submitted in writing, and that is it. Thank you.

Any questions or comments?

(The hearing was officially closed at 4:44 p.m.)

STATE OF COLORADO)

)ss. REPORTER'S CERTIFICATE

COUNTY OF MESA)

I, Candice F. Flowers, do hereby certify that I am a Certified Shorthand Reporter and Notary Public within the State of Colorado; that previous to the commencement of the examination, the deponent was duly sworn to testify to the truth.

I further certify that this deposition was taken in shorthand by me at the time and place herein set forth, that it was thereafter reduced to typewritten form, and that the foregoing constitutes a true and correct transcript.

I further certify that I am not related to, employed by, nor counsel for any of the parties or attorneys herein, nor otherwise interested in the result of the within action.

In witness whereof, I have affixed my signature this 31st day of July, 2015.

My commission expires February 14, 2016.

Candice F. Flowers, CSR
216 - 16th Street, Suite 600
Denver, Colorado 80202

GRAND JUNCTION REGIONAL AIRPORT

ENVIRONMENTAL ASSESSMENT/

RMP AMENDMENT FOR PROPOSED LAND TRANSFER

AND RUNWAY PROJECT

ORIGINAL

PUBLIC HEARING

Mesa County Central Public Library

443 North 6th Street

Mesa Community Room

Grand Junction, Colorado 81501

July 22, 2015

Reported by: Candice F. Flowers, CSR

(Grand Junction Regional Airport Environmental Assessment Public Hearing opened at 9:28 a.m.)

- - -

RYAN HAYES: I hope you can read the bullets here, but the slide show goes through the currents project. It talks about the purpose and need for the project, explains a little bit about why we have to do environmental documentation for this type of a project, and includes an overview of a typical environmental assessment. And then I have got a couple of the slides on the potential impacts of the project and the proposed mitigation.

So as we have been talking about this morning, this is the current project to relocate the primary runway at the Grand Junction Regional Airport approximately 637 feet to the north and a little bit to the west, which also requires the relocation of 27 1/4 Road and the transfer of 188 acres of land currently managed by the BLM. So the project is new runway, transfer of land, and moving 27 1/4 Road.

The reason we do environmental documentation for such a project is that it's required by the National Environmental Policy Act of 1969, which basically says any project that either

involves approval by the federal government or funding by the federal government needs to have some kind of environmental review.

There are three types of NEPA documents: Environmental impact statements, environmental assessments, and categorical exclusion documents. And, generally, the more impactful the project, the higher level of environmental review that's required. So EIS is the highest level, EA is kind of the middle level, Cat Ex is for very simple projects like a pavement overlay that's not going to have any environmental impacts. So this is kind of a middle-of-the-road environmental document.

What the FAA orders say is that an EA examines the environmental impacts, both positive and negative of a project, and essentially discloses those impacts. So my boss likes to say environmental assessments are the easiest thing to do in the world. All you have to do is tell the truth and disclose the impacts. And really that's all we are trying to do with the project, is disclose the potential environmental impacts associated with the project.

The other thing we do in an environmental assessment process is look at alternatives, so what

alternatives are there to the proposed action that may either avoid impacts or minimize impacts. So there's an entire chapter in the document that looks at various -- both development alternatives from a runway standpoint as well as various land transfer alternatives that looks at different amounts of acreage to be transferred as part of the project.

The FAA and the BLM then use that environmental document to make their official decisions, and those decisions are known as FONSIs. And not the Fonzie from Happy Days, but FONSI is an acronym for Finding of No Significant Impact. So we do all the environmental analysis and we either decide that the impacts are not significant or if they are determined to be significant, that would kick the project into the higher level of environmental documentation, which is an EIS.

Like I said, the document allows the agencies to make well-informed decisions. And in this particular case, this EA is unique in that usually we are doing the documentation for one federal agency. In this case, we have two federal agencies involved: The FAA and the Bureau of Land Management. So this document serves both agencies' purposes from a NEPA perspective.

So the first chapter of the document is entitled "Purpose and Need." We lay out why do we need to do this project: What's the purpose of the project and what's the need for the project. The purpose is simply to enhance safety at the airport. The need or the problem being fixed is to meet FAA design standards.

There are a number of what are called nonstandard conditions at the airport. The FAA's design standards have evolved over time. And while the runway was initially built to FAA standards, it no longer meets some of the FAA's current standards. One of those standards is the fact that the two runways at the airport intersect, which is a safety issue when the tower is closed. This project separates the two runways. They no longer intersect.

The other nonstandard conditions that are getting corrected are some gradients. In areas of the runway, the gradients are too steep. The FAA standards now require runways that serve this type of large aircraft to be much flatter. So by building a new runway adjacent to the existing runway, we correct all those nonstandard gradients. And the other advantage of the project is we're able

to build this new runway while we keep the existing runway open, so there's zero closure time to commercial service at the airport as a result of the phasing plan.

From the BLM's perspective, the purpose and need for the land transfer is simply to meet the need of correcting nonstandard conditions and responding to the airport's request for the transfer of land.

A little bit more about the BLM's role in this process: The BLM will be using this document to amend their resource management plan, assuming that the current RMP is not finalized by the time we get done. The BLM has also gone through this document, reviewed the environmental analysis, and commented on the environmental analysis and the documentation. And ultimately their role in this process will be to respond to the land transfer request, to follow the environmental decisions.

So a typical process for an EA looks like this, these bullets on this slide. The process starts with scoping. We scope the project. We collect scoping comments from the public and from interested federal, state, and local agencies. We then prepare the purpose and need for the project.

We look at alternatives. We lay out the affected environment.

And then the meat of the environmental document is the environmental consequences chapter where the environmental impacts are specified and the proposed mitigation is described. We then hold the public hearing, which is what we are doing today. And following the public hearing, we finalize the document, respond to any comments that require a response, and then we submit the document to the FAA and the BLM for their use.

So I have got a couple of slides here that show the amount of BLM land that's always been kind of held in reserve for the airport when its needed for airport purposes. So there's an agreement from the 1980s between the BLM and the airport that says when the airport needs this land, the BLM will respond to the transfer request.

In that memorandum of understanding, there's about 2,000 acres. So all of this pink property shown on the map here, all of this is -- it's about 2,100 acres, a little bit more than 2,100 acres, that has always been essentially held in reserve for the airport when it's needed.

In 2010, the airport did an airport master

plan and determined that that much acreage is not needed in order to build this new runway, and that reduced the land transfer amount to about 720 acres. So when we started this environmental process, we were at 720 acres of BLM land needed for the project. Through the alternatives process of the EA, we've further reduced that acreage down from 720 to 188.

And the reason we reduced that acreage is because we recognized that this land has recreational value. There's a number of recreational users that ride ATVs and motorcycles on this land, as you know all. And to minimize that impact on the recreational users, we have reduced the acreage to the minimum number of acres that are necessary to complete the project.

So this current slide shows these four triangles to the north as well as this 80-acre rectangle off the end of the runway as the property from the BLM that needs to be transferred to the airport to make the project happen. And, again, that total is 188 acres. So this is just a slide that compares the 1986 MOU as well as where we were when we scoped the project to where we are now and that reduction in acreage that I just mentioned.

This is a list of all the environmental resource categories that were considered in the document. Obviously, a lot of these resource categories were not -- they were not considered in the same detail as -- each one was not considered in the same level of detail. For instance, coastal resources, there's not a lot of coastal resources here in the middle of the country, so that section is very short. Fish, wildlife, and plants, that section goes on for pages and pages to make sure that we address those impacts. So these are all the categories that were considered.

Some of the impacts we did identify: The project requires the construction of a number of drainage ponds and water quality ponds to address the potential for downstream flooding as a result of building the new runway. By constructing those ponds, we have a -- the amount of time the water sits in those pounds and evaporates, there's a potential for depletion of water to the Colorado River. We had to quantify that level of depletion and look at the impact to some endangered fish species in the Colorado River. All of that is covered under a Programmatic Biological Assessment that the BLM has in place, so we simply had to

document that impact in the process.

Another impact that we identified is historic resources. There's a historic railroad grade that goes across airport property to the north up to the Bookcliffs. This was initially a railroad built for mining purposes. After the mine closed, it became a tourist attraction for a number of years. It's a very interesting history on the project.

So the railroad no longer exists, but the grade still exists. So in order to impact that grade, we had to go through a photo documentation process where we have a photographer come out, take pictures of the grade, write a report about its historical significance, and then the State Historic Preservation Officer said that we are -- once we did that, that's appropriate mitigation for the historic resource impact.

AUDIENCE MEMBER: Did you look at the historic town of Carpenter up there? It's a ghost town.

RYAN HAYES: We did not. Is that where the railroad grade went to?

AUDIENCE MEMBER: Yeah.

ROBIN LACY: I think that was

included in the archeological inventory, but apparently it didn't require mitigation. I would have to talk to --

RYAN HAYES: I think that's right, since it's so far north of the project, we are not going to impact the town.

ROBIN LACY: Right.

RYAN HAYES: But I'm guessing it is included in the report.

ROBIN LACY: Yeah.

AUDIENCE MEMBER: The other thing is archeological resources are probably up there and paleontological resources.

ROBIN LACY: Yeah, that was all taken into account in --

AUDIENCE MEMBER: So you have those documented.

ROBIN LACY: Yes. Well, if there were any. I would have to look at that section, but it wasn't an area that had a significant impact.

RYAN HAYES: So a couple other impacts that we identified: One is the Department of Transportation Section 4(f), which is basically a law that says the Secretary of Transportation will not approve a project that physically takes land

that's used for recreational purposes, unless there's no feasible and proven alternative. So there's an entire appendix to the EA that addresses the recreational impacts.

And the proposed reduction in acres was part of that, as well as a -- the additional mitigation for the recreational land impacts is the airport and the FAA and the BLM have committed to building a staging area for recreational users, which is essentially an area for recreational users to park and stage their vehicles. And that's considered -- through our coordination with some of the user groups that use the land, that's considered an appropriate mitigation for the amount of recreational land that the project is taking.

AUDIENCE MEMBER: Trailheads will be established or you will --

RYAN HAYES: It's not really a trailhead, but somewhere along 27 1/4 Road, the airport has committed to building a staging area. They're still working out the details of what amenities may be provided and how big it might be, but there will be something constructed as part of the project.

AUDIENCE MEMBER: The BLM will be

involved in it, correct?

ROBIN LACY: Yes.

AUDIENCE MEMBER: The BLM has also tried to separate users in those trails of motorized versus non-motorized. Mountain biking and horseback riding are separate from motorized.

ROBIN LACY: And, again, that's the area that's being deferred, so that will all be looked at when we do the specific analysis in that area.

RYAN HAYES: The last impact on this slide that we identified is waters of the U.S. The ephemeral drainages that cross the property have a nexus to the Colorado River such that the Army Corps of Engineers regulates these drainages as waters of the U.S., even though, for the most part, they don't have water in them. Only during storm events do they have water in them.

But we still have to go through the process of applying for a permit with the Corps of Engineers that show them how we are going to maintain the flow underneath the runway through natural bottom culverts, and there's some additional details like vertical mulching and some aspects that will be incorporated into the project design to

maintain the drainages. And that will all be reviewed and approved by the Army Corps of Engineers through their permitting process.

AUDIENCE MEMBER: So whose responsibility will it be to maintain the detention ponds and the drainages?

RYAN HAYES: That will all be the airport's responsibility after the project is constructed.

AUDIENCE MEMBER: And that's really great that you guys are doing those detention ponds, or showing them at least. The City of Grand Junction has had a lot of problems with Leech Creek and Indian Wash flooding into the urban areas, so by putting those detention dams in there, that's going to help us.

RYAN HAYES: Yes.

AUDIENCE MEMBER: The other thing is trail connections up those washes. Like I mentioned, Leech Creek and Lewis Wash and Indian Wash are potential trails from the urban area to the BLM area, north and south trail connections. And so I think we'd like to see those in your plan as well as the BLM plan.

Are you showing trails on Leech Creek and

Lewis Wash up into the Bookcliffs?

ROBIN LACY: I don't know. I would have to look.

RYAN HAYES: That is it. For those of you in attendance who would like to officially comment for the record, we have a court reporter who is taking everyone's comments down, so everything you just gave us is going to be part of the record.

AUDIENCE MEMBER: Thank you.

RYAN HAYES: The other option is to fill out a comment form. And right over by Robin are a number of comment forms that can be filled out and either e-mailed to us or physically mailed to us as part of the official record.

AUDIENCE MEMBER: Are there any plans of fencing those retention ponds?

RYAN HAYES: They will be outside of the perimeter fence, the majority of them. Some of them on the south side of the runway will be inside of the perimeter fence. But all the ones on the north will be -- they will actually be on BLM property and the BLM will give the airport a right-of-way easement to construct the ponds and have them basically exist on BLM property.

AUDIENCE MEMBER: Do you foresee

recreation vehicles making them mud pits?

RYAN HAYES: Good question. Probably.

AUDIENCE MEMBER: And what can be done to prevent it?

RYAN HAYES: Yeah. That's a good comment, and that might be something that has to be considered in the actual -- so the --

AUDIENCE MEMBER: Because it don't necessarily mean that the bottom would be affected so much, but the slopes on the pits themselves.

RYAN HAYES: That's a good comment, and we will take that into consideration. So when I say that this has all been designed, it's been designed at a very preliminary level. Once we finish the environmental process, they will go into the full-blown design that they'll use to construct all this.

AUDIENCE MEMBER: And at that time would there be an opportunity to extend the acreage to whatever it would take to include those retention ponds in the airport property?

RYAN HAYES: And have them fenced in?

AUDIENCE MEMBER: Uh-huh.

ROBIN LACY: Are you saying have them

actually -- have the property transferred to the airport like the other land --

AUDIENCE MEMBER: Yeah. Where it would be -- where the retention ponds would be completely on the airport authority land.

ROBIN LACY: Well, that would be --

AUDIENCE MEMBER: That would be a whole new ballgame.

ROBIN LACY: Yeah.

RYAN HAYES: That would probably require us to reassess all the --

AUDIENCE MEMBER: A redo.

RYAN HAYES: Yes, which I'd be fine with, but...

AUDIENCE MEMBER: Well, the other thing is wildlife is going to be attracted to those ponds if they have water in them. How are you going to deal with that, or are you going to deal with it?

RYAN HAYES: That's a good point. And the thought is that they are far enough away from the runway that the potential for wildlife traffic would not jeopardize safety.

ROBIN LACY: Could they just be fenced?

RYAN HAYES: They could possibly be

fenced as part of the design just to keep recreational users out of the ponds. That could certainly happen.

ROBIN LACY: So the title wouldn't be transferred, but that would just be part of the design included in the right-of-way grant.

RYAN HAYES: Sure. Well, thank you, everyone. The comment period officially closes August 3, so you have until August 3 to submit comments.

AUDIENCE MEMBER: A question on 27 1/4 Road, will that be rerouted?

RYAN HAYES: It will be rerouted. This yellow trapezoid area off the end of the runway is called a runway protection zone. The FAA's regulations now say no roads in RPZ, so this is 27 1/4 Road cutting through it.

AUDIENCE MEMBER: Right.

RYAN HAYES: So it will be rerouted around the RPZ as part of the project.

AUDIENCE MEMBER: And on those retention ponds, is the outlet at the bottom of them or at the side?

RYAN HAYES: I believe it's at the bottom.

AUDIENCE MEMBER: So the idea is to let them fill up and slowly release out.

RYAN HAYES: Exactly.

AUDIENCE MEMBER: If they overtop, where would the water go? I mean, it's very unlikely because they're designed for a 100-year storm. But what if they do overflow, is there a place for the water to go?

RYAN HAYES: That's a very good comment. Probably something that will need to be considered in the final design.

Is that all? Okay. Thank you.

(The hearing was officially closed at 11:05 a.m.)

STATE OF COLORADO)

)ss. REPORTER'S CERTIFICATE

COUNTY OF MESA)

I, Candice F. Flowers, do hereby certify that I am a Certified Shorthand Reporter and Notary Public within the State of Colorado; that previous to the commencement of the examination, the deponent was duly sworn to testify to the truth.

I further certify that this deposition was taken in shorthand by me at the time and place herein set forth, that it was thereafter reduced to typewritten form, and that the foregoing constitutes a true and correct transcript.

I further certify that I am not related to, employed by, nor counsel for any of the parties or attorneys herein, nor otherwise interested in the result of the within action.

In witness whereof, I have affixed my signature this 31st day of July, 2015.

My commission expires February 14, 2016.

Candice F. Flowers, CSR
216 - 16th Street, Suite 600
Denver, Colorado 80202

GRAND JUNCTION REGIONAL AIRPORT

ENVIRONMENTAL ASSESSMENT/

RMP AMENDMENT FOR PROPOSED LAND TRANSFER

AND RUNWAY PROJECT

ORIGINAL

PUBLIC HEARING

Fruita Community Center

324 North Coulson Street

Fruita, Colorado 81521

July 22, 2015

Reported by: Candice F. Flowers, CSR

(Grand Junction Regional Airport Environmental Assessment Public Hearing opened at 3:31 p.m.)

- - -

RYAN HAYES: So the agenda for the proposed project will explain what the current project looks like, talk a little bit about why we do environmental documentation for an airport project, go over the project purpose and need, an overview of a typical EA process, and then I just have a couple of slides about the environmental impacts that we have identified as well as proposed mitigation for those impacts.

The current project, as we have discussed, is shown on this slide. Again, it's primarily three components: The relocation of the primary runway approximately 637 feet to the north and west of the existing runway. The existing runway would then be turned into the parallel taxiway. In order to move the runway, we need a little bit of BLM land, so that's the second component of the project. These four pink triangles are the BLM land that we need as well as this 80-acre parcel off the end of the runway.

The third component is 27 1/4 road. And the FAA standards say no more roads in these yellow

trapezoidal-shaped areas, which are called runway protection zones. So as part of the project, we have got to run 27 1/4 Road around those RPZs. So those are the kind of three components of the project.

Obviously, we have talked about the drainage impacts, so we have done a drainage analysis to determine the proposed detention ponds and water quality ponds that would be necessary to prevent downstream flooding issues as a result of the project.

The reason we do environmental documentation for this project is because the National Environmental Policy Act of 1969 requires that for any project that requires federal approval or federal funding, there has to be some kind of environmental analysis prepared.

There are three types of environmental documents for compliance with NEPA: An environmental impact statement, an environmental assessment, or a categorical exclusion. And, generally, the more impact from the project, the higher level of environmental analysis. So EIS is the highest level, Cat Ex is the lowest level, EA is kind of in the middle and that's what we are doing

here.

The FAA's orders say that an EA prepares a review of potential environmental impacts, both positive and negative. So it's not just documenting the negative impacts of a project; it's also the positive impacts. For example, we're moving the runway a little bit to the north and a little bit to the west. That changes the noise contours and the noise environment and it gets noise a little bit farther away from some of the residential areas. So from a noise standpoint, there's technically a positive environmental impact from this project. And then the FAA and the BLM use this document to make their environmental findings.

The other thing the EA does is it compares alternatives, potential alternatives, that might minimize impacts and reduce impacts, and it discloses mitigation measures for the potential environmental impacts. It allows well-informed decisions to be made. And as I mentioned previously, this is a unique environmental document in that it's going to serve the needs of two federal agencies, both the BLM and the FAA, and both agencies will use the document to make their environmental decisions.

So the purpose and need for the new runway -- the purpose is primarily to enhance safety at the airport. The need or the problem to be fixed is the runway does not meet a number of FAA design standards. FAA design standards have evolved over the years. When the runway was initially constructed, it did meet FAA standards. Now it doesn't in some ways. One of those ways is that it intersects with the crosswind runway. So by relocating the runway, we decouple it from the crosswind runway, which enhances safety and meets FAA's criteria.

The other way that the runway doesn't meet standards is it's too steep in a number of areas. By rebuilding it, we are able to flatten those grades and bring it into compliance with the FAA's current gradient standards.

The purpose and need for the land transfer is related to the runway project in that it's meeting the needs of current and nonstandard conditions and it's responding to the airport's request to transfer the land. So the purpose of the land transfer again is to provide the airport with the land necessary to accomplish airport purposes.

A little bit about the BLM's role in the

process: The current resource management plan that the BLM has that was developed in 1987 does not identify this land for disposal, so this document will allow the BLM to dispose of that land. It's kind of strange timing with their RMP amendment that's been in the papers in the last few months; and if that document gets finished before we are finished with this environmental assessment, then our document will not amend their RMP because their current RMP does identify these lands for disposal.

The BLM's also reviewed the environmental documentation and helped us prepare a lot of the environmental documentation, and ultimately their role is to respond to the transfer-of-land request. And there is no cost. The Airport and Airway Improvement Act says that any public land that is needed for airport purposes can be transferred to a public airport at no cost, as long as the environmental impacts have been documented.

So the typical process we go through in an environmental assessment is we start with the project scoping. We did this -- we had scoping meetings at the beginning of the project where we talked to interested federal agencies, interested state agencies and local agencies. We also invited

the public to a scoping meeting.

Then we write the scope for the project. We prepare the purpose and need chapter. The prepare the alternatives chapter. We document the existing affected environment. And then the meat of the document is the environmental consequences chapter. That's where we examine all the potential environmental impacts and the proposed mitigation.

Then we do a public hearing, which is where we are today and what we're doing today. Following these public hearings and following our response to any comments, we will submit the document to the FAA and the BLM, and they will take it from there and use it to make their decisions.

The airport and the BLM have had a memorandum of understanding that was also developed in the '80s, and this was developed because the airport master plan at the time showed a secondary parallel runway. So this pink parcel, which is about 2,100 acres, is the amount of land that was identified to build -- or identified as necessary to build a secondary parallel runway to the primary runway.

When the airport updated its master plan in 2010, we determined that that much land is likely

not needed anytime soon. And the master plan proposed transfer was reduced from that 2,100 acres down to 720 acres, which is what's shown on this map. So the pink area on here is about 2,100 acres -- or about 720 acres as opposed to 2,100.

Then we went into the environmental process and we realized that this land has a recreational value. There are recreational users, ATVers and dirt bike riders, and folks that take advantage of this land for recreational purposes. And we started looking at alternative possibilities for what's the minimum number of acres that we can do this project with and reduce the land transfer to the bare minimum that we need to do the project; and that's how we got to our current proposed land transfer, which is shown on this map, and it's basically these four triangles north of airport property.

The existing airport property line looks kind of like a stair-step. And all we're doing is basically straightening out that stair-step and transferring these triangle parcels from BLM to the airport, as well as a parcel of land -- an 80-acre parcel of land off the end of the runway for approach protection purposes.

So our current proposed transfer is now 188 acres. So just a quick recap: 2,100 acres down to the master plan number of 720 acres, and now we are down to 188 acres.

During this process, Amy Jordan and I from the airport with the user groups -- specifically the Western Slope ATV Association, and we reached out to the motorcycle group, which is called the Bookcliff Rattlers, and were never able to attend one of their meetings -- or they never asked us to come attend one of their meetings. But we received very positive feedback when we brought these revised alternatives to that ATV association. We said, Look, we recognize that this land is valuable to you and important to you, and so we want to minimize the amount of land we take as part of the project. And we got a very good reception when we brought this to them.

This next list, this is a list of all the environmental resource categories that were evaluated as part of the proposed project. There's about 20. Some of them were examined in more detail than others. Obviously, coastal resources, there's not a lot of coastal resource impacts from the project, so that section is very short.

The fish, wildlife, and plants analysis goes on for pages and pages. And we had a wildlife biologist survey the property and look for endangered species and that type of thing. So these resource categories were not evaluated with the same level of analysis, depending on the potential for impact.

Some of the impacts that we did identify, I mentioned previously the drainage analysis and the proposed detention ponds and water quality ponds. It turns out that while those ponds are detaining water, there's the potential for evaporation, and that detainage and evaporation results in a depletion of water to the Colorado River. So we had to do a calculation and quantify that depletion, but it's covered under a Programmatic Biological Assessment that the BLM has. So all we had to do was document the impact, and then the BLM has the mitigation covered already for the potential impact to threatened fish species in the Colorado River.

Another impact we identified was a historic resource. There's an old railroad grade that used to cross airport property and go up to the north to the Bookcliffs that was a mining railroad. And then later on when the mine closed, the railroad

became a tourist attraction for a number of years, very interesting history on that railroad grade.

The project crosses that railroad grade and we're going to need to impact it, so the proposed mitigation was to do basically a photo documentation of the railroad grade, and a report was written by a qualified historian. We submitted that to the State Historic Preservation Officer and they said, Okay, now that we have this document and these photos, the impact is essentially mitigated.

The Department of Transportation Section 4(f) Act, this is an act that basically says the Secretary of Transportation will not approve a project that takes a public park or public recreation land unless there is no feasible and prudent alternative to doing so. So there's a very detailed appendix that deals with the recreation impact. And, again, the mitigation for the recreation impact was reduce the acreage to the minimum amount that we need, from 720 down to 188. And secondarily, the airport, the BLM, and the FAA are committed to constructing a staging area for the recreation users.

And when Amy and I met with the recreation users, they said, What we really need is somewhere

to park along 27 1/4 Road, just somewhere to park and stage. And exactly what that staging area will look like and how big it will be and what amenities it will consist of, those details are still being worked out. The bottom line is: In this environmental document, we are committing everyone to including that as part of the project.

The last impact on the list here is waters of the U.S. There's four or five ephemeral drainages that cross the property and carry a lot of storm water during storm water events. And the connection to the Colorado River requires us to coordinate with the Corps of Engineers, and they have determined that these drainages are essentially waters of the U.S. because of their connection to the Colorado River, which is hard to wrap your mind around given that they are dry almost all of the time. But because they are regulated waters of the U.S., the Corps of Engineers has jurisdiction, and we have to work with them and apply for a permit to impact these ephemeral drainages.

And essentially the mitigation is simply that we maintain the flow under the runway, so the culverts are sized appropriately. Potentially natural bottom culverts is one idea that they have

thrown out there, as well as some other ideas like vertical mulching and some various aspects that minimize the impacts to the ephemeral drainages.

So really not a lot of major, significant environmental impacts, and those impacts that we did identify through the process, we came up with what we feel are fairly appropriate mitigation measures.

So that is the project, and we are here today to receive comments. There are multiple ways to comment. We will take comments to our court reporter. We will also take comments in writing, and the comment period goes until August 3rd. At that point, we will respond to any comments we need to and finalize the document.

Any questions, comments?

(The hearing was officially closed at 4:40 p.m.)

STATE OF COLORADO)

)ss. REPORTER'S CERTIFICATE

COUNTY OF MESA)

I, Candice F. Flowers, do hereby certify that I am a Certified Shorthand Reporter and Notary Public within the State of Colorado; that previous to the commencement of the examination, the deponent was duly sworn to testify to the truth.

I further certify that this deposition was taken in shorthand by me at the time and place herein set forth, that it was thereafter reduced to typewritten form, and that the foregoing constitutes a true and correct transcript.

I further certify that I am not related to, employed by, nor counsel for any of the parties or attorneys herein, nor otherwise interested in the result of the within action.

In witness whereof, I have affixed my signature this 31st day of July, 2015.

My commission expires February 14, 2016.

Candice F. Flowers, CSR
216 - 16th Street, Suite 600
Denver, Colorado 80202

GRAND JUNCTION REGIONAL AIRPORT

ENVIRONMENTAL ASSESSMENT/

RMP AMENDMENT FOR PROPOSED LAND TRANSFER

AND RUNWAY PROJECT

ORIGINAL

PUBLIC HEARING

Palisade Community Center

120 West 8th Street

Palisade, Colorado 81526

July 23, 2015

Reported by: Candice F. Flowers, CSR

(Grand Junction Regional Airport Environmental Assessment Public Hearing opened at 8:45 a.m.)

- - -

(NO ATTENDEES)

(The hearing was officially closed at 9:57 a.m.)

July 21, 2015
Location: Airport

Sign-In

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Public Hearings—July 2015.

NAME	ADDRESS	TELEPHONE NUMBER	EMAIL ADDRESS
Justin Pietz	861 Rood Ave Grand Junction 81501	970242-0101	justin@armstrongconsultants.com
Chance Ballegeer	800 Eagle Drive	970 712 0969	cballegeer@gjairport.com
Victoria Villa	800 Eagle Drive	970-812-2080	VVilla@gjairport.com

Thank You!

Barnard Dunkelberg Company
a Mead & Hunt company

July 21, 2015
Location: Airport

Sign-In

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Public Hearings—July 2015.

NAME	ADDRESS	TELEPHONE NUMBER	EMAIL ADDRESS
Ben Peck	800 Eagle Dr., G.J. 81506	970 248-8589	bpeck@gjairport.com
Austin Fay	800 EAGLE Dr. G.J. 81506	970 986 7002	afay@GJAIRPORT.com
BRIAN HARRISON	800 EAGLE DR GJ. 81506	970 986 7001	BHARRISON@GJAIRPORT.COM
Dave Krogman	WEST STAR AVIATION	970-261-4256	
Amy Jordan	800 Eagle Drive GJ, CO	9702449[illegible]	ajordan@gjairport.com
Orville Creighton	382 Grand Fallway GJ CO	970-314-7165	

Thank You!

Barnard Dunkelberg Company
a Mead & Hunt company

July 22, 2015
Location: Mesa County Library Downtown Grand Jct

Sign-In

Public Hearings—July 2015.

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION REGIONAL AIRPORT

NAME	ADDRESS	TELEPHONE NUMBER	EMAIL ADDRESS
Tom Ross	633 27½ RD	970-216-8159	TROSS527@msn.com
Kaye Simansa	2005 Spruce	970 255-7189	kaye.simansa@mesacounty.us
Keith Fife	" "	2441650	Keith.Fife@mesacounty.us
Chris Joyner	BLM	970 2102126	cbjoyner@blm.gov
BENNETT BOESCHENSTEIN	1255 OURAY AVE	640-8153	bennettb@gjci.org
JOSE VARGAS	—	970-270-0698	
Al Jaffee	2880 Durango GJ		
Austin Fay	800 EAGLE DRIVE	970-986-7002	afay@gjairport.com
Victoria Villa	800 Eagle Dr.	970-812-2080	VVilla@gjairport.com
Robin Lacy		970-244-3028	RLacy@blm.gov

Thank You!

Barnard Dunkelberg Company
a Mead & Hunt company

July 22, 2015
Location: Fruita, CO

Sign-In

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Public Hearings—July 2015.

NAME	ADDRESS	TELEPHONE NUMBER	EMAIL ADDRESS
David Priske	2190 H 1/4 Rd	9702601408	dpriske@ute water.org
Tom Holman	845 22 RD	970-242-0001	tholman@gvp.org.
STEVE DON	845 22 RD	970-242-0010	SDON@GVP.ORG.
Amy Jordan	800 Eagle Drive, GJ CO 81506	9702449100	ajordan@gjairport.com
Ben Johnson	800 Eagle Drive	9702449100	bjohnson@gjairport.com
Robin Lacy		970-244-3028	RLacy@blm.gov

Thank You!

Barnard Dunkelberg Company
a Mead & Hunt company

July 23, 2015
Location: Palisade, CO

Sign-In

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION REGIONAL AIRPORT

Public Hearings—July 2015.

NAME	ADDRESS	TELEPHONE NUMBER	EMAIL ADDRESS
Robin Lacy		970-244-3028	RLacy@bhm.gov
Amy Jordan	800 Eagle Dr., GJ, CO 81506	9702449100	ajordan@gjairport.com
Ben Johnson	800 Eagle Dr GJ CO 81506	9702449100	bjohnson@gjairport.com

Thank You!

Barnard Dunkelberg Company
a Mead & Hunt company

Barnard Dunkelberg Company

Public Hearings

July 21, 22 and 23



ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

Agenda

- Current Proposed Project
- Overview of Typical EA Process
- Project Historical Timeline
- Impact Analysis and Proposed Mitigation
- Discussion of Next Steps
- Comments & Questions

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Current Proposed Project

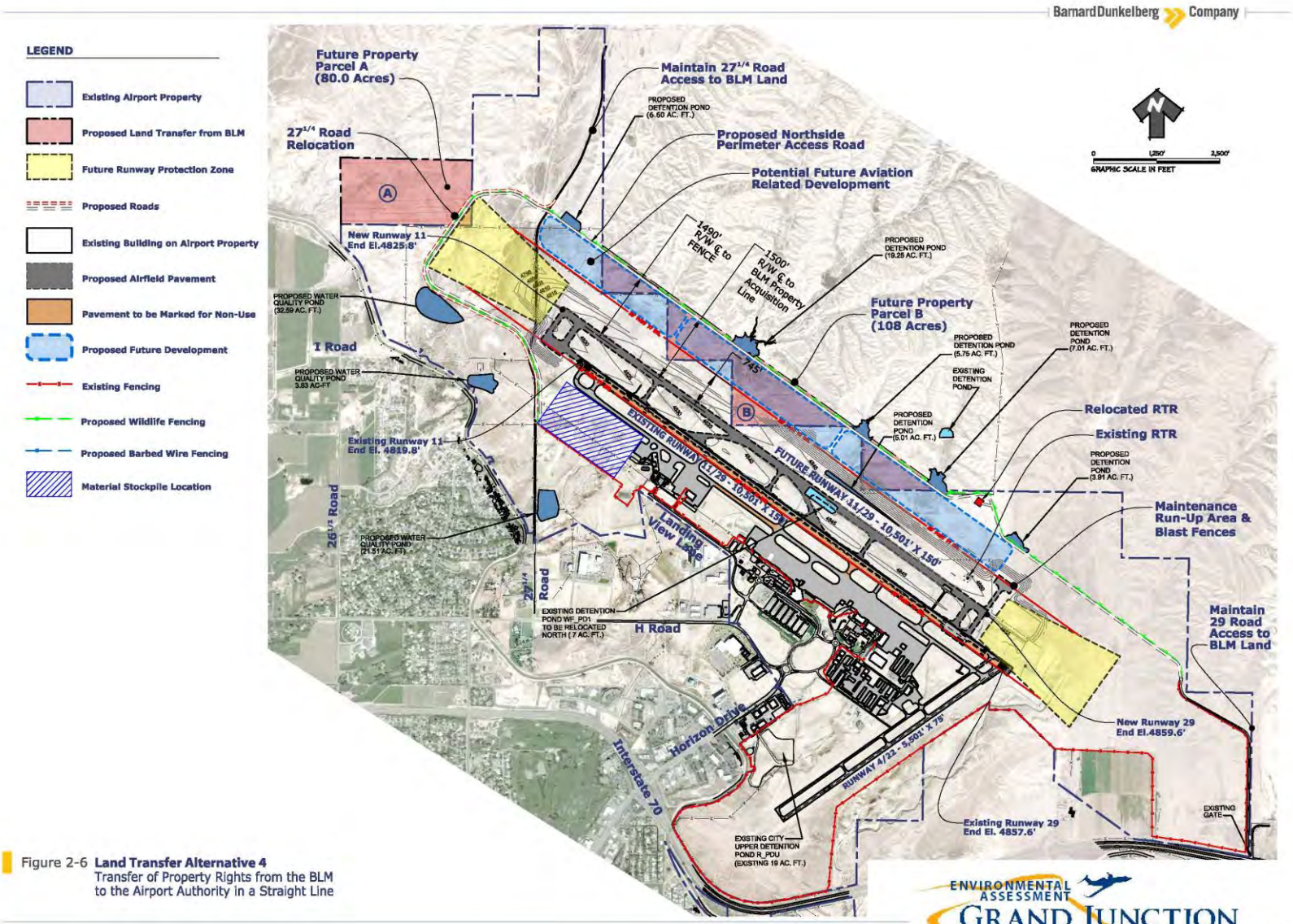


Figure 2-6 **Land Transfer Alternative 4**
Transfer of Property Rights from the BLM to the Airport Authority in a Straight Line

Environmental Documentation

- The National Environmental Policy Act (NEPA) requires the preparation of an environmental document for any major federal action. Federal action is, generally, either an approval or funding of a proposed project.
- There are three kinds of NEPA documents; an Environmental Impact Statement (EIS), and Environmental Assessment (EA) or a Categorical Exclusion (CatEx). Each type is defined by FAA Orders—generally, the more potential impact a proposed project has, the greater detail and more involved the NEPA document. An EIS is the most detailed and a CatEx is the least.

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Environmental Documentation (*Continued*)

- **An EA prepares a review of the potential environmental impacts, both positive and negative, associated with the proposed actions and the alternatives.**
- **The responsible FAA official uses the EA to meet the requirements of NEPA as the basis for recommending the issuance of a Finding of No Significant Impact (FONSI) or the preparation of an EIS.**

Environmental Documentation (*Continued*)

- **The EA compares alternatives and discloses mitigation measures for potential impacts to the public, agencies and the decision maker.**
- **Allows well informed decisions to be made.**
- **This is a unique EA in that it is serving as the NEPA decision document for both FAA and BLM.**

BLM's Role in the EA

- **Amend Resource Management Plan (RMP) to identify land for disposal**
- **Review environmental analysis and documentation**
- **Transfer Land**
  - *Both actions require an environmental review under NEPA*
  - *This EA will serve as the BLM's environmental review*
  - *BLM and FAA will issue separate environmental findings*

Environmental Assessment Process

- Project Initiation/Scoping Process
- Prepare Purpose and Need Chapter
- Prepare Alternatives Chapter
- Prepare Affected Environment Chapter
- Prepare Environmental Consequences Chapter
- Mitigation—if Necessary
- Public Hearing
- Submit to FAA and BLM

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Environmental Consequences Considered

The Following Categories were Evaluated:

- *Air Quality*
- *Coastal Resources*
- *Compatible Land Use*
- *Construction Impacts*
- *Department of Transportation Act: Section 4(f)*
- *Farmlands*
- *Fish, Wildlife, and Plants*
- *Floodplains*
- *Hazardous Materials, Pollution Prevention and Solid Waste*
- *Historical, Architectural, Archaeological and Cultural Resources*
- *Light Emissions and Visual Impacts*
- *Natural Resources and Energy Supply*
- *Noise*
- *Secondary (Induced) Impacts*
- *Socioeconomic Impacts, Environmental Justice, and Children's Environmental Health and Safety Risks*
- *Water Quality*
- *Wetlands*
- *Wild and Scenic Rivers*
- *Other BLM Resource Categories*

Proposed Transfer – 1986 MOU

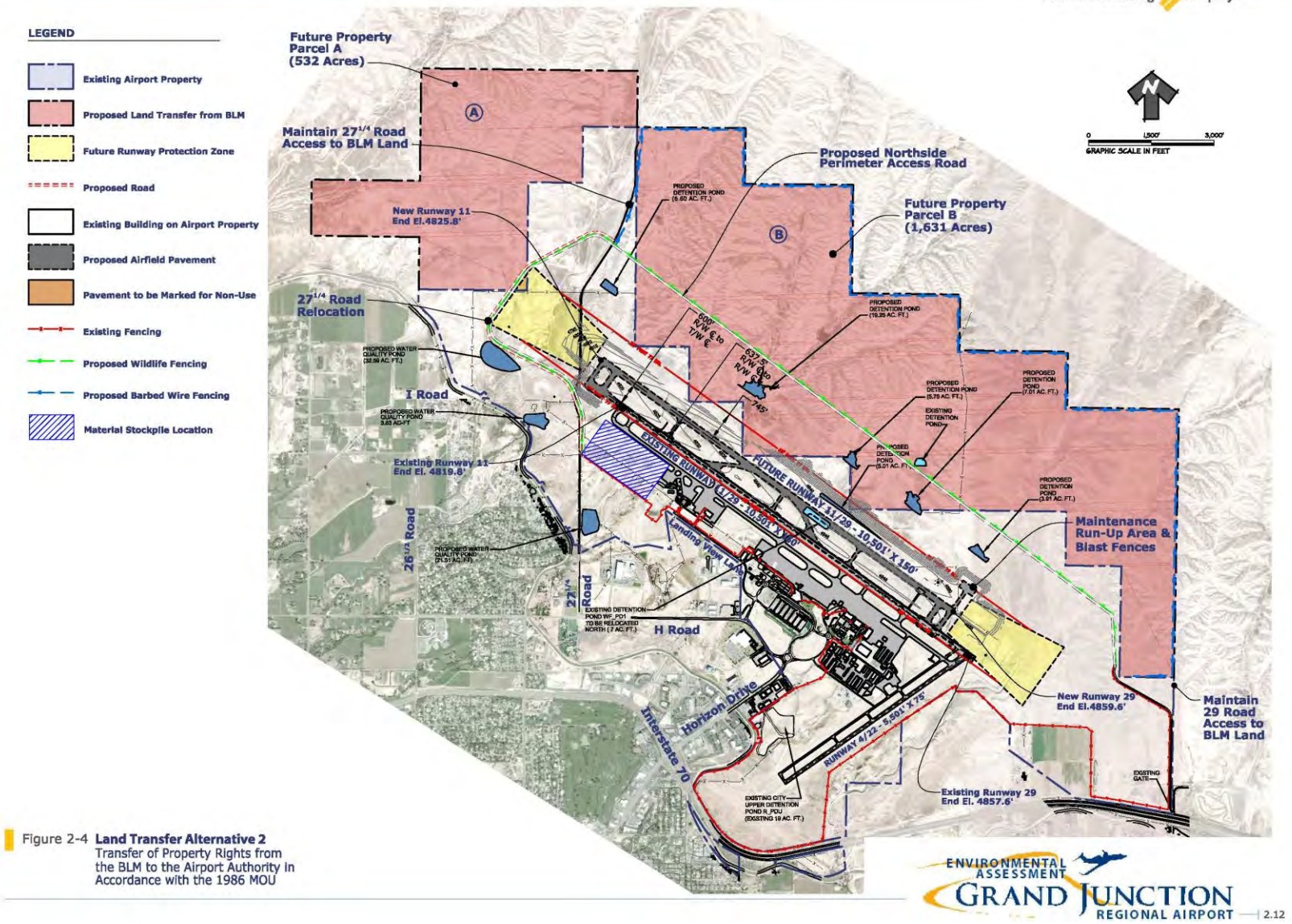


Figure 2-4 **Land Transfer Alternative 2**
Transfer of Property Rights from the BLM to the Airport Authority in Accordance with the 1986 MOU

Proposed Transfer – April 2011 Scoping

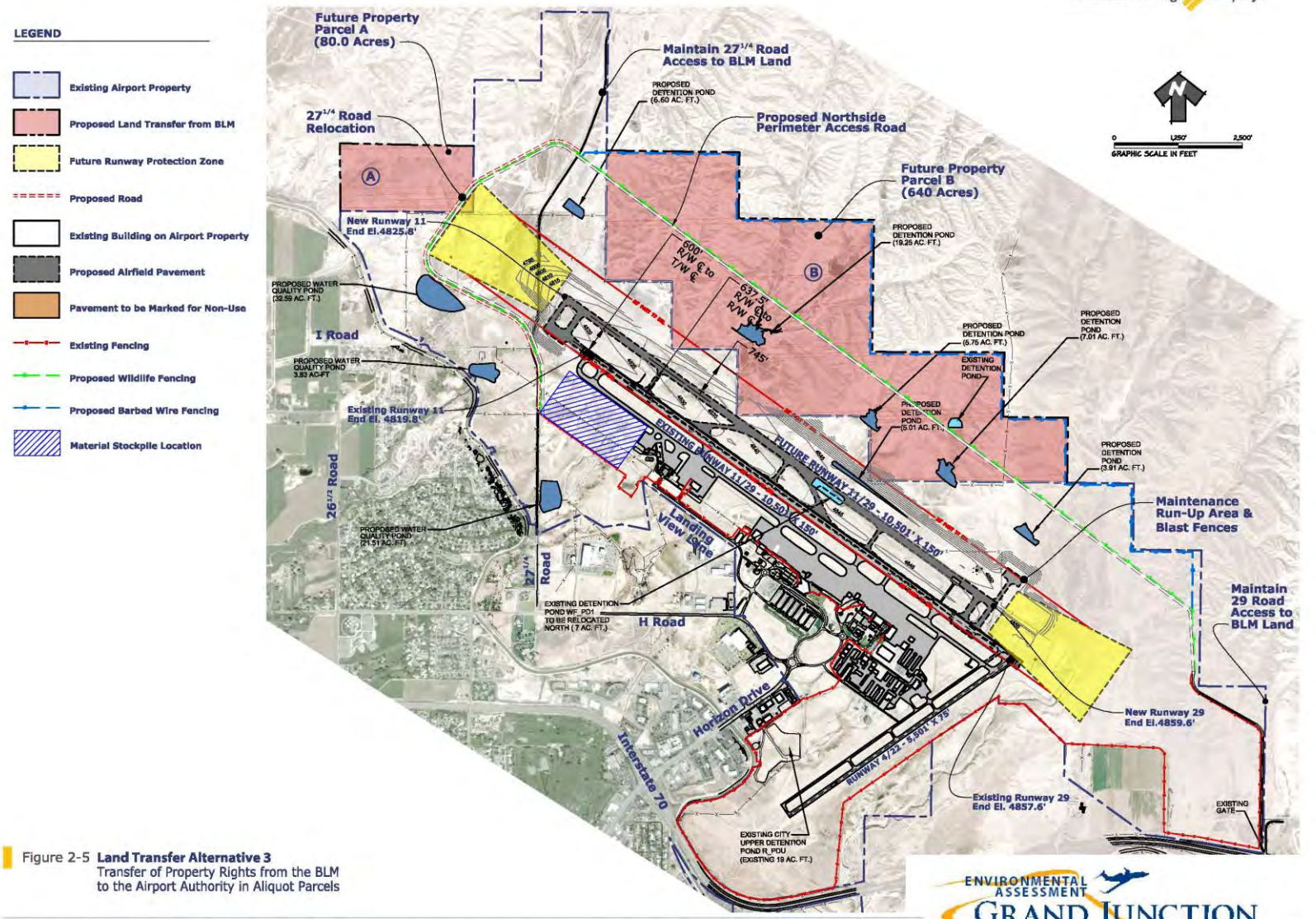


Figure 2-5 **Land Transfer Alternative 3**
Transfer of Property Rights from the BLM to the Airport Authority in Aliquot Parcels

ENVIRONMENTAL ASSESSMENT GRAND JUNCTION REGIONAL AIRPORT

Current Proposed Transfer

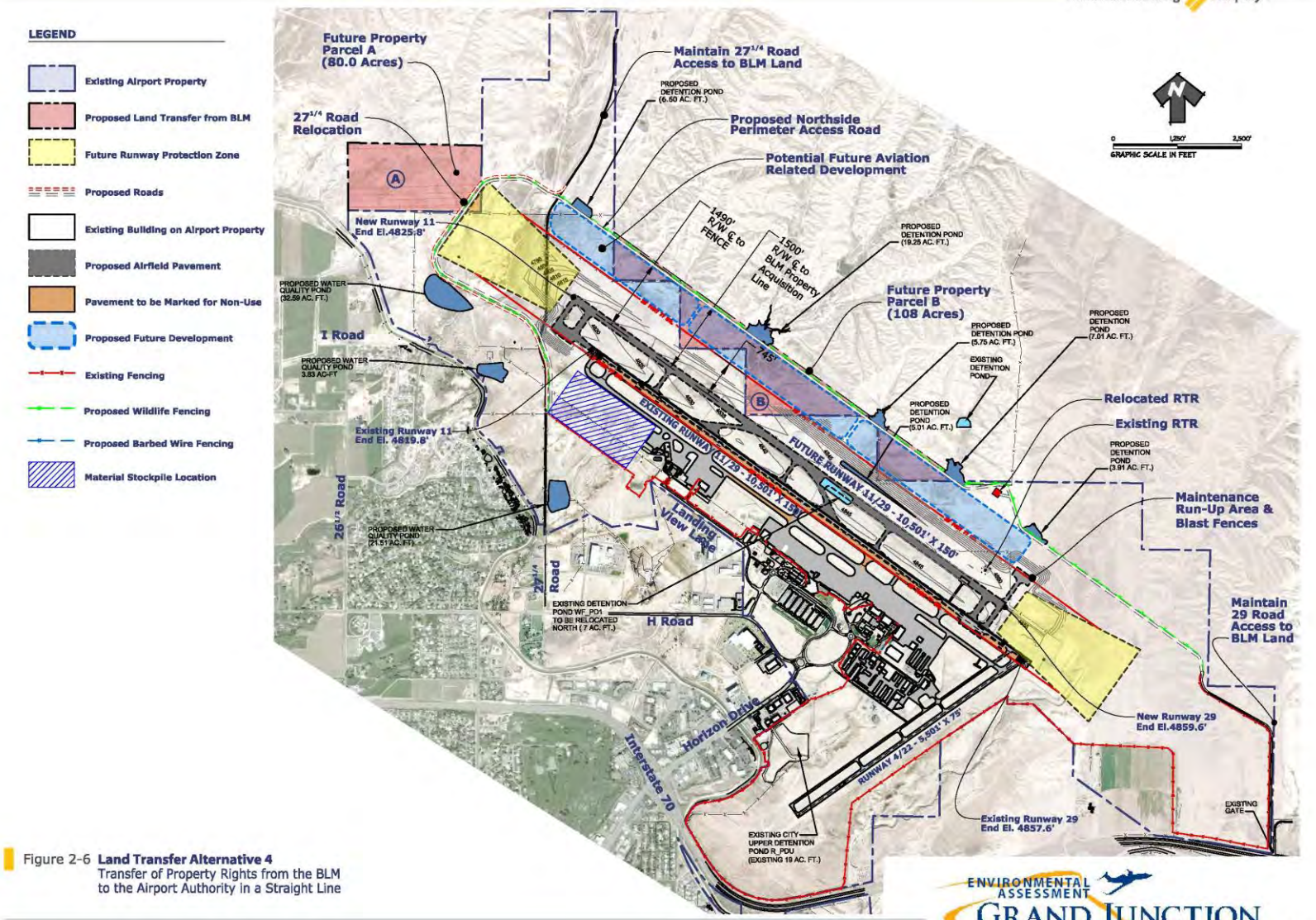


Figure 2-6 **Land Transfer Alternative 4**
Transfer of Property Rights from the BLM to the Airport Authority in a Straight Line

Potential Environmental Impacts and Proposed Mitigation

Fish, Wildlife and Plants

- *Potential impacts to endangered fish species due to water depletion to the Colorado River. Mitigated through BLM Programmatic Biological Assessment (PBO).*

Historic Resources

- *Potential impact to historic railroad grade. Mitigated through Level II Photo documentation of railroad grade.*

Potential Environmental Impacts and Proposed Mitigation (*Continued*)

DOT Section 4(f)

- *Impact to recreation land. Reduced through project acreage reduction 720 to 188. Mitigated by maintaining access to BLM land and constructing parking/staging area.*
- *Draft MOA being reviewed by BLM and FAA.*

Waters of the U.S.

- *Potential impact to ephemeral drainages identified as jurisdictional Waters of the U.S. due to their connection to the Colorado River. Mitigated through nationwide permit from Corps of Engineers detailing construction practices such as vertical mulching and natural bottom culverts.*

Next Steps

- Public Hearing and Comment Period
- Response to Comments
- MOA for Staging Area/Parking Area
- Publish Final EA
- FAA Finding
- BLM Finding
- Requests for Land Transfer and ROW grant

Barnard Dunkelberg Company

ENVIRONMENTAL ASSESSMENT
GRAND JUNCTION
REGIONAL AIRPORT

Barnard Dunkelberg Company

Questions and Comments



ENVIRONMENTAL ASSESSMENT

GRAND JUNCTION REGIONAL AIRPORT

State PROOF OF PUBLICATION

NOTICE OF PUBLIC HEARINGS AND NOTICE OF AVAILABILITY OF A DRAFT ENVIRONMENTAL ASSESSMENT (EA) FOR THE TRANSFER OF BLM LAND TO THE GRAND JUNCTION REGIONAL AIRPORT AUTHORITY AND THE RELOCATION OF THE PRIMARY RUNWAY AT GRAND JUNCTION REGIONAL AIRPORT

Public Hearings:
Tuesday, July 21, 2015 3:00-5:00 p.m.
Prior to the Grand Junction Airport Board Meeting
Airport Terminal Building, 2nd Floor
2828 Walker Field Drive
Grand Junction, CO 81506

Wednesday, July 22, 2015 9:30-11:30 a.m.
Mesa County Central Public Library
Mesa Community Room
443 N. 6th Street
Grand Junction, CO 81501

Wednesday, July 22, 2015 3:30-5:30 p.m.
Fruita Community Center
324 N. Coulson Street
Fruita, CO 81521

Thursday, July 23, 2015 8:30-10:30 a.m.
Palisade Community Center
120 W. 8th Street
Palisade, CO 81526

Public Comment Period: Written comments will be accepted until August 3rd.

The purpose of the Public Comment period and Public Hearing is to receive public comment on the National Environmental Policy Act (NEPA) Draft Environmental Assessment (EA) disclosing the potential economic, social and environmental consequences of transferring land from the Bureau of Land Management (BLM) to the Airport Authority and relocating the primary runway at the Grand Junction Regional Airport.

Draft Environmental Assessment Available:
The Grand Junction Regional Airport Authority, the FAA and the BLM announce the availability of the Draft EA examining the potential impacts of the proposed action. The Draft EA is now available for public review and comment. The public comment period runs until August 3rd, 2015, and public hearings will be held on July 21st, 22nd, and 23rd. Copies of the Draft EA are available for review at the following locations:
- Electronically on the Airport's web site at http://www.gjairport.com
- Electronically on the BLM's web site at http://www.blm.gov/co/st/en/fo/gjfo.html
- Draft EA copies may also be viewed during regular business hours at the following locations: Mesa County Central Library, 443 N. 6th Street, Grand Junction, CO 81501; The BLM Grand Junction Field Office, 2815 H Road, Grand Junction CO 81506; and the Grand Junction Airport Authority Administration Office, 2828 Walker Field Drive, Grand Junction, CO 81506

Comments on the Draft EA are encouraged and may be presented during the comment period either:
Verbally or written at the public hearings or,
By email to ajordan@gjairport.com
Written to:
Amy Jordan, Business and Administration Manager
Grand Junction Regional Airport
2828 Walker Field Drive
Grand Junction, CO 81506

The Airport and the BLM want to keep you informed and receive your input. Representatives of the Airport, the BLM, and the consultant team will be available at the public hearing to provide information and receive comments on the environmental analysis. Several exhibits will be set up for review prior to a short presentation given by the consultant team. Following the presentation at each of the hearings, the public is invited to provide verbal comments that will be transcribed by a court reporter and included in the transcript of the public hearings. Before including your address

STATE OF COLORADO

County of (Mesa)

Terry Flanagan

Being duly sworn, says that I am Legal Secretary of The Daily Sentinel, a daily newspaper, published and duly printed in The County of Mesa, State of Colorado; that said newspaper has a general circulation in said County and has been continuously and uninterruptedly published therein, during a period of at least fifty-two consecutive weeks next prior to the first publication of the annexed notice; that said newspaper is a newspaper within the meaning of the act of the general Assembly of the State of Colorado, entitled "An Act to regulate the printing of legal notices and advertisements," and amendments thereto; that the notice of which the annexed is a printed copy taken from said newspaper, was published in said newspaper, and in the regular and entire issue of every number thereof two (2) times in fifteen (15) days;

that said notice was so published in said newspaper proper and not in any supplement thereof, and that first publication of said notice as aforesaid, was on the 19th day of June, 2015,

and the last, on the 3rd day of July, 2015.

Copies of each number of said paper in which said notice and/or list was published were delivered by carriers or transmitted by mail to each of the subscribers of said newspaper, The Daily Sentinel, according to the accustomed mode of business in this office.

[signature]

Sworn to before me, this 10th day of July, 2015

Karen McLeish

KAREN McLEISH
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20134002084
MY COMMISSION EXPIRES JANUARY 17, 2017

800 Eagle Drive
Grand Junction, Colorado 81506
www.gjairport.com

NEWS RELEASE

Contact: Amy Jordan
Grand Junction Regional Airport
970-712-4116
ajordan@gjairport.com

Christopher Joyner
Bureau of Land Management
970-210-2126
cbjoyner@blm.gov

BLM, FAA and Grand Junction Regional Airport
seek public comment for proposed land transfer to relocate runway

GRAND JUNCTION, Colo. June 19, 2015, -- The Bureau of Land Management, the Federal Aviation Administration, and the Grand Junction Regional Airport are now seeking public comments on a proposed land transfer and runway relocation.

The airport seeks 188 acres of BLM managed land to relocate its primary runway approximately 650 feet north to enhance public safety and meet FAA design standards.

Public comments are needed for the draft Environmental Assessment evaluating this transfer under the Airport and Airway Improvement Act of 1982.

"The Federal Aviation Administration's Runway Safety Action Team has identified the intersecting runways as a "hotspot" that constitutes a runway risk factor," said Business and Administration Manager, Amy Jordan, of the Grand Junction Regional Airport. "This runway relocation will provide critical safety improvements for the Grand Junction Regional Airport."

The land proposed for transfer is immediately north and northwest of the airport and is currently a small portion of what would be the Grand Valley OHV Special Recreation Management Area in the Resource Management Plan awaiting approval. This is an area very popular for off-highway vehicle recreation. The original 720 acre proposal was modified to 188 acres. If the preferred alternative is constructed, the BLM and the Airport plan to construct a general use parking and staging area for public use on BLM managed property, adjacent to 27 ¼ Rd. to help further mitigate the impacts to recreation.

"This project has been in the works for about 20 years." said BLM Grand Junction Acting Field Manager Wayne Werkmeister. "We understand how important off highway vehicle recreation is in this valley. Now we want to know what the public think about transferring this valuable BLM land used for recreation to help the airport improve safety."

The project is currently scheduled in the Airport's Capital Improvement Program to begin in calendar year 2017 and be completed in approximately 10-12 years depending on construction phasing and funding availability.

The draft EA will be jointly reviewed and evaluated by the FAA and BLM. The FAA is the agency responsible for reviewing and approving Federal actions that pertain to airports. The BLM is the agency responsible for reviewing and approving the request for the land transfer to the Airport.

The draft EA is available online for public review electronically at the Airport's website at www.gjairport.com and the BLM's web site at http://www.blm.gov/co/st/en/fo/gjfo.html. Printed copies of the document can also be viewed during regular business hours at the following locations: Mesa County Central Library, 443 N. 6th Street, Grand Junction, CO 81501; The BLM Grand Junction Field Office, 2815 H Road, Grand Junction CO 81506; and the Grand Junction Regional Airport Authority Administration Office, 2828 Walker Field Drive, ATO1, Grand Junction, CO 81506.

Additionally, there will be a series of public meetings to receive comments on the draft EA.

- July 21; 3:00 – 5:00 p.m., Grand Junction Regional Airport, Terminal Building, 2nd Floor, 2828 Walker Field Drive, Grand Junction
- July 22; 9:30 – 11:30 a.m., Mesa County Central Public Library, 443 N. 6 St., Grand Junction
- July 22; 3:30 – 5:30 p.m., Fruita Community Center, 324 N. Coulson St., Fruita
- July 23; 8:30 – 11:30 a.m., Palisade Community Center, 120 W. 8 St., Palisade

Written comments will also be accepted through August 3, 2015 by email to ajordan@gjairport.com or to Amy Jordan, Business and Administration Manager, Grand Junction Regional Airport, 2828 Walker Field Drive, ATO1, Grand Junction, CO 81506.

Before including your address, phone number, e-mail address, or any other personal identifying information in your comment, you should be aware that your entire comment, including personal identifying information, may be made publicly available at any time. While individuals may request the Airport and BLM withhold personal identifying information from public view, complete confidentiality cannot be guaranteed.

(END)

West Star Aviation, Inc. • 796 Heritage Way • Grand Junction, CO 81506 • 800-255-4193

July 22nd, 2015

To the Grand Junction Regional Airport

Regarding: "**BLM, FAA and Grand Junction Regional Airport seeking public comment for proposed land transfer to relocate runway.**"

West Star Aviation supports this proposed land acquisition. The Grand Junction Regional Airport is a vital lifeline for our community, and for West Star Aviation. To be successful in Grand Junction, West Star depends on the Airport and Runway infrastructure in order to operate. The nearly 400 jobs created here at West Star rely on an operational airport and runways, similar to how other businesses rely on highways and interstates each day.

The land acquisition and new runway will provide a necessary improvement to the Grand Junction Regional Airport which will keep this airport operating long into the future. We support this forward looking planning, and appreciate the Grand Junction Regional Airport, FAA, and BLM's cooperative vision to help our community and region.

Best Regards,

Dave Krogman
General Manager
West Star Aviation, Inc.

MESA COUNTY OPERATIONS DEPARTMENT
Building Inspection – Code Compliance – Engineering – Environmental Health
Fleet – Planning – Regional Transportation Planning – Road and Bridge
Solid Waste Management – Traffic – Public Works

200 S. Spruce Street • P.O. Box 20,000 • Grand Junction, Colorado 81502-5022
Ph (970) 244-1765 Fax (970) 255-7171

July 23, 2015

Grand Junction Regional Airport
Attn. EA Comment
800 Eagle Drive
Grand Junction, CO 81506

RE: BLM Airport Transfer Draft Environmental Assessment

Dear Ms. Jordan:

Thank you for the opportunity to comment on the draft environmental assessment (EA) for the Proposed Land Transfer and Runway Project in Mesa County, Colorado for the Grand Junction Regional Airport Authority. We appreciate the cooperative relationship Mesa County has with the Airport and BLM and our opportunity to coordinate with the BLM on NEPA projects. Additionally our Memorandum of Understanding (MOU) with the BLM (MOU # CO-076-97-001) provides a good framework for this relationship.

Mesa County supports the intent of the proposed land transfer of 188 acres from the BLM to allow the Grand Junction Regional Airport Authority to relocate runway 11/29 and construct associated connector taxiways. We understand the vital role the airport serves in our local economy and a safer more efficient airport is in the greater interest of the community as a whole. In fact, the Grand Junction/Mesa County Comprehensive Plan identifies these lands and more as "Airport" for future expansion and operations. We appreciate the effort to balance the needs of the airport with the recreational assets of the BLM lands adjacent to the airport by minimizing the transfer acreage.

We are pleased to see the EA addresses to our satisfaction the following topics we raised in our scoping comments in 2011:

- Relocation of 27 ¼ Road to the northwest on a reserved sixty (60) feet right-of-way and keeping open recreational access to BLM lands to the north of the airport.

- Construction of a general use parking area for recreational users of BLM managed land north of the airport accessed by 27 ¼ Road and south of the shooting range in coordination with area recreational land user groups.

- Construction of service roads and a BLM right-of-way grant for the construction, operation, and maintenance of drainage-related facilities.

- The existing right-of-way for the Grand Valley Power electrical transmission line on the subject land should not be impacted by the land transfer.

- The existing oil and gas leases on the lands proposed for transfer should not be impacted since the BLM will retain mineral rights in those areas.

Thank you again for the opportunity to comment. We look forward to Findings of No Significant Impacts from the FAA and BLM on this important project. If you have any questions, please do not hesitate to contact us.

Sincerely,

Peter Baier
Deputy Administrator for Operations

cc: County Commissioners
Frank Whidden, County Administrator
Patrick Coleman, County Attorney
Tim Moore, Acting Grand Junction City Manager
Todd Hollenbeck, Mesa County Regional Transportation Planning Office
File

Amy Jordan

From: Steve Don <sdon@gvp.org>
Sent: Monday, July 27, 2015 8:47 AM
To: Amy Jordan
Subject: EA comments
Attachments: GJ airport EA.pdf

Amy Jordan
Grand Junction Regional Airport

Grand Valley Power would like to submit comments regarding the Environmental Assessment (EA) for the BLM land transfer to the Grand Junction Regional Airport. Grand Valley Power has reviewed the draft EA and noticed some potential issues on the west end of the existing and proposed runways. The potential issues we have identified are as follows:

1. Grand Valley Power owns a piece of property that is used as an electric substation near the west end of the existing runway. On the illustrations included in the EA it appears that this property is identified as existing airport property. We have attached a copy of the property description from the Mesa County Assessor's Office showing the ownership and legal description of the property.

2. It appears that a portion of the proposed water quality pond 6 would encroach on to this same substation property.

3. This substation property also has an easement for overhead power lines that originate at the substation and head south out of the substation, a copy of the easement is attached. The proposed water quality pond 6 should be designed with consideration of the overhead power lines and the easement. It is very important to consider the equipment to be used for construction of the pond to ensure proper working clearances between the equipment and the 12,470 volt power lines. Operating a track hoe, dump trucks, etc. in the vicinity of high voltage overhead power lines is dangerous and you must ensure the safety of the equipment and personnel operating the equipment.

4. In numerous places the EA addresses an existing BLM ROW grant for a Grand Valley Power transmission line. The EA mentions several options for maintaining Grand Valley Power's ROW if the land transfer occurs. Grand Valley Power prefers to obtain a new easement for the transmission line from the Grand Junction Regional Airport when the land transfer occurs. The BLM has indicated that they will be sending a letter to Grand Valley Power describing how the process will occur for transferring the Grand Valley Power ROW.

If you have any questions or require additional information, please contact me.

Steve Don
Manager of Engineering
Grand Valley Power
970-623-8572



MESA COUNTY

Property Information

Report Date: 7/22/2015

Parcel Number:	2701-252-00-257
Account Number:	R016149
Location:	
Mailing Address:	2727 GRAND AVE GRAND JUNCTION, CO 81501-8032
Owner	GRAND VALLEY RURAL POWER LINES INC
Joint Owner:	
Neighborhood:	AREA 28 (28.00CM)
Assoc. Parcel:	
Title Status:	
Property Use:	State Assessed

No Land Info Associated With This Parcel

Select Map Per Parcel... Print Friendly Page



Popup blocker must be off to open mapping site

Air Photography Date: 2012 & 2015

Legal Summary: A TR OF LAND SITUATED IN THE NW4NW4 SEC 25 1N 1W DESC AS FOLLS BEG NW COR OF SD SEC 25 N 90DEG E 417.42FT S 0DEG07' E 417.42FT S 90DEG E 417.42FT N 0DEG07' W 417.42FT TO POB EXC A TR OF LAND DESC IN WD RECD B-746 P-278 MESA CO RECDS + FURTHER EXC THE N 30FT AND W 30FT FOR PUBLIC RD WAY PURPOSES AKA BOOKCLIFF SUBSTATION - TAXED BY D.P.T.

Tax Information

TAC (Tax Assessor Code) Book | Manufactured Homes-Purging Titles/Classifying to Real Property | Real Property Valuation F.A.Q.'s

Year	Property Code	Improvements (Actual)	Land (Actual)	Total (Actual)	Improvements (Assessed)	Land (Assessed)	Total (Assessed)	TAC Code	Mill Levy	Water Assessment	Tax
2015		$0	$0	$0	$0	$0	$0	14100		$0.00	*$0.00
2014		$0	$0	$0	$0	$0	$0	14100	0.0621	$0.00	
2013		$0	$0	$0	$0	$0	$0	14100	0.0623	$0.00	

*Current Estimated Tax is Using Previous Year's Mill Levy (Mill Levy Determined in December of Current Year)

Taxing Authority Detail

Tax Authority Contact Info

Year	Agency Abbrev.	Agency Name	TAC Code	Mill Levy	Total (Assessed)	Tax Per Agency
2014	GRJCT	CITY OF GRAND JUNCTION	14100	8.0000	$0	$0
2014	COLRW	COLORADO RIVER WATER	14100	0.2530	$0	$0
2014	MCCCB	COUNTY - DEVELOP DISABLED	14100	0.2910	$0	$0
2014	MCGF	COUNTY GENERAL FUND	14100	9.3790	$0	$0
2014	MCRBS	COUNTY ROAD & BRIDGE-1/2 LEVY	14100	0.2215	$0	$0
2014	MCTV	COUNTY TRANSLATOR TV FUND	14100	0.0170	$0	$0
2014	GRMCD	GRAND RIVER MOSQUITO CTRL	14100	1.5130	$0	$0
2014	LIBR	LIBRARY DISTRICT	14100	3.0170	$0	$0
2014	GJRB	MESA CNTY ROAD & BRIDGE-GRAND JCT	14100	0.2215	$0	$0
2014	SD51O06	SCHOOL DIST# 51 2006 OVERID	14100	2.5250	$0	$0
2014	SD51B	SCHOOL DIST# 51 BOND	14100	6.9900	$0	$0
2014	SD51	SCHOOL DIST# 51 GENERAL	14100	24.3470	$0	$0
2014	SD51O	SCHOOL DIST# 51 OVERRIDE	14100	2.7100	$0	$0
2014	MCSS	SOCIAL SERVICES	14100	2.0840	$0	$0
2014	UTE	UTE WATER CONSERVANCY	14100	0.5000	$0	$0
			Totals:	62.0690		*$0.00

Land Description

Acres (Unofficial): 4

Photos

Photo 0 of 0

Photos not available

BOOK 920 PAGE 414

State of Colorado) Recorded at 11:30 o'clock A.M. March 1961
County of Mesa) ss. Reception No. 350695 Annie M. Winston Recorder

RIGHT OF WAY EASEMENT

KNOW ALL MEN BY THESE PRESENTS: That

Neil Van Den Heuvel

of the County of Mesa and the State of Colorado, in consideration of the sum of One Dollar ($1.00) and other good and valuable considerations, the receipt whereof is herby acknowledged, do(es) hereby grant, bargain, sell, warrant and convey unto GRAND VALLEY RURAL POWER LINES, INC., a Colorado corporation, its successors and assigns, the right, privilege and easement forever to enter upon the property hereinafter described and, from time to time, within a right of way not exceeding fifty (50) feet in width to erect, construct, operate, maintain, patrol, inspect, service, repair, relocate and reconstruct, upon, along, across, over and under said property, and upon, along, across, over and under the roads, streets and highways adjoining said property, a line or lines for the transmission or distribution of electric energy, and also telephone and telegraph lines, including without limitation all necessary or convenient poles, wires, towers, cables, guy-wires, brace-poles, anchors, ground connections, service line, fixtures and appliances, together with all rights and privileges necessary or convenient for the full enjoyment or use of said lines, including without limitation the right to trim, cut and keep clear all trees, limbs and undergrowth along said lines and all trees adjacent thereto that may, in any way, endanger the proper operation of the same, and the right to enter over adjoining lands of the grantor(s) for the purpose of exercising the rights and privileges herein granted.

The above mentioned property in located in Mesa County, Colorado, and is described as follows;

In the W½, NW¼, Section 25, T.1N., R.1W., Ute Meridian; beginning at a point 31 ft. east of the NW corner of said Section 25, thence South parallel to the west line of said Section 25, approximately ½ mile to a point 31 ft. east of the west ¼ corner of said Section 25.

In the NE¼ NE¼ Section 26, T.1N., R.1W., Ute Meridian; beginning at a point 31ft. south of the NE corner of said Section 26; thence west parallel to the North line of said Section 26 approximately ¼ mile to the west line of the said NE¼ NE¼ of said Section 26.

TO HAVE AND TO HOLD said easement, together with all and singular the rights and privileges appertaining thereto, unto said GRAND VALLEY RURAL POWER LINES, INC., its successors and assigns forever.

Signed and delivered this 24th day of October A.D., 1958

Neil Van den Heuvel (SEAL)

(SEAL)

(SEAL)

STATE OF COLORADO)
County of Mesa) ss

I, Lyle E. Shriver, a Notary Public in and for said Mesa County, in the State aforesaid, do hereby certify that Neil Vanden Heuvel

who is personally known to be to be the person whose name is subscribed to the foregoing deed, appeared before me this day in person and acknowledged that he signed, sealed and delivered the said instrument of writing as his free and voluntary act and deed, for the uses and purposes therein set forth.

Given under my hand and notarial seal, this 24 day of October A.D. 1958

My Commission expires Sept. 12, 1961

Lyle E. Shriver
Notary Public

LYLE E. SHRIVER NOTARY PUBLIC MESA COUNTY, COLO.

Response to Comments

Comment 1: West Star Aviation supports this proposed land acquisition. The Grand Junction Regional Airport is a vital lifeline for our community, and for West Star Aviation. To be successful in Grand Junction, West Star depends on the Airport and Runway infrastructure in order to operate. The nearly 400 jobs created here at West Star rely on an operational airport and runways, similar to how other businesses rely on highways and interstates each day.

The land acquisition and new runway will provide a necessary improvement to the Grand Junction Regional Airport which will keep this airport operating long into the future. We support this forward looking planning, and appreciate the Grand Junction Regional Airport, FAA, and BLM's cooperative vision to help our community and region.

Response: Thank you West Star, your comments have been noted.

Comment 2: Thank you for the opportunity to comment on the draft environmental assessment (EA) for the Proposed Land Transfer and Runway Project in Mesa County, Colorado for the Grand Junction Regional Airport Authority. We appreciate the cooperative relationship Mesa County has with the Airport and BLM and our opportunity to coordinate with the BLM on NEPA projects. Additional, our Memorandum of Understanding (MOU) with the BLM (MOU # CO-076-97-001) provides good framework for this relationship.

Mesa County supports the intent of the proposed land transfer of 188 acres from the BLM to allow the Grand Junction Regional Airport Authority to relocate runway 11/29 and construct associated connector taxiways. We understand the vital role the airport serves in our local economy and a safer more efficient airport is in the greater interest of the community as a whole. In fact, the Grand Junction/Mesa County Comprehensive Plan identifies these lands and more as "Airport" for future expansion and operations. We appreciate the effort to balance the needs of the airport with the recreational assets of the BLM lands adjacent to the airport by minimizing the transfer acreage.

Response: Thank you Mesa County, your comments have been noted.

Comment 3:
Grand Valley Power would like to submit comments regarding the Environmental Assessment (EA) for the BLM land transfer to the Grand Junction Regional Airport. Grand Valley Power has reviewed the draft EA and noticed some potential issues on the west end of the existing and proposed runways. The potential issues we have identified are as follows:

1. Grand Valley Power owns a piece of property that is used as an electric substation near the west end of the existing runway. On the illustrations included in the EA it appears that this property is identified as existing airport property. We have attached a copy of the property description from the Mesa County Assessor's Office showing the ownership and legal description of the property.

2. It appears that a portion of the proposed water quality pond 6 would encroach on to this same substation property.

3. This substation property also has an easement for overhead power lines that originate at the substation and head south out of the substation, a copy of the easement is attached. The proposed water quality pond 6 should be designed with consideration of the overhead power lines and the easement. It is very important to consider the equipment to be used for construction of the pond to ensure proper working clearances between the equipment and the 12,470 volt power lines. Operating a track hoe, dump trucks, etc. in the vicinity of high voltage overhead power lines is dangerous and you must ensure the safety of the equipment and personnel operating the equipment.

4. In numerous places the EA addresses an existing BLM ROW grant for a Grand Valley Power transmission line. The EA mentions several options for maintaining Grand Valley Power's ROW if the land transfer occurs. Grand Valley Power prefers to obtain a new easement for the transmission line from the Grand Junction Regional Airport when the land transfer occurs. The BLM has indicated that they will be sending a letter to Grand Valley Power describing how the process will occur for transferring the Grand Valley Power ROW.

Response: Thank you Grand Valley Power for the Comments.

This response is to confirm that we have received your letter and offer the following responses:

1. The official airport property map appears to incorrectly identify the parcel west of 27 ¼ Road containing your electric substation as airport property. The Airport will respect the property and avoid any impacts to the property in the final design of

both the relocation of 27 ¼ Road and the final design of the drainage system including detention and water quality ponds. The Airport will also continue to work cooperatively with Grand Valley Power to ensure the integrity of your property and the electric substation. The Airport will also work to revise our property map to correctly identify this parcel as owned by Grand Valley Power.

2. The Airport will consider the overhead power lines in its construction plans for both the relocation of 27 ¼ Road and the drainage system to ensure safety when equipment is operating in the cavity of the high voltage lines.

3. Finally, the Airport will work cooperatively with both Grand Valley Power and the BLM to grant a new easement for the transmission line crossing parcel A.