FORM 28 Rev 6/99

State of Colorado
Oil and Gas Conservation Commission

1120 Lincoln Street, Suite 801, Denver, Colorado 80203 (303) 894-2100 Fax: (303) 894-2109

CENTRALIZED E&P WASTE MANAGEMENT FACILITY PERMIT

Submit this Form and accompanying documents for each facility per Rule 908. Financial Assurance in the amount of $50,000 is required to operate each facility.

FOR OGCC USE ONLY
Facility 440177
Received 3/13/2015
Document 2314291

Surety ID: _____

OGCC Operator Number: 10515
Name of Operator: Gunnison Energy LLC
Address: 1801 Broadway, Suite 1200
City: Denver **State:** CO **Zip:** 80202

Contact Name and Telephone:
Lee Fyock
No: 303-293-2913
Fax: 303-296-4555

Surface Owner (if different than above): Randy Spadafora Edward Spadafora
Address: 9950-3200 Road, Hotchkiss CO 81419 11991 Menoken Road, Montrose, CO 81401
City: _____ **State:** _____ **Zip:** 970-209-1924 **Phone:** 970-249-8371

Facility Name: Spadafora Water Storage Facility
Address: Access from FR 851 onto private access road
City: Unincorporated **State:** CO **Zip:** n/a
Phone: 303-296-4222 **Fax:** 303-296-4555

Location (QtrQtr, Sec, Twp, Rng, Mer):
NW 1/4 NE 1/4 OF Section 20, T11S, R 90W
Latitude: 39.092092 N
Longitude: 107.4675444 W

Complete the Attachment Checklist

	Oper	OGCC
Site description (topo, geol, hydro)	✓	
Adjacent land use description	✓	
Topographic map	✓	
Site drainage map with structures	✓	
Scaled drawing and survey map	✓	
Facility design & engineering	✓	
Operating plan	✓	
Water analysis report	✓	
Financial assurance	✓	
Closure plan	✓	
Local gov't zoning compliance	✓	
Local gov't permits and notice	✓	

1. Is the site in a sensitive area? ☐ Y ☑ N

2. What are the average annual precipitation and evaporation rates for the site? Precipitation: 10.08 inches/year Evaporation: 57.45 inches/year

3. Has a description of the site's general topography, geology and hydrology been attached? ☑ Y ☐ N

4. Has a description of the adjacent land use been attached? ☑ Y ☐ N

5. Has a 1:24,000 topographic map showing the site location been attached? ☑ Y ☐ N

6. Has a site plan showing drainage patterns, diversion or containment structures, roads, fencing, tanks, pits, buildings and any other pertinent construction details been attached? ☑ Y ☐ N

7. If site is not owned by the operator, is written authorization of the surface owner attached? ☑ Y ☐ N

8. Has a scaled drawing and survey showing the entire section(s) containing the proposed facility been attached? ☑ Y ☐ N

9. What measures have been implemented to limit access to the facilty by wildlife, domestic animals or by members of the public? Briefly explain.
~~The facility will be fenced with an 8-ft chain link with three strands of barb wire on top and a fine mesh buried biota screen at the bottom. The pits will be covered with Ilexprotect.~~

10. Is there a planned firelane of at least 10 feet in width around the active treatment areas and within the perimeter fence? ☑ Y ☐ N

11. Is there an additional buffer zone of at least 10 feet within the perimeter firelane? ☑ Y ☐ N

12. Have surface water diversion structures been constructed to accommodate a 100-year, 24-hour event? ☑ Y ☐ N

13. Has a waste profile been calculated according to Rule 908.b.6? ☑ Y ☐ N

14. Has facility design and engineering been provided as required by Rule 908.b.7? ☑ Y ☐ N

15. Has an operating plan been completed as required by Rule 908.b.8? ☑ Y ☐ N

16. Has ground water monitoring for the site been provided? ☑ Y ☐ N ***Attach Water Analysis Report, Form 25, for each monitoring well installed.***

17. Has financial assurance been provided as required by Rule 704? ☑ Y ☐ N

18. Has a closure plan been provided? ☑ Y ☐ N

19. Have local government requirements for zoning and construction been complied with? ☑ Y ☐ N

20. Have permits and notifications required by local governments and other agencies been provided? ☑ Y ☐ N

Print Name: Lee Fyock, Gunnison Energy LLC

Signed: Lee Fyock Title: Vice President Date: 11/14/2014

OGCC Approved: _____ Title: _____ Date: _____

CONDITIONS OF APPROVAL, IF ANY:

Facility Number:

Form 28

Centralized E&P Waste Management Facility Application

Spadafora Water Storage Facility

NW ¼ NE ¼ of Section 20, Township 11 South, Range 90 West of the 6th PM,
Gunnison County, Colorado

November, 2014

Revised March, 2015

Prepared For

GUNNISON ENERGY LLC
AN OXBOW COMPANY

Gunnison Energy LLC
1801 Broadway, Suite 1200
Denver, Colorado 80202

Prepared By

Weston Solutions, Inc.
1435 Garrison St., Suite 100
Lakewood, Colorado 80215

Form 28

Centralized E&P Waste Management Facility Application

Gunnison Energy LLC
Spadafora Water Storage Facility

NW ¼ NE ¼ of Section 20, Township 11 South, Range 90 West of the 6th PM,
Gunnison County, Colorado

November, 2014

Revised March, 2015

Prepared For

GUNNISON ENERGY LLC
AN OXBOW COMPANY

Gunnison Energy LLC
1801 Broadway, Suite 1200
Denver, Colorado 80202

Prepared By

Weston Solutions, Inc.
1435 Garrison St., Suite 100
Lakewood, Colorado 80215

Gunnison Energy LLC
Spadafora Water Storage Facility

Introduction

Gunnison Energy LLC (GELLC) is seeking approval to construct and operate a Centralized Exploration and Production (E&P) Waste Management Facility [Spadafora Water Storage Facility (SWSF)] to manage the storage, beneficial reuse and disposal of water produced from oil and gas (O&G) production wells. This water storage facility is necessary to support natural gas production activities associated with the Sheep Park Unit on property owned by Randy and Edward Spadafora and operated by GELLC. Attachment A, Site Maps contains Figures illustrating the proposed project location.

The SWSF proposed in this application is part of the critical infrastructure needed to safely and efficiently manage the storage, beneficial reuse and disposal of produced water. The produced water would be stored in three (3) approximately 220,000 barrel (bbl) pits for reuse in drilling and completion operations and/or pumped via existing pipeline infrastructure to proposed underground injection wells for disposal.

At present, GELLC is managing its produced water storage and disposal from active wells through trucking and disposal.

Adherence to State and Local Rules and Regulations

This supplement to the Colorado Oil and Gas Conservation Commission (COGCC) Form 28 is intended to satisfy the informational requirements specified in COGCC Rules 704 and 908 for the construction and operation of a Centralized E&P Waste Management Facility. A Form 2A, *Oil and Gas Location Assessment*, for this facility has also been submitted to COGCC for review. A Gunnison County Oil and Gas Permit will also be submitted concurrently for their review.

Applications for construction air emission source permits (Form APCD-200, Air Pollutant Emission Notice [APEN]) will be submitted to the Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (APCD). The Paonia/Hotchkiss area is a National Ambient Air Quality Standards (NAAQS) attainment area for Volatile Organic Compounds (VOCs), which means the VOC emission limit is 2 tons per year for volatiles and 250 lbs per each Hazardous Air Pollutant (HAP) for the SWSF. Emissions from the pits will be evaluated.

The proposed SWSF would be constructed, operated, and maintained in accordance with all applicable laws, regulations, rules, and standards set forth by federal, state, and local governing agencies including, but not limited to:

- US Environmental Protection Agency (EPA): Title 40 C.F.R Parts 141 and 144 Federal Primary Drinking Water regulation and Underground Injection Control (UIC) regulation for Class II Disposal Wells (Oil and Gas); Parts 112 Spill Prevention, Control, and Countermeasures (SPCC) Guidance and Policy.
- Colorado Oil and Gas Conservation Commission (COGCC): 900 Series Rules for E&P Waste Management; specifically Rule 908 Centralized E&P Waste Management Facilities; Rule 324A Pollution; Rule 325 Underground Disposal of Water; 1000 Series Rules for Reclamation Regulations; and 1200 series Rules for the Protection of Wildlife Resources.
- Colorado Department of Public Health and Environment: 5 CCR 1001 Air Quality Control Commission Regulations; 5 CCR 1002-41 Basic Standards for Ground Water; 5 CCR

1002-31 Basic Standards and Methodologies for Surface Water; National Pollutant Discharge Elimination System (NPDES) for Stormwater and Construction Dewatering Regulation; Colorado Water Quality Control Act, (25-8-101 et seq., CRS, 1973 as amended) and the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq.),

- State of Colorado Department of Natural Resources Division of Water Resources Office of the State Engineer: Dam Safety Branch, 2 CCR 402-1 Rules and Regulations for Dam Safety and Dam Construction; State Board of Examiners of Water Well Construction and Pump Installation Contractors, 2 CCR 402-2 Rules And Regulations For Water Well Construction, Pump Installation, Cistern Installation, And Monitoring And Observation Hole/Well Construction (Water Well Construction Rules).
- Gunnison County: Gunnison County Regulations for Oil and Gas Operations, Gunnison County Board of County Commissioners, BOCC Resolution No. 2003-50.

Centralized E&P Waste Management Facilities

Rule 704 Centralized E&P Waste Management Facilities

As set forth in Rule 908.g, an estimated cost of reclamation, closure and abandonment for the proposed SWSF is provided within the *Closure/Reclamation Plan* included in this application as Attachment B, Closure Reclamation Plan. Financial Assurance will be provided to the COGCC. Additional financial assurance for the proper reclamation, closure and abandonment of the facility will be provided as requested by the COGCC.

Rule 908.a. Applicability

The proposed facility is a non-commercial centralized E&P waste management facility for the treatment, recycle, beneficial use and disposal of water produced from O&G production wells. The proposed SWSF would serve only GELLC operations in the Sheep Park Unit in Gunnison County, Colorado.

Rule 908.b. Permit Requirements

908.b.(1) The proposed facility would be owned and operated by GELLC. Contact information for this submittal is provided below:

Operator Name:	Gunnison Energy LLC
COGCC Operator No:	10515
Address:	1801 Broadway, Suite 1200, Denver, Colorado 80202
Contact:	Mr. Lee Fyock
Phone:	303 296-4222
Fax:	303 296-4555

908.b.(2) The surface rights are owned by Randy and Edward Spadafora.

Surface Owner:	Mr. Randy Frank Spadafora
Owner Address:	9950-3200 Road, Hotchkiss, CO 81419
Phone:	970.209.1924
Surface Owner:	Mr. Edward Lewis Spadafora
Owner Address:	11991 Menoken Road, Montrose, CO 81401
Phone:	970.249.8371

908.b.(3) The proposed SWSF would be located in the central portion of the Muddy Creek drainage approximately 11.5 miles north of Somerset, Colorado.

The subject site is located in the SW ¼ of SE ¼ of Section 17 and NW ¼ NE ¼ of Section 20, Township 11 South, Range 90 West, 6th Principal Meridian, Gunnison County, Colorado. A general coordinate for the site is 39.092092 N latitude, 107.4675444 W longitude, NAD 83.

908.b.(4) Topography: The SWSF is located in the Colorado Plateau physiographic province and the region is characterized by long, deep, narrow valleys with high, precipitous walls in an area with high local relief. The site slopes from east down toward the west and southwest at an inclinations ranging from about 6 to 15 percent. The subject area is within the Gentle Slopes and Lower Valley Floor sub-district of the Resource Lands Zone District (RLGS) which has historically been used for cattle grazing, mining and natural gas extraction as it is today.

The proposed location is situated in Sheep Park, a basin about 2 miles long and 0.8 miles wide at its widest point and oriented approximately north-south. Sheep Park runs between a ridge on the west which is just east of West Muddy Creek and Sheep Mountain to the east. The location is at an elevation of about 8,100 feet. The elevation of the Sheep Creek adjacent to the site is about 8,000 feet. The Spadafora Water Storage Facility will occupy approximately nineteen (19) acres. The site is currently undisturbed except for geotechnical drilling which has occurred on the site. The subject site is bounded 0.15 miles to the west by a private access road utilized by the land owners, Randy and Edward Spadafora, and GELLC for O&G exploration and production activities. The site is bounded directly to the east by U.S. Forest Service (USFS) property at the beginning of the ridge to the east. The property line runs approximately north south. On the west, north, and south sides the site slopes gently into Sheep Park. The surrounding area is currently utilized for active oil and gas development and open rangeland.

Vegetation on the proposed facility site is dominated by grassland community with some areas of big sagebrush. There is adequate open rangeland in the areas surrounding the proposed location to support cattle grazing and wildlife forage in the area following construction activities. See the Wildlife and Habitat Survey in Attachment C, Wildlife Habitat Survey conducted by Mr. John Monarch of Monarch and Associates for the subject site provided in Attachment C, Wildlife and Habitat Survey.

Adjacent Land Use: The property immediately adjacent to the subject site is owned and operated by Randy Frank Spadafora and Edward Lewis Spadafora and is similar in nature, character, and land use. The proposed SWSF would be situated near an existing private access road. There are two adjacent property owners, within the vicinity that would affect, or be affected by, the construction and operation of the proposed SWSF. A map showing all adjacent landowner's is presented on the Property Owner Map (Figure 3) in Attachment A, Site Maps. Future use of the adjacent land would likely be continued open range grazing and/or natural gas production. This proposal is not expected to affect the future use of this land.

The nearest structures are houses within the private property parcel. A house owned by the Spadafora's is 2,400 feet to the west of the SWSF and a house owned by Roger Cesario 3,060 feet to the southwest. The nearest town, Somerset, is about 11.5 miles south from the proposed location. Distance and contouring of the facility screens the subject site from public view and minimizes the potential for visual and other public nuisance impacts. The operation of the facility is not expected to adversely affect adjacent landowners, nearby communities, or otherwise constitute a nuisance or hazard to the general public.

Geology: According to the *Geologic Map of Colorado* by Ogden Tweto (1979), the site is underlain by claystone, mudstone, sandstone, and/or conglomerate of the Wasatch and Ohio Creek Formations. The soil encountered at the surface is classified by the U.S. Natural Resources

Conservation Service (NRCS) as primarily Weed-Herm complex on slopes of 0 to 25%. A copy of the NRCS Soils Report for the proposed site is presented in Attachment D, NRCS Report. Slopes are gentle to moderate around the site and are at approximately 6% under the pond proper and approximately 15% on the west side where the fill is being placed. In general, the site is located on a topographic bench that is a candidate for moderate accumulation of sediment, such as from aeolian (wind-blown) processes.

Hydrology: The SWSF location proposed in this application lies adjacent to Sheep Creek which is an ephemeral tributary to West Muddy Creek, a ephemeral stream, about 2.7 miles south of the facility. There are several stock ponds on Sheep Creek, one within 200 feet of the toe of the fill slope.

A geotechnical investigation was conducted at the proposed location in October 7th and 8th of 2013, and exploratory test borings performed during the investigations encountered groundwater in 5 of the 13 boreholes at depths of 10 to 36 feet at the time of drilling. All three of the dry holes drilled the first day had groundwater seep into the boring after 24 hours. The remaining 5 dry holes drilled on the second day were not monitored for 24 hours. Three of the boreholes where groundwater was encountered were off the footprint and assumed down gradient of the proposed SWTP excavation, one was in the north end of the pit proper and one was just upslope and assumed up gradient from the north end of the pit proper. See attached *Geotechnical Geologic Hazards Investigation* prepared by Huddleston-Berry Engineering & Testing, LLC, Inc. (the "geotechnical report") presented in Attachment E, Geotechnical Report for more detail. Additional groundwater level measurements were collected at the time of drilling and 24 hours after drilling. As reported, the groundwater observed at the site is defined as discontinuous in nature and not indicative of a true water table system.

Gunnison Area Climatology

In the Gunnison Area, the average annual precipitation over a 30 year period is presented below:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Average Total Precipitation (in.)	0.78	0.65	0.51	0.68	0.76	0.64	1.31	1.56	1.07	0.73	0.62	0.76	10.08

Notes:
(1) Precipitation in inches based on annual average of 10.08 inches determined from Western Regional Climate Center

Evaporation Data is presented on the following page.

Evaporation Data:

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Avg. Evaporation
MONTROSE 1948-1982	1.68	1.49	3.34	5.69	7.49	9.47	9.04	7.39	5.54	3.45	1.61	1.26	57.45

Reported in inches

Notes:
(1) Evaporation in acre-feet per acre based on annual evaporation rate of 57.45 inches determined from Western Regional Climate Center

908.b(5) Centralized Facility Siting Requirements

908.b.(5).A The proposed site plan describing the pit locations, facility equipment areas, containment structures, and construction details is provided in the engineered drawing package

presented in Attachment F, Engineering Package. The facility is further described in the Facility Design and Engineering subsection.

908.b.(5).B The proposed facility is situated directly on the section line between sections 17 and 20 and approximately 1800 feet from the east section line of sections 17 and 20 as shown on the attached Site Vicinity and Water Well Location Map (Figure 1, Attachment A, Site Maps).

908.b.(5).C Temporary perimeter fencing will be constructed as required to limit access during the construction phase of the project. As part of the final site development, a chain link fence will enclose the pits to limit access to unauthorized personnel, livestock and wildlife.

The site for the Spadafora Water Storage Facility was chosen based on the terrain, and because of the proximity of the existing produced water gathering system. The pasturelands surrounding the proposed facility will continue to support cattle and sheep grazing.
The following measures will be implemented at the proposed Water Storage Facility to limit the potential for adverse impacts to wildlife:

- The site will be fenced to prevent livestock or wildlife from entering the site and to minimize additional disturbance and potential for habitat fragmentation and each pit will be covered with a Hexprotect floating cover.
- No occupied structures are proposed for the subject site and the facility would be unmanned except for daily checks and routine maintenance. Additionally, remote monitoring systems (i.e. SCADA) would be employed thereby minimizing the human presence that is often disturbing for wildlife;
- All trash containing food items that might attract animals, especially bears, would be disposed of in bear-proof trash containers within the fenced area;
- GELLC policy prohibits feeding of wild animals and keeping food items in the back of pickup trucks, other open vehicles, or outside facilities is not allowed;
- Speed limits are strictly enforced on all roads, including state highways, county roads, and private access roads within Sheep Park Unit to minimize the risk of accident or injury and the potential for wildlife / vehicle collisions;
- No animals or pets would be allowed at the proposed facility;
- GELLC employees and contractors are instructed to avoid contact with wild and domestic animals;
- The site would be maintained in a clean, safe, and sanitary condition at all times. Good housekeeping practices would ensure that valve boxes, drip pans, and other areas with potential for water accumulations are kept clean and dry, and that these accumulations are re-introduced to the pits or properly removed from the site for disposal as soon as practicable;
- The potential for the introduction of hazardous attractions for wildlife and domestic animals such as food items, water, heat, etc. would be minimized by implementing best management practices, adhering to process, procedure, and policy, and practicing good housekeeping.

908.b.(5).D The adjacent pasturelands surrounding the SWSF are primarily devoid of trees and debris and would provide adequate defensible space around the facility in the event of a wildfire. The area has sage/grass vegetation with small pockets of Gambel oak/mountain shrub which would be minimally impacted.

The earthen containment berms surrounding each pit will provide greater than 10-feet of buffer zone around each pit in the event of a fire. An additional 10-foot wide fire lane is designed and would be constructed along the outer perimeter of the entire facility. All facility roadways are adequately sized to accommodate fire-fighting equipment and are designed with adequate turn radii and turnaround capabilities to provide unobstructed access to the pits and equipment in the event of a facility or wildland fire. For more detail, see the engineering drawings provided in Attachment F, Engineering Package for onsite access and fire lane details. GELLC personnel will be considered first responders in the case of a fire, however, will immediately call local firefighting personnel after any fire is reported. GELLC will not be considered as trained firefighters and will depend on local firefighting personnel to respond after notification.

908.b.(5).E Storm water runoff at the subject site flows in a west-southwest direction to Sheep Creek. The SWSF location will be graded as shown in the engineering drawings (Attachment F) to divert onsite runoff away from the pits wherever possible. Armored surface water diversion channels will be constructed to intercept run-on storm water and divert it around and away from the pits into sedimentation ponds prior to discharging to Sheep Creek.

The stormwater control features were developed and designed as a result of a hydrologic study of the drainage basin up-gradient of the site; a copy of the hydrologic study is provided in Attachment G, Engineering Calculations. Because of the limited size of the drainage basin and the overland flow discharge to the drainage swale which diverts storm water around the pits, the hydrologic analysis was performed using the Rational Formula and the basin map used for modeling is presented in Attachment G, Engineering Calculations. The calculations analyze a 6 acre watershed basin. The cumulative flow for a 25-year 24-hour storm event in the basin is 60,984 cubic feet. Assuming this flow splits at the point it enters the drainage channel on the east side of the pits, 30,492 cubic feet (cf) will flow to the north detention basin and 30,942 cf will flow to the south detention pond. Sizing for the drainage channel was based on results of the rational equation hydrologic study. The drainage channel design is based on a flow for the max rainfall intensity for a 30-minute event which assuming two three acre basins is 2.1 cubic feet per second (cfs) will flow each directions to the respective detention pond. The channel will convey 50 cfs at it discharge point from the basins, so a significant safety factor has been built into the drainage system.

Following stormwater flow transmissions through the diversion channels and connecting sedimentation pond, the stormwater will outlet from the sedimentation pond to the seasonal tributary Sheep Creek.

Where proposed stormwater diversion channels then Sheep Creek intersect the facility access road, culverts will be installed under the roadway to transmit flows under the road. The access roads will be graded at slopes to direct surface water flows across the road into the surrounding diversion channels (Attachment F, Engineering Package).

All cut and fill slopes and soil stockpiles would be potholed, tracked or furrowed for better seed and moisture retention to promote the establishment of desirable vegetation for erosion control and long-term soil stabilization. The well-drained, permeable soils, adequate vegetative buffer, and sedimentation ponds should prevent any remaining sediment from reaching West Muddy Creek.

An amendment (Site Specific Stormwater Management Plan [SWMP]) to the existing master EC Stormwater Management Plan, and associated Colorado Discharge Permit System (CDPS) stormwater discharge permit, describing all permanent erosion and sedimentation measures is provided in Attachment H, Stormwater Management Plan.

Temporary erosion control measures to be implemented during construction are presented on the erosion control sheets as part of the engineering drawings and Site Specific SWMP. Installation and maintenance of temporary stormwater pollution prevention and erosion control during construction work will be the responsibility of the construction contractor. The contractor will be covered under GELLC existing permit for Stormwater Discharges Associated with Construction (COR035658). All temporary stormwater and erosion controls would be monitored, maintained, and inspected regularly to minimize the potential for site erosion.

908.b.(6) Waste Profile: The type of water to be received by the pits is production water produced from natural gas wells. The P&ID drawing (Attachment F, Engineering Package) presents a description of the process flow for the SWSF. The produced water would be stored in the pits for reuse in drilling and completion operations. Water not reused will be pumped via pipeline to an injection well. The waste profile for the facility is based upon review of the analytical data from the six existing waste streams currently in operation which contribute water to the Hotchkiss Water Storage Facility. The Hotchkiss Water Storage Facility is approximately 7 miles from the SWSF. The contributing wells are representative of wells in the Sheep Park II Unit. A discussion of analytical data for the individual waste streams and the overall waste profile that can be a comparative set of data for the SWSF is presented below.

A review of the most recent waste stream analytical data provided for the Hotchkiss 1289 #20-12D waste stream flow back water sample collected on 9/17/12 indicated elevated levels of TDS (5,300 mg/L) and chlorides (2,200 mg/L). Detections were also reported for ethyl benzene and xylenes (total), however, the levels reported for these two constituents of concern (COCs) are below the associated maximum concentration level (MCL) for each COC listed on Table 910-1 when applicable. A comparison of the 9/17/12 sample results with the laboratory results reported for the 1289 #20-12D sample collected on 3/31/11 indicates a close correspondence in COCs detected, but with some variance in the levels reported. A review of the analytical data provided for the 3/31/11 sample indicated elevated levels of benzene (0.0745 mg/L) and TVH – GRO (0.23 mg/L) above the Table 910-1 MCLs, and elevated levels of TDS (76,500 mg/L), bromide (299 mg/L), chlorides (45,400 mg/L), and iron (56.9 mg/L). Detections were also reported for toluene, xylenes (total), fluoride, manganese, and selenium; however, the levels reported for these five COCs are below the associated MCL for each COC listed on Table 910-1 when applicable.

On 6/28/14, four additional existing waste stream wells that are representative of the future SWSF wells that will contribute water to the storage facility were sampled as part of annual monitoring. These wells are 1289 #17-11 (non-tributary well), 1289 #18-31 (non-tributary well), 1289 #18-H1 (natural gas well) and 1289 #18-H2 (natural gas well). Each well is considered a separate waste stream. A review of these laboratory results indicated elevated benzene levels in flow back water from 1289 #17-11 (0.73 mg/L), 1289 #18-31 (0.052 mg/L), 1289 #18-H1 (0.085 mg/L) and 1289 #18-H2 (0.13 mg/L) above the Table 910-1 MCLs. Elevated levels were also reported for TDS and chlorides in two of the wells, 1289 #18-31 (310 and 3000 mg/L respectively) and 1289 #18-H1 (16,000 and 29,000 mg/L respectively). Detections were also reported for toluene in two wells (1289 #17-11 and 1289 #18-H2) and xylenes (total) in two wells (1289 #17-11 and 1289 #18-H2) but at levels below the associated MCL for each COC listed on Table 910-1 when applicable. A summary of the waste stream laboratory analytical data is presented in Attachment I, Data Tables as Table 2.

GELLC does not currently have an operating injection/disposal well in the near vicinity of the SWSF. A Class II Disposal Well may eventually be added in the area to accommodate any disposal needs. The well will be permitted, constructed, and operated in conformance with all

federal and state Underground Injection Control (UIC) rules and regulations. The maximum injected fluid volume limitations for these wells, as determined by the COGCC, are set forth in the respective UIC permits.

Currently, it is anticipated that the facility will accept various E&P water generated during day to day operations (e.g., produced water, fracking fluids, etc.). A list of current drilling muds and completion fluids utilized for drilling operations is provided in Attachment J, Waste Profile Data. The actual quantity will vary from well to well as fluid flow back is dependent upon size of completion, formation density and other factors. With exception to the presence of a sheen and/or free product present in the waste stream(s), no set criteria for non-acceptance of waste streams is currently in place. The criteria for potential non-acceptance will be evaluated after the initial six months to one year of sample collection from the facility, assessment of the results, and based on criteria for re-use and/or disposal. All produced water is reused in completion operations or injected for disposal through an existing injection well. No produced water is trucked offsite for reuse, storage or disposal. Prevention of sheen and/or free product from entering the pits will be controlled by use of various engineering controls (e.g., filters near wellheads, skimmers, etc.). The waste stream analytical data presented in Table 2 is believed to be representative of current and future water quality conditions in the pit and all samples are within the current waste acceptance criteria for GELLC facility. The volume of water is anticipated to vary based on the number of wells in operation at any given time as well as the frequency of reuse and hydraulic fracturing operations. On average, it is anticipated that the new pits would receive approximately 75,000 bbls/month.

908.b.(7).A Geologic Data

A discussion on the geology of the area surrounding the proposed Spadafora Water Storage Facility is presented in the following subsections

.

908.b.(7).A.i The unconsolidated alluvial material observed at the proposed site consists primarily of sandy lean clay with some organics at the surface with sandy lean clay with some gravel and boulders down to a bedrock of a weathered shale.

The soil encountered at the surface is classified by the U.S. Natural Resources Conservation Service (NRCS) as primarily Weed-Herm complex on slopes of 0 to 25%. A copy of the NRCS Soils Report for the proposed site is presented in Attachment D, NRCS Report.

Slopes are gentle to moderate around the site and are at approximately 6% under the pond proper and approximately 15% on the west side where the fill is being placed. In general, the site is located on a topographic bench that is a candidate for moderate accumulation of sediment, such as from aeolian (wind-blown) processes.

908.b.(7).A.ii Consolidated bedrock material of a red highly weathered shale which was encountered in each of the borings and ranged in depths of 4 feet bgs (BH-7) to 15 feet bgs (BH-6). Bedrock material consisted primarily of weather shale, and was met with refusal of the auger.

908.b.(7).A.iii The regional geology in the vicinity of the site consists of the following geologic units starting with the youngest:

- Cretaceous Wasatch Formation: Gray or brown mudstone with minor sandstone and conglomerate lenses. Commonly contains coal layers in lower portions of formation.

- Cretaceous Mesa Verde Group: Gray thinly bedded sandstone with minor layers of shale and coal. Locally, the Group includes the Rollins Sandstone member within Gunnison County. The Mesa Verde Group is a marine and non-marine transitional sequence resulting from various transgressions and regressions.
- Cretaceous Mancos Formation: Gray shale with minor silt layers deposited in a marine environment.
-

Deposition of the Mancos Formation was followed by the complex transitional environment which resulted in the deposition of the several members of the Mesa Verde Group. Following the ultimate regression of the marine environment, the Wasatch Formation was deposited as part of the fluvial and lacustrine environment. Current erosion of the area has resulted in the topography of the area, but no additional alluvial deposits have been recognized or described.

Locally, subsurface geologic conditions were observed in borings that were installed in the vicinity of the two proposed pits and are described in this section. All borings were drilled using auger rig methods. Soil samples were collected for geotechnical analyses and where encountered, groundwater samples were obtained and analyzed for constituents detailed in the COGCC 910-1 Table COCs. Alluvial soil conditions were observed during the drilling of geotechnical borings and ranged from depths of 7 feet (BH-13) below ground surface (bgs) to 43 feet bgs (BH-1 and BH-2). All boring logs are presented within the geotechnical report (Attachment E, Geotechnical Report).

908.b.(7).A.iv No apparent geological hazards were observed or encountered that may affect the design and operation of the facility according to the geotechnical report (Attachment E, Geotechnical Report). An excerpt from the geotechnical report discussing geologic hazards is presented below.

> *The subject site is located on a bench in the northeast corner of Sheep Park. House Bill 1041 as passed by the Colorado State Legislature in 1974 was to designate geologic hazards that, if present, may pose a threat to life or property. Geologic hazards, outlined by House Bill 1041, are discussed below.*

1. Radioactivity

At the time of the investigation, no evidence of naturally occurring radioactive minerals were observed. In addition, no evidence of uranium mill tailings or other radioactive materials was observed. As a result, radiation hazards are not anticipated to adversely impact the proposed construction.

2. Faulting/Earthquakes

Based upon information from the Colorado Geological Survey (CGS), there are no significant faults in the vicinity of the site. In addition, the nearest significant earthquake event was the Montrose/Basalt quake in 1944, approximately 6.5 miles southwest of the site, which measured VI on the Modified Mercalli scale. Other small earthquakes reported by the CGS occurred approximately 5 miles to the northeast, 5.5 miles to the east, and 8.0 miles to the southeast of the site. These ranged from Richter magnitude 2.7 to 3.1. Also, numerous quakes have been reported in the vicinity of Somerset, approximately 10 miles south of the site. However, most of these are reported to be associated with coal mining activities. As a result, faults are not anticipated to adversely impact the proposed construction.

The CGS seismic hazard map of Colorado indicates that the site lies in an area where the anticipated PGA with a 2% chance of occurrence in 50 years is between 0.16 and 0.18g. Assuming any structures are designed using the above seismic coefficients, as necessary, seismic hazards are not anticipated to adversely impact the proposed construction.

3. Ground Subsidence

At the time of the investigation, no evidence of mine workings, karst topography, or other ground subsidence hazards were observed. The native clay soils were shown to be slightly collapsible; however, the magnitude of collapse measured in the laboratory was low and this is not anticipated to adversely impact the proposed construction.

4. Landslides

The site is not mapped as a landslide area. In addition, no evidence of mass earth movements was observed at the time of the investigation. As a result, landslides are not anticipated to adversely impact the proposed construction.

5. Avalanches

As indicated on Figure 1 of Attachment E, Geotechnical Report, the Geotechnical Report, the terrain rises gently to moderately to the east for some distance to the base of Sheep Mountain where steeper slopes are present. However, no evidence of avalanche chutes or other past avalanche activity was observed. In general, avalanches are not anticipated to adversely impact the proposed construction.

6. Rockfall

At the time of the investigation, no bedrock outcrops or talus slopes were observed above the site that could impact the site. As a result, rockfall is not anticipated to adversely impact the proposed construction.

7. Flooding

As discussed previously, the site is located on a terrace above Sheep Creek. In addition, Figure 1 of Attachment E, Geotechnical Report, shows drainages north and south of the terrace. A small drainage channel ran through the site; however, the tributary area to this drainage is small. In general, with proper realignment of the drainage channel running through the site, flooding is not anticipated to adversely impact the proposed construction.

8. Mudflows and/or Debris Fans

At the time of the investigation, no evidence of mudflows or debris fans were observed in the immediate vicinity of the site. As a result, mudflows and/or debris fans are not anticipated to adversely impact the proposed construction.

9. Expansive Soils and Rock

As discussed previously, the native clay soils are moderately plastic and are anticipated to be slightly expansive when compacted and introduced to excess moisture. In addition, the

native shale bedrock was indicated to be slightly expansive. In general, for the proposed construction of water storage ponds, expansive soils and bedrock are not anticipated to adversely impact the construction.

10. Slopes

As discussed previously, moderate slopes were present along the edges of the terrace that comprises the site. However, no evidence of slope instability was observed. In general, the stability of existing slopes is not anticipated to adversely impact the proposed construction.

Based on our site visit and review, it is our opinion, with proper civil, structural and geotechnical engineering design, no geologic hazards were identified which would preclude development of the subject site.

908.b.(7).B Hydrologic Data

A discussion on the hydrologic data of the area surrounding the proposed SWSF is presented in the following subsections.

908.b.(7).B.i A map of surface water features within two (2) miles of the subject location is shown on the Hydrology & Surface Water Map (Figure 2) included in Attachment A, Site Maps. As shown, the proposed SWSF is approximately 2.7 miles from West Muddy Creek up Sheep Creek, a seasonal tributary. Sheep Creek to West Muddy Creek would be the flow path of any discharge from the SWSF. This seasonal tributary to the West Muddy Creek drainage is primarily dry throughout the year, with the exception of spring runoff and storm events and is not a part of any headwater system in the vicinity of the proposed facility. SWSF is located in Sheep Park, a basin that discharges through Sheep Creek. In the basin, there are approximately 13 stock ponds of which 4 are hydraulically down gradient from the HWSF. Within two miles, but outside the Sheep Park basin are West Muddy Creek to the west, Little Henderson Creek to the north, Aspen Leaf Reservoir to the east and Ault Reservoir to the southeast.

There are no surface waters subject to COGCC Rule 317B in the vicinity of the proposed location.
908.b.(7).B.ii An unnamed alluvial aquifer is nearest to the surface in the vicinity of the Spadafora Water Storage Facility.

Water elevation measurements conducted in the area indicate groundwater depths in this shallow alluvial aquifer range from 10 to 36-feet on the northern portion of the SWSF proper (up on the ridge) to 12 – 17 feet in the drainage portions of the valley. No major groundwater aquifer was encountered during this investigation. The groundwater observed in the borings is defined as discontinuous and variable in elevation. As seen in a domestic well ½ mile southwest of SWSF and at approximately the same elevation, the deeper aquifer is 160 to 450 ft bgs (Colorado Department of Water Resources Well Permit 250836).

908.b.(7).B.iii According to Colorado Oil and Gas Information System (COGIS) Well database and the Department of Natural Resources Oil and Gas Well Locations database, a permit has been issued for 1 O&G well located within a 1-mile radius of the site; however, well construction has not been verified. A list of the wells permits issued within a 1-mile radius of the site is presented in Table 1 in Attachment I, Data Tables. Of the 2 well permits issued, one is domestic and 1 is an oil and gas producing/injection wells (Attachment A, Site Maps, Figure 1). Prior to facility operation, verification of all well constructions will be completed. All verified wells within the 1-mile radius will be included with the shallow groundwater monitoring program for the facility. The shallow groundwater monitoring network will be sampled annually to monitor for potential

impacts, if any, associated with the facility. The shallow groundwater monitoring network and associated constituent list for laboratory analysis of samples is presented in the Sampling and Analysis Plan which is included as an appendix to the Operating Plan (See section 908.b.(8)).

908.b.(7).B.iv A map posting the measured and corrected depths of groundwater encountered at the site has been prepared from groundwater measurements collected from borings in October 2013 and is included in Attachment K, Potentiometric Surface Map. The initial groundwater measurement data was collected from 8 borings (BH-1 – BH-8). The five remaining boreholes (13 in all), were observed dry. All of these borings, with the exception of five that had temporary observation wells installed were subsequently abandoned. As this groundwater condition does not indicate a true water table system, no contours are shown indicating flow direction. Prior to facility operation five site-specific monitoring wells will be installed.

908.b.(7).B.v The proposed SWSF is approximately 7.2 miles from West Muddy Creek. The Hydrology & Surface Water Feature Map (Figure 2) demonstrates that the facility would be outside the floodplain boundaries for West Muddy Creek and is outside the 150 foot setback for the seasonal tributary, Sheep Creek. There are no surface waters subject to COGCC Rule 317B in the vicinity of the proposed location.

908.b.(7).B.vi A shallow groundwater sample was collected from one of the five cased borings installed in October 2013. Laboratory results from this sample were evaluated to determine shallow groundwater baseline conditions for the parameters listed in COGCC Rule 908.b.(9).A. The evaluation of this data indicated no detections reported above the Table 910-1 MCLs, where applicable.

The sample results evaluated will serve as the baseline levels for comparison for subsequent sampling events. A summary of the waste stream laboratory analytical data is presented in Table 3 in Attachment I, Data Tables.

Prior to facility operation, borings BH-1, BH-2, BH-3, BH-4 and BH-8 will be abandoned and five site-specific monitoring wells will be installed. These five new wells, along with the associated stock ponds (three in all), will comprise the site specific shallow groundwater monitoring network. Measurement of water levels and collection of samples from the site specific monitoring network will be conducted on a quarterly basis, barring special circumstances that warrant additional sampling (e.g., known leak in the primary liner), to monitor for potential impacts, if any, associated with the facility. Groundwater samples collected from the site specific monitoring well network will initially be analyzed for the parameters listed in COGCC Rule 908.b.(9).A; however, after the initial two to four quarters of sampling, the site specific monitoring well network samples will be analyzed solely for parameters listed in Table 910-1. The site specific shallow groundwater monitoring network and associated constituent list for laboratory analysis of samples is presented in the Sampling and Analysis Plan which is included as an appendix to the Operating Plan (See section 908.b.(8)).

All verified wells within the 1-mile radius of the site will be included in the annual shallow groundwater monitoring program for the facility. The shallow groundwater monitoring network will be sampled annually to monitor for potential impacts, if any, associated with the facility. The shallow groundwater monitoring network and associated constituent list for laboratory analysis of samples is presented in the Sampling and Analysis Plan which is included as an appendix to the Operating Plan (See section 908.b.(8)).

908.b.(7).B.vii The potential for impacts to nearby surface water features is considered low based upon engineering controls to be implemented at the site and design aspects of the storage pits

intended to prevent and/or mitigate impacts of potential releases such as level alarms and double liner geonet system. In addition, a monitoring network of three surface water stations placed in locations up-gradient and down-gradient of the facility along West Muddy Creek and Muddy Creek, along with stock ponds SW-1, SW-2 and SW-3 located adjacent to the site, will be sampled annually to monitor for potential impacts, if any, associated with the facility. The surface water monitoring network and associated constituent list for laboratory analysis of samples is presented in the Sampling and Analysis Plan which is included as an appendix to the Operating Plan (See section 908.b.(8)).

Engineering controls to be implemented to aid in monitoring and mitigating potential impacts to surface and groundwater included high level alarms, double liners (60-mil high density polyethylene [HDPE] fabric) separated by a synthetic drainage layer material (such as Geonet®), a sump collection system, and site specific monitoring wells. There are multiple dedicated surface monitoring stations within a two mile radius upgradient and downgradient of the site that collect surface water samples quarterly or after a major precipitation event that causes large amounts of runoff.

908.b.(7).C Facility Design and Engineering

The proposed produced water storage pits will be located within a 40 acre leased parcel. GELLC plans to increase their water storage capacity to 652,635 barrels within three earthen basins ("pits"). The north pit will have a capacity of 210,717 barrels, the middle pit will have a 226,618 barrel capacity, and the south pit will have a capacity of 215,299 barrels. The new pits include yard piping and associated electrical and monitoring components. All proposed piping and instrumentation for the water storage facility are shown and detailed in the engineering drawings and specifications (Attachment F, Engineering Package).

The pits were designed based on the following data and criteria:

- Maximum pond volume = 652,635 barrels (total)
- Maximum embankment height = 10 feet
- Embankment (berm) top width = 20 feet
- Side slopes = 3 (horizontal) to 1 vertical (See geotechnical report in Attachment E, Geotechnical Report)
- Free board = 2 feet (per Article 902 b)
- Computed jurisdictional dam height per Colorado Dam Safety Regulations:
    - North pit = 9.76 feet maximum
    - Middle pit = 9.95 feet maximum
    - South pit = 8.56 feet maximum

Facility Description

Produced Water Pits:

The proposed pits are three surface impoundments with top-of-berm to top-of-berm dimensions of 480-foot long by 250-foot wide for the north pit, 340-foot long by 360-foot wide for the middle pit, and 360-foot long by 340-foot wide for the south pit. The pits will be approximately 20 feet deep at the deepest point. The side walls of the pits are sloped outward at 3:1 (horizontal to

vertical ratio). Earth berms surround the pits to provide vehicle access, free-board (two-foot minimum), and storm water run-on diversion. Run-on diversion channels include rock-lined V-shaped ditches to route storm water away from the pits.

The downhill containment berms of the pits are proposed to be constructed in fill and will thus be constructed using the toe key and bench method. To construct the berms using the toe key and bench method the toe key (located at the downhill toe of the fill slope) will be excavated to a minimum of 5 feet deep and 15 feet wide into competent foundation material. The foundation of the fill slopes will then be benched upslope from the toe key with 5 feet bench heights and key lengths a minimum of 5 times the toe key depth, for the length of the fill slope. A detail of the toe key and bench concept is presented in the geotechnical report (Attachment E, Geotechnical Report). Competent foundation materials, as defined by the geotechnical report, is material that "consists of natural undisturbed soils containing no appreciable organic or deleterious material, no soft or yielding soils and below the influence of frost action". The presence of competent foundation material will be verified by Huddleson Berry Engineering and Testing, Inc. during construction.

Power:

Power: Electrical utilities will be installed to provide power to transfer pumps and electrical controls. At this time, specific requirements for power are unknown. The power will be sufficient for opening and closing electronic actuated valves to operate the facility and to run the facility's continuous SCADA system. It is anticipated that electrical power will be supplied from two generators located at the SWSF providing redundant power supply. A battery backup will also be provided to temporarily maintain operations of the SCADA system in the event of losing the generator power supply.

Interconnecting Pipelines and Underground Injection Control:

Planned interconnecting pipelines needed to service the proposed SWSF include the following*:*

- Piping to transfer water between the pits.
- Piping to convey water to transfer water to existing water conveyance pipe.

The pipe will be 6-inch Steel Schedule 80, which allows for high operating pressures up to approximately 1,900 psi even though most operations will only require 500-700 psi. The additional thickness and strength will ensure that the pipe services the facilities throughout their expected lifespan. Cathodic protection will also be provided to lengthen the lifespan of the pipe. The installation of the 6-inch steel pipe will require a crossing of a private access road.

Instrument and Controls/Remote Monitoring Systems:

The proposed SWSF will be equipped with instrumentation and controls to provide operational security and safety as follows:

- The pits will have high level control and alarm instruments to prevent overfilling and accidental release of pit water. An on-site programmable logic controller will be installed in the electrical control panels to provide automatic shutdown of pumping systems at high-high level, high-level, low-level alarm conditions.
    - Water volumes piped to and from the pits will be monitored with flow meters and pressure gauges to document pumping rates and system pressures.

- Liner leaks will be monitored via an electronic detection probe installed in the leak detection sump. In the event of a leak, a signal will be sent to the main control panel indicating the sump has detected water. A submersible pump controlled by the level sensor will be utilized to remove liquid from the sump and return it to the pond.

- Pressure transducers will be incorporated into the pond to provide information on the water level in each pond and monitor and detect leaks that may have gone undetected in the liner leak detection system.

Groundwater Monitoring and Control:

The proposed SWSF will utilize site-specific groundwater monitoring wells to assist in enhancing the leak detection system for the pits. As shown on the engineering drawings (Attachment F, Engineering Package), monitoring wells are proposed at the facility, one well upgradient of the three pits (MW-1) to provide background water quality and four monitoring wells downgradient of the three pits (MW-2, MW-3, MW-4, and MW-5) to monitor groundwater quality down gradient of the pits.

Currently groundwater beneath the proposed Spadafora Water Storage Facility is being defined as discontinuous in nature and being further evaluated as to its impact on construction and long term operation of the pits. A French-drain system has been incorporated into the overall design of the pits to direct any groundwater that occurs beneath the pits to a drain system that will be located under the facility and discharge to the north and south of the pits. During the initial geotechnical study, limited groundwater was observed in fractures or small water producing lenses as groundwater was observed at limited locations. At this time it is unclear if the water encountered warrants any type of drainage control. If analysis of data indicates the potential need of a drainage system, it will be communicated to the COGCC. The French drain design for the SWSF is included in the final design drawing package.

908.b.(7).C.i Equipment used to transfer water to and from the pits will include pumps, isolation valves, piping, instrumentation, and electrical components.

The pits will be contained with two layers of 60-mil high density polyethylene (HDPE) membrane separated by a synthetic drainage layer material (such as Geonet®) for leak detection. The liner system will overlie a 12 ounce fabric placed on a prepared subgrade material with a hydraulic conductivity of no greater than 1.0 x 10-7 centimeters per second (cm/s). The leak detection system will be installed between the liners in a manner that will allow leakage to drain to a collection sump. The sump will be constructed in a manner to allow removal of any accumulated liquids that passes through the primary liner so that hydraulic heads on the secondary liner are kept to a minimum. Installation of the liner system will include double welded fusion seams that will be subject to quality control pressure and integrity testing.

Approximate quantity of liner materials, along with other material quantities, are presented on the engineering drawings (Attachment F, Engineering Package).

A liner anchor trench detail is provided in the engineering drawings (Attachment F, Engineering Package). The detail shown is a typical detail that has been successfully used for many liner applications such as leaching ponds, retention ponds, landfill applications, waste water treatment facilities, etc. and is more than adequate for the proposed application. As part of the submittal

process, the proposed liner and anchor trench will be reviewed and approved by the Engineer prior to construction.

Huddleston-Berry Engineering and Testing, LLC, Inc. conducted a slope stability analysis for the proposed facility. The scenarios modeled included the pond overburden at 3 to 1, the pond lower shale layer a 2 to 1, and the full section of overburden over shale. The results of the stability analysis indicated a calculated factors of safety against slope movement of > 1.49, >2.40, and >2.20 respectively. The analysis utilized the graphical computer program GSTABL 7, by GREGORY GEOTECHNICAL SOFTWARE**,** and the Modified Bishop Method of slices. The slope stability report is provided in Attachment G, Engineering Calculations.

908.b.(7).C.ii Locations and depths of cuts for liners are presented on the engineering drawings (Attachment F, Engineering Package).

908.b.(7).C.iii Locations, dimensions, and grades of all surface water diversion structures are presented on the engineering drawings (Attachment F, Engineering Package).

Pit containment berms proposed to be constructed in fill will be constructed using the toe key and bench method previously described. All fill slopes will be moisture conditioned to within 2 percent of the optimum moisture content and compacted to 95 percent of the maximum standard proctor (ASTM D 698) dry density. Berms constructed in cut will be cut and conditioned and compacted per the specifications (Attachment F, Engineering Package). Compaction of earthen structures will be accomplished with a sheepsfoot roller, or similar, to ensure dispersed soil compaction to the tolerances specified. To achieve surface stabilization, all exposed soil surfaces will be permanently seeded. To ensure proper construction and enable design changes in the event that encountered subsurface conditions differ from anticipated,

The Colorado Division of Water Resources (DWR) Office of the State Engineer Dam Safety Branch is evaluating the engineering drawings and all proposed structures insure they are in compliance with the 2 CCR 402-1 Rules and Regulations for Dam Safety and Dam Construction for a “Non-jurisdictional Size Dam”. Per 2 CCR 402-1, Rule 11, a ‘Notice of Intent to Construct a Non-Jurisdictional Water Impoundment Structure’ has been submitted to the DWR.

There will be no work in navigable waters of the United States, or dumping or placing of dredged or fill material in navigable waters of the United States, therefore no Army Corps of Engineer’s 404 permits are required for the proposed facility.

908.b.(7).C.iv A hydrologic study of the drainage basin up-gradient of the location was completed and a copy of the hydrologic study report is provided as Attachment G, Engineering Calculations. The resulting peak flow at the location is approximately 3 cfs per three-acre sub-basin for a 100-year storm event. The facility would be graded as shown in the engineering drawings (Attachment F, Engineering Package) to divert onsite runoff away from the pits wherever possible.

Armored surface water diversion channels will be constructed to intercept runon stormwater and divert it around and away from the pits. The channels are designed to run along the perimeters of the pits and transmit and discharge stormwater flows to the seasonal tributary Sheep Creek. Where the diversion channels intersect the proposed pit access roads, culverts will be installed to transmit flows under the roads. The diversion channels were sized based off of expected water volumes for a 100-year 24-hour storm event. The channels are proposed to be approximately 12 feet wide and 3 feet deep (typical) with a 1 foot deep erosion protection layer (i.e. rip-rap) underlined by a 12 ounce geotextile fabric lining the bottom of the channel. The maximum water

depth during a 100-year storm would range from 0.6 feet deep at grade, allowing for a typical freeboard of 1.0 feet, minimum. All diversion channels will require periodic inspections to ensure they are working properly and any major sediment deposits or buildup will need to be removed.
Two sedimentation ponds will be constructed on the west side of the facility. The sedimentation ponds have been designed to contain the water from a 25-year 24-hour storm. Sizing for the sedimentation ponds was based on results of the hydrologic study. The proposed sedimentation pond for the southern half of the site will contain a volume of 0.87 Acre-Feet and the sedimentation pond for the northern half of the site (sub-basin B) will contain a volume of 0.84 Acre-Feet. Calculations for the sedimentation ponds are presented in Attachment G, Engineering Calculations. Periodically the base of the sedimentation pond will need to be scraped or regraded and all collected sediment will need to be removed to maintain adequate containment volume.

Locations and dimensions of all surface water containment structures are presented on the engineering drawings (Attachment F, Engineering Package).
908.b.(7).C.iv Locations of all proposed facility structures and site access roads are presented on the engineering drawings (Attachment F, Engineering Package). All new access roads will tie-in to the existing private road to the south of the proposed facility.

908.b.(8) Operating Plan

A preliminary Operation Plan is presented in Attachment L, Operation Plan.

908.b.(9).A Wells Within a 1-Mile Radius

According to Colorado Oil and Gas Information System (COGIS) Well database and the Department of Natural Resources Oil and Gas Well Locations database, a permit has been issued for 1 O&G well located within a 1-mile radius of the site; however, well construction has not been verified. A list of the wells permits issued within a 1-mile radius of the site is presented in Table 1 in Attachment I, Data Tables. Of the 2 well permits issued, one is domestic and 1 is an oil and gas producing/injection wells (Attachment A, Site Maps, Figure 1). Prior to facility operation, verification of all well constructions will be completed. All verified wells within the 1-mile radius will be included with the shallow groundwater monitoring program for the facility. The shallow groundwater monitoring network will be sampled annually to monitor for potential impacts, if any, associated with the facility. The shallow groundwater monitoring network and associated constituent list for laboratory analysis of samples is presented in the Sampling and Analysis Plan which is included as an appendix to the Operating Plan (See section 908.b.(8)).

908.b.(9).B Site Specific Monitoring Wells

Site-specific monitoring wells are proposed to be installed at the facility. A minimum of five monitoring wells are proposed at the facility to assist in enhancing the leak detection system for the pits. One well will be installed upgradient of the North pit to provide background water quality, one well will be installed west of each of the North, Middle and South pits to monitor water quality downgradient of the facility, and one monitoring well will be installed upgradient of the Middle pit to monitor groundwater quality upgradient of all three pits. Each well location will positioned in such a fashion that they are placed in line with the presumed groundwater flow direction which is east to southeast. Each monitoring well will be sampled on a routine basis, to be determined, but at a minimum samples will be collected once per quarter for the constituents presented in COGCC Table 910-1.

908.b.(10) Surface Water Monitoring

A review of historic surface water sample results collected by GELLC from various permanent sampling stations in Sections 8 and 20 along West Muddy Creek and Muddy Creek was

conducted to determine baseline surface water conditions. In addition, five surface water samples were collected from nearby stock ponds and analyzed for the constituents listed in COGCC Table 910-1 for use in the surface water baseline evaluation. Of the laboratory data reviewed for surface water samples, no reported exceedances of COGCC Table 910-1 MCLs were reported. Laboratory results of the surface water samples evaluated is presented in Table 4 in Attachment I. All referenced surface water monitoring locations are shown on the Hydrology & Surface Water Feature Map (Figure 2) in Attachment A, Site Maps.

Once in operation, a monitoring network of three surface water stations placed in locations up-gradient and down-gradient of the facility along West Muddy Creek and Muddy Creek, along with three of the Spadafora Stock Ponds located adjacent to the site, will be sampled annually to monitor for potential impacts, if any, associated with the facility. The surface water monitoring network and associated constituent list for laboratory analysis of samples is presented in the Sampling and Analysis Plan which is included as an appendix to the Operating Plan (See section 908.b.(8)).

908.b.(11). Contingency Plan

A contingency plan (Emergency Response Plan) for the facility is included in the Operation Plan (Attachment L, Operation Plan).

908.c. Permit Approval

Not applicable to submission.

908.d. Financial Assurance

An estimated cost of reclamation, closure and abandonment for the proposed SWSF is provided within the *Closure/Reclamation Plan* included in this application as Attachment B, Closure Reclamation Plan. Financial Assurance will be provided to the COGCC. Additional financial assurance for the proper reclamation, closure and abandonment of the facility will be provided as requested by the COGCC.

908.e&f. Facility Modifications and Annual Permit Review

GELLC shall submit any proposed modifications to the facility design, operating plan or permit conditions to the Director, via a Form 4 Sundry Notice, for approval prior to implementing any substantial change. An annual report summarizing operations, including the types and volumes of waste handled by the facility would be provided to the Director on the anniversary of permit approval each year to ensure compliance with permit conditions. A final Operating Plan would be provided when complete and prior to start up and operations of the facility.

908.g. Closure/Reclamation Plan

The Closure/Reclamation Plan for the proposed SWSF is presented in Attachment B, Closure Reclamation Plan.

908.h. Adherence to Local Requirements

This facility will operate within the guidelines of the COGCC and Gunnison County oil and gas regulations. At the time of submitting this application, GELLC has notified appropriate agencies (Local, State, Federal) and submitted the necessary permits applications for preliminary approval. The following notifications and permit applications, and any associated agency responses, or

documentation stating acceptance, have been or will be submitted and are submitted or approved applications are presented in Attachment M, Permit Applications and Notifications:

Permit Applications

- Application Submittal for Oil and Gas Permits for Gunnison County to comply with the *Gunnison County Temporary Regulations for Oil and Gas Operation*.
- Pending Colorado Department of Public Health and the Environment, Oil and Gas Industry Construction Permit Application, Form APCD-100, Air Pollutant Emission Notice (APEN)

Notifications

- CDPHE – GELLC requested amendment to Stormwater Discharge Permit No. COR-035685
- Colorado State Engineer's Office, Dam Safety Branch, Notice of Intent to Construct and Non-Jurisdictional Water Impoundment Structure – Accepts with no objections

There will be no work in navigable waters of the United States, or dumping or placing of dredged or fill material in navigable waters of the United States, therefore no Army Corps of Engineers 404 permits are required for the proposed facility.

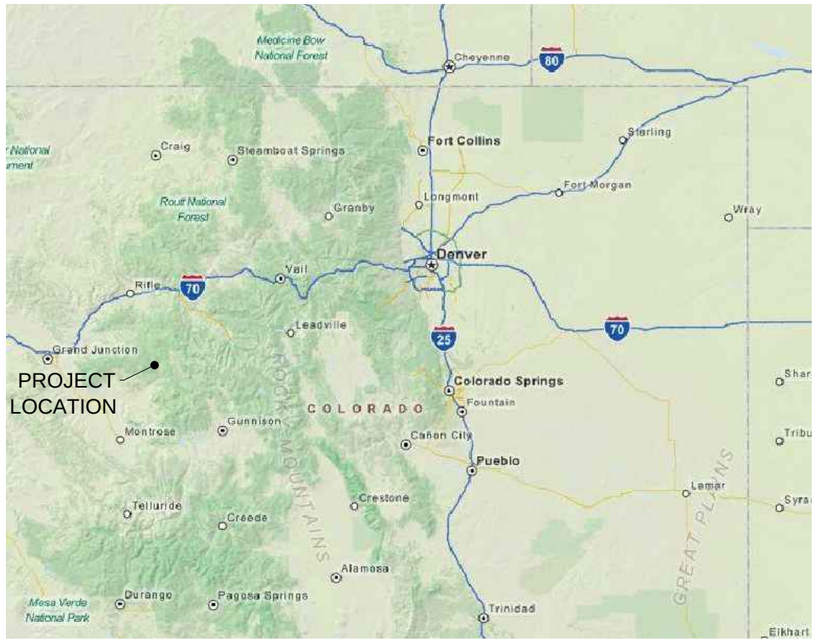
Outstanding Permits and or Notifications

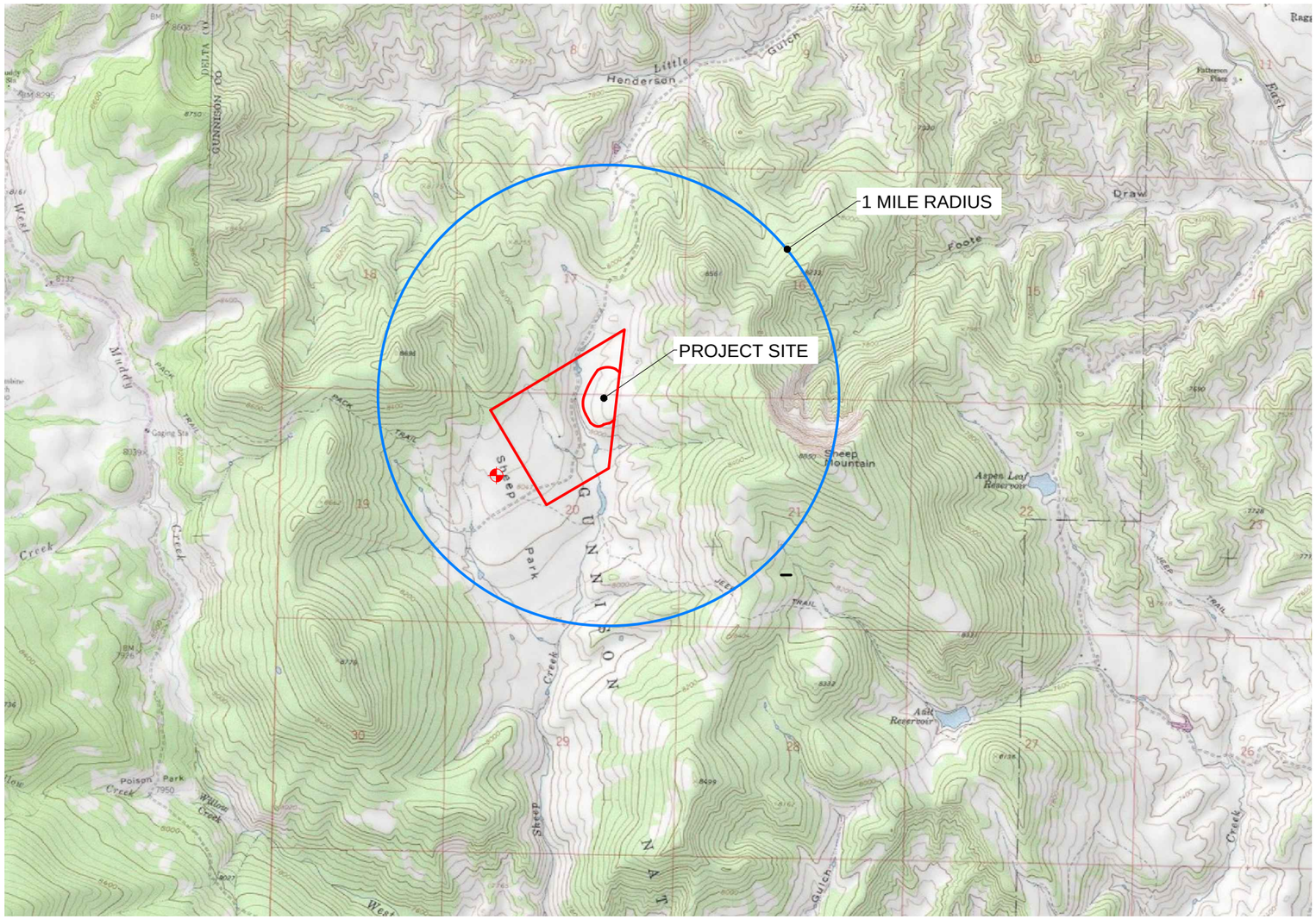
Zoning for land development in unincorporated Gunnison County is governed by a "performance-based" land use regulation, meaning that proposed land use is evaluated on the ability to mitigate the potential impacts of development resulting from the location, design, infrastructure requirements and resource protection standards defined in the *Gunnison County Land Use Resolution*. The proposed Spadafora Produced Water Management Facility is designed and will be constructed in adherence with the *Gunnison County Land Use Resolution* requirements. Prior to start of construction a Reclamation Permit will be obtained from Gunnison County to comply with the grading and erosion control requirement per Section 13-116 of the *Gunnison County Land Use Resolution* and a copy of the approved permits and or notifications will be submitted to the COGCC.

Additional permits anticipated for the facility that will be submitted to the COGCC as they are received include:

- CDPHE Colorado Discharge Permit System - Stormwater Discharges Associated with Construction Activities

ATTACHMENT A
SITE MAPS





LEGEND

- 1 MILE RADIUS
- PROPERTY BOUNDARY
- AREA WELLS

WELL DATA SOURCE:
COLORADO DIVISION OF WATER RESOURCES

0 1500' 3000'

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
PRE-APPLICATION SUBMITTAL

GUNNISON COUNTY COLORADO

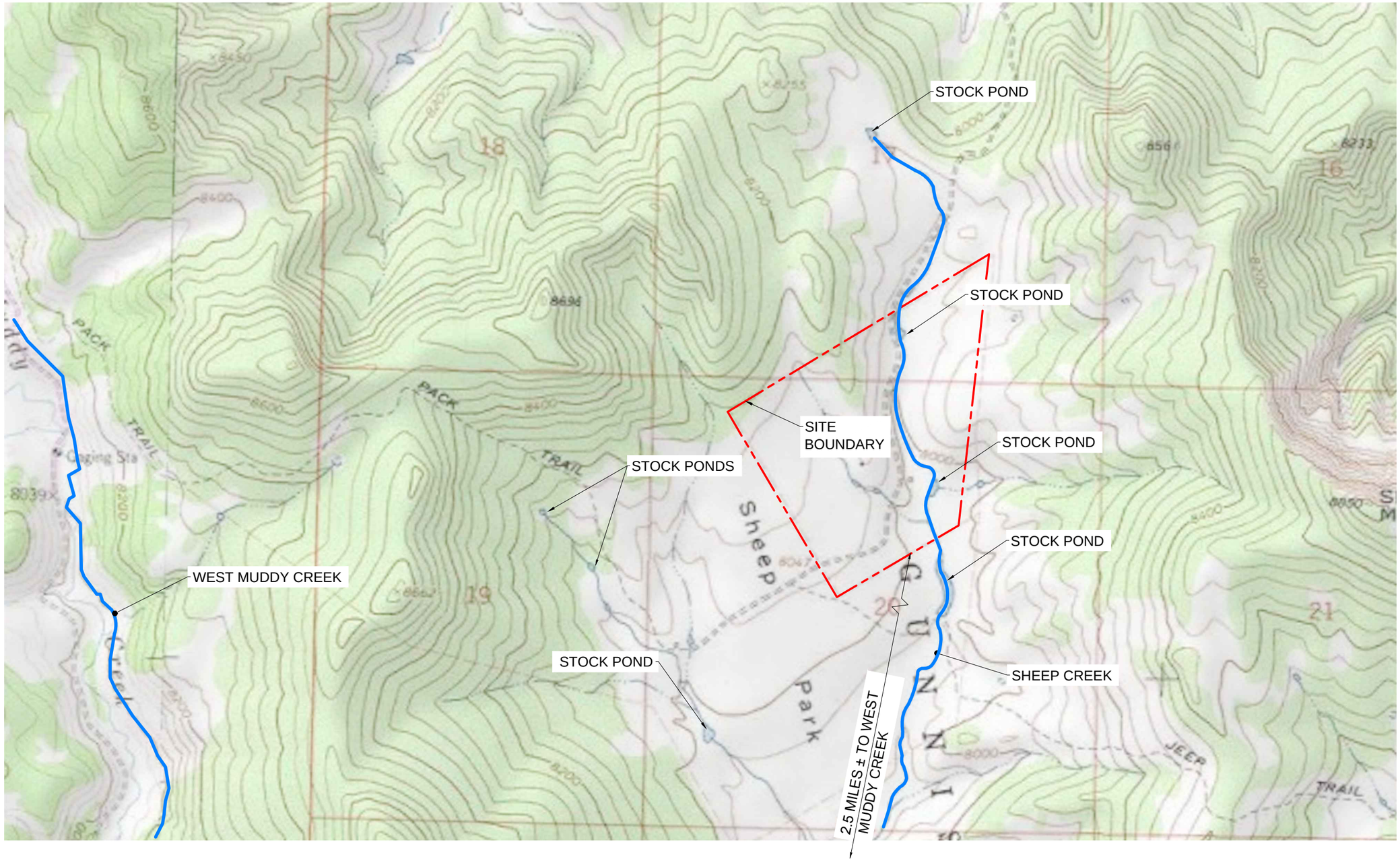
LAKEWOOD COLORADO

CHECKED	DG	22JUL14	CLIENT APPROVALS	DATE
DES. ENG.	DG	22JUL14		
PROJ. ENG.	DG	22JUL14		
PROJ. MGR.	DG	22JUL14		
APPROVED				
APPROVED				

VICINITY MAP
PLANNED SPADAFORA WATER STORAGE PITS

DRAWN	DATE	DWG. NO.	REV. NO.
CLP	22 SEPT 14	C1	A
SCALE	W.O. NO.	SHT. 1 OF 3	
	14798.001.001		

C:\Users\jvenes\Desktop\Active\40%\LOCATION3.dwg October 29, 2014 - 2:27pm



LEGEND

PROPERTY BOUNDARY

0 600' 1200'

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
PRE-APPLICATION SUBMITTAL

GUNNISON COUNTY COLORADO

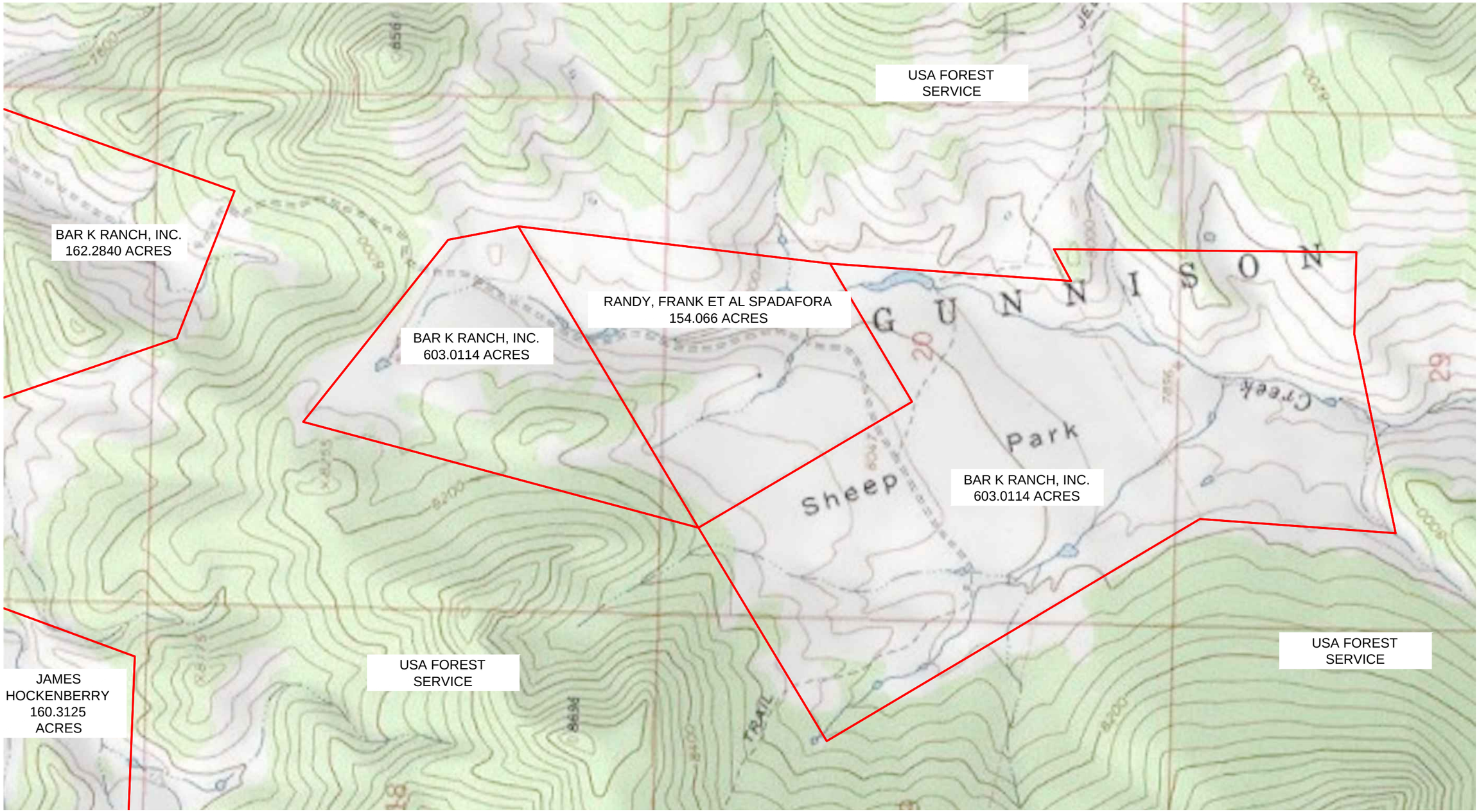
LAKEWOOD COLORADO

		DATE	CLIENT APPROVALS	DATE
CHECKED	DG	22JUL14		
DES. ENG.	DG	22JUL14		
PROJ. ENG.	DG	22JUL14		
PROJ. MGR.	DG	22JUL14		
APPROVED				
APPROVED				

HYDROLOGY AND SURFACE WATER MAP

DRAWN	DATE	DWG. NO.	REV. NO.
CLP	22 SEPT 14		A
SCALE	W.O. NO.	SHT. 1 OF	
	14798.001.001		

C:\Users\jdeccec\Spatial\ora40\LOCATION3.dwg September 24, 2014 - 5:44pm



LEGEND

PROPERTY BOUNDARY

0 500' 1000'

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
PRE-APPLICATION SUBMITTAL

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	22JUL14	CLIENT APPROVALS	DATE
DES. ENG.	DG	22JUL14		
PROJ. ENG.	DG	22JUL14		
PROJ. MGR.	DG	22JUL14		
APPROVED				
APPROVED				

PROPERTY OWNERS MAP
PLANNED SPADAFORA
WATER STORAGE PITS

DRAWN: CLP	DATE: 22 SEPT 14	DWG. NO.	REV. NO. A
SCALE	W.O. NO.: 14798.001.001	SHT. 1 OF 3	

C:\Users\pierce\Spadafora\Arcmap\LOCATION3.mxd September 23, 2014 - 4:25:pm

ATTACHMENT B
CLOSURE RECLAMATION PLAN

1 Interim Reclamation

Interim reclamation work will begin as soon as practicable throughout phases of construction and will be fully implemented at the completion of construction of the facility. Areas disturbed during construction including cut and fill slopes, access roads, and equipment lay-down areas will be graded to eliminate abrupt angular or linear transitions and tracked to prevent erosion. Where required to establish seed growth during re-vegetation of bare soil, topsoil will be placed over the finished grade.

The topsoil will be seeded and mulched using methods suitable for proper germination and establishment. For example, on slopes that are greater than three percent, the seed bed will be imprinted by methods including drilled holes, tracking, or furrows to improve seed and moisture retention. The seed mix will be the Gunnison Energy mix given in the SWMP.

Temporary stormwater controls; such as armored drains, sediment ponds, straw wattles, and/or silt fence will be placed at the appropriate locations around the job site to prevent erosion and sediment transport. Soil from the pit excavation stockpiled as a access pad for the pits will have side slopes prepared and seeded and the top of the access pad will be treated as a road surface. This stockpile will preserve the soils for use in final closure and reclamation of the pits.

The reclamation work will be inspected every 14 days until such time as the vegetative cover is established sufficiently to prevent erosion. After vegetative cover establishment has occurred, stormwater inspections will continue monthly until the site has stabilized. Periodic stormwater, erosion and noxious weed inspections will take place over the life of the facility.

2 Pit Closure

The proposed Produced Water Management Facility will be in operation at this location for the productive life of the nearby production wells or until Gunnison Energy LLC (GE) determines that the facility is no longer necessary or until the facility becomes incapable of supporting operations. GE anticipates the useful operational life of the proposed facility to be 20 years.

The facility will undergo final reclamation within six months following cessation of permanent operations. Final closure will include removal of all mechanical and electrical equipment, removal and disposal of synthetic liners, filling and grading of the pits, and final reclamation.

Closure Sequence

Following cessation of permanent operations of the facility and upon decommissioning of the pits, the facility will be closed and reclaimed as outlined below:

- Stormwater and erosion control Best Management Practices (BMPs) will be installed prior to closure construction activities (per the NPDES general construction permit) and will remain in place until final stabilization occurs. The site will be monitored until final stabilization as described in Section 1.

- Water remaining in the pits and transmission piping will be removed and disposed of in accordance with the COGCC 900 Series rules;

- All equipment, structures, appurtenances and fencing will be disassembled and or demolished and removed from the site;

- Pit sediment will be removed and stockpiled for drying, testing, characterization and final disposal determination;

- The containment liners will be removed and recycled or otherwise disposed of at a permitted waste facility;

- The aggregate surfacing materials from access roads will be removed, stockpiled at an appropriate location, and re-used as surfacing material elsewhere or mixed with fill soil;

- Compacted soils will ripped and re-graded to the approximate pre-construction grades;

- After the pit liners have been removed, the compacted surfaces will be ripped to loosen the soil and to mix subgrade materials. The pit depressions will then be backfilled with stockpiled soil and soil the earth berms surrounding the pits. The backfill will occur in lifts that allow proper moistening and compaction, up to the pre-excavation grade.

- Topsoil that was stockpiled from initial excavation will be distributed across the pit area and seeded as described in Section 1;

All transmission piping to be decommissioned and demolished will be disconnected and tested prior to proper disposal or recycling at a permitted facility.

Any lubricants or other maintenance chemicals stored onsite will be relocated for other facility use, properly disposed, or recycled according to federal, state and local regulations.

Equipment and support structures will be hauled offsite for reuse elsewhere, or otherwise properly disposed of according to federal, state, and local regulations.

Following removal of the synthetic liner system, the underlying soil will be tested for the presence or absence of regulated contaminants. If testing indicates chemical contamination, the affected soil will be excavated, stockpiled, tested, and; either properly disposed of or treated onsite and reused as fill material.

Aggregate surfacing material will be removed and stockpiled for reuse or mixed with fill soil. The earthen containment berms will be bulldozed and stockpiled for use as fill material and the rest of the site will be ripped and de-compacted. Stockpiled and ripped soils will be redistributed over the site during reclamation activities.

Following demolition and de-compaction, the site will be graded to match original pre-construction grades and contours. Topsoil would then be evenly spread over the disturbed area and seeded with a native seed mix for final stabilization. Stormwater and erosion control BMPs will be implemented accordingly to reduce and control the volume of runoff as well as to prevent and sediment transport offsite during reclamation activities. All stormwater and erosion control BMPs will remain in place, as appropriate, until the site reaches final stabilization.

To verify compliance with WQCC standards, following facility closure groundwater samples will be collected from site monitoring wells within one mile of the site. Samples will also be collected from any nearby surface water bodies present at the time of closure.

Per COGCC 900 Rules, a Site Investigation and Remediation Workplan, Form 27, will be provided to the Director for approval at least sixty (60) days prior to closure. If it is determined that soils and or surface and ground water were detrimentally impacted by the facility, and the necessary remediation efforts will be implemented immediately. Implementation details for site remediation and emergency response procedures and contacts are included in the preliminary Operating Plan which is appended to this application as Appendix E.

3 Final Reclamation

Following the removal of all structures, appurtenances, equipment, and materials described above, final reclamation activities will be initiated. All final site reclamation activities will be conducted in accordance with COGCC 1000 Series Rules and Gunnison County Standards as well as any other state and local agency requirements. The site will be graded as near as possible to original contours following the ripping and de-compaction and any remaining stockpile will be evenly distributed over the disturbed area. Grading will match

pre-construction contours as close as practicable and or to contours desired for the future land use. The area will be seeded with native or adapted vegetation using an appropriate distribution method to that will provide proper establishment and soil stabilization.

The goal of the final site reclamation is to return the disturbed area to as close to pre-disturbance conditions as practical. Following all site reclamation activities, the site will be monitored for erosion caused by the elements as well as any weeds or uncharacteristic vegetation growth until the site reaches final stabilization levels.

Estimate of Probable Final Closure and Reclamation Cost
Gunnison Energy LLC
Spadafora Water Storage Facility
Estimate of Probable Pit Closure Cost

Table F-1. Pit Closure/Reclamation Estimate of Probable Cost

Item	Description	Quantity	Unit of Measure	Unit Cost	Amount
A.	**Construction Contractor Costs**				
1	Mobilization/Demobilization	2	Lump Sum	$16,900	$ 33,800
2	Remove & Dispose Pond Fluids	548,213	Gallons	$ 0.03	$15,400
3	Remove & Dispose Operating Equipment	40	Hours	$252.5	$ 10,100
4	Remove & Dispose Pond Liners	1,095,201	Square feet	$0.21	$228,200
5	Test Soils for Contamination	30	Borings	450.00	$13,500
6	Backfill & Compact Pits	432,295	Cubic yards	$4.94	$2,135,900
7	Site Restoration (Grading/Seeding)	20	Acres	$3,392.86	$66,500
8	Site Management	10	months	$11,560	$115,600
Subtotal - Construction					***$2,619,000***
B.	**Administrative and Engineering Costs**				
1	**Project Management Fee (5% of construction)**				**$130,950**
2	**Workplans, Engineering Design, and Bid Documents (15% of Construction)**				**$392,850**
3	**Contingency (20% of Construction Costs)**				**$523,800**
Total Estimate of Probable Closure Cost					**$3,666,600**

Notes:

1 Pond disposal assumes 90% of fluids are pumped to a future injection well. The remaining 10% is hauled.
2 Pond liners include two 60-mil HDPE and one geonet layer at 365,067 sf each
3 Restoration includes the fenced area at 750-ft x750-ft.
4 Assumes 548,213 gallons for fluids
5 Unit Costs have been rounded

The cost estimate is based on the following data, information, and assumptions:

- General Approach: The costs were developed based upon estimating the direct cost of labor, equipment, materials, and subcontractors and applied to quantity take-offs. Costs are based on calendar year 2010. Allowances for escalation due to economic factors are applied at two (2) percent per year.

- Labor Rates: Applicable labor rates are based on the Colorado Wage Decision per the U.S. Department of Labor for Gunnison County "Heavy Construction" effective September 2014. These rates include the base pay and fringe benefits. Allowances were added to the labor rates to for FICA/Medicare (7.65%), Workman's Compensation Insurance (12.85%), and contractor's liability insurance (1.5%).

- Equipment Rates: The equipment rates were developed from Equipment Watch Custom Cost Evaluator and include fuel, lubrications, and non-labor operating costs. Fuel cost is estimated at $3.34 per gallon.

- Where provided, production rates for pit liner removal, soil backfill, and site restoration are based on the R.S. Means Heavy Construction Cost Data (17th Edition). Pit liner removal is assumed to occur at the same production rate as installation.

- Mobilization/Demobilization Costs: Mobilization and demobilization travel is assumed to be to and from Denver, Colorado.

- Disposal Costs: All disposal costs are assumed to include transportation and tipping fees based on a permitted facility near Denver, Colorado.

- Pre-closure operation of the pits will divert fluids from the pits such that at the time of closure 2% of the fluids will be remaining.

- Miscellaneous Unit Costs: Miscellaneous unit costs were obtained from R.S. Means New Mexico Heavy Construction Cost Data.

- Soil Material Swell: Volumes of bank cut soil were increased by 20 percent to account for bulking or swell.

- Site Management: Site Management was estimated separately to support construction for the duration of the

closure/restoration work. Labor includes a full-time superintendent, construction clerk, field engineer, quality control engineer, laborer, and heavy equipment mechanic. Support equipment includes a four wheel drive crew-cab pickup, water truck, motor grader, and mechanics truck with portable welder. Support facilities include an office trailer, portable toilets, fueling area, and erosion control supplies.

- Re-vegetation Unit Costs: The revegetation unit cost is based on quotes in similar estimates provided by Rocky Mountain Reclamation.

- Indirect Cost Allowances: Indirect cost allowances were applied to the construction contractor's direct costs as follows: Contingency (10.0%), Payment and Performance Bond (1.5%), and Contractor Profit and Overhead (15.0%). Contractor overhead includes home office salaried and clerical personal, shop and facilities, fees and Insurance (except those applicable to labor and equipment), training, and quality assurance/quality control.

- Administrative and Engineering Cost Allowances: Project Management Fee (5.0%), engineering for final reclamation work plans, design, and preparation of bid documents (15.0%).

- State and local taxes were excluded.

ATTACHMENT C
WILDLIFE HABITAT SURVEY

Monarch & Associates Ecological Consultants
18482 Eastridge Road · Cedaredge, Colorado 81413 · Phone & FAX (970) 856-7819

August 28, 2014

Lee Fyock
Gunnison Energy Corporation
1801 Broadway, Suite 1200
Denver, CO 80302

Via email

Re: Habitat and wildlife report for the proposed Sapadafora Water Storage Facility

Dear Lee,

At your request, I completed habitat and wildlife surveys for the proposed Spadafora Water Storage Facility and access road. Information gathered during a survey conducted on August 25, 2014 and prior surveys in the general area, is included in this report.

INTRODUCTION

This report presents findings from a habitat and wildlife survey conducted on August 25, 2014. In addition to information collected on that date, data collected during habitat and wildlife surveys for the Spadafora drill pad site in 2009, 2010 and 2013 and Bar K 17-33 drill pad in 2013 and for those portions of the Sheep Pipeline in the area of the proposed facility collected during the years of 2006 – 2010 was reviewed. This survey focused on habitat type/condition and wildlife activity within approximately a one-fourth mile radius around the proposed water storage facility site.

PROJECT AREA

The proposed water storage facility site is on a small rise east of the Sheep Creek bottom. The area is primarily in sage/grass vegetation with small pockets of Gambel oak/mountain shrub. Access to the site will be via FSR 851 along Little Henderson Creek and an existing road on private land that was upgraded during construction of the Sheep Pipeline. A short section of road and pipeline corridor to the facility will be constructed from the existing private road across Sheep Creek to the site. There are several vegetation types found on and around the proposed site. These are discussed in the vegetation section of this report. Sheep Creek and adjacent drainages supply water to several small constructed stock watering ponds in the drainages.

METHODS

Emphasis was placed on compiling data on U.S. Fish and Wildlife Service (USFWS) and Colorado Parks and Wildlife (CPW) Threatened, Endangered and Species of Concern, USFS Sensitive Species and nesting raptors that are known to or may occur in the area. Data was compiled on locations and habitat type if any of these species were observed.

Vegetation/habitat on and within an approximately one-fourth mile radius of the road and facility site was surveyed.

All suitable raptor nesting habitat within a one-fourth mile radius of the facility site was surveyed for nests. Only the presence of nests could be confirmed as this survey occurred well after any young would have fledged. There is suitable raptor nesting habitat in Aspen stands located just east of the proposed site. However, not all aspen stands provide suitable raptor nesting habitat. Only stands that provide suitable nest sites were checked. Areas such as Gambel oak dominated habitat were not surveyed, as raptors in this area have not been found to nest in this habitat type.

Opportunistic observations of mammals and neotropical birds were made while conducting listed species and raptor nest surveys.

Several stock ponds that are located along Sheep Creek and side drainages were checked for the presence of amphibians.

During wildlife surveys, opportunistic observations of listed plants were made. Of the listed species, suitable habitat is lacking for all species.

Sheep Creek and the associated stock watering ponds in the project area are not capable of supporting viable fisheries which eliminated the need to do any fishery surveys.

VEGETATION

Vegetation on the proposed facility site is dominated by grassland community with some areas of big sagebrush (*Artemisia tridentata*). Early in the last century the sagebrush community was removed and the area cultivated and hayed. For the last 60 plus years this area has only been grazed (Randy Spadafora, Per. comm.). On both sides of Sheep Creek where the proposed access road and pipeline will cross, the area is dominated by a big sage/grassland community and a narrow strip of riparian habitat along the steam course.

The mixed sagebrush/grassland community is composed primarily of big sagebrush (*Artemisia tridentata*). Other common shrubs include gray rabbitbrush (*Chrysothamnus nauseosus*) and snowberry (*Symphoricarpos rotundifolius*). Throughout the area there is an abundant perennial herbaceous layer. Common graminoids include green needlegrass (*Stipa viridula*), western wheatgrass (*Pascopyrum smithii*), timothy (*Phleum pratense*), and bluegrass (*Poa spp.*).

The Gambel oak/mountain shrub community is codominated by Gambel oak (*Quercus gambelii*) and big sagebrush. Other common shrubs include Western serviceberry (*Amelanchier alnifolia*), gray rabbitbrush, chokecherry (*Prunus virginiana*), and snowberry (*Symphoricarpos rotundifolius*). Grasses and forbs similar to those found in the sagebrush/grassland habitat are found in these areas.

To the east of the proposed facility site on USFS lands aspen stands are found. Within these stands serviceberry, chokecherry and snowberry are common understory shrub species. Grasses and forbs include bluegrass *Poa spp*., sedges *Carex spp*., other grass species and an abundance of forbs.

Willows *Salix spp.* are the only shrub species in the riparian area along the Sheep Creek drainage. Herbaceous species occurring in the drainage are a variety of forbs, sedges *Carex spp.* and rushes *Juncus spp*

LISTED SPECIES

For purposes of this report, only federal and state listed T&E species and species listed as Sensitive by the USFS are addressed. Even though the facility site is located on private land the proximity of the site to USFS lands means that some USFS sensitive species could occur in the project area. During the survey conducted on August 25, 2014 and prior drill site and Sheep Pipeline corridor surveys in the area all species listed as USFS Sensitive were recorded.

THREATENED AND ENDANGERED SPECIES

No T & E species listed by the U.S. Fish & Wildlife Service (FWS) or Colorado Parks and Wildlife (CPW) were observed during this habitat and wildlife survey or during prior years surveys for drill pads and the Sheep Pipeline corridor. In the immediate area of the proposed facility site habitat is lacking for all listed T&E species.

There are portions of the existing access road (FSR 851) to Sheep Park that crosses forest service lands mapped as primary suitable lynx habitat. The existing road goes through approximately 1/4 mile of USFS land. Surveys of the aspen stand for the Sheep Pipeline showed suitable lynx habitat is lacking. Both suitable vegetation structure and prey base are lacking. The USFS agreed with this finding in the past and approved construction of the Sheep Pipeline through this short section of mapped habitat in 2008.

A review of CPW lynx monitoring data from 1999 to 2011 show that no radioed lynx were ever located in or near the project area. Radioed lynx locations within a few miles of the site declined over time and none have been located within miles of the area in the last ten years.

No new construction or modification of roads will occur in the mapped lynx habitat. Vehicle traffic, which is one of the primary causes of lynx mortality will not be a problem as vehicle speeds on the USFS or private access roads will be slow. **There will be no effect on lynx or lynx habitat.**

USFS REGION 2 SENSITIVE SPECIES

Of the USFS sensitive species listed for the GMUG habitat in this portion of the Gunnison National Forest is lacking for all but a few species. Of the species that may occur in the project area the only species observed during the August 25, 2014 survey was the Brewer's sparrow. During prior years surveys for the pipeline corridor and proposed drill pads, Brewer's sparrow, American peregrine falcon, Northern harrier, purple martin and olive-sided flycatcher were observed in the general area.

RAPTORS

During the August 25, 2014 survey and during prior surveys it was determined there is suitable raptor nesting habitat in aspen stands located within one-fourth mile to the east of the proposed facility location.

There is one raptor nest located approximately 200 yards into an aspen stand to the east of the northeast corner of the proposed facility. Condition of the nest and lack of evidence around the nest site indicated that it was not used this year. Location and size of the nest indicated it was probably that of a red-tailed hawk. This nest is less than one-fourth mile from the proposed facility, but trees in the aspen stand precludes it from being observed from the facility site.

Raptors observed in, near to, or flying over the proposed facility area during the August 25, 2014 survey were red-tail hawk, golden eagle, turkey vulture and kestrel. During prior years surveys for the Sheep Pipeline, golden eagle, peregrine falcon, American kestrel, northern harrier and Swainson's hawk were observed in the general area. Of these species, suitable nesting habitat in the area is lacking for golden eagles and peregrine falcons. With the large expanses of suitable raptor nesting habitat in the Sheep Park area development activity at the facility site will not adversely affect those raptor species that do nest in the area.

NEOTROPICAL BIRDS

Both species and numbers of birds observed during the August 25, 2014 survey were what would be expected in the various habitat types found in the project area. There were numerous young birds in the area with most being observed in the aspen stands and in willows along the bottoms. Both species and numbers observed were similar to what was observed during previous surveys for the Sheep Pipeline and other projects in the area. The exception to this was two groups (3 and 4 birds) of Sandhill cranes that were observed on August 25, 2014 flying into the area and stopping by ponds down drainage from the proposed site.

BIG GAME

Colorado Parks and Wildlife has the area around where this site is located mapped as summer range for deer and elk. None of the area is mapped as calving habitat for elk. All of Sheep Park is mapped as elk winter range. Portions of Sheep Park are also mapped as elk winter concentration range. The line marking the west boundary of the winter concentration area runs adjacent to the bench where the proposed facility site is located. During prior site surveys in 2009, 2010 and 2013 there was no evidence that would indicate it being a winter concentration area. Browse condition was checked during this survey and prior surveys and every time there was little evidence of elk or deer use. On April 27, 2010 a site visit was made with Kirk Madariaga, District Wildlife Manger with CPW to check browse condition in the area of the proposed Spadafora drill pad site. At that time we agreed that browse condition and other sign did not indicate this area was a winter concentration area for elk. The observation that Sheep Park is not an elk winter concentration area is supported by Randy Spadafora who owns land in Sheep Park and has been going to his place in the park during the winter for over 50 years. For at least the last 20 years he has been making several trips a winter via snowmobile to his place and has never observed elk wintering in the park. His observations over time indicate that the elk move through the area in the late fall after hunting season and move back through in the spring on their way to the high country. He stated that during virtually all winters the snow is several feet deep and the animals move further down country to winter.

Evidence of recent elk and deer activity in the area was observed during the August 25, 2014 survey and prior years surveys. For both elk and deer, evidence of use of the area by these animals at this time of the year was low during this and prior surveys.

No bears were observed during this survey, but there was a sheep that had been killed by a bear and other evidence of their presence in the survey area. During prior years surveys no bears were observed, but there was evidence of bear activity in the area.

AMPHIBIANS AND REPTILES

The only species of amphibians observed were Northern leopard frogs and Tiger salamanders in ponds located along Sheep Creek and in the side drainages. No reptiles were observed. However, western terrestrial garter snakes have been observed in the area during past surveys.

SUMMARY

During wildlife surveys conducted on August 25, 2014 and in prior years for the Sheep Pipeline and nearby drill pads, no federal or state listed T&E wildlife species were observed in the project area.

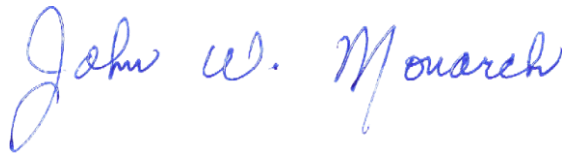
The only USFS sensitive species observed in the project area during the August 25, 2014 survey was Brewer’s sparrow.

One raptor nest was found in the survey area. This nest site will not be affected by the presence of the storage facility. Large expanses of suitable nesting habitat for raptors occur throughout the Sheep Park area.

Both density and diversity of neotropical birds observed in the facility site area were similar to what was observed in the area during prior years surveys for drill pads and the Sheep Pipeline.

Big game observed or evidence of their activity was similar to that observed in prior years surveys for this site, nearby drill proposed pad sites and the Sheep Pipeline.

If you have any questions or comments, please contact me.



John Monarch

ATTACHMENT D
NRCS REPORT

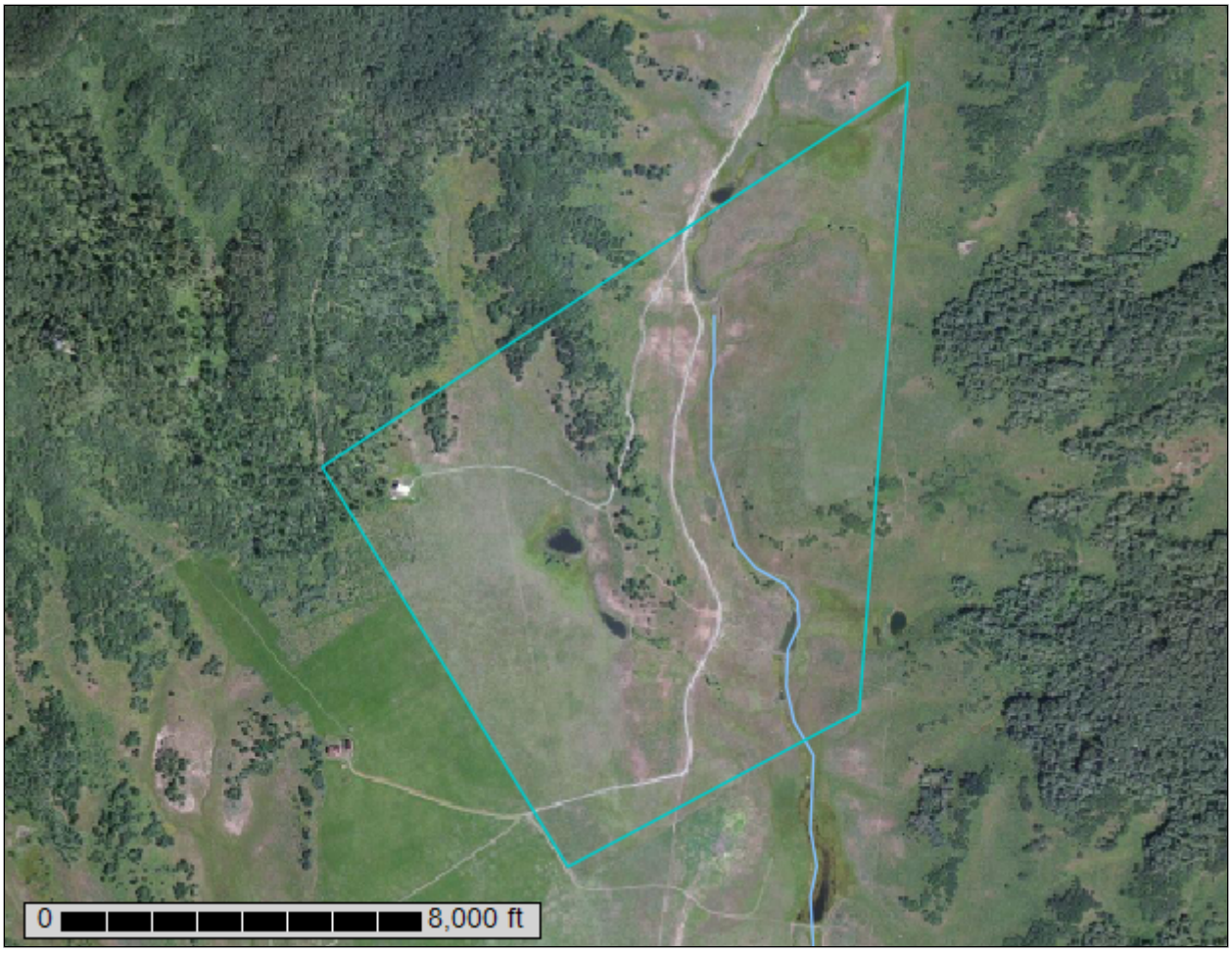
United States Department of Agriculture

NRCS

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 Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties



August 5, 2014

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://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) 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://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

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 Web Soil Survey, the site for 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

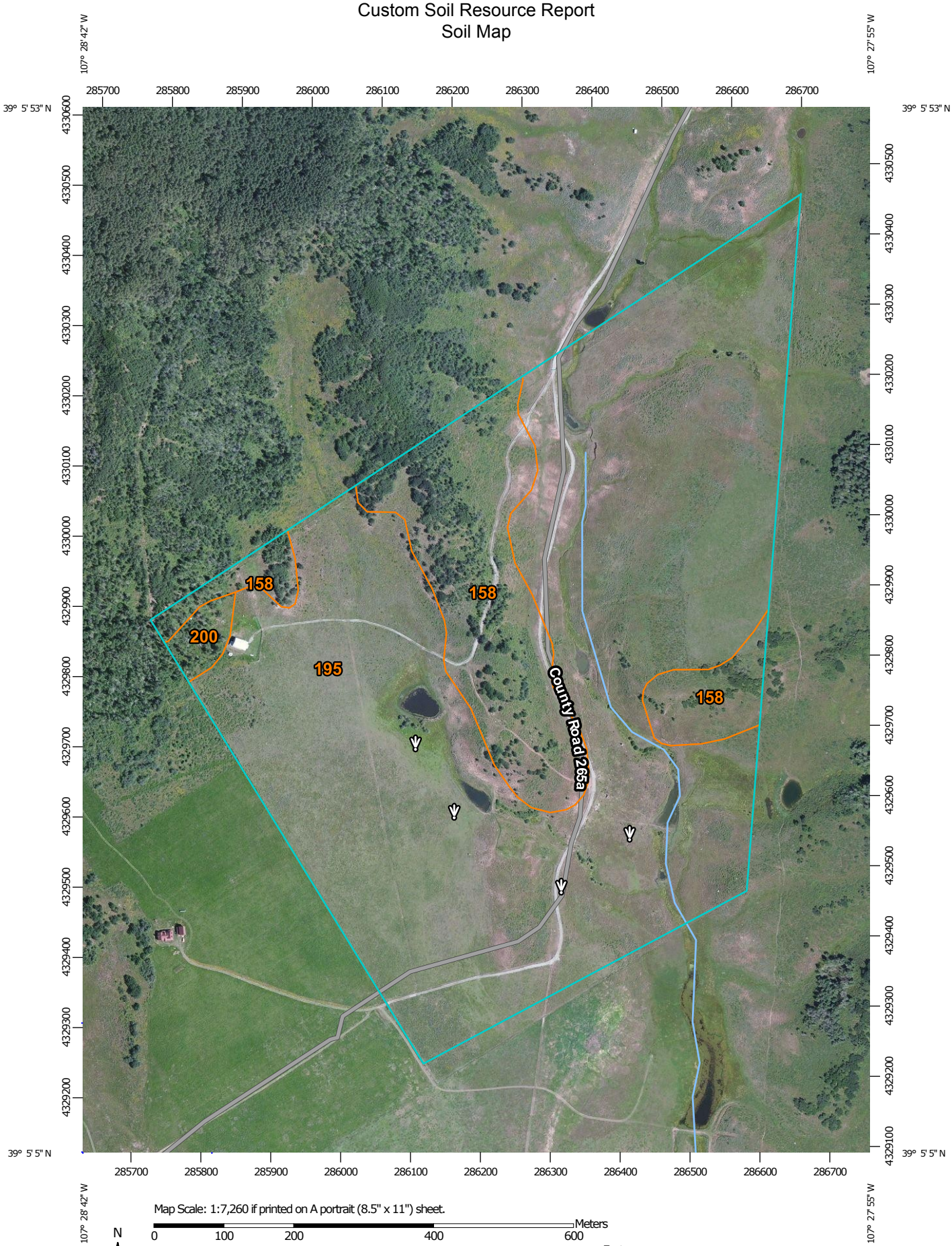
for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or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

Contents

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 Scale: 1:7,260 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 100 200 400 600

Feet
0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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 map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties
Survey Area Data: Version 3, Dec 23, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 7, 2011—Sep 3, 2011

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

Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties (CO660)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
158	Herm-Fughes-Kolob family complex, 25 to 40 percent slopes	28.7	18.3%
195	Weed-Herm complex, 0 to 25 percent slopes	126.5	80.6%
200	Wetopa-Wesdy complex, 5 to 65 percent slopes	1.7	1.1%
Totals for Area of Interest		**156.9**	**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.

Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties

158—Herm-Fughes-Kolob family complex, 25 to 40 percent slopes

Map Unit Setting

Elevation: 7,000 to 9,400 feet
Mean annual precipitation: 16 to 24 inches
Mean annual air temperature: 39 to 43 degrees F
Frost-free period: 75 to 95 days

Map Unit Composition

Herm and similar soils: 35 percent
Fughes and similar soils: 30 percent
Kolob family and similar soils: 25 percent

Description of Herm

Setting

Landform: Mountains
Parent material: Interbedded alluvium derived from sandstone and shale and/or interbedded residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 9 inches: clay loam
H2 - 9 to 60 inches: clay

Properties and qualities

Slope: 25 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural 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
Available water storage in profile: Moderate (about 8.8 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Mountain Clay Loam (R048AY248CO)

Description of Fughes

Typical profile

H1 - 0 to 19 inches: loam
H2 - 19 to 32 inches: clay, clay loam
H2 - 19 to 32 inches: gravelly clay loam
H3 - 32 to 38 inches: very gravelly loam
H4 - 38 to 47 inches: weathered bedrock
H5 - 47 to 51 inches:

Properties and qualities

Slope: 25 to 40 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural 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
Available water storage in profile: Moderate (about 8.8 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Deep Clay Loam (R048AY247CO)

Description of Kolob Family

Typical profile

H1 - 0 to 15 inches: clay loam
H2 - 15 to 25 inches: very stony clay
H3 - 25 to 34 inches: very stony clay loam
H4 - 34 to 60 inches: very stony sandy clay loam

Properties and qualities

Slope: 25 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural 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 in profile: 5 percent
Available water storage in profile: Moderate (about 6.5 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Brushy Loam (R048AY238CO)

195—Weed-Herm complex, 0 to 25 percent slopes

Map Unit Setting

Elevation: 6,800 to 9,500 feet

Mean annual precipitation: 14 to 24 inches
Mean annual air temperature: 39 to 44 degrees F
Frost-free period: 75 to 100 days

Map Unit Composition

Weed and similar soils: 50 percent
Herm and similar soils: 30 percent

Description of Weed

Setting

Landform: Alluvial fans, valley floors, toes
Parent material: Interbedded alluvium derived from sandstone and shale and/or interbedded residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 13 inches: loam
H2 - 13 to 30 inches: clay loam
H3 - 30 to 60 inches: loam

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural 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 in profile: 10 percent
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Mountain Loam (R048AY228CO)

Description of Herm

Typical profile

H1 - 0 to 9 inches: clay loam
H2 - 9 to 60 inches: clay

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural 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
Available water storage in profile: Moderate (about 8.8 inches)

Interpretive groups

Farmland classification: Not prime farmland

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Mountain Clay Loam (R048AY248CO)

200—Wetopa-Wesdy complex, 5 to 65 percent slopes

Map Unit Setting

Elevation: 7,800 to 10,400 feet
Mean annual precipitation: 24 to 34 inches
Mean annual air temperature: 34 to 42 degrees F
Frost-free period: 55 to 75 days

Map Unit Composition

Wetopa and similar soils: 50 percent
Wesdy and similar soils: 35 percent

Description of Wetopa

Setting

Landform: Mountain slopes
Parent material: Interbedded colluvium derived from sandstone and shale and/or interbedded residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 10 inches: clay loam
H2 - 10 to 34 inches: clay, clay loam
H2 - 10 to 34 inches: clay, clay loam
H3 - 34 to 60 inches:
H3 - 34 to 60 inches:

Properties and qualities

Slope: 5 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural 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
Available water storage in profile: Very high (about 17.9 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C

Description of Wesdy

Typical profile

H1 - 0 to 7 inches: cobbly loam
H2 - 7 to 11 inches: very cobbly silt loam
H3 - 11 to 26 inches: very cobbly clay
H4 - 26 to 60 inches: very cobbly clay

Properties and qualities

Slope: 5 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural 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
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C

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://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

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://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

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://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

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://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

ATTACHMENT E
GEOTECHNICAL REPORT

Huddleston-Berry
Engineering & Testing, LLC

GEOTECHNICAL AND GEOLOGIC HAZARDS INVESTIGATION
WATER IMPOUNDMENTS
PAONIA, COLORADO
PROJECT#01302-0001

WESTON SOLUTIONS, INC.
1435 GARRISON STREET, SUITE 100
LAKEWOOD, COLORADO 80215

AUGUST 6, 2014

Huddleston-Berry Engineering and Testing, LLC
640 White Avenue, Unit B
Grand Junction, Colorado 81501

TABLE OF CONTENTS

1.0 INTRODUCTION

As part of extensive development in western Colorado, a new drilling production water storage facility is proposed near Paonia. As part of the development process, Huddleston-Berry Engineering and Testing, LLC (HBET) was retained by Weston Solutions, Inc. to characterize the site.

1.1 Purpose

As discussed above, site characterization was conducted for a proposed water storage facility near Paonia, Colorado. The purpose of the work was to identify any geologic, hydrologic, or geotechnical considerations which may impact the use of the site for water storage.

1.2 Site Location and Description

The site is located approximately 15 miles northeast of Paonia, Colorado. The project location is shown on Figure 1 – Site Location Map.

At the time of the field investigation, the proposed pond site was generally open and located on a hillside terrace. The terrace generally sloped gently down to the west with steeper slopes off of the terrace down to the north, west, and south. East of the terrace, the slopes rose moderately to the east. A small drainage channel ran through the south central portion of the terrace. Additional drainage features were present at lower elevations north of the terrace. In addition, Sheep creek was present below the site to the west. Vegetation on the terrace consisted primarily of grasses with some small trees and brush along the perimeter. The hill slopes on the north, south, and west sides of the site were vegetated primarily with grasses and brush. The terrace was bounded to the north, south, and west by open, private land. National Forest Service land was present east of the site.

1.3 Proposed Construction

The proposed construction is anticipated to include one or more large water storage ponds. Based upon information provided to HBET, the ponds are anticipated to be lined with a double-synthetic liner system.

2.0 GEOLOGIC SETTING

2.1 Soils

Soils data was obtained from the USDA Natural resource Conservation Service Web Soil Survey. The data indicates that the soils at the site consist of Herm-Fughes-Kolob family complex, 25 to 40 percent slopes and Weed-Herm complex, 0 to 25 percent slopes. Soil survey data, including descriptions of the soil units, is included in Appendix A.

Excavation in the site soils is indicated to be somewhat limited to very limited due to slope, clay content, cutbank caving, and/or large stones content. The site soils are indicated to have a low to moderate potential for frost action, low to high risk of corrosion of uncoated steel, and low to moderate risk of corrosion of concrete.

Pond construction in the site soils is described as being very limited due to slope, seepage, and/or depth to bedrock. Embankment/dike/levee construction in the site soils is described as being somewhat limited to very limited due to piping, seepage, minimal layer thickness, large stones content, and/or difficulties in achieving compaction.

2.2 Geology

According to the *Geologic Map of Colorado* by Ogden Tweto (1979), the site is underlain by claystone, mudstone, sandstone and/or conglomerate of the Wasatch and Ohio Creek Formations.

3.0 FIELD INVESTIGATION

The subsurface investigation was conducted on October 7th and 8th, 2013 and consisted of thirteen borings drilled across the site to depths of between 7.0 and 43.0 feet below the existing ground surface. The locations of the borings are shown on Figure 2 – Site Plan. The borings were located in the field using a handheld GPS unit. Typed boring logs are included in Appendix B. Samples of the native soils were collected during Standard Penetration Testing (SPT) and/or using bulk sampling methods at the locations shown on the logs.

As indicated on the logs, the subsurface conditions at the site were slightly variable. However, the borings generally encountered 1.0 foot of sandy lean clay with organics topsoil above brown to gray, moist, medium stiff to hard sandy lean clay with occasional gravels and boulders to depths of between 4.0 and 15.5 feet. Below the clay soils, red to brown to gray, very soft to soft, completely to highly weathered shale bedrock extended to the bottoms of the borings.

Groundwater was encountered in the borings conducted on the terrace at depths of between 10.0 and 36.0 feet below the existing ground surface. Groundwater was encountered in the borings conducted at lower elevations at depths of between 12.0 and 17.0 feet below the existing ground surface. In general, HBET does not believe that the observed groundwater reflects a static water table. HBET believes that the groundwater is perched and flows through bedrock fractures/joints.

4.0 LABORATORY TESTING

Selected native soil samples collected from the borings were tested in the Huddleston-Berry Engineering and Testing LLC geotechnical laboratory for natural moisture and density, sieve analysis, hydrometer analysis, maximum dry density and optimum moisture (Proctor), Atterberg limits, swell/consolidation, hydraulic conductivity, direct shear, dispersion, and soluble sulfates content. The laboratory testing results are included in Appendix C.

The laboratory testing results indicate that the native clay overburden soils are moderately plastic. In addition, the overburden soils were shown to be slightly collapsible at their existing density, with up to approximately 1.2% collapse measured in the laboratory. However, based upon the plasticity of the material, the native clay soils are anticipated to be slightly expansive when compacted and introduced to excess moisture.

The native clay soils were indicated to have a saturated hydraulic conductivity of $4.0x10^{-4}$ cm/sec when remolded to 90% of the maximum dry density. In addition, the clay soils were shown to have an internal friction angle of 36.2° and cohesion of 0.556 ksf when remolded. Water soluble sulfates were detected in the clay soils in a concentration of 0.002%.

Double hydrometer testing indicated that the native clay soils have a dispersion value of 36%. In general, a dispersion value of less than 30% indicates non-dispersive soils and a value of greater than 50% indicates dispersive soils. Therefore, the native clay soils may be dispersive and the design should consider dispersion of the clay soils.

The shale bedrock was also indicated to be moderately plastic. In addition, the shale was shown to be slightly expansive with up to approximately 0.5% expansion at 1,000 psf measured in the laboratory.

The shale was indicated to have a saturated hydraulic conductivity of $1.1x10^{-5}$ cm/sec when remolded to 90% of the maximum dry density. In addition, the shale was shown to have an internal friction angle of 32.5° and cohesion of 0.660 ksf when remolded. Water soluble sulfates were detected in the shale in a concentration of 0.002%.

Double hydrometer testing indicated that the shale bedrock materials have a dispersion value of 48%. As mentioned above, a dispersion value of less than 30% indicates non-dispersive soils and a value of greater than 50% indicates dispersive soils. Therefore, the shale bedrock materials may be dispersive and the design should consider dispersion of the shale.

5.0 GEOLOGIC HAZARDS EVALUATION

5.1 Radioactivity

At the time of the investigation, no evidence of naturally occurring radioactive minerals were observed. In addition, no evidence of uranium mill tailings or other radioactive materials was observed. As a result, radiation hazards are not anticipated to adversely impact the proposed construction.

5.2 Faulting/Earthquakes

Based upon information from the Colorado Geological Survey (CGS), there are no significant faults in the vicinity of the site. In addition, the nearest significant earthquake event was the Montrose/Basalt quake in 1944, approximately 6.5 miles southwest of the site, which measured VI on the Modified Mercalli scale. Other small earthquakes reported by the CGS occurred approximately 5 miles to the northeast, 5.5 miles to the east, and 8.0 miles to the southeast of the site. These ranged from Richter magnitude 2.7 to 3.1. Also, numerous quakes have been reported in the vicinity of Somerset, approximately 10 miles south of the site. However, most of these are reported to be associated with coal mining activities. As a result, faults are not anticipated to adversely impact the proposed construction.

The CGS seismic hazard map of Colorado indicates that the site lies in an area where the anticipated PGA with a 2% chance of occurrence in 50 years is between 0.16 and 0.18g. Assuming any structures are designed using the above seismic coefficients, as necessary, seismic hazards are not anticipated to adversely impact the proposed construction.

5.3 Ground Subsidence

At the time of the investigation, no evidence of mine workings, karst topography, or other ground subsidence hazards were observed. The native clay soils were shown to be slightly collapsible; however, the magnitude of collapse measured in the laboratory was low and this is not anticipated to adversely impact the proposed construction.

5.4 Landslides

The site is not mapped as a landslide area. In addition, no evidence of mass earth movements was observed at the time of the investigation. As a result, landslides are not anticipated to adversely impact the proposed construction.

5.5 Avalanches

As indicated on Figure 1, the terrain rises gently to moderately to the east for some distance to the base of Sheep Mountain where steeper slopes are present. However, no evidence of avalanche chutes or other past avalanche activity was observed. In general, avalanches are not anticipated to adversely impact the proposed construction.

5.6 Rockfall

At the time of the investigation, no bedrock outcrops or tallus slopes were observed above the site that could impact the site. As a result, rockfall is not anticipated to adversely impact the proposed construction.

5.7 Flooding

As discussed previously, the site is located on a terrace above Sheep Creek. In addition, Figure 1 shows drainages north and south of the terrace. A small drainage channel ran through the site; however, the tributary area to this drainage is small. In general, with proper realignment of the drainage channel running through the site, flooding is not anticipated to adversely impact the proposed construction.

5.8 Mudflows and/or Debris Fans

At the time of the investigation, no evidence of mudflows or debris fans were observed in the immediate vicinity of the site. As a result, mudflows and/or debris fans are not anticipated to adversely impact the proposed construction.

5.9 Expansive Soils and Rock

As discussed previously, the native clay soils are moderately plastic and are anticipated to be slightly expansive when compacted and introduced to excess moisture. In addition, the native shale bedrock was indicated to be slightly expansive. In general, for the proposed construction of water storage ponds, expansive soils and bedrock are not anticipated to adversely impact the construction.

5.10 Slopes

As discussed previously, moderate slopes were present along the edges of the terrace that comprises the site. However, no evidence of slope instability was observed. In general, the stability of existing slopes is not anticipated to adversely impact the proposed construction.

6.0 RESOURCE EVALUATION

6.1 Water Resources

No water supply wells were observed at the site. As discussed previously, shallow groundwater was encountered in some of the borings at the time of the investigation. Based upon the fact that the groundwater observed at the site consists of perched water within the bedrock, with proper design and construction of the ponds, the pond construction is not anticipated to adversely affect groundwater.

6.2 Mineral Resources

No significant mineral resources were identified on the property. Potential mineral resources in Western Colorado generally include gravel, uranium ore, coal, heavy metals, etc. No significant gravel, coal, uranium bearing bedrock, or other mineable bedrock units were encountered on the subject site at the time of the investigation, nor was any literary or cartographic information discovered that indicate the existence or potential existence of commercial quality mineral deposits.

7.0 CONCLUSIONS

Based upon the available data sources, field investigation, and nature of the proposed subdivision, HBET does not believe that there are any geologic conditions which should preclude construction on the site. However, the shallow bedrock and presence of perched groundwater will likely impact the design and construction. Specific aspects of the proposed construction will be discussed in the following sections.

7.1 Excavations

Excavations in the soils and bedrock at the site may stand for short periods of time but should not be considered to be stable. Trenching and excavations should be sloped back, shored, or shielded for worker protection in accordance with applicable OSHA standards. The overburden soils generally classify as Type C soil with regard to OSHA's *Construction Standards for Excavations*. For Type C soils, the maximum allowable slope in temporary cuts is 1.5H:1V. The shallow shale bedrock generally classifies as Type B soil. For Type B soils, the maximum allowable slope in temporary cuts is 1H:1V. It may be possible to complete vertical cuts into the deeper shale. However, HBET should be contacted to evaluate the stability of the shale where vertical cuts are proposed.

7.2 Earthwork

As indicated in the boring logs, boulders were encountered in the overburden soils. Some of these were fairly large. While the precise dimensions of boulders in the subsurface is impossible to determine from geotechnical borings, HBET anticipates that the boulders may interfere with the use of scrapers to complete the pond excavation. It is likely that excavators or dozers will be necessary to excavate the overburden.

With regard to the shale bedrock, while the SPT N-values were fairly high, auger refusal was not encountered in any of the borings. Therefore, HBET believes that the shale will be rippable in a manner similar to a very stiff clay soil. However, rippability of the subsurface materials cannot be fully evaluated until construction.

Based upon the nature of the construction, large cuts are likely. The excess material from the pond excavation will likely be used as fill. In general, the native overburden soils and weathered shale bedrock materials are suitable for use as grading fill, provided boulders are removed. It is recommended that grading fills comprised of the native materials be moisture conditioned, placed in maximum 8-inch loose lifts, and compacted to a minimum of 95% of the standard Proctor maximum dry density, within ±2% of the optimum moisture content as determined in accordance with ASTM D698. However, fills in excess of 5 feet in thickness should be compacted to a minimum of 97% of the maximum dry density.

As discussed previously, the native clay soils and shale bedrock materials may be dispersive. As a result, cut and fill slopes should be protected to prevent excessive erosion.

7.3 Seismic Site Classification

Based upon the results of the subsurface investigation, the site generally classifies as Seismic Site Class C for very dense soil and soft rock.

7.4 Drainage

As discussed previously, groundwater was encountered in many of the borings. Due to the fact that the groundwater likely flows through fractures/joints in the bedrock, the precise depth of water bearing zones is difficult to predict. However, due to the likelihood of significant cuts at the site, groundwater will likely impact the construction. It may be necessary to install French drains, sheet drains, or other drainage systems to complete the construction and protect the liners from buoyancy forces. At your request, HBET can provide recommendations for drainage alternatives during construction once the nature and extent of groundwater seepage has been determined.

7.5 Water Soluble Sulfates

As indicated previously, water soluble sulfates were detected in the subsurface materials in a concentration of 0.002%. This concentration of sulfates represents a negligible degree of potential sulfate attack on concrete. Therefore, sulfate resistant cement may not be required for concrete at this site.

8.0 GENERAL

The recommendations included above are based upon the results of the subsurface investigation and on our local experience. These conclusions and recommendations are valid only for the proposed construction.

Huddleston-Berry Engineering and Testing, LLC is pleased to be of service to your project. Please contact us if you have any questions or comments regarding the contents of this report.

Respectfully Submitted:
Huddleston-Berry Engineering and Testing, LLC

Michael A. Berry, P.E.
Vice President of Engineering

FIGURES

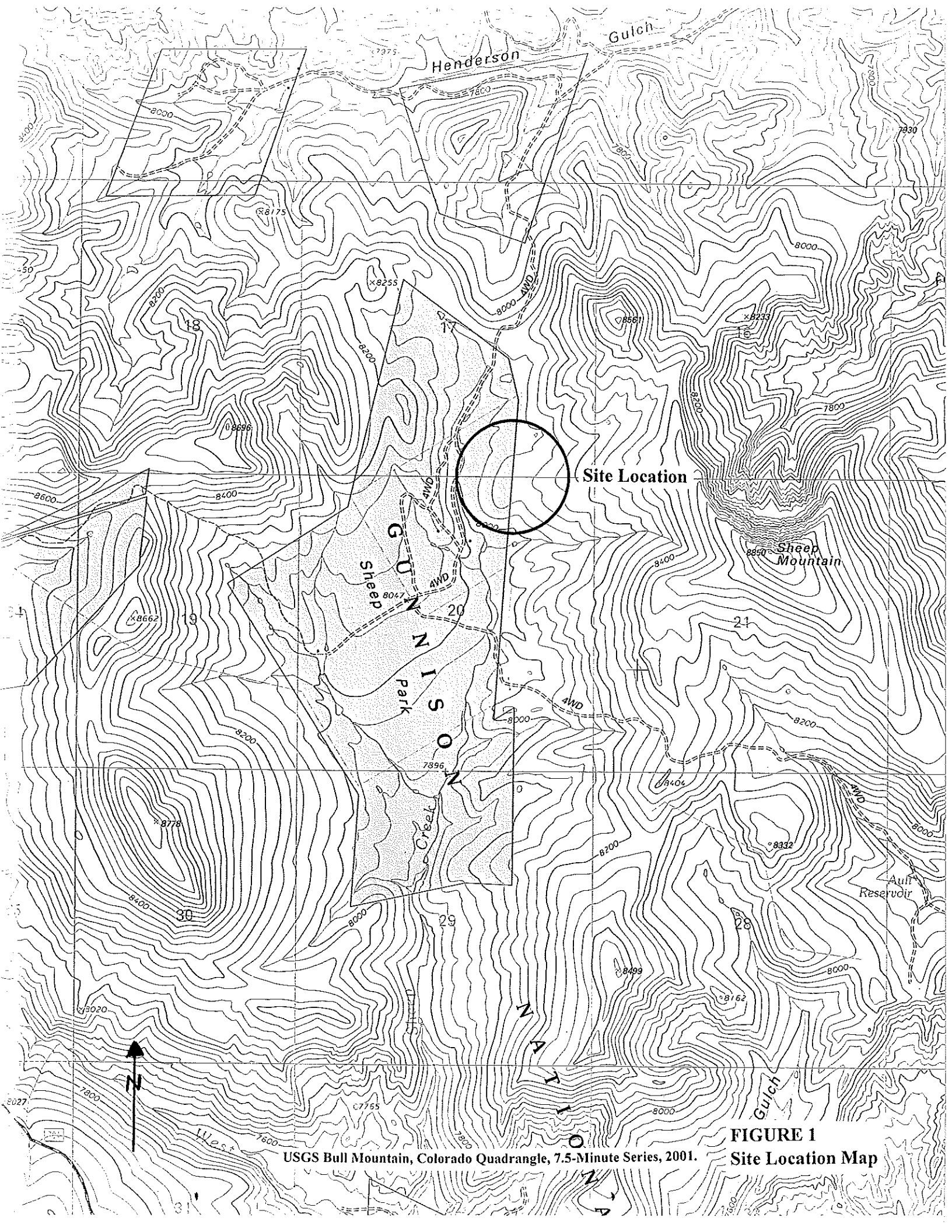


FIGURE 1
Site Location Map

USGS Bull Mountain, Colorado Quadrangle, 7.5-Minute Series, 2001.

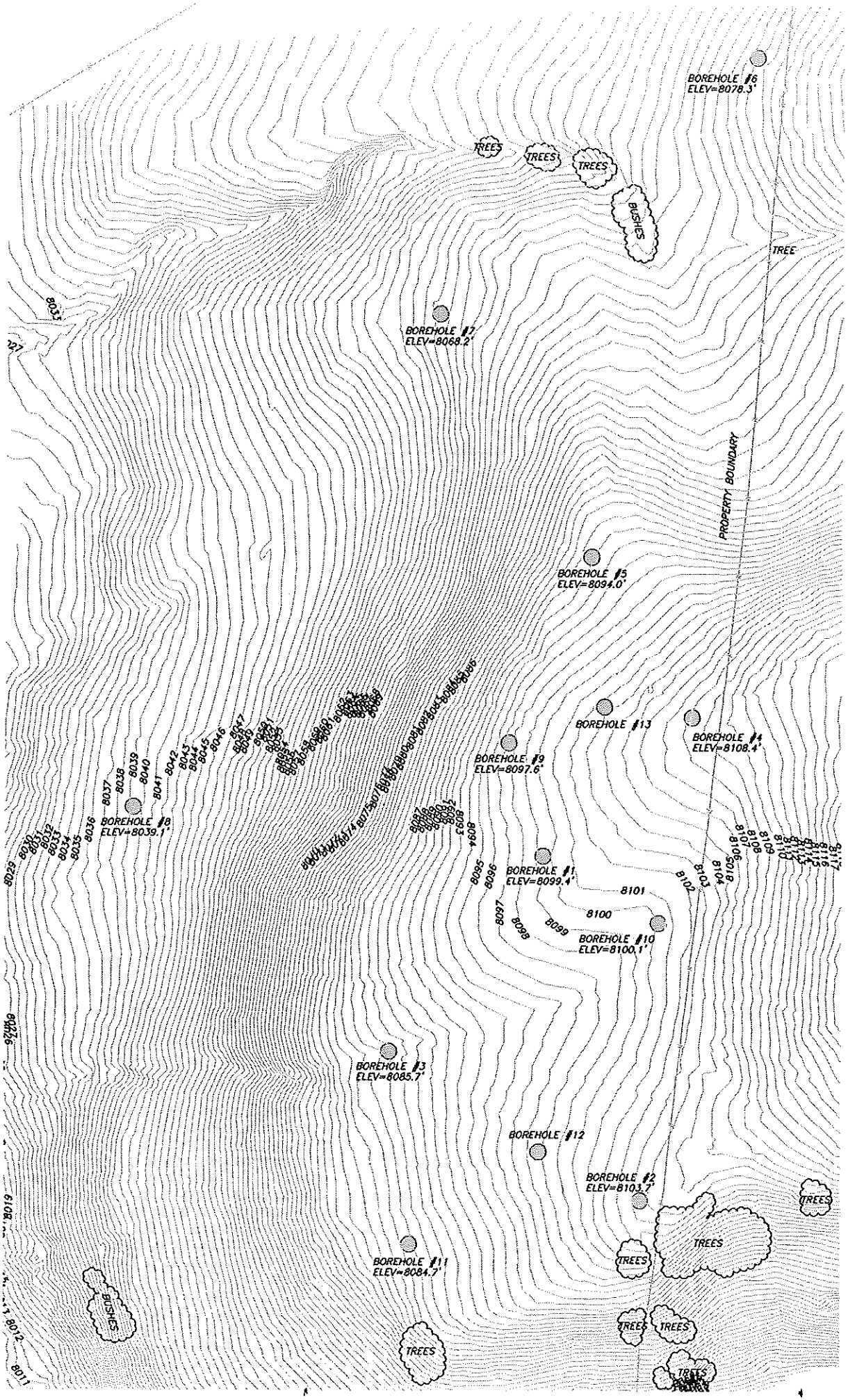
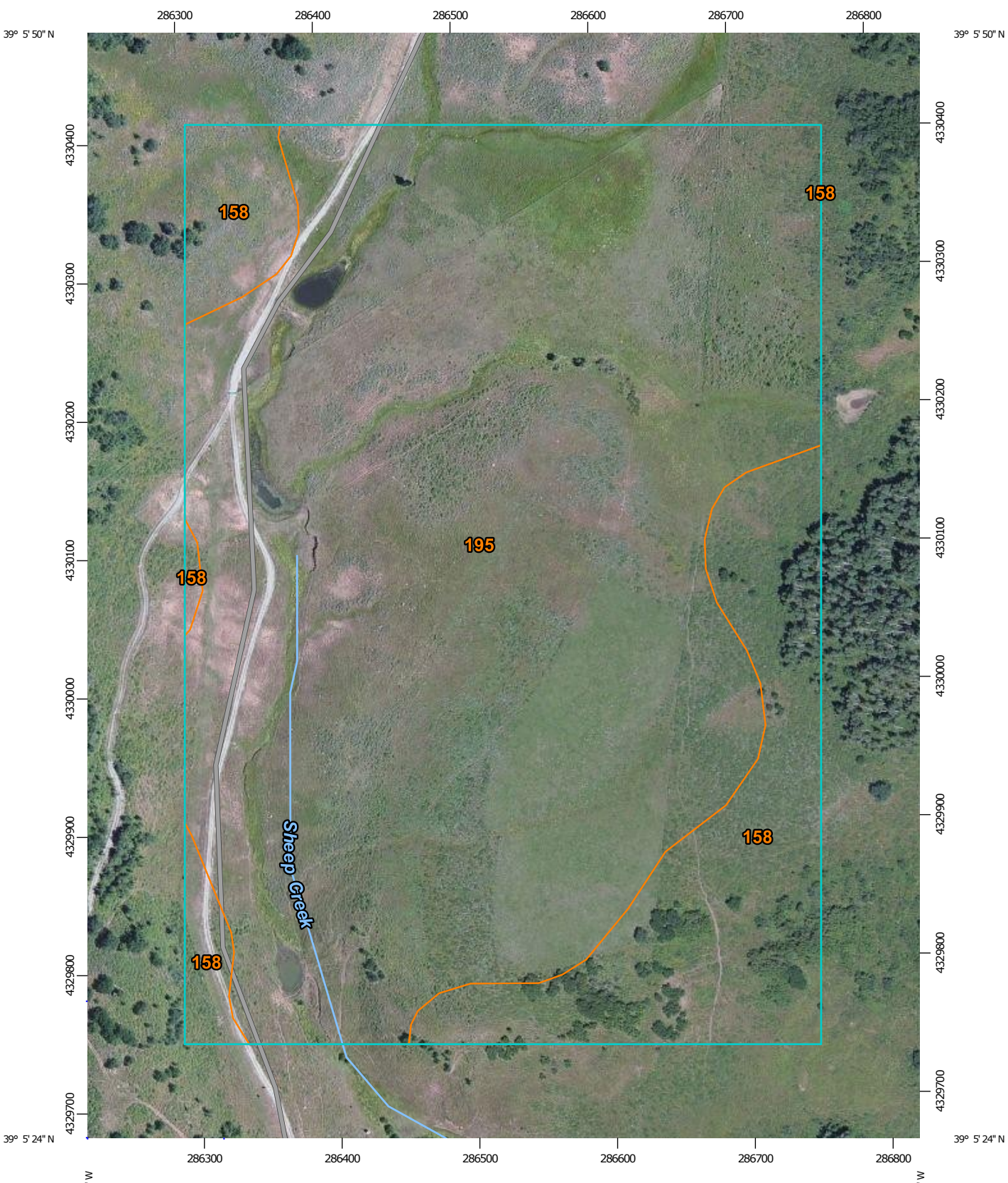


FIGURE 2
Site Plan

APPENDIX A
Soil Survey Data



Map Scale: 1:3,890 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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 map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties
Survey Area Data: Version 2, Apr 30, 2008

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 7, 2011—Sep 3, 2011

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

Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties (CO660)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
158	Herm-Fughes-Kolob family complex, 25 to 40 percent slopes	14.9	19.5%
195	Weed-Herm complex, 0 to 25 percent slopes	61.3	80.5%
Totals for Area of Interest		**76.1**	**100.0%**

Map Unit Description

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 in this report, 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*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given 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.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties

158—Herm-Fughes-Kolob family complex, 25 to 40 percent slopes

Map Unit Setting

Elevation: 7,000 to 9,400 feet
Mean annual precipitation: 16 to 24 inches
Mean annual air temperature: 39 to 43 degrees F
Frost-free period: 75 to 95 days

Map Unit Composition

Herm and similar soils: 35 percent
Fughes and similar soils: 30 percent
Kolob family and similar soils: 25 percent

Description of Herm

Setting

Landform: Mountains
Parent material: Interbedded alluvium derived from sandstone and shale and/or interbedded residuum weathered from sandstone and shale

Properties and qualities

Slope: 25 to 40 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
Available water capacity: Moderate (about 8.8 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Mountain Clay Loam (R048AY248CO)

Typical profile

0 to 9 inches: Clay loam
9 to 60 inches: Clay

Description of Fughes

Properties and qualities

Slope: 25 to 40 percent
Depth to restrictive feature: 40 to 60 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
Available water capacity: Moderate (about 8.8 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Deep Clay Loam (R048AY247CO)

Typical profile

0 to 19 inches: Loam
19 to 32 inches: Clay loam, clay
32 to 38 inches: Gravelly clay loam
38 to 47 inches: Very gravelly loam
47 to 51 inches: Weathered bedrock

Description of Kolob Family

Properties and qualities

Slope: 25 to 40 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: 5 percent
Available water capacity: Moderate (about 6.5 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Brushy Loam (R048AY238CO)

Typical profile

0 to 15 inches: Clay loam
15 to 25 inches: Very stony clay
25 to 34 inches: Very stony clay loam
34 to 60 inches: Very stony sandy clay loam

195—Weed-Herm complex, 0 to 25 percent slopes

Map Unit Setting

Elevation: 6,800 to 9,500 feet
Mean annual precipitation: 14 to 24 inches
Mean annual air temperature: 39 to 44 degrees F
Frost-free period: 75 to 100 days

Map Unit Composition

Weed and similar soils: 50 percent
Herm and similar soils: 30 percent

Description of Weed

Setting

Landform: Alluvial fans, valley floors, toes
Parent material: Interbedded alluvium derived from sandstone and shale and/or interbedded residuum weathered from sandstone and shale

Properties and qualities

Slope: 0 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: 10 percent
Available water capacity: High (about 10.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Mountain Loam (R048AY228CO)

Typical profile

0 to 13 inches: Loam
13 to 30 inches: Clay loam
30 to 60 inches: Loam

Description of Herm

Properties and qualities

Slope: 0 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 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
Available water capacity: Moderate (about 8.8 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Mountain Clay Loam (R048AY248CO)

Typical profile

0 to 9 inches: Clay loam
9 to 60 inches: Clay

Data Source Information

Soil Survey Area: Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties
Survey Area Data: Version 2, Apr 30, 2008

Roads and Streets, Shallow Excavations, and Lawns and Landscaping

Soil properties influence the development of building sites, including the selection of the site, the design of the structure, construction, performance after construction, and maintenance. This table shows the degree and kind of soil limitations that affect local roads and streets, shallow excavations, and lawns and landscaping.

The ratings in the table are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect building site development. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. Irrigation is not considered in the ratings. The ratings are based on the soil properties that affect plant growth and trafficability after vegetation is established. The properties that affect plant growth are reaction; depth to a water table; ponding; depth to bedrock or a cemented pan; the available water capacity in the upper 40 inches; the content of salts, sodium, or calcium carbonate; and sulfidic materials. The properties that affect trafficability are flooding, depth to a water table, ponding, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer.

Information in this table is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil between the surface and a depth of 5 to 7 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this table. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Report—Roads and Streets, Shallow Excavations, and Lawns and Landscaping

[Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The table shows only the top five limitations for any given soil. The soil may have additional limitations]

Roads and Streets, Shallow Excavations, and Lawns and Landscaping–Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties							
Map symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Lawns and landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
158—Herm-Fughes-Kolob family complex, 25 to 40 percent slopes							
Herm	35	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Shrink-swell	1.00	Too clayey	0.28		
		Frost action	0.50	Cutbanks cave	0.10		
Fughes	30	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Shrink-swell	1.00	Cutbanks cave	1.00		
		Frost action	0.50	Too clayey	0.03		
Kolob family	25	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Large stones content	1.00	Large stones content	1.00	Large stones content	0.68
		Shrink-swell	0.50	Too clayey	0.13		
				Cutbanks cave	0.10		
195—Weed-Herm complex, 0 to 25 percent slopes							
Weed	50	Somewhat limited		Somewhat limited		Somewhat limited	
		Slope	0.84	Slope	0.84	Slope	0.84
		Shrink-swell	0.50	Cutbanks cave	0.10		
		Frost action	0.50				
Herm	30	Very limited		Somewhat limited		Somewhat limited	
		Shrink-swell	1.00	Slope	0.84	Slope	0.84
		Slope	0.84	Too clayey	0.28		
		Frost action	0.50	Cutbanks cave	0.10		

Data Source Information

Soil Survey Area: Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties
Survey Area Data: Version 2, Apr 30, 2008

Soil Features

This table gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A *restrictive layer* is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation. *Depth to top* is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage, or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, saturated hydraulic conductivity (Ksat), content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Report—Soil Features

Soil Features–Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties									
Map symbol and soil name	**Restrictive Layer**				**Subsidence**		**Potential for frost action**	**Risk of corrosion**	
	Kind	**Depth to top**	**Thickness**	**Hardness**	**Initial**	**Total**		**Uncoated steel**	**Concrete**
		In	*In*		*In*	*In*			
158—Herm-Fughes-Kolob family complex, 25 to 40 percent slopes									
Herm		—	—		0	—	Moderate	High	Moderate
Fughes	Paralithic bedrock	40-60	—	Weakly cemented	0	—	Moderate	High	Low
Kolob family		—	—		0	—	Low	Low	Low
195—Weed-Herm complex, 0 to 25 percent slopes									
Weed		—	—		0	—	Moderate	Moderate	Low
Herm		—	—		0	—	Moderate	High	Moderate

Data Source Information

Soil Survey Area: Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties
Survey Area Data: Version 2, Apr 30, 2008

Ponds and Embankments

This table gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the saturated hydraulic conductivity (Ksat) of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. Embankments that have zoned construction (core and shell) are not considered. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, Ksat of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Information in this table is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil between the surface and a depth of 5 to 7 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this table. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Report—Ponds and Embankments

[Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The table shows only the top five limitations for any given soil. The soil may have additional limitations]

Ponds and Embankments–Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties							
Map symbol and soil name	Pct. of map unit	Pond reservoir areas		Embankments, dikes, and levees		Aquifer-fed excavated ponds	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
158—Herm-Fughes-Kolob family complex, 25 to 40 percent slopes							
Herm	35	Very limited		Somewhat limited		Very limited	
		Slope	1.00	Hard to pack	0.14	Depth to water	1.00
Fughes	30	Very limited		Somewhat limited		Very limited	
		Slope	1.00	Piping	0.98	Depth to water	1.00
		Seepage	0.72	Seepage	0.13		
		Depth to bedrock	0.01	Thin layer	0.11		
Kolob family	25	Very limited		Very limited		Very limited	
		Slope	1.00	Large stones content	1.00	Depth to water	1.00
		Seepage	0.54				
195—Weed-Herm complex, 0 to 25 percent slopes							
Weed	50	Very limited		Very limited		Very limited	
		Slope	1.00	Piping	1.00	Depth to water	1.00
		Seepage	0.72				
Herm	30	Very limited		Somewhat limited		Very limited	
		Slope	1.00	Hard to pack	0.14	Depth to water	1.00

Data Source Information

Soil Survey Area: Grand Mesa - West Elk Area, Colorado, Parts of Delta, Garfield, Gunnison, Mesa, and Montrose Counties
Survey Area Data: Version 2, Apr 30, 2008

APPENDIX B
Typed Boring Logs

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-1

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/7/13 COMPLETED 10/7/13
GROUND ELEVATION ____ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY NWB CHECKED BY MAB
AT END OF DRILLING dry
NOTES
24hrs AFTER DRILLING 34.5 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels and boulders, brown to gray, moist, stiff hard	SS 1	94	3-4-7 (11)							
		Boulder at 3.5 ft										
5			SS 2	89	7-10-13 (23)							
			SS 3	83	13-44-14 (58)							
10			SS 4	89	34-14-11 (25)							
		SHALE, red to brown to gray, very soft to soft, completely to highly weathered	SS 5	100	8-15-20 (35)							
15			SS 6	94	11-19-21 (40)							
			SS 7	100	50/5"							
20			SS 8	50	50/2"							
25			SS 9	67	50/3"							
30												
35												
40		Bottom of hole at 43.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-2

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/7/13 COMPLETED 10/7/13
GROUND ELEVATION _____ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY NWB CHECKED BY MAB
AT END OF DRILLING dry
NOTES _____
▼ 24hrs AFTER DRILLING 36.0 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels and boulders, brown to gray, moist, very stiff to hard	SS 1	67	5-7-16 (23)							
5		**Boulder at 5 ft**										
			MC 1	67	19-13-19 (32)		115	10				
10			SS 2	83	9-11-13 (24)							
			SS 3	94	7-17-22 (39)							
		SHALE, red to brown to gray, very soft to soft, completely to highly weathered										
15												
			MC 2	0	50/3"							
20												
			SS 4	100	50/4"							
25												
30			SS 5	100	50/3"							
35		▼										
40		Bottom of hole at 43.0 feet.										

GEOTECH BH COLUMNS 01302-0001 WATER IMPOUNDMENTS.GPJ GINT US LAB.GDT 11/18/13

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-3

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/7/13 COMPLETED 10/7/13
GROUND ELEVATION _____ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY NWB CHECKED BY MAB
AT END OF DRILLING dry
NOTES
▼ 24hrs AFTER DRILLING 10.0 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels and boulders, brown to gray, moist, stiff to very stiff	SS 1	44	10-11-7 (18)							
5		**Boulder at 4 ft**	MC 1	67	6-5-7 (12)		107	10				
10		▼	SS 2	83	20-50							
		SHALE, red to brown to gray, soft, completely to highly weathered	MC 2	89	32-30-50 (80)		113	10				
15												
20			SS 3	72	16-26-36 (62)							
25			SS 4	27	50							
30		Bottom of hole at 30.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-4

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/7/13 COMPLETED 10/7/13
GROUND ELEVATION _____ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
▽ AT TIME OF DRILLING 26.0 ft
LOGGED BY NWB CHECKED BY MAB
▼ AT END OF DRILLING 26.0 ft
NOTES _____
▼ 24hrs AFTER DRILLING 15.5 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels and boulders, brown to gray, moist, very stiff to hard	SS 1	67	4-8-11 (19)							
5			SS 2	72	9-23-15 (38)							
			SS 3	100	5-50/0"							
10		**Boulder at 9.5 ft**	SS 4	0	50/3"							
			SS 5	79	8-11-10-15 (21)							
		SHALE, red to brown to gray, very soft to soft, completely to highly weathered	MC 1	67	14-26-35 (61)		113	13				
15		▼										
20			SS 6	81	18-36-50/4"							
25		▼										
30		Bottom of hole at 30.0 feet.	SS 7	0	50/1"							

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-5

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/8/13 COMPLETED 10/8/13
GROUND ELEVATION ____ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
▽ AT TIME OF DRILLING 21.0 ft
LOGGED BY NWB CHECKED BY MAB
▼ AT END OF DRILLING 21.0 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels and boulders, brown to gray, moist, very stiff	SS 1	61	4-6-9 (15)							
5		**Boulder at 5 ft**										
		SHALE, red to brown to gray, very soft to soft, completely to highly weatherd	SS 2	44	13-13-12 (25)							
10												
			SS 3	72	14-18-26 (44)							
15												
			SS 4	67	50							
20		▼										
25		Bottom of hole at 25.2 feet.	SS 5	0	50/2"							

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-6

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/8/13 COMPLETED 10/8/13
GROUND ELEVATION ____ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
▽ AT TIME OF DRILLING 17.0 ft
LOGGED BY NWB CHECKED BY MAB
▼ AT END OF DRILLING 17.0 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels and boulders, brown to gray, moist, medium stiff to hard	SS 1	94	2-3-5 (8)							
5			SS 2	67	4-4-4 (8)							
			SS 3	89	4-5-7 (12)							
10			SS 4	94	4-5-8 (13)							
			SS 5	100	5-15-30 (45)							
15		SHALE, red to brown to gray, very soft to soft, completely to highly weathered	SS 6	100	50/3"							
20												
25		Bottom of hole at 25.3 feet.	SS 7	100	50/3"							

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-7

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/8/13 COMPLETED 10/8/13
GROUND ELEVATION ___ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
▽ AT TIME OF DRILLING 15.0 ft
LOGGED BY NWB CHECKED BY MAB
▼ AT END OF DRILLING 15.0 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels and boulders, brown to gray, moist, very stiff	SS 1	39	5-6-7 (13)							
		Boulder at 3.5 ft										
5		SHALE, red to brown to gray, very soft to soft, completely to highly weathered	SS 2	22	50							
10												
15			SS 3	100	50/4"							
20												
25		Bottom of hole at 25.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-8

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/8/13 COMPLETED 10/8/13
GROUND ELEVATION ___ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
▽ AT TIME OF DRILLING 12.0 ft
LOGGED BY NWB CHECKED BY MAB
▼ AT END OF DRILLING 12.0 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels and boulders, brown to gray, moist, very stiff	SS 1	61	6-7-11 (18)							
5			SS 2	89	9-8-12 (20)							
			SS 3	78	6-6-11 (17)							
		SHALE, red to brown to gray, very soft to soft, completely to highly weathered	MC 1	78	11-20-29 (49)							
10												
		▼										
15			SS 4	61	18-34-50 (84)							
20		Bottom of hole at 20.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-9

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/8/13 COMPLETED 10/8/13
GROUND ELEVATION ____ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY NWB CHECKED BY MAB
AT END OF DRILLING dry
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels and boulders, brown to gray, moist, stiff										
2.5		**Boulder at 4 ft**										
5.0												
7.5		SHALE, red to brown to gray, very soft, completely weathered	SS 1	61	11-16-22 (38)							
		Bottom of hole at 8.5 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-10

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/8/13 COMPLETED 10/8/13
GROUND ELEVATION ____ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY NWB CHECKED BY MAB
AT END OF DRILLING dry
NOTES ____
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels and boulders, brown to gray, moist, stiff to very stiff										
		Boulder at 2 ft										
2.5												
5.0												
7.5			SS 1	78	6-6-5 (11)							
			SS 2	100	5-5-8 (13)							
10.0			SS 3	83	5-8-11-14 (19)							
12.5		SHALE, red to brown to gray, very soft, completely weathered	SS 4	67	8-15-24 (39)							
		Bottom of hole at 13.5 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-11

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/8/13 COMPLETED 10/8/13
GROUND ELEVATION ____ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY NWB CHECKED BY MAB
AT END OF DRILLING dry
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels, brown to gray, moist, stiff										
2.5												
5.0												
7.5												
		SHALE, red to brown to gray, very soft, completely weathered	SS 1	79	8-11-12-16 (23)							
		Bottom of hole at 9.5 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-12

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/8/13 COMPLETED 10/8/13
GROUND ELEVATION ____ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY NWB CHECKED BY MAB
AT END OF DRILLING dry
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels, brown to gray, moist, very stiff										
2.5												
5.0												
7.5			SS 1	88	4-8-11-22 (19)							
10.0			SS 2	96	3-4-4-9 (8)							
		SHALE, red to brown to gray, very soft, completely weathered										
		Bottom of hole at 11.5 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-13

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO
DATE STARTED 10/8/13 COMPLETED 10/8/13
GROUND ELEVATION ___ HOLE SIZE 4 inch
DRILLING CONTRACTOR S. McCracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY NWB CHECKED BY MAB
AT END OF DRILLING dry
NOTES ___
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Sandy Lean CLAY with Organics (TOPSOIL), brown, moist										
		Sandy Lean CLAY (cl), trace gravels and boulders, brown to gray, moist										
2.5												
5.0			SS 1	71	10-10-17-18 (27)							
		SHALE, red to brown to gray, very soft, completely weathered										
		Bottom of hole at 7.0 feet.										

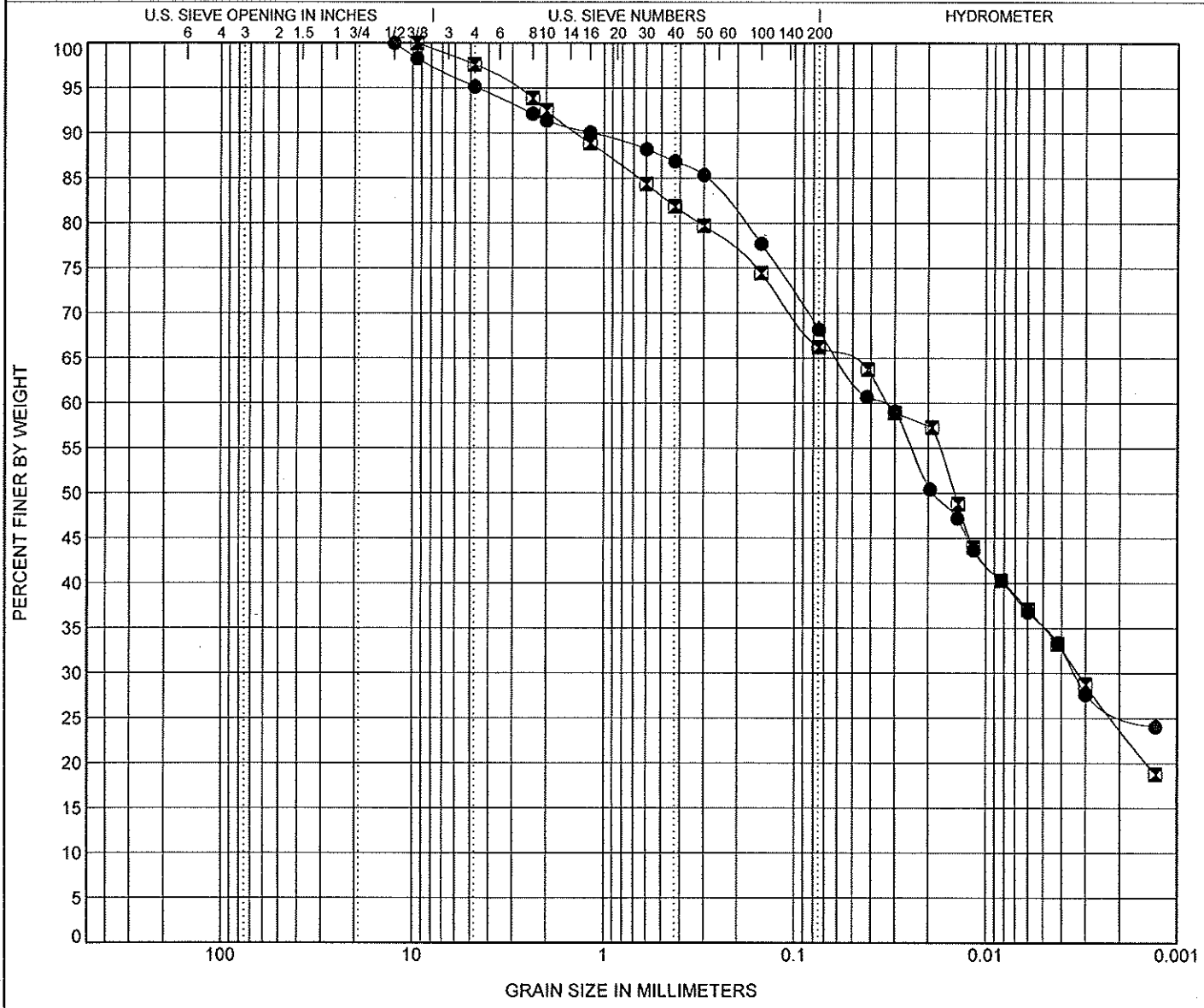
APPENDIX C
Laboratory Testing Results

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

GRAIN SIZE DISTRIBUTION

CLIENT Weston Solutions Inc **PROJECT NAME** Water Impoundments

PROJECT NUMBER 01302-0001 **PROJECT LOCATION** Paonia, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● Overburden 10/13	SANDY LEAN CLAY(CL)	37	16	21		
⊠ Shale 10/13	SANDY LEAN CLAY(CL)	35	18	17		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● Overburden 10/13	12.5	0.036	0.003		4.8	27.0	42.3	25.9
⊠ Shale 10/13	9.5	0.032	0.003		2.4	31.4	42.3	23.9

GRAIN SIZE 01302-0001 WATER IMPOUNDMENTS.GPJ GINT US LAB.GDT 11/18/13

Client:	Huddleston-Berry Engineering & Testing, LLC 640 White Avenue Unit B Grand Junction, CO 81501-	**Report Date:**	November 20, 2013
		Project #:	13-519-00116
		Work Order #:	6
Attn:	Jason Collard	**Lab #:**	13-1287-02
Project Name:	Huddleston-Berry 2013-14 Misc. Testing	**Sampled By:**	Client
		Date Sampled:	
	Albuquerque, NM	**Visual Description of Material:**	Overburden
		Sample Source:	
Project Manager:	Jason Olivar	**SOILS / AGGREGATES**	

Particle Size Analysis of Soils (ASTM D422-63)

ASTM 4221-99 2.732

Weight of Sample Dispersed: 57.44

Hydrometer Results (% Passing)

Particle Size Diameter (mm)	0.0329	0.0215	0.0127	0.0091	0.0065	0.0032	0.0014	0.0010
Percent of Test Sample:	40.2	30.8	25.7	20.5	17.1	12.0	6.8	3.4
Percent of Total Sample:	34.2	26.2	21.8	17.5	14.5	10.2	5.8	2.9

Size Classification:	Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Colloids
Percent (%):	12.3	2.8	3.6	12.8	56.0	12.5	3.1

Coarse Portion:

Sieve Size	Passing
1in.	100%
3/4in.	97.8%
1/2in.	95.3%
3/8in.	92.9%
#4	87.7%
#8	85.4%
#10	84.9%

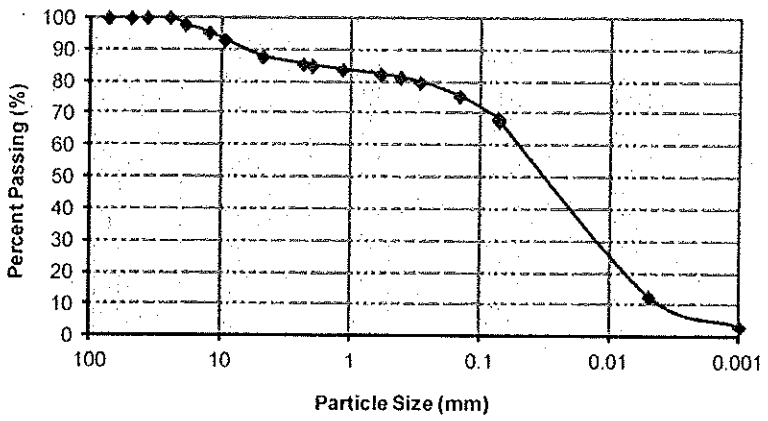
Fine Portion:

#16	83.8%
#30	82.3%
#40	81.4%
#50	79.9%
#100	75.5%
#200	68.5%

Hydrometer Portion:

0.074 mm	67.7%
0.005 mm	12.5%
0.001 mm	3.1%

Particle Size Distribution Curve



Dispersing Device Used: A

Length of Dispersing Period (min): 1

Description of sand and gravel particles:

Shape:

Hardness:

Reviewed By: Jan

Distribution: Client ; File: ✓ Supplier: ✓ Email: ; Other: Jason Collard (email) (1)

AMEC Environment & Infrastructure, Inc
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371

www.amec.com

Client:	Huddleston-Berry Engineering & Testing, LLC 640 White Avenue Unit B Grand Junction, CO 81501-	**Report Date:**	November 20, 2013
		Project #:	13-519-00116
		Work Order #:	6
Attn:	Jason Collard	**Lab #:**	13-1287-01
Project Name:	Huddleston-Berry 2013-14 Misc. Testing	**Sampled By:**	Client
		Date Sampled:	
	Albuquerque, NM	**Visual Description of Material:**	Shale
		Sample Source:	
Project Manager:	Jason Olivar	**SOILS / AGGREGATES**	

Particle Size Analysis of Soils (ASTM D422-63)

ASTM 4221-99 2.662

Weight of Sample Dispersed: 73.60

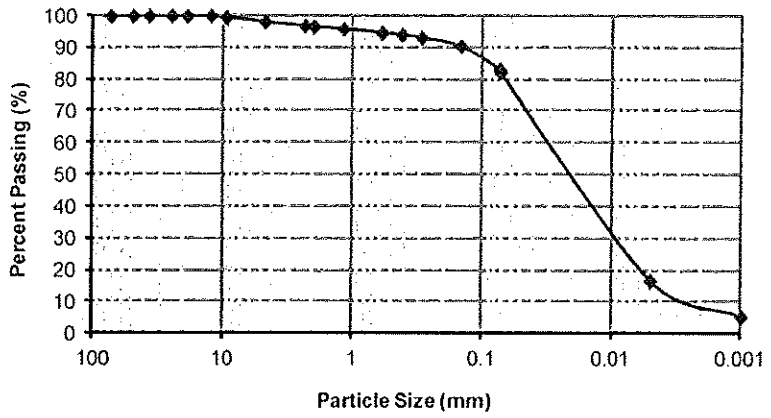
Hydrometer Results (% Passing)

Particle Size Diameter (mm)	0.0314	0.0204	0.0125	0.0090	0.0065	0.0033	0.0014	0.0010
Percent of Test Sample:	44.7	39.3	28.5	24.4	20.3	13.6	8.1	5.4
Percent of Total Sample:	43.2	38.0	27.5	23.6	19.6	13.1	7.9	5.2

Size Classification:	Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Colloids
Percent (%):	1.9	1.5	2.6	10.8	66.5	16.7	5.3

	Sieve Size	Passing
Coarse Portion:	1/2in.	100%
	3/8in.	99.5%
	#4	98.1%
	#8	96.9%
	#10	96.6%
Fine Portion:	#16	95.9%
	#30	94.7%
	#40	94.0%
	#50	93.1%
	#100	90.5%
	#200	83.2%

Particle Size Distribution Curve



Hydrometer Portion:

0.074 mm	82.3%
0.005 mm	16.7%
0.001 mm	5.3%

Dispersing Device Used: A

Length of Dispersing Period (min): 1

Description of sand and gravel particles:

Shape:

Hardness:

Reviewed By: Jan

Distribution: Client File: ✓ Supplier: ✓ Email: Other: Jason Collard (email) (1)

AMEC Environment & Infrastructure, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

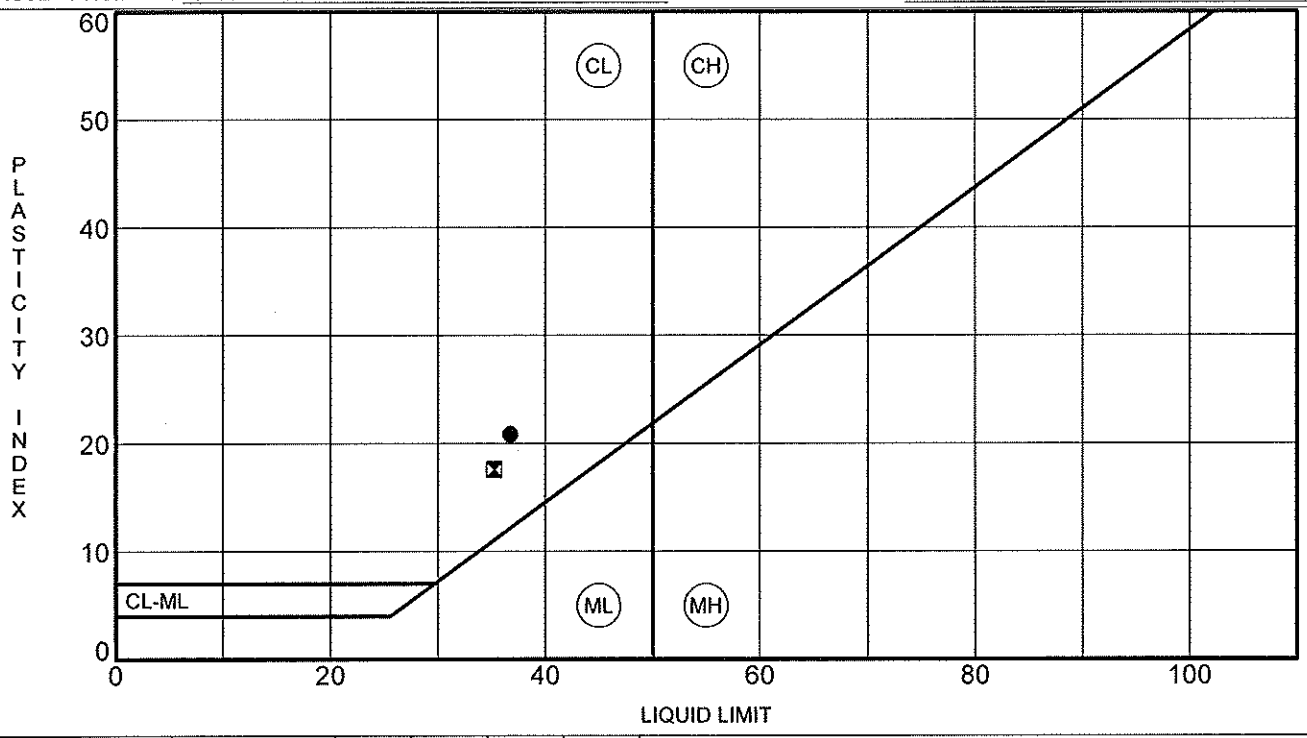
ATTERBERG LIMITS' RESULTS

CLIENT Weston Solutions Inc

PROJECT NAME Water Impoundments

PROJECT NUMBER 01302-0001

PROJECT LOCATION Paonia, CO

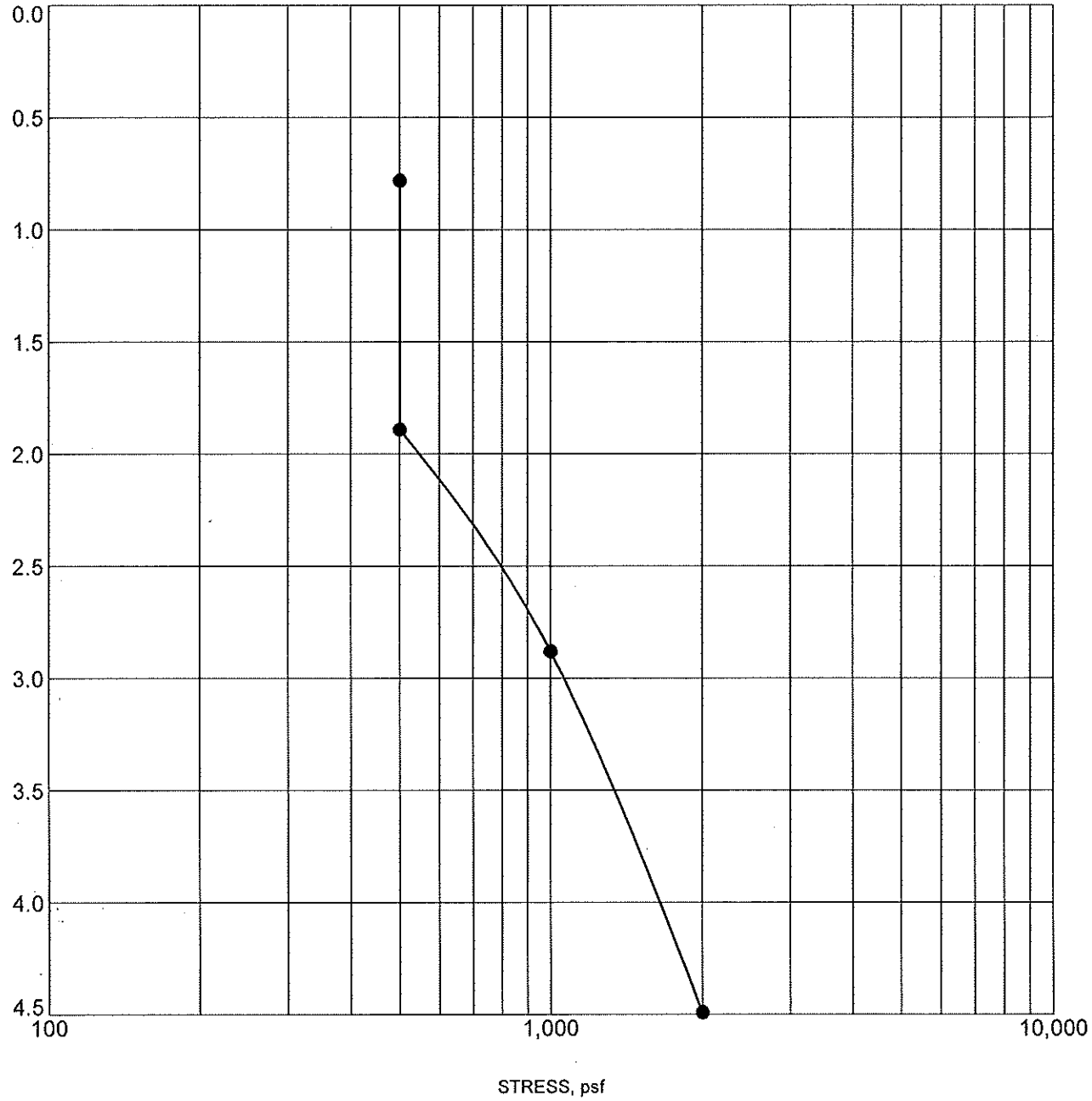


	Specimen Identification		LL	PL	PI	#200	Classification
●	Overburden	10/8/2013	37	16	21	68	SANDY LEAN CLAY(CL)
⊠	Shale	10/8/2013	35	18	17	66	SANDY LEAN CLAY(CL)

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

CONSOLIDATION TEST

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO



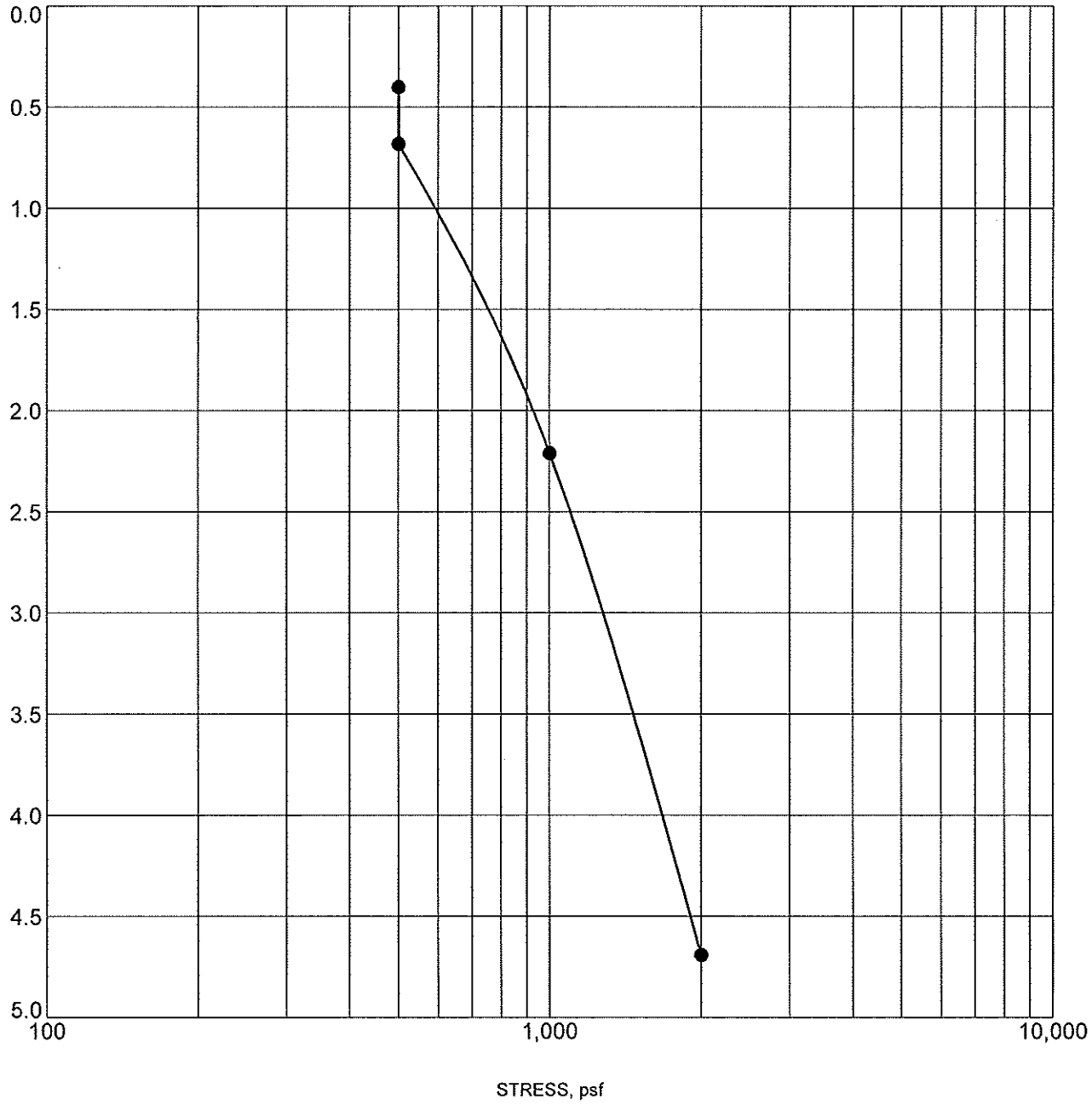
Specimen Identification		Classification	γ_d	MC%
● B-2 7.0			115	10

CONSOL STRAIN 01302-0001 WATER IMPOUNDMENTS.GPJ GINT US LAB.GDT 11/18/13

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

CONSOLIDATION TEST

CLIENT Weston Solutions Inc
PROJECT NAME Water Impoundments
PROJECT NUMBER 01302-0001
PROJECT LOCATION Paonia, CO



Specimen Identification		Classification	γ_d	MC%
● B-3 7.0			107	10

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

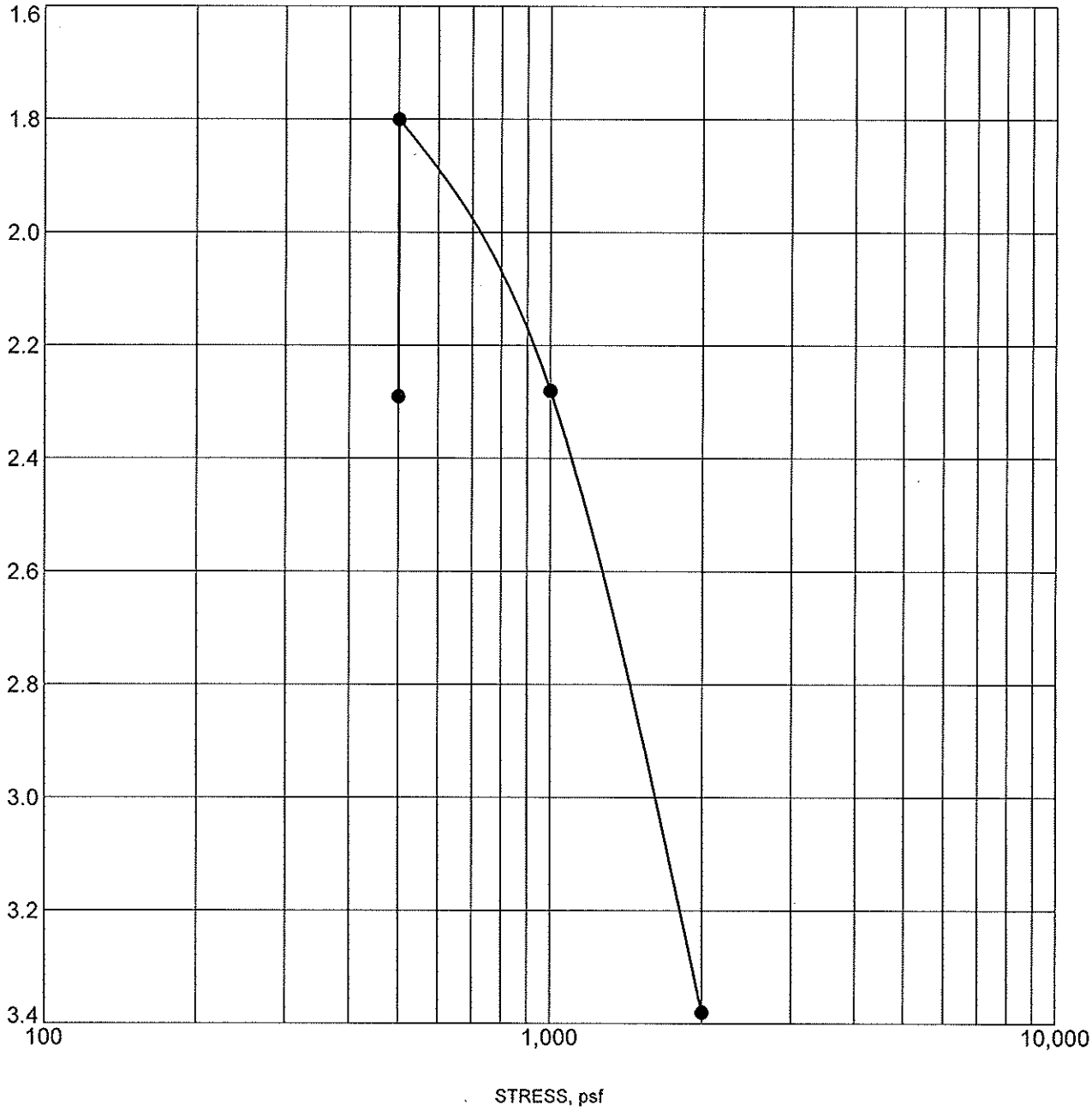
CONSOLIDATION TEST

CLIENT Weston Solutions Inc

PROJECT NAME Water Impoundments

PROJECT NUMBER 01302-0001

PROJECT LOCATION Paonia, CO



Specimen Identification		Classification	γ_d	MC%
● B-4	14.0		113	13

CONSOL STRAIN 01302-0001 WATER IMPOUNDMENTS.GPJ GINT US LAB.GDT 11/18/13

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

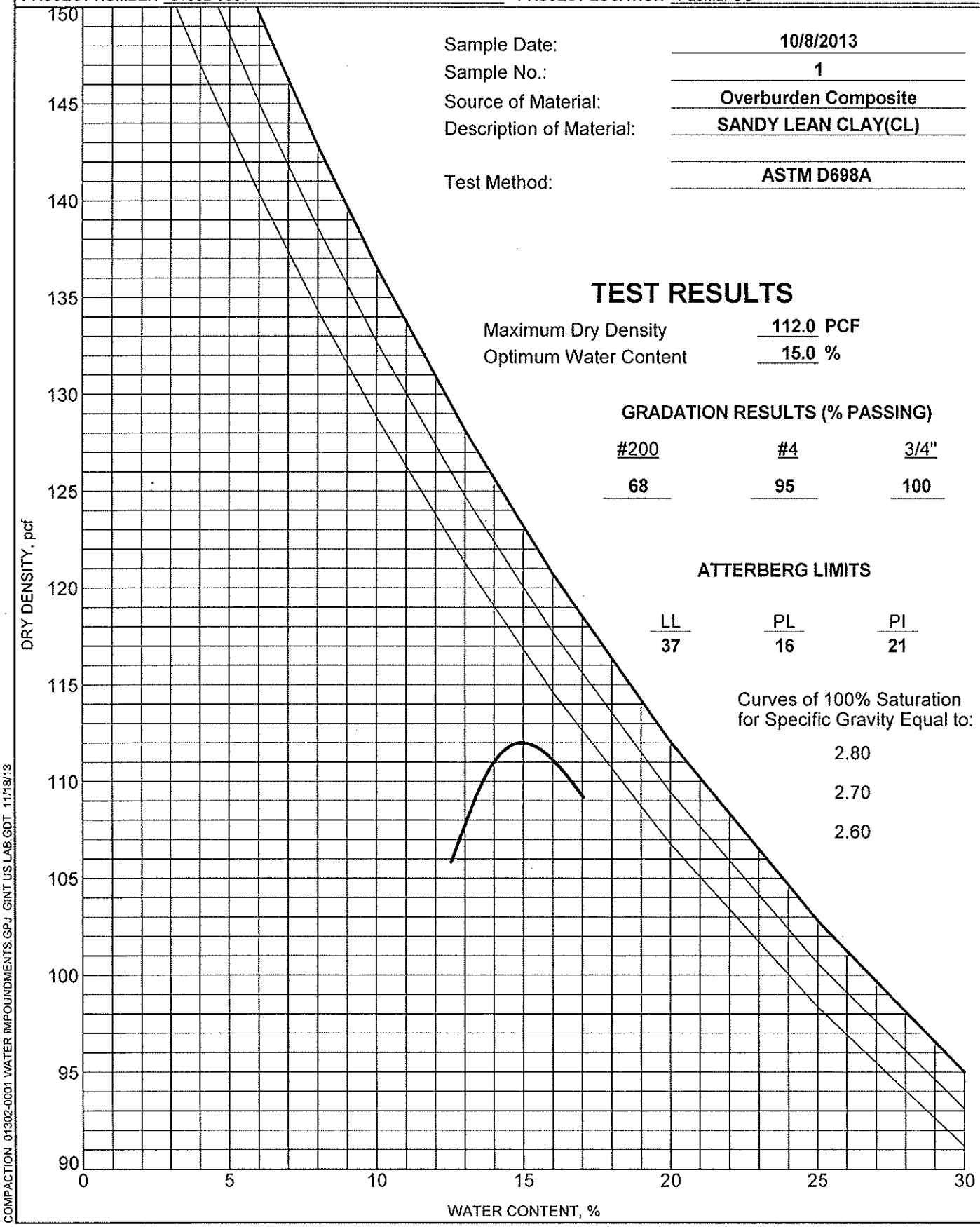
MOISTURE-DENSITY RELATIONSHIP

CLIENT Weston Solutions Inc

PROJECT NAME Water Impoundments

PROJECT NUMBER 01302-0001

PROJECT LOCATION Paonia, CO



Sample Date: 10/8/2013

Sample No.: 1

Source of Material: Overburden Composite

Description of Material: SANDY LEAN CLAY(CL)

Test Method: ASTM D698A

TEST RESULTS

Maximum Dry Density 112.0 PCF

Optimum Water Content 15.0 %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
68	95	100

ATTERBERG LIMITS

LL	PL	PI
37	16	21

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

COMPACTION 01302-0001 WATER IMPOUNDMENTS.GPJ GINT US LAB.GDT 11/18/13

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

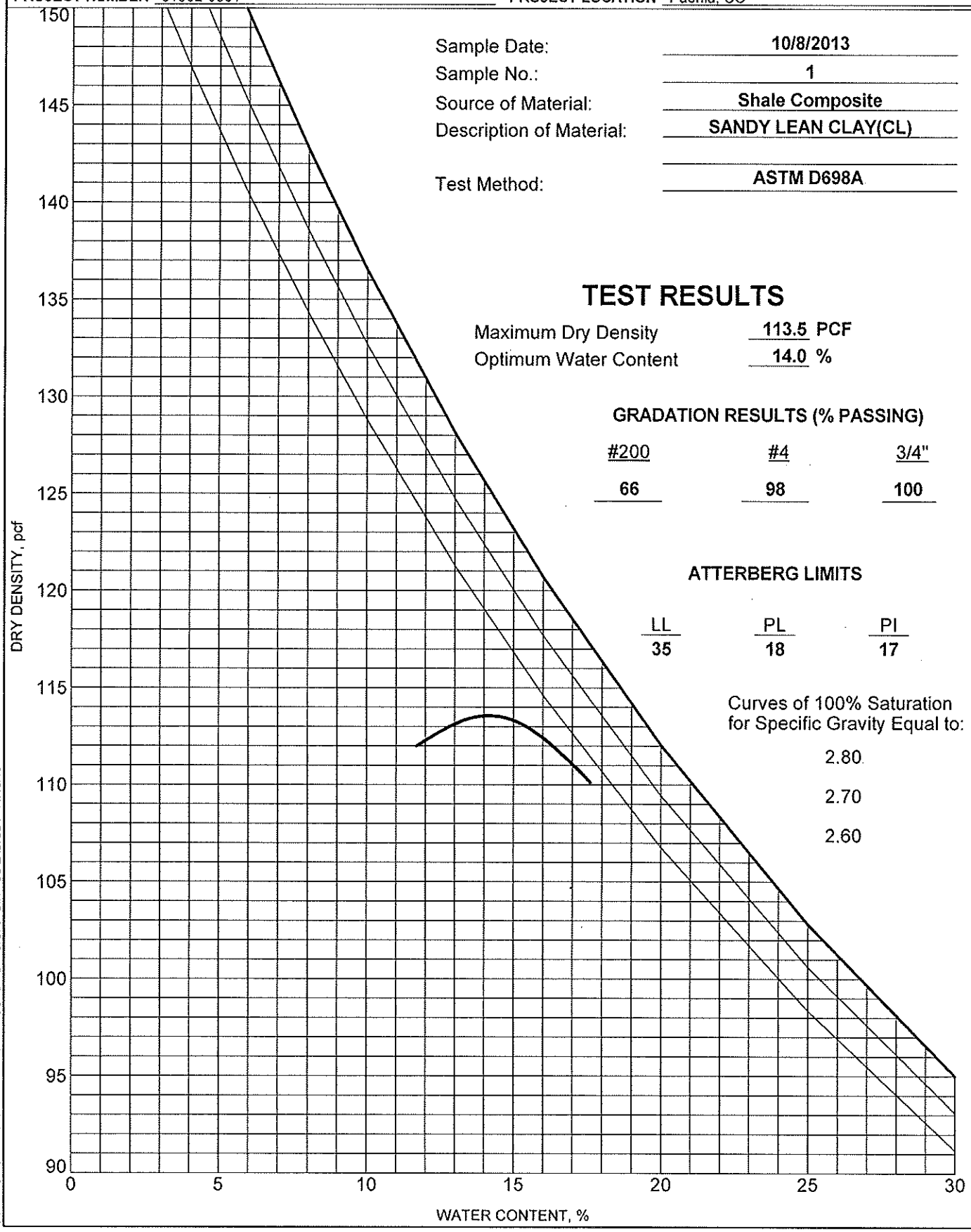
MOISTURE-DENSITY RELATIONSHIP

CLIENT Weston Solutions Inc

PROJECT NAME Water Impoundments

PROJECT NUMBER 01302-0001

PROJECT LOCATION Paonia, CO



Sample Date:	10/8/2013
Sample No.:	1
Source of Material:	Shale Composite
Description of Material:	SANDY LEAN CLAY(CL)
Test Method:	ASTM D698A

TEST RESULTS

Maximum Dry Density	113.5 PCF
Optimum Water Content	14.0 %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
66	98	100

ATTERBERG LIMITS

LL	PL	PI
35	18	17

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

Client:	Huddleston-Berry Engineering & Testing, LLC 640 White Avenue Unit B Grand Junction, CO 81501-	Report Date:	November 08, 2013
		Project #:	13-519-00116
		Work Order #:	6
Attn:	Jason Collard	Lab #:	13-1287-02
Project Name:	Huddleston-Berry 2013-14 Misc. Testing	Sampled By:	Client
		Date Sampled:	
	Albuquerque, NM	Visual Description of Material:	Overburden
		Sample Source:	
Project Manager:	Jason Olivar	SOILS / AGGREGATES	

Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter (ASTM D5084-10)

Method: C

Sample Preparation: Remolded to 90% of 112.0 @ 15.0%
Compaction Method:

Initial Diameter (cm):	6.02	Final Diameter (cm):	6.10
Initial Length (cm):	7.67	Final Length (cm):	7.72
Initial Moisture:	15.0%	Final Moisture:	25.5%
Initial Unit Weight (pcf):	100.6	Final Unit Weight (pcf):	97.4
Initial Volume (in³):	13.3	Final Volume (in³):	13.8
Initial Degree of Saturation:	62%	Final Degree of Saturation:	97%

Permeant Liquid:	Water
Magnitude of Total Backpressure:	83.0
Effective Stress:	2.0
Range of Hydraulic Gradient Used:	1.76 To 2.78
Estimated Specific Gravity:	2.65

Time Interval (sec)	Corrected Hydraulic Conductivity (cm/sec)
15	4.00E-04
16	3.95E-04
22	4.00E-04
25	3.99E-04
Average:	4.0E-04

Note: All final sample dimensions are subject to sample deformation caused by exsolution of air in pore water and handling during removal from cell.

Reviewed By: _____
jo

Distribution: Client ☐ File: ☑ Supplier: ☑ Email: ☐ Other: Jason Collard (email) (1)

AMEC Environment & Infrastructure, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371 www.amec.com

Client:	Huddleston-Berry Engineering & Testing, LLC	Report Date:	November 06, 2013
	640 White Avenue		
	Unit B	Project #:	13-519-00116
	Grand Junction, CO 81501-	Work Order #:	6
Attn:	Jason Collard	Lab #:	13-1287-01
Project Name:	Huddleston-Berry 2013-14 Misc. Testing	Sampled By:	Client
		Date Sampled:	
	Albuquerque, NM	Visual Description of Material:	Shale
		Sample Source:	
Project Manager:	Jason Olivar	SOILS / AGGREGATES	

Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter (ASTM D5084-10)

Method: C

Sample Preparation: Remolded to 90% of 113.5 @ 14.0%
Compaction Method:

Initial Diameter (cm):	6.05	**Final Diameter (cm):**	5.97
Initial Length (cm):	7.68	**Final Length (cm):**	7.84
Initial Moisture:	14.1%	**Final Moisture:**	22.3%
Initial Unit Weight (pcf):	101.5	**Final Unit Weight (pcf):**	102.1
Initial Volume (in³):	13.5	**Final Volume (in³):**	13.4
Initial Degree of Saturation:	59%	**Final Degree of Saturation:**	95%

Permeant Liquid:	Water
Magnitude of Total Backpressure:	68.0
Effective Stress:	2.0
Range of Hydraulic Gradient Used:	3.29 To 3.50
Estimated Specific Gravity:	2.65

Time Interval (sec)	Corrected Hydraulic Conductivity (cm/sec)
97	1.07E-05
96	1.14E-05
103	1.08E-05
101	1.09E-05
Average:	1.1E-05

Note: All final sample dimensions are subject to sample deformation caused by exsolution of air in pore water and handling during removal from cell.

Reviewed By: _____
jo

Distribution: Client ☐ File: ☑ Supplier: ☑ Email: ☐ Other: Jason Collard (email) (1)

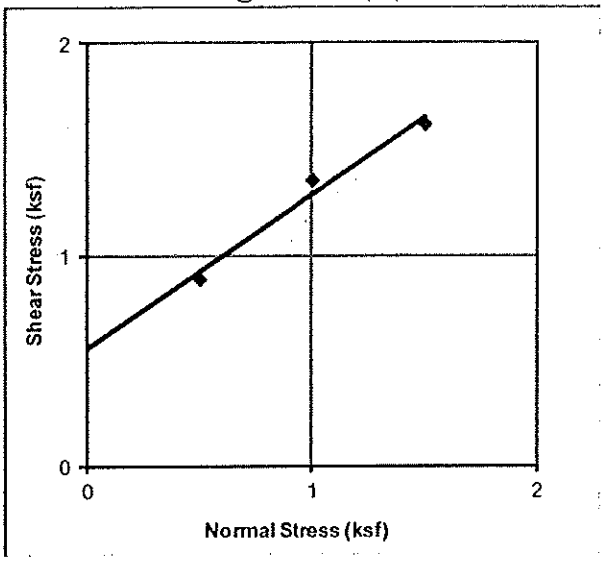
AMEC Environment & Infrastructure, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371 www.amec.com

Client:	Huddleston-Berry Engineering & Testing, LLC 640 White Avenue Unit B Grand Junction, CO 81501-	**Report Date:**	October 31, 2013
		Project #:	13-519-00116
		Work Order #:	6
Attn:	Jason Collard	**Lab #:**	13-1287-02
Project Name:	Huddleston-Berry 2013-14 Misc. Testing	**Sampled By:**	Client
		Date Sampled:	
	Albuquerque, NM	**Visual Description of Material:**	Overburden
		Sample Source:	
Project Manager:	Jason Olivar		

SOILS / AGGREGATES

Direct Shear Test of Soils Under Consolidated Drained Conditions (ASTM D3080-04)

Direct Shear Point Number:	1	2	3
Initial Diameter of specimen (in.):	2.42	2.42	2.42
Initial Thickness of specimen (in.):	1.00	1.00	1.00
Dry Mass of Specimen (g):	121.8	121.1	121.9
Initial Moisture (%):	15.1%	14.9%	14.9%
Initial Wet Density (pcf):	116.5	115.6	116.4
Initial Dry Density (pcf):	101.2	100.6	101.3
Final Thickness of specimen (in.)::	1.01	1.01	0.99
Final Moisture (%):	14.8%	14.7%	14.7%
Final Wet Density (pcf):	115.4	114.4	117.9
Final Dry Density (pcf):	100.5	99.7	102.9
Normal Stress (ksf):	0.50	1.00	1.50
Maximum Shearing Stress (ksf):	0.888	1.356	1.620
Vertical Deformation @ Max Shear (in.):	0.068	0.029	0.017
Horizontal Deformation @ Max Shear (in.):	0.245	0.160	0.550



Shearing Device Used:
Geomatic Direct Shear Apparatus, Model 8914

Sample Preparation:
Remolded to 90% of 112.0 @ 15.0%

Rate of Deformation (in./min.): 0.01

Internal Friction Angle (deg.): 36.2

Cohesion (kips/sq.ft.): 0.5560

Reviewed By: _____
Jan

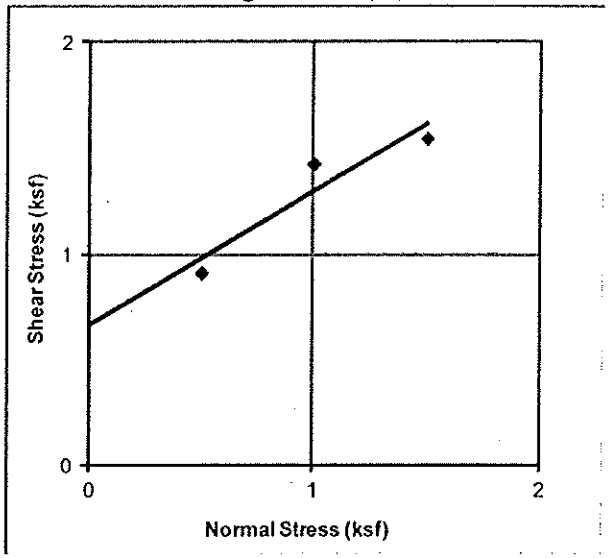
Distribution: Client ☐ File: ☑ Supplier: ☑ Email: ☐ Other: Jason Collard (email) (1)

AMEC Environment & Infrastructure, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client:	Huddleston-Berry Engineering & Testing, LLC 640 White Avenue Unit B Grand Junction, CO 81501-	**Report Date:**	October 31, 2013
		Project #:	13-519-00116
		Work Order #:	6
Attn:	Jason Collard	**Lab #:**	13-1287-01
Project Name:	Huddleston-Berry 2013-14 Misc. Testing	**Sampled By:**	Client
		Date Sampled:	
	Albuquerque, NM	**Visual Description of Material:**	Shale
		Sample Source:	
Project Manager:	Jason Olivar	**SOILS / AGGREGATES**	

Direct Shear Test of Soils Under Consolidated Drained Conditions (ASTM D3080-04)

Direct Shear Point Number:	1	2	3
Initial Diameter of specimen (in.):	2.42	2.42	2.42
Initial Thickness of specimen (in.):	1.00	1.00	1.00
Dry Mass of Specimen (g):	123.7	123.5	123.5
Initial Moisture (%):	14.0%	14.0%	14.0%
Initial Wet Density (pcf):	117.1	117.0	117.0
Initial Dry Density (pcf):	102.8	102.6	102.6
Final Thickness of specimen (in.)::	1.01	1.01	0.99
Final Moisture (%):	13.5%	13.8%	13.7%
Final Wet Density (pcf):	115.6	115.9	117.6
Final Dry Density (pcf):	101.8	101.8	103.4
Normal Stress (ksf):	0.50	1.00	1.50
Maximum Shearing Stress (ksf):	0.912	1.428	1.548
Vertical Deformation @ Max Shear (in.):	0.060	0.031	0.028
Horizontal Deformation @ Max Shear (in.):	0.250	0.150	0.175



Shearing Device Used:
Geomatic Direct Shear Apparatus, Model 8914

Sample Preparation:
Remolded to 90% of 113.5 @ 14.0%

Rate of Deformation (in./min.): 0.01

Internal Friction Angle (deg.): 32.5

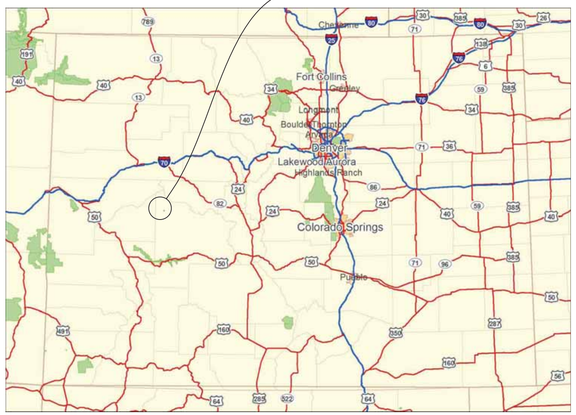
Cohesion (kips/sq.ft.): 0.6600

Reviewed By: _____
Jan

Distribution: Client ☐ File: ☑ Supplier: ☑ Email: ☐ Other: Jason Collard (email) (1)

AMEC Environment & Infrastructure, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

ATTACHMENT F
ENGINEERING PACKAGE



STATE MAP
NO SCALE

GUNNISON ENERGY LLC
AN OXBOW COMPANY

CONSTRUCTION PLANS FOR

SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY, COLORADO

VICINITY MAP
NO SCALE

DRAFT COPY
NOT FOR CONSTRUCTION

NAME 05AUG14 — ENGINEER OF RECORD — DATE

NAME 05AUG14 — PROJECT MANAGER — DATE

ABBREVIATIONS

ABBREVIATION	DESCRIPTION	ABBREVIATION	DESCRIPTION
<	LESS THAN	LVC	LENGTH OF VERTICAL CURVE
>	GREATER THAN	MAX.	MAXIMUM
AMSL	ABOVE MEAN SEA LEVEL	MFR.	MANUFACTURER
AST	ABOVEGROUND STORAGE TANK	MIN.	MINIMUM
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS	N	NORTHING COORDINATE
BCF	BASIN CHARACTERISTICS FILE	NAD	NORTH AMERICAN DATUM
BFE	BASE FLOOD ELEVATION	NAVD	NORTH AMERICAN VERTICAL DATUM
BMP(S)	BEST MANAGEMENT PRACTICES	NFIP	NATIONAL FLOOD INSURANCE PROGRAM
BOP	BEGINNING OF PROJECT	NFIS	NATIONAL FLOOD INSURANCE SERVICE
BVCE	BEGINING VERTICAL CURVE ELEVATION	NIC	NOT IN CONTRACT
BVCS	BEGINING VERTICAL CURVE STATION	O.C.	ON CENTER
CBC	CONCRETE BOX CULVERT	OFF.	OFFSET
CGP	CONSTRUCTION GENERAL PERMIT	OHU	OVERHEAD UTILITY
CIP	COMPLETE IN PLACE	OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
C_L	CENTERLINE	PC	POINT OF CURVATURE
CMP	CORRUGATED METAL PIPE	PI	POINT OF INTERSECTION
CON	CONSTRUCTION	PVI	POINT OF VERTICAL INTERSECTION
CONC.	CONCRETE	R	RADIUS
CU. FT.	CUBIC FEET	RCP	REINFORCED CONCRETE PIPE
CY	CUBIC YARD	ROW	RIGHT OF WAY
DWG	DRAWING	S	SLOPE
E	EASTING COORDINATE	SHT	SHEET
ELEC	ELECTRIC	SPEC	SPECIFICATION
ELEV	ELEVATION	SS	SANITARY SEWER
EOP	END OF PROJECT	STA.	STATION
FEMA	FEDERAL EMERGENCY MANAGEMENT AGENCY	STD	STANDARD
FOD	FOREIGN OBJECT DAMAGE	SWPPP	STORM WATER POLLUTION PREVENTION PLAN
FT	FEET	TBM	TEMPORARY BENCHMARK
H:V	HORIZONTAL: VERTICAL	TCP	TEMPORARY CONTROL POINT
HAZMO	HAZARDOUS MATERIALS MANAGEMENT OFFICE	TYP	TYPICAL
HP	HIGH POINT	U.S.	UNITED STATES
IN	INCH	UFGS	UNITED FACILITIES GUIDE SPECIFICATIONS
INV	INVERT	USACE	UNITED STATES CORPS OF ENGINEERS
IPC	INTERNATIONAL PLUMBING CODE	USGS	UNITED STATES GEOLOGICAL SURVEY
K	RATE OF VERTICAL CURVATURE	W	WATER
LF	LINEAR FEET	W/O	WITHOUT
LP	LOW POINT	Z	VERTICAL ELEVATION

INDEX

APPROVED FOR CONSTRUCTION:

PROJECT ENGINEER — DATE

CONTACTS

OWNER
GUNNISON ENERGY LLC
1801 BROADWAY, SUITE 1200
DENVER, CO 80202

ENGINEER
WESTON SOLUTIONS, INC.
1435 GARRISON STREET, SUITE 100
LAKEWOOD, CO 80215

P:\Spadafora\101\COVER.dwg March 11, 2015 - 1:40pm

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY — COLORADO
LAKEWOOD — COLORADO

	CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

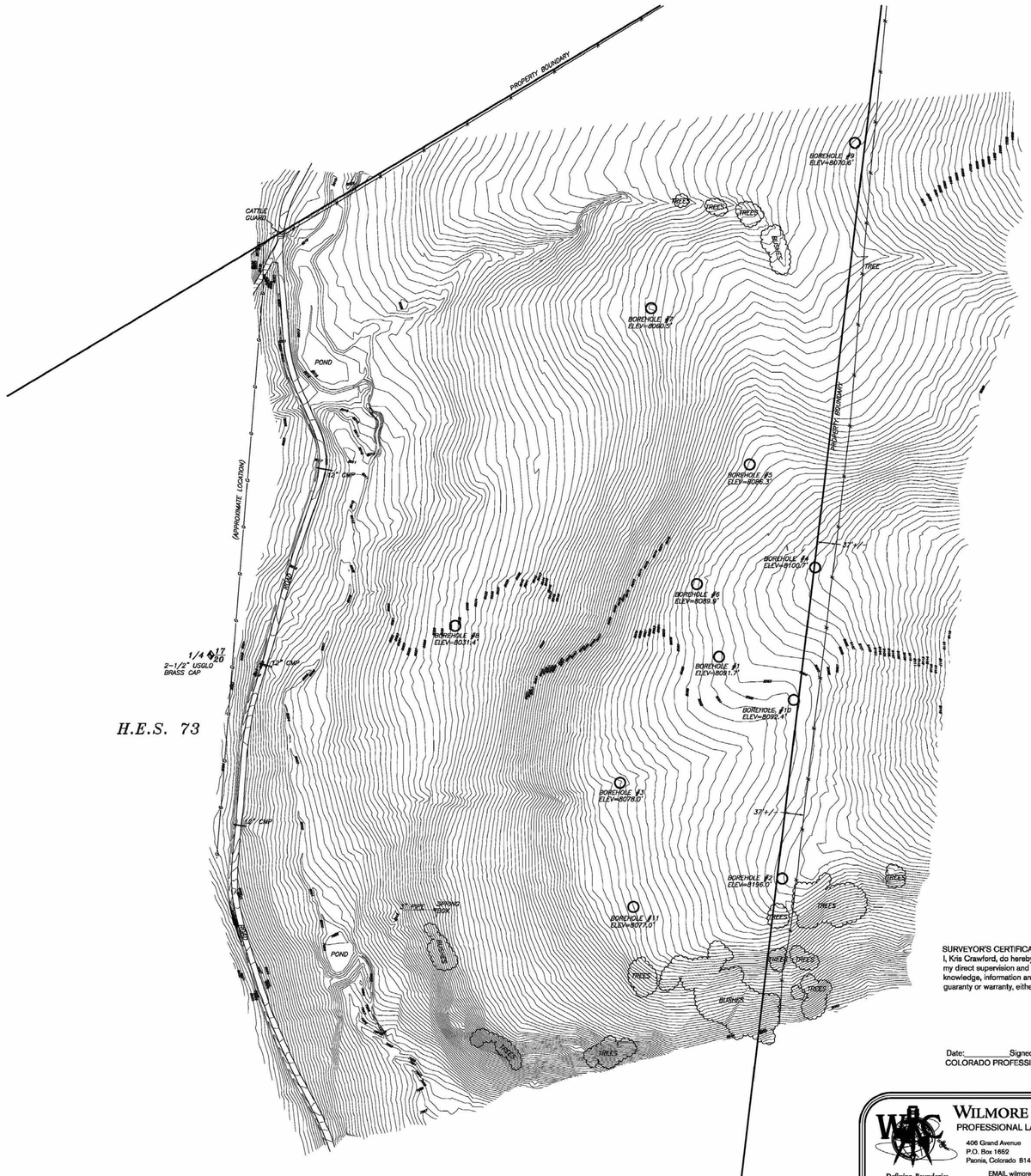
NOT FOR CONSTRUCTION

COVER

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C001	A
SCALE	W.O. NO.	SHT 1 OF 34	
	14798.001.001		

SITE TOPO PREPARED FOR GUNNISON-ENERGY-SPADAFORA

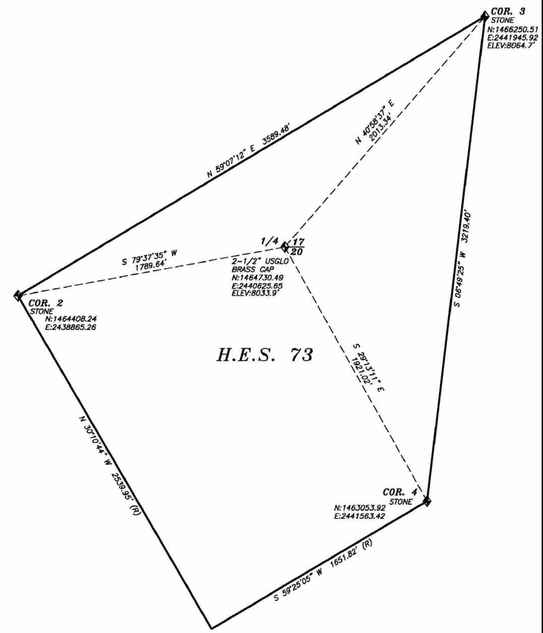
WITHIN H.E.S. 73, SEC. 17 & 20, T.11S., R.90W., 6TH P.M.
GUNNISON COUNTY, COLORADO



COORDINATE SYSTEM:
U.S. STATE PLANE 1983
COLORADO CENTRAL ZONE
LAMBERT CONFORMAL CONIC
GEOID–CONUS 2009

GPS OBSERVATION
SCALE 1"=100 U.S. SURVEY FEET
0 50 100 200

OVERVEW SCALE: 1"=400'



SURVEYOR'S CERTIFICATION
I, Kris Crawford, do hereby certify that the above described parcel has been surveyed by me and under my direct supervision and that such survey is accurately represented hereon, and is based upon my knowledge, information and belief, and is in accordance with applicable standards of practice and is not a guaranty or warranty, either expressed or implied.

Date:_____Signed: _____
COLORADO PROFESSIONAL LAND SURVEYOR #38255

NOTE: According to Colorado law you must bring any legal action based upon a defect in this survey within three years after you first discover such defect. In no event may any action based upon any defect in this survey be commenced more than ten years from the date shown on the certification hereon.

WILMORE & COMPANY
PROFESSIONAL LAND SURVEYING, INC.
406 Grand Avenue
P.O. Box 1652
Paonia, Colorado 81428
970.527-4200 PHONE
970.527-4202 FAX
www.wilmorelandsurveying.com
EMAIL wilmoreandcompany@tds.net
Defining Boundaries

FIELD CREW: RAW, KC
DRAFTER: KC
CHECKED BY: RAW

SITE TOPO PREPARED FOR GUNNISON-ENERGY-SPADAFORA
WITHIN H.E.S. 73, SEC. 17 & 20, T.11S., R.90W., 6TH P.M.
GUNNISON COUNTY, COLORADO

J13169 | 22 OCTOBER 2013

P:\Spadafora\101\COVER.dwg March 11, 2015 - 1:41pm

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

SURVEY

DRAWN: CP	DATE: MAR15	DWG. NO.: C002	REV. NO.: A
SCALE:	W.O. NO.: 14798.001.001	SHT. 2 OF 34	

PROPERTY BOUNDARY

FIRE ROAD

DRAINAGE SWALE 1/C111

MW-1

NORTH PIT 1/C105

MIDDLE PIT 1/C107

SOUTH PIT 1/C109

MW-2

VALVE BUILDING 1/C128

1/C125

MW-3

1/C126

1/C123

MW-4

MW-5

1/C114 NORTH SEDIMENT BASIN

1/C115 SOUTH SEDIMENT BASIN

ACCESS ROAD

SPRING BOX

3" PIPE EXISTING

BUSHES

TREES

STOCK POND

12" CMP EXISTING

ROAD

8050.00

8025.00

8075.00

GAS

W

CONSTRUCTION NOTES

A. TOTAL VOLUME OF THREE PITS 643,264 BARRELS
NORTH PIT VOLUME 209,056 BARRELS
MIDDLE PIT VOLUME 217,760 BARRELS
SOUTH PIT VOLUME 216,446 BARRELS

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- PROPOSED MONITORING WELL
- BURIED PIPE ROUTING

5 FOOT CONTOUR INTERVAL

0 60' 120'

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

GENERAL SITE PLAN

DRAWN: CP	DATE: MAR15	DWG. NO.: C101	REV. NO.: A
SCALE:	W.O. NO.: 14798.001.001	SHT. 3 OF 34	

P:\Spadafora\101\SITE\LAYOUT.dwg March 11, 2015 - 1:41pm

KEYED NOTES

1 SMOOTHLY GRADE TRANSITION OF FIRE ROAD TO EXISTING GROUND.

CONSTRUCTION NOTES

A. CLEAR AND GRUB 10-FOOT FIRE ROAD NEXT TO PROPERTY BOUNDARY.

B. CUT VOLUME = 287,520 CY
FILL VOLUME = 287,915 CY

C. FILL VOLUME BASED ON COMPACTION OF FILL TO 0.85 THE CUT VOLUME.

D. NO FILL WILL BE PLACED OUTSIDE THE DISTURBED AREA.

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE

2 FOOT CONTOUR INTERVAL

0 60' 120'

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

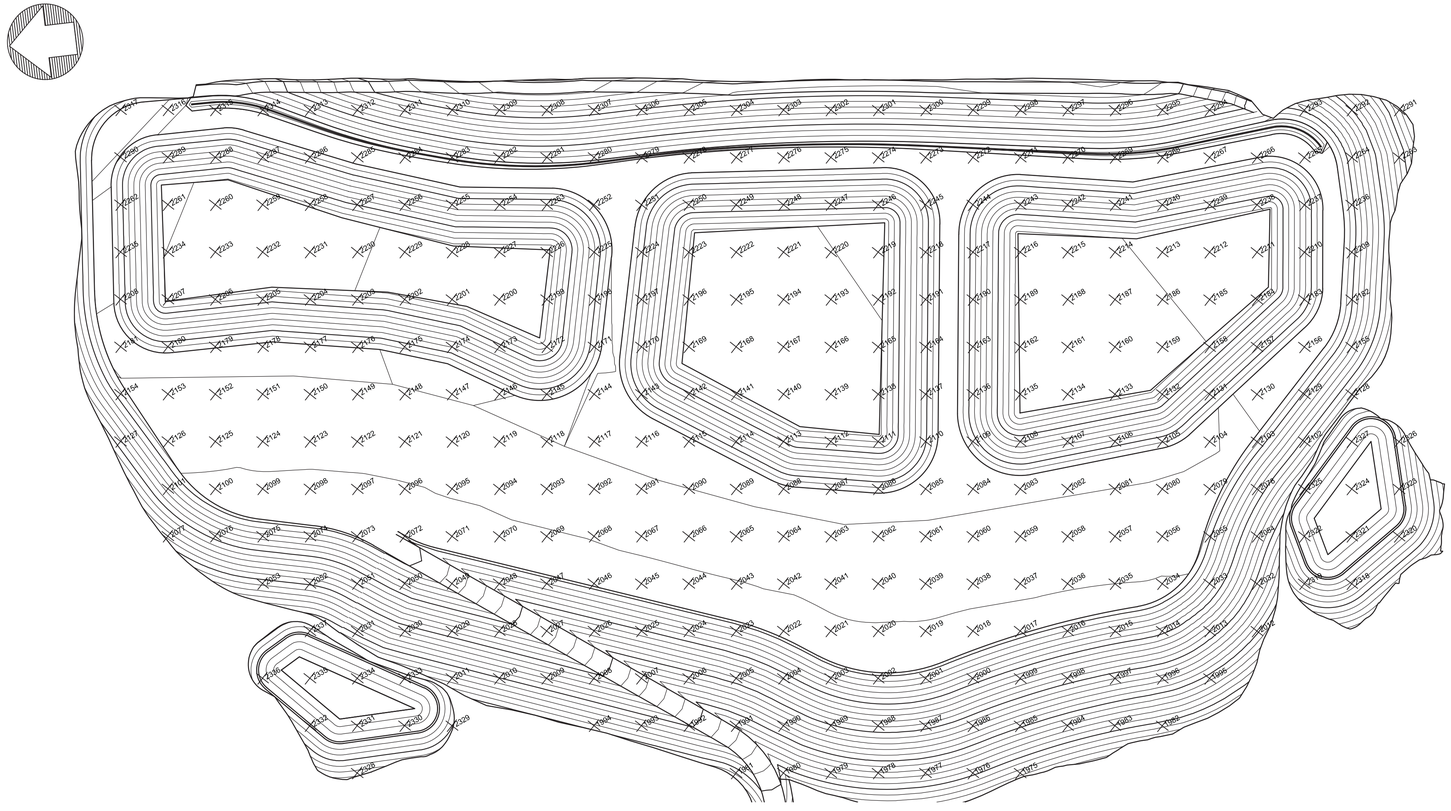
CHECKED DG	DATE MAR15	CLIENT APPROVALS	DATE
DES. ENG. DG	MAR15		
PROJ. ENG. DG	MAR15		
PROJ. MGR. DG	MAR15		
APPROVED			
APPROVED			

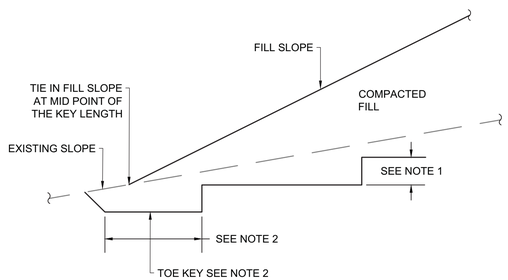
NOT FOR CONSTRUCTION

GRADING PLAN

DRAWN CP	DATE MAR15	DWG. NO. C102	REV. NO. A
SCALE	W.O. NO. 14798.001.001	SHT. 4 OF 34	

P:\Spadafora\101\GRADING\PLAN.dwg March 11, 2015 - 1:41pm





NOTE 1: EXCAVATED INTO COMPETENT FOUNDATION MATERIAL (ESTIMATED 5 FEET MINIMUM). TO BE VERIFIED BY GEOTECHNICAL ENGINEER DURING CONSTRUCTION.

NOTE 2: TOE KEY LENGTH A MINIMUM OF 5 TIMES TOE KEY DEPTH (ESTIMATED 15 FEET MINIMUM).

1 TOE KEY AND BENCH CONCEPT
NTS

Staking Table

Point #	Elevation	Northing	Easting
1974	8026.88	1464725.49	2440973.32
1975	8024.86	1464471.31	2440993.22
1976	8030.76	1464520.96	2440999.17
1977	8034.73	1464570.60	2441005.12
1978	8035.67	1464620.25	2441011.06
1979	8033.51	1464669.89	2441017.01
1980	8028.56	1464719.54	2441022.96
1981	8028.50	1464769.18	2441028.91
1982	8028.55	1464316.43	2441025.02
1983	8031.76	1464366.07	2441030.97
1984	8035.71	1464415.72	2441036.92
1985	8040.59	1464465.36	2441042.86
1986	8046.36	1464515.01	2441048.81
1987	8051.18	1464564.65	2441054.76
1988	8052.32	1464614.30	2441060.71
1989	8049.65	1464663.94	2441066.66
1990	8043.35	1464713.59	2441072.61
1991	8036.13	1464763.23	2441078.55
1992	8040.15	1464812.88	2441084.50
1993	8035.88	1464862.52	2441090.45
1994	8031.60	1464912.17	2441096.40
1995	8038.71	1464260.84	2441068.72
1996	8044.88	1464310.48	2441074.66
1997	8048.05	1464360.13	2441080.61
1998	8051.80	1464409.77	2441086.56
1999	8056.43	1464459.42	2441092.51
2000	8061.89	1464509.06	2441098.46
2001	8067.47	1464558.71	2441104.41
2002	8068.97	1464608.35	2441110.35
2003	8065.53	1464658.00	2441116.30
2004	8058.28	1464707.64	2441122.25
2005	8051.74	1464757.29	2441128.20
2006	8047.44	1464806.93	2441134.15
2007	8046.72	1464856.58	2441140.10
2008	8048.34	1464906.22	2441146.04
2009	8044.07	1464955.87	2441151.99
2010	8039.79	1465005.51	2441157.94
2011	8035.52	1465055.15	2441163.89
2012	8040.66	1464205.24	2441112.41
2013	8052.30	1464254.89	2441118.36
2014	8060.94	1464304.53	2441124.31
2015	8064.41	1464354.18	2441130.26
2016	8067.96	1464403.82	2441136.21
2017	8071.32	1464453.47	2441142.15
2018	8071.54	1464503.11	2441148.10
2019	8071.79	1464552.76	2441154.05
2020	8071.83	1464602.40	2441160.00
2021	8071.62	1464652.05	2441165.95
2022	8071.11	1464701.69	2441171.90
2023	8067.67	1464751.34	2441177.84

Staking Table

Point #	Elevation	Northing	Easting
2024	8063.63	1464800.98	2441183.79
2025	8059.68	1464850.63	2441189.74
2026	8055.72	1464900.27	2441195.69
2027	8057.02	1464949.92	2441201.64
2028	8056.53	1464999.56	2441207.59
2029	8052.26	1465049.21	2441213.53
2030	8047.89	1465098.85	2441219.48
2031	8041.26	1465148.50	2441225.43
2032	8049.20	1464199.29	2441162.06
2033	8063.92	1464248.94	2441168.01
2034	8071.84	1464298.58	2441173.95
2035	8072.00	1464348.23	2441179.90
2036	8072.15	1464397.87	2441185.85
2037	8072.35	1464447.52	2441191.80
2038	8072.52	1464497.16	2441197.75
2039	8072.74	1464546.81	2441203.70
2040	8072.78	1464596.45	2441209.64
2041	8072.62	1464646.10	2441215.59
2042	8072.23	1464695.74	2441221.54
2043	8071.92	1464745.39	2441227.49
2044	8071.61	1464795.03	2441233.44
2045	8071.30	1464844.68	2441239.39
2046	8071.00	1464894.32	2441245.33
2047	8067.96	1464943.97	2441251.28
2048	8064.01	1464993.61	2441257.23
2049	8067.11	1465043.26	2441263.18
2050	8063.65	1465092.90	2441269.13
2051	8056.07	1465142.55	2441275.08
2052	8050.47	1465192.19	2441281.02
2053	8048.60	1465241.84	2441286.97
2054	8054.91	1464193.35	2441211.70
2055	8070.47	1464242.99	2441217.65
2056	8072.85	1464292.64	2441223.60
2057	8072.98	1464342.28	2441229.55
2058	8073.17	1464391.93	2441235.50
2059	8073.34	1464441.57	2441241.44
2060	8073.51	1464491.22	2441247.39
2061	8073.69	1464540.86	2441253.34
2062	8073.73	1464590.51	2441259.29
2063	8073.64	1464640.15	2441265.24
2064	8073.41	1464689.80	2441271.19
2065	8073.13	1464739.44	2441277.13
2066	8072.80	1464789.09	2441283.08
2067	8072.49	1464838.73	2441289.03
2068	8072.12	1464888.38	2441294.98
2069	8071.82	1464938.02	2441300.93
2070	8071.55	1464987.66	2441306.88
2071	8071.24	1465037.31	2441312.82
2072	8070.90	1465086.95	2441318.77
2073	8070.65	1465136.60	2441324.72

Staking Table

Point #	Elevation	Northing	Easting
2074	8067.01	1465186.24	2441330.67
2075	8065.16	1465235.89	2441336.62
2076	8061.08	1465285.53	2441342.57
2077	8052.72	1465335.18	2441348.51
2078	8062.58	1464187.40	2441261.35
2079	8073.35	1464237.04	2441267.29
2080	8073.76	1464286.69	2441273.24
2081	8073.99	1464336.33	2441279.19
2082	8074.00	1464385.98	2441285.14
2083	8074.00	1464435.62	2441291.09
2084	8074.00	1464485.27	2441297.04
2085	8074.00	1464534.91	2441302.99
2086	8072.49	1464584.56	2441308.93
2087	8073.70	1464634.20	2441314.88
2088	8074.00	1464683.85	2441320.83
2089	8074.00	1464733.49	2441326.78
2090	8073.99	1464783.14	2441332.73
2091	8073.65	1464832.78	2441338.68
2092	8073.24	1464882.43	2441344.62
2093	8072.92	1464932.07	2441350.57
2094	8072.53	1464981.72	2441356.52
2095	8072.20	1465031.36	2441362.47
2096	8071.86	1465081.01	2441368.42
2097	8071.65	1465130.65	2441374.37
2098	8071.58	1465180.30	2441380.31
2099	8071.64	1465229.94	2441386.26
2100	8071.57	1465279.59	2441392.21
2101	8065.00	1465329.23	2441398.16
2102	8059.31	1464131.80	2441305.04
2103	8072.48	1464181.45	2441310.99
2104	8074.00	1464231.09	2441316.94
2105	8071.74	1464280.74	2441322.89
2106	8068.46	1464330.38	2441328.84
2107	8065.18	1464380.03	2441334.78
2108	8062.08	1464429.67	2441340.73
2109	8071.42	1464479.32	2441346.68
2110	8069.80	1464528.96	2441352.63
2111	8055.83	1464578.61	2441358.58
2112	8057.07	1464628.25	2441364.53
2113	8059.96	1464677.90	2441370.48
2114	8067.63	1464727.54	2441376.42
2115	8074.00	1464777.19	2441382.37
2116	8074.00	1464826.83	2441388.32
2117	8074.00	1464876.48	2441394.27
2118	8073.94	1464926.12	2441400.22
2119	8073.50	1464975.77	2441406.17
2120	8073.12	1465025.41	2441412.11
2121	8072.86	1465075.06	2441418.06
2122	8072.69	1465124.70	2441424.01
2123	8072.60	1465174.35	2441429.96

P:\Spadafora\101\STAKINGPLAN.dwg March 11, 2015 - 1:41pm

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

STAKING PLAN

DRAWN: CP	DATE: MAR15	DWG. NO.: C103	REV. NO.: A
SCALE	W.O. NO.: 14798.001.001	SHT. 5 OF 34	

Staking Table

Point #	Elevation	Northing	Easting
2124	8072.61	1465223.99	2441435.91
2125	8072.66	1465273.64	2441441.86
2126	8072.67	1465323.28	2441447.80
2127	8061.64	1465372.93	2441453.75
2128	8056.30	1464076.21	2441348.74
2129	8069.49	1464125.86	2441354.69
2130	8074.00	1464175.50	2441360.64
2131	8068.42	1464225.15	2441366.58
2132	8057.08	1464274.79	2441372.53
2133	8052.90	1464324.44	2441378.48
2134	8052.51	1464374.08	2441384.43
2135	8052.13	1464423.73	2441390.38
2136	8068.64	1464473.37	2441396.33
2137	8069.48	1464523.02	2441402.27
2138	8053.53	1464572.66	2441408.22
2139	8053.11	1464622.31	2441414.17
2140	8052.70	1464671.95	2441420.12
2141	8052.83	1464721.60	2441426.07
2142	8060.49	1464771.24	2441432.02
2143	8069.90	1464820.89	2441437.97
2144	8074.00	1464870.53	2441443.91
2145	8071.91	1464920.17	2441449.86
2146	8074.00	1464969.82	2441455.81
2147	8074.00	1465019.46	2441461.76
2148	8073.86	1465069.11	2441467.71
2149	8073.72	1465118.75	2441473.66
2150	8073.63	1465168.40	2441479.60
2151	8073.63	1465218.04	2441485.55
2152	8073.64	1465267.69	2441491.50
2153	8073.66	1465317.33	2441497.45
2154	8071.54	1465366.98	2441503.40
2155	8065.94	1464070.26	2441398.38
2156	8074.00	1464119.91	2441404.33
2157	8067.55	1464169.55	2441410.28
2158	8056.20	1464219.20	2441416.23
2159	8053.61	1464268.84	2441422.18
2160	8053.22	1464318.49	2441428.13
2161	8052.83	1464368.13	2441434.07
2162	8052.44	1464417.78	2441440.02
2163	8068.76	1464467.42	2441445.97
2164	8069.34	1464517.07	2441451.92
2165	8053.81	1464566.71	2441457.87
2166	8053.40	1464616.36	2441463.82
2167	8052.98	1464666.00	2441469.76
2168	8052.57	1464715.65	2441475.71
2169	8052.16	1464765.29	2441481.66
2170	8066.85	1464814.94	2441487.61
2171	8071.41	1464864.58	2441493.56
2172	8055.96	1464914.23	2441499.51
2173	8060.83	1464963.87	2441505.46

Staking Table

Point #	Elevation	Northing	Easting
2174	8067.82	1465013.52	2441511.40
2175	8071.26	1465063.16	2441517.35
2176	8073.61	1465112.81	2441523.30
2177	8074.00	1465162.45	2441529.25
2178	8074.00	1465212.10	2441535.20
2179	8073.56	1465261.74	2441541.15
2180	8071.80	1465311.39	2441547.09
2181	8074.00	1465361.03	2441553.04
2182	8070.21	1464064.31	2441448.03
2183	8068.27	1464113.96	2441453.98
2184	8055.33	1464163.60	2441459.93
2185	8054.31	1464213.25	2441465.87
2186	8053.92	1464262.89	2441471.82
2187	8053.53	1464312.54	2441477.77
2188	8053.15	1464362.18	2441483.72
2189	8052.76	1464411.83	2441489.67
2190	8068.87	1464461.47	2441495.62
2191	8069.20	1464511.12	2441501.56
2192	8054.09	1464560.76	2441507.51
2193	8053.68	1464610.41	2441513.46
2194	8053.27	1464660.05	2441519.41
2195	8052.85	1464709.70	2441525.36
2196	8052.44	1464759.34	2441531.31
2197	8068.77	1464808.99	2441537.25
2198	8069.55	1464858.63	2441543.20
2199	8052.99	1464908.28	2441549.15
2200	8052.55	1464957.92	2441555.10
2201	8053.01	1465007.57	2441561.05
2202	8054.94	1465057.21	2441567.00
2203	8056.98	1465106.86	2441572.95
2204	8058.17	1465156.50	2441578.89
2205	8058.76	1465206.15	2441584.84
2206	8056.98	1465255.79	2441590.79
2207	8055.79	1465305.44	2441596.74
2208	8071.62	1465355.08	2441602.69
2209	8071.17	1464058.37	2441497.67
2210	8067.53	1464108.01	2441503.62
2211	8055.01	1464157.66	2441509.57
2212	8054.62	1464207.30	2441515.52
2213	8054.24	1464256.95	2441521.47
2214	8053.85	1464306.59	2441527.42
2215	8053.46	1464356.24	2441533.36
2216	8053.07	1464405.88	2441539.31
2217	8068.99	1464455.53	2441545.26
2218	8069.06	1464505.17	2441551.21
2219	8054.37	1464554.82	2441557.16
2220	8053.96	1464604.46	2441563.11
2221	8053.55	1464654.11	2441569.05
2222	8053.14	1464703.75	2441575.00
2223	8054.13	1464753.40	2441580.95

Staking Table

Point #	Elevation	Northing	Easting
2224	8070.69	1464803.04	2441586.90
2225	8067.76	1464852.68	2441592.85
2226	8052.28	1464902.33	2441598.80
2227	8052.74	1464951.97	2441604.74
2228	8053.20	1465001.62	2441610.69
2229	8053.66	1465051.26	2441616.64
2230	8054.13	1465100.91	2441622.59
2231	8054.59	1465150.55	2441628.54
2232	8055.05	1465200.20	2441634.49
2233	8055.52	1465249.84	2441640.44
2234	8055.98	1465299.49	2441646.38
2235	8071.23	1465349.13	2441652.33
2236	8070.72	1464052.42	2441547.32
2237	8067.61	1464102.06	2441553.27
2238	8057.77	1464151.71	2441559.22
2239	8060.95	1464201.35	2441565.16
2240	8064.14	1464251.00	2441571.11
2241	8065.58	1464300.64	2441577.06
2242	8064.48	1464350.29	2441583.01
2243	8063.39	1464399.93	2441588.96
2244	8072.03	1464449.58	2441594.91
2245	8070.32	1464499.22	2441600.85
2246	8061.02	1464548.87	2441606.80
2247	8061.47	1464598.51	2441612.75
2248	8061.91	1464648.16	2441618.70
2249	8062.36	1464697.80	2441624.65
2250	8062.96	1464747.45	2441630.60
2251	8074.00	1464797.09	2441636.54
2252	8074.00	1464846.74	2441642.49
2253	8068.16	1464896.38	2441648.44
2254	8067.97	1464946.03	2441654.39
2255	8067.33	1464995.67	2441660.34
2256	8063.72	1465045.32	2441666.29
2257	8060.10	1465094.96	2441672.24
2258	8055.62	1465144.61	2441678.18
2259	8055.24	1465194.25	2441684.13
2260	8055.70	1465243.90	2441690.08
2261	8056.17	1465293.54	2441696.03
2262	8070.84	1465343.19	2441701.98
2263	8051.94	1463996.82	2441591.02
2264	8068.32	1464046.47	2441596.96
2265	8074.00	1464096.11	2441602.91
2266	8074.00	1464145.76	2441608.86
2267	8074.00	1464195.40	2441614.81
2268	8074.00	1464245.05	2441620.76
2269	8072.91	1464294.69	2441626.71
2270	8073.78	1464344.34	2441632.65
2271	8074.00	1464393.98	2441638.60
2272	8074.00	1464443.63	2441644.55
2273	8074.00	1464493.27	2441650.50

Staking Table

Point #	Elevation	Northing	Easting
2274	8074.00	1464542.92	2441656.45
2275	8074.00	1464592.56	2441662.40
2276	8074.00	1464642.21	2441668.34
2277	8074.00	1464691.85	2441674.29
2278	8074.00	1464741.50	2441680.24
2279	8073.31	1464791.14	2441686.19
2280	8075.04	1464840.79	2441692.14
2281	8076.06	1464890.43	2441698.09
2282	8075.51	1464940.08	2441704.03
2283	8073.14	1464989.72	2441709.98
2284	8074.00	1465039.37	2441715.93
2285	8074.00	1465089.01	2441721.88
2286	8071.59	1465138.66	2441727.83
2287	8066.80	1465188.30	2441733.78
2288	8064.06	1465237.95	2441739.73
2289	8065.77	1465287.59	2441745.67
2290	8073.68	1465337.24	2441751.62
2291	8046.37	1463990.88	2441640.66
2292	8060.00	1464040.52	2441646.61
2293	8069.45	1464090.17	2441652.56
2294	8082.07	1464189.46	2441664.45
2295	8085.56	1464239.10	2441670.40
2296	8087.44	1464288.75	2441676.35
2297	8087.19	1464338.39	2441682.30
2298	8086.55	1464388.04	2441688.25
2299	8085.92	1464437.68	2441694.20
2300	8085.29	1464487.33	2441700.14
2301	8084.96	1464536.97	2441706.09
2302	8085.05	1464586.62	2441712.04
2303	8085.57	1464636.26	2441717.99
2304	8086.50	1464685.90	2441723.94
2305	8087.86	1464735.55	2441729.89
2306	8089.63	1464785.19	2441735.83
2307	8091.60	1464834.84	2441741.78
2308	8092.72	1464884.48	2441747.73
2309	8092.11	1464934.13	2441753.68
2310	8089.80	1464983.77	2441759.63
2311	8086.57	1465033.42	2441765.58
2312	8082.32	1465083.06	2441771.52
2313	8076.88	1465132.71	2441777.47
2314	8072.03	1465182.35	2441783.42
2315	8074.00	1465232.00	2441789.37
2316	8074.00	1465281.64	2441795.32
2317	8074.00	1465331.29	2441801.27
2318	8045.44	1464100.00	2441150.16
2319	8045.51	1464149.65	2441156.11
2320	8047.25	1464044.41	2441193.86
2321	8044.43	1464094.06	2441199.80
2322	8048.11	1464143.70	2441205.75
2323	8049.46	1464038.46	2441243.50

Staking Table

Point #	Elevation	Northing	Easting
2324	8044.00	1464088.11	2441249.45
2325	8050.25	1464137.75	2441255.40
2326	8048.93	1464032.51	2441293.15
2327	8048.07	1464082.16	2441299.09
2328	8025.02	1465166.34	2441076.50
2329	8030.27	1465061.10	2441114.24
2330	8034.08	1465110.75	2441120.19
2331	8032.35	1465160.39	2441126.14
2332	8036.00	1465210.04	2441132.09
2333	8036.00	1465104.80	2441169.84
2334	8031.11	1465154.44	2441175.79
2335	8030.00	1465204.09	2441181.73
2336	8035.39	1465253.73	2441187.68
2337	8037.23	1465198.14	2441231.38

P:\Spadafora\101STAKING\PLAN.dwg March 11, 2015 - 1:42pm

NO.	DATE	APPR.	REVISION

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

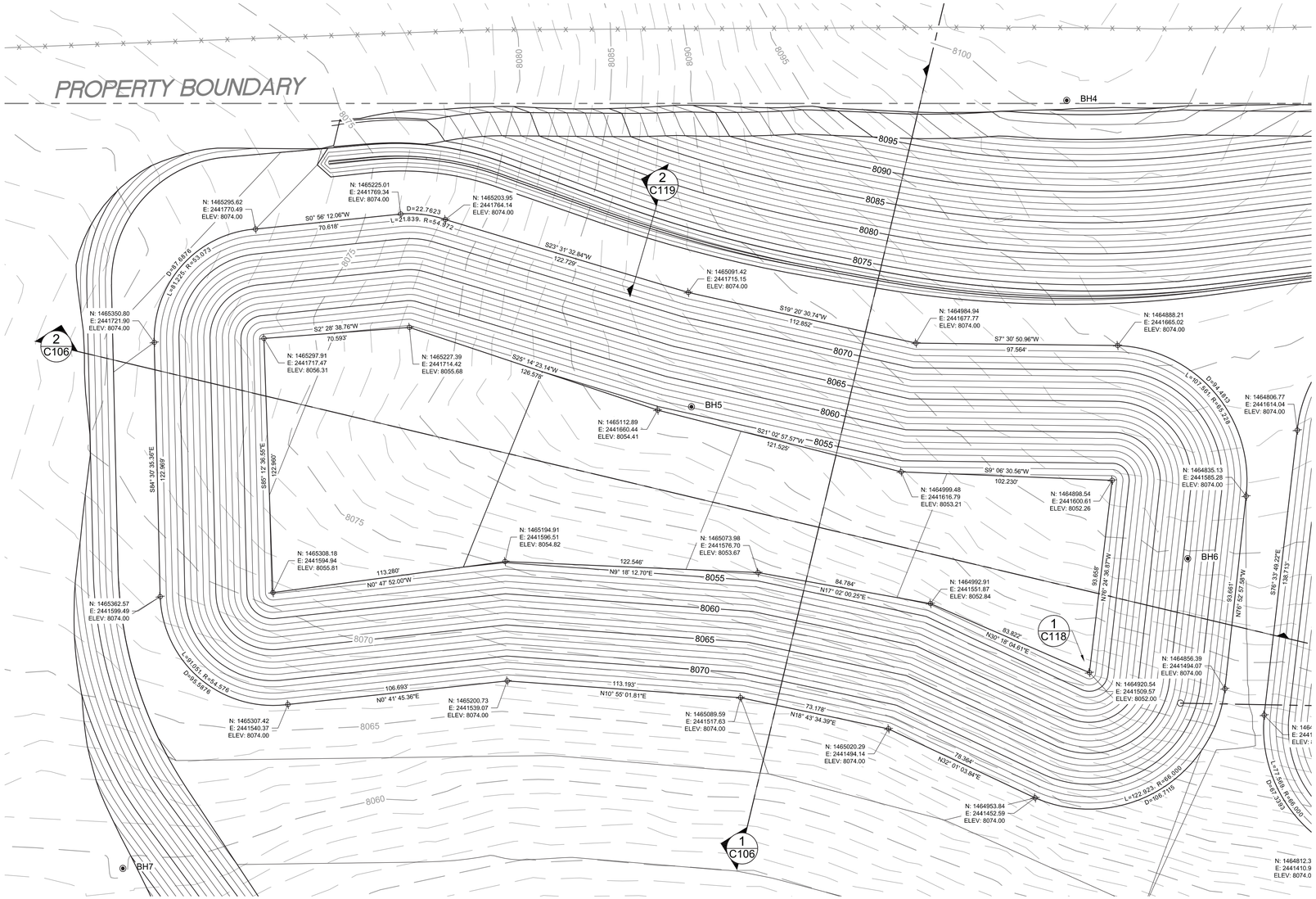
LAKEWOOD COLORADO

	CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

STAKING TABLE

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C104	A
SCALE	W.O. NO.	SHT. 6 OF 34	
	14798.001.001		



1 NORTH PIT PLAN

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- BH-1 BOREHOLE
- CULVERT

1 FOOT CONTOUR INTERVAL

0 30' 60'
HORIZONTAL

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

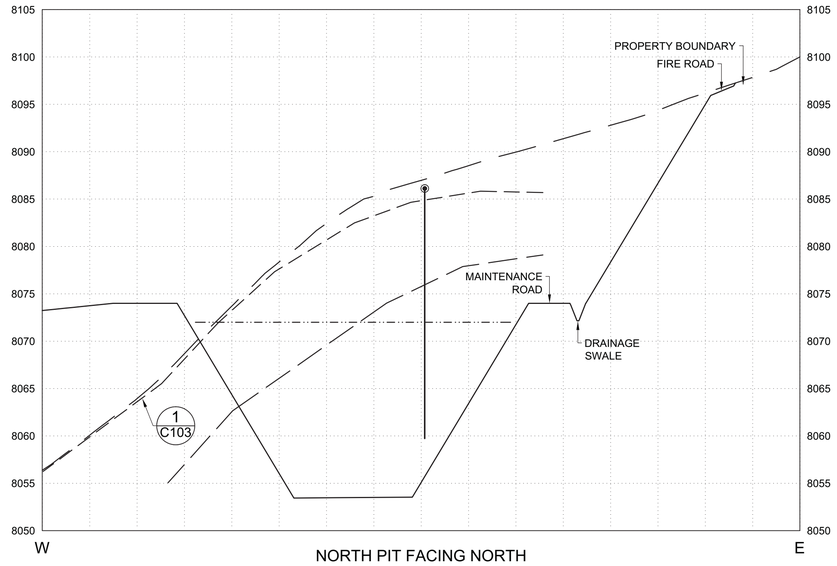
CHECKED	DG	MAR15	CLIENT APPROVALS	DATE
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

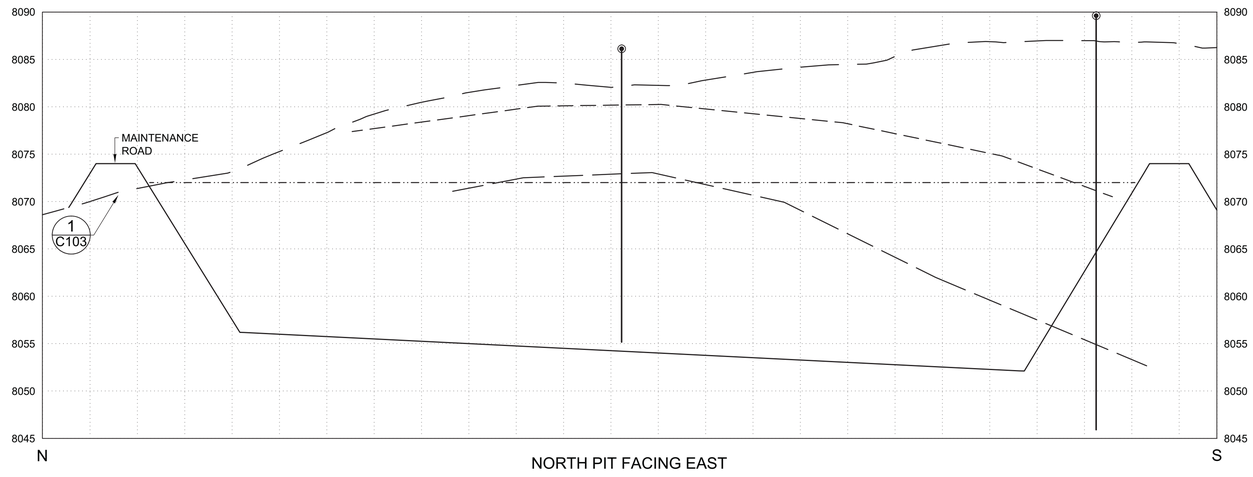
NORTH PIT PLAN

DRAWN CP	DATE MAR15	DWG. NO. C105	REV. NO. A
SCALE	W.O. NO. 14798.001.001	SHT. 7 OF 34	

P:\Spadafora\101\PIT\GRADING.dwg March 11, 2015 - 1:42pm



1 SECTION



2 SECTION

CONSTRUCTION NOTES

A NOTE: BORE HOLES (BH) SHOWN IN BACKGROUND OR FOREGROUND OF CROSS SECTION FOR CLARITY

LEGEND

- EXISTING GROUND PROFILE
- FINISHED GROUND PROFILE
- TOP OF CLAY
- TOP OF SHALE
- 2' FREEBOARD WATER LEVEL

0 40' 80'
HORIZONTAL

0 8' 16'
VERTICAL

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

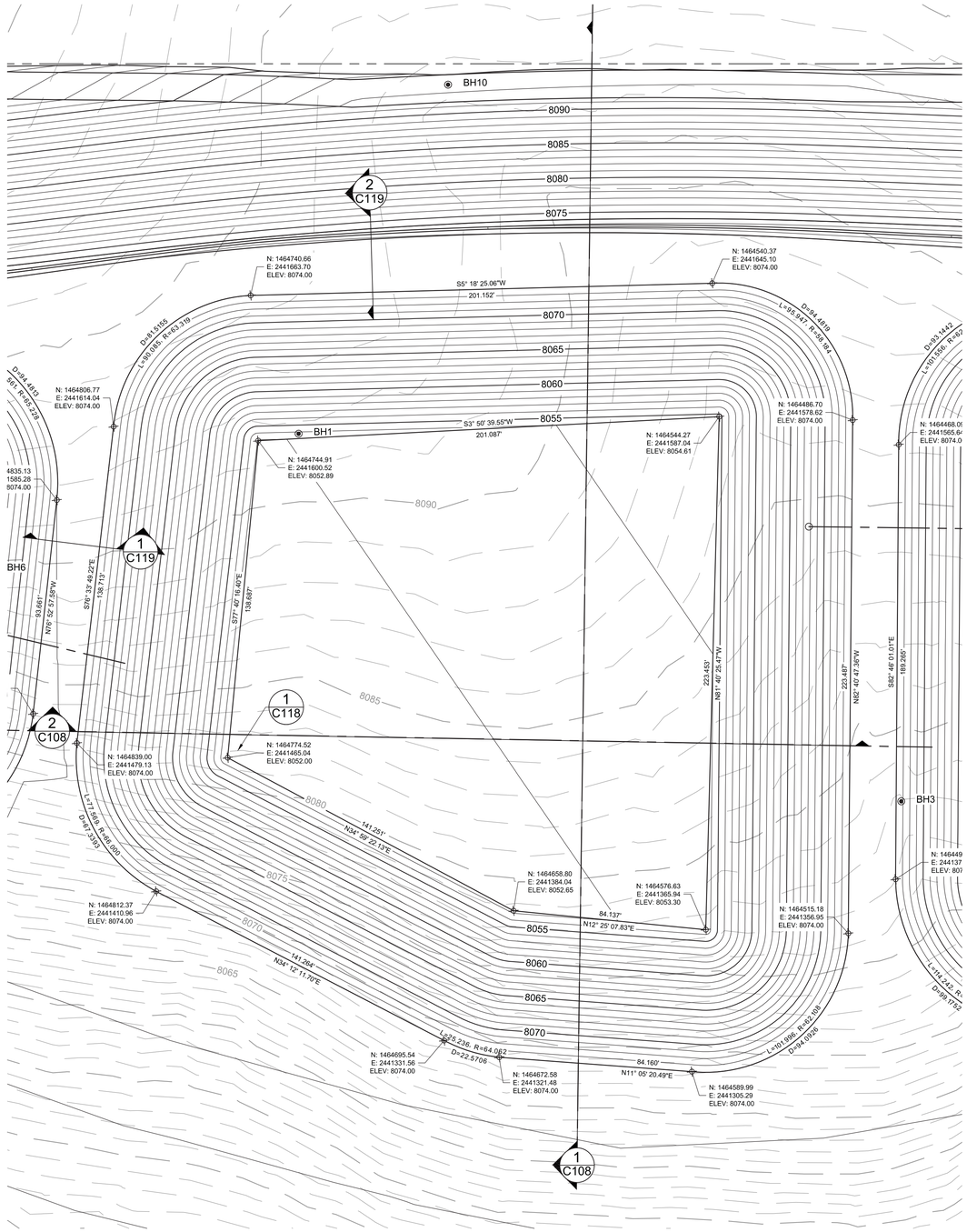
CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

NORTH PIT SECTIONS

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C106	A
SCALE	W.O. NO.	SHT 8 OF 34	
	14798.001.001		

P:\Spadafora\101\PTGRADING.dwg March 11, 2015 - 1:42pm



1 MIDDLE PIT PLAN

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- BH-1 BOREHOLE
- CULVERT

1 FOOT CONTOUR INTERVAL

0 30' 60'

HORIZONTAL

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

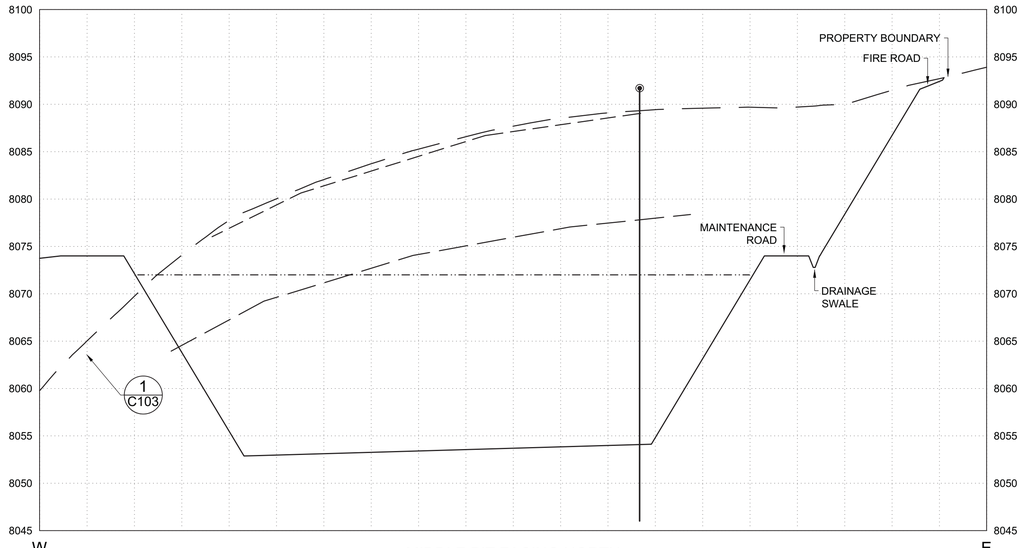
CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

MIDDLE PIT PLAN

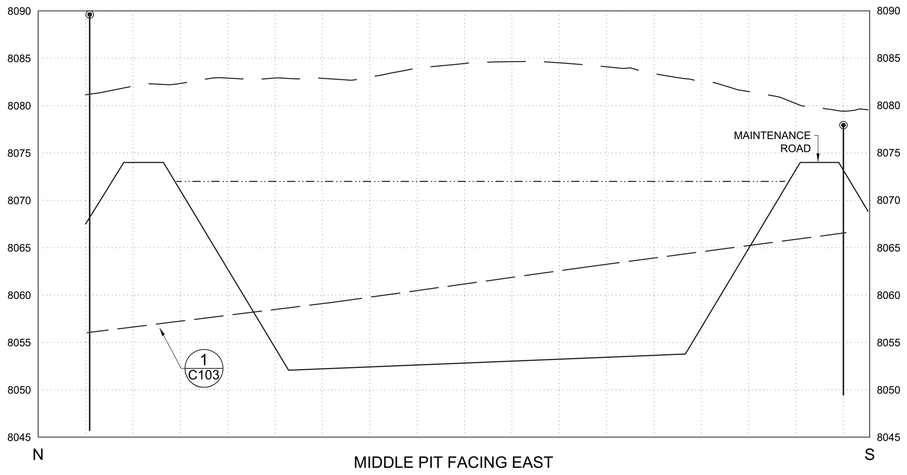
DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C107	A
SCALE	W.O. NO.	SHT. 9 OF 34	
	14798.001.001		

P:\Spadafora\101\PITGRADING.dwg March 11, 2015 - 1:42pm



MIDDLE PIT FACING NORTH

1 SECTION



MIDDLE PIT FACING EAST

2 SECTION

CONSTRUCTION NOTES

A NOTE: BORE HOLES (BH) SHOWN IN BACKGROUND OR FOREGROUND OF CROSS SECTION FOR CLARITY

LEGEND

- EXISTING GROUND PROFILE
- FINISHED GROUND PROFILE
- TOP OF CLAY
- TOP OF SHALE
- 2' FREEBOARD WATER LEVEL

0 40' 80'
HORIZONTAL

0 8' 16'
VERTICAL

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

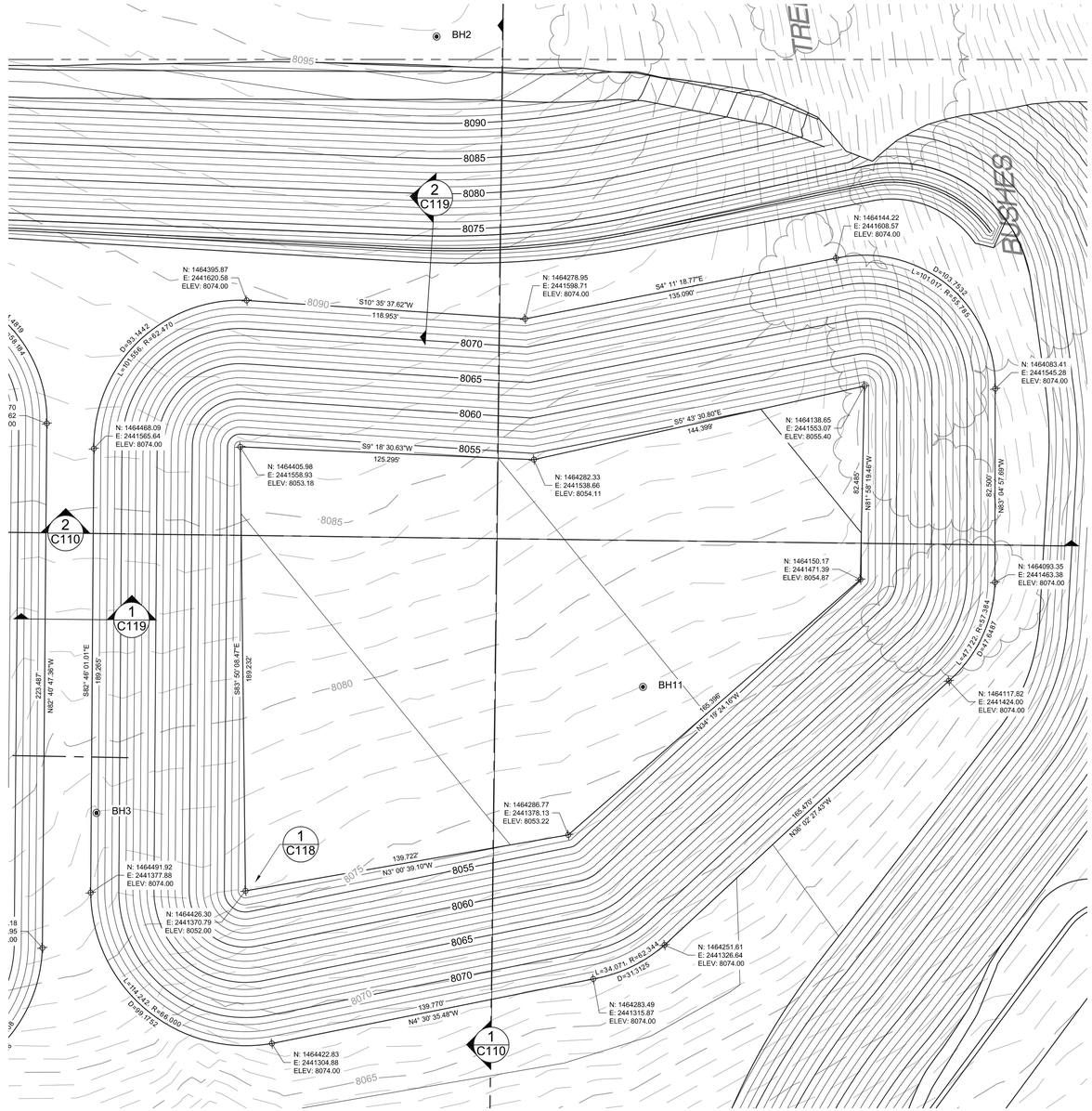
CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

MIDDLE PIT SECTIONS

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C108	A
SCALE	W.O. NO.	SHT. 10 OF 34	
	14798.001.001		

P:\Spadafora\101\PTGRADING.dwg March 11, 2015 - 1:42pm



1 SOUTH PIT PLAN

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- BH-1 BOREHOLE
- CULVERT

1 FOOT CONTOUR INTERVAL

0 30' 60'
HORIZONTAL

NO.	DATE	APPR.	REVISION

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

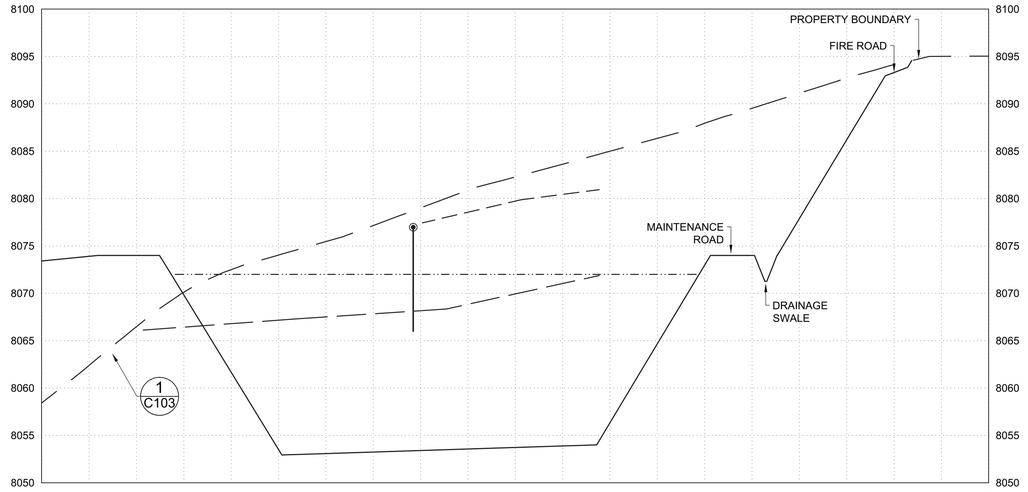
CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

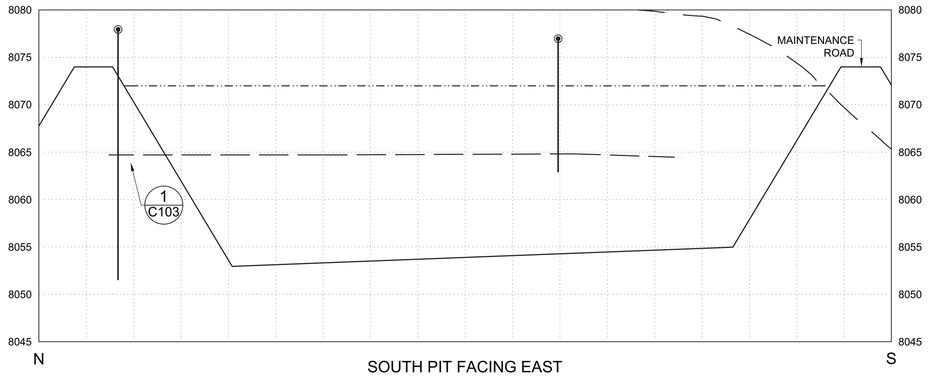
SOUTH PIT PLAN

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C109	A
SCALE	W.O. NO.	SHT. 11 OF 34	
	14798.001.001		

P:\Spadafora\101PITGRADING.dwg March 11, 2015 - 1:42pm



1 SECTION



2 SECTION

CONSTRUCTION NOTES

A NOTE: BORE HOLES (BH) SHOWN IN BACKGROUND OR FOREGROUND OF CROSS SECTION FOR CLARITY

LEGEND

- EXISTING GROUND PROFILE
- FINISHED GROUND PROFILE
- TOP OF CLAY
- TOP OF SHALE
- 2' FREEBOARD WATER LEVEL

0 40' 80'
HORIZONTAL

0 8' 16'
VERTICAL

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

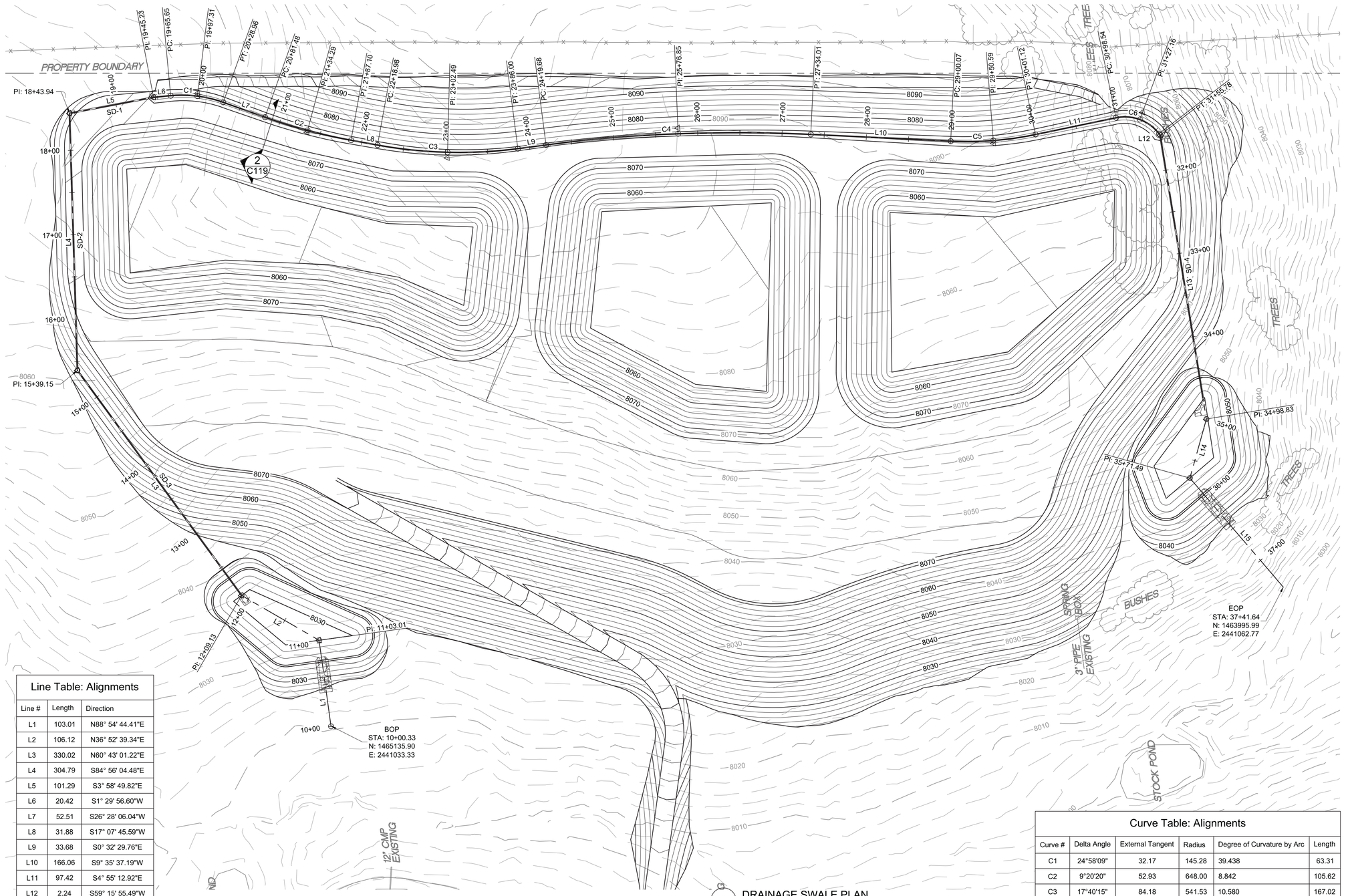
CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

SOUTH PIT SECTIONS

DRAWN: CP	DATE: MAR15	DWG. NO.: C110	REV. NO.: A
SCALE:	W.O. NO.: 14798.001.001	SHT. 12 OF 34	

P:\Spadafora\101\PTGRADING.dwg March 11, 2015 - 1:43pm



Line Table: Alignments

Line #	Length	Direction
L1	103.01	N88° 54' 44.41"E
L2	106.12	N36° 52' 39.34"E
L3	330.02	N60° 43' 01.22"E
L4	304.79	S84° 56' 04.48"E
L5	101.29	S3° 58' 49.82"E
L6	20.42	S1° 29' 56.60"W
L7	52.51	S26° 28' 06.04"W
L8	31.88	S17° 07' 45.59"W
L9	33.68	S0° 32' 29.76"E
L10	166.06	S9° 35' 37.19"W
L11	97.42	S4° 55' 12.92"E
L12	2.24	S59° 15' 55.49"W
L13	340.82	S87° 33' 42.72"W
L14	72.66	N67° 32' 08.39"W
L15	170.14	S56° 14' 05.44"W

Curve Table: Alignments

Curve #	Delta Angle	External Tangent	Radius	Degree of Curvature by Arc	Length
C1	24°58'09"	32.17	145.28	39.438	63.31
C2	9°20'20"	52.93	648.00	8.842	105.62
C3	17°40'15"	84.18	541.53	10.580	167.02
C4	10°08'07"	157.58	1776.95	3.224	314.33
C5	14°30'50"	50.79	398.89	14.364	101.05
C6	64°11'08"	32.04	51.10	112.135	57.24

CONSTRUCTION NOTES

A. ALL DRAINAGE SWALES TO HAVE 1-FOOT EROSION PROTECTION LAYER

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- CULVERT
- RIPRAP PROTECTION

2 FOOT CONTOUR INTERVAL

0 60' 120'
HORIZONTAL

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

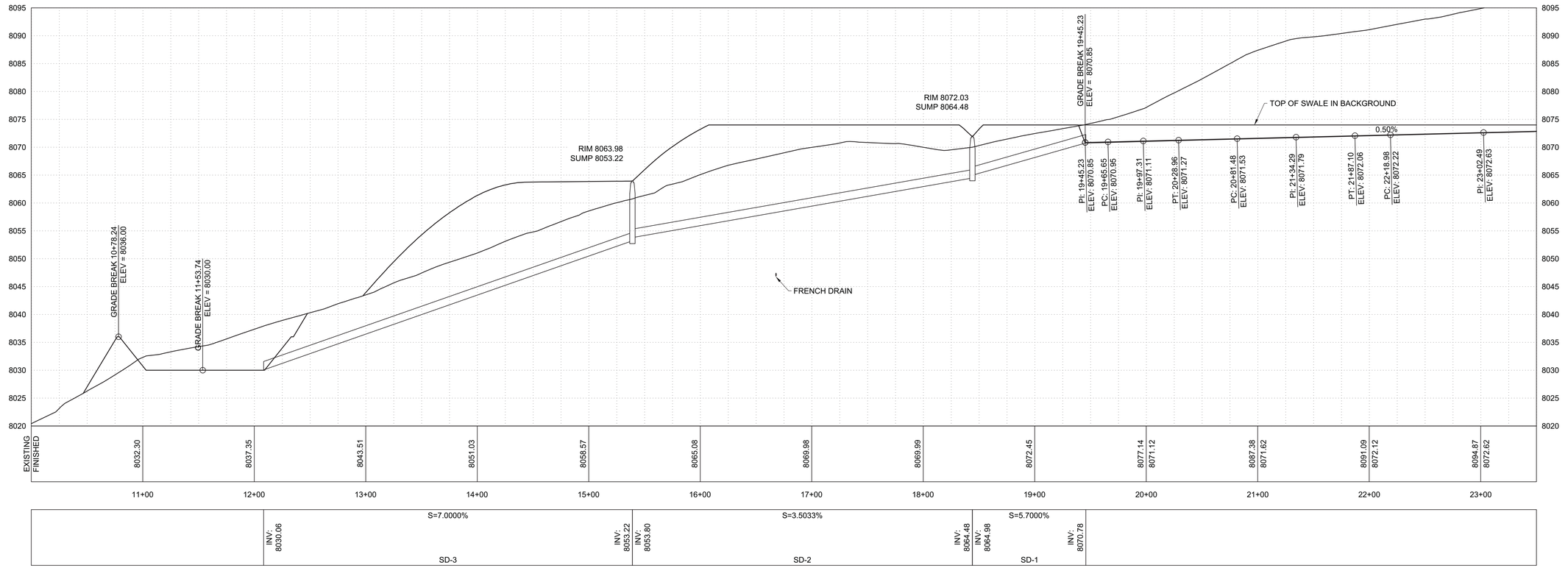
		DATE	CLIENT APPROVALS	DATE
CHECKED	DG	MAR15		
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

DRAINAGE SWALE PLAN

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C111	A
SCALE	W.O. NO.	SHT. 13 OF 34	
	14798.001.001		

P:\Spadafora\101\DESIGN\SWALE.dwg March 11, 2015 - 1:43pm



Culvert Table									
NAME	SIZE	LENGTH	SLOPE	START INVERT	END INVERT	START NORTHING	START EASTING	END NORTHING	END EASTING
SD-1	18"	101.74'	5.70%	8070.78	8064.98	1465255.72	2441798.14	1465357.23	2441791.23
SD-2	18"	304.90'	3.50%	8064.48	8053.80	1465357.23	2441791.23	1465384.16	2441487.53
SD-3	18"	330.80'	7.00%	8053.22	8030.06	1465384.16	2441487.53	1465222.38	2441198.99

1 NORTH SWALE PROFILE

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- EXISTING GROUND PROFILE
- FINISHED GROUND PROFILE
- TOP OF SWALE IN BACKGROUND
- CULVERT
- RIPRAP PROTECTION

0 50' 100'
HORIZONTAL

0 10' 20'
VERTICAL

P:\Spadafora\01\DESIGN\SWALE.dwg March 11, 2015 - 1:43pm

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

CLIENT APPROVALS DATE

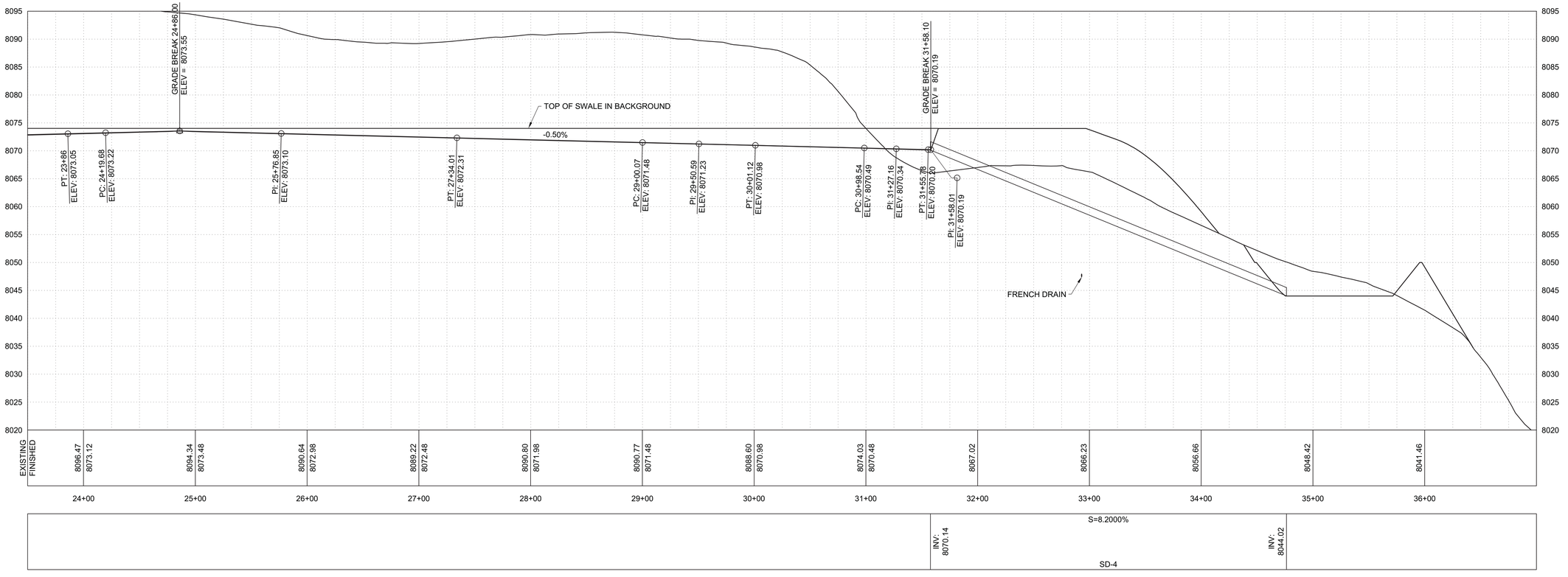
NOT FOR CONSTRUCTION

SOUTH SWALE PROFILE

DRAWN	CP	DATE	MAR15
SCALE		W.O. NO.	14798.001.001

DWG. NO. **C112** REV. NO. **A**

SHT. 14 OF 34



Culvert Table									
NAME	SIZE	LENGTH	SLOPE	START INVERT	END INVERT	START NORTHING	START EASTING	END NORTHING	END EASTING
SD-4	18"	318.54'	8.20%	8070.14	8044.02	1464077.42	2441612.11	1464063.73	2441293.87

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- EXISTING GROUND PROFILE
- FINISHED GROUND PROFILE
- TOP OF SWALE IN BACKGROUND
- CULVERT
- RIPRAP PROTECTION

1 SOUTH SWALE PROFILE

0 20' 40' HORIZONTAL

0 4' 8' VERTICAL

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

WESTON SOLUTIONS

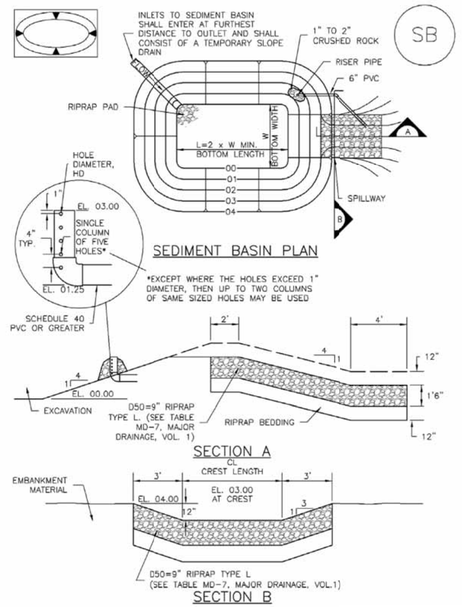
		DATE	CLIENT APPROVALS	DATE
CHECKED	DG	MAR15		
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

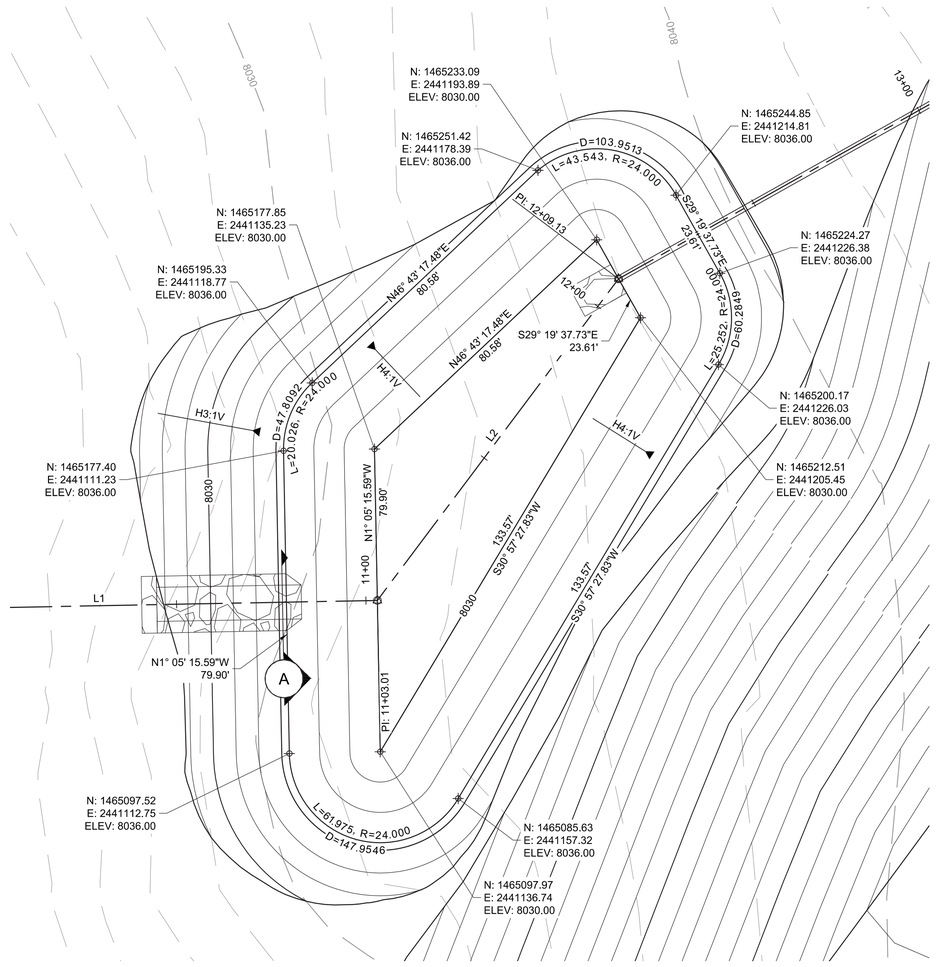
NOT FOR CONSTRUCTION

NORTH SWALE PROFILE

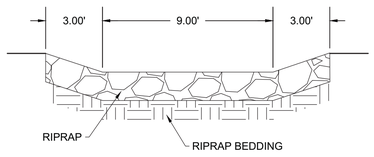
DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C113	A
SCALE	W.O. NO.	SHT. 15 OF 34	
	14798.001.001		

P:\Spadafora\101\DESIGNS\NSWALE.dwg March 11, 2015 - 1:43pm





1 NORTH SEDIMENT BASIN PLAN



A SPILLWAY SECTION

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- EXISTING GROUND PROFILE
- FINISHED GROUND PROFILE
- TOP OF SWALE IN BACKGROUND
- CULVERT
- RIPRAP PROTECTION

2 FOOT CONTOUR INTERVAL

0 20' 40'
HORIZONTAL

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO
LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

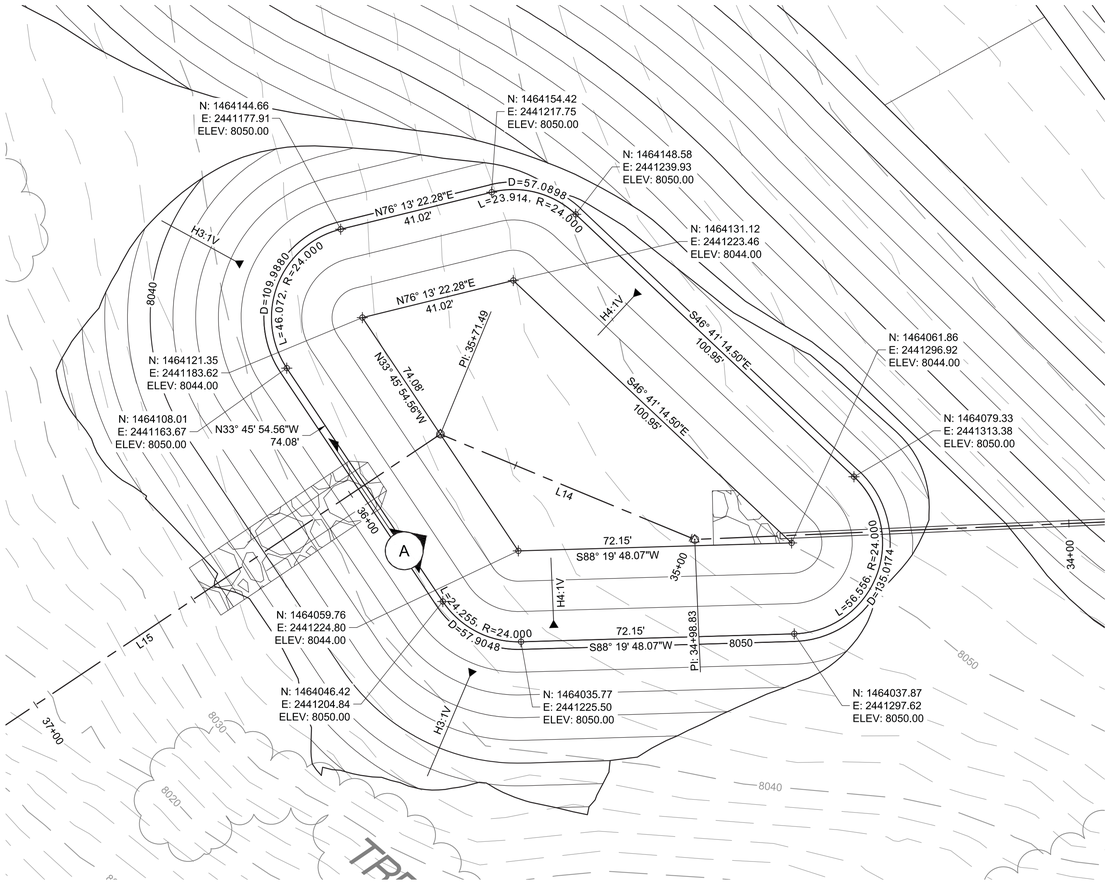
CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

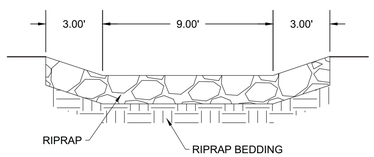
NORTH SEDIMENT BASIN

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C114	A
SCALE	W.O. NO. 14798.001.001	SHT. 16 OF 34	

P:\Spadafora\101\DESIGN\SWALE.dwg March 11, 2015 - 1:43pm



1 SOUTH SEDIMENT BASIN PLAN



A SPILLWAY SECTION

CONSTRUCTION NOTES

A. SEE SEDIMENT BASIN DETAILS (SC-7) ON PREVIOUS SHEET

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- EXISTING GROUND PROFILE
- FINISHED GROUND PROFILE
- TOP OF SWALE IN BACKGROUND
- CULVERT
- RIPRAP PROTECTION

2 FOOT CONTOUR INTERVAL

0 20' 40'
HORIZONTAL

P:\Spadafora\101\DESIGNS\WALE.dwg March 11, 2015 - 1:44pm

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

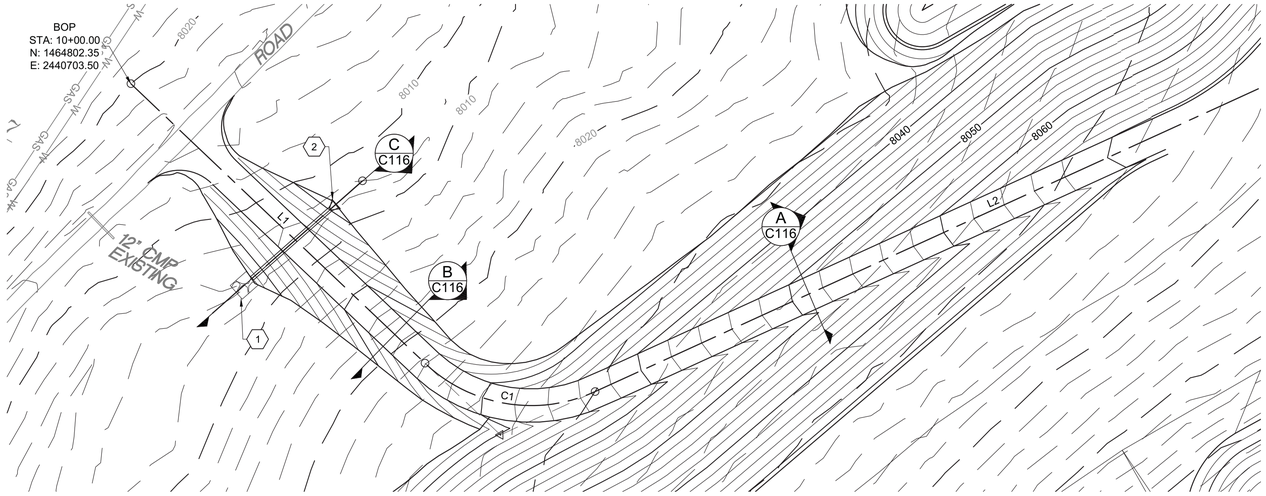
CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

CLIENT APPROVALS — DATE

NOT FOR CONSTRUCTION

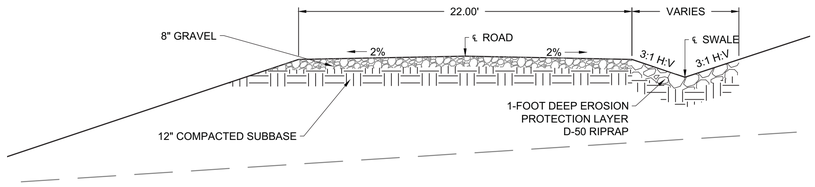
SOUTH SEDIMENT BASIN

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C115	A
SCALE	W.O. NO. 14798.001.001	SHT. 17 OF 34	



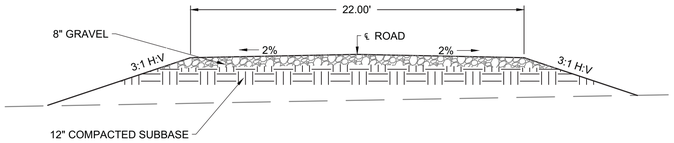
KEYED NOTES

1. 12 FEET WIDE BY 14 FEET LONG LOOSE ROCK APRON, D50 OF 6 INCHES
2. MANUFACTURED END SECTION



A SECTION ACCESS ROAD

0 5' 10'



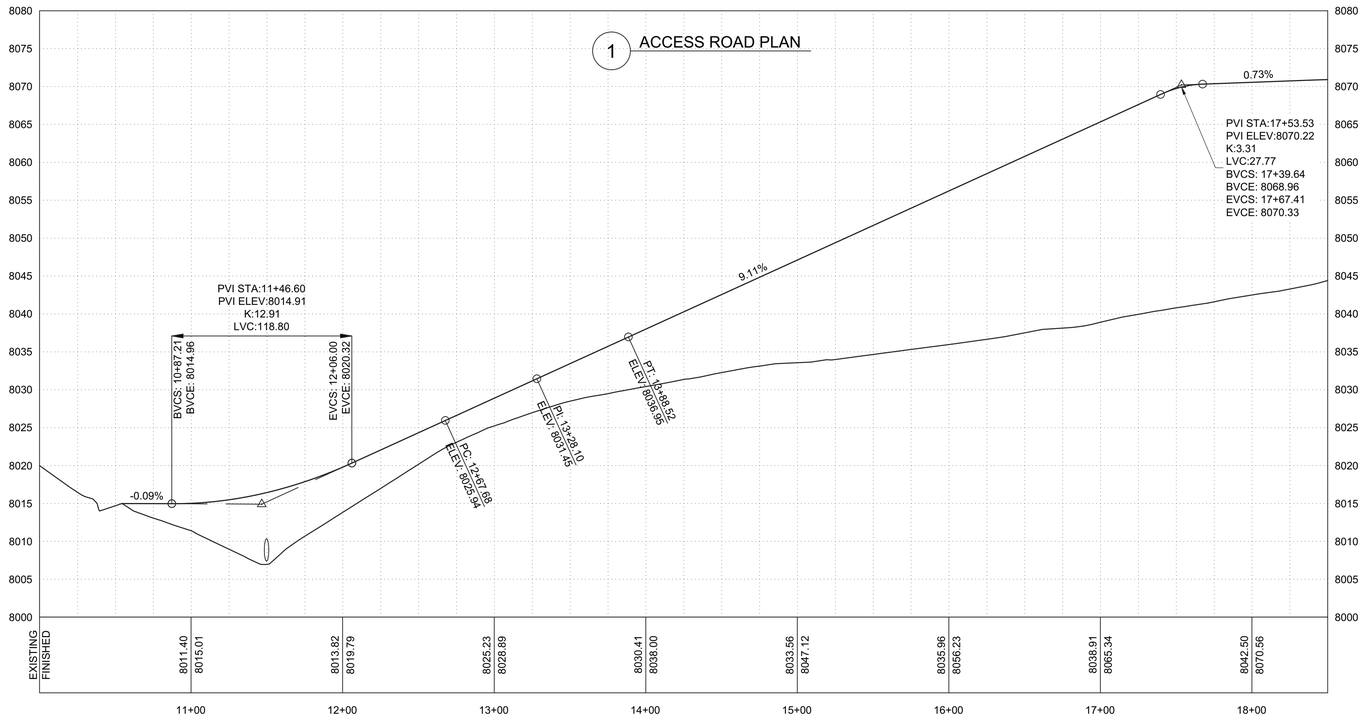
B SECTION ACCESS ROAD

0 5' 10'

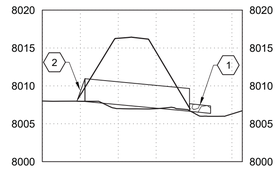
CONSTRUCTION NOTES

A. CULVERT DESIGN FLOW IS 27 CFS

B. DRAINAGE AREA FOR CULVERT 373 ACRES



2 ACCESS ROAD PROFILE



CULVERT					
	SIZE	LENGTH	SLOPE	START INVERT	END INVERT
	36"	69.01'	1.87%	8007.94	8006.65

C CULVERT SECTION

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- EXISTING GROUND PROFILE
- FINISHED GROUND PROFILE
- CULVERT
- RIPRAP PROTECTION

Line Table: Alignments						
Line #	Length	Direction	Start Northing	Start Easting	End Northing	End Easting
L1	267.68	S75° 28' 41.90"E	1464802.35	2440703.50	1464735.23	2440962.63
L2	582.03	N36° 27' 05.39"E	1464773.26	2441069.94	1465241.42	2441415.75

Curve Table: Alignments					
Curve #	Delta Angle	External Tangent	Radius	Degree of Curvature by Arc	Length
C1	68°04'13"	68.70	101.71	56.332	120.84

2 FOOT CONTOUR INTERVAL

0 50' 100' HORIZONTAL

0 10' 20' VERTICAL

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

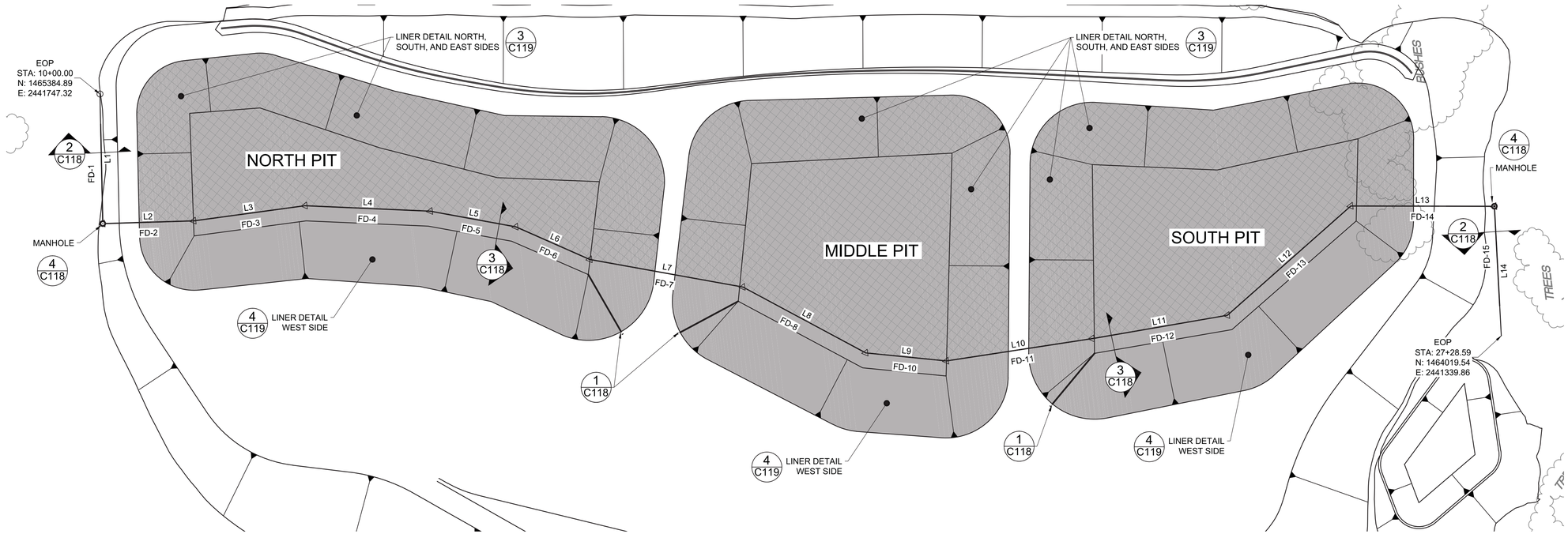
CLIENT APPROVALS — DATE

NOT FOR CONSTRUCTION

ACCESS ROAD PLAN AND PROFILE

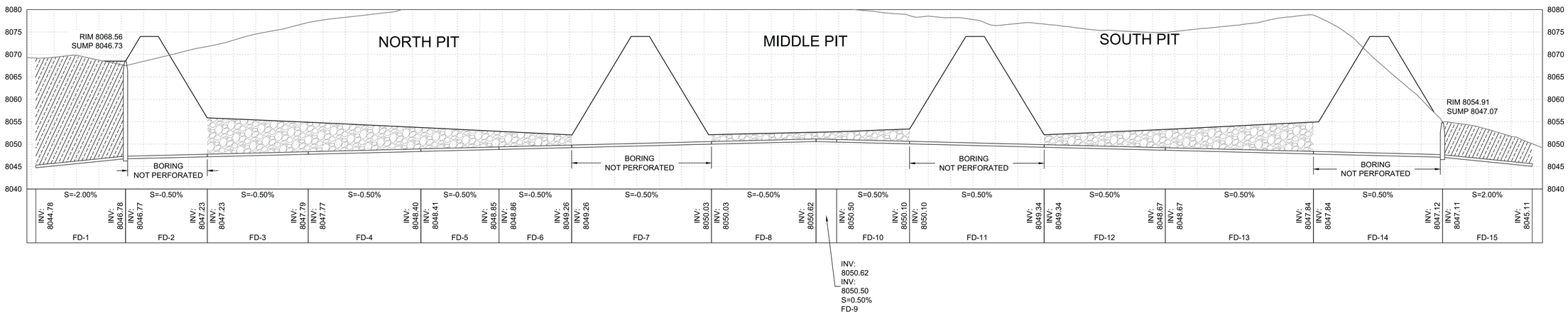
DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C116	A
SCALE	W.O. NO. 14798.001.001	SHT 18 OF 34	

P:\Spadafora\101\ACCESSROAD.dwg March 11, 2015 - 1:44pm



LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- EXISTING GROUND PROFILE
- FINISHED GROUND PROFILE
- PVC PIPE
- CULVERT
- SOIL FILL
- WASHED GRAVEL
- RIPRAP PROTECTION
- GEONET (SUBDRAIN) 3 C119
- GEOTEXTILE FABRIC 4 C119



Line Table: Alignments

Line #	Length	Direction	Start Point	End Point
L14	130.00	N86° 13' 25.16"W	E 2441469.58, N 1464010.98	E 2441339.86, N 1464019.54
L13	143.90	S6° 56' 30.59"W	E 2441486.97, N 1464153.82	E 2441469.58, N 1464010.98
L12	165.19	S34° 42' 51.99"E	E 2441392.90, N 1464289.60	E 2441486.97, N 1464153.82
L11	137.55	S2° 58' 04.53"E	E 2441385.78, N 1464426.97	E 2441392.90, N 1464289.60
L10	147.67	S1° 54' 12.50"E	E 2441380.87, N 1464574.56	E 2441385.78, N 1464426.97
L9	81.33	S12° 32' 31.51"W	E 2441398.53, N 1464653.94	E 2441380.87, N 1464574.56
L8	139.60	S35° 02' 09.85"W	E 2441478.68, N 1464768.25	E 2441398.53, N 1464653.94

Line Table: Alignments

Line #	Length	Direction	Start Point	End Point
L7	155.83	S17° 01' 58.74"W	E 2441524.32, N 1464917.25	E 2441478.68, N 1464768.25
L6	81.03	S30° 39' 34.44"W	E 2441565.64, N 1464986.95	E 2441524.32, N 1464917.25
L5	87.10	S17° 12' 30.15"W	E 2441591.41, N 1465070.15	E 2441565.64, N 1464986.95
L4	125.68	S9° 18' 33.26"W	E 2441611.74, N 1465194.17	E 2441591.41, N 1465070.15
L3	112.50	S0° 55' 24.91"E	E 2441609.93, N 1465306.66	E 2441611.74, N 1465194.17
L2	91.22	S5° 01' 59.48"W	E 2441617.93, N 1465397.53	E 2441609.93, N 1465306.66
L1	130.00	N84° 25' 27.69"W	E 2441747.32, N 1465384.89	E 2441617.93, N 1465397.53

Pipe Table

NAME	SIZE	LENGTH	SLOPE	START INVERT	END INVERT
FD-1	6"	99.94'	-2.00%	8044.78	8046.78
FD-2	6"	91.22'	-0.50%	8046.77	8047.23
FD-3	6"	112.49'	-0.50%	8047.23	8047.79
FD-4	6"	125.67'	-0.50%	8047.77	8048.40
FD-5	6"	87.12'	-0.50%	8048.41	8048.85
FD-6	6"	81.02'	-0.50%	8048.86	8049.26
FD-7	6"	155.83'	-0.50%	8049.26	8050.03
FD-8	6"	116.64'	-0.50%	8050.03	8050.62

Pipe Table

NAME	SIZE	LENGTH	SLOPE	START INVERT	END INVERT
FD-9	6"	22.97'	0.50%	8050.62	8050.50
FD-10	6"	81.33'	0.50%	8050.50	8050.10
FD-11	6"	150.01'	0.50%	8050.10	8049.34
FD-12	6"	135.19'	0.50%	8049.34	8048.67
FD-13	6"	165.22'	0.50%	8048.67	8047.84
FD-14	6"	143.87'	0.50%	8047.84	8047.12
FD-15	6"	99.96'	2.00%	8047.11	8045.11

APPROXIMATE QUANTITIES (SQUARE FEET)			
	NORTH	MIDDLE	SOUTH
60-MIL HDPE LINER (PRIMARY LINER)	108257	100847	102960
200-MIL GEONET	108257	100847	102960
60-MIL HDPE LINER (SECONDARY LINER)	108257	100847	102960
200-MIL GEONET (SUBDRAIN)	70388	73831	71672
16 OZ. GEOTEXTILE FABRIC	108257	100847	102960

2 FOOT CONTOUR INTERVAL

HORIZONTAL 0 60' 120'

VERTICAL 0 12' 24'

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

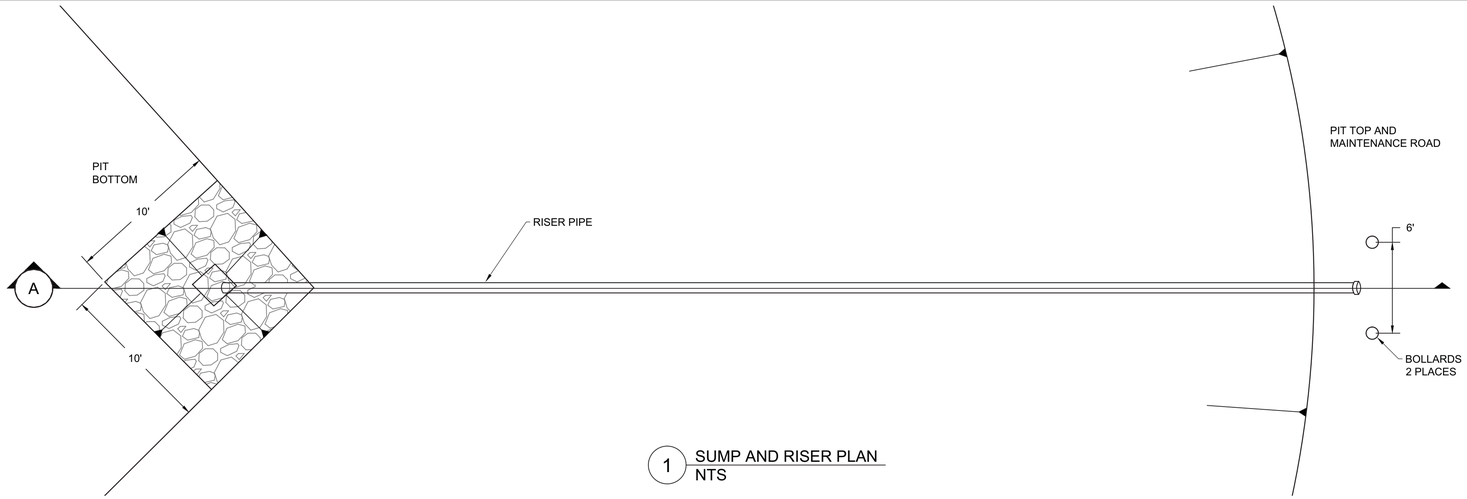
CLIENT APPROVALS — DATE

NOT FOR CONSTRUCTION

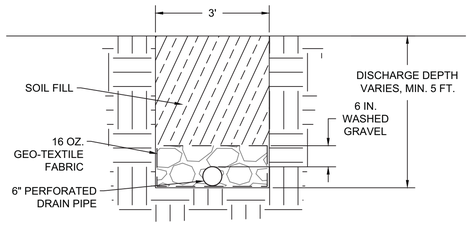
FRENCH DRAIN PLAN AND PROFILE

DRAWN: CP	DATE: MAR15	DWG. NO.: C117	REV. NO.: A
SCALE:	W.O. NO.: 14798.001.001	SHT. 19 OF 34	

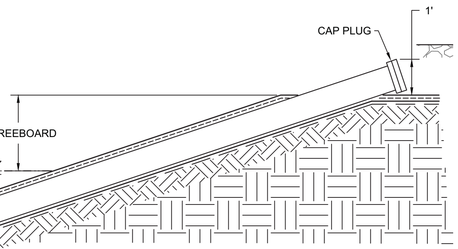
P:\Spadafora\101\FRENCHDRAIN.dwg March 11, 2015 - 1:44pm

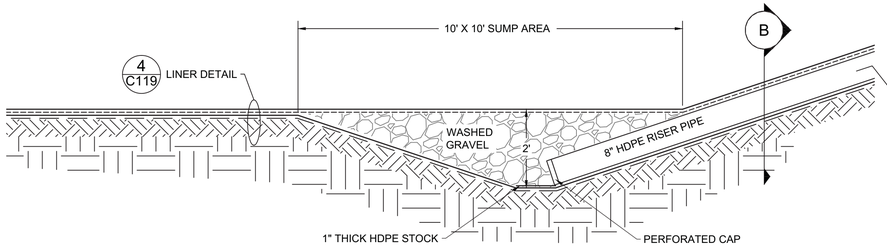


1 SUMP AND RISER PLAN
NTS

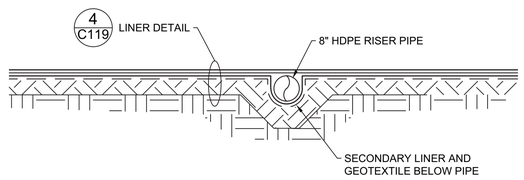


2 OUTLET SECTION

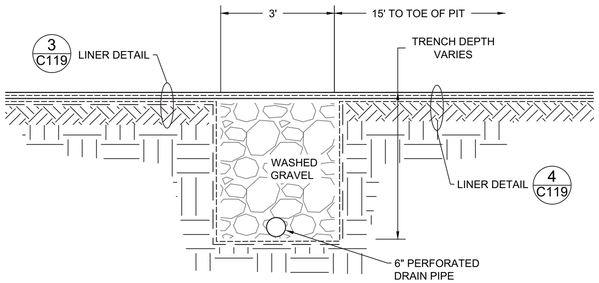




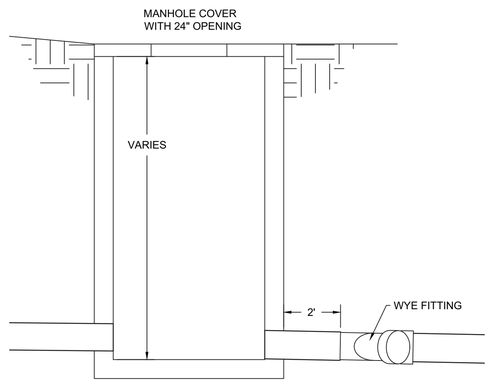
A SUMP AND RISER PROFILE



B RISER SECTION



3 FRENCH DRAIN SECTION



4 OUTLET MANHOLE

CONSTRUCTION NOTES

A ALL GEOSYNTHETICS AND LINERS SHALL BE ANCHORED, AS NECESSARY, DURING INSTALLATION TO PREVENT SLIPPAGE AS SPECIFIED BY MANUFACTURER.

B. PIPELINE PENETRATION IN DETAIL A SHALL BE APPROVED BY ENGINEERS.

0 2' 4'

P:\Spadafora\101\DETAILS.dwg March 11, 2015 - 1:56pm

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

CLIENT APPROVALS DATE

NOT FOR CONSTRUCTION

RISER PIPE AND DRAIN DETAILS

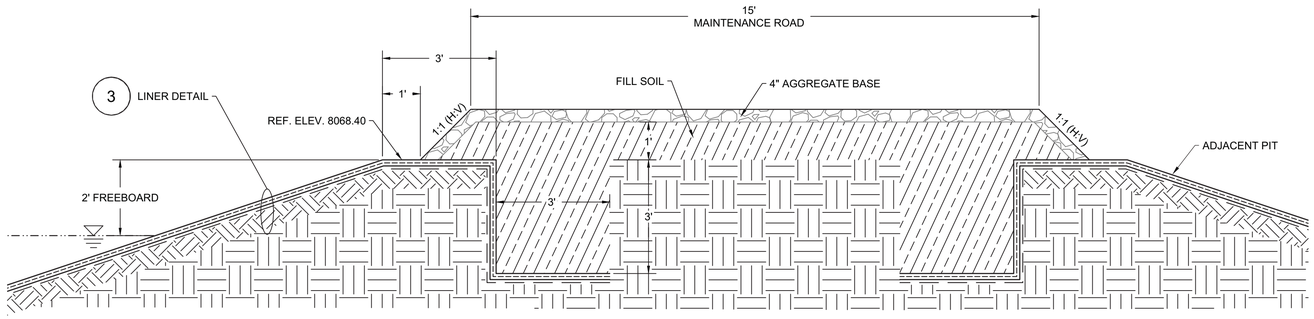
DRAWN CP	DATE MAR15	DWG. NO. C118	REV. NO. A
SCALE	W.O. NO. 14798.001.001	SHT. 20 OF 34	

KEYED NOTES

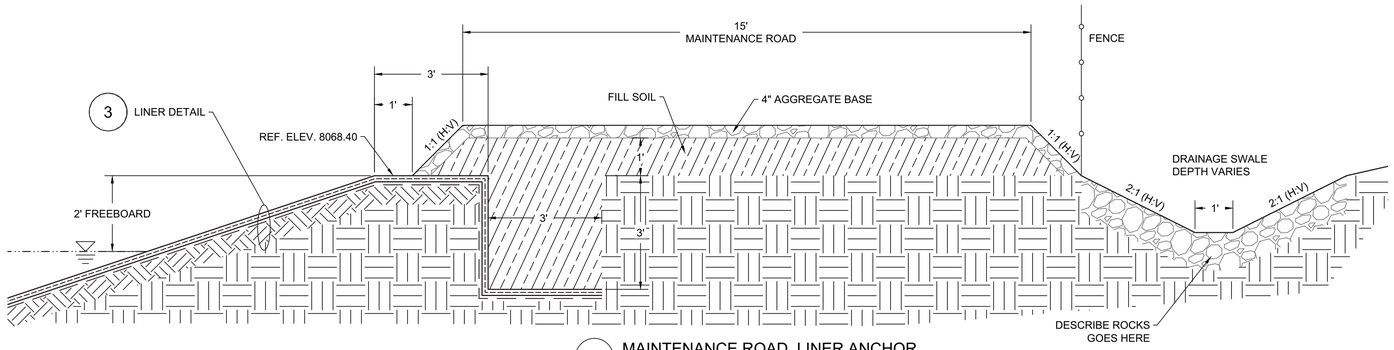
1 THE GEONET AND GEOTEXTILE MAY BE REPLACED WITH A BONDED GEONET AND GEOFABRIC AS APPROVED BY THE ENGINEER.

CONSTRUCTION NOTES

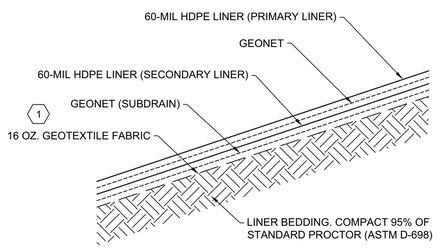
A ALL GEOSYNTHETICS AND LINERS SHALL BE ANCHORED, AS NECESSARY, DURING INSTALLATION TO PREVENT SLIPPAGE.



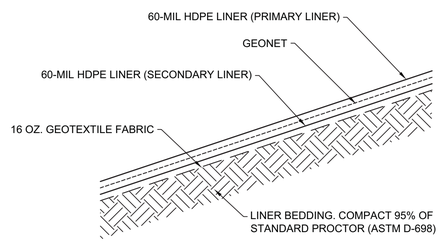
1 MAINTENANCE ROAD, LINER ANCHOR BETWEEN PITS



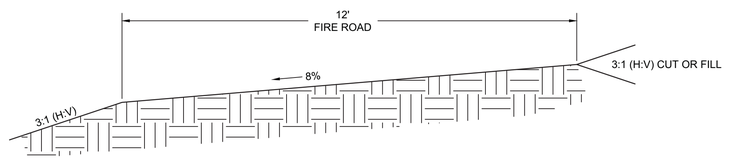
2 MAINTENANCE ROAD, LINER ANCHOR PERIMETER OF PITS



3 LINER WITH UNDER-DRAIN DETAIL NTS



4 LINER DETAIL NTS



5 FIRE ROAD DETAIL NTS

0 2" 4"

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

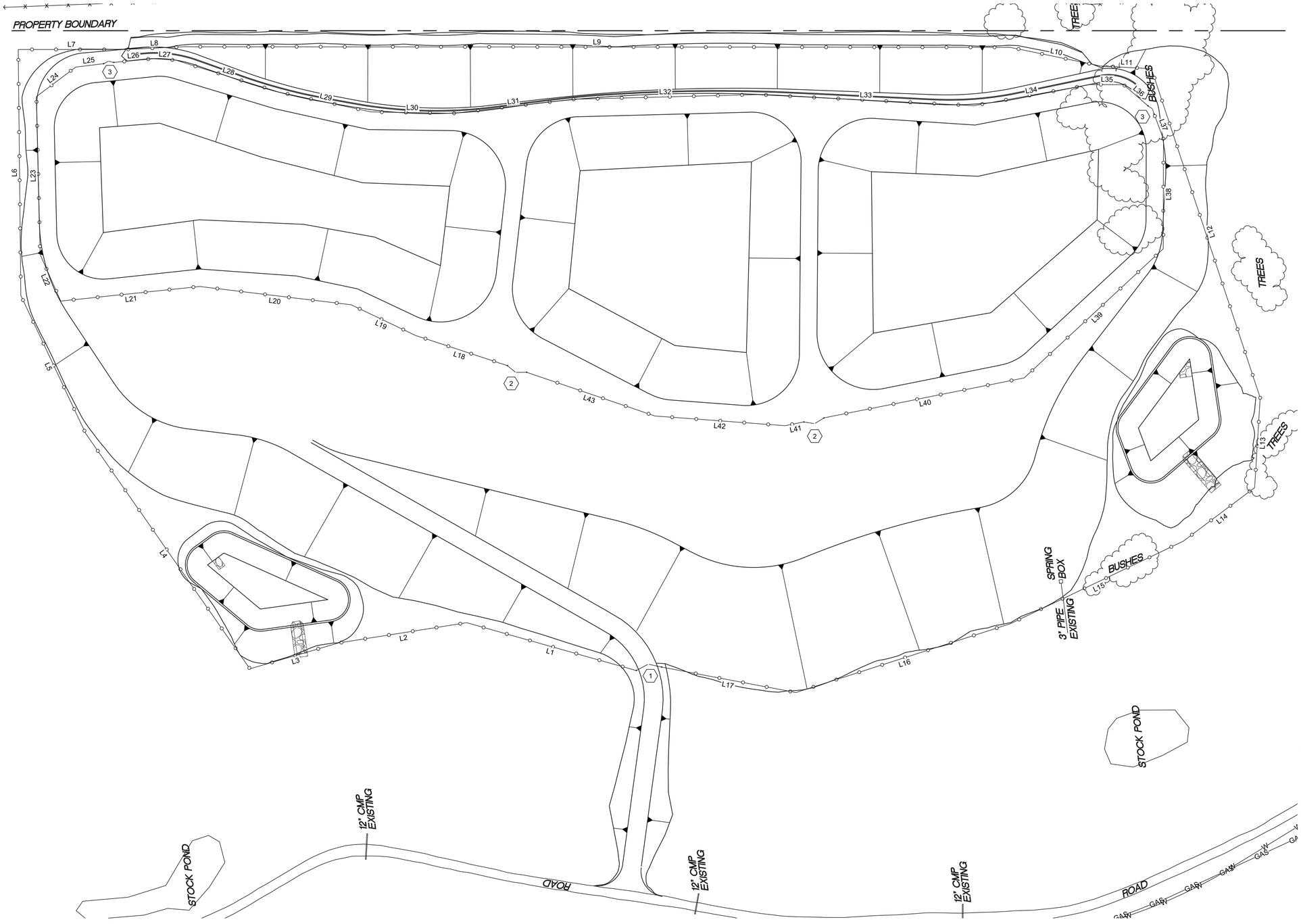
CHECKED DG	DATE MAR15	CLIENT APPROVALS	DATE
DES. ENG. DG	MAR15		
PROJ. ENG. DG	MAR15		
PROJ. MGR. DG	MAR15		
APPROVED			
APPROVED			

NOT FOR CONSTRUCTION

ROAD AND LINER DETAILS

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C119	A
SCALE	W.O. NO. 14798.001.001	SHT. 21 OF 34	

P:\Spadafora\101\DETAILS.dwg March 11, 2015 - 1:55pm



Fence Line Table						
Line #	Length	Direction	Start Northing	Start Easting	End Northing	End Easting
L1	205.83	N22° 35' 02.20"E	1464749.54	2441011.56	1464939.59	2441090.61
L2	151.88	N2° 07' 47.95"W	1464939.59	2441090.61	1465091.37	2441084.97
L3	108.44	N9° 27' 19.29"W	1465091.37	2441084.97	1465198.33	2441067.15
L4	336.20	N61° 54' 37.22"E	1465198.33	2441067.15	1465356.63	2441363.75
L5	178.55	N71° 38' 55.15"E	1465356.63	2441363.75	1465412.85	2441533.22
L6	288.23	S83° 47' 03.28"E	1465412.85	2441533.22	1465381.64	2441819.76
L7	125.19	S6° 48' 38.68"W	1465381.64	2441819.76	1465257.33	2441804.91
L8	69.32	S4° 09' 17.91"W	1465257.33	2441804.91	1465188.19	2441799.89
L9	967.78	S6° 51' 56.19"W	1465188.19	2441799.89	1464227.35	2441684.20
L10	108.37	S18° 29' 41.95"W	1464227.35	2441684.20	1464124.57	2441649.82
L11	59.49	S9° 47' 43.64"W	1464124.57	2441649.82	1464065.95	2441639.70
L12	406.12	S78° 32' 01.05"W	1464065.95	2441639.70	1463985.21	2441241.68
L13	105.38	N79° 37' 23.34"W	1463985.21	2441241.68	1464004.19	2441138.03
L14	104.45	N30° 03' 13.12"W	1464004.19	2441138.03	1464094.60	2441085.71
L15	224.63	N18° 41' 32.63"W	1464094.60	2441085.71	1464307.39	2441013.72
L16	263.78	N10° 57' 27.07"W	1464307.39	2441013.72	1464566.35	2440963.58
L17	159.68	N17° 33' 30.70"E	1464566.35	2440963.58	1464718.59	2441011.76
L18	112.85	N25° 01' 42.68"E	1464857.13	2441384.24	1464959.38	2441431.98
L19	83.20	N32° 17' 12.14"E	1464959.38	2441431.98	1465029.71	2441476.42
L20	178.88	N13° 43' 39.00"E	1465029.71	2441476.42	1465203.48	2441518.87
L21	163.80	N0° 49' 14.91"E	1465203.48	2441518.87	1465367.26	2441521.22
L22	59.52	N73° 01' 04.66"E	1465367.26	2441521.22	1465384.65	2441578.14
L23	185.11	S84° 33' 11.42"E	1465384.65	2441578.14	1465367.08	2441762.42
L24	57.68	S30° 03' 22.95"E	1465367.08	2441762.42	1465317.15	2441791.31
L25	32.43	S0° 00' 31.48"W	1465317.15	2441791.31	1465284.73	2441791.31
L26	46.22	S1° 26' 53.42"W	1465271.73	2441791.41	1465225.52	2441790.24
L27	25.87	S10° 25' 12.00"W	1465225.52	2441790.24	1465200.08	2441785.56
L28	126.89	S24° 02' 45.73"W	1465200.08	2441785.56	1465084.20	2441733.86
L29	110.27	S18° 56' 38.71"W	1465084.20	2441733.86	1464979.90	2441698.06
L30	96.92	S7° 46' 58.35"W	1464979.90	2441698.06	1464883.88	2441684.94
L31	141.14	S0° 08' 03.12"W	1464883.88	2441684.94	1464742.74	2441684.61
L32	215.84	S5° 21' 29.90"W	1464742.74	2441684.61	1464527.84	2441664.45
L33	254.06	S9° 45' 11.15"W	1464527.84	2441664.45	1464277.46	2441621.41
L34	138.80	S3° 27' 51.62"E	1464277.46	2441621.41	1464138.91	2441629.80
L35	38.61	S7° 14' 40.24"W	1464138.91	2441629.80	1464100.61	2441624.93
L36	37.30	S47° 38' 46.56"W	1464100.61	2441624.93	1464075.48	2441597.37
L37	31.11	S76° 28' 26.11"W	1464069.02	2441586.17	1464061.75	2441555.92
L38	128.29	N83° 03' 08.40"W	1464061.75	2441555.92	1464077.26	2441428.58
L39	222.35	N36° 03' 05.14"W	1464077.26	2441428.58	1464257.03	2441297.72
L40	238.76	N4° 27' 57.35"W	1464257.03	2441297.72	1464495.07	2441279.13
L41	21.73	N4° 24' 46.92"W	1464520.03	2441277.14	1464541.69	2441275.47
L42	152.93	N11° 03' 58.13"E	1464541.69	2441275.47	1464691.78	2441304.82
L43	158.38	N25° 37' 30.21"E	1464691.78	2441304.82	1464834.58	2441373.32

KEYED NOTES

1. 12-FOOT SWING GATES (24-FOOT OPENING)
2. 8-FOOT SWING GATES (16-FOOT OPENING)
3. MAN GATE

CONSTRUCTION NOTES

A. FENCED AREA 21.14 ACRES

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- GATE
- FENCE
- RIPRAP PROTECTION

0 60' 120'

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

FENCE PLAN

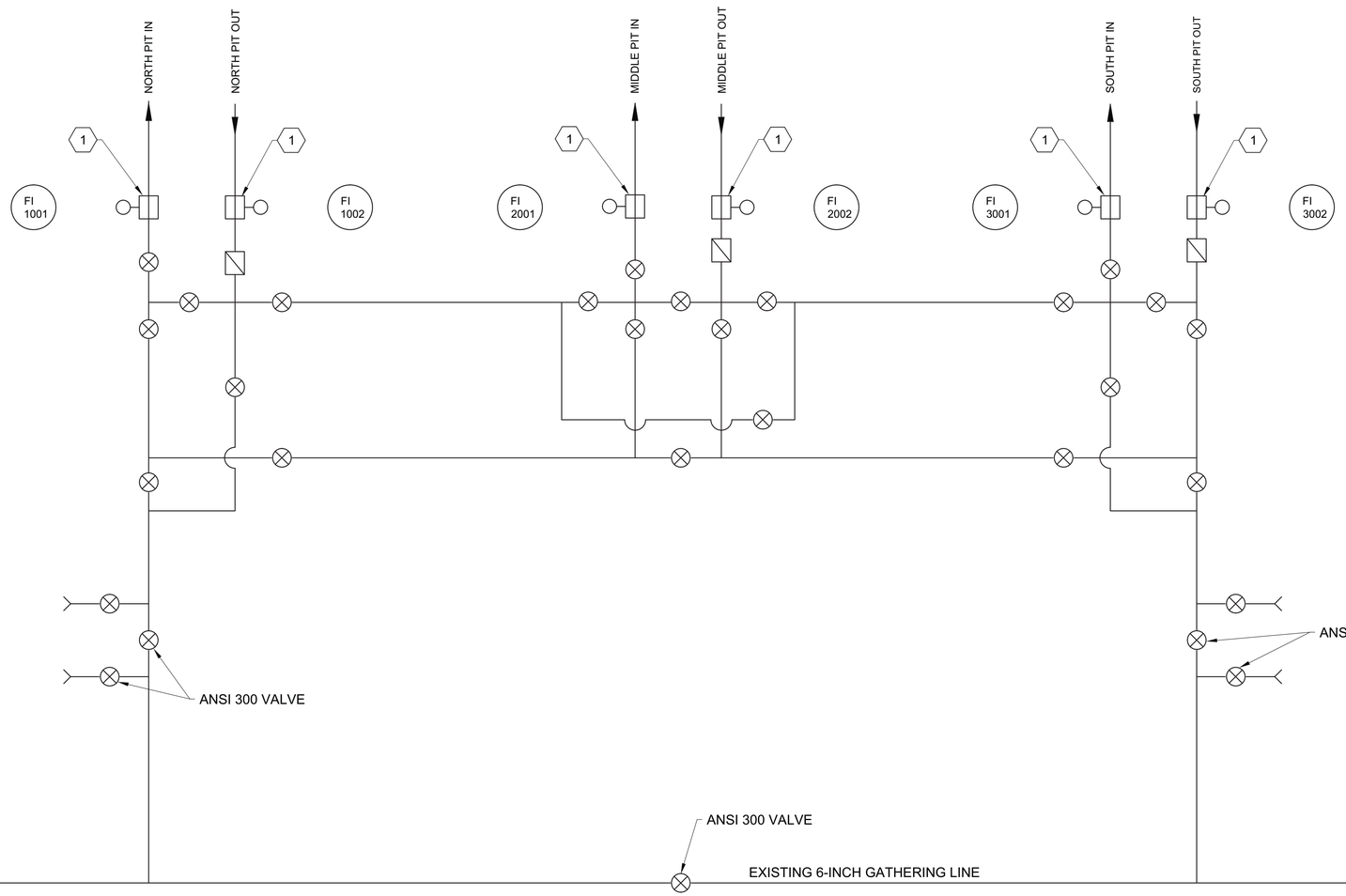
DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C120	A
SCALE	W.O. NO. 14798.001.001	SHT 22 OF 34	

P:\Spadafora\101\FENCER.AN.dwg March 11, 2015 - 1:55pm

KEYED NOTES

1. 6-INCH ELECTROMAGNETIC FLOW METERS

CONTINUES NEXT SHEET



1 PIPING DETAIL

CONSTRUCTION NOTES

A. UNLESS OTHERWISE NOTED ALL VALVES ARE ANSI 150.

B. FLOW METERS SHALL HAVE A MINIMUM OF 10 DIAMETERS STRAIGHT PIPE UPSTREAM AND 5 DIAMETERS DOWNSTREAM.

C. PIPING AND VALVES BY OTHERS.

LEGEND

- BALL VALVE
- ONE WAY VALVE
- FLOW METER

P:\Spadafora\101\PhiD.dwg March 11, 2015 - 1:55pm

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	MAR15		
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

CLIENT APPROVALS | DATE

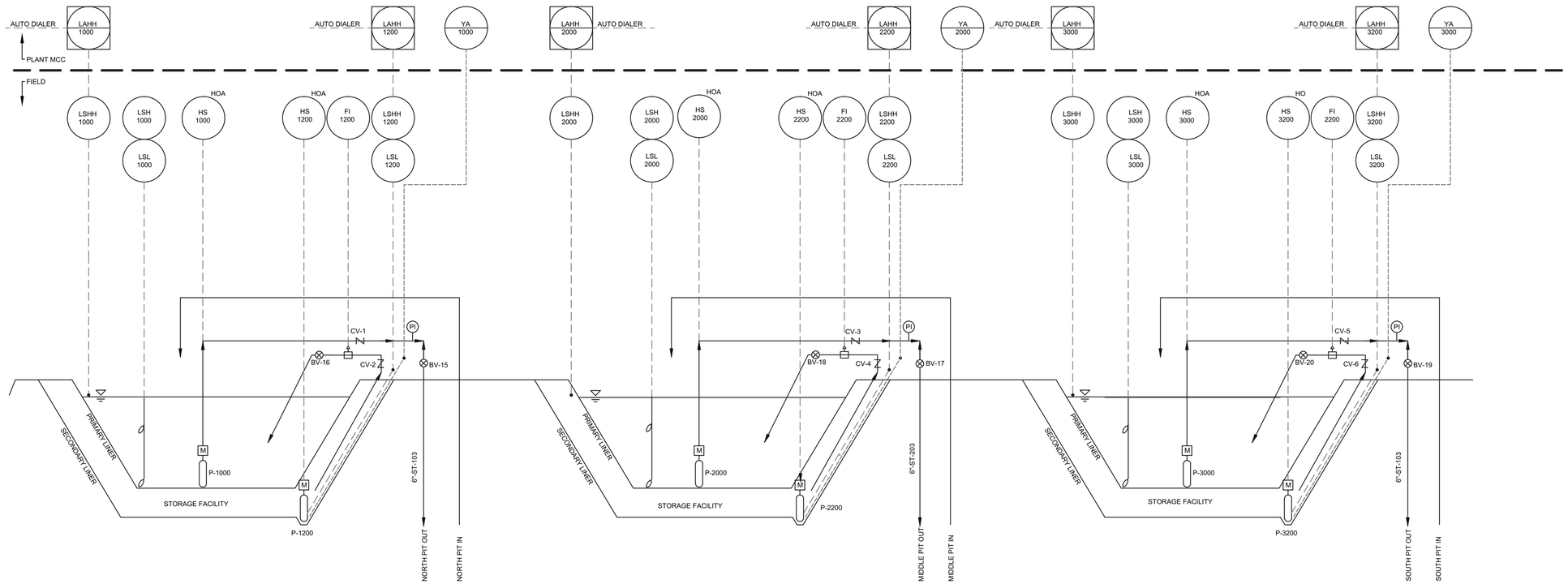
NOT FOR CONSTRUCTION

PIPING SCHEMATIC

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C121	A
SCALE	W.O. NO.	SHT. 23 OF 34	
	14798.001.001		

CONSTRUCTION NOTES

A. PUMPING SYSTEM ALARM AND LEVEL MONITORING BY OTHERS.



FROM PREVIOUS SHEET

1 PIPING DETAIL

LEGEND

- BALL VALVE
- SUBMERSIBLE PUMP
- LEVEL PROBE
- CHECK VALVE (CV)

E/T = ELECTRICAL TRACE
EXIST = EXISTING
HO = HAND ON-OFF
HOA = HAND-OFF-AUTO
HS = HAND SWITCH
LAHH = LEVEL ALARM HIGH-HIGH
LSH = LEVEL SWITCH HIGH
LSHH = LEVEL SWITCH HIGH-HIGH
LSL = LEVEL SWITCH LOW
MCC = MOTOR CONTROL CENTER
NC = NORMALLY CLOSED
P-1000 = PUMP-DESIGNATION
PI = PRESSURE INDICATOR
ST = STEEL
YA = EVENT (LEAK) ALARM

- FIELD MOUNTED-DISCRETE INSTRUMENTATION
- PRIMARY LOCATION MOUNTED-DISCRETE INSTRUMENTATION
- PRIMARY LOCATION-SHARED DISPLAY/CONTROL

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO
LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

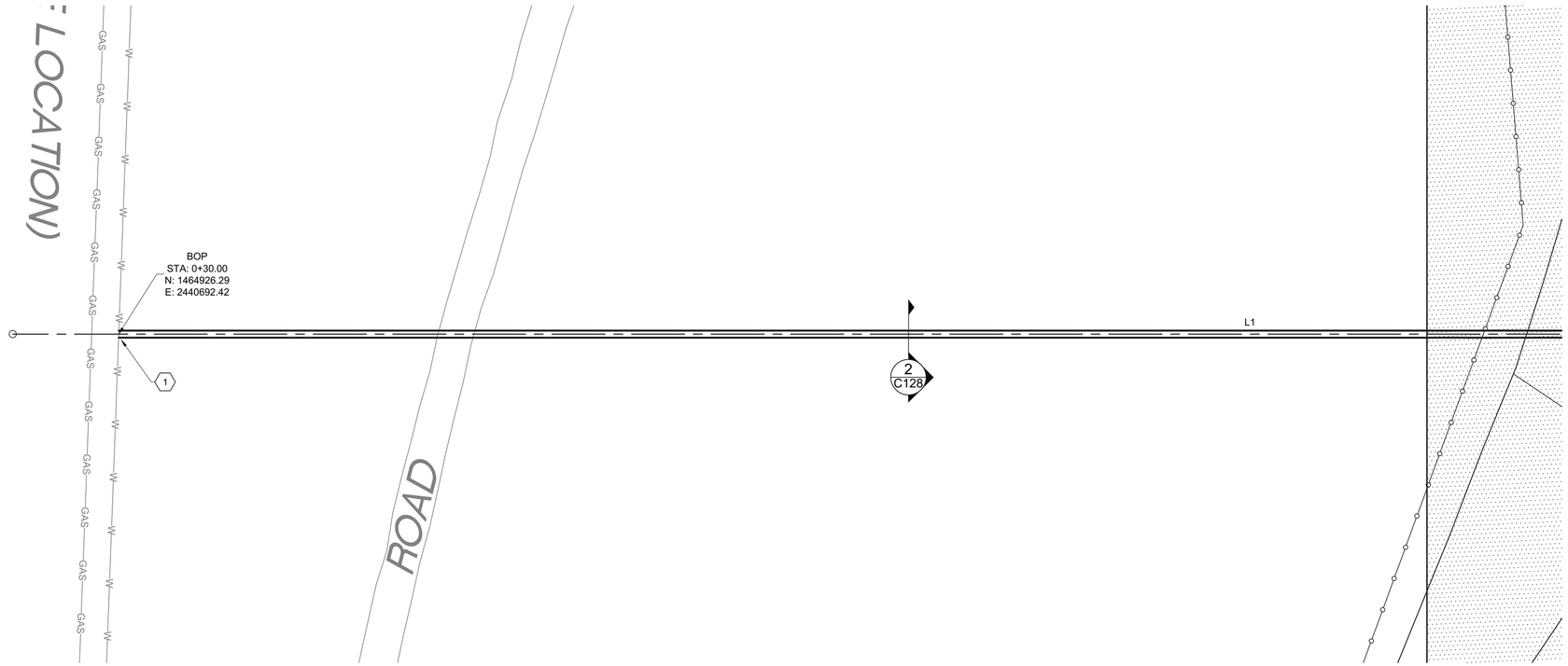
CLIENT APPROVALS — DATE

NOT FOR CONSTRUCTION

P & ID

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C122	A
SCALE	W.O. NO. 14798.001.001	SHT. 24 OF 34	

P:\Spadafora\101\PnID.dwg March 11, 2015 - 1:55pm



KEYED NOTES

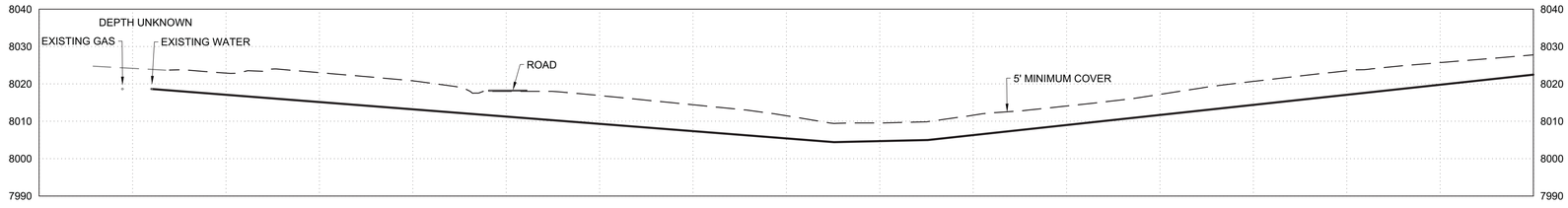
1. ANSI 300 VALVE TO BE INSTALLED ON EXISTING WATERLINE BETWEEN PROPOSED NEW LINE CONNECTIONS.

CONSTRUCTION NOTES

A. ALL BURIED PIPE IS 6-INCH COATED STEEL

1 WATERLINE PIPING

Line Table: Alignments						
Line #	Length	Direction	Start Northing	Start Easting	End Northing	End Easting
L1	703.97	S87° 28' 17.32"E	1464927.62	2440662.45	1464896.56	2441365.74
L2	4.08	S64° 57' 24.44"E	1464896.56	2441365.74	1464894.83	2441369.44
L3	17.02	N25° 02' 35.56"E	1464894.83	2441369.44	1464910.26	2441376.64



LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- PIPING

0 20' 40'
HORIZONTAL

0 20' 40'
VERTICAL

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

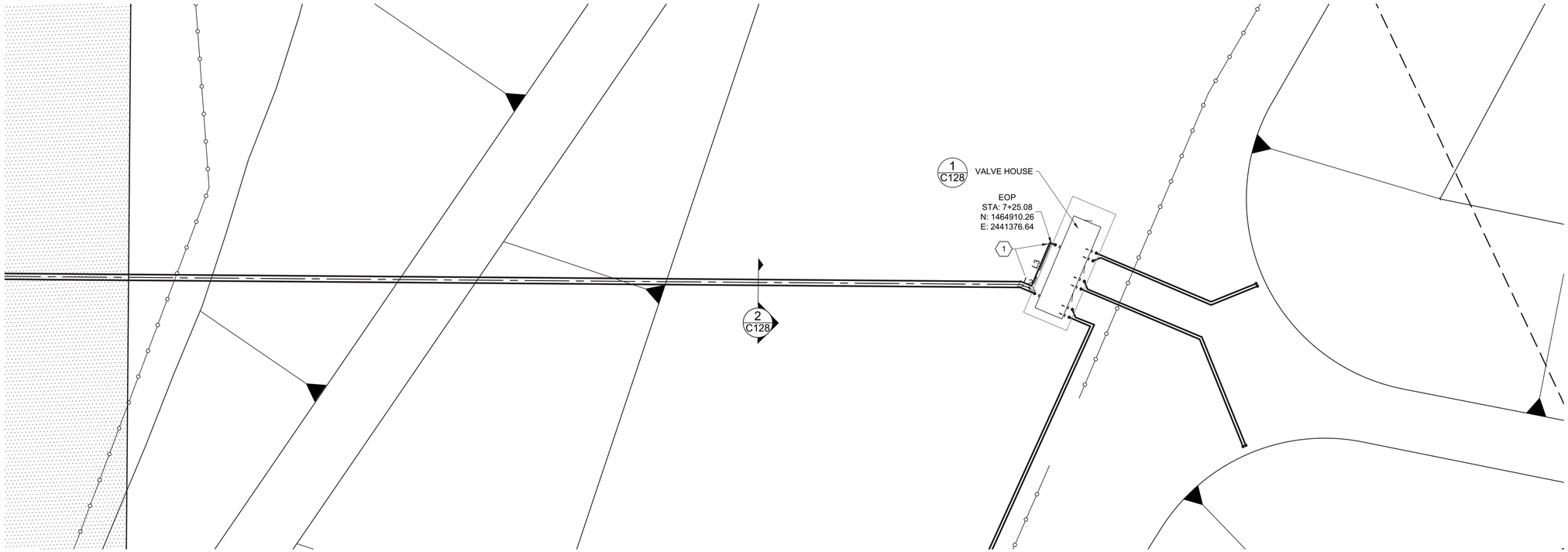
CHECKED	DG	MAR15	CLIENT APPROVALS	DATE
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

WATERLINE PIPING PLAN AND PROFILE

DRAWN: CP	DATE: MAR15	DWG. NO.: C123	REV. NO.: A
SCALE:	W.O. NO.: 14798.001.001	SHT. 25 OF 34	

P:\Spadafora\101\WATERPNP.dwg March 11, 2015 - 1:55pm



KEYED NOTES

1. CONNECTION TO VALVE HOUSE TO BE COORDINATED WITH VALVE HOUSE CONTRACTOR.

CONSTRUCTION NOTES

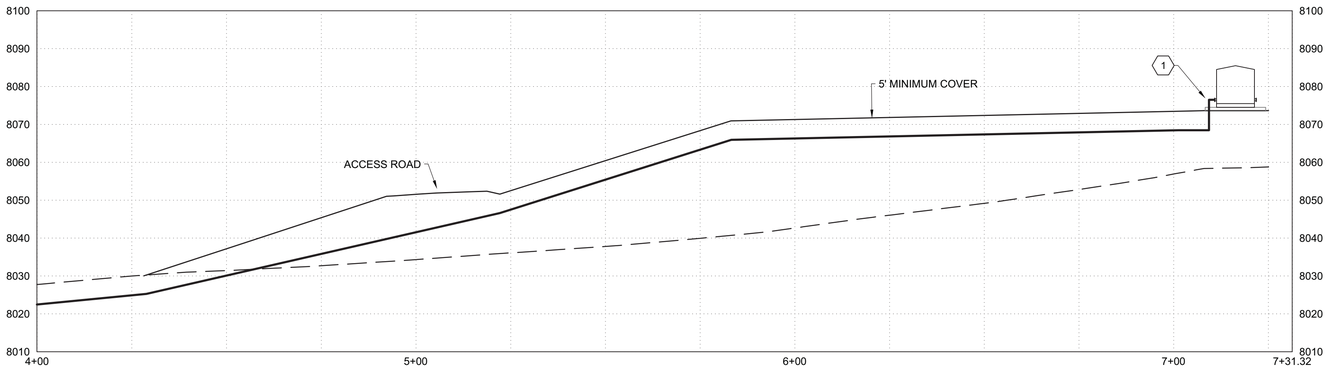
A. ALL BURIED PIPE IS 6-INCH COATED STEEL

B. VALVE HOUSE AND PUMP SYSTEM BY OTHERS.

C. LOCATION OF THE BURIED PIPE AT THE VALVE HOUSE MUST BE COORDINATED WITH THE VALVE HOUSE CONTRACTOR.

Line Table: Alignments						
Line #	Length	Direction	Start Northing	Start Easting	End Northing	End Easting
L1	703.97	S87° 28' 17.32"E	1464927.62	2440662.45	1464896.56	2441365.74
L2	4.08	S64° 57' 24.44"E	1464896.56	2441365.74	1464894.83	2441369.44
L3	17.02	N25° 02' 35.56"E	1464894.83	2441369.44	1464910.26	2441376.64

1 WATERLINE PIPING



LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- PIPING

HORIZONTAL 0 20' 40'

VERTICAL 0 20' 40'

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

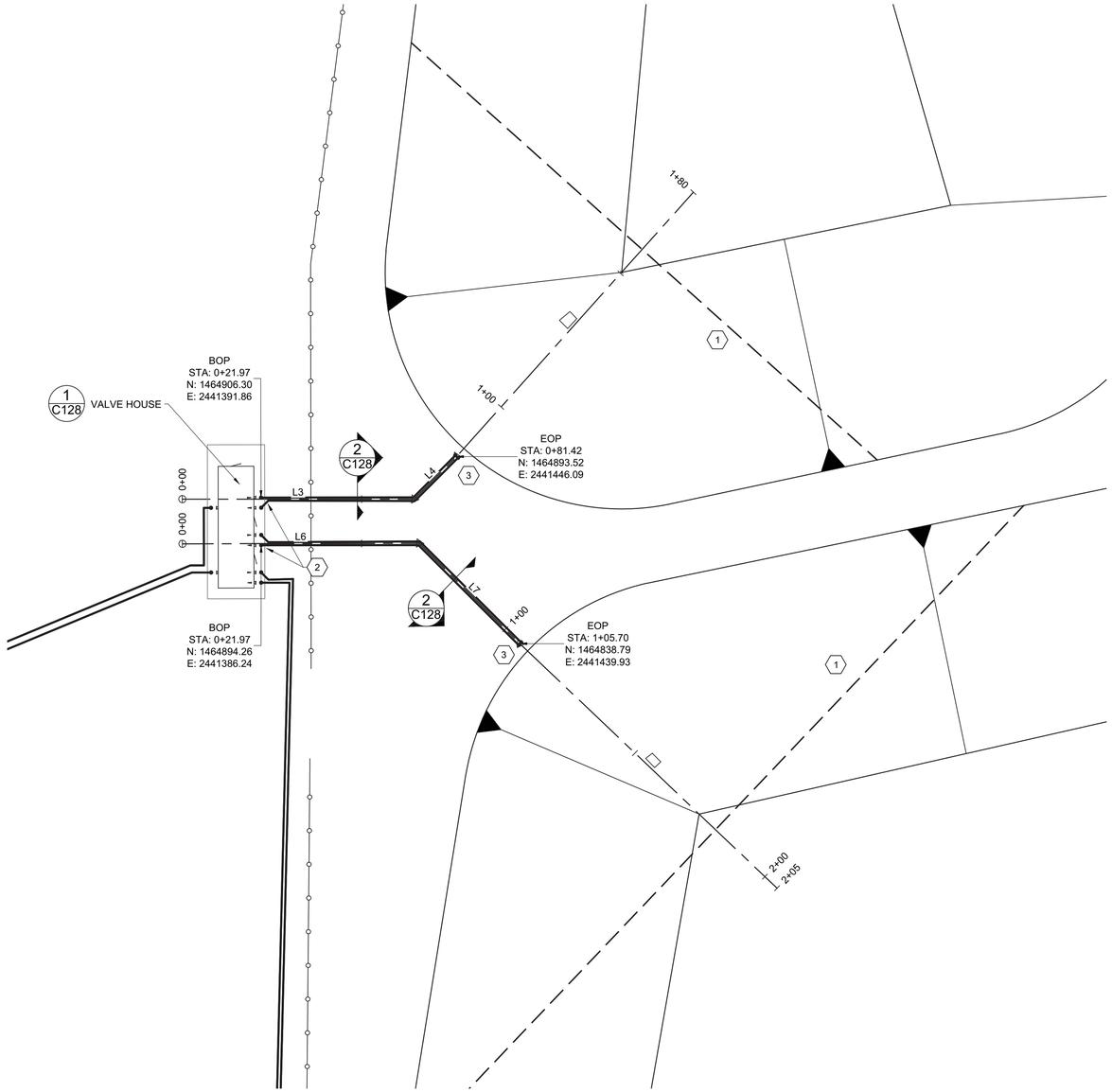
CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

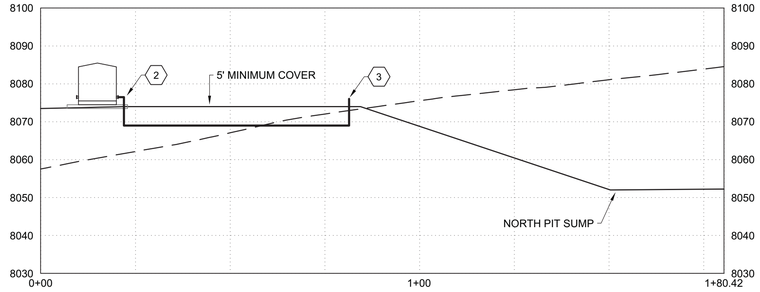
WATERLINE PIPING PLAN AND PROFILE

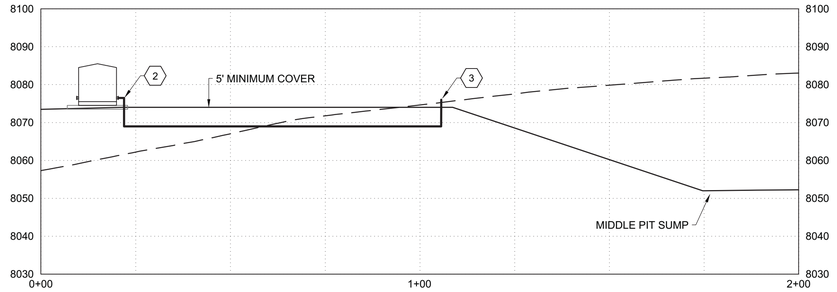
DRAWN: CP	DATE: MAR15	DWG. NO.: C124	REV. NO.: A
SCALE	W.O. NO.: 14798.001.001	SHT. 26 OF 34	

P:\Spadafora\101\WATERPNP.dwg March 11, 2015 - 1:46pm



1 NORTH AND MIDDLE PIT PIPING





KEYED NOTES

1. FLOATING CENTRIFUGAL PUMPS HELD IN POSITION BY DUAL CABLES BY OTHERS.
2. CONNECTION TO VALVE HOUSE TO BE COORDINATED WITH VALVE HOUSE CONTRACTOR.
3. CONNECT TO FLEXIBLE PUMP DISCHARGE LINE TO BE COORDINATED WITH PUMP CONTRACTOR.

CONSTRUCTION NOTES

A. ALL BURIED PIPE IS 6-INCH COATED STEEL
B. VALVE HOUSE AND PUMP SYSTEM BY OTHERS.
C. LOCATION OF THE BURIED PIPE AT THE VALVE HOUSE MUST BE COORDINATED WITH THE VALVE HOUSE CONTRACTOR.

Line Table: Alignments						
Line #	Length	Direction	Start Northing	Start Easting	End Northing	End Easting
L3	64.64	S64° 53' 54.84"E	1464915.21	2441371.78	1464887.79	2441430.32
L4	16.78	N70° 01' 33.79"E	1464887.79	2441430.32	1464893.52	2441446.09

Line Table: Alignments						
Line #	Length	Direction	Start Northing	Start Easting	End Northing	End Easting
L6	66.03	S65° 02' 34.27"E	1464903.93	2441366.51	1464876.07	2441426.38
L7	39.66	S19° 58' 18.06"E	1464876.07	2441426.38	1464838.79	2441439.93

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- PIPING

0 20' 40'
HORIZONTAL
0 20' 40'
VERTICAL

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

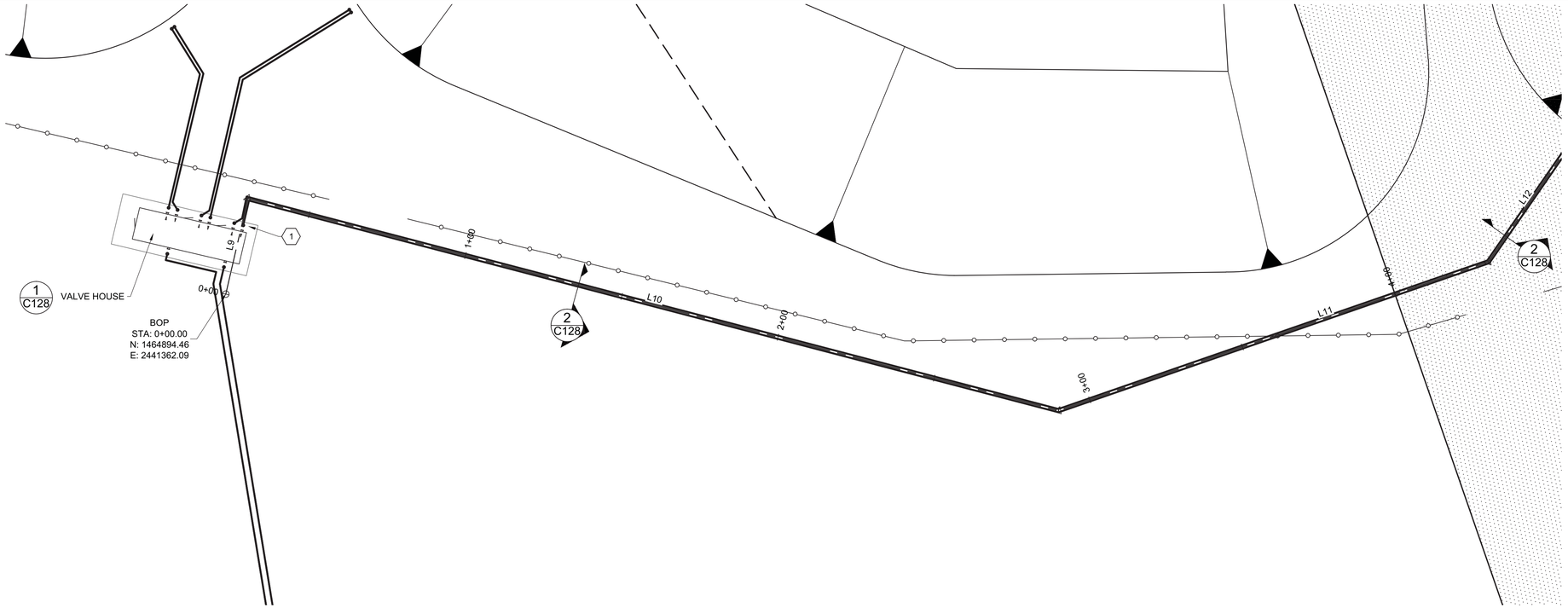
		DATE	CLIENT APPROVALS	DATE
CHECKED	DG	MAR15		
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

NORTH AND MIDDLE PITS PIPING PLAN AND PROFILE

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C125	A
SCALE	W.O. NO. 14798.001.001	SHT. 27 OF 34	

P:\Spadafora\101\NORTHMIDDLEPNP.dwg March 11, 2015 - 1:56pm



1 SOUTH PIT PIPING

KEYED NOTES

1. CONNECTIONS TO VALVE HOUSE TO BE COORDINATED WITH VALVE HOUSE CONTRACTOR.

CONSTRUCTION NOTES

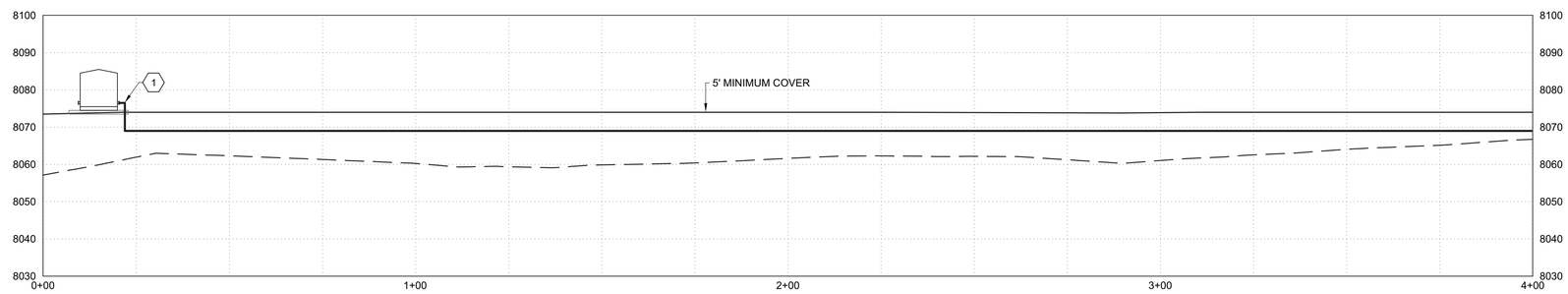
A. ALL BURIED PIPE IS 6-INCH COATED STEEL

B. VALVE HOUSE AND PUMP SYSTEM BY OTHERS.

C. LOCATION OF THE BURIED PIPE AT THE VALVE HOUSE MUST BE COORDINATED WITH THE VALVE HOUSE CONTRACTOR.

Line Table: Alignments

Line #	Length	Direction	Start Northing	Start Easting	End Northing	End Easting
L9	30.35	S65° 07' 36.35"E	1464894.46	2441362.09	1464881.70	2441389.63
L10	259.41	S26° 29' 10.96"W	1464881.70	2441389.63	1464649.51	2441273.93
L11	140.81	S7° 15' 49.04"E	1464649.51	2441273.93	1464509.83	2441291.74
L12	46.01	S43° 25' 23.78"E	1464509.83	2441291.74	1464476.41	2441323.36



LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- PIPING

0 20' 40'
HORIZONTAL

0 20' 40'
VERTICAL

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

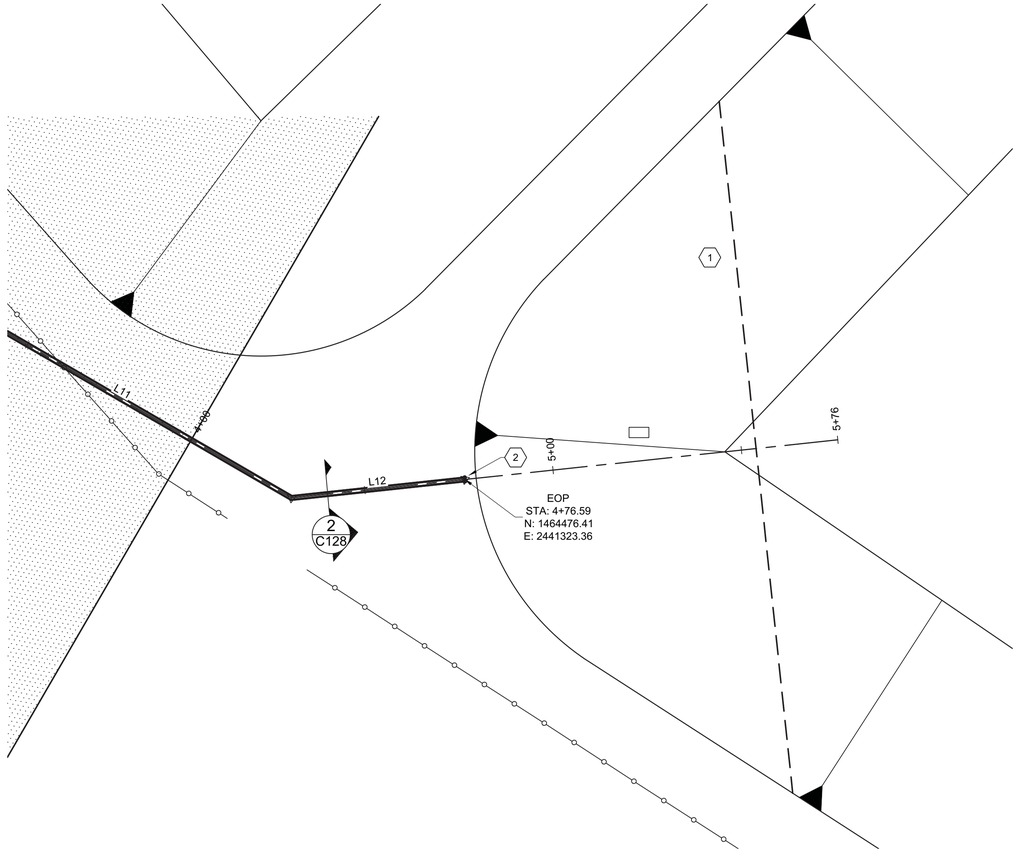
		DATE	CLIENT APPROVALS	DATE
CHECKED	DG	MAR15		
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

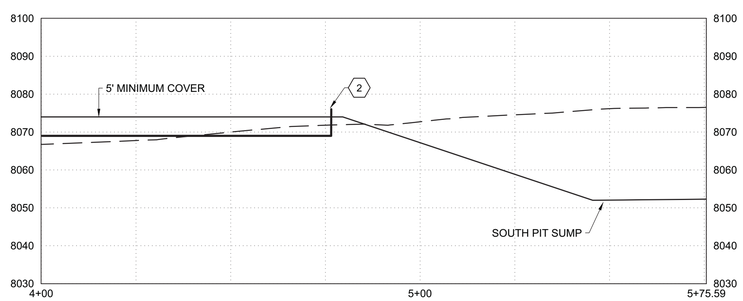
SOUTH PIT PIPING
PLAN AND PROFILE

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C126	A
SCALE	W.O. NO. 14798.001.001	SHT. 28 OF 34	

P:\Spadafora\101\SOUTHPNP.dwg March 11, 2015 - 1:45pm



1 SOUTH PIT PIPING



KEYED NOTES

1. FLOATING CENTRIFUGAL PUMPS HELD IN POSITION BY DUAL CABLES BY OTHERS.
2. CONNECTION TO FLEXIBLE LINE TO PUMP TO BE COORDINATED WITH PUMP CONTRACTOR.

CONSTRUCTION NOTES

A. ALL BURIED PIPE IS 6-INCH COATED STEEL
B. VALVE HOUSE AND PUMP SYSTEM BY OTHERS.
C. LOCATION OF THE BURIED PIPE AT THE VALVE HOUSE MUST BE COORDINATED WITH THE VALVE HOUSE CONTRACTOR.

Line Table: Alignments

Line #	Length	Direction	Start Northing	Start Easting	End Northing	End Easting
L9	30.35	S65° 07' 36.35"E	1464894.46	2441362.09	1464881.70	2441389.63
L10	259.41	S26° 29' 10.96"W	1464881.70	2441389.63	1464649.51	2441273.93
L11	140.81	S7° 15' 49.04"E	1464649.51	2441273.93	1464509.83	2441291.74
L12	46.01	S43° 25' 23.78"E	1464509.83	2441291.74	1464476.41	2441323.36

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- PIPING

0 20' 40' HORIZONTAL
0 20' 40' VERTICAL

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO
LAKEWOOD COLORADO

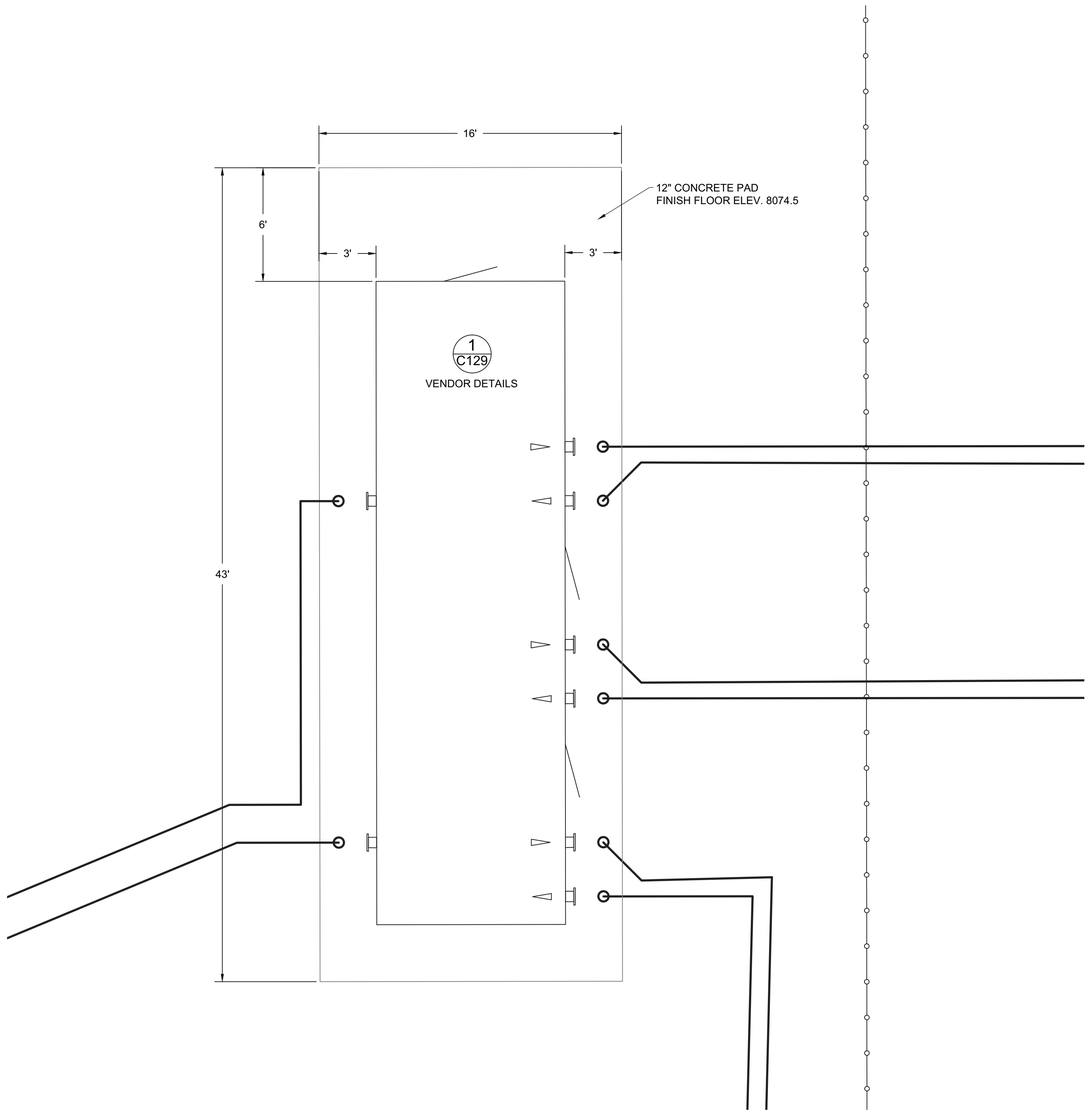
		DATE	CLIENT APPROVALS	DATE
CHECKED	DG	MAR15		
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

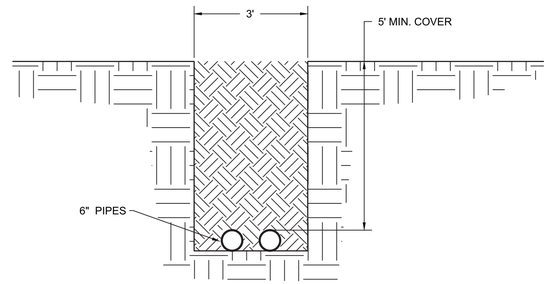
SOUTH PIT PIPING
PLAN AND PROFILE

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C127	A
SCALE	W.O. NO.	SHT. 29 OF 34	
	14798.001.001		

P:\Spadafora\101SOUTHPNP.dwg March 11, 2015 - 1:46pm



1 VALVE HOUSE



2 TRENCH DETAIL

CONSTRUCTION NOTES

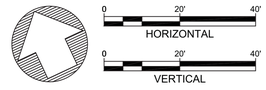
A. ALL BURIED PIPE IS 6-INCH COATED STEEL

B. VALVE HOUSE AND PUMP SYSTEM BY OTHERS.

C. LOCATION OF THE BURIED PIPE AT THE VALVE HOUSE MUST BE COORDINATED WITH THE VALVE HOUSE CONTRACTOR.

LEGEND

PIPING



NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

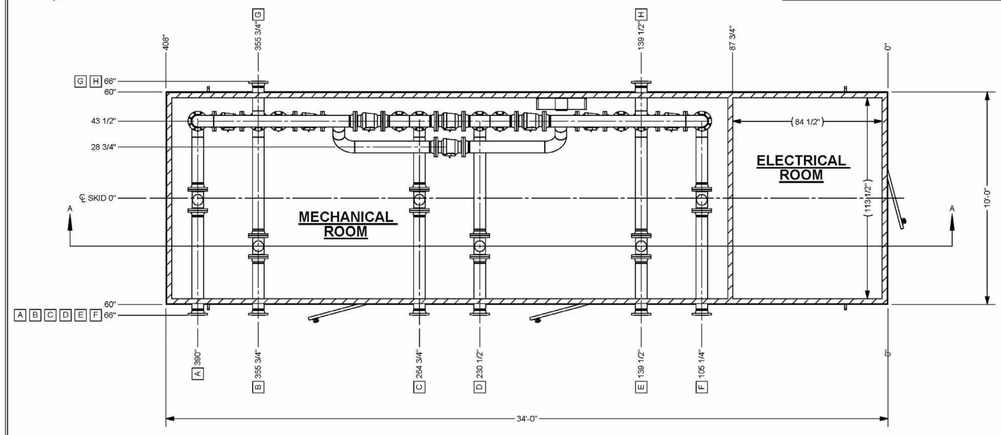
PIPING DETAILS

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C128	A
SCALE	W.O. NO.	SHT. 30 OF 34	
	14798.001.001		

P:\Spadafora\101\PIPING\PHP.dwg March 11, 2015 - 1:56pm

PRELIMINARY - BID SET
NOT FOR CONSTRUCTION

- CUSTOMER CONNECTIONS -			
ITEM	SIZE	TYPE	CONNECTION NAME
A	6" 150# RFWN	FLANGE	SOUTH PIT IN
B	6" 150# RFWN	FLANGE	SOUTH PIT OUT
C	6" 150# RFWN	FLANGE	MIDDLE PIT IN
D	6" 150# RFWN	FLANGE	MIDDLE PIT OUT
E	6" 150# RFWN	FLANGE	NORTH PIT IN
F	6" 150# RFWN	FLANGE	NORTH PIT OUT
G	6" 150# RFWN	FLANGE	GATHERING LINE
H	6" 150# RFWN	FLANGE	GATHERING LINE



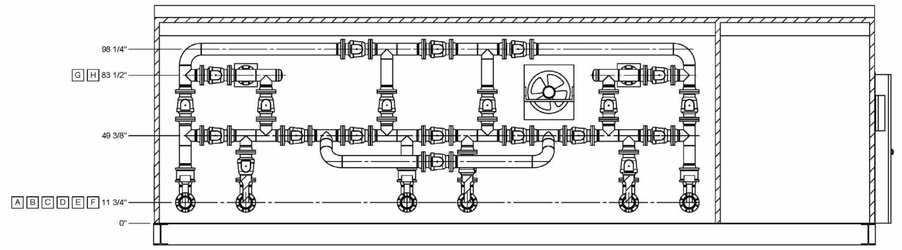
STANDARD DIMENSIONS	CUSTOMER CONNECTIONS
UNLESS OTHERWISE SPECIFIED	UNLESS OTHERWISE SPECIFIED
TOLERANCES	TOLERANCES
FRACTIONAL ±1/16"	FRACTIONAL ±1"
DECIMAL	DECIMAL
1 PLACE ±.1	1 PLACE ±.1
2 PLACE ±.05	2 PLACE ±.05
3 PLACE ±.031	3 PLACE ±.03
BREAK ALL SHARP EDGES	BREAK ALL SHARP EDGES

REFERENCE DRAWINGS		
DWG. NO.	TITLE	
-	ENCLOSURE DETAILS	
-	PIPE SUPPORT DETAILS	
-	PIPE DETAILS	
-	SKID PACKAGE DETAILS	
-	PIPING & INSTRUMENTATION DIAGRAM	

REVISIONS					
REV	DESCRIPTION	BY	DATE	CHK'D	DATE
A	ISSUE FOR BID	MS	1/20/15		

DRAWN BY: M.SMITH	CHECKED BY:	DXP	
DATE DRAWN: 1/20/2015	DATE CHECKED:	WESTON - VALVE HOUSE GENERAL ARRANGMENT DRAWING	
SCALE: 1:36	PROJECT NO: -	DWG NO: 100149	REV: A
		SHEET 2 OF 3	

PRELIMINARY - BID SET
NOT FOR CONSTRUCTION



SECTION A-A

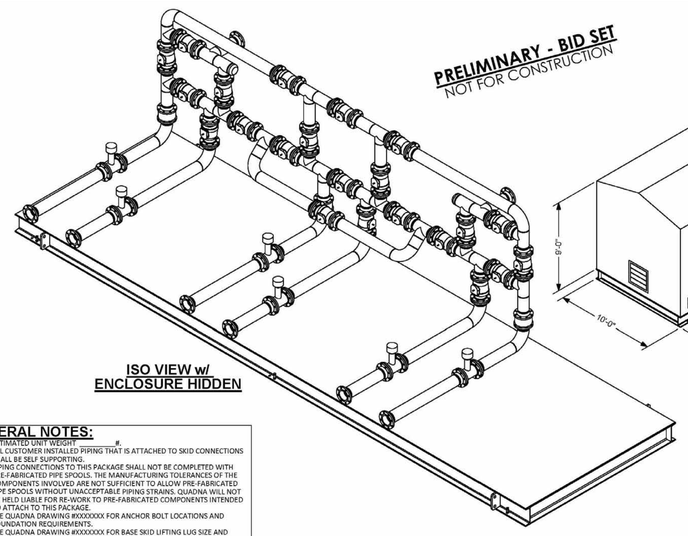
STANDARD DIMENSIONS	CUSTOMER CONNECTIONS
UNLESS OTHERWISE SPECIFIED	UNLESS OTHERWISE SPECIFIED
TOLERANCES	TOLERANCES
FRACTIONAL ±1/16"	FRACTIONAL ±1"
DECIMAL	DECIMAL
1 PLACE ±.1	1 PLACE ±.1
2 PLACE ±.05	2 PLACE ±.05
3 PLACE ±.031	3 PLACE ±.03
BREAK ALL SHARP EDGES	BREAK ALL SHARP EDGES

REFERENCE DRAWINGS		
DWG. NO.	TITLE	
-	ENCLOSURE DETAILS	
-	PIPE SUPPORT DETAILS	
-	PIPE DETAILS	
-	SKID PACKAGE DETAILS	
-	PIPING & INSTRUMENTATION DIAGRAM	

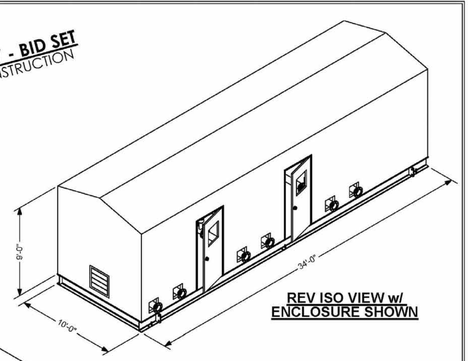
REVISIONS					
REV	DESCRIPTION	BY	DATE	CHK'D	DATE
A	ISSUE FOR BID	MS	1/20/15		

DRAWN BY: M.SMITH	CHECKED BY:	DXP	
DATE DRAWN: 1/20/2015	DATE CHECKED:	WESTON - VALVE HOUSE GENERAL ARRANGMENT DRAWING	
SCALE: 1:36	PROJECT NO: -	DWG NO: 100149	REV: A
		SHEET 3 OF 3	

PRELIMINARY - BID SET
NOT FOR CONSTRUCTION



ISO VIEW w/
ENCLOSURE HIDDEN



REV ISO VIEW w/
ENCLOSURE SHOWN

GENERAL NOTES:

1. ESTIMATED UNIT WEIGHT _____#.
2. ALL CUSTOMER INSTALLED PIPING THAT IS ATTACHED TO SKID CONNECTIONS SHALL BE SELF SUPPORTING.
3. PIPING CONNECTIONS TO THIS PACKAGE SHALL NOT BE COMPLETED WITH PRE-FABRICATED PIPE SPOOLS. THE MANUFACTURING TOLERANCES OF THE COMPONENTS INVOLVED ARE NOT SUFFICIENT TO ALLOW PRE-FABRICATED PIPE SPOOLS WITHOUT UNACCEPTABLE PIPING STRAINS. QUADNA WILL NOT BE HELD LIABLE FOR RE-WORK TO PRE-FABRICATED COMPONENTS INTENDED TO ATTACH TO THIS PACKAGE.
4. SEE QUADNA DRAWING #XXXXXXX FOR ANCHOR BOLT LOCATIONS AND FOUNDATION REQUIREMENTS.
5. SEE QUADNA DRAWING #XXXXXXX FOR BASE SKID LIFTING LUG SIZE AND LOCATION. USE LIFTING LUGS ON MAIN SKID ONLY.
6. NOTED ITEMS ARE TO SHIP LOOSE AND BE INSTALLED IN THE FIELD BY CUSTOMER.
   SHIP LOOSE ITEMS INCLUDE:
   - XXXXXXX

WESTON - VALVE HOUSE
GENERAL ARRANGEMENT

STANDARD DIMENSIONS	CUSTOMER CONNECTIONS
UNLESS OTHERWISE SPECIFIED	UNLESS OTHERWISE SPECIFIED
TOLERANCES	TOLERANCES
FRACTIONAL ±1/16"	FRACTIONAL ±1"
DECIMAL	DECIMAL
1 PLACE ±.1	1 PLACE ±.1
2 PLACE ±.05	2 PLACE ±.05
3 PLACE ±.031	3 PLACE ±.03
BREAK ALL SHARP EDGES	BREAK ALL SHARP EDGES

REFERENCE DRAWINGS		
DWG. NO.	TITLE	
-	ENCLOSURE DETAILS	
-	PIPE SUPPORT DETAILS	
-	PIPE DETAILS	
-	SKID PACKAGE DETAILS	
-	PIPING & INSTRUMENTATION DIAGRAM	

REVISIONS					
REV	DESCRIPTION	BY	DATE	CHK'D	DATE
A	ISSUE FOR BID	MS	1/20/15		

DRAWN BY: M.SMITH	CHECKED BY:	DXP	
DATE DRAWN: 1/20/2015	DATE CHECKED:	WESTON - VALVE HOUSE GENERAL ARRANGMENT DRAWING	
SCALE: 1:36	PROJECT NO: -	DWG NO: 100149	REV: A
		SHEET 1 OF 3	

NO.	DATE	APPR.	REVISION

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

	CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

VALVE HOUSE

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	C129	A
SCALE	W.O. NO.	SHT. 31 OF 34	
	14798.001.001		

P:\Spadafora\101\VALVEHOUSE.dwg March 11, 2015 - 1:56pm

PROPERTY BOUNDARY

FIRE ROAD

DRAINAGE SWALE

TREES

BUSHES

NORTH PIT

MIDDLE PIT

SOUTH PIT

TREES

TREES

NORTH SEDIMENT BASIN

SOUTH SEDIMENT BASIN

SPRING BOX

BUSHES

3" PIPE EXISTING

ACCESS ROAD

150-FOOT WETLAND EXCLUSION ZONE BOUNDARY

STOCK POND

STOCK POND

12" CMP EXISTING

12" CMP EXISTING

12" CMP EXISTING

ROAD

ROAD

W GAS

CONSTRUCTION NOTES

A. EROSION CONTROL BLANKET USED DURING CONSTRUCTION CAN BE RETAINED AS POST CONSTRUCTION PERMANENT EROSION BLANKET AT THE DISCRETION OF THE ENGINEER

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- CHECK DAM EC-6
- SILT FENCE SC-1
- EROSION CONTROL BLANKET EC-6
- RIPRAP PROTECTION

0 60' 120'

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

EROSION CONTROL PLAN DURING CONSTRUCTION

DRAWN: CP	DATE: MAR15	DWG. NO.: EC101	REV. NO.: A
SCALE:	W.O. NO.: 14798.001.001	SHT. 32 OF 34	

P:\Spadafora\101\EROSIONPLAN.dwg March 11, 2015 - 1:46pm

PROPERTY BOUNDARY

FIRE ROAD

DRAINAGE SWALE

TREES

BUSHES

NORTH PIT

MIDDLE PIT

SOUTH PIT

TREES

TREES

NORTH SEDIMENT BASIN

SOUTH SEDIMENT BASIN

SPRING BOX

BUSHES

3" PIPE EXISTING

ACCESS ROAD

150-FOOT WETLAND EXCLUSION ZONE BOUNDARY

STOCK POND

12" CMP EXISTING

12" CMP EXISTING

12" CMP EXISTING

STOCK POND

ROAD

ROAD

W

GAS

CONSTRUCTION NOTES

A. ROAD BASE SHALL BE 4-INCHES THICK

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- SEEDING AND MULCHING
- EROSION CONTROL BLANKET EC-6
- RIPRAP PROTECTION
- ROAD BASE

0 60' 120'

P:\Spadafora\101\EROSIONPLAN.dwg March 11, 2015 - 1:56pm

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

WESTON SOLUTIONS

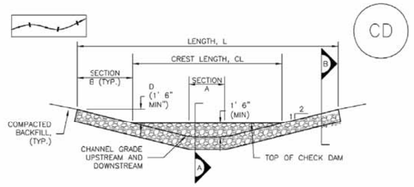
		DATE	CLIENT APPROVALS	DATE
CHECKED	DG	MAR15		
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

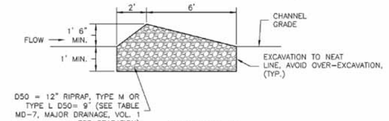
EROSION CONTROL PLAN
POST CONSTRUCTION

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	EC102	A
SCALE	W.O. NO.	SHT. 33 OF 34	
	14798.001.001		

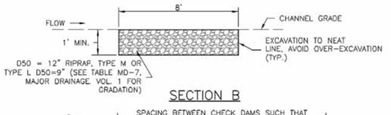
Check Dams (CD) EC-12



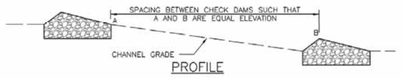
CHECK DAM ELEVATION VIEW



SECTION A



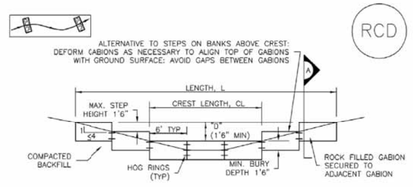
SECTION B



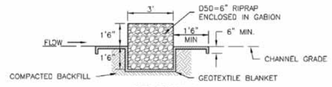
PROFILE

CD–1. CHECK DAM

Check Dams (CD) EC-12



REINFORCED CHECK DAM ELEVATION VIEW



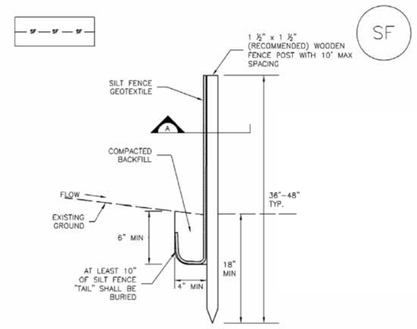
SECTION A

REINFORCED CHECK DAM INSTALLATION NOTES

1. SEE PLAN VEW FOR:
   –LOCATIONS OF CHECK DAMS.
   –CHECK DAM TYPE (CHECK DAM OR REINFORCED CHECK DAM).
   –LENGTH (L), CREST LENGTH (CL), AND DEPTH (D).
2. CHECK DAMS INDICATED ON THE SWMP SHALL BE INSTALLED PRIOR TO AN UPSTREAM LAND–DISTURBING ACTIVITIES.
3. REINFORCED CHECK DAMS, GABIONS SHALL HAVE GALVANIZED TWISTED WIRE NETTING WITH A MAXIMUM OPENING DIMENSION OF 4½" AND A MINIMUM WIRE THICKNESS OF 0.10". WIRE "HOG RINGS" AT 4" SPACING OR OTHER APPROVED MEANS SHALL BE USED AT ALL GABION SEAMS AND TO SECURE THE GABION TO THE ADJACENT SECTION.
4. THE CHECK DAM SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 1' 6".
5. GEOTEXTILE BLANKET SHALL BE PLACED IN THE REINFORCED CHECK DAM TRENCH EXTENDING A MINIMUM OF 1' 6" ON BOTH THE UPSTREAM AND DOWNSTREAM SIDES OF THE REINFORCED CHECK DAM.

CD–2. REINFORCED CHECK DAM

Silt Fence (SF) SC-1



SECTION A

SF–1. SILT FENCE

2005 PRODUCTION SYSTEM
For the Drilling and Construction of Three Wells

Table 2
Approved USFS Seed Mixes

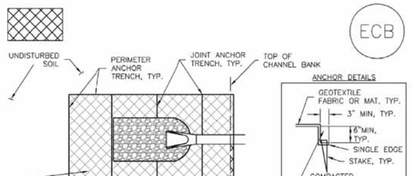
Habitat Type	Species	Pure-Live-Seed (PSL) lbs/acre	Percent of Mixture
Mountain Shrub (7,000 to 8,000 feet)	Mountain brome (*Bromus marginatus*)	4	20
	Prairie junegrass (*Koelerlacristata*)	3	15
	Western wheatgrass (*Agropyron smithii*)	4	20
	Indian ricegrass (*Oryzopsis hymenoides*)	3	15
	Sandberg bluegrass (*Poa sandbergii*)	3	15
	Bluebunch wheatgrass (*Pseudoroegneria spicata* spp. *spicata*)	3	15
Total		20	100
Aspen/Spruce-Fir (8,000 to 9,500 feet)	Mountain brome (*Bromus marginatus*)	5	26
	Slender wheatgrass (*Agropyron trachycaulum*)	3	16
	Thickspike wheatgrass (*Elymus lanceolatus* spp. *dasystachyum*)	3	16
	Canby bluegrass (*Poa canbyi*)	3	16
	Blue Wildrye (*Elymus glaucus*)	5	26
Total		19	100
Temporary Revegetation[1]	Species		lb/acre
Regreen (brand name)	Tall wheatgrass/winter wheatgrass (*Elytrigia elongata*)		20
Pioneer (brand name)	Tritacale/winter wheat (*Triticum aestivum*)		20

[1]For temporary revegetation to reduce noxious weed infestations.

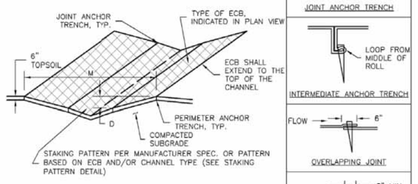
The Mountain Shrub Mix will be used for the Project area.

Seeding depth should be 0.5 to 1 inch. Planting dates should be planned from mid-September through October. Results are best if planting occurs after the first snowfall, generally in September or October.

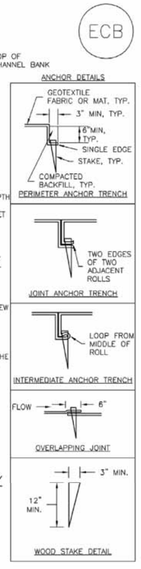
EC-6 Rolled Erosion Control Products (RECP)



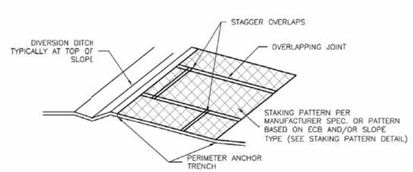
ECB–1. PIPE OUTLET TO DRAINAGEWAY



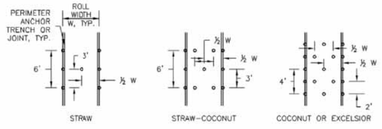
ECB–2. SMALL DITCH OR DRAINAGEWAY



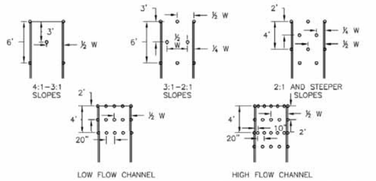
Rolled Erosion Control Products (RECP) EC-6



ECB–3. OUTSIDE OF DRAINAGEWAY

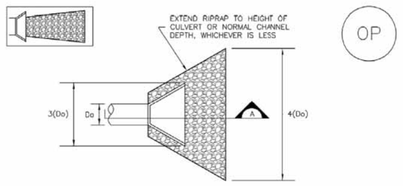


STAKING PATTERNS BY ECB TYPE

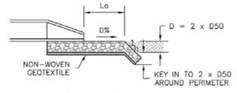


STAKING PATTERNS BY SLOPE OR CHANNEL TYPE

EC-8 Temporary Outlet Protection (TOP)



TEMPORARY OUTLET PROTECTION PLAN



SECTION A

TABLE OP–1. TEMPORARY OUTLET PROTECTION SIZING TABLE

PIPE DIAMETER, Do (INCHES)	DISCHARGE, Q (CFS)	APRON LENGTH, La (FT)	RIPRAP D50 DIAMETER MIN (INCHES)
8	2.5 5	5 10	4 6
12	5 10	10 13	4 6
18	10 20 30 40	10 16 23 26	6 9 12 16
24	30 40 50 60	16 26 26 30	9 9 12 16

OP–1. TEMPORARY OUTLET PROTECTION

P:\Spadafora\101\EROS\CNDETAIL.dwg March 11, 2015 - 1:46pm

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

	CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

EROSION CONTROL DETAILS

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	EC103	A
SCALE	W.O. NO. 14798.001.001	SHT. 34 OF 34	

TECHNICAL SPECIFICATIONS
FOR THE
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY, COLORADO

Prepared for:

Gunnison Energy LLC
1801 Broadway, Suite 1200
Denver, Colorado 80202

Prepared by:

Weston Solutions, Inc.
1435 Garrison St, Suite 100
Lakewood, Colorado 80226
(303) 729-6100

November 2014

CERTIFICATION PAGE

TECHNICAL SPECIFICATIONS
CENTRALIZED E&P WASTE MANAGEMENT FACILITY
APPLICATION SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY, COLORADO

The Engineering material and data contained in these Technical Specifications were prepared under the supervision and direction of the undersigned, whose seal as a registered Professional Engineer is affixed below.

David Goertz, P.E.
Engineer of Record

TABLE OF CONTENTS

SECTION 01010

SUMMARY OF WORK

PART 1 – GENERAL

1.01 SUMMARY

Gunnison Energy LLC (GEC) is seeking to construct and operate a Centralized Exploration and Production (E&P) Waste Management Facility (Spadafora Water Storage Facility) to manage the storage, beneficial reuse and disposal of water produced from oil and gas (O&G) production wells. This water storage facility is necessary to support natural gas production activities associated with the Spadafora Ranch Project Area on property owned by Spadafora Ranches near Paonia Reservior and operated by GEC.

The Spadafora Water Storage Facility proposed in this application is part of the critical infrastructure needed to safely and efficiently manage the storage, beneficial reuse and disposal of produced water. The produced water would be stored in up to two pits for reuse in drilling and completion operations and/or pumped via existing pipeline infrastructure to existing underground injection wells for disposal.

1.02 DESCRIPTION OF WORK

A. The Work generally involves the construction of two dual-lined water storage pits, yard piping, and monitoring equipment.

B. The following construction activities will occur during the project:

1.

a. Mobilization.

b. Clearing and Grubbing.

c. Demolition.

d. Initial topographic survey.

e. Mass excavation.

f. Engineered fill.

g. Storm water control installation: Sediment basins, storm drain pipe, , earthen channels

h. Subgrade preparation.

i. Post-excavation grade survey.

j. Sump construction.

k. Monitoring system installation, including side slope riser pipe installation, geomembrane installation, cushion geotextile placement, drainage aggregate placement.

l. Liner installation, including: primary 60-mil layer, geocomposite, and secondary 60-mil layer.

m. French Drain system installation, including: collection pipes, drainage aggregate, and filter geotextile.

n. Excavation, scraping, hauling, mixing, solidifying, and placement of soils .

o. As-built preparation and submittal.

1.03 DEFINITIONS

A. OWNER - The term Owner means Gunnison Energy LLC (GEC) for whom the Work is to be provided.

B. CONSTRUCTION MANAGER – The term Construction Manager means the firm responsible for project administration and project documentation control (Weston Solutions, Inc). All formal documents shall be submitted to the Construction Manager for proper distribution and/or review. During the period of Work the Construction Manager shall act as an authorized representative of the Owner.

C. DESIGN ENGINEER - The term Design Engineer(s) means the firm(s) responsible for the design and preparation of the Construction Documents and is the Engineer-of-Record for the project. The Engineer is responsible for approving all design changes, modifications, or clarifications encountered during construction. The Design Engineer reports directly to the Owner.

D. CQA ENGINEER – The term CQA Engineer refers to the firm responsible for CQA related monitoring and testing activities. The CQA Engineer's authorized personnel shall include CQA Engineer-of-Record and Lead CQA Monitor. The CQA Engineer may also perform CQC work as appropriate. The CQA Engineer reports directly to the Owner.

E. CONTRACTOR - The term Contractor means the firm that is responsible for the Work. The Contractor's responsibilities include the Work of any and all subcontractors and suppliers. The Contractor reports directly to the Construction Manager. All subcontractors report directly to the Contractor.

F. SURVEYOR – The term Surveyor means the firm that shall perform field surveys and provide as-built Record Drawings for the Work. A Surveyor shall be employed by the Contractor to provide construction layout, as-built Record Drawings, base-line surveys, and quantity estimates. A third party Surveyor, employed and paid for by the Owner, will perform quality assurance checks of control points, as-builts, and quantities, as directed by the Construction Manager. The Surveyor shall be a Registered Land Surveyor, licensed to practice in the State of Colorado.

G. SITE - The term Site refers to all approved staging areas, and all areas where the Work is to be performed, both public and privately owned.

H. WORK - The term Work means the entire completed construction, or various separately identifiable parts thereof, required to be furnished under the Contract Documents. Work includes any and all labor, services, materials, equipment, tools, supplies, and facilities required by the Contract Documents and necessary for the completion of the project. Work is the result of performing services, furnishing labor, and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

I. DAY - A calendar day.

J. CONTRACT DOCUMENTS - Contract Documents consist of all documents identified in the Agreement executed between the Owner and the Contractor.

1.04 REFERENCES

1.05 SUBMITTALS

A. The following shall be submitted prior to issuance of Notice to Proceed:

1. Insurance Certificates

B. The following shall be submitted prior to issuance of Notice to Proceed in accordance with Section 01560:

1. Health and Safety Plan

2. Dust control and mitigation plan

1.06 CONTRACTOR QUALIFICATIONS

A. The Contractor, and all subcontractors, shall be licensed at the time of bidding, and throughout the period of the Contract, to work in Gunnison County, Colorado to do the type of work required under terms of these Contract Documents. By submitting a bid, the Contractor certifies that he is skilled, competent, and knowledgeable on the nature, extent and inherent conditions of the Work to be performed and has been regularly engaged in the general class and type of work called for in these Contract Documents and meets the qualifications required in these Specifications.

B. By submission of a bid for this Project, the Contractor acknowledges that he is thoroughly familiar with the Site conditions.

1.07 CONTRACTOR'S RESPONSIBILITIES

A. Start, layout, construct, and complete the Project in accordance with the Contract Documents.

B. Provide a competent Site superintendent, capable of reading and understanding the Construction Documents, who shall receive instructions from the Construction Manager.

C. Provide labor, construction supplies, equipment, tools, machinery, and other services and facilities necessary to properly execute and complete the work, and pay the cost thereof.

D. Establish means, techniques, and procedures for constructing and otherwise executing the Work.

E. Establish and maintain proper Health and Safety practices for the duration of the Project. The Contractor shall be responsible for health and safety of the personnel on site including: Contractor's personnel, Owner, Construction Manager and personnel, consultants, subcontractors, suppliers, and visitors. In particular, the Contractor shall account for site specific Health and Safety issues (hazards), including but not limited to waste excavation, heat, construction activities, etc.

F. Pay cost of legally required sales, consumer, and use taxes and governmental fees.

G. Perform Work in accordance with codes, ordinances, rules, regulations, orders, and other legal requirements of governmental bodies and public agencies bearing on performance of Work.

H. Forward submittals and communications to the Construction Manager. Where applicable, the Construction Manager shall coordinate submittals and communications with the representatives who shall give approvals and directions through the Construction Manager.

I. Maintain order, safe practices, and proper conduct at all times among Contractor's employees. The Construction Manager, and its authorized representative, may require that disciplinary action be taken against an employee of the Contractor for disorderly, improper, or unsafe conduct. Should an employee of the Contractor be dismissed from his duties for misconduct, incompetence, or unsafe practice, or combination thereof, that employee shall not be rehired for the duration of the Work.

J. Coordinate the Work with the utilities, private utilities, and/or other parties performing work on or adjacent to the Site. Other parties include those responsible for construction management, construction quality assurance monitoring, air and dust monitoring, and conformance sampling. Other parties also include Owner, utility representatives, regulatory agencies, and/or inspectors. Eliminate or minimize delays in the Work and conflicts with those utilities or contractors. Coordinate activities with the Construction Manager. Schedule private utility and public utility Work relying on survey points, lines, and grades established by the Contractor to occur immediately after those points, lines and grades have been established.

K. Coordinate activities of the several trades, suppliers, and subcontractors, if any, performing the Work.

L. The Contractor shall cooperate with all other parties engaged in project-related activities to the greatest extent possible. Disputes or problems shall be referred to the Construction Manager for resolution.

M. The Contractor is responsible for becoming familiar with all aspects of the Work prior to performing the Work.

N. The Contractor shall provide documentation for the following training for site personnel:

1. All on-site supervisors:

   a. Red Cross First Aid and CPR training

2. Geosynthetic Material Installation Technicians

   a. Qualifications and experience installing similar materials

1.08 CONFORMANCE

A. Work shall conform to the Technical Specifications, CQA Plan, and Drawings that form a part of these Contract Documents.

B. Omissions from the Technical Specifications, CQA Plan, and Drawings or the misdescription of details of Work which are necessary to carry out the intent of the Contract Documents are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the Work, but they shall be performed as if fully and correctly set forth and described in the Technical Specifications, CQA Plan, and Drawings.

1.09 CONTRACTOR USE OF WORK SITE

A. Confine Site operations to areas permitted by law, ordinances, permits, and the Contract Documents. The Contractor shall ensure that all persons under his control (including Subcontractors and their workers and agents) are kept within the boundaries of the Site and shall be responsible for any acts of trespass or damage to property by persons who are under his control. Consider the safety of the Work, and that of people and property on and

adjacent to work Site, when determining amount, location, movement, and use of materials and equipment on work Site.

B. The Contractor shall be responsible for protecting private and public property including pavements, drainage culverts, electricity, highway, telephone, and similar property and shall make good of, or pay for, all damage caused thereto. Control of erosion throughout the project is of prime importance and is the responsibility of the Contractor. The Contractor shall provide and maintain all necessary measures to control erosion during progress of the Work to the satisfaction of the Construction Manager and all applicable laws and regulations, and shall remove such measures and collected debris upon completion of the project. All provisions for erosion and sedimentation control apply equally to all areas of the Work.

C. Contractor shall promptly notify the Construction Manager in writing of any subsurface or latent physical conditions at the Site that differ materially from those indicated or referred to in the Contract Documents. Construction Manager shall promptly review those conditions and advise Owner in writing if further investigations or tests are necessary. If the Construction Manager finds that the results of such investigations or tests indicate that there are subsurface and latent physical conditions which differ materially from those intended in the Contract Documents, and which could not reasonably have been anticipated by Contractor, a Change Order shall be issued incorporating the necessary revisions.

D. At no time shall Contractor interfere with operations of businesses on or in the vicinity of the Site. Should the Contractor need to work outside the regular working hours, the Contractor is required to submit a written request and obtain approval by the Construction Manager.

1.10 EXISTING UTILITIES

A. The Contractor shall be responsible for locating, uncovering, protecting, flagging, and identifying all existing utilities encountered while performing the Work. The Contractor shall request that Underground Service Alert (USA) locate and identify the existing utilities. The request shall be made 48 hours in advance.

B. The Contractor shall locate all overhead utilities that enter the construction boundary and locate these lines until they terminate or exit the site to ensure that no underground utilities originate from these overhead utilities. If underground utilities do originate from these overhead lines, the Contractor shall locate the underground utility until it terminates or exits the construction boundary.

C. All located live underground utilities shall be put on the as-built drawings and staked 50 feet on center or marked with other equal physical markings, and shall be protected until all intrusive work is completed in the area. Markings shall indicate both the horizontal and vertical position of the utilities.

D. Where the work may encounter existing utilities:

1. The Contractor shall de-energize the utilities. When this affects other utility users the Contractor shall make arrangements for alternate service if required.

2. The Contractor shall determine and comply with the requirements of the utility owner for protection of that utility. The Contractor shall provide adequate advance notice to the utility owner, of work near an existing utility.

E. When the Work requires the Contractor to be near or to cross locations of known utilities, the Contractor shall carefully uncover, support and protect these utilities and shall not cut,

damage, or otherwise disturb them without prior authorization from the Construction Manager.

F. Costs resulting from damage to utilities shall be borne by the Contractor. Costs of damage shall include repair and compensation for incidental costs resulting from the unscheduled loss of utility service to affected parties.

G. The Contractor shall immediately stop work and notify the Construction Manager of all utilities encountered and/or damaged. The Contractor shall also Survey the exact location of any utilities encountered during construction.

1.11 PRESERVATION OF SCIENTIFIC INFORMATION

A. Federal and State legislation provides for the protection, preservation, and collection of data having scientific, prehistoric, historical, or archaeological value (including relics and specimens) that might otherwise be lost due to alteration of the terrain as a result of any construction work. If evidence of such information is discovered during the course of the Work, the Contractor shall notify the Construction Manager immediately, giving the location and nature of the findings. Written confirmation shall be forwarded within two (2) working days.

B. The Contractor shall exercise care so as not to damage artifacts uncovered during excavation operations, and shall provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition by the Construction Manager or Government agency.

C. Where appropriate, by reason of a discovery, the Construction Manager may order delays in the time of performance, or changes in the Work, or both. If such delays, or changes, or both, are ordered, the time of performance and contract price shall be adjusted in accordance with the applicable clauses of the Contract.

1.12 ADDITIONAL REQUIREMENTS

A. SURVEYING - The Surveyor shall be employed by the Contractor to provide construction layout, as-built Record Drawings, base-line surveys, and quantity estimates. A third party Surveyor, employed and paid for by the Owner, will perform quality assurance checks of control points, as-builts, and quantities, as directed by the Construction Manager. Surveying shall be conducted such that all applicable standards required by the State of Colorado are in accordance with Section 01050 of these Specifications. The Surveyor shall be a Registered Land Surveyor, licensed to practice in the State of Colorado.

B. PERMITS – The following permits shall be obtained by the Owner and Contractor for the Work.

1. The Owner will provide the following permits: None

2. The Contractor shall be required to prepare permits in accordance with construction of the facility. Owner will be responsible for all permit fees. Permits include:

   a. Dust Control Permit – Obtained from Gunnison County. Owner shall provide Contractor with Dust Control Mitigation Plan and Perimeter Air Monitoring Plan outlining procedures for Dust Control Permit compliance.

   B SEDIMENTATION, EROSION CONTROL, AND DEWATERING - Contractor shall comply with all laws, ordinances, and permits for controlling erosion, water pollution, and dust emissions resulting from construction activities; the Contractor shall be responsible for any fines imposed due to noncompliance. The Contractor shall prepare

and perform work in accordance with the Storm Water Management Plan (SWMP) in accordance with Section 01100 Subpart 3.08 of these Specifications. Stormwater shall be handled in accordance with SWMP.

C. PROTECTION OF EXISTING WELLS - The Contractor shall exercise care to avoid disturbing or damaging the existing monitor wells that are to remain in place. All wells damaged by the Contractor shall be immediately repaired by the Contractor to the satisfaction of the Construction Manager at no additional cost.

D. WORKING HOURS - Contractor shall establish normal working hours and notify Construction Manager when work is scheduled outside of those hours. Available working hours are 24 hours a day, 7 days a week, with restricted work hours for the following:

1. None

E. BURNING - The use of open fires for any reason is prohibited.

F. TEMPORARY ROADS - The Contractor shall be responsible for constructing and maintaining all temporary roads and lay down areas that the Contractor may require in the execution of the Work in accordance with Section 01500.

G. CONSTRUCTION WATER - The Contractor shall obtain water and truck it into the site .

H. SAFEGUARDS - The Contractor shall provide and use all personnel safety equipment, barricades, guardrails, signs, lights, flares, and flagmen as required by OSHA, state, or local codes and ordinances.

I. SECURITY - The Contractor is responsible for 24-hour site security and the safety and condition of all of his tools and equipment. The Contractor shall maintain security in accordance with Section 01100, Part 3.07.

J. ACCEPTANCE OF WORK - The Contractor shall retain ownership and responsibility for all Work until Substantial Completion has been issued by Construction Manager.

PART 2 – PRODUCTS

[NOT USED]

PART 3 – EXECUTION

3.01 CONSTRUCTION DRAWINGS

A. One set of construction drawings comprise the Construction Drawings:

1. Construction Drawings, Spadafora Water Storage Facility, Gunnison County, Colorado, June 2011 prepared by Weston Solutions, Inc.

B. Dimensions shown on the drawings take precedence over scaled dimensions. Large-scale details have precedence over smaller scale.

PART 4 – MEASUREMENT AND PAYMENT

[NOT USED]

[END OF SECTION]

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. This section covers measurement and payment criteria applicable to the Work performed under lump sum and unit price payment methods, and non-payment for rejected work.

1.02 RELATED SECTIONS

A. This section relates to all other sections of the contract.

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300, "Submittals."

B. With each request for payment, the Contractor shall submit supporting information as necessary to justify the payment request as specified elsewhere throughout these specifications.

C. Weight tickets when measurement for payment is by weight.

1.04 AUTHORITY

A. Measurement methods delineated in the individual specification sections are intended to complement the criteria of this section. In the event of conflict, the requirements of the individual specification section shall govern.

B. A surveyor, licensed in the State of Colorado, hired by the Contractor shall take all measurements. All measurements, cross-sections and quantities shall be stamped and certified by the licensed surveyor and submitted to the Construction Manager. The Construction Manager maintains the right to provide additional measurements and calculation of quantities to verify measurements and quantities submitted by the Contractor.

1.05 GENERAL

A. Undefined items shall be included in the closed related item on the Bid Schedule.

1.06 LUMP SUM ITEMS

A. Lump-sum measurement will be for the entire item or unit of work, or combination thereof, as specified and as indicated in the Bid Schedule of the Bid Form.

1. If the Contractor requests progress payments for lump-sum items or amounts in the Bid Schedule, such progress payments will be made in accordance with a well-balanced, detailed program of payment-apportioning, prepared by the Contractor and submitted to the Construction Manager for approval.

2. Such program for each applicable lump-sum item shall show fixed definable and measurable quantities where possible and unit prices therefore as developed and assigned by the Contractor to the different features of the work and major subdivisions thereof. The summation of extensions of quantities and unit prices and related costs shall equal the amount of the lump-sum bid item indicated on the Bid Schedule.

3. Following the Construction Manager's approval, progress payments will be made in accordance with the Contractor's payment-apportioning program and from the approved progress schedule, reflecting the progress which occurred during the payment period as approved by the Construction Manager.

1.07 UNIT PRICE ITEMS

A. Values of Unit Prices:

1. The number of units and quantities in the Bid Schedule as estimated quantities are approximate only, and final payment will be made for the actual number of units and quantities which are incorporated in the Work and required by the Contract.

B. Measurement Standards:

1. All work to be paid for at Contract price per unit measurement, as indicated in the Bid Schedule, will be measured by the Surveyor and verified by the Owner in accordance with United States Standard Measures.

C. Measurement by Volume:

1. Measurement by volume will be by the cubic dimension indicated in the Bid Schedule. Method of volume measurement will be by the unit volume in place or removed as specified.

2. Measurement shall be by the cubic dimension using mean lengths, widths and heights or thickness, or by average end area method as measured by Contractor's surveyor and as verified by Owner's surveyor as appropriate. All measurement shall be the difference between the original ground surface and the design ("neat-line") dimensions and grades.

3. Quantities and measurements indicated in the Bid Schedule are for bidding and contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the Construction Manager shall determine payment. If the actual work requires more or fewer quantities than those quantities indicated, the Contractor shall provide the required quantities at the lump sum and unit prices contracted unless modified elsewhere in these Contract Documents.

D. Measurement by Area: measurement by area will be by the square dimension shown as specified. Measurement shall be by the square dimension using mean lengths and widths and/or radius as measured by Contractor's surveyor and as verified by Owner's surveyor as appropriate. All measurement shall be the difference between the original ground surface and the design ("neat-line") dimensions and grades.

E. Linear Measurement: linear measurement will be by the linear dimension listed in the Bid Schedule. Unless otherwise indicated, items, components, or work to be measured on a linear basis will be measured at the centerline of the item in place.

1.08 PAYMENT

A. Payment includes full compensation for all required labor, products, tools, equipment, transportation, services and incidentals; erection, application or installation of an item of the Work; and all overhead and profit. Final payment for Work governed by unit prices shall be made on the basis of the actual measurements and quantities accepted by the Construction Manager multiplied by the unit price for Work which is incorporated in or made necessary by the Work.

B. A monthly progress payment schedule shall be used to compensate the Contractor for the Work. The monthly amount to be paid to the Contractor is calculated as the percent of completed work for each bid item multiplied by the total anticipated work for that bid item.

1.09 NON-PAYMENT FOR REJECTED PRODUCTS

A. Payment shall not be made for any of the following:

1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from the transporting vehicle.
4. Products placed beyond the design lines, dimensions, grades and levels of the required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected Products.
7. Products rejected because of contamination (i.e. soil residues, fuel spills, solvents, etc.).

1.10 BID ITEMS

A. The bid items provided in the Bid Schedule shall be used by the Construction Manager and Contractor to bid the Work described in these bid documents.

B. Incidentals to be included in bid items are described in the associated Section.

PART 2 – PRODUCTS

[NOT USED]

PART 3 – EXECUTION

[NOT USED]

PART 4 – MEASUREMENT AND PAYMENT

[NOT USED]

[END OF SECTION]

SECTION 01050

FIELD ENGINEERING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. This section covers field surveys, contractor design (not including shop drawing designs), as-built documentation, and locations of sampling and testing points.

B. The Owner provide 3rd party quality assurance surveying at his discretion to verify as-built documentation based on control points and to provide measurement for payment.

C. The Contractor shall perform all surveying work to complete the Project except where survey work is specifically indicated in the Contract documents to be the Owner's responsibility.

D. Costs for replacement by the Construction Manager of Construction Manager-established reference monuments damaged or destroyed by the Contractor shall be charged to the Contractor at the actual cost of labor, materials, supplies, and equipment to repair or replace such damaged or destroyed Construction Manager-established monuments and reference points.

1.02 RELATED SECTIONS

Section 01100—Project Meetings and Procedures

Section 01300—Submittals

Section 01400—Quality Control

Section 01500—Construction Facilities

Section 01560—Temporary Controls

Section 02300—Earthwork

1.03 SUBMITTALS

A. Contractor shall submit documentation verifying surveying field supervisor is a Registered Land Surveyor in the State of Colorado.

B. Original field books and electronic data not related to pay requests.

C. Survey data and drawings of all sampling and testing location information shall be submitted to the Construction Manager showing coordinates and elevations. Horizontal coordinates shall be within ± 1.0 foot and vertical locations shall be within ± 0.1 foot.

D. Survey information, drawings, survey data reductions, and calculations used to calculate the progress pay estimate quantities to the Construction Manager with each request for progress payment. Survey information shall include copies of original field books and electronic data.

E. Survey data for final payment for applicable work: The Contractor shall reduce the field notes and calculate final quantities for payment purposes. Documentation shall bear the seal and signature of a Registered Land Surveyor. Specific submittals include:

1. Measurement or survey field books or field notes, including original field books, electronic data, and note reductions. Field books or notes shall include signatures of all personnel participating in the survey or measurements.

2. Measurement drawings, topographic survey drawings, and cross-section drawings.

3. Calculation sheets used to derive an actual quantity. Each calculation sheet shall clearly indicate the subject, calculations, totals, date, and signature of author.

F. Written notification to Construction Manager of any survey work or layout work to be done.

G. Survey as-built data.

1.04 QUALITY ASSURANCE

A. The Contractor shall provide experienced construction surveyors. All survey and layout work, and work quantity estimate documentation performed by the Contractor shall be performed under the supervision and direction of a Land Surveyor licensed in the State of Colorado with a minimum of 3 years responsible charge of construction surveys for construction work similar in nature to that required by the Project. The Contractor shall maintain sufficient qualified personnel to perform required surveying work, including having a Registered Land Surveyor in the field overseeing the survey crew(s) at all times that survey work is performed.

B. The Contractor instruments and other survey equipment shall be accurate, suitable for the surveys required in accordance with recognized professional standards, and in proper condition and adjustment at all times. Any equipment found to be inaccurate (beyond allowable tolerances) or defective shall immediately be repaired or removed from the work site by the Contractor.

PART 2 – PRODUCTS

[Not Used]

PART 3 – EXECUTION

3.01 FIELD SURVEYS

A. Field Surveys, at a minimum, shall be performed:

1. Initially, before any soil disturbance at the site,

2. for verification of the final water pipe alignments,

3. for verification of final finish grades of Drainage Channels, culverts, sediment ponds,

4. after French drain excavations, prior to backfilling,

5. compacted subgrade and liner bedding ,

6. for as-built conditions of installed primary and secondary liners showing, seams, corners, and the location of all recorded defects and repairs,

7. final condition of all site areas disturbed.

B. Electronic survey data submittals shall consist of the following:

1. Hard copy printouts from survey data collector with observations and position of points showing coordinates and elevations.

2. Copy of field books used during data collection.

3. Electronic file of all points used in volume calculations in ASCI format.

4. Electronic files of all drawings in AutoCAD, 2007 format or better, or in a DXF format that can be converted to AutoCAD.

5. Electronic files shall be delivered to the Construction Manager on compact disk.

6. Hard copies of all drawings, cross-sections, and other information generated during survey data collection, including drawings that show control points used for each survey.

C. Data gathered from incremental surveys performed of a respective surface shall be combined and coordinated into a single cumulative composite drawing file that presents the entire surface as it is incrementally developed.

D. The Contractor shall establish the final grade for backfill work by resurveying and staking the grid system points. The Contractor survey work shall demonstrate that drainage patterns have not changed, unless changes were specifically authorized by the Construction Manager. Where it is practical, the Contractor may propose alternate methods for establishing original and final grades within small excavation areas. Such alternate methods shall be approved by the Construction Manager prior to commencing the survey.

E. Horizontal coordinates shall be within ±1.0 ft and vertical locations shall be within ± 0.1 ft.

F. The Contractor shall conduct such other surveys as are required to calculate payment quantities, document completion of a phase of excavation or backfill, or other documentation required for a complete record of Project activities and actions.

G. The Construction Manager may at any time use line and grade points and markers established by the Contractor. The Contractor's surveys are a part of the work and may be checked by the Construction Manager. The Contractor shall be responsible for any lines, grades, or measurements which do not comply with specified or proper tolerances, or that are otherwise defective, and for any resultant defects in the work. The Contractor shall be required to conduct resurveys or check surveys to correct errors.

H. The Contractor shall establish lines and grades necessary to control the work, and shall be responsible for measurements for execution of the work prescribed in these specifications or on the drawings. The Contractor shall establish, place, and replace stakes, markers, and other monuments for survey control, interim checks, and guidance of construction operation.

I. The Contractor shall provide all materials and equipment for performing survey work, including, but not limited to instruments, stakes, spikes, steel pins, templates, and tools. Except for material that is to be incorporated in the work or left in place, all such materials and equipment shall remain property of the Contractor.

J. Before commencing any layout of work and surveys, the Contractor shall provide written notice to the Construction Manager so the Construction Manager may witness or independently check such work.

K. Prior to commencing excavation on existing ditch lines, and/or culverts planned for removal and replacement, a survey of existing features shall be performed by the Contractor. The survey shall be used as a control to establish the ditch/culvert alignment during reconstruction. The survey shall be sufficiently accurate to allow reinstalled and/or replacement ditches, or culverts to perform in a manner that is hydraulically equivalent to the original ditches, or culverts.

L. On a monthly basis, the Contractor shall provide survey data to the Construction Manager on the excavation and backfill production during the previous month.

M. Copies of all surveying notes and drawings prepared by the Construction Manager for verification of Contractor surveys shall be made available to the Contractor, when requested.

N. The Contractor shall secure all field measurements required for proper and accurate fabrication and installation of the work included in this Contract. Exact measurements are the Contractor's responsibility. The Contractor shall furnish or obtain all templates, patterns, and setting instructions required for the installation of all work. All dimensions shall be verified by the Contractor by survey in the field.

O. Unless otherwise stated in these Specifications, or by Construction Manager approval, tolerances in layout of work shall not exceed the following:

TYPE OF LINE OR MARK	HORIZONTAL POSITION	ELEVATION
Permanent reference points	1 in 10,000	± 0.02 ft.
Reference points for general excavation and earthwork	1 in 2,000	± 0.10 ft.

P. The Construction Manager shall perform sufficient field surveys to verify that the Contractor's field survey work is within acceptable tolerances and accurately depicts requirements of the drawings and these specifications. In the event that the Construction Manager's survey differs from the Contractor's survey, the Construction Manager's survey shall govern.

Q. The use of aerial survey for quantity determination shall not be allowed on this Project. All survey work shall be performed with land survey methods that have been approved by the Construction Manager.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment shall be made for requirements of this section. Full compensation for conforming to such requirements shall be included in the price bid for Bid Schedule Items of Work and no additional compensation shall be allowed.

[END OF SECTION]

SECTION 01100

PROJECT MEETINGS AND PROCEDURES

PART 1 – GENERAL

1.01 SCOPE

A. This section covers preconstruction meeting, project meetings, regulatory oversight, community relations, site security, permits, final inspection, and project record documents

1.02 RELATED SECTIONS

Section 01010—Summary of Work

Section 01050—Field Engineering

Section 01300—Submittals

Section 01560 – Temporary Controls

1.03 REFERENCES

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300, "Submittals"

B. The following shall be submitted prior to issuance of Notice to Proceed:

1. Storm Water Management Plan

C. The Contractor shall submit the following to the Construction Manager daily:

1. Progress Reports

2. Inspection Checklists

D. The Contractor shall submit weekly inspection reports to the Construction Manager

E. The Contractor shall submit the following to the Construction Manager monthly:

1. Status Report

2. Inspection Checklist

F. The Contractor shall submit monthly inspection reports to the Construction Manager

G. Within 24-hours after a storm event, the Contractor shall submit to the Construction Manager a post-storm inspection checklist

H. The Contractor shall submit to the Construction Manager incident reports as needed within 24-hours of the incident occurrence.

I. Job Set of Project Record Documents

J. If the Work discussed in these Specifications is interrupted for reasons other than inclement weather, the Contractor shall notify the Construction Manager in writing a minimum of 24 hours prior to the resumption of Work.

PART 2 – PRODUCTS

2.01 NOT USED

PART 3 – EXECUTION

3.01 PRECONSTRUCTION MEETINGS

A. Construction Manager shall arrange a preconstruction meeting with the Contractor within 21 days of notice of award and before receipt of Notice to Proceed (NTP). The preconstruction meeting shall be required prior to issuing NTP.

B. Authorized representatives of the Contractor, including the Bid Preparer, Project Manager, and On-Site Superintendent shall attend the preconstruction meeting.

C. Data shall be distributed and/or discussed as necessary by the Construction Manager or Contractor as appropriate. The Project site shall be toured with the Contractor representative present, and at the least, the following items shall be addressed.

1. Organizational arrangement of the forces and personnel, and those of the Contractor, the material and equipment suppliers, Subcontractors, and the Construction Manager.

2. Procedures and protocol for Project communication.

3. Contractor's mobilization schedule. The Contractor shall discuss how equipment, personnel, materials, etc., are to be mobilized throughout this Project and the effects of mobilization on the construction schedule.

4. Construction schedule, work hours, planned overtime, and sequence of work.

5. A narrative of the Contractor's general method of approach for each sequence of the work.

6. Processing of shop drawings, submittals, and other data for Construction Manager for review.

7. Procedures for Field Directives and Change Orders.

8. Rules and regulations governing performance of the work.

9. Training requirements.

10. Procedures for safety and first aid, security, quality control, housekeeping, and related matters.

11. Work quantity measurement and payment request procedures.

3.02 PROJECT MEETINGS

A. Weekly construction progress meetings shall be conducted between the Construction Manager and Contractor. The Contractor's Project Manager shall attend these construction meetings. The meeting shall be conducted at the Project support facilities area and the time shall be coordinated between the Construction Manager and Contractor.

B. At a minimum, the following items shall be discussed at the weekly meetings.

1. Review of applicable specifications.

2. Review of safety issues.

3. Required equipment and personnel.

4. Weekly progress and production.

5. Two-week look-ahead schedule.

C. Major Construction Activity meetings shall be conducted between the Construction Manager and Contractor prior to starting each general sequence of construction. Meetings will be conducted prior to each of the following major construction activities

1. Storm water collection system

2. Excavation and embankment placement

3. Liner system installation

These meetings may be combined with other Project meetings with the mutual consent of the Construction Manager and Contractor. The intent of these meetings is to review and discuss specification requirements for that particular construction activity. A "dry run" walkthrough of major process may be required prior to starting each sequence, if deemed appropriate by the Construction Manager. The meetings shall assess, as examples

1. Specification Requirements

2. Adequacy of planning and procedures.

3. Availability of equipment, personnel, and materials.

4. Safety, emergency preparedness, and hazard analysis.

5. Regulatory compliance.

The results of these meetings shall be formally documented by the Construction Manager and the applicable portions shall be provided to the Contractor. The Contractor shall address any identified concerns prior to the start of the reviewed work activity.

D. Plan of the Day (POD) Meetings: The Construction Manager shall hold daily planning meeting that will not exceed 1 hour. Daily planning meetings shall be attended by the Contractor's Project Manager, Operations Superintendent, Project Engineer, and Health and Safety Manager. The Quality Assurance Manager attendance at the POD meetings is optional. The Contractor shall provide a list of all activities planned for the next day. If changes to the daily plan are necessary, the Contractor shall verbally notify the Construction Manager Project Manager as soon as need for the change is identified by the Contractor. The intent of the meeting will be to discuss issues, concerns, and resolutions encountered during the day and the work plan for the next day.

E. Problem or Work Deficiency Meetings: A special meeting shall be held when and if a problem or deficiency is present or likely to occur. The meeting shall be attended by the Contractor, the Construction Manager, the CQA Site Manager, and other parties as appropriate.

3.03 PROJECT REPORTING AND RECORDKEEPING

A. The Contractor shall provide the following records to the Construction Manager daily:

1. Daily progress reports documenting daily construction activities. Records include:

   a. Date, Project Name, Location, and other Identification;

b. Summary of weather conditions;

c. Summary of construction location(s) and activities;

d. Daily production records;

e. Equipment and personnel on the project; and

f. Meeting summary and attendance record.

2. Inspection Checklist documenting: health and safety, haul roads, surface and storm water, waste placement, security, equipment.

B. The Contractor shall provide inspection checklists to the Construction Manager weekly~~:~~

C. The Contractor shall provide the following records to the Construction Manager monthly:

1. Inspection Checklist documenting: health and safety, haul roads, surface and storm water, security, equipment.

2. Monthly status report summarizing:

a. Significant milestones in construction;

b. Completed milestones in construction;

c. Estimated volumes of soil excavation, engineered fill;

d. Estimated quantity of liner system components delivered to the project and/or installed.

D. The Contractor shall provide the following record to the Construction Manager post-storm:

1. Inspection Checklist documenting: health and safety, haul roads, surface and storm water.

E. The Contractor shall provide incident reports to the Construction Manager as-needed. Incident reports shall summarize all incidents of: injury, fire, shut down, and/or hazardous or toxic Materials Release. The summary report shall include:

a. Date, time, and type of incident;

b. Name and quantity of material(s) involved;

c. Assessment of actual or potential hazards to human health or the environment, where applicable; and

d. Estimated quantity and disposition of recovered material that resulted from the incident.

F. The Contractor shall maintain all personnel records onsite and shall make records available to Construction Manager upon request. Records include:

1. Name of the employee filling each position

2. A written job description including: requisite skill, education, or other qualifications

3. Assigned duties of employee

4. Description of training

5. Records documenting completion of training.

3.04 REGULATORY OVERSIGHT

A. Authorized agents of the Colorado Oil and Gas Conservation Commission (COGCC) and Gunnison County and other agencies designated by the Construction Manager shall have right of access to inspect the work covered by the Contract documents during the performance of this Contract. These inspections shall be performed in conjunction with an inspection by the Construction Manager. The Construction Manager shall coordinate inspections with the Contractor.

3.05 COMMUNITY RELATIONS

A. The Contractor shall direct public inquiries to the Construction Manager and shall provide information necessary to respond to public inquiries as requested by the Construction Manager.

3.06 ENDANGERED SPECIES

A. N/A.

3.07 SITE SECURITY

A. The Contractor shall protect the work and control the site for the duration of the Project, except that control of the project site shall not become the responsibility of the Contractor until the effective date of the Notice to Proceed. Site security during non-work hours, shall be maintained 24 hours per day, 7 days per week, including shutdown periods.

B. Exterior Fence Signage:

1. Contractor shall install and maintain "Danger. Construction Area. No Trespassing" bilingual signs at 500 foot intervals along the perimeter fence. Signs shall be 18 inch x 12 inch aluminum with red or black l-inch lettering.

3.08 STORM WATER POLLUTION PREVENTION PLAN

A. The Contractor shall develop Storm Management Plan (SWMP) in accordance with the requirements of the Colorado Water Quality Act for all areas where work shall be taking place. The Contractor may divide the site into manageable units and submit a separate SWMP for each unit. The SWMP shall be developed to show pollution prevention measures to be applied at various stages of excavation and backfill and measures to be applied after completion of excavation and backfill. The Contractor may not disturb any area until the pertinent SWMP is accepted by the Construction Manager and the BMP's identified in the SWMP have been installed.

B. All SWPMP prepared by the Contractor must incorporate the following performance requirements:

1. The Contractor shall construct and maintain temporary storm-water pollution-control measures as necessary throughout the duration of the Project.

2. Storm-water runoff shall include runoff water from any source. The Contractor is responsible for controlling storm-water runoff and erosion for all other areas disturbed under this Contract. Temporary erosion-control provisions shall be coordinated with permanent erosion-control features, if any, to the extent practical to assure economical, effective, and continuous erosion control throughout construction.

3. Storm-water pollution and erosion control measures may include, but are not limited to, berms, dams, ditches, sediment/water retention basins, fiber mats, netting, gravel, mulches,

grasses, slope drains, silt fences, and other methods as appropriate. Pumping water to runoff water control facilities is also an option.

4. Contractor shall conduct storm water system inspections, at a minimum, after every storm exceeding ½ inch in 24 hours. Storm water conveyance system shall be inspected quarterly during the dry season and weekly during the wet season. Conveyance system shall be inspected for sediment and debris build-up and scour or other damage.

3.09 FINAL INSPECTION

A. At the completion of this Project, the Contractor representative shall attend the final inspection to document any deficiencies in the completed Project. A Notice of Final Completion Inspection form shall be completed by the Construction Manager, with one copy delivered to the Contractor in accordance with the Terms and Conditions.

B. The Contractor may request an inspection of work items at the time of completion, but these items shall be inspected again during the final inspection to verify compliance with the Contract.

C. The Contractor shall schedule all inspections with the Construction Manager.

3.10 PROJECT RECORD DOCUMENTS

A. Promptly following receipt of the Notice to Proceed, the Contractor shall secure from the Construction Manager, at no charge to the Contractor, three sets of full-size drawings and specifications. Throughout progress of the Project, the Contractor shall maintain a neat, current, and accurate record of the as-built status of the Project on the job set of the Project record documents. One set of the full-size drawings shall be used to record as-built survey data only. The drawings and these specifications are the Project record documents. As-built documents shall include documentation of all deviations from the original or revised drawings and these specifications.

B. Upon receipt of the job set, identify each of the documents with the title, "RECORD DOCUMENTS—JOB SET."

C. Store Record Documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Contractor shall maintain on site, one set of the following record documents and record actual revisions to the Work.

1. Drawings.

2. Specifications.

3. Addenda.

4. Change Orders and other Modifications to the Contract.

5. Reviewed Shop Drawings, product data, and samples.

F. The Contractor shall thoroughly document changes on each page of the specifications and each sheet of drawings and other documents where such entry is required to show all changes. Documentation shall include the Change Order number as appropriate and shall be initialed and dated by the individual making the entry.

G. Make entries within 24 hours after receipt of information that a change has occurred.

H. Project record document entries shall be made using terminology and drafting standards that match those used in the Contract documents. Deviations from standards, if required, shall be noted on glossaries, legends, or other appropriate lists of definitions included in the Project record documents for that work.

I. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface features.

2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible, accessible, and permanent features of the Work.

3. Field changes of dimension and detail.

4. Details not shown on original Construction Drawings.

5. Making entries on drawings

   a. Use an erasable colored pencil (not ink or indelible pencil) and clearly describe the change by graphic line and note.

   b. Date and initial all entries.

   c. Call attention to the entry by a "cloud" drawn around the area or areas affected and reference the Change Order number as appropriate.

   d. In the event of overlapping changes, use a different color for each overlapping changes.

J. Specifications: Legibly mark and record at each product Section a description of actual products installed, including the following:

1. Manufacturer's name and product model and number.

2. Product substitutions or alternates utilized.

3. Changes made by Addenda and Modifications.

K. Contract drawings and Specifications shall be submitted to the Construction Manager at completion of the work in accordance with Section this section. The requirements for submitting as-built survey data shall not relieve the Contractor in any way from the Contractor's responsibility to conform to the requirements of the work.

L. As-built Project Record Documents

1. The Contractor shall provide surveying services to document as-built conditions for completed work. The Contractor shall provide survey data to confirm that as-built locations of the work conform to the drawings where coordinates and/or elevations are shown. Where the drawings or specifications permit variable locations or detail for specific items of work, the Contractor shall survey the as-built locations or details. Surveys shall be sufficient to define the features or details at any given location.

2. Submit the job set of as-built Project record documents to the Construction Manager after Construction Manager acceptance of the work. Construction Manager acceptance of the as-built documents is required before any release of payment retainage shall be allowed.

3. Verification of as-built locations shall be performed by Owner based on control points.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment shall be made for requirements of this section. Full compensation for conforming to such requirements shall be included in the price bid for Bid Schedule Items of Work and no additional compensation shall be allowed.

[END OF SECTION]

SECTION 01110

HEALTH AND SAFETY REQUIREMENTS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. This section describes the Project health and safety requirements. All work performed shall be conducted in accordance with safety and health regulations promulgated by the Federal and State Occupational Safety and Health Administration (OSHA), Subcontract documents, and other Federal, State, and local agencies.

B. The Contractor shall protect the health and safety of Contractor employees, visitors, and the public; prevent damage to property, materials, supplies, and equipment; and avoid work interruptions.

1.02 RELATED SECTIONS

Section 01010 – Scope of Work

Section 01560 – Temporary Controls

Section 02300 – Earthwork

1.03 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI Z88.2 Practices for Respiratory Protection
2. ANSI Z89.1 Safety Requirements for Industrial Head Protection
3. ANSI Z41.1-75 Men's Safety Toe Footwear

B. Code of Federal Regulations (CFR)

1. 29 CFR Labor

1.04 SUBMITTALS

A. The Contractor shall submit a Health and Safety Plan to the Construction Manager prior to Notice to Proceed. The Construction Manager shall review the Plan and forward any questions to the Contractor, within 14 days of receipt, but shall not approve the Plan.

PART 2 – PRODUCTS

[Not Used]

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

A. The Contractor shall not conduct any work at the site, including mobilization, until Construction Manager has reviewed the Contractor's Health and Safety Plan.

B. The Contractor shall conduct daily health and safety tailgate meetings and record those in attendance.

C. The Contractor shall conduct quarterly site specific health and safety meetings to review site specific hazards and incidents of the past quarter.

D. The Contractor shall maintain on site all training records of employees. Training records shall be submitted to Construction Manager in accordance with Section 01010.1.08.N.

E. The Contractor shall maintain records of analytical reports and monitoring data, provided by the Construction Manager or obtained by the Contractor, that document potential health hazards to employees. The Construction Manager will supply monitoring data as required by Federal, State, and local regulations or upon Contractor request.

F. The Contractor shall provide appropriate safety barricades, signs, and signal lights in accordance with 29 CFR 1926 Subpart G, and 29 CFR 1910.144.

G. Safety Inspections

1. The Contractor shall conduct and document daily inspections of the job site, materials, and equipment for unsafe conditions or practices. Corrective action shall be taken promptly to avoid hazardous Project site conditions and practices.

2. The Contractor shall perform initial safety inspections of vehicles, heavy equipment, and materials prior to commencement of work. Vehicles, heavy equipment, or materials that do not meet Federal OSHA standards shall not be used on site unless approved by the Construction Manager.

3. A qualified safety technician shall be on-site during all work activities. The designee can have other responsibilities on the site, but is responsible for all H&S monitoring.

3.02 HEALTH AND SAFETY PROGRAM AND PLAN

A. The Contractor shall have a written Health and Safety Program that complies with all applicable OSHA regulations prior to commencement of work. Certification of such program shall be submitted to the Construction Manager

B. One site-specific Health and Safety Plan (HASP) shall be developed by the Contractor. The Contractor shall maintain and distribute the HASP. This HASP shall meet OSHA requirements contained in 29 CFR 1910.120 and be prepared and signed by a certified industrial hygienist.

C. The HASP shall include the following at a minimum:

1. Site location and description

2. Scope of work

3. Project team and organization

4. Unique issues and concerns

5. Activity hazard analysis

6. Emergency assistance network

7. General health and safety procedures for

   a. Injury and illness prevention

   b. Health and safety organization

c. Personnel training

d. Site controls

e. Emergency response plan

f. Documentation

g. Thermal stress and severe weather

h. Biological hazards

i. Standard operating procedures

j. Common physical hazards and controls

8. The following figures, at a minimum, shall be included:

a. Site location

b. Hospital route

9. The following tables, at a minimum, shall be included:

a. Activity hazard analysis form

b. Emergency supplies

D. The HASP shall also address the chemicals brought onsite by the Contractor for the Project. The HASP shall reference the MSDS binders.

E. A Spill Prevention and Response Plan shall be contained within the site-specific HASP. The Spill Response Plan shall be maintained on site throughout construction.

F. Consequences of Noncompliance

1. Failure of a worker to comply with the health and safety requirements shall be considered ample cause for suspension by the Contractor, pending correction of the problem. Suspension shall be at the Contractor's expense.

2. Repeated or serious violations of health and safety rules and/or requirements by a worker shall be cause to restrict or disqualify the worker from further on-site work. This requirement is at the discretion of the Construction Manager after review of documentation of violations and shall be enforced by the Contractor. Such violations by any Contractor or subcontractor personnel may result in further actions by the Construction Manager up to and including Subcontract Termination for Default in accordance with the Terms and Conditions.

G. The Contractor shall permit only those employees qualified by training and/or experience to operate equipment and machinery. Records of such qualification shall be maintained on site by the Contractor and made available for review upon request by the Construction Manager.

3.03 TRAINING REQUIREMENTS

1. All on-site supervisors:

a. Red Cross First Aid and CPR training

2. Contractor shall provide quarterly on-the-job fire training.

3.04 CLOTHING

A. Work Clothing: Adequate levels of protection for personnel on the Project site shall be identified by task in the site-specific HASP. Clothing such as tank tops, shirts cut off at the midriff, cutoff pants, moon boots, sandals, sneakers, and jogging shoes are considered unacceptable dress and will not be permitted.

1. In general, work clothing should consist of the following:

   a. Full-length trousers/slacks/jeans in good condition.

   b. Sturdy work shoes, boots, or other footwear meeting the requirements of ANSI Standards Z41.1-75.

   c. Shirts that cover the shoulders, with sleeves at least T-shirt length.

   d. Hard hats that meet the requirements of ANSI Standard Z-89.1.

2. Orange safety vests or "hunter orange" colored shirts shall be worn at all times. Exception may be granted by the Construction Manager.

3.05 GENERAL HAZARD REQUIREMENTS

A. The site-specific HASP shall identify hazards and controls.

B. The Contractor is responsible for inspecting the site before and during construction activities to identify hazards, and shall take all necessary actions to protect the workers, the environment, and the general public against such known hazards. The Contractor shall notify the Construction Manager immediately of any previously unidentified hazards, and of any accidents, injuries, or illness that have occurred. Newly identified hazards shall be discussed during the daily health and safety tailgate meeting.

C. Buried Utility Lines: Underground utilities (abandoned and active) may be encountered during the performance of the Project. Overhead utilities are not present over work areas. Utilities known or suspected by the Contractor are shown on the drawings and include a gas line and water line. Refer to Section 01010, "Summary of Work," for requirements for Contractor utility location, protection, and replacement.

1. Manually excavate active utility lines shown on the drawings. Notify the local utility company and Construction Manager if:

   a. The line is not found within 18 inches of the estimated depth at the marked position;

   b. There is evidence of leaks in utility lines (Do not disturb this ground further until after the responsible utility and the Construction Manager have been notified and the Construction Manager authorizes further work in this area.);

   c. The line has been nicked, cut, or damaged in any way; or

   d. The corrosion-protection tape on a steel line has been nicked.

2. The following actions shall be taken if there is a strong odor of gas or a line is broken:

   a. Remove the equipment bucket from the immediate vicinity of the break.

   b. ***Do Not*** move the equipment. Shut off equipment. Do not restart any vehicles in the area.

c. Leave the area immediately.

d. Notify the local utility company or the local Fire Department if there is no answer at the utility company. Give the following information: your name, location of incident, nature of incident, and type or color of pipe damaged (if known).

e. Secure the area to prevent access by anyone except the utility company.

f. Do not attempt to repair or stop the gas flow.

3. Notify the Construction Manager immediately of any utility damage and any suspicious odors or soil discolorations encountered during the work.

D. Industrial Hygiene/Chemicals Concerns

1. Noise Limitations

a. Noise level restrictions as specified in Section 01560 and as measured from the property line, shall supersede noise restrictions discussed in this section.

b. Construction equipment, including trucks, shall not exceed 85 dB(A) at 50 feet for a stationary noise limit per 40 CFR 202.21.

c. Noise surveys shall be conducted by the Contractor on equipment.

d. Hearing protection shall be provided by the Contractor and shall be worn when noise levels exceed 85 dB(A). Hearing protection shall be made available to all employees whose noise exposure may exceed an 82-dB(A) 8-hour time-weighted average (TWA). The Construction Manager may monitor the Contractor's equipment and on-site personnel. This monitoring shall be considered incidental to the Contract.

e. The Contractor shall institute a hearing conservation program for its employees per 29 CFR 1910.95.

2. The Contractor shall maintain MSDSs on site for all chemicals the Contractor brings onto the Project site. Chemicals include, but are not limited to, cements, fuels, lubricants, bleaches, and cleaners. Material Safety Data Sheet (MSDS) books shall be provided by and made available by the Contractor. The books shall be clearly marked and located in the work space or at the Access-Control Point for chemicals used within the exclusion zone. MSDS books stored in equipment or vehicles are not acceptable.

E. Industrial Safety Concerns

1. Refueling: Refueling shall only be permitted in the refueling area as identified in the Fueling Plan.

2. Storage of Combustible Liquids: When storing 5 gallons or more of combustible liquids, or 5 pounds of flammable gas, a 10B fire extinguisher shall be provided by the Contractor within 50 feet of the storage area.

3.06 INCIDENT REPORTING

A. The Contractor shall provide the Construction Manager a report detailing incidents occurring at the Site. The report shall include:

1. Name, address, and telephone number of the operator;

2. Name, address, and telephone number of the site;

3. Date, time, and type of incident;

4. Name and quantity of material(s) involved;

5. Extent of injuries, if any;

6. Assessment of actual or potential hazards to human health or the environment, where applicable; and

7. The estimated quantity and disposition of recovered material that resulted from the incident.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section for Health and Safety Requirements shall be incidental to Earthworks, Section 02300.

B. Providing for and complying with the requirements set forth in this Section for the Health and Safety Plan shall be considered as incidental to Mobilization, Section 01505.

[END OF SECTION]

SECTION 01300

SUBMITTALS PROCEDURES

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. This section contains requirements for administrative and work-related submittals such as construction progress schedules, Shop Drawings, test results, operation and maintenance data, and other submittals required by Contract Documents.

B. Submit required materials to the Construction Manager for proper distribution and review in accordance with requirements of the Contract Documents.

1.02 CONSTRUCTION PROJECT SCHEDULES

A. Project Schedules shall be prepared in the form of a horizontal bar chart. The Project Schedule shall include the following items.

1. A separate horizontal bar for each activity. The following shall be included for each activity:

   a. Activity duration

   b. Percent complete

   c. Remaining duration

   d. Early finish

   e. Calendar used.

2. A horizontal time scale, which identifies the first workday of each week.

3. A time scale with spacing to allow space for notations and future revisions.

4. Listings arranged in order of early start for each item of the Work.

5. Critical milestone dates and mandatory construction sequence constraints.

B. The Project Schedule for construction of the Work shall include the following items where applicable.

1. Submittals: dates for beginning and completion of each major element of construction and installation dates for major items. Elements shall include, but not be limited to, the following items which are applicable:

   a. Mobilization schedule.

   b. Demobilization schedule.

   c. Final site clean-up.

   d. Show weekly, as of the first day of each week, anticipated percent of completion for each item.

   e. Show each individual Bid Item with adequate support detail.

C. Schedule Revisions:

1. Weekly to reflect changes in progress of Work.

2. Indicate progress of each activity at submittal date.

3. Show changes occurring since the previous schedule submittal. Changes shall include the following.

   a. Major changes in scope.

   b. Logic changes.

   c. Activities modified since previous submittal such as:

      i. name changes

      ii. duration changes

   d. Revised projections of progress and completion.

   e. Other identifiable changes that affect the projected project completion.

4. Provide a log of changes made to schedule since last version to define:

   a. Problem areas, anticipated delays, and impact on schedule.

   b. Recommended corrective action and its effect.

1.03 DESIGN SUBMITTALS

A. Prepare and submit to the Construction Manager detailed designs and plans for the construction facilities and temporary controls indicated or specified to be designed by the Contractor.

B. Design submittals include:

1. Valve house

2. Piping manifold within valve house and above-ground piping leading in and out of the water storage facilities to/from the valve houses.SCADA System

3. Soil Stockpile

C. Each design submittal shall include:

1. All field, geotechnical, survey, environmental, or other investigations performed to support the design.

2. Descriptions of all design criteria, assumptions, calculations, or other documents that support the basis of the design.

3. Blueline or blackline prints, one reproducible hard copy, and one electronic copy of all drawings. Electronic copies shall be in AutoCAD 2007 format or in a format readily convertible to AutoCAD 2007.

4. Notes on the drawings or specifications that explain construction procedures, methods, and performance criteria.

D. Designs prepared by the Contractor shall bear the seal and signature of a Professional Engineer registered in the State of Colorado.

E. The designs shall be reviewed by the Construction Manager for acceptability based on comparison with the minimum performance criteria set forth in these specifications and on the drawings. The Construction Manager shall forward, within 14 days after receiving the design documentation, any questions related to the design to the Contractor in writing requesting clarification. The Contractor shall respond in writing within five days after receiving the request for clarification from the Construction Manager.

1.04 SHOP DRAWINGS AND SAMPLES

A. Shop Drawings, product data, and samples shall be submitted as required in individual Sections of the Specifications.

B. The Contractor's Responsibilities:

1. Review Shop Drawings, product data, and samples prior to submittal.

2. Determine and verify:

   a. Field measurements.

   b. Field construction criteria.

   c. Catalog numbers and similar data.

   d. Conformance with Specifications.

3. Coordinate each submittal with requirements of the Work and Contract Documents.

4. Notify the Construction Manager in writing, at the time of the submittal, of deviations from requirements of Contract Documents.

5. Begin no fabrication or Work pertaining to required submittals until return of the submittals with appropriate approval.

6. Designate dates for submittal and receipt of reviewed Shop Drawings and samples in the construction progress schedule.

C. Submittals shall contain:

1. Date of submittal and dates of previous submittals.

2. Project title and number.

3. Contract identification.

4. Names of:

   a. The Contractor.

   b. Supplier.

   c. Manufacturer.

5. Summary of items contained in the submittal.

6. Identification of the product with identification numbers, and the Drawing and Specification section numbers.

7. Clearly identified field dimensions.

8. Details required on the Drawings and in the Specifications.

9. Manufacturer, model number, dimensions, and clearances, where applicable.

10. Relation to adjacent or critical features of the Work or materials.

11. Applicable standards, such as ASTM or Federal Specification numbers.

12. Identification of deviations from Contract Documents.

13. Identification of revisions on re-submittals.

14. 8-in. by 3-in. blank space for the Contractor's proper approval stamp.

15. The Contractor's stamp, signed, certifying to review of the submittal, verification of the products, field measurements, field construction criteria, and coordination of information within the submittal with requirements of Work and Contract Documents.

D. Submittal Response – Within 14 days of submittal receipt, Construction Manager will stamp and provide two copies to the Contractor. Construction Manager will respond as follows:

1. No exceptions taken: Contractor shall file submittal and proceed with associated work.

2. Correct as noted: Contractor shall make corrections noted and proceed with associated work.

3. Rejected: Contractor shall not proceed with the associated work.

4. Revise and resubmit: Contractor shall revise submittal and resubmit to Construction Manager.

5. Submit Specified Items: Contractor shall submit specified items to provide Construction Manager information for appropriate review of submittal.

E. Re-submittal Requirements:

1. Re-submittal is required when corrections or changes in submittals are required by the Construction Manager. Re-submittals are required until all comments by the Construction Manager, Design Engineer, or CQA Engineer is addressed and the submittal is approved.

2. Shop Drawings and Product Data:

   a. Revise initial drawings or data and resubmit as specified for initial submittal.

   b. Indicate changes made other than those requested by the Construction Manager.

1.05 TEST RESULTS AND CERTIFICATION

A. Results of tests conducted by the Contractor on materials or products shall be submitted for review.

B. Certification of products shall be submitted for review.

1.06 SUBMITTAL REQUIREMENTS

A. Provide complete copies of required submittals as follows.

1. Project Schedule

a. Three copies of initial schedule.

b. Three copies of each revision.

2. Shop Drawings: Three copies.

3. Certification Test Results: Three copies.

4. Other Required Submittals:

a. Three copies if required for review.

b. Three copies if required for record.

B. Deliver the required copies of the submittals to the Construction Manager.

PART 2 – PRODUCTS

[Not Used]

PART 3 – EXECUTION

[Not Used]

PART 4 – MEASUREMENT AND PAYMENT

[Not Used]

[END OF SECTION]

SECTION 01400

QUALITY CONTROL

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Monitor quality control over suppliers, Manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.

B. Comply with Manufacturers' instructions, including each step in sequence.

C. Should Manufacturers' instructions conflict with Technical Specifications, request clarification from Construction Manager before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce workmanship of specified quality.

1.02 TOLERANCES

A. Monitor tolerance control of installed products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with Manufacturers' tolerances. Should Manufacturers' tolerances conflict with Technical Specifications, request clarification from Construction Manager before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.03 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, complies with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of current issue on date of Notice to Proceed with construction, except where a specific date is established by code.

C. Obtain copies of standards where required by product Specification sections.

1.04 INSPECTING AND TESTING SERVICES

A. The CQA Engineer shall perform construction quality assurance (CQA) inspections, tests, and other services specified in individual Sections of the Specification.

B. The Contractor shall provide labor and equipment to assist in sample collection as needed for testing as well as assist in the preparation of test locations.

C. The Contractor shall cooperate with CQA Engineer; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

D. CQA testing or inspecting does not relieve Contractor, subcontractors, and suppliers from their requirements to perform quality control Work as indicated in the Technical Specifications.

E. Owner's Surveyor will perform QA monitoring of as-built documents using control points.

PART 2 – PRODUCTS

[Not Used]

PART 3 – EXECUTION

[Not Used]

PART 4 – MEASUREMENT AND PAYMENT

[Not Used]

[END OF SECTION]

SECTION 01500

TEMPORARY CONTROLS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Temporary Controls required during the term of the Contract for the protection of the environment and the health and safety of workers and general public.

B. Furnishing all equipment, materials, tools, accessories, incidentals, and labor, and performing all work for the installation of equipment and construction of facilities, including their maintenance and operation during the term of the Contract.

C. Temporary Controls include:

1. Dust Control.
2. Pollution Control.
3. Traffic and Safety Controls.
4. Access Control.

D. Perform Work as specified in the Technical Specifications and as required by the Construction Manager. Maintain equipment and accessories in clean, safe and sanitary condition at all times until completion of the Work.

1.02 RELATED SECTIONS

Section 01505 – Mobilization/Demobilization

Section 02820 – Chain Link Fence

1.03 SUBMITTALS

A. Contractor shall submit the following submittals prior to Earthwork Notice to Proceed:

1. Dust Control Permit and Mitigation Plan
2. Fuel Plan
3. Site Security Plan

1.04 DUST CONTROL

A. Provide dust control measures in-accordance with the Technical Specifications and Dust Control Permit. Dust control measures must meet requirements of applicable laws, codes, ordinances.

B. The Contractor is responsible for applying for, obtaining, and complying with a Dust Control Permit. Dust control consists of transporting water, furnishing required equipment, testing of equipment, additives, accessories and incidentals, and carrying out proper and efficient measures wherever and as often as necessary to reduce dust nuisance, and to prevent dust originating from construction operations throughout the duration of the Work.

C. Dust suppression shall include all roadways, stockpiles, excavations, and other areas.

D. Dust suppression activities shall be conducted as necessary, 7 days per week, 24 hours per day, including holidays.

E. The Contractor shall take necessary measures to eliminate dust. Visible dust is not allowed. The Contractor may use techniques that include, but are not limited to, the following:

1. Minimize disturbance of vegetated areas.

2. Enforcement of lower speed limits on all vehicles traveling within the Project site.

3. Suppressing dust generation by spraying the area with water or a Construction Manager-accepted dust retardant.

F. Adequate moisture content shall be maintained at all times in areas where the pre-existing surfaces have been removed or disturbed, and in materials that have been stockpiled on the job site, so that dust shall not be generated.

G. The Contractor shall protect all areas from any refuse or dust generated by the work.

H. The Contractor shall provide surface covering to maintain mud-free conditions at the ingress/egress locations of the facility support area and at Project access locations indicated on the drawings. The Contractor shall maintain the covering for the duration of the Project.

1.05 POLLUTION CONTROL

A. Pollution of Waterways:

1. Perform Work using methods that prevent entrance or accidental spillage of solid or liquid matter, contaminants, debris, and other objectionable pollutants and wastes into watercourses, flowing or dry, and underground water sources.

2. Such pollutants and wastes shall include, but shall not be limited to, refuse, earth and earth products, garbage, cement, concrete, sewage effluent, industrial waste, hazardous chemicals, oil and other petroleum products, aggregate processing tailings, and mineral salts.

B. Contractor shall be responsible for disposal of pollutants resulting from Contractor's operations.

C. Contractor shall only perform fueling activities and maintenance and repair activities in designated areas.

D. Contractor shall be responsible for pollution that results from refueling, maintenance, or repair of construction equipment, or work activities resulting in pollutant release.

E. Storage and Disposal of Petroleum Product:

1. Petroleum products covered by this Section include gasoline, diesel fuel, lubricants, and refined and used oil. During project construction, store all petroleum products in such a way as to prevent contamination of all ground and surface waters and in accordance with local, state, and federal regulations.

2. Lubricating oil may be brought into the project area in steel drums or other means, as the Contractor elects. Store used lubricating oil in steel drums, or other approved means, and return them to the supplier for disposal. Do not burn or otherwise dispose of at the Site.

3. Secondary containment shall be provided for products stored on site, in accordance with the Contractor provided Storm Water Pollution Prevention Plan.

1.06 TRAFFIC AND SAFETY CONTROLS

A. Traffic controls shall be in accordance with the Owner provided Traffic Control Plan.

B. Post construction areas and roads with traffic control signs or devices used for protection of workmen, the public, and equipment. Signs and devices must conform to the American National Standards Institute (ANSI) Manual on Uniform Traffic Control Devices for Streets and Highways.

C. Barricades for protection of employees must conform to the portions of the ANSI Manual on Uniform Traffic Control Devices for Streets and Highways, relating to barricades.

D. Construct and maintain fences, planking, barricades, lights, shoring, and warning signs as required by local authorities and federal and state safety ordinances, and as required to protect all property from injury or loss and as necessary for the protection of the public, and provide walks around any obstructions made in a public place for carrying out the Work covered in this Contract. Leave all such protection in place and maintained until removal is authorized by the Construction Manager.

1.07 ACCESS CONTROL

A. Temporary perimeter fencing can be installed and/or repaired to restrict, reduce, or eliminate access by the public, livestock, and wildlife into the work area. Fencing shall be placed and moved as necessary to minimize disruption to ongoing operations at the Project site and adjacent properties.

B. Private and personal vehicles not used for authorized construction purposes shall not access the controlled areas. All Contractor vehicles shall comply with applicable licensing regulations.

1.08 MAINTENANCE

A. Maintain all temporary controls in good working conditions during the term of the Contract for the safe and efficient transport of equipment and supplies, and for construction of permanent works.

1.09 STATUS AT COMPLETION

A. Upon completion of the Work, or prior thereto as approved by the Construction Manager, remove all temporary controls and restore disturbed areas.

PART 2 – PRODUCTS

[Not Used]

PART 3 – EXECUTION

[Not Used]

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section for establishing and removing Temporary Controls shall be considered as incidental to Mobilization and Demobilization, Section 01505, and payment shall be based on the lump sum price provided on the Bid Schedule.

B. Providing for and complying with the requirements set forth in this Section for operations and maintenance of Temporary Controls shall be considered as incidental to Earthworks Section 02300, , and payment shall be based on the unit prices provided on the Bid Schedule.

[END OF SECTION]

SECTION 01505

MOBILIZATION/DEMOBILIZATION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Mobilization consists of preparatory work and operations, including but not limited to those necessary for the movement of personnel and project safety; including: adequate personnel, equipment, supplies, and incidentals to the project Site; establishment of facilities necessary for work on the project; premiums on insurance for the project and for other work and operations the Contractor must perform or costs the Contractor must incur before beginning work on the project, which are not covered in other bid items.

B. Demobilization consists of work and operations including, but not limited to, movement of personnel, equipment, supplies, incidentals, and temporary facilities including trailers, haul roads, parking lots, and decontamination pads off-site.

PART 2 – PRODUCTS

[Not Used]

PART 3 – EXECUTION

[Not Used]

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section for Mobilization and Demobilization shall be lump sum (LS) and payment shall be based on the prices provided on the Bid Schedule.

B. The Contractor shall include the following specified items as incidental to Mobilization and Demobilization and shall be included in the lump sum costs provided on the Base Bid Schedule. With the noted exceptions, the lump sum costs shall include initial set up and removal, operational and maintenance costs shall be included as incidental to Earthworks Sectios 02300:

1. Construction Facilities
    a. Parking Areas
    b. Interior, Private, Temporary Roads
        i. Haul Road Maintenance and Repair Plan
        ii. Haul Road Plan
    c. Temporary Trailers
    d. Temporary Utilities
    e. On-site communications
    f. Weather Protection

g. Contractor Generated Debris and Trash Control

h. Temporary Sanitary Facilities: includes initial set-up, maintenance, and removal

i. Lighting

j. Material and Equipment Storage

k. Dust Control Water Storage

l. Construction Equipment

m. First Aid Facilities

n. HDPE-liner Storage Area

2. Contract Close-out

3. Temporary Controls:

   a. Dust Control

      i. Dust Control and Mitigation Plan

   b. Pollution Control

      i. Fuel Plan

   c. Traffic and Safety Control

      i. Signs

      ii. Traffic control equipment: cones, barricades

   d. Noise Control

      i. Equipment Mufflers

4. Health and Safety Plan

   a. Spill Prevention and Response Plan

5. And all other incidentals necessary for mobilization and demobilization.

C. The Contract Price for Mobilization / Demobilization shall include the provision for movement of equipment onto the job site; removal of all facilities and equipment at the completion of the project; permits; preparation of a Health and Safety Plan; and all other related mobilization and demobilization costs. Price bid for mobilization shall not exceed 10 percent of the total bid for the Project.

[END OF SECTION]

SECTION 15102

BALL VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products.

B. Product options.

C. Product substitution procedures.

1.2 PRODUCTS

A. Furnish products of specified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Provide Balon Series F Carbon Steel Flanged End Connection Ball Valves.

C. Three valves will be electrically actuated normally closed. The actuators should be installed on the stock Balon Valves by McJunkin Red Man Corporation. The Denver phone is (303) 293-8703.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. For exterior storage of fabricated products, place on sloped supports above ground.

D. Cover products with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

E. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

F. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

PART 2 PRODUCTS

2.1 Ball Valves

A. Valves shall be Balon 6R-F13N-RF.

B. Flanges end connection.

C. ANSI Class 150.

D. NACE valves with 316 stainless steel ball and stem.

E. Wheel operators.

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 016903

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Programmable logic controllers.

B. Remote input/output units.

C. Programmer/loader unit.

1.02 REFERENCES

A. NEMA ICS 1 - General Standards for Industrial Control and Systems.

B. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

C. NEMA ICS 3 - Industrial Systems.

D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.03 SUBMITTALS

A. Submit shop drawings.

B. Submit shop drawings indicating layout of completed assemblies, interconnecting cabling, dimensions, weights, and external power requirements.

C. Submit product data.

D. Submit product data for each component specified.

E. Submit manufacturer's certificate.

F. Submit manufacturer's installation instructions.

1.04 PROJECT RECORD DOCUMENTS

A. Submit record documents.

B. Accurately record actual locations of controller cabinets and input and output devices connected to system. Include interconnection wiring and cabling information, and terminal block layouts in controller cabinets.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation data.

B. Include bound copies of operating and programming instructions.

C. Submit maintenance data.

D. Include card replacement, adjustments, and preventative maintenance procedures and materials.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience, which maintains service facilities within 300 miles of project.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site.

B. Store and protect products.

C. Accept products on site in factory containers and verify damage.

D. Store products in clean, dry area; maintain temperature to NEMA ICS 1.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature above 32 degrees F (0 degrees C) and below 104 degrees F (40 degrees C) during and after installation of products.

B. Maintain area free of dirt and dust during and after installation of products.

1.09 MAINTENANCE SERVICE

A. Provide manufacturer's maintenance services of programmable logic controllers for three years from Date of Substantial Completion.

PART 2 – PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLER

A. The Programmable Logic Controllers will have the following functionalities. The Contractor shall design and provide per this specification a functioning controller capable of.

1. Programmable Logic Controller will be capable of providing the controls as described in Section 13441.

2. The PLC shall be accessible through current communication system on site.

3. The PLC shall control the discharge pumps based on:

   a. Elevation of water in the pit.

   b. Set time period.

   c. Set percent of time.

   d. Remote control (on-off).

4. The PLC shall be easily operated from a control panel or remotely.

B. There are two pits with similar functions. The contractor shall recommend the option of one PLC or a PLC at each pump house. The distance between the pump houses where the controls are located is about 300 feet.

C. There will be three actuated valves which will be controlled based on water level elevations.

D. The PLC(s) should have an additional 50% capacity for expansion in the future.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field measurements are as [shown on drawings.] [instructed by manufacturer.]

C. Verify that required utilities are available, in proper location, and ready for use.

D. Beginning of installation means installer accepts conditions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Do not install products until major construction is complete and building interior is enclosed and heated.

C. Connect input and output devices as shown on drawings.

3.03 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems.

3.04 DEMONSTRATION

A. Provide systems demonstration.

B. Demonstrate operation and programming of controller. Provide 8 hours of instruction each for four persons, to be conducted at project site with manufacturer's representative.

END OF SECTION

SECTION 01770

CONTRACT CLOSEOUT

PART 1 – GENERAL

1.01 CLOSEOUT PROCEDURES

A. Contractor shall submit written certification that the Technical Specifications, CQA Plan, and Drawings have been reviewed, Work has been inspected, and that Work is complete and in-accordance with the Technical Specifications, CQA Plan, and Drawings and ready for Construction Manager's inspection.

1.02 RELATED SECTIONS

Section 01505 – Mobilization/Demobilization

1.03 FINAL CLEANING

A. Contractor shall execute final cleaning prior to final inspection.

B. Contractor shall clean equipment and fixtures to a sanitary condition.

C. Contractor shall remove waste and surplus materials, rubbish, and construction facilities from the construction Site.

1.04 AS-BUILT DOCUMENTATION

A. Contractor shall provide Construction Manager with all record documents.

PART 2 – PRODUCTS

[Not Used]

PART 3 – EXECUTION

[Not Used]

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section for Contract Closeout shall be considered as incidental to Mobilization and Demobilization, Section 01505, and payment shall be based on the lump sum price provided on the Base Bid Schedule.

[END OF SECTION]

SECTION 02110

SITE CLEARING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.

B. The Contractor shall remove and dispose of all debris, vegetation, other organic and deleterious material, and other materials not suitable for Engineered fill materials that exist within the designated construction limits.

1.02 RELATED SECTIONS

Section 02300 – Earthwork

Section 02770 – Geomembrane

1.03 REFERENCES

A. Construction Drawings

1.04 DEFINITIONS

A. Clean Vegetation/Debris: Clean vegetation/debris is vegetation/debris which is not contaminated as verified by analytical testing and can be disposed of in a municipal, solid waste landfill.

B. Contaminated Vegetation/Debris: Contaminated vegetation/debris found to be contaminated by analytical testing and cannot be disposed of in a municipal, solid waste landfill.

PART 2 – PRODUCTS

[Not Used]

PART 3 – EXECUTION

3.01 GENERAL

A. The Contractor shall be responsible for all clearing and grubbing operations within the limits of work.

B. No open burning of combustible materials shall be allowed.

C. Prior to site clearing, Contractor shall have implemented SWMP.

3.02 SITE CLEARING

All clean vegetation, deleterious and other organic material not suitable for Engineered fill materials shall be removed completely from within the construction limits and disposed of off site.

The top 6 inches removed shall be set aside and reused later as topsoil placed over the stockpile location to the maximum extent possible.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section for clean vegetation disposal shall be per ton (TON) and payment shall be based on the unit price for clean debris/vegetation disposal provided on the Base Bid Schedule.

B. Providing for and complying with the requirements set forth in this Section for contaminated vegetation disposal shall be per ton (TON) and payment shall be based on the unit price for contaminated debris/vegetation disposal provided on the Base Bid Schedule.

[END OF SECTION]

SECTION 02225

DRAINAGE AGGREGATE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.

1.02 RELATED SECTIONS

Section 02300 —Earthwork

Section 02711 — Polyethylene Pipe

Section 02712 — Corrugated Polyethylene Pipe

Section 02771 — Geotextile

1.03 REFERENCES

A. Construction Drawings

B. Latest Version of American Society for Testing and Materials (ASTM) Standards:

ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 2434	Standard Test Method for Permeability of Granular Soils (Constant Head)

1.04 SUBMITTALS

A. The Contractor shall submit to the Construction Manager for approval, at least 7 days prior to the start of construction, Certificates of Compliance for proposed aggregate materials. Certificates of Compliance shall include, at a minimum, typical gradation and source of aggregate materials.

1.05 QUALITY ASSURANCE

A. The Contractor shall ensure that the materials and methods used for Drainage Aggregate meet the requirements of the Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager shall be rejected and shall be repaired or replaced by the Contractor.

B. The Contractor shall be aware of all monitoring and field/laboratory conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed work, shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the materials or completed work, the Contractor shall be required to repair the deficiency or replace the deficient materials.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Aggregate shall meet the requirements specified in ASTM C-33 and shall have a maximum particle size of 1-inch. Aggregate shall have a minimum permeability of 1 x 10-2 cm/sec when tested in accordance with ASTM D 2434.

2.02 EQUIPMENT

A. The Contractor shall furnish, operate, and maintain hauling, placing, and grading equipment as necessary for aggregate placement.

PART 3 – EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the work in this Section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this and other related Sections.

3.02 PLACEMENT

A. Place to the lines, grades, and dimensions shown on the Drawings.

B. The Contractor shall avoid tearing, puncturing, folding, or damaging in any way the geotextile and HDPE liner materials during placement of the aggregate material.

C. Any damage to the HDPE liner system which is caused by the Contractor or his representatives shall be repaired by the HDPE liner Installer at the Contractor's expense.

D. No density or moisture requirements are specified for placement of the aggregate material. Aggregate material shall be compacted to minimize settlement of materials placed above the aggregate material.

E. All equipment to be used in placing the aggregate material must be approved in writing by the Construction Manager prior to use. The Contractor shall provide a list of the equipment to be used for placing the aggregate material and the necessary technical information (equipment specifications) on each piece of equipment to be approved at least two working days prior to use.

F. Place filter geotextile overlying aggregate as shown on the Drawings and as specified in Section 02771.

3.03 FIELD TESTING

A. The minimum frequency and details of quality control testing are provided below. This testing shall be performed by the CQA Engineer. The Contractor shall take this testing frequency into account in planning the construction schedule.

1. Aggregates quality control testing:

   a. particle-size analyses conducted in accordance with ASTM C-136 at a frequency of one test per 5,000 yd^3;

b. permeability tests conducted in accordance with ASTM D 2434 at a frequency of one test per 10,000 yd^3.

3.04 CONSTRUCTION TOLERANCE

A. The Contractor shall perform the aggregate construction to within +0.1 ft of the thickness indicated on the Drawings.

3.05 PROTECTION OF WORK

A. The Contractor shall use all means necessary to protect all work of this Section.

B. In the event of damage, the Contractor shall make repairs and replacements to the satisfaction of the Construction Manager.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section for Drainage Aggregate shall be incidental to the french drain rigid perforated PVC pipe.

[END OF SECTION]

This page intnetionally blank.

SECTION 02300

EARTHWORK

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.

B. The Work shall include, but not be limited to excavating, hauling, placing, moisture conditioning, backfilling, compacting, grading, stockpiling, and subgrade preparation. Earthwork shall conform to the dimensions, lines, grades and sections shown on the Drawings or as directed by the Construction Manager.

1.02 RELATED SECTIONS

Section 01025 — Measurement and Payment

Section 02110 — Site Clearing

Section 02771 — Geotextile

Section 02773 — Geocomposite

Section 03400 — Cast-in-Place Concrete

1.03 REFERENCES

A. Construction Drawings

B. Site Geotechnical Report

C. Latest version of American Society for Testing and Materials (ASTM) standards:

ASTM D 422	Standard Method for Particle-Size Analysis of Soils
ASTM D 1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))
ASTM D 2216	Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D 2487	Standard Test Method for Classification of Soils for Engineering Purposes
ASTM D 2922	Standard Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Density Methods (Shallow Depth)
ASTM D 3017	Standard Test Method for Water Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)

ASTM D 3080 Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions

ASTM D 4318 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

D. Latest version of American Association of State Highway and Transportation Officials (AASHTO) standards:

AASHTO T 180 Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

1.04 SUBMITTALS

A. Prior to beginning earthwork, Contractor shall perform baseline topographic survey on a minimum 25-foot grid and at all grade breaks. Baseline topographical survey shall be submitted to the Construction Manager within 20 working days of notice to proceed.

B. The Contractor shall submit to the Construction Manager a notice of completion for within 24 hours of completed excavation, engineered fill, and prepared subgrade as-built survey to provide the Owner with sufficient time to verify as-built surveys

C. The Contractor shall submit to the Construction Manager the Stockpile Plan within 10 days of Notice to Proceed.

D. The Contractor shall submit to the Construction Manager product data sheets and manufacturer's recommendations for soil binder material that will be used.

1.05 QUALITY ASSURANCE

A. The Contractor shall ensure that the materials and methods used for Earthwork meet the requirements of the Construction Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager shall be rejected and shall be repaired or replaced by the Contractor.

B. The Contractor shall be aware of and accommodate all monitoring and field/laboratory conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed work, shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the materials or completed work, the Contractor shall be required to repair the deficiency or replace the deficient materials.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and protect products brought to the Project site in accordance with this Section.

B. Stockpiles

1. Stockpile materials at locations in accordance with the contract documents or as agreed to by the Contractor and the Construction Manager. Stockpiles shall be located so as not to interfere with other aspects of the work.

2. Clear stockpile areas and install erosion and sedimentation controls before depositing fill or excavated materials on approved stockpile areas.

3. Prevent segregation of fill materials and mixing of one type of fill material with other types.

4. Topsoil stripped from project site shall be reused as topsoil for the stockpile to the maximum extent possible.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Engineered fill shall consist of on-site relatively homogeneous, natural soils that contain <5% of debris, foreign objects, large rock fragments (greater than 6 inches in maximum dimension), roots, and organics. No materials larger than 4 inches shall be allowed within the Engineered fill beneath the liners. All other locations requiring engineered fill may allow materials less than or equal to 6 inches. The Engineered fill shall be classified according to the Unified Soil Classification System (per ASTM D 2487) as SC, ML, CL, SM, SW, SP, GW, GP, GM, GC, or combinations of these materials. The Contractor may propose the use of other soil types as Engineered fill, but then such use shall be at the sole discretion of the Engineer.

B. Prepared subgrade is defined as the material directly underlying the HDPE liner system which shall meet the requirements listed above for Engineered fill. The material must also pass compaction requirements and permeability requirements as defined by COGCC which are: No materials larger than 3/4 inch shall project or protrude from the surface of the prepared subgrade.

C. Anchor Trench Backfill materials shall meet the requirements listed above for the Engineered Fill.

D. Aggregate base for Base Road shall conform to CCAUSS Section 704.03.04 for Type II Aggregate Base and the Construction Drawings.

E. Grouted Riprap atop 6-inch Type II aggregate base along the embankment channels shall have D50 = 12-inch rip rap. Grouted rip rap shall be in accordance with CCAUSS Section 610 and the Construction Drawings.

F. Soil binder shall be long lasting plant derived material such as pitch and rosin emulsion, polymeric emulsion blends, or Portland cement based material as approved by the Construction Manager.

2.02 EQUIPMENT

A. The Contractor shall furnish, operate, and maintain compaction equipment as is necessary to produce the required in-place soil density and moisture content.

B. The Contractor shall furnish, operate and maintain tank trucks, pressure distributors, or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths.

C. The Contractor shall furnish, operate, and maintain miscellaneous equipment such as scarifiers or disks, earth excavating equipment, earth hauling equipment, and other equipment, as necessary for Earthwork construction.

PART 3 – EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the work in this Section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this and other related Sections.

3.02 SITE PREPARATION

A. Prior to performing any earthworks on the site, the Contractor shall perform a baseline topographic survey. The survey, at a minimum shall be performed on a 25 foot grid and account for grade breaks and other topographic features affecting volume of earthworks. This survey shall be conducted by a Professional Land Surveyor licensed in the state of Colorado. This survey shall serve as the starting point for earthwork quantities, both excavation and fill placement.

B. The Contractor shall perform demolition and site clearing in accordance with the Construction Drawings and Sections 02010 and 02110 of these Specifications prior to any Earthwork activity.

C. Prior to performing earthworks on the site, the Contractor shall install drainage and erosion-control measures in accordance with the SWMP.

3.03 GENERAL EXCAVATION

A. The Contractor shall excavate materials to the limits and grades shown on the Drawings.

B. All excavated materials not used for Engineered Fill shall be stockpiled in accordance with the contract documents or in an area designated by the Construction Manager in accordance with Subpart 3.06 of this Section.

C. Excavations in native soil shall not have slopes steeper than 2.1H:1V, unless otherwise indicated on the Construction Drawings or when approved by the Construction Manager.

D. No excavations deeper than 4 feet with side slopes steeper than 2:1 (horizontal:vertical) shall be made unless otherwise indicated on the Construction Drawings or without the prior approval of the Construction Manager. When shoring is required, the design and inspection of such shoring shall be the Contractor's responsibility and shall be subject to the review of the Construction Manager prior to use. No personnel shall Work within or next to an excavation requiring shoring until such shoring has been installed, inspected, and approved by an engineer registered in the State of Colorado. The Contractor shall be responsible for any fines imposed due to violation of any laws and regulations relating to the safety of the Contractor's personnel.

E. Excavations shall be kept free from water.

F. The Contractor shall notify the Construction Manager at once of springs, seeps, or wet zones found in excavations.

G. Oversized materials encountered within the excavation or that result from screening operations of clean fill shall be segregated and stockpiled in a location approved by the Construction Manager.

H. Permanent Ditches and Channels:

1. Cut ditches and channels accurately to the cross sections, grades, and elevations indicated on the drawings. Do not cut below indicated grades without prior Construction Manager authorization.

2. Do not deposit excavated material within 4 feet from the edge of a ditch or channel, unless the material is fill placed as indicated and specified.

3. Keep completed ditches and channels free from blockage or obstruction by leaves, brush, sticks, trash, sediment, and other debris.

3.04 ANCHOR TRENCH EXCAVATION

A. The Contractor shall excavate the anchor trench to the limits and grades shown on the Drawings. If the liner submittals indicate a larger trench is necessary, then the requirements of the submittal apply.

B. All excavated materials not used for Anchor Trench Backfill or Engineered fill shall be stockpiled in areas shown on Construction Drawings or as designated by the Construction Manager.

3.05 SUBGRADE SURFACE PREPARATION

A. The subgrade shall be prepared and made suitable as a foundation for placement and compaction of soil material and geosynthetic components of liner system, where applicable. The prepared subgrade shall be proof-rolled and meet the requirements outlined in Subpart 2.01 The subgrade shall be firm and able to support the Contractor's construction equipment without the development of depressions or ruts. In addition, the subgrade shall provide adequate support such that the overlying fill material may be placed and compacted to the specified density.

3.06 STOCKPILING

A. Soil shall be stockpiled in areas shown on Construction Drawings or as designated by the Construction Manager. Stockpile shall be free of incompatible soil, clearing, clearing debris, or other objectionable materials.

3.07 PIPE TRENCH EXCAVATION AND BACKFILL

A. Trench excavation and backfill shall conform to the lines and grades shown on the Construction Drawings.

3.08 ENGINEERED FILL AND SLIT TRENCH, WASTE TRENCH, AND ANCHOR TRENCH BACKFILL

A. The Engineered Fill and Anchor Trench Backfill shall be placed to the lines and grades shown on the Drawings, unless approved otherwise during submittals.

B. Soil used for the Engineered Fill and Anchor Trench Backfill shall be on-site materials meeting the requirements of Subpart 2.01 of this Section.

C. Soil used for the Engineered Fill and Anchor Trench Backfill shall be placed in a loose lift that results in a compacted lift thickness of no greater than 12 inches.

D. The maximum permissible Engineered Fill and Anchor Trench Backfill pre-compaction soil clod size is 6 inches.

E. Each 12-inch horizontal lift of Engineered Fill placed against a slope shall be keyed into the slope as directed in the Geotechnical Report.

F. The Contractor shall compact each lift as directed in the Geotechnical Report.

G. Engineered Fill and Anchor Trench Backfill shall be compacted by a minimum of 2 passes, forward and backward are counted as one pass, of a smooth drum compactor operating in static mode, Ingersoll-Rand SD 122 or equivalent

H. During wetting or drying, the material shall be regularly disced or otherwise mixed so that uniform moisture conditions in the appropriate range are obtained.

3.09 STRUCTURE EXCAVATION AND EMBANKMENT

A. This shall include, but not be limited to, the following: detention basins, footings for riprap, concrete-lined storm water channels, aggregate-lined storm water channels, and cut-off walls for concrete aprons.

B. Refer to CCAUSS Sections 206 and 207 for Structure Excavation and Structure Backfill, respectively.

3.10 AGGREGATE BASE

A. Aggregate base placement and compaction shall be in accordance. Type II aggregate base. Aggregate base shall be compacted to not less than 95% compaction as determined by AASHTO T 180.

3.11 FIELD TESTING

A. The minimum frequency and details of quality control testing for engineered fill are provided below. The Contractor shall provide equipment and operators to accommodate testing. This testing shall be performed by the CQA Engineer and Geotechnical Engineer and is not separate from the testing outlined in the CQA Plan (i.e. QC and QA testing are the same and will not be duplicated). The Contractor shall take this testing frequency into account in planning the construction schedule.

1. Engineered fill material quality control testing:

   a. particle-size analyses conducted in accordance with ASTM D 422 at a frequency of one test per 10,000 yd^3;

   b. Atterberg Limits conducted in accordance with ASTM D 4318 at a frequency of one test per 10,000 yd^3;

   c. soil classification tests conducted in accordance with ASTM D 2487 at a frequency of one test per 10,000 yd^3; and

   d. modified Proctor compaction tests conducted in accordance with ASTM D 1557 at a frequency of one test per 10,000 yd^3/lift.

2. The CQA Engineer and Geotechnical Engineer shall perform conformance tests on placed and compacted engineered fill to evaluate compliance with these Specifications. These tests shall include in-situ moisture content and dry density. The frequency and procedures for moisture-density testing are given in the CQA Plan. At a minimum, the dry density and moisture content of the soil shall be measured in-situ in accordance with ASTM D 2922 and ASTM D 3017, respectively.

3. A special testing frequency shall be used by the CQA Engineer and Geotechnical Engineer when visual observations of construction performance indicate a potential problem. Additional testing shall be considered when:

   a. the rollers slip during rolling operation;

   b. the lift thickness is greater than specified;

   c. the fill is at improper and/or variable moisture content;

   d. fewer than the specified number of roller passes are made;

   e. dirt-clogged rollers are used to compact the material;

   f. the rollers do not have optimum ballast; or

   g. the degree of compaction is doubtful.

4. During construction, the frequency of testing shall be increased by the CQA Engineer in the following situations:

   a. adverse weather conditions;

   b. breakdown of equipment;

c. at the start and finish of grading;

d. if the material fails to meet specifications; or

e. the work area is reduced.

B. Defective Areas:

1. If a defective area is discovered in the Earthwork, the CQA Engineer and Geotechnical Engineer shall evaluate the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Engineer shall determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA Engineer deems appropriate. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQA Engineer shall define the limits and nature of the defect.

2. Once the extent and nature of a defect is determined, the Contractor shall correct the deficiency to the satisfaction of the CQA Engineer and Geotechnical Engineer. The Contractor shall not perform additional work in the area until the CQA Engineer and Geotechnical Engineer approve the correction of the defect.

3. Additional testing may be performed by the CQA Engineer and Geotechnical Engineer to verify that the defect has been corrected. This additional testing shall be performed before any additional work is allowed in the area of deficiency. The cost of the additional testing after failure shall be borne by the Contractor.

3.12 SURVEY CONTROL

A. The Contractor shall perform all surveys necessary for construction layout and control.

3.13 CONSTRUCTION TOLERANCE

A. The Contractor shall perform the Earthwork construction to within ±0.1 ft on areas with a slope less than 10 percent and ±0.2 ft on areas with a slope greater than 10 percent of the grades indicated on the Drawings.

3.14 PROTECTION OF WORK

A. The Contractor shall use all means necessary to protect completed work of this Section.

B. At the end of each day, the Contractor shall verify that the entire work area is left in a state that promotes drainage of surface water away from the area and from finished work. If threatening weather conditions are forecast, at a minimum, compacted surfaces shall be seal-rolled to protect finished work.

C. In the event of damage to prior work, the Contractor shall make repairs and replacements to the satisfaction of the Construction Manager.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section shall be measured as Lump Sum (LS) and payment shall be based on the lump sum price provided on the Bid Schedule.

1. Anchor trench excavation
2. Storm water channel excavation
3. Stockpiling
4. Prepared subgrade

B. Providing for and complying with the following incidentals shall be included in the Earthworks Section 02300, costs on the Bid Schedules:

1. Construction and Dust Control Water
2. Uncontaminated Dewatering
3. Dust Control
4. Health and Safety
   a. Personal Protective Equipment
   b. Monitoring
5. Operations and Maintenance of the following items:
   a. Parking Areas
   b. Temporary Roads
   c. Temporary Trailers
   d. Temporary Utilities
   e. On-site communications
   f. Weather Protection
   g. Contractor Generated Debris and Trash Control
   h. Temporary Sanitary Facilities
   i. Lighting
   j. Material and Equipment Storage
   k. Dust Control Water Storage

l. Construction Equipment

m. First Aid Facilities

n. Dust Control

o. Pollution Control

p. Traffic and Safety Control

q. Noise Control

6. And all other incidentals necessary for Earthwork

[END OF SECTION]

SECTION 02711

POLYETHYLENE PIPE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.

1.02 RELATED SECTIONS

Section 02225 — Drainage Aggregate

Section 02771 — Geotextile

1.03 REFERENCES

A. Drawings

B. Construction Quality Assurance (CQA) Plan

C. Latest Version of American Society for Testing and Materials (ASTM) Standards:

ASTM F 714	Specification for Polyethylene Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM D 1248	Specification for Polyethylene Plastics Molding and Extrusion
ASTM D 2657	Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
ASTM D 3035	Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter
ASTM D 3350	Specification for Polyethylene Plastic Pipe and Fitting Materials

1.04 DEFINITIONS

A. Standard Dimensional Ratio (SDR) is defined as the actual outside pipe diameter divided by the wall thickness.

1.05 SUBMITTALS

A. The Contractor shall submit, at least 14 days prior to installation of this material, to the Construction Manager, certificates of compliance for the pipe materials and fittings to be furnished.

B. The Contractor shall submit, at least 14 days prior to installation of this material, to the Construction Manager, copies of certifications for each operator responsible for welding pipe.

C. The Construction Manager shall supply a surveyor to document the as-built conditions of the piping. The Contractor shall notify and allow the Construction Manager sufficient time to survey piping prior to backfilling the pipe.

D. Contractor shall submit Manufacturer Butt-Fusion Training documentation for HDPE Pipe Joining Technicians

E. Contractor shall submit Manufacturer Electro-Fusion Training documentation for HDPE Pipe Joining Technicians if Electro-Fusion welding is used.

1.06 QUALITY ASSURANCE

A. The Contractor shall ensure that the materials and methods used for polyethylene pipe meet the requirements of the Construction Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager shall be rejected and shall be repaired or replaced by the Contractor.

PART 2 – PRODUCTS

2.01 PIPE

A. HDPE pipe sizes shown on the Drawings and specified in this Section reference nominal inside diameter. Pipe size shall be in accordance with ASTM F 714 and ASTM D 3035.

B. Pipe shall be 18-inch diameter, and shall be HDPE with a minimum standard dimension ratio (SDR) of 13.5, and have a cell classification of 345434C in accordance with ASTM D 3350.

C. Pipe shall conform to the following requirements:

1. Pipe and fittings shall contain no recycled compound except that generated in the Manufacturer's own plant and from resin of the same specification as the raw material supplier.

2. Pipe and fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects, being uniform in color, capacity, density, and other physical properties.

D. The following information shall be continuously marked on the pipe or spaced at intervals not exceeding 5 feet.

1. Name and/or trademark of the pipe Manufacturer.

2. Nominal pipe size.

3. Standard Dimensional Ratio (SDR).

4. PE 3408.

5. A production code from which the date and place of manufacture can be determined.

PART 3 – EXECUTION

3.01 GENERAL

A. When shipping, delivering, and installing pipe, fittings, and accessories, do so to ensure a sound, undamaged installation. Provide adequate storage for all materials and equipment delivered to the job site. Handle and store pipe and fittings in accordance with the Manufacturer's recommendation.

3.02 PLACING AND LAYING PIPE

A. Follow the Manufacturer's recommendations when hauling, unloading, and stringing the pipe.

B. Protect liners and other materials from damage while installing the pipe

C. HDPE solid and perforated pipe shall be installed as shown on the Drawings.

D. HDPE pipe shall be inspected for cuts, scratches, or other damages prior to installation. Any pipe showing damage, which in the opinion of the Construction Manager shall affect performance of the pipe, must be removed from the Site. The Contractor shall replace any material found to be defective at no additional cost to the Construction Manager.

E. The Contractor shall place HDPE solid and perforated pipe in such a manner that does not damage the pipe.

F. The Contractor shall place the drainage aggregate material around the polyethylene pipe so as to not deform or otherwise damage the pipe and fittings. Special care shall be taken when placing pipe bedding material beneath the spring-line of the pipe and fittings.

G. The Contractor shall clean out pipe interior, as necessary, to remove debris that may affect performance of pipe.

3.03 JOINING PIPE

A. All pipe fusion shall be performed by the Supplier, or a by fusion operator certified by the Manufacturer.

Join the polyethylene pipe by the method of thermal butt fusion, as outlined in ASTM D 2657. Electro-fusion couplings shall only be use with prior approval by the Design Engineer. Perform fusion joining of pipe and fittings in accordance with the procedures established by the pipe Manufacturer. Of particular importance is the use of proper interface pressures and heater plate temperatures.

B. Do not perform pipe fusion on wet or excessively dirty pipe or when conditions are unsuitable for the work. Secure open ends of pipe when work is not in progress, so that no water, earth, or other substance shall enter the pipe or fittings. Plug, cap, or valve off ends of pipe left for future connections, if any.

C. In order to allow the joining operation to continue in adverse weather conditions, a shelter may be required for the joining machine. Particular caution should be

exercised to prevent water from entering the pipe and from coming in contact with the heater plate.

D. Only fully trained personnel shall be allowed to perform the fusion, installation, supervision, or inspection of polyethylene fusion joints.

E. Pipe joints made with couplings can be slipped fitted for perforated pipe. Solid wall pipe shall be joined with butt fusion or fusion coupler methods only.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section for 4-inch , 12-inch, and 18-inch HDPE solid wall and perforated pipe, fittings, and gravel shall be measured as lump sum (LS), and payment shall be based on the lump sum price for HDPE piping and gravel provided on the Bid Schedule. Specified items incidental to LCRS HDPE piping and gravel include:

1. Filter geotextile
2. Drainage aggregate
3. And all other incidentals necessary for a complete installation of HDPE Pipe

[END OF SECTION]

SECTION 02712

CORRUGATED POLYETHYLENE PIPE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.

1.02 RELATED SECTIONS

Section 02300 — Earthwork

1.03 REFERENCES

A. Construction Drawings

B. Site Construction Quality Assurance (CQA) Plan

C. Latest Version of American Society for Testing and Materials (ASTM) Standards:

ASTM F 405	Standard Specification for Corrugated Polyethylene (CPE) Pipe and Fittings

D. Latest American Association of State Highway and Transportation Officials (AASHTO) Standards:

AASHTO M252M-96	Corrugated Polyethylene Drainage Pipe

1.04 SUBMITTALS

A. The Contractor shall submit, at least 14 days prior to installation of this material, to the Construction Manager, certificates of compliance for the pipe materials and fittings to be furnished.

B. The Contractor shall supply a surveyor to document the as-built conditions of the piping. The Contractor shall notify and allow the Construction Manager sufficient time to survey piping prior to backfilling the pipe. Owner shall verify survey as-built conditions using control points.

1.05 QUALITY ASSURANCE

A. The Contractor shall ensure that the materials and methods used for corrugated polyethylene pipe meet the requirements of the Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager shall be rejected and shall be repaired or replaced by the Contractor.

PART 2 – PRODUCTS

2.01 PIPE

A. HDPE pipe sizes shown on the Drawings and specified in this Section reference nominal inside diameter. Pipe material, markings, properties, and size shall be in accordance with AASHTO M252.

B. Pipes shall be corrugated polyethylene pipe with a smooth interior wall, Type SP with Class 2 perforations in accordance with AASHTO M252.

PART 3 – EXECUTION

3.01 GENERAL

A. When shipping, delivering, and installing pipe, fittings, and accessories, do so to ensure a sound, undamaged installation. Provide adequate storage for all materials and equipment delivered to the job site. Handle and store pipe and fittings in accordance with the Manufacturer's recommendation.

3.02 PLACING AND LAYING PIPE

A. Follow the Manufacturer's recommendations when hauling, unloading, and stringing the pipe.

B. Corrugated polyethylene solid and perforated pipe shall be installed as shown on the Drawings.

C. Corrugated polyethylene pipe shall be inspected for cuts, scratches, or other damages prior to installation. Any pipe showing damage, which in the opinion of the Construction Manager shall affect performance of the pipe, must be removed from the site. Replace any material found to be defective.

3.03 CONSTRUCTION TOLERANCE

A. The Contractor shall perform the work to within ±0.1 ft of the grades indicated on the Drawings.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section for 8-inch and 12-inch HDPE perforated and solid wall CPE pipe and fittings shall be measured in linear feet (LF), and payment shall be based on the unit price provided on the Scope Bid Schedule. Specified items considered incidental to Corrugate Polyethylene Pipe include:

1. Filter Geotextile
2. Drainage Aggregate
3. And all other incidentals necessary for a complete installation of HDPE CPE Pipe.

[END OF SECTION]

SECTION 02770

GEOMEMBRANE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings

1.02 RELATED SECTIONS

Section 02771 — Geotextile

Section 02773 — Geocomposite

1.03 REFERENCES

A. Construction Drawings

B. Latest version of the American Society for Testing and Materials (ASTM) standards:

ASTM D 638	Standard Test Method for Tensile Properties of Plastics
ASTM D 792	Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 1004	Standard Test Method of Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1505	Standard Test Methods for Density of Plastics by Density-Gradient Technique
ASTM D 1603	Standard Test Method for Carbon Black in Olefin Plastics
ASTM D 5321	Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
ASTM D 5397	Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
ASTM D 5596	Recommended Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds
ASTM D 5641	Practice for Geomembrane Seam Evaluation by Vacuum Chamber
ASTM D 5820	Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes
ASTM D 5994	Standard Test Method for Measuring Core Thickness of Textured Geomembranes
ASTM D 6392	Test Method for Determining the Integrity of Non-reinforced Geomembrane Seams Produced using Thermo-Fusion Methods.

1.04 QUALIFICATIONS

A. The Geomembrane Manufacturer shall be responsible for the production of geomembrane rolls from resin and shall have sufficient production capacity and qualified personnel to provide material meeting the requirements of this Section and the construction schedule for this project.

B. Geosynthetics Installer:

1. The Geosynthetics Installer shall be responsible and shall provide sufficient resources for field handling, deploying, seaming, temporarily restraining (against wind), and other aspects of the deployment and installation of the geomembrane and other geosynthetic components of the project.

2. The Geosynthetics Installer shall have successfully installed a minimum of 10,000,000 ft2 of polyethylene geomembrane on previous projects. The Geosynthetics Installer shall provide documentation of installations to the Construction Manager.

3. The installation crew shall have the following experience.

   a. The Superintendent shall have supervised the installation of a minimum of 5,000,000 ft^2 of polyethylene geomembrane on at least five (5) different projects. The Superintendent shall provide documentation of installations to the Construction Manager.

   b. At least one seamer shall have experience seaming a minimum of 1,000,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Seamers with such experience shall be designated "master seamers" and shall provide direct supervision over less experienced seamers. The master seamer shall provide documentation of experience to the Construction Manager.

   c. All other seaming personnel shall have seamed at least 100,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Personnel who have seamed less than 100,000 square feet shall be allowed to seam only under the direct supervision of the master seamer or Superintendent. The other seamers shall provide documentation of seaming experiences to the Construction Manager.

C. Contractor shall provide resumes for all geomembrane installation technicians with documentation of Manufacturer training on seaming geomembrane.

1.05 WARRANTY

A. The Geosynthetic Installer shall furnish the Construction Manager a 20-year written warranty against defects in materials. Warranty conditions concerning limits of liability shall be evaluated by, and must be acceptable to, the Construction Manager.

B. The Geosynthetic Installer shall furnish the Construction Manager with a 1-year written warranty against defects in workmanship. Warranty conditions concerning limits of liability shall be evaluated by, and must be acceptable to, the Construction Manager.

1.06 SUBMITTALS

A. The Geosynthetic Installer shall submit the following documentation on the resin used to manufacture the geomembrane to the Construction Manager for approval prior to transporting any geomembrane to the site.

1. Copies of quality control certificates issued by the resin supplier including the production dates and origin of the resin used to manufacture the geomembrane for the project.

2. Results of tests conducted by the Geomembrane Manufacturer to verify the quality of the resin used to manufacture the geomembrane rolls assigned to the project.

3. Certification that no reclaimed polymer is added to the resin during the manufacturing of the geomembrane to be used for this project, or, if recycled polymer is used, the Manufacturer shall submit a certificate signed by the production manager documenting the quantity of recycled material, including a description of the procedure used to measure the quantity of recycled polymer.

B. The Geosynthetic Installer shall submit the following documentation on geomembrane roll production to the Construction Manager for approval prior to transporting any geomembrane to the site.

1. Quality control certificates, which shall include:

   a. roll numbers and identification; and

   b. results of quality control tests, including descriptions of the test methods used, outlined in Part 2.02 of this Section.

2. The manufacturer warranty specified in Part 1.05.A of this Section.

C. The Geosynthetic Installer shall submit the following information to the Construction Manager for approval 21 days prior to mobilization.

1. A drawing showing the installation layout identifying geomembrane panel configurations, dimensions, details, locations of seams, as well as any variance or additional details that deviate from the Drawings. The layout shall be adequate for use as a construction plan and shall include dimensions, details, etc. The layout drawings, as modified and/or approved by the Construction Manager, shall become part of these Specifications.

2. Copy of Geosynthetic Installer's letter of approval or license by the Geomembrane Manufacturer.

3. Installation capabilities, including:

   a. information on equipment proposed for this project;

   b. average daily production anticipated for this project; and

   c. quality control procedures.

4. A list of completed facilities for which the installer has installed a minimum of 10,000,000 ft2 of polyethylene geomembrane, in accordance with Part 1.04 of this Specification. The following information shall be provided for each facility:

   a. the name and purpose of the facility, its location, and dates of installation;

   b. the names of the owner, project manager, and geomembrane manufacturer;

   c. name of the supervisor of the installation crew; and

   d. thickness and surface area of installed geomembrane.

5. In accordance with Part 1.04, a resume of the Superintendent to be assigned to this project, including dates and duration of employment, shall be submitted at least 14 days prior to beginning geomembrane installation.

6. In accordance with Part 1.04, resumes of all personnel who shall perform seaming operations on this project, including dates and duration of employment, shall be submitted at least 14 days prior to beginning geomembrane installation.

D. A Certificate of Calibration less than 12 months old shall be submitted for each field tensiometer prior to installation of any geomembrane. Certificates of Calibration shall be renewed as necessary to provide certificates less than 12 months old throughout project duration.

E. During installation, the Geosynthetic Installer shall be responsible for the timely submission to the Construction Manager of Quality Control documentation.

F. Upon completion of the installation, the Geosynthetic Installer shall be responsible for the submission to the Construction Manager of a warranty from the Geosynthetic Installer as specified in Part 1.05.B of this Section.

G. The Geosynthetic Installer shall submit the following documentation on welding rod to the Construction Manager for approval 21 days prior to transporting welding rod to the site:

1. Quality control documentation, including lot number, welding rod spool number, and results of quality control tests on the welding rod.

1.07 QUALITY ASSURANCE

A. The Geosynthetic Installer shall ensure that the materials and methods used for installation of the geomembrane meet the requirements of the Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager, shall be rejected and shall be repaired or replaced by the Geosynthetic Installer.

B. The Geosynthetic Installer shall be aware of and accommodate all monitoring and conformance testing. This monitoring and testing, including random conformance testing of construction materials and completed work, shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the Geosynthetic Installer's materials or completed work, the Geosynthetic Installer shall be required to repair the deficiency or replace the deficient materials.

C. Leak testing will be required as part of the contract. Both liners shall be filled with a minimum of 8 feet of Owner-approved water and tested in accordance with COGCC Rules.

PART 2 – PRODUCTS

2.01 GEOMEMBRANE PROPERTIES

A. The Geomembrane Manufacturer shall furnish double-sided, 60-mil textured geomembrane having properties that comply with the required property values shown in Table 02770-1.

B. In addition to the property values listed in Table 02770-1, the geomembrane shall:

1. Contain a maximum of 1 percent by weight of additives, fillers, or extenders (not including carbon black).

2. Not have striations, pinholes (holes), bubbles, blisters, nodules, undispersed raw materials, or any sign of contamination by foreign matter on the surface or in the interior.

2.02 MANUFACTURING QUALITY CONTROL

A. Rolls:

1. The Geomembrane Manufacturer shall continuously monitor geomembrane during the manufacturing process for defects.

2. No geomembrane shall be accepted that exhibits any defects.

3. The Geomembrane Manufacturer shall measure and report the geomembrane thickness at regular intervals along the roll length.

4. No geomembrane shall be accepted that fails to meet the specified thickness.

5. The Geomembrane Manufacturer shall sample and test the geomembrane at a minimum of once every 50,000 ft2 to demonstrate that its properties conform to the values specified in Table 02770-1. At a minimum, the following tests shall be performed:

Test	Procedure
Thickness	ASTM D 5994
Specific Gravity	ASTM D 792 Method A or ASTM D 1505
Tensile Properties	ASTM D 638
Puncture Resistance	ASTM D 4833
Carbon Black	ASTM D 1603
Carbon Black Dispersion	ASTM D 5596

6. Tests not listed above but listed in Table 02770-1 need not be run at the 1 per 50,000 ft2 frequency. However, the Geomembrane Manufacturer shall certify that these tests are in compliance with this section and have been performed on a sample that is identical to the geomembrane to be used on this project. The Geosynthetic Installer shall provide the test result documentation to the Construction Manager.

7. Any geomembrane sample that does not comply with the requirements of this Section shall result in rejection of the roll from which the sample was obtained and shall not be used for this project. If a geomembrane sample fails to meet the quality control requirements of this Section the Geomembrane Manufacturer shall sample and test, at the expense of the Manufacturer, rolls manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established to bound the failed roll(s).

8. If a geomembrane sample fails to meet the quality control requirements of this Section, the roll shall be rejected and shall not be delivered to site.

B. The Geomembrane Manufacturer shall permit the CQA Engineer to visit the manufacturing plant for project specific visits. If possible, such visits shall be prior to or during the manufacturing of the geomembrane rolls for the specific project.

2.03 LABELING

A. Geomembrane rolls shall be labeled with the following information.

1. thickness of the material;

2. length and width of the roll;

3. name of Geomembrane Manufacturer;

4. product identification;

5. lot number; and

6. roll number.

2.04 TRANSPORTATION, HANDLING AND STORAGE

A. Handling and care of the geomembrane prior to and following installation at the site shall be the responsibility of the Geosynthetic Installer. The Geosynthetic Installer shall be liable for all damage to the materials incurred prior to final acceptance of the liner system by the Construction Manager.

B. Geosynthetic Installer shall be responsible for storage of the geomembrane at the site. The geomembrane shall be protected from excessive heat or cold, dirt, puncture, cutting, or other damaging or deleterious conditions. Any additional storage procedures required by the Geomembrane Manufacturer shall be the Geosynthetic Installer's responsibility. Geomembrane rolls shall be stacked per the manufacturer's recommendations.

C. Geosynthetic materials may be delivered to the site once submittals have been approved and CQA conformance tests have been completed and the results of the conformance testing comply with the requirements outline in the Technical Specifications.

D. The CQA Engineer shall follow Chain-of-Custody procedures for sample transportation.

E. If the geomembrane is to be stored on-site longer than 3 months, contractor shall elevate rolls off of the ground and cover rolls of geomembrane with water proof

tarpaulins or other thin film membranes, appropriately weighted to protect from wind uplift and overlapped to prevent water intrusion. Care shall be taken when removing cover so as to not damage the underlying materials and to protect personnel from animals or other dangerous conditions may exist beneath the cover.

PART 3 – GEOMEMBRANE INSTALLATION

3.01 FAMILIARIZATION

A. Prior to implementing any of the work described in this Section, the Geosynthetic Installer shall become thoroughly familiar with all portions of the work falling within this Section.

B. Inspection:

1. The Geosynthetic Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the work of this Section may properly commence without adverse effect.

2. If the Geosynthetic Installer has any concerns regarding the installed work of other Sections, he shall notify the Construction Manager in writing prior to the start of the work of this Section. Failure to inform the Construction Manager in writing or installation of the geomembrane shall be construed as the Geosynthetic Installer's acceptance of the related work of all other Sections.

C. A pre-installation meeting shall be held to coordinate the installation of the geomembrane with the installation of other components of the composite liner system.

3.02 GEOMEMBRANE DEPLOYMENT

A. Layout Drawings:

1. The Geosynthetic Installer shall deploy the geomembrane panel in general accordance with the layout drawing submitted to the Construction Manager.

B. Field Panel Identification:

1. A geomembrane field panel is a roll or a portion of roll cut in the field.

2. Each field panel shall be given an identification code (number or letter-number). This identification code shall be agreed upon by the Construction Quality Assurance Manager and Geosynthetic Installer.

C. Field Panel Placement:

1. Field panels shall be installed, as approved or modified, at the location and positions indicated on the layout drawings.

2. Field panels shall be placed one at a time, and each field panel shall be seamed immediately after its placement. Panels shall be overlapped so that the flow of liquid above the liner is across the top of the weld and not into the flap area of the fusion weld (shingled to allow water to cross seam).

3. Geomembrane shall not be placed when the ambient temperature is below 32°F or above 122°F, unless otherwise authorized in writing by the Construction Manager.

4. Geomembrane shall not be placed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds.

5. The Geosynthetic Installer shall ensure that:

   a. Vehicular traffic shall be limited to vehicles with balloon tires or rubber tracks that exhibit a ground pressure less than 5 pounds per square inch.

   b. Equipment used does not damage the geomembrane by handling, trafficking, or leakage of hydrocarbons (i.e., fuels).

   c. Only hook knives are used to cut geomembrane.

   d. Personnel working on the geomembrane do not smoke, wear damaging shoes, bring glass onto the geomembrane, or engage in other activities that could damage the geomembrane.

   e. The method used to unroll the panels does not scratch or crimp the geomembrane and does not damage the supporting soil or geosynthetics.

   f. The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels). The method used to place the panels results in intimate contact with adjacent components.

   g. Temporary ballast and/or anchors (e.g., sand bags), not likely to damage the geomembrane, are placed on the geomembrane to prevent wind uplift. Sand bags shall be filled with sand material with a maximum particle size of ½ inch.

   h. The geomembrane is especially protected from damage in heavily trafficked areas.

   i. Any rub sheets to facilitate seaming are removed prior to installation of subsequent panels.

6. Any field panel or portion thereof that becomes seriously damaged (torn, twisted, or crimped) shall be replaced with new material. Less serious damage to the geomembrane may be repaired, as approved by the CQA Engineer. Damaged panels or portions of damaged panels that have been rejected shall be removed from the work area. Any damaged materials shall be replaced at the Geosynthetic Installers' expense.

D. If the Geosynthetic Installer intends to install geomembrane between one hour before sunset and one hour after sunrise, he shall notify the Construction Manager in writing prior to the start of the work. The Geosynthetic Installer shall indicate additional precautions, which shall be taken during these installation hours. The Geosynthetic Installer shall provide proper, adequate illumination for work during this time period.

3.03 FIELD SEAMING

A. Seam Layout:

1. In corners and at odd-shaped geometric locations, the number of field seams shall be minimized. No horizontal seam shall be along a slope with an inclination steeper than 10 percent. Horizontal seams shall be considered as any seam having an alignment exceeding 20 degrees from being perpendicular to the slope contour lines, unless otherwise approved by the Construction Manager and/or Design Engineer. No seams shall be located in an area of potential stress concentration.

B. Personnel:

1. All personnel performing seaming operations shall be qualified as indicated in Part 1.04 of this Section. No seaming shall be performed unless a "master seamer" is present on-site.

C. Weather Conditions for Seaming:

1. Unless authorized in writing by the Construction Manager, seaming shall not be attempted at ambient temperatures below 32°F or above 122°F. Between 32°F and 40°F, the Geosynthetic Installer shall use preheating or other cold weather seaming methodologies, as appropriate, and shall address frost or other adverse cold weather conditions that may affect seaming. If the Geosynthetic Installer wishes to use methods that may allow seaming at ambient temperatures below 32°F or above 122°F, he shall use a procedure approved by the Construction Manager.

2. A meeting shall be held with the Geosynthetic Installer and Construction Manager to establish acceptable installation procedures. In all cases, the geomembrane shall be dry and protected from wind damage.

3. Ambient temperatures shall be measured between 0 to 6 in. above the geomembrane surface.

D. Overlapping:

1. Geomembrane panels shall be sufficiently overlapped for welding and to allow peel tests to be performed on the seam. Any seams that cannot be destructively tested because of insufficient overlap shall be treated as failing seams.

E. Seam Preparation:

1. Prior to seaming, the seam area shall be clean and free of moisture, dust, dirt, debris of any kind, and foreign material.

2. If seam overlap grinding is required, the process shall be completed according to the Geomembrane Manufacturer's instructions within 20 minutes of the seaming operation and in a manner that does not damage the geomembrane. The grind depth shall not exceed ten percent of the geomembrane thickness.

3. Seams shall be aligned with the fewest possible number of wrinkles and "fishmouths."

F. General Seaming Requirements:

1. Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is insufficient shall be patched with an oval or round patch of geomembrane that extends a minimum of 6 in. beyond the cut in all directions.

2. Any electric generator shall be placed outside the area to be lined or mounted in a manner that protects the geomembrane from damage. The electric generator shall be properly grounded.

G. Seaming Process:

1. Approved processes for field seaming are extrusion welding and fusion welding. Only equipment identified as part of the approved submittal specified in Part 1.06 shall be used.

2. Extrusion Equipment and Procedures:

   a. The Geosynthetics Installer shall maintain at least one spare operable seaming apparatus on site.

   b. Extrusion welding apparatus shall be equipped with gauges giving the temperature in the apparatus.

   c. Prior to beginning a seam, the extruder shall be purged until all heat-degraded extrudate has been removed from the barrel.

   d. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.

3. Fusion Equipment and Procedures:

   a. The Geosynthetic Installer shall maintain at least one spare operable seaming apparatus on site.

   b. Fusion-welding apparatus shall be automated vehicular-mounted devices equipped with gauges giving the applicable temperatures and speed.

   c. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.

H. Trial Seams:

1. Trial seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. Trial seams shall be conducted on the same material to be installed and under similar field conditions as production seams. Such trial seams shall be made at the beginning of each seaming period, beginning of the day and after lunch, for each seaming apparatus used each day. The trial seam sample shall be a minimum of 5-ft long by 1-ft wide (after seaming) with the seam centered lengthwise for fusion equipment and at least 3-ft long by 1-ft wide for extrusion equipment. Seam overlap shall be as indicated in Part 3.03.D of this Section. The CQA Engineer shall be present during trial seaming.

2. The CQA Engineer shall collect four adjoining coupon specimens, each 1-in. wide, cut from the trial seam sample by the installer using a die cutter to ensure precise 1-in. wide coupons. The coupons shall be tested by the CQA Engineer in peel (outside (fusion only) and inside track) and shear using an electronic readout field tensiometer in accordance with ASTM D 6392, at a strain rate of 2 in./min., and they shall not fail in the seam (i.e., Film Tear Bond (FTB), which is failure in the parent material, is required). The required peel and shear seam strength is listed in Table 02770-2. Ideally, samples shall be conditioned at 23±2oC at a relative humidity of 50±5% for two hours prior to testing. If test conditions vary from these conditions, a 1-in. wide coupon of the parent geomembrane material (no weld) shall be tested in the same manner as the seam specimens to determine the break strength at this condition.

3. If a coupon specimen fails, the entire operation shall be repeated. If the additional coupon specimen fails, the seaming apparatus and seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful trial seams are achieved.

I. Nondestructive Seam Continuity Testing:

1. The Geosynthetic Installer shall nondestructively test for continuity on all field seams over their full length. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all field seaming. The Geosynthetic Installer shall complete any required repairs in accordance with Part 3.03.K of this Section. The following procedures shall apply:

   a. Vacuum testing in accordance with ASTM D 5641.

   b. Air pressure testing (for double-track fusion seams only) in accordance with ASTM D 5820 and the following:

      i. Energize the air pump to a pressure between 25 and 30 pounds per square inches, close valve, and sustain the pressure for not less than 5 minutes.

      ii. If loss of pressure exceeds 3 pounds per square inches, or does not stabilize, locate faulty area and repair in accordance with Part 3.03.K of this Section.

      iii. Cut opposite end of air channel from pressure gauge and observe release of pressure to ensure air channel is not blocked.

      iv. Remove needle, or other approved pressure feed device, and seal repair in accordance with Part 3.03.K of this Section.

   c. Spark testing shall be performed if the seam cannot be tested using other nondestructive methods.

J. Destructive Testing:

1. Destructive seam tests shall be performed on samples collected from selected locations to evaluate seam strength and integrity. Destructive tests shall be carried out as the seaming work progresses, not at the completion of all field seaming.

2. Sampling:

   a. Test locations shall be determined during seaming, and may be prompted by suspicion of excess crystallinity, contamination, offset seams, or any other potential cause of imperfect seaming. The CQA Engineer shall be responsible for coordinating the locations. The Geosynthetic Installer shall not be informed in advance of the locations where the seam samples shall be taken. The CQA Engineer reserves the right to increase the sampling frequency.

   b. Obtain 1 sample (minimum) for each 500 linear feet, or fraction thereof, of fusion welded seam for each welding machine/welding technician combination.

   c. After completing a number of consecutive destructive sample laboratory tests for each welding machine/welding technician combination, as outlined in the following table, the frequency for the specific welding machine/welding technician may be adjusted as indicated in the following table.

Number of Destructive Samples per Welding Machine/Welding Technician	Failures	Frequency (ft)
0-10	0/≥1	500/500
11-20	0/≥1	750/500
21+	≤1/≥2	1000/750

   d. Destructive testing of extrusion seams may be conducted upon scrap material that has been extrusion welded past the initial startup seam for the shift if the footage of extrusion weld for the shift is less than 200 linear feet and if the Contractor concurs

   e. Samples shall be cut by the Geosynthetic Installer at the locations designated by the CQA Engineer as the seaming progresses in order to obtain laboratory test results before the geomembrane is covered by another material. Each sample shall be numbered and the sample number and location identified on the panel layout drawing. All holes in the geomembrane resulting from the destructive seam sampling shall be immediately repaired in accordance with the repair procedures described in Part 3.03.K of this Section. The continuity of the new seams in the repaired areas shall be tested according to Part 3.03.I of this Section.

   f. Two strips of dimensions 1-in. wide and 12 in. long with the seam centered parallel to the width shall be taken from either side of the sample location. These samples shall be tested in the field in accordance with Part 3.03.J.3 of this Section. If these samples pass the field test, a laboratory sample shall be taken. The laboratory sample shall be at least 1-ft wide by 42-inches long with the seam centered lengthwise. The sample shall be cut into three parts and distributed as follows:

      i. One portion 12-in. long to the Geosynthetic Installer.

      ii. One portion 18-in. long to the Geosynthetic CQA Laboratory for testing.

iii. One portion 12-in. long to the Construction Manager for archival storage.

3. Field Testing:

   a. The two 1-in. wide strips shall be tested in the field tensiometer in the peel mode. The CQA Engineer has the option to request an additional test in the shear mode. If any field test sample fails to meet the requirements in Table 02770-2, then the procedures outlined in Part 3.03.J.5 of this Section shall be followed.

4. Laboratory Testing:

   a. Testing by the Geosynthetics CQA Laboratory shall include "Seam Strength" and "Peel Adhesion" (ASTM D 6392) with the 1-in. wide strip tested at a rate of 2 in./min. At least 5 specimens shall be tested for each test method (peel and shear). Four of the five specimens per sample must pass both the shear strength test and peel adhesion test when tested in accordance with ASTM D 6392. The minimum acceptable values to be obtained in these tests are indicated in Table 02770-2. Both inside and outside tracks of the dual track fusion welds shall be tested in peel.

5. Destructive Test Failure:

   a. The following procedures shall apply whenever a sample fails a destructive test, whether the test is conducted by the Geosynthetic CQA's laboratory, the Geosynthetic Installer laboratory, or by a field tensiometer. The Geosynthetic Installer shall have two options:

      i. The Geosynthetic Installer can reconstruct the seam (e.g., remove the old seam and reseam) between any two passed destructive test locations.

      ii. The Geosynthetic Installer can trace the welding path to an interim location, a minimum of 10 feet from the location of the failed test (in each direction) and take a small sample for an additional field test at each location. If these additional samples pass the field tests, then full laboratory samples shall be taken. These full laboratory samples shall be tested in accordance with Part 3.03.J.4 of this Section. If these laboratory samples pass the tests, then the seam shall be reconstructed between these locations. If either sample fails, then the process shall be repeated to establish the zone in which the seam should be reconstructed. All acceptable seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 ft of reconstructed seam, a sample taken from within the reconstructed zone must pass destructive testing.

   b. Whenever a sample fails, the CQA Engineer may require additional tests for seams that were formed by the same seamer and/or seaming apparatus or seamed during the same time shift.

K. Defects and Repairs:

1. The geomembrane shall be inspected before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be swept or washed by the Installer if surface contamination inhibits inspection.

2. Each suspected location, both in seam and non-seam areas, shall be nondestructively tested using the methods described Part 3.03.I of this Section, as appropriate. Each location that fails nondestructive testing shall be marked by the CQA Engineer and repaired by the Geosynthetic Installer.

3. When seaming of a geomembrane is completed (or when seaming of a large area of a geomembrane is completed) and prior to placing overlying materials, the CQA Engineer shall identify all excessive geomembrane wrinkles (Wrinkles with a height to width ratio greater than 1H:6W, (e.g., 2" height over 12" width). The Geosynthetic Installer shall cut and reseam all wrinkles so identified. The seams thus produced shall be tested like any other seams.

4. Repair Procedures:

    a. Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the Geosynthetic Installer. Several repair procedures exist. The final decision as to the appropriate repair procedure shall be agreed upon between the CQA Engineer and the Geosynthetic Installer. The procedures available include:

        i. patching, used to repair holes larger than 1/16 inch, tears, undispersed raw materials, and contamination by foreign matter;

        ii. abrading and reseaming, used to repair small sections of extruded seams;

        iii. spot seaming, used to repair minor, localized flaws;

        iv. capping, used to repair long lengths of failed seams; and

        v. removing bad seam and replacing with a strip of new material seamed into place (used with long lengths of fusion seams).

    b. In addition, the following criteria shall be satisfied:

        i. surfaces of the geomembrane that are to be repaired shall be abraded no more than 20 minutes prior to the repair;

        ii. all surfaces must be clean and dry at the time of repair;

        iii. all seaming equipment used in repair procedures must be approved;

        iv. the repair procedures, materials, and techniques shall be approved in advance, for the specific repair, by the CQA Engineer;

        v. patches or caps shall extend at least 6 in. beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 in.; and

        vi. the geomembrane below large caps shall be appropriately cut to avoid water or gas collection between the two sheets.

5. Repair Verification:

    a. Each repair shall be nondestructively tested using the methods described in Part 3.03.I of this Section, as appropriate. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Failed tests shall require the

repair to be redone and retested until a passing test results. At the discretion of the CQA Engineer, destructive testing may be required on large caps.

3.04 ANCHORAGE

A. Temporary anchorage of the geomembrane shall be in accordance with the Construction Drawings and consist of the geomembrane extended approximately 10 ft from the toe of the waste slope and have two feet of operations layer placed on top. The edge of the geomembrane shall be protected with plywood.

B. Temporary anchor trenches shall be as shown on the Construction Drawings.

C. Permanent anchorage shall be as shown on the Construction Drawings and in accordance with the Specifications for Anchor Trenching in Section 02300.

3.05 MATERIALS IN CONTACT WITH THE GEOMEMBRANE

A. The Geosynthetic Installer shall take all necessary precautions to ensure that the geomembrane is not damaged during its installation. During the installation of other components of the liner system by the Contractor, the Contractor shall ensure that the geomembrane is not damaged. Any damage to the geomembrane shall be repaired by the Geosynthetic Installer , at the expense of the Contractor.

~~B.~~ Soil and aggregate materials shall not be placed over the geomembranes at ambient temperatures below 32°F or above 122°F, unless otherwise specified.

C All attempts shall be made to minimize wrinkles in the geomembrane.

D Equipment shall not be driven directly on the geomembrane. Equipment shall only be driven above operations layer.

3.06 CONFORMANCE TESTING

A. Samples of the geomembrane shall be removed by the CQA Engineer and sent to a Geosynthetic CQA Laboratory for testing to ensure conformance with the requirements of this Section. The Geosynthetic Installer shall assist the CQA Engineer in obtaining conformance samples. The Geosynthetic Installer and Construction Manager shall account for this testing in the installation schedule. Only material that meets the requirements of Part 2.02 this Section shall be installed. Conformance sampling may be conducted at the manufacturing facility prior to shipment to the site.

B. Samples shall be selected by the CQA Engineer in accordance with this Section.

C. Samples shall be taken at a minimum frequency of one sample per 100,000 ft2.

D. The CQA Engineer may increase the frequency of sampling in the event that test results do not comply with the requirements of Part 2.02 of this Section.

E. The following tests shall be performed by the CQA Engineer:

Test	Test Method
Specific Gravity	ASTM D 792 or D 1505
Thickness	ASTM D 5994
Tensile Properties	ASTM D 638
Carbon Black Content	ASTM D 1603
Carbon Black Dispersion	ASTM D 5596

F. Any geomembrane that is not certified in accordance with Part 1.07.C of this Section, or that conformance testing indicates do not comply with Part 2.02 of this Section, shall be rejected. The Geosynthetic Installer shall replace the rejected material with new material.

3.07 GEOMEMBRANE ACCEPTANCE

A. The Geosynthetic Installer shall retain all ownership and responsibility for the geomembrane until accepted by the CQA Engineer.

B. The geomembrane shall be accepted by the CQA Engineer when:

1. the installation is completed;

2. all documentation is submitted;

3. verification of the adequacy of all field seams and repairs, including associated testing, is complete; and

4. all warranties are submitted.

3.08 PROTECTION OF WORK

A. The Geosynthetic Installer and Contractor shall use all means necessary to protect all work of this Section.

B. In the event of damage, the Geosynthetic Installer shall make all repairs and replacements necessary, to the satisfaction of the CQA Engineer.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Payment shall be made according to bid schedule with approval of the Construction Manager.

B. The Lump Sum costs shall include all incidentals necessary for a complete installation of Geomembrane liner.

TABLE 02770-1
REQUIRED HDPE GEOMEMBRANE PROPERTIES

PROPERTIES	QUALIFIERS	UNITS	SPECIFIED VALUES	TEST METHOD
Physical Properties				
Thickness	Average Minimum	mils mils	60 54	ASTM D 5994
Specific Gravity	Minimum	N/A	.940	ASTM D 792 Method A or ASTM D 1505
Mechanical Properties				
Tensile Properties (each direction)				
1. Tensile (Break) Strength Tensile (Break) Strength	Minimum	lb/in	90	ASTM D 638
2. Elongation at Break		%	100	
3. Tensile (Yield) Strength		lb/in	126	
4. Elongation at Yield		%	12	
Puncture	Minimum	lb	90	ASTM D 4833
Tear Resistance	Minimum	lb	42	ASTM D 1004
Interface Shear Strength	-	-	Note 1	ASTM D 5321
Environmental Properties				
Carbon Black Content	Range	%	2-3	ASTM D 1603
Carbon Black Dispersion	N/A	none	Note 2	ASTM D 5596
Environmental Stress Crack	Minimum	hr	300	ASTM D 5397

Notes: (1) Interface shear strength test(s) shall be performed, by the CQA Engineer, on the composite liner system in accordance with Section 02772 —Geosynthetic Clay Liner.
(2) Minimum 8 of 10 in Categories 1 or 2; 10 in Categories 1, 2, or 3.

TABLE 02770-2
REQUIRED GEOMEMBRANE SEAM PROPERTIES

PROPERTIES	QUALIFIERS	UNITS	SPECIFIED VALUES	TEST METHOD
Shear Strength[1]				
Fusion	minimum	lb/in	120	ASTM D 6392
Extrusion	minimum	lb/in	120	ASTM D 6392
Peel Adhesion				
FTB[2]				
Fusion	minimum	lb/in	91	ASTM D 6392
Extrusion	minimum	lb/in	78	ASTM D 6392

Notes: (1) Also called "Bonded Seam Strength".
(2) FTB = Film Tear Bond means that failure is in the parent material, not the seam. The maximum seam separation is 25 percent of the seam area.

[END OF SECTION]

SECTION 02771

GEOTEXTILE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.

B. The work shall include, but not be limited to, delivery, storage, placement, and seaming of the various geotextile components of the project.

C. Filter geotextile shall be used beneath the secondary liner, surrounding the French drain aggregate, beneath the channel rock armoring, and other locations as indicated in the Plans.

1.02 RELATED SECTIONS

Section 02300 — Earthwork

Section 02225 — Drainage Aggregate

Section 02770 — Geomembrane

Section 02773 — Geocomposite

1.03 REFERENCES

A. Drawings

B. Construction Quality Assurance (CQA) Plan

C. Latest version of American Society for Testing and Materials (ASTM) standards:

ASTM D 3786	Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabric-Diaphragm Bursting Strength Test Method
ASTM D 4355	Standard Test Method for Deterioration of Geotextile from Exposure to Ultraviolet Light and Water
ASTM D 4491	Standard Test Method for Water Permeability of Geotextile by Permittivity
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextile
ASTM D 4595	Standard Test Method for Wide Width Tensile Properties of Geosynthetics
ASTM D 4632	Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method)
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile

ASTM D 4833 Standard Test Method for Index Puncture Resistance of Geotextile, Geomembranes, and Related Products

ASTM D 5261 Standard Test Method for Measuring Mass Per Unit Area of Geotextile

1.04 SUBMITTALS

A. The Geosynthetic Installer shall submit to the Construction Manager, prior to geotextile delivery, the following information regarding the proposed geotextile:

1. manufacturer and product name;

2. minimum property values of the proposed geotextile and the corresponding test procedures;

3. projected geotextile delivery dates; and

4. list of geotextile roll numbers for rolls to be delivered to the site.

B. Prior to geotextile placement, the Geosynthetic Installer shall submit to the Construction Manager the manufacturing quality control certificates for each roll of geotextile. The certificates shall be signed by responsible parties employed by the geotextile manufacturer (such as the production manager). The quality control certificates shall include:

1. lot, batch, and/or roll numbers and identification; and

2. results of quality control tests, including a description of the test methods used.

1.05 QUALITY ASSURANCE

A. The Geosynthetic Installer shall ensure that the geotextile and installation methods used meet the requirements of the Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager, shall be rejected and shall be repaired or replaced by the Geosynthetic Installer.

B. The Geosynthetic Installer shall be aware of all monitoring and conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed work, shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the Geosynthetic Installer's materials or completed work, the Geosynthetic Installer shall be required to repair the deficiency or replace the deficient materials.

PART 2 – PRODUCTS

2.01 GEOTEXTILE PROPERTIES

A. Geotextile suppliers shall furnish materials in which the "Minimum Average Roll Values", as defined by the Federal Highway Administration (FHWA), meet or exceed the criteria specified in Table 02771-1.

B. The geotextile shall be woven materials, suitable for use in filter/separation applications and woven geotextile for use as a UV protective layer.

2.02 MANUFACTURING QUALITY CONTROL

A. The geotextile shall be manufactured with quality control procedures that meet or exceed generally accepted industry standards.

B. The Geotextile Manufacturer shall sample and test the geotextile to demonstrate that the material conforms to the requirements of these Specifications.

C. Any geotextile sample that does not comply with this Section shall result in rejection of the roll from which the sample was obtained. The Geosynthetic Installer shall replace any rejected rolls.

D. If a geotextile sample fails to meet the quality control requirements of this Section the Manufacturer shall sample and test, at the expense of the Manufacturer, rolls manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established to bound the failed roll(s).

E. Additional sample testing may be performed, at the Geotextile Manufacturer's discretion and expense, to identify more closely any non-complying rolls and/or to qualify individual rolls.

F. Sampling shall, in general, be performed on sacrificial portions of the geotextile material such that repair is not required. The Geotextile Manufacturer shall sample and test the geotextile, at a minimum once every 100,000 ft2, to demonstrate that the geotextile properties conform to the values specified in Table 02771-1. At a minimum, the following manufacturing quality control tests shall be performed on each type of geotextile:

Test	Procedure	Filtration	UV Protective
Grab strength	ASTM D 4632	Yes	No
Puncture strength	ASTM D 4833	Yes	No
Mullen Burst	ASTM D 3786	Yes	No
Trapezoidal Tear	ASTM D 4533	Yes	No
Permittivity	ASTM D 4491	Yes	No
A.O.S.	ASTM D 4751	Yes	Yes
Wide Width Tensile	ASTM D 4595	No	Yes

G. The Geotextile Manufacturer shall comply with the certification and submittal requirements of this Section.

2.03 PACKING AND LABELING

A. Geotextile shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers.

B. Geotextile rolls shall be marked or tagged with the following information:

1. manufacturer's name;

2. product identification;

3. lot or batch number;

4. roll number; and

5. roll dimensions.

2.04 TRANSPORTATION, HANDLING, AND STORAGE

A. The Geosynthetic Installer shall be liable for any damage to the materials incurred prior to and during transportation to the site.

B. Geosynthetic materials may be delivered to the site once submittals have been approved and CQA conformance tests have been completed and the results of the conformance testing comply with the requirements outlined in the Technical Specifications.

C. Handling, unloading, storage, and care of the geotextile prior to and following installation at the site, is the responsibility of the Geosynthetic Installer. The Geosynthetic Installer shall be liable for any damage to the materials incurred prior to final acceptance by the Construction Manager.

D. The Geosynthetic Installer shall be responsible for storage of the geotextile at the site.

E. The geotextile shall be protected from sunlight, excessive heat or cold, puncture, or other damaging or deleterious conditions. The geotextile shall be protected from mud, dirt, and dust. Any additional storage procedures required by the geotextile Manufacturer shall be the responsibility of the Geosynthetic Installer.

F. If the geotextile is to be stored on-site longer than 1 month, contractor shall elevate rolls off of the ground and cover rolls of geotextile with water proof tarpaulins or other thin film membranes, appropriately weighted to protect from wind uplift and overlapped to prevent water intrusion. Care shall be taken when removing cover so as to not damage the underlying materials and to protect personnel from animals or other dangerous conditions may exist beneath the cover.

PART 3 – EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the work described in this Section, the Geosynthetic Installer shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this Section.

B. Inspection:

1. The Geosynthetic Installer shall carefully inspect the installed work of all other Sections and verify that all such work is complete to the point where the installation of this Section may properly commence without adverse effect.

2. If the Geosynthetic Installer has any concerns regarding the installed work of other Sections or the site, the Construction Manager shall be notified, in writing, prior to commencing the work. Failure to notify the Construction Manager or installation of

the geotextile shall be construed as Geosynthetic Installer's acceptance of the related work of all other Sections.

3.02 PLACEMENT

A. Geotextile installation shall not commence until CQA conformance evaluations, by the CQA Engineer, of previous work are complete, including evaluations of the Contractor's survey results to confirm that the previous work was constructed to the required grades, elevations, and thicknesses. Should the Contractor begin the work of this Section prior to the completion of CQA evaluations, he does so at his own risk. The Contractor shall account for the CQA conformance evaluations in the construction schedule.

B. The Geosynthetic Installer shall handle all geotextile in such a manner as to ensure they are not damaged in any way.

C. The Geosynthetic Installer shall take any necessary precautions to prevent damage to underlying materials during placement of the geotextile.

D. After unwrapping the geotextile from its opaque cover, the filtration geotextile shall not be left exposed for a period in excess of 15 days unless a longer exposure period is approved in writing by the geotextile manufacturer.

E. The Geosynthetic Installer shall take care not to entrap stones, excessive dust, or moisture in the geotextile during placement.

F. The Geosynthetic Installer shall anchor or weight all geotextile with sandbags, or the equivalent, to prevent wind uplift.

G. The Geosynthetic Installer shall examine the entire geotextile surface after installation to ensure that no foreign objects are present that may damage the geotextile or adjacent layers. The Contractor shall remove any such foreign objects and shall replace any damaged geotextile.

3.03 SEAMS AND OVERLAPS

A. On slopes steeper than 10 horizontal to 1 vertical, geotextiles shall be continuous down the slope; that is, no horizontal seams are allowed. Horizontal seams shall be considered as any seam having an alignment exceeding 20 degrees from being perpendicular to the slope contour lines, unless otherwise approved by the Construction Manager.

B. Geotextile shall be continuously sewn (i.e., spot sewing is not allowed) using a "single prayer" seam, with the stitching a minimum of 1.5 inches from the edge of the geotextile.

C. Geotextile shall be sewn with polymeric thread, having similar strength characteristics as the geotextile.

3.04 REPAIR

A. Any holes or tears in the geotextile shall be repaired using a patch made from the same geotextile. Geotextile patches shall be sewn into place no closer than 1 inch

from any panel edge. Should any tear exceed 50% of the width of the roll, that roll shall be removed and replaced.

B. Where geosynthetic materials underlie the geotextile being placed, care shall be taken to remove any soil or other material that may have penetrated the torn geotextile.

3.05 PLACEMENT OF SOIL MATERIALS

A. The Contractor shall place soil materials on top of the geotextile in such a manner as to ensure that:

1. the geotextile and the underlying materials are not damaged;

2. minimum slippage occurs between the geotextile and the underlying layers during placement; and

3. excess stresses are not produced in the geotextile.

B. Equipment shall not be driven directly on the geotextile.

C. Unless otherwise approved in writing by the Construction Manager, all equipment operating on materials overlying the geotextile shall comply with Section 02300 and Section 02225.

3.06 CONFORMANCE TESTING

A. Samples of the geotextile materials shall be removed by the CQA Engineer after the material has been received at the site and sent to a Geosynthetic CQA Laboratory for testing to ensure conformance with the requirements of this Section. This testing shall be carried out, in accordance with the CQA Plan, prior to the start of the work of this Section. Conformance sampling may be conducted at the manufacturing facility prior to shipment to the site.

B. Samples of each geotextile shall be taken, by the CQA Engineer, at a minimum frequency of one sample per 200,000 ft2.

C. The CQA Engineer may increase the frequency of sampling in the event that test results do not comply with requirements of Part 2.01 of this Section until passing conformance test results are obtained for all material that is received at the site. This additional testing shall be performed at the expense of the Contractor.

D. The following conformance tests shall be performed:

Test	Procedure	Filtration	UV Protective
Grab strength	ASTM D 4632	Yes	No
Puncture strength	ASTM D 4833	Yes	No
Mullen Burst	ASTM D 3786	Yes	No
Trapezoidal Tear	ASTM D 4533	Yes	No
Permittivity	ASTM D 4491	Yes	No
A.O.S.	ASTM D 4751	Yes	Yes

Wide Width Tensile	ASTM D 4595	No	Yes

E. Any geotextile that is not certified in accordance with Part 1.04 of this Section, or that conformance testing results do not comply with Part 2.01 of this Section, shall be rejected. The Geosynthetic Installer shall replace the rejected material with new material.

3.07 PROTECTION OF WORK

A. The Geosynthetic Installer shall use all means necessary to protect all work of this Section.

B. In the event of damage, the Geosynthetic Installer shall make repairs and replacements to the satisfaction of the Construction Manager at the expense of the Contractor.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Payment will be based on bid schedule as approved by Construction Manager.

TABLE 02771-1
REQUIRED PROPERTY VALUES FOR GEOTEXTILE

PROPERTIES	QUALIFIERS	UNITS	FILTER SPECIFIED VALUES	UV PROTECTIVE SPECIFIED VALUES	TEST METHOD
Type			nonwoven	woven	(-)
Mass per unit area	minimum	oz/yd^2	12[(1)]	-	ASTM D 5261
Filter Requirements					
Apparent opening size (O_{95})	maximum	mm	0.21	0.43	ASTM D 4751
Permittivity	minimum	s^{-1}	0.6	-	ASTM D 4491
Mechanical Requirements					
Grab strength	minimum	lb	130	-	ASTM D 4632
Puncture strength	minimum	lb	40	-	ASTM D 4833
Mullen Burst	minimum	psi	210	-	ASTM D 3786
Trapezoidal Tear	minimum	lb	40	-	ASTM D 4533
Wide Width Tensile Strength	minimum	ppi	-	110	ASTM D 4595
Durability					
Ultraviolet Resistance @ 500 hours	minimum	%	70	70	ASTM D 4355

Notes: (1) For information purposes only, not a required property.

[END OF SECTION]

SECTION 02773

GEOCOMPOSITE

PART 5 – GENERAL

5.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings

B. The work shall include, but not be limited to, delivery, storage, placement, and seaming of the geocomposite.

C. Geocomposite shall be used between the primary and secondary liners.

5.02 RELATED SECTIONS

Section 02300 — Earthwork

Section 02770 — Geomembrane

Section 02771 — Geotextiles

5.03 REFERENCES

A. Drawings

B. Construction Quality Assurance (CQA) Plan

C. Latest version of American Society for Testing and Materials (ASTM) standards:

ASTM D 413. Standard Test Method for Rubber Property-Adhesion to Flexible Substrate.

ASTM D 792. Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

ASTM D 1603. Standard Test Method for Carbon Black in Olefin Plastics.

ASTM D 4491. Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

ASTM D 4533. Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

ASTM D 4632. Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

ASTM D 4716. Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.

ASTM D 4751. Standard Test Method for Determining Apparent Opening Size of a Geotextile.

ASTM D 4833. Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

ASTM D 5199. Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

ASTM D 5261. Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

5.04 QUALIFICATIONS

A. The manufacturer shall be a well-established firm with more than one year documented experience in the manufacturing of geocomposite.

B. The Geosynthetic Installer shall install the geocomposite and shall meet the requirements of Section 02770 and this Section.

5.05 SUBMITTALS

A. The Geosynthetic Installer shall submit to the Construction Manager, prior to geocomposite delivery, the following information regarding the proposed geocomposite:

1. manufacturer and product name;

2. manufacturer documentation of at least 1-year of experience manufacturing geocomposite

3. minimum property values of the proposed geocomposite and the corresponding test procedures;

4. projected geocomposite delivery dates; and

5. list of geocomposite roll numbers for rolls to be delivered to the site.

B. Prior to geocomposite placement, the Geosynthetic Installer shall submit to the Construction Manager the manufacturing quality control certificates for each roll of geocomposite. The certificates shall be signed by responsible parties employed by the geocomposite manufacturer (such as the production manager). The quality control certificates shall include:

1. lot, batch, and/or roll numbers and identification; and

2. results of quality control tests, including a description of the test methods used.

5.06 CONSTRUCTION QUALITY ASSURANCE MONITORING

A. The Geosynthetic Installer shall ensure that the geocomposite and installation methods used meet the requirements of the Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager, shall be rejected and shall be repaired or replaced by the Geosynthetic Installer.

B. The Geosynthetic Installer shall be aware of and accommodate all monitoring and conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed work,

shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the Geosynthetic Installer's materials or completed work, the Geosynthetic Installer shall be required to repair the deficiency or replace the deficient materials.

PART 6 – PRODUCTS

6.01 GEOCOMPOSITE PROPERTIES

A. The Geocomposite Manufacturer shall furnish geocomposites having properties that comply with the required property values shown in Table 02773-1. The Geocomposite Manufacturer shall provide results of tests performed using the procedures listed in Table 02773-1, as well as certification that the materials meet or exceed the specified values.

B. Geotextiles shall be thermally bonded to both sides of the geonet component of geocomposite material rather than chemically bonded.

C. Geocomposite suppliers shall furnish materials in which the "Minimum Average Roll Values", as defined by the Federal Highway Administration (FHWA), meet or exceed the criteria specified in Table 02773-1.

D. The geocomposite's geotextile components shall be nonwoven materials, suitable for use in filter/separation and cushion applications.

6.02 MANUFACTURING QUALITY CONTROL

A. The geocomposite shall be manufactured with quality control procedures that meet or exceed generally accepted industry standards.

B. The geocomposite Manufacturer shall sample and test the geocomposite to demonstrate that the material conforms to the requirements of these Specifications.

C. Any geocomposite sample that does not comply with this Section shall result in rejection of the roll from which the sample was obtained. The Geosynthetic Installer shall replace any rejected rolls.

D. If a geocomposite sample fails to meet the quality control requirements of this Section the geocomposite Manufacturer shall sample and test, at the expense of the Manufacturer, rolls manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established to bound the failed roll(s).

E. Additional sample testing may be performed, at the geocomposite Manufacturer's discretion and expense, to identify more closely any non-complying rolls and/or to qualify individual rolls.

F. Sampling shall, in general, be performed on sacrificial portions of the geocomposite material such that repair is not required. The Geocomposite Manufacturer shall sample and test the geocomposite, at a minimum once every 100,000 ft2, to demonstrate that the geocomposite properties conform to the values specified in Table 02773-1. At a minimum, the following manufacturing quality control tests shall be performed on the geotextile component of the geocomposite:

Test	Procedure
Mass per unit area	ASTM D 5261
Grab strength	ASTM D 4632
Puncture strength	ASTM D 4833
Mullen Burst	ASTM D 3786
Trapezoidal Tear	ASTM D 4533
Permittivity	ASTM D 4491
A.O.S.	ASTM D 4751

G. At a minimum, the following manufacturing quality control tests shall be performed on the geonet component of the geocomposite:

Test	Procedure
Specific gravity	ASTM D 792
Nominal thickness	ASTM D 5199

H. At a minimum, the following manufacturing quality control tests shall be performed on the geocomposite:

Test	Procedure
Transmissivity	ASTM D 4716
Peel strength	ASTM D 413

I. The geocomposite Manufacturer shall comply with the certification and submittal requirements of this Section.

6.03 PACKING AND LABELING

A. Geocomposite shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers.

B. Geocomposite rolls shall be marked or tagged with the following information:

1. manufacturer's name;
2. product identification;
3. lot or batch number;
4. roll number; and
5. roll dimensions.

6.04 TRANSPORTATION, HANDLING, AND STORAGE

A. Geosynthetic materials may be delivered to the site once submittals have been approved and CQA conformance tests have been completed and the results of the conformance testing comply with the requirements outlined in the Technical Specifications.

B. The Geosynthetic Installer shall be liable for any damage to the materials incurred prior to and during transportation to the site.

C. Handling, unloading, storage, and care of the geocomposite prior to and following installation at the site, is the responsibility of the Geosynthetic Installer. The Geosynthetic Installer shall be liable for any damage to the materials incurred prior to final acceptance by the Construction Manager.

D. The Geosynthetic Installer shall be responsible for storage of the geocomposite at the site.

E. The geocomposite shall be protected from sunlight, excessive heat or cold, puncture, or other damaging or deleterious conditions. The geocomposite shall be protected from mud, dirt, and dust. Any additional storage procedures required by the geocomposite Manufacturer shall be the responsibility of the Geosynthetic Installer.

F. If the geocomposite is to be stored on-site longer than 1 month, contractor shall elevate rolls off of the ground and cover rolls of geocomposite with water proof tarpaulins or other thin film membranes, appropriately weighted to protect from wind uplift and overlapped to prevent water intrusion. Care shall be taken when removing cover so as to not damage the underlying materials and to protect personnel from animals or other dangerous conditions may exist beneath the cover.

PART 7 – EXECUTION

7.01 FAMILIARIZATION

A. Prior to implementing any of the work described in this Section, the Geosynthetic Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of this Section may properly commence without adverse impact.

B. Inspection:

1. The Geosynthetic Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of this Section may properly commence without adverse impact.

2. If the Geosynthetic Installer has any concerns regarding the installed work of other Sections, he should notify the Construction Manager in writing prior to commencing the work. Failure to notify the Construction Manager or installation of the geocomposite shall be construed as Geosynthetic Installer's acceptance of the related work of all other Sections.

C. A pre-installation meeting shall be held to coordinate the installation of the geocomposite with the installation of other components of the lining system.

7.02 HANDLING AND PLACEMENT

A. The Geosynthetic Installer shall not begin geocomposite installation until all QC/QA documentation is complete for underlying materials.

B. The Geosynthetic Installer shall handle all geocomposite in such a manner that it is not damaged in any way.

C. The Geosynthetic Installer shall inspect and verify geomembrane surface below geocomposite is free of loose soil and rocks. Geosynthetic installer shall remove loose soil and rocks from geomembrane surface prior to geocomposite placement.

D. Install the geocomposite down the slope not across the slope. Place ends into the anchor trenches in such a manner as to continually keep the geocomposite in tension.

E. Precautions shall be taken to prevent damage to underlying layers during placement of the geocomposite.

F. In the presence of wind, all geocomposites shall be sufficiently weighted with sandbags or the equivalent to prevent movement.

G. The geocomposite shall be positioned by hand after being unrolled to minimize wrinkles.

H. Care shall be taken during placement of geocomposites not to entrap dirt or excessive dust in the geocomposite that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the geocomposite, it should be cleaned prior to placement of the next material on top of it. Care shall be exercised when handling sandbags, to prevent rupture or damage of the sandbags.

I. Geocomposites shall only be cut using a hooked utility blade.

J. After unwrapping the geocomposite from its opaque cover, the geocomposite shall not be left exposed for a period in excess of 15 days.

7.03 OVERLAPS AND SEAMS

A. Geonet Components:

1. The geonet components shall be overlapped a minimum 4 in. along the length. The geonet shall be overlapped by a minimum 1 ft. across the width.

2. Geonet overlaps shall be secured by tying with nylon cable ties. Tying devices shall be white or yellow for easy inspection. Metallic devices shall not be used.

3. Seaming of the geonet shall be performed by wrap-ties at 12-in. centers for end of panels and at 5-ft centers for edge of panel seams.

4. No end-of-panel seams shall be placed on slopes exceeding 10 %.

B. Geotextile Components:

1. The bottom layers of geotextile shall be overlapped. The top layers of geotextiles shall be continuously sewn.

2. Polymeric thread, with chemical resistance properties equal to or exceeding those of the geotextile component, shall be used for all sewing.

7.04 PLACEMENT OF OVERLYING MATERIALS

A. All overlying materials shall be placed in such a manner as to ensure that:

1. The geocomposite and underlying materials are not damaged;

2. Minimal slippage occurs between the geocomposite and underlying layers; and

3. Excess tensile stresses are not produced in the geocomposite.

4. Equipment shall not be driven directly on the geocomposite.

5. Unless otherwise approved in writing by the Construction Manager, all equipment operating on the materials overlying the geotextile shall comply with Section 02300 and Section 02225.

B. Overlying materials shall be placed in compliance with Section 02770.3.05.B.

7.05 ANCHORAGE

A. Temporary anchorage of the geocomposite shall be in accordance with the Construction Drawings and manufacturer's guidelines and consist of the geocomposite extended approximately 8 ft from the toe of the waste slope and have two feet of operations layer placed on top.

B. Permanent anchorage shall be as shown on the Construction Drawings and in accordance with the Specifications for Anchor Trenching in Section 02300.

7.06 REPAIRS

A. Patches for holes or tears in geocomposite shall extend 2 ft beyond the edges of the hole or tear.

B. Patch shall be secure by tying with engineer approved tying device every 6-inches.

C. Ties shall be through the bottom geotextile and geonet of the patch, through the top geotextile and geonet components of the geocomposite needing repair.

D. Top geotextile component of patch shall be heat sealed to top geotextile of geocomposite needing repair.

E. If hole or tear width across roll is greater than 50 percent of the roll width, damaged area shall be cut out and two portions of the geocomposite shall be joined in accordance with Section 3.03.

7.07 CONFORMANCE TESTING

A. Samples of geocomposite shall be removed by the CQA Engineer and sent to a Geosynthetic CQA Laboratory for testing to ensure conformance with the requirements of this Section. The Geosynthetic Installer shall assist the CQA Engineer in obtaining conformance samples. Conformance sampling may be conducted at the manufacturing facility prior to shipment to the site. The Geosynthetic Installer shall account for this testing in the installation schedule.

B. Samples shall be taken at a minimum frequency rate of one sample per 200,000 square feet.

C. The CQA Engineer may increase the frequency of sampling in the event that test results do not comply with the requirements of Part 2.01 of this Section until passing conformance test results are obtained for all material that is received at the site. This additional testing shall be performed at the expense of the Contractor.

D. If a geocomposite sample fails to meet the quality control requirements of this Section the Manufacturer shall sample and test, at the expense of the Manufacturer, rolls manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established to bound the failed roll(s).

E. As a minimum, transmissivity and peel strength shall be performed on each sample.

F. Any geocomposite that is not certified by the Manufacturer in accordance with Part 1.05 of this section or that does not meet the requirements specified in Part 2.01 shall be rejected and replaced by the Geosynthetic Installer.

7.08 PROTECTION OF WORK

A. The Geosynthetic Installer shall use all means necessary to protect all work of this Section.

B. In the event of damage, the Geosynthetic Installer shall immediately make all repairs and replacements necessary to the approval of the Construction Manager.

PART 8 – MEASUREMENT AND PAYMENT

8.01 GENERAL

A. Providing for a complying with the requirements set forth in this Section for Geocomposite shall be measured as Lump Sum (LS), including Geocomposite in the anchor trench to the limits shown on the Drawings, and payment shall be included with the lump sum price provided on the Base Bid Schedule for Liner System Geosynthetic Materials.

B. Providing for a complying with the requirements set forth in this Section for Geocomposite shall be measured as square foot (SF), including Geocomposite in the anchor trench to the limits shown on the Drawings, and payment shall be included with the unit price provided on the Option Scope Bid Schedule for Geosynthetic System.

C. The bid item costs shall include all incidentals necessary for a complete installation of Geocomposite.

TABLE 02773 - 1

GEOCOMPOSITE PROPERTY VALUES

PROPERTIES	QUALIFIER	UNITS	SPECIFIED VALUES [1]		TEST METHOD
			Base Liner	Final Cover	
Geonet Component:					
Specific gravity	Minimum		0.935	0.935	ASTM D 792
Carbon black content	Range	%	2 – 3	2 – 3	ASTM D 1603
Nominal thickness	Minimum	mils	200	200	ASTM D 5199
Geotextile Components:					
Mass per unit area	Minimum	oz/yd^2	8	6	ASTM D 5261
Filter Requirements					
Apparent opening size	Maximum	mm	0.21	0.21	ASTM D 4751
Permittivity	Minimum	1/s	0.6	0.5	ASTM D 4491
Mechanical Requirements					
Grab strength	Minimum	lb	190	130	ASTM D 4632
Puncture strength	Minimum	lb	110	40	ASTM D 4833
Mullen Burst	Minimum	psi	350	210	
Trapezoidal Tear	Minimum	lb	85	40	
Geocomposite:					
Transmissivity	Minimum	m^2/s	9.2×10^{-5} [2]	5×10^{-4} [3]	ASTM D 4716
Peel Strength	Minimum	gm/in	500	500	ASTM D 413

Notes:

1. All values except transmissivity represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table).

2. The design transmissivity is the hydraulic transmissivity of the base liner geocomposite measured using water at 68°F ±3°F (20°C ±1.5°C) with a hydraulic gradient of 0.1 under a compressive stress of not less than 12,000 psf. For the test, the geocomposite shall be sandwiched between a layer of operations material and a textured 60-mil HDPE geomembrane. The minimum test duration shall be 24 hours and the report for the test results shall include measurements at intervals over the entire test duration.

3. The design transmissivity is the hydraulic transmissivity of the final cover geocomposite measured using water at 68°F ±3°F (20°C ±1.5°C) with a hydraulic gradient of 0.1 under a compressive stress of not less than 300 psf. For the test, the geocomposite shall be sandwiched between a layer of cover soil material and a textured 60-mil HDPE geomembrane. The minimum test duration shall be 24 hours and the report for the test results shall include measurements at intervals over the entire test duration.

END OF SECTION

SECTION 02820

CHAIN LINK FENCE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings

B. The Work shall include construction of footers, construction of posts, rails, and bracing, placement and securing the fence fabric, construction and installation of swing gates, and all other Work incidental to construction of a completed fence as shown on the Drawings and as described in this Section.

1.02 RELATED SECTIONS

Section 01025 – Measurement and Payment

Section 01050 – Field Engineering

Section 01300 – Submittals

Section 01400 – Quality Control

Section 01500 – Construction Facilities

Section 01560 – Temporary Controls

Section 02300 – Earthwork

Section 03400 – Cast-in-Place Concrete

1.03 REFERENCES

A. Construction Drawings

B. Latest Version of American Society for Testing and Materials (ASTM) Standards:

ASTM A 153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 392	Zinc-Coated Steel Chain Link Fence Fabric
ASTM A 1043	Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Site in good condition, in unopened packaging, and with labels intact. Inspect materials upon delivery and replace damaged or contaminated materials.

B. Store materials above ground, under cover, in a dry place, and in a manner to prevent damage or staining.

C. Handle materials to prevent damage to surfaces, edges, and ends. Replace damaged materials at no additional cost to the Construction Manager.

1.05 SUBMITTALS

A. The Contractor shall submit to the Construction Manager, at least 14 days prior to installation of fence material, certificates of compliance with the fence Manufacturer's specifications and that the material meets or exceeds all internal quality control requirements and the requirements of this Section.

B. The Contractor shall submit the locations of the fence posts shall be surveyed by the Surveyor, and shall be included in the Record Drawings in accordance with Section 01050 of these Specifications.

1.06 QUALITY ASSURANCE

A. The Contractor shall ensure that the materials and methods used for security chain link fence construction meet the requirements of the Manufacturer, the Drawings, and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager shall be rejected and shall be repaired or replaced by the Contractor to the satisfaction of the CQA Engineer at the Contractor's expense.

PART 2 – PRODUCTS

2.01 SECURITY FENCE FABRIC

A. Fence height shall be eight feet.

B. The fence shall contain a rodent barrier buried to two feet below grade. Fence fabric: 2" by 2" mesh size, 11 gauge core size, hot-dip zinc galvanized steel wire.

C. Fence fabric shall be a commercial-grade fence system, as supplied by Master-Halco, or shall be equivalent in core material, metallic-coating material, and all coating processes and strengths.

D. Manufacturer shall warranty the fence materials against defects and deterioration, other than normal wear and tear, for a minimum of 12 years.

E. Fabric selvages shall be twisted (barbed) on the top and knuckled on the bottom.

F. The heights of fabric shall be sufficiently long so that no horizontal splices are required.

2.02 FRAMEWORK

A. Framework includes all posts and rails.

B. Fencing framework shall be made of tubular galvanized steel pipe that conforms to ASTM F 1043, Group 1a. The framework shall be standard weight, schedule 40 steel pipe, galvanized by the hot-dip method, with a minimum average of 1.8 ounces per square foot of zinc-coated surface.

C. Dimensions of the framework components shall be as shown on the Drawings.

2.03 FOOTERS

A. Post footers shall be made with concrete rated at a minimum of 2,500 pounds per square inch (psi) and shall be constructed to the dimensions as shown on the Construction Drawings.

2.04 SWING GATES

A. Gates frames shall be of the same materials and coatings as for the fence fabric and framework.

B. Dimensions of the gates and gate components shall be as shown on the Construction Drawings.

C. Gate frame members shall be welded at joints for a rigid connection.

D. Contractor shall provide and install the following hardware for each gate:

1. Hinges: provide hinges of type to, size, and material to suit gate size. Hinges shall be non-liftoff type, offset to permit 180 degree gate opening.

2. Latch: exit control lock and cylinder, as shown on the Drawings.

3. Latch rail: steel plate, weld to stiles at interior side of gate to receive and protect latch.

2.05 HARDWARE

A. Hardware shall include bolts, tension rods, and truss rods.

B. Hardware shall be made of galvanized steel as per ASTM A 153.

C. Bolts shall be 3/16" diameter self drilling hex head TEK screws with flat washers, as manufactured by Hilti, Red Head, or approved.

D. Tension rods shall be in standard lengths to equal full height of fabric, with maximum cross section to suit fabric openings. Provide one tension rod for each gate post and corner post.

E. Truss rods shall be minimum 3/8" diameter threaded, galvanized steel rod and turnbuckle.

2.06 FITTINGS

A. Fittings include: tension and brace bands, caps, eye tops, rail ends, sleeves, and tie wires.

B. All fittings, except tie wires, shall be hot-dip galvanized steel. Tie wires shall be zinc-coated steel wire.

PART 3 – EXECUTION

3.01 GENERAL

A. When shipping, delivering, and installing all fence materials, do so to ensure a sound, undamaged installation. Provide storage for all materials and equipment delivered to the Site that is protective of stored materials. Handle and store materials in accordance with the Manufacturer's recommendations.

B. Prior to installation, examine surfaces designated to receive Work described in the Section for conditions adversely affecting the finished Work. Repair or replace surfaces not meeting tolerances or quality requirements governing substrate construction prior to initiating this Work.

C. Do not begin installation and erection before construction of the concrete secondary containment portion of the Work is complete.

3.02 INSTALLATION

A. Install materials in accordance with accepted shop drawings and Manufacturer's printed instructions.

B. Provide top and interim rails as shown on Drawings. Install each as one piece between posts. Offset as necessary to allow for depth of fabric.

C. Place chain link fabric on the outside of the area to enclosed. Secure one end and apply sufficient tension to remove all slack before making attachments elsewhere. Tighten the fabric to provide a smooth uniform appearance, free from sag.

D. Set line posts equidistant at 10 foot (maximum) spacings.

E. Set terminal (end, corner, and pull) and gate posts at 500 foot (maximum) spacings.

F. Install braces and truss rods at gate posts and terminal posts.

G. Install fence fabric 1 inch above ground level.

H. Cut the fence fabric at the terminal posts.

I. Cut fabric by untwisting on picket and attach each span independently at all terminal posts. Install tension rods with bolts and washers at 15" on center.

J. Fasten fabric to all posts, rails, and gate frames with bolts and washers at 15" on center.

K. Clearances: install fencing and gates with a maximum ½" clearance between the perimeter of the fabric and the framing, between the framing and adjacent construction, and between the perimeter of each gate leaf and surrounding construction. Close off gaps exceeding 1/2"at the direction of the Construction Manager.

3.03 GATES

A. Install gates plumb, level and secure, for full operation without interference. Adjust hardware for smooth operation and lubricate where necessary. Gates shall open outward form the area to be secured.

B. Set keepers, stops, and other accessories into concrete as indicated and in accordance with manufacturer's instructions.

C. Adjust hardware for smooth operation and lubrication where necessary

3.04 CLEANING UP

A. During the progress of the Work, the premises shall be kept free of debris and waste. Upon completion, remove from the Site and dispose of all debris and surplus materials in a lawful manner.

B. At completion of Work, touch up minor damage to all surfaces to the satisfaction of the Construction Manager. Protect completed Work until final acceptance by the Construction Manager.

C. Repair of Galvanized Surfaces: use galvanize repair compound (stick form) or other method to repair galvanized surfaces. Comply with manufacturer's instructions.

3.05 SURVEY

A. The locations of the fence posts shall be surveyed by the Surveyor, and shall be included in the Record Drawings in accordance with Section 01050 of these Specifications.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section for chain link fence shall be included with the Mobilization and Demobilization lump sum costs provided on the Base Bid Schedule.

B. The bid item costs shall include all incidentals necessary for a complete installation of Chain Link Fence.

[END OF SECTION]

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings

B. The Work shall include, but not be limited to, procurement, delivery, subgrade preparation, formwork, concrete placement, control joints, surface treatment, and curing.

1.02 RELATED SECTIONS

Section 02300 – Earthwork

1.03 REFERENCES

A. Construction Drawings

B. Latest version of American Concrete Institute (ACI) standards:

ACI 117	Tolerances for Concrete Construction and Materials
ACI 211.1	Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	Structural Concrete for Buildings
ACI 304R	Measuring, Mixing, Transporting, and Placing Concrete
ACI 308	Standard Practice for Curing Concrete
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 347R	Formwork for Concrete

C. Latest version of the American Society for Testing and Materials (ASTM) standards:

ASTM A185	Welded Steel Wire Fabric for Concrete Reinforcement
ASTM A497	Welded Deformed Steel Wire Fabric for Concrete Reinforcement
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 33	Concrete Aggregates
ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94	Ready- Mixed Concrete
ASTM C 127	Specific Gravity and Adsorption of Coarse Aggregate

ASTM C 128	Specific Gravity and Adsorption of Fine Aggregate
ASTM C 143	Slump of Hydraulic Cement Concrete
ASTM C 150	Portland Cement
ASTM C 171	Sheet Materials for Curing Concrete
ASTM C 172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 192	Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 260	Air Entraining Admixtures for Concrete.
ASTM C 293	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading)
ASTM C 309	Liquid Membrane - Forming Compounds for Curing Concrete
ASTM C 403	Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C 494	Chemical Admixtures for Concrete
ASTM C 618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM D 1751	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
ASTM D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D. Latest version of Federal Standards (FS):

FS TT-C-800	Curing Compound, Concrete, for New and Existing Surfaces.

1.04 SUBMITTALS

A. At least 14 days prior to construction of the concrete, Contractor shall submit a mix design for the type of concrete to the Construction Manager. The Contractor shall submit a complete list of materials including types, brands, sources, amount of cement, fly ash, pozzolans, retardants, and admixtures, and applicable reference specifications for the following:

1. Slump design based on total gallons of water per cubic yard.
2. Type and quantity of cement.
3. Brand, type, ASTM designation, active chemical ingredients, and quantity of each admixture.
4. Compressive strength based on 28-day compression tests.

B. Delivery Tickets:

1. Provide duplicate delivery tickets with each load of concrete delivered, one for Contractor's records and one for Construction Manager, with the following information:

   a. Date and serial number of ticket.

   b. Name of ready-mixed concrete plant, operator, and job location.

   c. Type of cement, admixtures, if any, and brand name.

   d. Cement content, in bags per cubic yard (CY) of concrete, and mix design.

   e. Truck number, time loaded, and name of dispatcher.

   f. Amount of concrete (CY) in load delivered.

   g. Gallons of water added at job, if any, and slump of concrete after water was added.

   h. Identification of mix design number.

C. Contractor shall submit Record Drawings presenting the dimensions, locations and elevations of the features.

1.05 MANUFACTURER QUALITY CONTROL (MQC)

A. Aggregates shall be sampled and tested in accordance with ASTM C 33.

B. Concrete test specimens shall be made, cured, and stored in conformity with ASTM C 192 and tested in conformity with ASTM C 39.

C. Slump shall be determined in accordance with ASTM C 143.

1.06 LIMITING REQUIREMENTS

A. Unless otherwise specified, each concrete mix shall be designed and concrete shall be controlled within the following limits:

1. Concrete slump shall be kept as low as possible, consistent with proper handling and thorough compaction. Unless otherwise authorized by the Construction Manager, slump shall be 4 inches plus or minus 1 inch. Concrete with a slump greater than 5 inches shall be rejected.

2. The admixture content, batching method, and time of introduction to the mix shall be in accordance with the manufacturer's recommendations for minimum shrinkage and for compliance with this Section. A water-reducing admixture may be included in concrete.

PART 2 – PRODUCTS

2.01 CONCRETE

A. Concrete Materials

1. Portland cement concrete shall be in accordance with CCAUSS Section 501.

2. Cement: ASTM C150 Sulphate Resistant-Type V low alkali Portland type only, gray color; shall conform to CCAUSS Section 701.

3. Fine and Coarse Aggregates: Shall conform to ASTM C33, and Section 706 of the Standard Specifications. Coarse aggregates shall be 1 ½ inches maximum size, except otherwise specified within.

4. Water: Clean and not detrimental to concrete. Water shall be of potable quality.

2.02 FORM MATERIALS

A. Conform to ACI 301.

2.03 REINFORCEMENT

A. Reinforcing materials shall be in accordance with CCAUSS Section 713. Reinforcing Steel: ASTM A615; Grade 60; plain or deformed billet steel bars, as noted on Drawings.

B. Welded Steel Wire Fabric: Plain type, ANSI/ASTM A185; in flat sheets; uncoated.

C. Tie Wire: Annealed steel, minimum 16 gage size.

D. Dowels: ASTM A615; 40 ksi yield grade, plain steel, uncoated finish.

2.04 ACCESSORIES

A. Concrete curing materials and admixtures shall be in accordance with CCAUSS Section 702. Curing Compound: FS TT-C-800, Type 1, 30 percent solids.

B. Joint material shall conform to CCAUSS Section 707, except as otherwise noted on drawings or by Engineer.

2.05 ADMIXTURES

A. Air Entrainment: ASTM C260.

B. Chemical Admixture: ASTM C494, Type A - water reducing, or Type D water reducing and retarding.

2.06 CONCRETE MIX

A. Concrete shall conform to the requirements of CCAUSS Section 501 and to the requirements of ASTM C94, subject to the modifications and supplemental requirements contained in these Specifications.

B. Concrete mix shall be Class AA - 3,000 psi, 28 day compressive strength.

C. The Contractor is hereby cautioned that the cement contents shown above are minimum values and for general information. The contractor or concrete supplier shall, at its own expense, furnish additional quantities of cement as required to consistently obtain the compressive strengths designated above. Mix design shall be per governing agency standards and specifications.

PART 3 – EXECUTION

3.01 SUBGRADE PREPARATION

A. Subgrade preparation shall be in accordance with Section 02300.

B. Subgrade shall be graded to the lines and elevations as shown on the Drawings.

C. Standing water, mud, debris, and foreign matter shall be removed before concrete is placed.

3.02 INSPECTION

A. Provide written verification that compacted granular base is ready to support paving and imposed loads.

B. Provide written verification that gradients and elevations of base are correct.

C. Beginning of installation means acceptance of existing conditions.

3.03 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

B. Notify Construction Manager a minimum of 24 hours prior to commencement of concreting operations.

3.04 FORMING

A. Place and secure forms to correct location, dimension, and profile.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint fillers vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

A. Place reinforcement at mid-height of slabs-on-grade unless otherwise indicated on Drawings.

B. Interrupt reinforcement at joints as shown on Drawings.

C. Provide dowelled joints at interruptions of concrete with one end of dowel lubricated to allow longitudinal movement.

3.06 FORMED JOINTS

A. Locate joints as specified herein or shown on the plans.

B. Make all joints perpendicular and straight.

C. Contraction Joints.

1. Contraction joints shall be constructed every 10 feet (maximum) and shall conform to CCAUSS Section 613 unless otherwise noted on Drawings or by the Construction Manager.

2. Contraction joints shall be constructed every 10 feet (maximum) by using steel templates not less than 1/8 inch nor more than 3/16 inch in thickness. The templates shall be removed as soon as the concrete has set sufficiently to hold its shape. Where concrete is placed by slipform methods, the contraction joints every 10 feet may be provided by cutting into the fresh concrete to a minimum depth of 1-1/2 inches to create a plane of weakness. The edges of such joints shall be rounded to provide a neat workmanship appearance.

3. Immediately after the forms are removed, the Construction Manager shall inspect the contraction joints carefully. Any concrete or mortar that has sealed across the joint shall be cut neatly and removed.

D. Expansion joints.

1. Expansion joints, ½ inch in thickness, shall be constructed every 30 feet and at changes in direction by using premolded expansion joint filler and shall conform to CCAUSS Section 613 unless otherwise noted on Drawings or by the Construction Manager.

3.07 PLACING CONCRETE

A. Place concrete in accordance with ACI 301 and CCAUSS Section 502.

B. Ensure reinforcement, inserts, embedded parts, formed joints and dowels are not disturbed during concrete placement.

C. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

D. Place concrete to straight line pattern.

3.08 FINISHING OF CONCRETE SURFACES

A. All finished or formed surfaces shall conform accurately to the shape, alignment, grades and sections as shown or requested. Surfaces shall be free of fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous, hard surface.

B. Exposed vertical corners of all concrete structures shall be given a ¾ inch chamfer. Forms shall not be removed until permission to do so has been received from the Construction Manager.

C. Excessive floating of surfaces while the concrete is plastic shall not be permitted. Exposed uniformed surfaces of concrete shall be given the following finishes: Area paving – broom finish; Other surfaces – steel trowel finish.

D. Dusting on of dry cement or sand to absorb excess moisture shall not be permitted. Unless otherwise shown, the edges of all exposed horizontal surfaces shall be finished with an edging tool to a radius of ½ inch.

E. All concrete surfaces on which pedestrians can walk shall be finished such that the minimum static coefficient of friction between the surface and normal hard soled shoes shall be in strict accordance with ADA Guidelines, latest edition.

3.09 CURING

A. Place curing compound on exposed concrete surfaces immediately after finishing. All structural concrete shall be cured by being moist for fourteen (14) days after placing or, at the option of the Contractor, may be cured by use of a curing compound meeting the requirements of CCAUSS Section 702, and which has been approved by the Engineer and Construction Manager.

B. The curing compound shall be applied in accordance with the manufacturer's instructions at a minimum coverage rate of 150 square feet per gallon in such a manner as to cover the surface with a uniform film which will seal thoroughly.

3.10 FIELD QUALITY CONTROL

A. Concrete Tests

1. A set of four (4) concrete cylinders shall be taken for every 75 cubic yards, or fraction thereof, of each class of concrete placed each day. One (1) additional test cylinder will be taken during cold weather and cured on site under the same conditions as the concrete it represents.

2. One (1) slump test shall be per 20 cubic yards, or fraction thereof, of concrete.

3. Maintain records of placed concrete items. Record data, location of placement, quantity, air temperature, and test samples taken.

4. Portland cement concrete shall be subject to the requirements and test methods contained in CCAUSS Section 501.02.03. ASTM C 293 shall be performed at a frequency of 1 test per 300 cubic yards of concrete.

5. The determination of compressive strength in psi shall be made by testing 6 inch diameter by 12 inch cylinders, made and cured in accordance with ASTM C31 and ASTM C39. Tests and analysis of the aggregates and of the resulting concrete will be made by the Construction Manager and the mixes used shall be changed whenever, in the opinion of the Construction Manager, such change is necessary or desirable to secure the required workability, density, impermeability, surface finish and strength; and the Contractor shall be entitled to no additional compensation because of such changes. The cost of laboratory tests on cement, aggregate, and concrete will be borne by the Contractor. The Contractor shall assist the Construction Manager in obtaining specimens for testing.

3.11 PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures, and mechanical injury.

3.12 SURVEY

A. The Surveyor shall locate the features of the concrete structure. The dimensions, locations and elevations of the features shall be presented on the Surveyor's Record Drawings.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section for Cast-In-Place Concrete Anchors shall be on a per-anchor basis (EA) and payment shall be based on the unit price for Concrete Anchors provided on the Bid Schedule.

B. Providing for and complying with the requirements set forth in this Section for Concrete shall be lump sum (LS), and payment shall be based on the Lump Sum price provided on the Bid Schedule.

C. The bid item costs shall include all incidentals necessary for a complete installation of Cast-in-Place Concrete.

[END OF SECTION]

SECTION 11062

PUMPS

PART 1 – GENERAL

1.01 RELATED WORK

A. Section 13441: Instrumentation Functional Descriptions

B. Section 13442: Instrumentation Equipment

C. Section 13443: Instrumentation & Control Panel

D. Section 13444: Instrumentation Installation

E. Section 16000 Series: Electrical

1.02 SYSTEM DESCRIPTION

A. The System to be furnished is shown schematically on the Drawings. Contractor is to provide Engineer with submittals showing the pump selection, pump specfifications, pump integration with the proposed piping prior to procurement.

1.03 PUMP CONTROLS

A. Discharge pumps shall be electric submersible pumps capable of being installed on a floating platform. The pump shall be capable of constant immersion and operation in produced water.

B. The pumps shall be capable of pumping 500 gpm @ 200 psi.

C. The discharge piping shall be 4 or 6 inches.

D. Pump material shall be compatible with produced water.

1.04 SUMP PUMPS

A. Sump pumps shall be electric submersible pumps capable of being installed in a 18-inch HDPE pipe at a 3 horizontal to 1 vertical slope. The pump shall be capable of constant immersion and operation in produced water.

B. The pumps shall be capable of pumping 30 gpm @ 100 psi.

C. The motor will be approximately 2 HP.

D. The discharge piping shall be 1 or 1.5 inches.

Pump material shall be compatible with produced water.

1.05 SUMP PUMP CONTROL TRANSDUCERS

A. Pressure transducer shall be vented to the atmosphere and able to operate separately from the sump pumps; however, shall be able to control pump shut off when the sump water surface elevation reaches the minimum manufacturer's head.

B. Control wires shall be contained within threaded PVC pipe and shall exit the HDPE side slope riser pipe in a manner which does not interfere with cap removal. Threaded PVC pipe shall be of sufficient diameter to contain wires without interfering with pump discharge piping and wires.

C. Pressure transducer shall be continuously battery powered by disposal batteries.

D. Pressure transducer for the sump pumps shall be capable of reading 0 to 20 feet of head in the bottom of the sump. Pressure transducers for the discharge pumps shall be capable of reading 0 to 25 feet of head at the pit bottom.

E. Pressure transducer shall have a digital read-out in inches of water in the sumps and shall be accurate to within 0.1 inches. Digital display shall be mounted with pump controls as specified in Subpart 2.05 below.

1.06 SUMP PUMP CONTROLS

A. Controls shall operate on generator power with a battery backup capable of 12 hours

B. Controls shall be resistant to weather conditions associated with this site and placed within a shed.

C. Controls shall be supplied with motor running light, dry run protection system to prevent pump and motor from running dry, manual selector switch, and lightning arrestor.

D. Controls shall be mounted within a NEMA IV box attached to the concrete headwall.

E. A run-time meter in the panel box that displays the cumulative hours of operation of the pump measured (and displayed) to the nearest 0.1 hour.

F. Flow meters shall be installed in-line for each pump, providing real-time flow data as well as totalized flow to an accuracy of 0.10 gallon per minute for sump pumps.

G. Battery back-up shall be provided to maintain run-time and totalized flow data for a minimum of 1-year.

H. Control wires shall be contained within threaded PVC pipe and shall exit the HDPE side slope riser pipe in a manner which does not interfere with cap removal. Threaded PVC pipe shall be of sufficient diameter to contain wires without interfering with pump discharge piping and wires.

I. Pressure transducer shall be continuously battery powered by disposal batteries.

J. Pressure transducer shall be capable of reading 0 to 72" of leachate head in the bottom of the sump.

K. Pressure transducer shall have a digital read-out in inches of water in the sumps and shall be accurate to within 0.1 inches. Digital display shall be mounted with pump controls as specified in Subpart 2.05 below.

[END OF SECTION

This page intentionally blank.

SECTION 13440

INSTRUMENTATION - GENERAL

PART 1 GENERAL

1.01 RELATED WORK

A. Section 13441: Instrumentation Functional Descriptions

B. Section 13442: Instrumentation Equipment

C. Section 13443: Instrumentation & Control Panel

D. Section 13444: Instrumentation Installation

E. Section 16010: Electrical

1.02 1SYSTEM DESCRIPTION

A. The System to be furnished is described functionally in Section 13441, Instrumentation Functional Description and shown schematically on the Drawings.

B. The Systems Supplier shall be identified in the bid.

C. All of the instruments identified by an ISA single circle instrument bubble including a tag number shown on the drawings are part of the Instrument System and shall be furnished.

D. All of the instruments described in the Instrumentation Functional Description (Section 13441) shall be furnished as part of the System.

E. Instruments shown with double bubbles on the drawings are furnished by an equipment supplier and are interfaced to the instrumentation system by the System Supplier as described in Section 13441, Functional Description.

F. The instruments listed in Instrumentation Equipment (Section 13442) are only the ones specifically used as the basis of design. Data Sheets are not included for all of the required instruments. Ancillary instruments required but not listed shall be part of the System.

G. Provide a complete integrated, operable, Instrument and Control system including instruments, main control panel, associated equipment, documentation, start up assistance, operator training, submittals and drawings.

H. The system shall be compatible with the installation described in Section 13444 and shown on the drawings.

1.03 DEFINITIONS

A. System: All of the equipment and services required to meet the functions shown and described, assembled and integrated into a complete unit.

B. Systems Supplier: The designated party regularly engaged in supplying Systems of this projects size and type and assuming overall responsibility for and implementation of the detail engineering, coordination and compatibility, and furnishing of the instrumentation segment of this Project as described herein.

C. Equipment Supplier: A party regularly engaged in the sales and application of instrumentation required for this project.

D. Manufacturer: A party regularly engaged in the manufacture, testing, application and sales of instrumentation components specifically applicable to this Project.

E. Calibration: Checking, adjusting, and verifying the performance of individual components. This function includes:

1. Setting ranges, zeros and set and trip points.

2. This can be either a field or factory function.

3. Setting and checking of the range and span of elements at least three points.

4. The data shall be documented.

F. Commissioning: Verify that the loop is complete and that all of the components are functioning together properly. At the completion and the acceptance of commissioning the system should be ready to run.

G. .Start-Up: With the process operational, adjust, fine tune, and debug the system to monitor and control the process. This function starts after the system has been calibrated and commissioned and these functions signed off by the Owner. It does not include set-up and checkout of equipment.

H. Support (Construction): Providing the installation personnel with information and/or service to clarify the contract documents or the furnished equipment.

An example is: If a valve is shown with one position switch and it arrives on site with two switches. To identify which switch is to be used is a function of construction support. Furnishing supplemental sketches and inspection of the installation are also support functions.

1.04 QUALIFICATIONS

A. (This shall not relieve the General Contractor of his responsibility under this Contract.)

B. Systems responsibility shall be by a single System Supplier. The System Supplier shall be preapproved or a Manufacturer and market under his label or trademark the equipment appearing on 50% of the Data Sheets in Section 13442. When 50% or more are not of his manufacture, the Supplier shall itemized by Data Sheet, the manufacturer and model number of the items being supplied. Use a single principle manufacturer and its equipment, where possible.

C. If the System Supplier is not preapproved, the System Supplier shall submit the information requested in Paragraph E with the bid and list all of the manufacturers and model numbers of proposed equipment by Data Sheet. If approved, the System Supplier shall supply the proposed equipment.

D. The Systems Supplier shall have in his direct employ a staff of capable personnel for detail engineering, coordination, drafting, procurement, expediting, scheduling, construction inspection, installation start-up service for calibration and commissioning and service for guarantee compliance for the period specified.

E. The Equipment and/or Systems Supplier shall on request of the Owner or Engineer submit in writing a detailed description of his capabilities and qualifications. The description shall include but not limited to a listing of specific staff members and their responsibility purchasing and expediting capabilities, a listing of recently completed projects of this project's size and type, and a statement of financial qualifications to support equipment purchase and warranty compliance (see Appendix A).

1.05 REFERENCE CODES AND STANDARDS

A. All instrumentation equipment and installation shall conform to the latest addition of the following Codes and Standards:

1. American National Standards Institute (ANSI).
2. Instrument Society of America (ISA).
3. National Electric Code (NEC).
4. National Fire Protection Association (NFPA).
5. National Electrical Manufacturers Association (NEMA).
6. Occupational Safety and Health Act (OSHA).
7. Applicable local and State codes.

B. Measurement methods shall conform to the latest published standards and practices of the appropriate regulating body.

1.06 OPERATOR TRAINING

A. .The Systems Supplier shall conduct a group training program on the operation and routine maintenance of the system for Owner's employees. Conduct training at the Project site, consisting of two nonconsecutive days of classroom and field training, four hours per day during normal working hours. The text shall be the loop diagrams, operation and maintenance manual and shall concentrate on the operation of the equipment as applied to this installation, and required maintenance.

1.07 SUBMITTALS

A. Submit Shop Drawings in accordance with Section 01340.

B. Submit Operation and Maintenance Manual in accordance with Section 01730.

C. Submit a schedule of shop drawings ten working days after notice to proceed, showing submittal dates and content of each submittal.

D. Incomplete or partial (without Owners prior approval) submittals are not permitted unless preapproved and accompanied by loop diagrams and/or other support data (i.e., Bill of Material) to establish submittal's relationship to the entire system. Support data shall accompany its respective submittal. Reference to previous submittals is not permitted. The maximum allowable subdivision of submittals with prior Owner approval shall be: in line devices, miscellaneous field devices, panel devices, panel(s) (with graphics) layouts, and panel wiring.

E. . Identify all equipment submittals by "tag" number and specification section number.

F. . Submit the following items in the quantity and format required.

1. For approval before release for manufacturing or purchase:

   a. Preliminary loop diagrams and logic diagrams in the ISA Standard S-5.4 NFPA 79 format and/or NEMA ICSI-102 format. Loop diagrams shall include all details except terminal numbers, model numbers, controller settings, wire/cable number, and other data dependent on equipment approval. Indicate where data will appear. Show all components, terminals, tag numbers, initial calibrations, circuit loading and setpoints. Drawings shall be 22 x 36 reduced to 11 x 17 format with one loop per sheet except for alarm only and status lights which may be combined with multi-circuits on a single sheet.

   b. Bill of Material listing all equipment being furnished. Include data on quantity, function, model number and supplier.

   c. Catalogue cuts and specifications or data sheets for each piece of equipment specific and/or to be furnished, identifying all options being furnished. Strike out options or features not furnished. Identify each component with tag numbers.

   d. Instrument and control panel(s) layout internal and face with overall size, mounting, and field entry dimensioned, and items listed in Section 13443, Instrumentation and Control Panel.

2. For Installation Contractor use, compliance review and record when order(s) [is/are] placed with factory or suppliers:

   a. Manufacturer's data, order sheet or equivalent for each individual instrument or device being supplied. The information shall include but not be limited to model number, scale or calibration range, type of enclosure and mounting, input/output and power data, and the instrument tag number (or loop number for auxiliary equipment).

   b. Manufacturer's outline and mounting dimensions, information on field mounting fixtures being furnished, and installation arrangement including restrictions and special requirements for all field mounted devices and devices mounted in or on equipment furnished elsewhere. Submit the latter to the Contractor for transmission to the appropriate installation crafts. Note deviations in mounting and arrangements from the Drawings.

   c. Preliminary Operation and Maintenance Manuals containing factory order sheets, spare parts list, operation description, loop diagrams, and calibration and service information.

3. Two weeks prior to calibration, factory tests or commissioning:

    a. Submit for approval a calibration and commissioning sign off sheet. (See attached sample)

    b. Submit calibration records for each instrument with available information filled in (i.e., tag, make, model, factory calibration, etc.) (see attached).

4. Three weeks prior to startup:

    a. Loop diagrams with preliminary startup data.

    b. Preliminary operational description.

    c. Preliminary equipment calibration sheet(s).

    d. Approved start-up plan.

5. Prior to final acceptance:

    a. Final loop diagrams containing start-up data. (ISA Standard S-5.4, Figures 4, 5, and/or 6 or NFPA 79). The drawing shall contain all specific termination data to equipment supplied by others, terminal numbers, model numbers, calibrations, control settings and wire numbers. The Contractor shall be responsible for supplying the required data (terminal number, etc., of vendor equipment) for coordination, and documentation of the instrument system with equipment supplied by others.

    b. Operations and maintenance manual supplement as specified in Section 13444 containing final Loop diagrams with start up settings and calibrations, copies of certified calibration sheets and corrected information previously supplied. Loop drawing to be in reduced 11 x 17 format.

    c. As-built drawings and Data Sheet(s).

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver material to Project site in its entirety or as sub-assemblies if agreed to by the Owner and/or Contractor. Partial shipments of sub-assemblies are not permitted. If refused at the job site, the System Supplier shall pay all reshipment or storage costs.

B. The Contractor shall receive materials on site, inspect and store all material required for the instrumentation and control system. Store materials to prevent physical damage. Protect materials from moisture, corrosion, and similar environmental damage.

1.09 JOB CONDITIONS

A. The Systems Supplier and Contractor(s) shall be responsible for inspection of or familiarization with the job site and all Contract Documents to ensure compatibility of the system with existing and specified conditions.

B. All work and materials shall be compatible with the environment of the Project.

C. The Installation Contractor shall be responsible for the restoration of all damage to the instrument system and components sustained as a result of the storage and installation work.

D. The Systems Supplier shall coordinate and implement detail design to comply with requirement of Section 13444 and the contract drawings. If additional field wiring beyond that appearing in the contract documents is required and not identified in the bid, the cost of the addition. Work shall be the responsibility of the System Supplier.

1.10 COORDINATION

A. Material and labor required to coordinate with the process and equipment (in addition to standard quoted fixtures required to conform the instrumentation to the process) shall be the responsibility of the Installation Contractor.

B. The Systems Supplier shall provide detailed information on the equipment and fixtures being supplied and the extent of the field installation required.

C. The Systems Supplier shall advise the Installation Contractor of deficiency in equipment not supplied by the Systems Supplier that would effect the completion and function of the system. Corrections of the deficiencies shall be the responsibility of the Installation Contractor.

D. The detail design shall be compatible with the installation specifications and drawings. When interfacing with existing or packaged systems the Systems Supplier shall obtain from the field or the Package Vendor all information required to complete the detailed system design.

1.11 ALTERNATES

A. The System Supplier may submit, for consideration and approval, alternate methods and/or material if accompanied by documentation on technical and complete financial benefits including impact on all other Work not a part of the Instrumentation System. The submittal shall be independent of other submittals and identified as an "Alternate Method". The System Supplier shall assume the cost of any undisclosed work resulting from approved alternates.

B. The documentation of technical and financial benefits or equivalency shall be substantiated by certified test data and agreement(s) of others affected.

1.12 GUARANTEE

A. The Systems Supplier shall guarantee in writing that the materials and workmanship of all equipment furnished by him, regardless of manufacturer, be new and free from defects for a period of one year from the date of plant acceptance or two years from shipping date of the last component.

B. The system shall be certified, calibrated, and commissioned as described in Section 13444 by the Systems Supplier and/or Installation Contractor. The party assigned this responsibility shall be identified in the bid.

PART 2 – PRODUCTS

2.01 INSTRUMENTATION

A. The System instrumentation shall be the product of one manufacturer. Where the principle manufacturer cannot supply a device, alternates shall be supplied, except that all equipment of any one type shall be of one manufacturer and the number of alternate manufacturers

minimized. When a principal manufacturer's device does not meet all specification requirements, the exception shall be noted and an alternate offered that is recommended by the manufacturer. The Owner will express his preference and that item used at no additional cost.

B. Equipment necessary to complete the functional requirements but not specifically listed in these specifications shall be provided and be of a quality equal to or better than the equipment specifically described. Equipment shown on contract drawings and/or listed but not specifically mentioned in the functional description shall be a part of the Work.

C. All equipment shall be of the latest proven design. First generation equipment with less than three years general use shall have documentation on construction, operations, field tests, and users list submitted for approval. The submittal shall be properly identified as First Generation and not included with general submittals.

D. The basic equipment used as the basis of design is listed in Section 13442. Additional equipment not listed but required by the equipment supplier(s) and/or as shown on the Contract Documents (drawings and functional description) shall be supplied.

E. All pneumatic field devices requiring an air supply shall be complete with air set (filter and regulator).

F. Provide UL, FM or similar approval for all equipment operating in hazardous areas.

2.02 CONTROL PANELS

A. The Systems Supplier shall furnish the main control panels and any specified satellite panels, local instrument and transmitter panels, pre-assembled, wired, and piped.

B. The Systems Supplier shall coordinate the instrumentation system and panels, with all packaged systems, the electrical system, and the process. The Systems Supplier shall supply all controls and materials within the control panel not specifically supplied by others.

C. The panels shall be fabricated in accordance with Section 13443 Instrument Control Panel.

2.03 INSTALLATION MATERIALS

A. Details specified in Section 13444 shall be a part of this specification.

B. Materials shall conform to the applicable specifications described elsewhere. Material not defined shall be of equal quality.

C. Interface fixtures shall be compatible with the equipment to which they are attached and the process application.

2.04 SPARE PARTS AND ACCESSORIES

A. Spare parts and accessories such as special fuses, electrodes, membranes, fluids, charts, and ink required to start-up the system and operate it for a period of 60 days shall be supplied. Package materials in a consolidated but separate container and ship to the job site with the instruments. Tag container INSTRUMENT START-UP EQUIPMENT.

B. A one year supply of charts, ink, and consumable parts (i.e. electrodes and membranes) shall be supplied. Package materials in a consolidated but separate container, with an inventory list and

mark INSTRUMENT MAINTENANCE EQUIPMENT. The container shall contain the specified maintenance test equipment and spare parts.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The System shall be installed in accordance with Section 13444 Instrumentation Installation. When the Installation (13444) is by other than the System Supplier, the instrumentation Systems Supplier shall inspect, review and otherwise monitor the installation to insure the compatibility with the system. Installation deficiencies shall not be justification for a malfunctioning system.

B. When the installation and/or purchase of equipment is by the General or Installation Contractor or others, the Systems Suppliers shall still be responsible for the total integrity of the System operation.

C. The System Supplier shall be responsible for the cost of any undisclosed work required to furnish a functional system.

3.02 CALIBRATION AND COMMISSIONING

A. Calibration and Commissioning:

1. Provide the services of a single qualified engineer to calibrate and commission the entire system and individual components. Use qualified technicians with proper tools and equipment for calibration.

2. Calibrate each instrument at 10%, 50% and 90% using test instruments that are rated to an accuracy of at least 2 times greater than the instrument being checked. The test instrument shall have its accuracy traceable to the National Bureau of Standards, as applicable.

3. Commission each system by simulating inputs at the first element in the loop for 10%, 50% and 90% of span (or on/off) and verify the output for accuracy. Make provisional settings on controllers and switches during commissioning. The final calibrations and settings shall be included on the loop diagrams and on separate sheets for inclusion with the instruction books.

4. During the start-up, provide sufficient personnel to aid with the start-up of the instrument and control equipment to correct any faults and to make the necessary adjustments for the proper operation of the equipment and installation.

5. Provide complete documentation of calibration.

6. Provide manufacturers service as required. This service does not relieve the Contractor or Subcontractors of their responsibilities.

B. Cleaning

1. After calibration and commissioning and prior to startup, clean all equipment and panels and replace all covers, guards, etc.

END OF SECTION

SECTION 13441

INSTRUMENT FUNCTIONAL DESCRIPTION

PART 1 – GENERAL

1.01 GENERAL

A. This section contains the basic functional description of each instrument loop. The individual components in a loop shall, when appearing in other specifications or on drawings, be identified in the following sections..

B. All instrumentation equipment unless specifically noted shall be provided to satisfy the functional requirements of this section. The functional system is shown schematically on the Piping and Instrumentation Diagram.

C. Additional elements such as power supplies, relays, repeaters, transient voltage protectors, etc., required to complete the system shall be provide even though not listed or shown.

D. The operating characteristics of major components used as the basis for design are described in Section 13442 - Instrument Equipment.

1.02 FUNCTIONAL DESCRIPTIONS

A. Vendor Equipment Package Pump Control

B. General contractor will coordinate the control strategy for this equipment as it interfaces with the process. The vendors control panel will be located at the valve house to be installed next to the middle and north pit.

1. System Loop: Leak detection sumps instrumentation.

   Function: Pump fluids from the leak detection sump based on transducer

   Equipment: HS 1200, LSHH 1000, LSL 1000, LAHH 1000, HS 2200, LSHH 2000, LSL 2000, LAHH 2000, HS 3200, LSHH 3000, LSL 3000, LAHH 3000

Manual operator control on each of the pumps shall be via momentary start and stop pushbuttons on the control panel. The function of these two systems, one each for the leak detection system in the threepits, is to automatically control the pumps to remove water from the leak detection system. There are sump pumps in the collection sumps which have hand on-off switches as well as a mode for automatic operation.

There is a transducers described in Section 11062 placed in the leak detection sumps. The transducer generates a high and low water level switch signal. On the P&ID, these are shown as LSL1200 (level switch low) and LSHH 1200 (level switch high) in the north pit, LSL 2200 and LSHH 2200 in the middle pit and LSL 3200 and LSHH 3200 . The level switch low shuts down the sump pumps. A water level above the level low indicator turns the pump on, if the hand switch is on automatic.

The level switch high high means the water level in the sump has risen to an unacceptable level. The level switch high high will send an alarm through LAHH 1200 (level alarm high high), LAHH 2200, and LAHH 3200 to an SCADA system for sending an alarm signal off site. There is an independent alarm which is also sends and alarm based on an independent transducer in the leak detection sump. All transducer outputs and pump controls will be processed through a Process Logic Controller (PLC).

2. System Loop: Water Discharge Pumps.

Function: Water Discharge Pumps on-off control as well as inlet valve status.

Equipment: HS 1000, LSL 1000, LSH 1000, LSHH 1000, LAHH 1000, HS 2000, LSL 2000, LSH 2000, LSHH 2000, LAHH 2000, HS 3000, LSL 3000, LSH 3000, LSHH 3000, LAHH 3000

Operation of the water discharge pumps shall be controlled via a HAND/OFF/AUTO selector switch on each of the pump control panels.

Manual operator control on each of the pumps shall be via momentary start and stop pushbuttons on the control panel. The function of these two systems, one each for the water discharge pumps in the north, middle and south pits, is to automatically discharge water through the produced water gathering and discharge system.

There are discharge pumps described in Section 11062 in both discharge sumps which have hand on-off switches as well as a mode for automatic operation. There are transducers described in Section 11062 placed the pits. The transducer generates a high and low water level switch signal, designated as LSH 1000 (level switch high) and LSL 1000 (level switch low) in the north pit, LSH 2000 and LSL 2000 in the middle pit, and . LSH 3000 and LSL 3000 in the south The level low signal shuts down the discharge pumps, to avoid running the pumps dry. A signal from the PLC turns the pump on, if the hand switch is on automatic. The level in the pit is monitored using the previous referenced pressure transducers in the pit used for the level alarms. Discharge from the pit is by demand controlled by the PLC.

The level switch high high, LSHH 1000, LSHH-2000 and LSHH 3000, indicates the water level in the pit has risen to an unacceptable level. The level switch high high will send an alarm to an SCADA system for sending an alarm signal off site as well as close the actuated inlet valve to the pit. All transducer outputs and pump controls will be processed through a Process Logic Controller (PLC).

3. System Loop: Flow Measurement.

Function: Record water inputs and outputs from the pits.

Equipment: FI-1001, FI-1002, FI-2001, FI-2002, FI-3001, FI-3002

Flow measurements shall be made during all water management activities. Flow data will be recorded by PLC and available on the SCADA system.

END OF SECTION

SECTION 13442

INSTRUMENTATION EQUIPMENT

PART 1 – GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Section 13440: Instrumentation - General

B. Section 13441: Instrumentation Functional Description

C. Section 13443: Instrumentation and Control Panel

D. Section 13444: Instrumentation Installation

1.02 SUBMITTALS

A. Submittals shall be made as part of the requirements of Section 13440 and described in that section.

1.03 GENERAL REQUIREMENTS

A. Only the basic and specific equipment used as the basis of design is listed. Additional non-specific equipment is required (but not listed) to meet the functional requirements and shall be furnished.

B. All instrumentation shall meet or exceed I.S.A. Standards and Recommended Practices, ANSI, NATIONAL ELECTRIC CODE, NFPA, OSHA and any other applicable code or local regulation.

C. Instrumentation shall comply with Section 13440, Paragraph 2.1 and meet the functional requirement of Section 13441.

D. All instruments shall be of the same manufacturer and model type to provide ease of maintenance, uniform appearance and to minimize spare parts requirements.

PART 2 – PRODUCTS

2.01 EQUIPMENT REQUIREMENTS

A. The primary power shall be 115 volts, 60 Hertz. Panel devices may be powered from a low voltage system (i.e. 24 or 48 volt d.c.) provided each device or loop has an individual fused disconnect and that a minimum of 2 power supplies each capable of handling the entire system, are provided with 25% minimum spare capacity each.

B. Transmission to and from electronic analog field devices shall be at 4-20 madc. Distribution within a panel may use variable voltage, but must be consistent (current or voltage) throughout the system. Voltage resistors shall be separately mounted from individual devices in the loop.

Electrical surge protectors shall be provided for those AC devices which are identified as being exposed to transient voltages as defined in ANSI/IEEE C62.41-1980. Surge protectors shall be installed in series with the AC device, shall provide a 10kA minimum level of protection, and shall have a response <1 nanosecond.

C. Transmission to the main panel of alarms and status signals shall be 48 VDC maximum.

D. All component external connection points shall be made at terminal blocks with No. 6-32 or larger screws.

E. All equipment shall be suitable for operation in ambient temperature of 20 deg. C to 55 deg. C for panel and indoor devices and ASHRA max./min. temperature listing for the site for field devices. Field devices may be equipped with protection (fans or heaters) to meet the requirements.

F. Electronic receiving equipment shall be capable of receiving accurate data over specified instrumentation wiring as described in the Specifications, and shown on the Drawings. Any filters, amplifiers, surge and lightning protectors, isolators, or similar devices required to transmit, and receive accurately, or protect the device shall be provided.

G. Electronic receiving equipment shall have ungrounded isolated inputs.

H. Indicators, recorders, controllers, integrators, relays and other receiving devices when operating in a loop shall be of a design such that a failure of an individual device shall not effect the operation and integrity of the remaining loop functions.

I. Enclosures for instruments installed in a control panel may be general purpose if the enclosure is dust tight or better in construction. If not, devices shall be dust tight or better as dictated by the installation area classification.

J. Rack mounted devices may be used if the rack contains 25% spare slots for expansion and active slots (not the device in the slot) are labeled with tag number of device in slot.

2.02 INSTRUMENT DATA SHEETS

A. The attached Data Sheets by themselves are not a complete specification. The equipment must also meet the functional, system and general requirements. Only the basic requirements are listed. The attached Data Sheets list the basic instrumentation equipment. Only the principle equipment used as the basis of design is listed. Supplemental and additional equipment may be required and shall be of equal or better quality to that listed. Heavy duty industrial type (not commercial, residential, computer or laboratory) equipment shall be considered standard.

B. The listing of a manufacturer and model number represents the equipment used as the basis of design to indicate the size, capacity mounting arrangement, mounting dimensions, function and technical capabilities of the instrumentation.

PART 3 – EXECUTION

Not Used

END OF SECTION

This page intentionally blank.

SECTION 13443

INSTRUMENT AND CONTROL PANEL

PART 1 – GENERAL

1.01 RELATED WORK

A. Section 13440: Instrumentation General

B. Section 13441: Instrumentation Functional Description

C. Section 13442: Instrumentation Equipment

D. Section 13444: Instrumentation Installation

1.02 SUBMITTALS

A. Submit Shop Drawings and product data in accordance with Section 01340.

B. The panel fabricator shall submit the following for approval prior to fabrication:

1. Panel Shop Drawings showing overall size, face layout with typical dimensions, panel interior layout showing rear of panel components, terminal blocks, bulk heads, wire and tube troughs. The submittal shall have sufficient detail to present:

   a. The component content.

   b. The face arrangement for logistics and operator efficiency.

   c. Accessibility of components and terminals.

   d. Separation of signal routing and terminals.

2. Graphic Layout (if a graphic is used or specified).

   a. Submit a full sized layout drawing, drawn on a one inch grid. Layout shall contain all legends. One copy shall contain colored lines and symbols.

   b. Submit samples of tiles and grid.

   c. Submit color charts to permit alternate selections if the submitted colors are not satisfactory.

   d. Submit assembly drawing showing mounting and terminal location.

3. Catalogue cuts or data sheets, properly identified, for all accessory components such as terminal blocks, auxiliary relays, sockets, lamps, pushbuttons, and switches.

   a. The specific requirements and features described below shall be circled, underlined or otherwise highlighted on the submittal.

4. Provide and submit schematics or ladder type J.I.C. diagrams for all circuits not covered by specific diagrams elsewhere. Typical or tabulated type circuit presentations are not permitted.

C. The panel fabricator shall submit internal wiring and piping diagrams with the terminal points of all wires and tubes identified with the wire or tube number and the terminal point identification. The diagram shall have terminals and components shown in their relative location.

D. Submit a test plan as described below.

E. The panel fabricator shall prepare an operation and maintenance manual in accordance with Section 01730. Include only items and systems furnished under this section. The manual shall be submitted as part of the O&M manual required in Section 13440 and Section 01730.

1.03 SPARE PARTS

A. The panel fabricator shall furnish the following spare parts:

1. Ten each size fuse.

2. 10% (or 2 each minimum) of plug-in relays, alarm cards, pilot lights, assemblies, push buttons, and indicator bulbs (10 minimum).

3. One year's supply of expendable items such as chart paper, pen tips, and ink for equipment supplied.

1.04 FACTORY INSPECTION AND TESTING

A. Permit Engineer to inspect the panel(s) during construction with 24 hour notice to the fabrication shop.

B. The panel fabricator shall submit for approval a final test demonstration plan to the Engineer for review 5 weeks prior to the start of the final test. The plan shall consist of the operational features that will be demonstrated to verify that the panel has been properly wired and piped. A test stand with switches, lights, meters, and signal generators shall be available to simulate field conditions.

C. The panel fabricator shall advise the Engineer two weeks prior to the date of the scheduled final test and the expected duration of the test.

D. The Owner will witness the final testing of the panel and will authorize release for shipment. Waiver of the witnessing of the test shall not release the fabricator of his contract responsibilities or quality of work.

1.05 COORDINATION

A. The panel fabricator and Systems Supplier shall coordinate the panel with all other Divisions with respect to installation details.

PART 2 – PRODUCTS

2.01 ENCLOSURE

A. The size, type, and installation arrangement of enclosures are shown on the Drawings. The final enclosure size shall be governed by the component selection. If different than shown on the Drawings, written approval of the Engineer is required prior to shop drawing submittal.

B. Manufacture enclosures from cold rolled steel free of dents or other defects with a straight flat face.

C. Fabricated enclosures shall be an angle frame, with welded frame and shell construction.

1. Enclosure face: 3/16 inch thick minimum.

2. All other surfaces of the shell: 11 gauge minimum.

D. Pre-fabricated standard catalogue enclosures: heavy duty Hoffman Custom Controls type or equal.

E. Provide print storage pockets on the inside of each enclosure, sized to hold all prints required to service the equipment.

2.02 COMPONENTS

A. Basic components are described in Section 13442 and below if not described elsewhere.

B. All miscellaneous components shall be heavy duty industrial type equal in quality than the basic instrumentation.

C. Mounting hardware shall be stainless steel or cadmium plated.

D. Relays:

1. Relays: 3 pole, D.T., octal plug-in type with a transparent dust cover, equipped with an indicating light to indicate when its coil is energized. Provide 5 amp 117 volt ac contacts. The mechanical life of the relay shall be 10,000,000 operations minimum.

   ****** OR ******

2. Industrial machine tool track mounted relays. The relays shall have power reed type encapsulated contacts. Provide a visual indication to show that the relay is energized.

3. Provide 24 VDC interface relays, coil currents, and operating characteristics compatible with the transmission system.

E. Timers:

1. General purpose timers shall be plug-in, multi-range analog with selectable ranges between 1 second and 10 hours full scale or digital type with a dust and moisture

resistant case. Provide output contacts rated at 5 amp 115 volt ac minimum and a timing in progress indication. The mechanical life shall be 10,000,000 operations minimum

****** OR ******

2. Track mounted solid timers of the same style and configuration as the track mounted relays may be used in conjunction with the relays where operator adjustability and critical timing are not required.

F. Pushbuttons & Non-Graphic Pilot Lights:

1. Pushbuttons and non-graphic pilot lights: heavy duty, oil tight of standard size.

2. Pilot lights: press-to-test type unless a master lamp test system is provided.

3. A.C. pilot lights: transformer type with 5000 hour minimum lamp life.

4. Pushbuttons: full guard type with screw terminal type contact blocks. Pushbutton colors:

   a. .Start: Green.

   b. Stop: Red.

   c. Acknowledge or reset: Yellow.

   d. All others: Black.

   e. Emergency: Red Mushroom.

G. Transient Voltage Protectors

1. Electrical surge protectors shall be provided for those AC devices which are identified as being exposed to transient voltages as defined in ANSI/IEEE Standard C62.41-1980.

2. Surge protectors shall be installed in series with the AC device.

   a. DIN-Rail or panel mounting. Single or multiple channels. 10kA minimum protection level. Response time <1 nanosecond.

      *** OR ***

   b. Field mounted single channel device. 10kA minimum protection level. Response time <1 nanosecond.

H. Equipment identification nameplates: laminated plastic engraved on the upper 1/2 of the surface to permit recording of changing process and operational data or future identification on the remaining lower half.

1. Use white surface with a black core (letters) on the panel exterior.

2. Use black with white core (letters) inside panels with white or light interiors.

I. Interior lighting: full length fluorescent type.

J. Provide a grounded 110V service receptacle wired to a separate circuit.

2.03 WIRE, WIRING AND TUBING COMPONENTS

A. Power and control wire: Power No. 12 AWG minimum, control No. 16 AWG minimum, type THHN stranded unless specified otherwise. Wire color as follows:

1. Line power: black
2. Neutral or common: white
3. A.C. control: red
4. D.C. control: blue
5. Low voltage status and alarm: orange
6. Equipment or chassis ground: green
7. Externally powered circuits: yellow

B. Instrument signal wiring: 2 or 3 conductor, twisted, shielded cable, No. 18 gauge minimum with external vinyl jacket.

C. Graphic light wiring (24 volt) maximum at the lamp socket may be 20 AWG, minimum, if properly fuse protected and terminating in a terminal block capable of accepting No. 14 AWG field wiring.

D. Wiring trough for supporting internal wiring: plastic type with snap on covers and open top sidewalls to permit wire changing without disconnecting.

E. Terminal blocks shall be barrier type with the appropriate voltage rating (300V min.), raised (to trangh height) channel mounted type, angled when mounted on side panels. Signal terminal shal have removable pins or similar disconnect method. Common or neutral terminals do not require disconnect method.

F. Wire connectors: hook fork type with non-insulated barrel for crimp type compression connection to the wire for screw terminals.

G. Wire and tube markers: sleeve type with heat impressed letters and numbers (one sleeve per wire). Multiple wrap around markers are not permitted unless covered by a transparent protective overall shield and samples submitted and approved.

H. Provide a 1/8" x 1" copper ground bus for the total width of the panel.

2.04 GRAPHIC DISPLAY

A. A mosaic tile graphic shall consist of a non-corrosive, non-conductive thermoplastic grid with 1" square cells to accept 1" or 2" snap-in tiles, indicating lights, switches, and indicator that will fix the modules. The grid shall be mounted in an extruded

aluminum frame (channels) with front trim bezel. All mounting hardware shall be furnished.

B. The tiles shall be molded from a high temperature polycarbonate resin. The tiles shall have molded-in basic color which are fad resistant to UV light. The antistatic surface shall be smooth enough to accept silk-screening, air brushing or engraving.

C. Terminal block mounting and terminals shall be mounted to the lower segment of the frame. One side of the terminals shall be wired to the graphic. The other side of the terminals shall be capable of accepting #14 AWG wire.

D. The tile and lamp modules shall be modular to permit ease of modifications and maintenance without special tools. Lamps shall be easily replaced from the front or rear without unsoldering. The edges shall precisely abut each other when assembled.

E. Graphic lights shall be 28V powered by a 24V supply to extend lamp life. Wiring may be 20 AWG between the annunciator and the lamps. Components e.g., lamps shall be removable without effecting the operation f the remaining system.

2.05 TUBING

A. All instrument tubing shall be ISA color coded per RP 7.2

B. Single tube:

1. Soft copper seamless with 0.030 inch wall thickness 1/4" O.D. unless noted, with a burst strength of 6500 psig.

2. Conform to ASTM B 66 and 75.

3. The tubing shall be plastic covered.

4. Polyethylene tubing shall be pressure rated 80 psig @ 120 F.

2.06 SPACE DESIGNATIONS

A. Equip future space with all wiring terminals, panel racks, sockets, and fixtures required by the type of device indicated. Do not include the plug-in final elements. Provide blank nameplates comparable to active equipment.

B. Spare space is space only for surface mounting and be limited to mounting cut outs and drillings for specified items as shown on the Drawings. Provide removable cover plates over cut outs, finished to match the surrounding surface.

C. Blank space requires no mountings or cut outs.

2.07 ENCLOSURE ASSEMBLY

A. Make cut-outs true and square with no ragged cuts and de-burr leaving no sharp edges.

B. Grind welds smooth. Keep welding on the panel face to a minimum.

C. Provide stiffeners and supports to insure a rigid stable structure.

D. Degrease the finished enclosure and paint with two coats prime paint and two coats finish paint in accordance with the paint manufacturer's instructions. Paint prior to the installation of equipment.

1. Provide final finish smooth, free of runs, and uniform in tone and thickness.

2. Supply two 1-pint containers of each color used with the panel for field touch up.

3. Colors to be selected by the Engineer from color chips supplied by the panel manufacturer.

4. The interior shall be white.

E. not paint brushed anodized aluminum, stainless steel and FRP panels.

2.08 COMPONENTS SHOP INSTALLATION

A. Mount all components to permit servicing, adjustment, testing and removal without disconnecting, moving, or removing any other component. Arrange terminal block to be accessible and serviceable with a standard 8 inch blade screw driver with terminal marking easily visible from outside the open door of the enclosure.

B. Mount components with cadmium plated or stainless steel machine screws utilizing tapped holes or captive nuts. Nuts are not permitted for securing mounting screws.

C. Attach components mounted on the inside of panels to removable plates and not directly to the enclosure. Mounting components on door or swing panels requires prior approval.

D. Do not mount alarm chassis, function generators, auxiliary relays, power supplies, and similar devices within 18 inches of the bottom of the panel base on free standing panel.

E. Mounting shall be rigid and stable unless shock mounting is required by the manufacturer to protect equipment from vibration.

F. Identify all internal components plastic or metal engraved tags attached with epoxy cement and/or drive pins adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and supplier's data.

G. Attach panel face nameplates with screws to permit future changes.

H. Orient components mounting in accordance with the component manufacturer's and industries' standard practices.

I. The interior lighting shall be operated by an internal switch, wired to the same circuit as the service receptacle. This power shall be separate from the instrument power.

2.09 SHOP WIRING

A. All field wiring shall be terminal and a dedicated master terminal block separate from component terminals. Panel components may be wired direct from the field for thermocouples and similar signals.

B. Route power and low voltage DC signal wiring in separate wire ways. Crossing of the two system wires shall be at right angles. Separate parallel troughs of different systems by a minimum of 3 inches for low voltage D.C. and 12" between A.C. and D.C. systems. Connect shields and shield drain wires to a separate isolated ground bus with a single green wire to the main ground beds..

END OF SECTION

SECTION 13444

INSTRUMENTATION INSTALLATION

PART 1 – GENERAL

1.01 RELATED WORK

A. Section 13440: Instrumentation General

B. Section 13441: Instrumentation - Functional Descriptions

C. Section 13442: Instrumentation Equipment

D. Section 13443: Instrument and Control Panel

E. Section 13445: Instrument and Control for Package Systems

F. Section 16010 Series: Electrical

1.02 WORK INSTALLED BUT FURNISHED UNDER OTHER SECTION

A. Instrumentation and control panels specified in Section 13443.

B. Field instrumentation equipment specified in Section 13442.

C. Connection to the instrument system of Package Systems referenced in Section 13445 and shown on the Drawings.

1.03 WORK FURNISHED BUT NOT INSTALLED

A. In-line devices such as control valve, flow elements, etc., and instrumentation with only piping connections furnished under Section 13442 shall be delivered for installation into piping systems and/or installed by the appropriate contractor.

B. Special equipment e.g., interconnection wire and manifolds furnished with equipment shall be installed by the appropriate craft.

C. Pressure, float, position, and similar switches used in conjunction with systems specified in Division 16.

1.04 DESCRIPTION OF SYSTEM

A. The entire system is described in Sections 13440 through 13443 and shown schematically on the Drawings.

B. This section includes installation, certified calibration, start-up and documentation to provide a functional system.

C. Conduit, duct banks, and wiring shall be furnished and installed by the Electrical contractor as specified in Section 16010.

1.05 QUALITY ASSURANCE

A. All workmen shall be skilled in the work to which they are assigned, and all work shall be performed under the direct supervision of an experienced and competent instrument foreman.

B. All craftsmen shall be properly licensed and/or certified.

C. All work shall be done in accordance with standards set by the latest addition of the National Electric Code, NFPA, UL, FM, applicable local, state, federal and owner agencies and departments.

1.06 SUBMITTALS

A. Submit shop drawings in accordance with Section 01340.

B. Submit Operations and Maintenance Manuals in accordance with Section 01730 and in conjunction with Section 13440.

C. Furnish a supplement to the manual within two weeks of final acceptance containing all of the wiring diagrams, containing all required data and a copy of each instrument's certified calibration and commissioning sheets. The original certified calibration and commissioning sheets shall be retained by the Contractor for a period of five years or delivered to the Owner.

D. Submit the following for approval prior to installation or use:

1. cuts of terminal blocks, junction boxes, conduit hubs, and mounting fixtures not supplied elsewhere.

2. Samples of the wire and cable markers and connectors.

3. Specification sheets for wire, wire bundles, tube, tube bundles, and tube fittings.

4. Field sketches or drawings of terminal box layouts, sensor mounting fixtures (field fabricated) and equipment racks.

E. Four weeks prior to start-up, submit two complete sets of loop diagrams, vendor equipment calibration procedures, field connection diagrams, and vendor equipment specification sheets.

1.07 DELIVERY, STORAGE AND HANDLING

A. This specification section includes the receipt, handling and storage of all instrumentation equipment and panels until accepted by the Owner. Restore all damage caused by mishandling and environmental conditions to its original condition by replacement or repair.

1.08 JOB CONDITIONS

A. Coordinate the instrumentation installation and insure its compatibility with limitations or restrictions imposed by other divisions with respect to such things as Electrical Classification, Operations activity (i.e. washdown), and environmental protection (i.e. weather). Where conflicts occur the most stringent requirement will govern unless defined otherwise by the Engineer.

B. Maintain sequence and work schedule charts showing the coordination of instrumentation with other crafts and start-up schedule.

1.09 ALTERNATES

A. Alternate material and methods may be submitted as indicated in Section 13440.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide materials suited to the environment and compatible with the process at points of contact.

B. All material shall be heavy duty industrial type unless commercial, laboratory, or computer and communication type are noted specifically.

2.02 CONDUIT AND FITTINGS

A. Conduit shall conform to the requirements of Division 16. Non-metallic conduit shall not be used unless specifically approved in writing.

B. Junction boxes, terminal boxes, and wiring troughs not specifically mentioned below shall conform to the requirements of Division 16.

C. Field terminal boxes: RFI type with a grounding lug for areas not requiring Nema 7-9 construction.

1. Provide terminals mounted to the front of the box to permit access without interference of incoming cable.

2. Provide sufficient space at the bottom (or top and sides) for access to the entering wiring without removal of terminal mounting.

2.03 WIRE AND CABLE

A. Wire not specifically mentioned below shall conform to the requirements of Division 16. Pair cable means twisted paired cable.

B. Shielded single pair or triples (Triad) (Instrument Cable):

1. Acceptable manufacturers: Thermo Electric or Dekoron.

2. For general shielded service, (signal 4-20 ma) single pair or triad cables shall consist of two or three conductors, with drain wire, twisted together, served with a continuous grounding shield and protected with an insulating jacket.

3. Individual conductors: tinned, soft, annealed copper conductor, No. 16 AWG, stranded, insulated with 90 degrees C flame retardant cross links polyethylene insulation rated 600 volts.

4. The twisted pair or triad shall have a maximum lay of 2 inches (6 twists per foot).

5. Drain wire: tinned, stranded copper No. 18 AWG.

6. The twisted assembly shall be shielded with a spirally applied aluminum mylar or polyester shield with 35% overlap and covered with a 45 mil heavy duty thermosetting jacket meeting the requirements of paragraph 7.4.7 of IPCEA S-66-524 for thermosetting jackets.

7. The cable shall pass the UL flame test for tray cable.

C. Shielded multi-pair or multiple triad cable (Instrument Cable):

1. Acceptable manufacturers: Thermo Electric or Dekoron.

2. Shielded multi-pair or multi-triad cable (signal cable) construction shall be an assembly of twisted pairs or triads of AWG No. 20 tinned copper as described in paragraph B above except without jacket.

3. Color code or number the pairs or triads and cable together as an assembly having a circular cross section served with an overall spirally wrapped aluminum or polyester mylar shield with a stranded tinned copper drain wire and polyester tape for complete shield isolation.

4. Cover the assembled cable with a heavy duty thermosetting jacket meeting the requirements of paragraph 7.4.7 of IPCEA S-66-524 for thermosetting jackets.

5. The cable shall pass the UL flame test for tray cable.

D. Single pair or triples (Triad)(Instrument Cable):

1. Acceptable manufacturers: Thermo Electric or Dekoron.

2. For general alarm and indication service, single pair or triad cables shall consist of two or three conductors, twisted together, and protected with an insulating jacket.

3. Individual conductors: tinned, soft, annealed copper conductor, No. 16 AWG, stranded, insulated with 90 degrees C flame retardant cross linked polyethylene insulation rated 600 volts.

4. The twisted pair or triad shall have a maximum lay of 2 inches (6 twists per foot).

5. Cover the twisted assembly with a 45 mil heavy duty thermosetting jacket meeting the requirements of paragraph 7.4.7 of IPCEA S-66-524 for thermosetting jackets.

6. The cable shall pass the UL flame test for tray cable.

E. Multi-pair or multiple triad cable (Instrument Cable):

1. Acceptable manufacturers: Dekoron, or Thermo Electric.

2. Multi-pair or multi-triad cable (alarm and indication) construction shall be an assembly of twisted pairs or triads of AWG No. 20 tinned copper and as described in paragraph D above except without jacket.

3. Color code or number the pairs or triads and cable together as an assembly having a circular cross section served with an overall spirally wrapped aluminum or polyester mylar shield with a stranded tinned copper drain wire and polyester tape for complete shield isolation.

4. Cover the assembled cable with a heavy duty thermosetting jacket meeting the requirements of paragraph 7.4.7 of IPCEA S-66-524 for thermosetting jacket.

5. The cable shall pass the UL flame test for tray cable.

F. UL listed tray rated cable is not required when all wiring is installed in metal conduit.

G. General wiring shall conform with Section 16010.

H. Direct burial shielded multi-pair or multiple triad cable (Instrument Cable):

1. Acceptable manufacturers: Dekoron, or Thermo Electric.

2. Shielded multi-pair or multi-triad cable (signal cable) construction shall be an assembly of twisted pairs or triads of AWG No. 20 tinned copper.

3. Individual conductors: tinned, soft, annealed copper conductor, No. 20 AWG, stranded, insulated with 90 degrees C flame retardant cross linked polyethylene insulation rated 600 volts.

4. The twisted pair or triad shall have a maximum lay of 2 inches (6 twists per foot).

5. Drain wires: tinned, stranded copper No. 22 AWG.

6. The twisted assembly shall be shielded with a spirally applied aluminum mylar or polyester shield with 35% overlap.

7. Color code or number the pairs or triads and cable together as an assembly having a circular cross section served with an overall spirally wrapped aluminum or polyester mylar shield with a stranded tinned copper drain wire and polyester tape for complete shield isolation.

8. Cover the assembled cable with a heavy duty thermosetting inner jacket with an aluminum co-polymer bonded to it to form a waterproof cover.

9. Apply an outer jacket of low density polyethylene or PVC over the entire assembly.

I. Wire markers: vinyl sleeve type with heat impressed letters and numerals. Individual numeral (or letter) wrap around markers, unless provided with an overall protection, are not permitted.

J. Wire termination connectors: hook fork type.

K. Terminal blocks: track mounted barrier type with a marking strip, rated 300V minimum, medium duty, and manufactured by Pheonix, Allen Bradley or Square D.

2.04 NAMEPLATES

A. Provided engraved nameplates for identifying each field transmitter or final control element minimum of 2 x 4 inches in size with 1/4 inch high characters. The background shall be white, the letters black.

2.05 TUBING

A. Single tube: soft copper seamless with 0.030 inch wall thickness, 1/4" O.D. unless noted, with a burst strength of 6500 psig.

1. Conform to ASTM B 66 and 75.

2. The tubing shall be plastic covered.

B. Tubing bundling.

1. The bundle shall consist of multi-tubes of the standard listed in "A" above.

2. The tape separator: 2 mil polyester.

3. Outside jacket: PVC spark tested at 5000V.

4. Each individual tube shall be numbered at frequent intervals or color identified.

5. Provide 22 AWG communication wire pair.

C. Fittings: stainless steel or plastic flareless compression, single ferrule type that will not damage or bite into the tube wall. Nomenclature shall be consistent with ISA RP-42.1.

PART 3 – EXECUTION

3.01 INSPECTION OF WORK DONE BY OTHERS

A. Inspect installation of instrumentation equipment installed by others.

B. Report conditions that will restrict the performance of the instrumentation system, together with a recommended solution to the Contractor, Owner, and Engineer in writing.

3.02 PREPARATION

A. The Contractor shall verify that utility connections (electrical power, air, etc.) and grounding required by the instrumentation system are available and at the proper use point.

3.03 INSTALLATION GENERAL

A. All wiring and piping shall be constructed perfectly plumb, square, level, and true to lines and surfaces indicated, in a neat, substantial and workmanlike manner, and in such a way as to properly serve for the purpose intended.

1. All members and parts, upon installation, shall be properly framed, secured together, and anchored in place.

2. All cuts shall be deburred and immediately cleaned from opposite end before connecting.

B. All instruments shall be mounted, piped and connected in strict accordance with manufacturer's instructions.

C. Field mounted instruments shall be located where shown on the drawings.

1. Control panels and controls shall have unobstructed access from an aisle or walkway. They shall be securely supported on pipes, stands or brackets or satisfactory heavy material to prevent excess vibration or movement.

2. All instruments shall be located to allow convenient access for readability, calibration and routine maintenance.

D. Identify each instrument with an engraved nameplate, applied adjacent not on to the instrument.

3.04 ELECTRICAL INSTALLATION

A. Maintain maximum practical separation between signal (analog, alarm and status) conduits and power feeders and ac systems. The following is a guide to separation:

Separation in Inches

Levels		1-2	1-3	1-4	2-3	2-4
Conduit/conduit		3*	6*	12*	3	9
Tray/conduit		4*	6*	18*	6	12
Tray/tray	6	12	24	6	12	

*Unshielded conductors

Level 1 - Low voltage d.c. analog signal, thermocouple & RTD wiring.

Level 2 - Low voltage switched signals; lights, alarms, digital.

Level 3 - a.c. voltage below 300 volts or 20 amps.

Level 4 - a.c. voltage above 300 volts or 20 amps.

B. Do not place Level 1 and 2 signal wires in the same conduits or pull boxes as Level 3 and 4 wires.

C. All conductors running from the field to the control panel shall be a single, continuous length, without splices, except at approved junction boxes. The junction boxes shall have terminal blocks with 20% of the total installed terminals spare. All wires used or unused shall be terminated on terminal.

These and designated future terminals shall not be considered "spare" but shall be included with used terminals in calculating spares.

D. Multi-conductor cable may be used between junction boxes and control panels.

Identify cable or wire bundles at both ends with a permanent tag identifying the cable or bundle number, function, and the location of the other end of the cable or bundle

END OF SECTION

.

SECTION 13445

INSTRUMENTATION AND CONTROL FOR PACKAGE SYSTEMS

PART 1 – GENERAL

1.01 RELATED WORK

A. Section 13440: Instrumentation General

B. Section 13441: Instrument Functional Description

1.02 1.02 SYSTEM DESCRIPTION

A. The requirements of this section are not intended to restrict the functional and safety requirements of the package design or the responsibility of the manufacturer or supplier of the various equipment packages required by this contract, but shall provide uniformity of generic equipment and methods and standardize documentation between the various instrumentation and controls provided by different equipment package manufacturer's.

B. The systems shown on the drawings are subject to design requirements of specific vendors and their methods. The supplier shall at no additional cost to the Owner deliver a functioning installed control system with the interfaces required by the drawings and specifications.

C. The package supplier shall be responsible for additions and changes required to provide a functional system using his equipment. The additions and/or changes shall be made at no cost to the Owner or Engineer.

1.03 1.03 SUBMITTALS

A. Submit Shop Drawings and product data in accordance with Section 01340.

B. Provide system electrical and instrumentation documentation. Use NEMA, NFPA 70 and ISA Standard symbols and identification designations on Shop Drawings. Drawings shall be specific to this project (not typical or fragmented) and include the types listed which shall conform to the following format:

1. Single Line or One Line Diagrams:

   a. Show the basic power distribution of the equipment package system.

   b. Include, but do not limit information to, circuit disconnect frame size and setting (trip or fuse), horsepower or KW, starter or contactor size and type, transformer sizing, load and short circuit data, motor or equipment identification, wire sizes and circuit identification.

2. Schematic or Elementary Diagrams (NFPA 79 Standard):

   a. Draw diagrams between vertical lines which represent the source of power. Connect one side of all coils to the right line (exception - motor starter overload contacts may be between the starter coil and the right line). Make diagram complete with all control devices of the system indicated. Indicate devices remote

from the control panel by appropriate symbols. Indicate field (non-prewired) wiring with dashed lines.

b. Use a cross-referencing system for each relay or timer coil to locate all contacts on the diagram. Identify each line with a number. Identify all wires with a wire number.

c. Where color coded cable is used, include color code in the diagram.

d. Indicate limit, pressure, floats and similar devices in the turned-off, disconnected or shelf position.

e. Show selector and other multi-contact switches with contact closure sequence on the diagram or a separate chart.

f. Describe the functions of valves, starters and indicating lights on the diagram and completely describe the sequence of operation, both automatic and manual.

g. If a single line or one line is not required, equipment ratings including horsepower, starter size, transformer data, fuses, and breaker size shall be shown on the schematic.

3. Connection or Wiring Diagrams (NFPA 79 Standard):

a. may be of the wireless type, indicating the wire numbers adjacent to the contact, coil or light to which they are connected. Indicate the components and spare space for future equipment in their respective positions in panels and cabinets. Indicate all terminal blocks with numbering.

4. Interconnection Diagrams:

a. Make diagrams similar to connection or wiring diagrams. Indicate all field mounted devices external to panels and cabinets. These devices need not be shown in their relative locations. Interconnection diagrams may be incorporated on connection or wiring diagrams.

5. Instrument Loop Diagrams:

a. Vendor shall provide loop diagrams, one diagram for each system containing process Instrumentation in the format of Instrument Society of America (ISA), standards and recommended Practices for Instrumentation and Control - Standard ISA-S5.4 showing all items. Drawings shall be on nominal 11" x 17" sheets.

b. Where switch functions or status indications are the only functions required of instrumentation, they may be incorporated into electrical and/or pneumatic drawings in lieu of separate Loop Diagrams.

6. Plot Plan or Assembly Drawings:

a. Show the location of panels and field devices in plan view.

b. Show the wiring and control tubing requirements.

c. List component elevation from a base elevation on the plan view unless a specific detail or elevation is required to clarify a location.

7. Panel Drawings:

   a. Provide enclosure face and interior arrangement drawing. Make drawings to scale and indicate all outline, mounting and clearance dimensions.

   b. Indicate relative location and size of panel mounted components. Components need not be dimensioned if drawn to scale.

   c. Show nameplate legends with exact engraving.

   d. Indicate, identify and dimension useable spare panel space.

   e. Submit the panel face and internal layout drawing together with a complete nameplate schedule including wording to Owner for approval prior to fabrication.

8. Miscellaneous Items:

   a. Provide a bill of materials listing the make, model and type and rating of all components, except for mounting hardware, wire, wire lugs and similar installation items.

C. Submit interface details required for coordination with equipment and systems supplied elsewhere. The data shall be identified as "Interface Requirements".

1.04 PROTECTION OF EQUIPMENT

A. Protect equipment from all damage in the factory or during shipment, including chafing and scratching from inadequate packing, until Owner's acceptance.

B. Repair all damage to the equipment at no cost to Owner.

1.05 FACTORY TESTING

A. Conduct final tests only in Owner's presence unless Owner has given written authorization to conduct tests without witness. Waiver of witness does not release the manufacturer of systems responsibility and cost, factory or field, of providing an operational system.

B. Connect the panel to a temporary power source with identical ratings as supplied to check the functional operation of all instrumentation, control switches and alarm points prior to crating and shipment. Include simulated transmitter signals and dummy loads in functional test.

PART 2 – PRODUCTS

2.01 GENERAL

A. All material and equipment shall be new undamaged at the time of installation and suitable for operating in ambient temperatures up to 40^{o}C minimum.

B. The maximum number of conductors permitted in outlet boxes and junction boxes to be in accordance with NEC. All wiring shall be rigid conduit or flexible conduit unless equipment is portable. Type SO or SWO cord shall be used with portable equipment.

C. Provide flexible metallic conduit (liquid tight) between rigid metal conduit and motor, solenoid valves, limit switches, and other equipment for convenience of making position adjustment or facilitate disassembly.

D. All non-flexible conduits shall be rigid galvanized steel (no thin wall conduit).

E. Interconnecting wiring between equipment on a common skid shall be supplied and installed by the vendor.

F. Vendor's circuits and equipment shall be designed to allow fail-safe operation of all equipment on emergency shutdown, power failure, or loss of wire or connection.

G. After return of power, control system must not automatically restart unless otherwise noted. In addition, vendor's circuit shall be designed to allow fail-safe operation of all equipment on an emergency shutdown or power failure mode; this includes:

1. Electrical circuits

2. Pneumatic circuits

3. Hydraulic circuits

4. "Gravity" circuits (stop at end of gravity conv., etc.).

H. All alarm control devices such as pressure and temperature switches shall have contact which open under alarm conditions and are closed under normal operating conditions.

I. All motor starters supplied with equipment shall be in compliance with the current National Electrical Code Article 430 and any other applicable articles referred to therefrom.

J. Vendor's special grounding requirements are to be clearly defined.

K. Vendor to provide ground continuity within cabinets, panels, and between all components.

L. All equipment grounding conductors are to be bare or color coded green. Color coding is to be continuous, and a green or bare conductor can only be used as an equipment ground.

M. Provide separate ground conductors in all cables to movable equipment.

N. Vendor to provide appropriated sized ground lug for termination of field installed bare ground wire at common grounding point in cabinets and/or on skids.

2.02 OPERATORS PANEL

A. Enclosures smaller than 36 inches by 48 inches: wall mounted with provisions for pedestal mounting at Engineer's option. For skid mounted prewired panels the vendor shall submit mounting arrangement for approval.

B. All other enclosures: floor mounted, free standing, totally enclosed, straight front with provisions for top or bottom entry of cable and tubing. For skid mounted prewired panels the vendor shall submit mounting arrangement for approval.

C. Panel maximum dimensions: seven feet high by three feet deep with the length of the panel sufficient to contain all the required equipment, plus designated spare space for 20 percent future equipment. Refer to the Drawings for available space and access arrangement.

D. Fabricated panels: angle iron frame of welded construction covered by the shell material. Provide stiffeners to prevent warping and distortion.

E. Panel shell material: cold rolled steel, flat and free of dents or other defects. Provide continuous welded seams and joints watertight and ground smooth.

1. Front face: 3/16 inch thick.

2. All other surfaces: 12 gauge.

F. All enclosure shall be suited for the environment of intended use. At a minimum all cabinets shall be NEMA 12 construction.

G. Prefabricated panel enclosures shall be Hoffman Eng. or equal.

H. For panels larger than 36 inches by 48 inches provide the following:

a. interior lighting system: fluorescent, rapid start fixtures making a continuous lighting strip from side to side. Provide exterior wall switch mounted beside the door. Reflectors are not required.

2. Maintenance receptacle: grounded, separately powered 115 volt, 60 Hz.

I. Panel access doors: hinged, full length doors, maximum 34.5 inches wide, formed with stiffening to provide rigidity in any position. Concealed hinges: continuous piano-type stainless steel. Latches: three point with chrome plates, recessed handles, complete with lock. Provide continuous 1/8 inch thick cellular neoprene gasketing full perimeter of door.

J. Provide a print pocket in each panel.

2.03 PANEL WIRING

A. Power Wiring: No. 12 AWG, minimum, type THHN or MTW, stranded. Control wiring (non-signal): No. 16 AWG, minimum, type THHN or MTW stranded. Color code wire as follows:

1. Primary voltage source or hot power: black

2. Grounded common or neutral: white

3. Equipment ground: green

4. A.C. control: red

5. D.C. control: blue

6. Low voltage status and alarm system: orange

7. Circuits containing voltage from foreign source (i.e. remote motor starters): yellow

B. Low voltage internal panel graphic light wiring: No. 22 AWG, minimum, between the light and an appropriate terminal block that shall accept No. 14 AWG field wiring.

C. Electronic signal wiring: twisted paired No. 16 shielded cable with a vinyl cover.

D. Terminals: barrier type of the appropriate voltage rating manufactured by Phoenix, UK4, or equal.

2.04 PANEL PIPING AND TUBING

A. Instrument Tubing:

1. Soft drawn, seamless copper with 0.030 wall, 1/4 inch O.D. (stretch tubing prior to installation.)

2. Color coded in accord with I.S.A. recommended practice RP 7.2.

3. Polyethylene tubing with 80 psig @ 120 deg. F pressure rating.

2.05 PANEL GRAPHIC (IF USED)

A. For the basic method use back lighted translucent type or laminated plastic material with beveled edges approximately 1/16" thick or laminated sealed buildup sandwich, non-glare type or mosaic tile type.

B. For laminated plastic or sandwich type, apply the graphic presentation to a sheet of 3/16 inch thick aluminum with background color and superimposed components, lines, and details suitably mounted.

C. Background, symbol, and line colors will be recommended by the Vendor with optional selection by the Owner from samples supplied from the panel manufacturer.

D. Arrange the display to depict the process schematically including major equipment items, piping, pumps and valves as shown on the Flow Diagrams or equipment layout.

E. Mount display in an aluminum frame, with a natural brushed finish, enclosing all sides. Provide gasketing within the frame for sealing, cushioning and expansion of the graphic sheet.

F. Dry type field contacts shall activate the graphic indication. Provide terminal blocks for field contacts. Provide a lamp test with a single pushbutton on the front of the panel.

2.06 GENERAL COMPONENTS

A. Coordinate components between packaged units and peripheral equipment.

B. Provide components of the latest design and proven successful operation.

C. Operator devices: heavy duty oil tight industrial construction. Screw terminal connections.

1. All indicating lights: transformer type. Individual lights shall be press to test unless a master lamp test system is provided.

2. Bulbs: interchangeable and all of the same type having a minimum 5000 hour rated life.

3. Pushbuttons and Selectors: Full size w/modular contact blocks 1-N.O. 1-N.C. contacts each device min.

D. Control relays:

1. Relays: 3 pole, double throw, octal plug-in type with a transparent dust cover and a visual means of indication when the relay is energized (i.e. lamp). Screw terminals on socket. (Potter Brumfield KRP-13 compatible)

E. Timers:

1. Timers: plug type with multiple range analog or 5 digit digital of the same make and model for all applications. Screw terminals on socket.

F. Nameplates (non-graphic): 1/16 inch laminated plastic with 1/8" high characters arranged in two or three rows. Overall size: 1 x 2.5 inches unless mounting space or legend content dictate otherwise.

1. Exterior nameplate: white with a black core (letters).

2. Interior nameplates: black with a white core (letters).

G. All field mounted device housings: NEMA 4 construction, minimum.

H. All field mounted operator devices shall be industrial heavy duty oil tight.

1. Intrinsically safe and NEMA 7-9 equipment: UL, FM, or equal approved for the area classification.

2.07 ALARMS

A. Conform to ISA Standard S18.1.

B. Solid state systems are standard.

C. If relay type systems are proposed as an option, cost and other advantages justifying the use of equipment must be presented in detail.

D. Field power to dry contacts: 24 volt dc unless otherwise approved to reduce need of separation between alarm and instrument signal lines.

E. Alarm application:

1. Furnish the Engineer a tabulated list of the nameplate designations for all functions to be alarmed.

2. A central alarm panel may be furnished under other Sections in addition to any local alarm panels required for packaged systems.

3. Provide the local annunciator with an alarm test and acknowledge pushbuttons.

4. Where multiple functions associated with a shut down are alarmed, provide a First Out feature to ascertain which function tripped first.

5. Where three alarm points or less are required for packaged equipment, provide lights for each point and an auxiliary S.P.D.T. dry contact that operates on abnormal conditions for retransmitting alarm condition to a central panel. The initial alarm and acknowledgement shall not inhibit the operation of subsequant alarms. Provide a horn relay, a flashing light or beacon, and an acknowledge pushbutton.

6. For more than three alarm points provide an annunciator in the package panel complying with I.S.A. S18.1 standard (Type A-1-6-7-14). Audible alarm or relay shall not inhibit subsequent alarms after acknowledging initial alarm. Replace the horn with a relay containing two normally open and two normally closed dry isolated contacts for retransmitting alarm condition to a central panel. In addition to the relay install a flashing light or beacon on the top of the control panel replacing the normal audible device. Wire this light to terminals to facilitate moving to an alternate location at the option of the Engineer.

2.08 PANEL SHOP FINISH

A. Finish paint: air dry lacquer for steel panels.

B. Anodized aluminum, stainless steel and FRP panels: a natural brushed finish.

C. After all cutting, drilling and welding is complete, degrease, sand or sand blast all surfaces to be painted to insure good bonding.

D. Apply two coats of prime paint in accordance with the paint manufacturer's instructions.

E. Apply one coat of finish paint smooth, free of runs and uniform in applied tone and thickness. Paint the panel interior white and the exterior color as selected by the Owner from samples supplied by the paint manufacturer.

F. Provide two one quart cans of the finish paint with the panel for field touch-up.

2.09 PANEL EQUIPMENT INSTALLATION

A. Provide all switches, terminal blocks, indication lights, relays, flashers, or other control equipment as specified and wire complete to terminal blocks for connection to the field wiring. Align and mount equipment and nameplates.

B. Mount all equipment with cadmium plated or stainless steel hardware and tapped holes.

C. Identify all components, such as control instrument, relays, terminal blocks, and miscellaneous equipment in the panels visible from the open door of the panel. Use designations corresponding to the identification on the Drawings and Shop Drawings. Use engraved nameplates. Locate identification on panel(s) not on component.

D. Mount components to permit complete removal without disturbing the mounting or wiring of adjacent components.

1. Do not mount equipment or terminals on access doors or swing panels without Engineer's prior approval.

2. Terminals shall be easily visible and accessible.

E. Operator and Control Devices:

1. Mount devices in a logical arrangement for ease of operation.

2. Space devices in accordance with the manufacturer's recommendation.

3. Do not spread devices apart for appearance. Group devices logically to make extra space available for future use.

4. Mount internal equipment above 18 inches from floor.

5. Mount face devices above 36 inches from floor.

F. Nameplates:

1. Identify all control groups and instruments on the front of the panel with laminated plastic nameplates stating the Service and Tag Number. Fasten nameplates to the panel with pan head stainless steel sheet metal screws (no glue).

2.10 PANEL WIRING

A. Provide a multi-row master terminal block at the bottom of each panel for field wiring. Arrange the blocks in vertical rows.

1. If single row master terminal blocks are provided, install blocks at the side of the panel to permit easy access from either top or bottom wire entry

2. Use only one side of the row of each terminal block for connections from inside the panel.

3. Terminals to be raised equal in height to top of wiring trough.

4. Provide unobstructed access between field side of terminals and field entry location.

B. Make connections for all power and signal wires for field connections to terminal blocks. Power, control and signal wiring terminals shall not be intermixed but clearly separate. Provide 20 percent spares in each group.

C. Permanently mark all terminal blocks with the proper wire numbers. (Not consecutive number.)

D. Mark both ends of all wires with vinyl permanent marking tape with wire the same numbers in agreement with the manufacturer's wiring drawings.

E. Maintain continuity on shields throughout each loop with grounding only at the panel master terminal block. Reinsulate all other exposed shields.

F. Install the internal panel wiring in supported, covered wiring throughs or channels.

G. Intrinsically safe devices: conform to NFPA Section 493 and NEC 480.

H. NEMA 7-9 relay and control panels:

1. Provide multi-pole local disconnect or intrinsically safe relays in separate enclosures for dry contact power isolation entering relay panels.

2. Provide warning nameplate to "disconnect power before opening" on relay and control panels.

3. Provide Underwriters (UL, FM, or equal) certification on assembled enclosure

2.11 PANEL PIPING AND TUBING

A. Install piping and tubing plumb and square. Support tubing to permit the removal of instruments without the tubing sagging. Clamp adjacent tube runs together with a common clamp.

B. Provide bulkhead fittings in the shell of the panel for field connections with 1/4 inch female NPT field side connection. Locate the bulkheads at the top or bottom of the panel, as shown on the Drawings.

C. If required, provide a single filter regulator, 2-30 psig output, with output gages to furnish air to the panel supply header.

2.12 EQUIPMENT WIRING AND TUBING

A. Prewire or prepipe wiring and tubing from groups of locally mounted devices and sub-assemblies to locally mounted NEMA 4 junction boxes with terminal blocks and/or bulkhead fittings. Use junction boxes to minimize the number of conduit or tubing bundle runs to the Operator's Panel or between sub-assemblies. Elevate terminals from back of box to approximately 1" from cover.

B. Mount all equipment and/or field devices. Identify all devices with an engraved nameplate attached adjacent to (not on) the device.

C. Design device control system to use a maximum of 4 wires total between remote device and the control panel. On powered devices use two wires to supply power to the unit and two wires for switch sensing. Accomplish additional functional switch sensing and/or additional functional requirements such as remote auxiliary indication or interlocks with an auxiliary control relay in the panel.

D. Limit flexible conduit to a maximum of 18" in length.

E. Entry to panels and junction boxes shall be in the sides, bottom or back (not top except as noted on drawing or in equipment specification) via threaded hubs.

2.13 MOTOR CONTROLLER INTERFACE

A. When controllers are furnished separately in motor control centers, the control circuits will be 120 V, 60 Hz from individual control circuit transformers in each motor controller.

B. When motor starters are provided with the system the motor control voltage shall be 120 volt.

C. For operator control panels furnished with the packaged equipment system, provide all operator actuated devices and automatically controlled devices arranged to operate the motor controller through individual dry contact, one for each motor, separately wired to terminals in the Operator's Panel. Arrange each dry contact to close when its associated motor is required to run and open when the motor is required to stop.

D. The motor controller will be equipped with a single dry contact for wiring to terminals in the Operator's Panel. The dry contact shall be closed when the controller is energized and opened when the controller is de-energized. Use contact in the control system to furnish logic information for run indicating lights and interlocks with relays furnished with the packaged equipment system for multiple functions in the system.

E. Arrange motor control logic of the packaged equipment system having start-stop pushbutton stations located at the motor or remote from the Operator's Panel either in addition to or in lieu of the Operator Panel controls, to control the motor via the dry contact in the Operator's Panel.

F. Power wiring from the motor control center to the motors furnished with the system is furnished under other Sections.

2.14 PROGRAMMABLE LOGIC CONTROLLERS (IF USED)

A. The equipment shall be standard catalog devices of manufacturers' regularly engaged in supplying PLC system and servicing the systems.

B. The equipment shall be heavy duty industrial type, not commercial, residential, or dedicated non-catalog type.

C. The listing of equipment requirements below is for quality standard and basis of design. The listing is not to be considered complete. Additional equipment required to execute the functional requirements shall be provided and shall be of the same quality (or better) and compatible with the listed equipment.

D. Available power will be standard commercial with no special conditioning. Isolation, filtering and surge protection shall be included with the system.

E. Provide all documentation required to operate service and maintain the system including hard copies of all programs.

F. Basic Equipment.

1. Processor

   a. User available memory to have 30% of total capacity unprogrammed and undedicated at time of shipment.

   b. The program shall be protected during power outage and restoration by battery.

   c. Capabilities for future printer installation shall be available. The printer is intended to log operational data.

   d. Key switch or password protected security shall be provided for engineering program changes.

e. Operational changes shall be entered via an interface panel or push buttons and selectors.

f. Diagnostic indication shall be provided separate from programmer or operator data entry panel.

g. The system shall have an RS232 port and support modbus for remote access by the Owner or a master system.

2. I/O

a. Modular type (individual cards for each function type) with module removable without disconnecting field wiring.

b. Field terminals - screw type suitable for 2-#16 AWG wire.

c. Modules shall have dual indication lights (one to indicate logic status and one for the power status).

d. Input modules to accept dry contact input with anti bounce circuit. Maximum of 16 isolated inputs per card

e. Output modules to have non-solder fuse output with blown fuse indicator either on the module or a separate terminal block. Output configuration to be individually isolated and compatible with application.

f. Analog inputs shall support 4-20 mAdc input from either 2 or 4 wire transmitter.

g. Analog output shall be 4-20 mAdc @ 600 ohms minimum.

3. Operator Interface

a. Panel Mounted

b. Cabled to processor

c. Security keyswitch or password protected key pool to inhibit unauthorized changes.

4. Programmer

a. Provide programmer to permit program reconfiguration by the Owner.

b. Unit to be manufacturer's standard.

5. Auxiliary Output Relays:

a. Auxiliary relays shall be provided if the output cannot support 115 volt 60 Hz 5 in rush continuous loads (e.g. motor starter coils).

b. Enclosed plug-in type.

c. D.P.D.T. Octal pin configuration (P-B KRP-11 compatible).

d. Lamp type operation indicator.

e. Screw terminal socket.

6. Documentation

a. Provide complete program documentation.

END OF SECTION

SECTION 15400
LEAK DETECTION SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to construct sump monitoring and pump systems and to provide for a complete installation.

1.02 RELATED SECTIONS

A. Section 02711 – Polyethylene Pipe

B. Section 11062-Pumps

1.03 REFERENCES

A. Drawings

B. Site Construction Quality Assurance (CQA) Plan

1.04 SUBMITTALS

A. The Contractor shall submit, at least 7 days prior to installation of this material, to the Owner, certificates of compliance for the pipe materials and fittings to be furnished.

B. The Contractor shall submit, at least 7 days prior to installation of this material, to the Owner, certificates of compliance for the transducers

C. The Contractor shall submit, at least 7 days prior to installation of this material, to the Owner, operations and maintenance manuals for the sump pump, transducer, and other necessary pump controls.

1.05 QUALITY ASSURANCE

A. The Contractor shall ensure that the materials and methods used for the pumps meet the requirements of the Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Owner will be rejected and shall be repaired or replaced by the Contractor.

PART 2 – PRODUCTS

2.01 HDPE PIPE AND FITTINGS

A. HDPE pipe and fittings shall be in accordance with Section 02711.

B. Sumps discharge pipes shall be 1.5 inch HDPE with an SDR of 17. Pipe shall be straight stick (non-coiled) and fusion welded according to Section 02711.

C. HDPE to stainless steel, quick connect transition fittings shall be included at both ends of discharge pipe.

D. Non-hardening pipe dope or thread tape shall be used for all threaded pipe and fitting connections.

2.02 PUMP GENERATOR

A. Two existing generators capable of operating sump pumps are Owner provided.

PART 3 – EXECUTION

3.01 GENERAL

A. When shipping, delivering, and installing materials, do so to ensure a sound, undamaged installation. Provide storage for all materials and equipment delivered to the job site that is protective of stored materials. Handle and store materials in accordance with the Manufacturer's recommendation.

B. Modifications to the side-slope riser pipe or end caps shall be made to allow access to pump wiring and hoses as well as transducer wiring without the need to remove the side slope riser end cap.

C. Removal of cap shall not damage wiring for pump or transducer.

3.02 HDPE PIPE INSTALLATION

A. HDPE Pipe shall be installed in accordance with Section 02711.

PART 4 – MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Providing for and complying with the requirements set forth in this Section for Pumping System will be measured as a Lump Sum (LS), and payment will be based on the unit price provided on the Bid Schedule.

B. The following are considered incidental to the Work:

- Submittals.
- Quality Control.
- Shipping, handling and storage.

- Couplings, fittings, and other pipe appurtenances.
- Layout and as-built survey.
- Mobilization.
- Rejected material.
- Rejected material removal, handling, re-testing, and repair.
- Controls.
- Electrical.
- Start-up and testing for proper operation.

[END OF SECTION]

SECTION 16010

ELECTRICAL GENERAL

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Basic electrical requirements specifically applicable to Division 16 Sections, Division 13 Sections in addition to Division 1 - General Requirements.

1.02 RELATED SECTIONS

A. Section 11062: Pumps

B. Section 13440: Instrumentation General

C. Section 13441: Instrumentation Functional Description

D. Section 13442: Instrumentation Equipment

E. Section 13443: Instrumentation & Control Panel

F. Section 13444: Instrumentation Installation

1.03 WORK INCLUDED

A. The electrical work shall include, but is not limited to, the following:

1. Power distribution system.

2. Lighting system.

3. Motor control system.

4. Ground systems.

5. Instrumentation and control systems wiring.

B. The instrumentation work covered under the provisions of this section includes furnishing and installing wire, conduit, ductwork, raceway support, wire labeling, wiring connections as required by the wiring drawings prepared by the Instrumentation and Control System Vendor for all equipment specified in Section 13440. The instrumentation wiring shall conform to Section 13440.

1.04 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code (NEC)

B. IEEE - Institute of Electrical and Electronics Engineers

C. ISA - Instrument Society of America

D. NEMA - National Electrical Manufacturers Association

E. National Fire Protection Association (NFPA)

F. National Institute for Occupational Safety and Health (NIOSH)

G. Factory Mutual (FM)

H. Underwriters Laboratory (UL)

I. Local, state and national agencies having jurisdiction.

1.05 REGULATORY REQUIREMENTS

A. The work manufactured and furnished under this specification shall conform to the following:

1. Applicable federal, state and local codes, ordinances and regulations in force in the locality of the project.

2. Regulations of local utility and telephone companies.

3. Applicable standards of ANSI, IEEE, ISA, NEMA, UL and NEC.

B. Where standards differ, the Contractor shall state which standard applies. Unless modified by provisions of this specification, these standards apply, whether mentioned in the text or not. The Contractor shall also note where existing standards are not satisfied or only partially satisfied. Where non-standard hardware, or services are offered, the Contractor shall defend their adequacy in relation to the functions to be performed, and the cost of fully satisfying existing standards.

C. All materials, equipment and lighting fixtures shall bear a UL label or shall be UL listed, unless UL does not have an examination service for the item in question.

D. Before submitting bids, consult the above necessary provisions for bid, and call to WESTON's attention, any work conflicting with the above codes, regulations and requirements so proper addendum may be issued.

1.06 ELECTRICAL WORK

A. In addition to requirements specified under other sections of electrical work, the following work shall be included:

1. Furnish all labor; and furnish, install, connect, test and adjust all equipment and materials to form a complete operating installation, including without limiting the generality of the foregoing: hangers, supports for equipment, cables, conduits, cable tray, cable trench, pull boxes, anchors and inserts; identification plates; signs and tags for equipment, conduits, wiring, and wire labels.

2. Clean and lamp all lighting fixtures after installation and wiring. Install all fuses. All lighting fixtures shall be clean at time of final acceptance.

3. Wire and connect all electrical equipment which has been split or sectionalized for shipping purposes.

4. Provide all wiring during testing and trials, for all required corrections, changes, additions, completions and adjustments until final acceptance of the work.

5. Coordinate numbers and label all field wiring between equipment of the various electrical equipment suppliers.

6. Install the electrical work in a manner and at times to minimize cutting and patching of the building structure.

7. Repair any damage to work already in place, as a result of electrical work at no expense to WESTON.

8. Provide all sleeves, inserts, and other embedded items required in the work.

9. Provide all conduit, wiring, wiring devices and connections for the instrumentation and control.

10. Provide all conduit, wires, and switches necessary for heating, air conditioning, ventilating fans, lighting fixtures and ballasts, motors, and other electrical loads.

11. Provide all wires, cable, wiring devices, conduits, pole lines, trench systems, manholes, ductbanks and ducts, including excavation and backfill for underground conduits.

12. Provide all starters, contactors, circuit breakers, pushbuttons, limit switches, float switches, relays, including structural supports as shown on the drawings, specified herein, and as required.

1.07 QUALITY ASSURANCE

A. All personnel employed by the manufacturer, supplier, and/or Contractor(s) shall be experienced in their respective trades and tasks.

B.

C. The Contractor(s) shall be properly licensed in accordance with all state, federal, and local requirements.

D. Journeyman shall have completed an apprenticeship program or have equivalent experience.

E. At the request of WESTON, the qualifications of the Contractor, subcontractors, and/or technical personnel shall be submitted for review and approval.

1.08 DESIGN CRITERIA

A. The work site is located at Paonia, CO.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Receive, unload, and store all equipment.

B. The Contractor shall inspect all incoming material for damage and compliance with the specifications and drawings. Defective or improper material shall be reported in writing to the supplier and WESTON and arrangements made with the supplier to correct the deficiency.

C. Store the provided equipment and materials in an environmentally safe location to preserve the quality and operation condition.

1.10 OUTAGES

A. Schedule any and all power outages required during construction with WESTON.

1.11 SHOP DRAWINGS AND MANUALS

A. Submit shop drawings in accordance with Section 01340 giving performance data, physical size, wiring diagrams, and materials, on following items:

1. Lighting fixtures
2. Motor controllers
3. Panelboards
4. Pushbutton stations
5. Dry type transformers
6. Conduit and duct
7. Cable Trays
8. Cable and wire
9. Fire alarm system
10. Handholes/manholes

B. Submit shop drawings showing detailed conduit routing, wiring and equipment locations in accordance with Section 01340.

C. Submit Operation and Maintenance Manuals for motor controllers, and panelboards in accordance with Section 01730.

D. Identify requirements of each electrical system before submission of shop drawings. Identify all necessary accessory parts required between items of electrical equipment (on separate drawings, if necessary, showing the particular system) in sufficient detail to prove that the total equipment furnished and installed will operate as specified and shown on the drawings.

1.12 FINAL ACCEPTANCE

A. WESTON will consider final acceptance of the power and control systems when all wiring considered as a complete system functions to operate all connected electrical equipment in the manner as indicated in the detailed specifications and drawings. Complete the following before acceptance:

1. Motors shall be connected to protective devices and control panels to provide proper motor acceleration, and correct motor rotation as shown on the drawings and as required by the driven equipment.

2. Control wiring shall be connected to all the control devices associated with a machine or a group of machines to produce the correct operating, timing and sequencing necessary for the proper functioning of the mechanical equipment as set forth by the specifications.

3. All necessary adjustments and alterations necessary from start of operations.

1.13 WORK BY OTHER CONTRACTORS

A. Excavation, trenching and backfill.

1. Physical installation of in-line instruments, valves and in pit mounted instruments.

1.14 WORK SEQUENCE

A. Install work to accommodate WESTON's schedule. During the construction period coordinate electrical schedule and operations with WESTON.

1.15 GUARANTEE

A. The manufacturer and/or Contractor shall guarantee in writing that the materials and workmanship of all equipment furnished by him, regardless of manufacturer, be new and free of defect for a period of one year from the date of acceptance or eighteen months from delivery of the last component whichever is reached first.

B. Defective materials and/or installation shall be replaced or repaired at no cost to WESTON in accordance with a schedule acceptable to WESTON.

1.16 REGULATORY REQUIREMENTS

A. Electrical: Conform to NFPA 70, The National Electrical Code.

B. Obtain permits, and request inspections from authority having jurisdiction.

1.17 PROJECT/SITE CONDITIONS

A. Install work in locations shown on drawings, unless prevented by project conditions.

B. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other sections. Obtain permission of WESTON before proceeding.

PART 2 – PRODUCTS

2.01 MATERIALS

A. All of the material shall be suitable for the listed environment.

B. All materials shall be heavy duty industrial type as manufactured by a principal industrial equipment manufacturer.

PART 3 – EXECUTION

3.01 INSPECTION

A. Prior to the submission of bid, the Contractor shall inspect the site to insure compatibility with the Work as shown on the drawings and in the specifications. Any conflicts shall be reported to WESTON.

3.02 PREPARATION

A. The Contractor shall verify all locations in the field and make minor adjustments to the Work to suit existing conditions.

B. Adjustments to dimensioned items on the drawings not indicated as being approximate shall be submitted to WESTON for approval.

C. All changes shall be accurately recorded on the "as-built" drawings and other related documents.

3.03 INSTALLATION

A. Install all equipment in strict accordance with the manufacturer's requirements unless otherwise approved by WESTON.

B. Verify the performance of all equipment.

3.04 QUALITY CONTROL

A. Perform such tests as are required to insure the integrity of the system.

B. The contractor shall verify that all connections are complete and correct, and that all grounds are in place and tested.

C. Submit all test and inspection reports to WESTON as required by the individual sections.

D. Deliver a set of as-built drawings to WESTON at the completion of the Project.

3.05 ADJUSTMENTS AND CLEANING

A. The manufacturer/supplier shall provide the services of a qualified start-up person to inspect and start-up the installed Work. The initial specified time and cost shall be a part of the cost of the equipment. Any additional time or cost shall be paid by the Contractor.

B. All components shall be properly set and adjusted.

C. All fuses, overloads, lamps, etc. shall be furnished and installed.

D. Deliver all specified spares to WESTON.

E. All equipment shall be cleaned, paint retouched, and have all covers installed prior to start-up.

END OF SECTION

ATTACHMENT G
ENGINEERING CALCULATIONS

R. K. FROBEL & ASSOCIATES
Consulting Engineers

Mr. Dave Goertz, P.E. October 22, 2014
Weston Solutions, Inc.
1435 Garrison Street
Suite 100
Lakewood, CO 80215

RE: Technical Memorandum
Gunnison Energy LLC Ponds
Anchor Trench Evaluation

Evaluation Scope:

Evaluate anchor trench design to prevent wind and water from moving under the geomembrane and pullout at a tensile force that will resist downslope movement without rupturing the geomembrane. An Anchor Ratio (AR) is determined based on input data.

The geosynthetic lining system for the ponds consists of a Primary and Secondary 60 mil HDPE Geomembrane with a Geocomposite Drainage Net sandwiched between the two liners:

- HDPE 60 mil Primary Geomembrane
- 6-200-6 Geonet Composite
- HDPE 60 mil Secondary Geomembrane
- Compacted and Smooth Subgrade Soil

The geosynthetic lining system will be anchored at the top of slope of all ponds in a conventional anchor trench with soil backfill as shown on the pond sections and details. The anchor trench will be cut a minimum of 3.0 ft back from the top of slope (3.0 ft. runout) and minimum depth of the trench will be 2.5 ft with a minimum width of 2.5 ft.

Assumptions and Considerations:

1. The runout length will not be backfilled but will be left exposed top of slope. Therefore, there is no cover soil interface friction angle and no cover soil depth (d)
2. The liner system consists of 3 layers. The critical interface is between the geocomposite nonwoven and the smooth HDPE. Historical interface shear data indicates that the interface exhibits a 14 degree friction angle.
3. Based on the Geotechnical Report, it is assumed that the site soil will be directly under the Secondary liner and will be used for anchor trench backfill. Site soil internal friction angle is 32.5 degrees.
4. The top primary HDPE geomembrane will be subjected to pullout due to wind, downslope tension, water/wave action.

32156 Castle Court, Suite 211/ M240, Evergreen, CO 80439 Ph 303-679-0285 / Fx 303-679-8955
geosynthetics@msn.com

Procedure:

$$AR = T_{GMallow}/T_{ATallow}$$

Where	AR	Anchor Ratio
	$T_{GMallow}$	Allowable geomembrane trench tension (ASTM D3886)
	$T_{ATallow}$	Allowable Anchor trench tension from analytical model

For the 60 mil smooth HDPE geomembrane, the yield strength is used for determining maximum allowable tension with a FS of 1.3

$T_{GMallow}$ = 126 lb/in/FS = 97 lb/in or 1164 lb/ft

$$T_{ATallow} = \frac{[\tan \delta_u + \tan \delta_L * (\gamma * d)] * L + (K_P - K_A) * [0.5\gamma * d_{AT\,2} + d * \gamma * d_{AT}]}{\text{Cos } \beta - \text{Sin } \beta * \tan \delta_L}$$

Where:	$T_{ATallow}$	Allowable anchor trench tension	
	γ	Common fill unit weight	120 pcf
	d_{AT}	Depth of Anchor Trench	2.5 ft
	d	Depth of Cover Soil	0.0 ft
	δ_L	Critical Interface	14.0 degrees
	δ_U	Cover Soil Interface	0.0 degrees
	φ	Soil internal friction angle	32.5 degrees
	β	Side slope angle	18.4 degrees
	K_p	Coefficient Passive Earth Pressure	2.05
	K_A	Coefficient Active Earth Pressure	0.23
	FS	HDPE Yield Strength Factor of Safety	1.3

Assume a value for the trench depth d and calculate the AR:

AR > 1.0	Geomembrane Pullout Mode Controls
AR = 1.0	Balanced Design
AR < 1.0	Geomembrane Tension Mode Controls

$T_{ATallow}$ = 770 lb/ft

AR = 1164 lb/ft / 770 lb/ft = 1.96

Geomembrane Tension/Pullout Mode Controls and Geomembrane Rupture does not occur = OK

32156 Castle Court, Suite 211/ M240, Evergreen, CO 80439 Ph 303-679-0285 / Fx 303-679-8955
geosynthetics@msn.com

References:

Koerner, R.M., "Designing with Geosynthetics" 5th Edition, Prentice Hall Publishing, Englewood Cliffs, NJ., 2005.

Richardson, G.N. and Koerner, R.M., "Geosynthetic Design Guidance for Hazardous Waste Landfill Cells and Surface Impoundments", EPA, 1987

If you have any questions on the above technical memorandum, give me a call at 303-679-0285 or email geosynthetics@msn.com.

Sincerely Yours,

R. K. Frobel

Ronald K. Frobel, MSCE, PE
Owner/Principal

Calculation of Required Channel Depth and Retention Volume

Peak Runoff Calculation;

Step 1: Since channel will be split calculate as two 3 acre basins. Area calculated from attached figure. Assume peak flow from each basin is 55 cfs.
Step 2: Assume sheet flow in basin represented by 300-foot wide channel (average width of basin) and that Manning's Equation applies.
Step 3: Assume Manning n for channel is 0.13.
Step 4: Measured slope of channed is 0.0833 ft/ft.
Step 5: Add slope and n and channel dimensions to attached "Basin Sheet Flow Calculation" spreadsheet.
Step 6: From spreadsheet flow of 55 CFS is 0.180 feet deep with a velocity of 1.05 ft/second.
Step 7: Time of concentration is 934 ft (measured longest flow path) divided by 1.05 feet per second equals 890 seconds or 14.8 minutes.
Step 8: From rainfall period/intensity diagram (City of Aspen, Urban Runoff Management Plan, Rev 2, 2010) is 3.8 inchs per hour for a 100 yr event.
Step 9: Calculate peak runoff for the basin: Qp= CIA

C= Runoff coefficient is 0.4 for Heavy Soil, Pasture, Steep
I=Intensity which is 3.9 inch/hr
A=Area of basin which is 3 acres.

Qp= 4.72 CFS

Step 10: So assumption made in Step 1 is wrong.
Step 11: Since channel will be split calculate as two 3 acre basins. Area calculated from attached figure. Assume peak flow from each basin is 5 cfs.
Step 12: Assume sheet flow in basin represented by 300-foot wide channel (average width of basin) and that Manning's Equation applies.
Step 13: Assume Manning n for channel is 0.13.
Step 14: Measured slope of channed is 0.0833 ft/ft.
Step 15: Add slope and n and channel dimensions to attached "Basin Sheet Flow Calculation" spreadsheet.
Step 16: From spreadsheet flow of 5 CFS is 0.045 feet deep with a velocity of 0.42 ft/second.
Step 17: Time of concentration is 934 ft (measured longest flow path) divided by 0.42 feet per second equals 2,224 seconds or 37 minutes.
Step 18: From rainfall period/intensity diagram (City of Aspen, Urban Runoff Management Plan, Rev 2, 2010) is 2.5 inchs per hour for a 100 yr event.
Step 19: Calculate peak runoff for the basin: Qp= CIA

C= Runoff coefficient is 0.4 for Heavy Soil, Pasture, Steep
I=Intensity which is 2.5 inch/hr
A=Area of basin which is 3 acres.

Qp= 3 CFS

Step 20: So assumption made in Step 11 is acceptable.

Channel Depth Calculation

Channel flow spreadsheet indicates flow depth at the outlet for a 1-foot wide channel with 2:1 side slopes is 0.60 feet.
As conservative estimate make outlet depth be 2.5 feet with 1 foot freeboard.
Flow is 0 cfs at midpoint so depth is 0 ft plus 1 foot freeboard.

Calculate Required Volume of Retention Ponds

Step 1. From NOAA Atlas 2 Volume III, 25yr 24hr event is 2.8 inches of water.
Step 2. Total volume for each basin is 2.8 inches times 3 acres is 30,492 cubic feet.

1st Iteration Spadafora Sheet Flow Velocity Calculation

Enter Channel Width, Mannings n and Slope

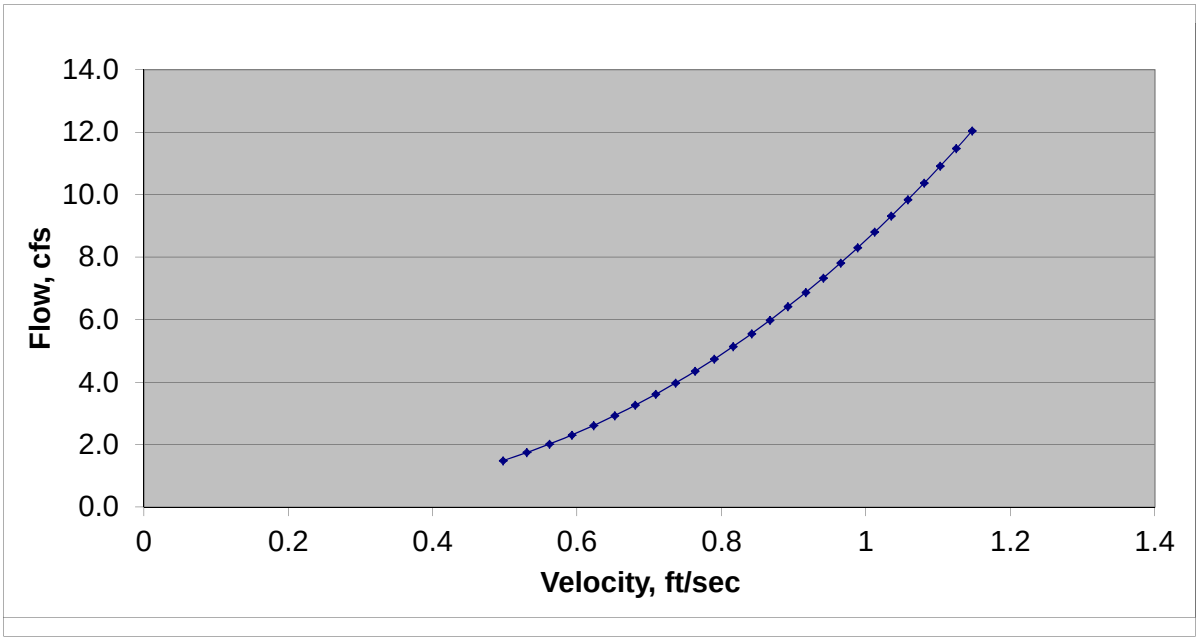
Mannings n 0.13

Slope 0.0833 ft/ft

**** Assumes channel has side slopes of 1/side.**

Fr<1, Subcritical
Fr = 1, Critical
Fr > 1, Supercritical

Depth ft	Side 1 feet	Side 2 feet	Base feet	Surface feet	Area ft^2	Wetted Perimeter feet	Rh** ft	V ft/sec	Q cfs	Q mgd	Q gpm	Fr
0.050	2.00	2.00	300.00	300.20	15.01	300.22	0.05	0.45	6.72	4.34	3014	0.35
0.060	2.00	2.00	300.00	300.24	18.01	300.27	0.06	0.51	9.10	5.88	4085	0.36
0.070	2.00	2.00	300.00	300.28	21.01	300.31	0.07	0.56	11.77	7.61	5282	0.37
0.080	2.00	2.00	300.00	300.32	24.01	300.36	0.08	0.61	14.70	9.50	6598	0.38
0.090	2.00	2.00	300.00	300.36	27.02	300.40	0.09	0.66	17.89	11.56	8030	0.39
0.100	2.00	2.00	300.00	300.40	30.02	300.45	0.10	0.71	21.33	13.78	9571	0.40
0.110	2.00	2.00	300.00	300.44	33.02	300.49	0.11	0.76	25.00	16.16	11219	0.40
0.120	2.00	2.00	300.00	300.48	36.03	300.54	0.12	0.80	28.90	18.68	12970	0.41
0.130	2.00	2.00	300.00	300.52	39.03	300.58	0.13	0.85	33.02	21.34	14821	0.41
0.140	2.00	2.00	300.00	300.56	42.04	300.63	0.14	0.89	37.37	24.15	16770	0.42
0.150	2.00	2.00	300.00	300.60	45.05	300.67	0.15	0.93	41.92	27.09	18813	0.42
0.160	2.00	2.00	300.00	300.64	48.05	300.72	0.16	0.97	46.68	30.17	20950	0.43
0.170	2.00	2.00	300.00	300.68	51.06	300.76	0.17	1.01	51.64	33.38	23178	0.43
0.180	2.00	2.00	300.00	300.72	54.06	300.80	0.18	1.05	56.81	36.71	25495	0.44
0.190	2.00	2.00	300.00	300.76	57.07	300.85	0.19	1.09	62.16	40.17	27899	0.44
0.200	2.00	2.00	300.00	300.80	60.08	300.89	0.20	1.13	67.71	43.76	30390	0.44
0.210	2.00	2.00	300.00	300.84	63.09	300.94	0.21	1.16	73.45	47.47	32964	0.45
0.220	2.00	2.00	300.00	300.88	66.10	300.98	0.22	1.20	79.37	51.30	35622	0.45
0.230	2.00	2.00	300.00	300.92	69.11	301.03	0.23	1.24	85.48	55.24	38362	0.45
0.240	2.00	2.00	300.00	300.96	72.12	301.07	0.24	1.27	91.76	59.30	41183	0.46
0.250	2.00	2.00	300.00	301.00	75.13	301.12	0.25	1.31	98.22	63.48	44083	0.46
0.260	2.00	2.00	300.00	301.04	78.14	301.16	0.26	1.34	104.86	67.77	47061	0.46
0.270	2.00	2.00	300.00	301.08	81.15	301.21	0.27	1.38	111.67	72.17	50117	0.47
0.280	2.00	2.00	300.00	301.12	84.16	301.25	0.28	1.41	118.65	76.68	53249	0.47
0.290	2.00	2.00	300.00	301.16	87.17	301.30	0.29	1.44	125.80	81.30	56457	0.47
0.300	2.00	2.00	300.00	301.20	90.18	301.34	0.30	1.48	133.11	86.02	59740	0.47



2nd Iteration Spadafora Sheet Flow Velocity Calculation

Enter Channel Width, Mannings n and Slope

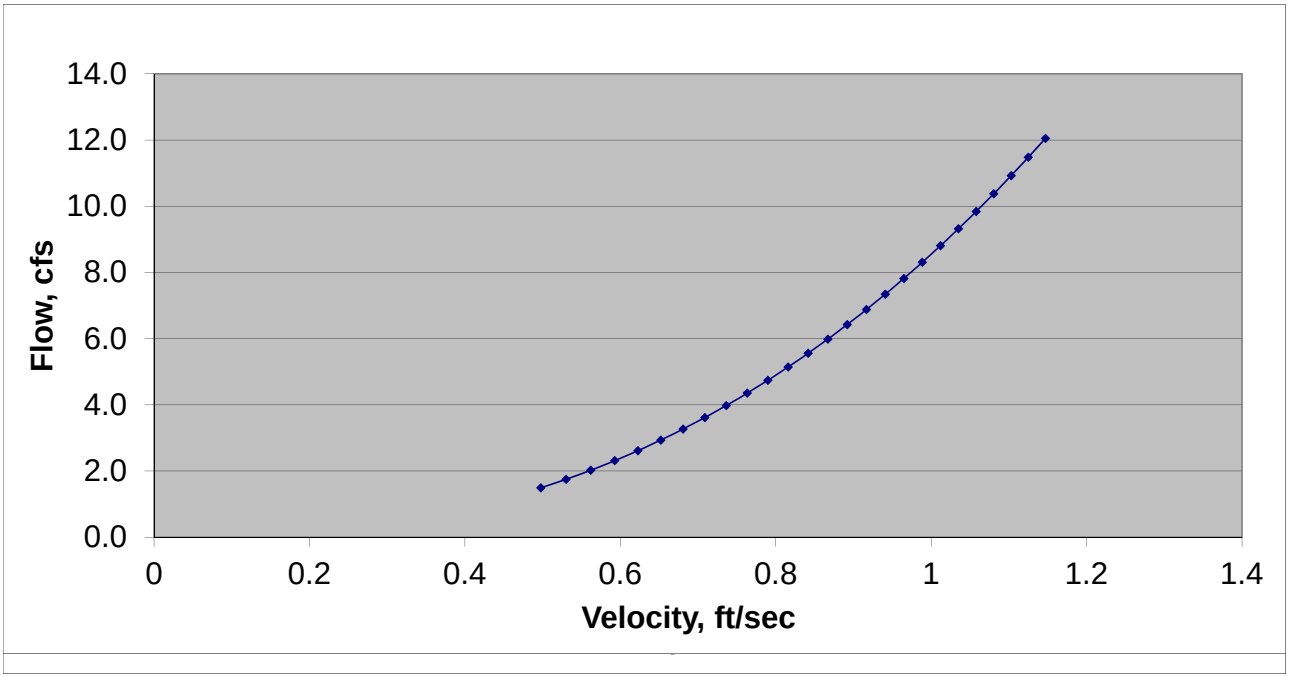
Mannings n 0.13

Slope 0.0833 ft/ft

**** Assumes channel has side slopes of 1/side.**

Fr<1, Subcritical
Fr = 1, Critical
Fr > 1, Supercritical

Depth ft	Side 1 feet	Side 2 feet	Base feet	Surface feet	Area ft^2	Wetted Perimeter feet	Rh** ft	V ft/sec	Q cfs	Q mgd	Q gpm	Fr
0.030	2.00	2.00	300.00	300.12	9.00	300.13	0.03	0.32	2.87	1.85	1287	0.32
0.035	2.00	2.00	300.00	300.14	10.50	300.16	0.03	0.35	3.71	2.40	1664	0.33
0.040	2.00	2.00	300.00	300.16	12.00	300.18	0.04	0.39	4.63	2.99	2078	0.34
0.045	2.00	2.00	300.00	300.18	13.50	300.20	0.04	0.42	5.64	3.64	2529	0.35
0.050	2.00	2.00	300.00	300.20	15.01	300.22	0.05	0.45	6.72	4.34	3014	0.35
0.055	2.00	2.00	300.00	300.22	16.51	300.25	0.05	0.48	7.87	5.09	3533	0.36
0.060	2.00	2.00	300.00	300.24	18.01	300.27	0.06	0.51	9.10	5.88	4085	0.36
0.065	2.00	2.00	300.00	300.26	19.51	300.29	0.06	0.53	10.40	6.72	4668	0.37
0.070	2.00	2.00	300.00	300.28	21.01	300.31	0.07	0.56	11.77	7.61	5282	0.37
0.075	2.00	2.00	300.00	300.30	22.51	300.34	0.07	0.59	13.20	8.53	5925	0.38
0.080	2.00	2.00	300.00	300.32	24.01	300.36	0.08	0.61	14.70	9.50	6598	0.38
0.085	2.00	2.00	300.00	300.34	25.51	300.38	0.08	0.64	16.27	10.51	7300	0.39
0.090	2.00	2.00	300.00	300.36	27.02	300.40	0.09	0.66	17.89	11.56	8030	0.39
0.095	2.00	2.00	300.00	300.38	28.52	300.42	0.09	0.69	19.58	12.65	8787	0.39
0.100	2.00	2.00	300.00	300.40	30.02	300.45	0.10	0.71	21.33	13.78	9571	0.40
0.105	2.00	2.00	300.00	300.42	31.52	300.47	0.10	0.73	23.13	14.95	10382	0.40
0.110	2.00	2.00	300.00	300.44	33.02	300.49	0.11	0.76	25.00	16.16	11219	0.40
0.115	2.00	2.00	300.00	300.46	34.53	300.51	0.11	0.78	26.92	17.40	12082	0.41
0.120	2.00	2.00	300.00	300.48	36.03	300.54	0.12	0.80	28.90	18.68	12970	0.41
0.125	2.00	2.00	300.00	300.50	37.53	300.56	0.12	0.82	30.93	19.99	13883	0.41
0.130	2.00	2.00	300.00	300.52	39.03	300.58	0.13	0.85	33.02	21.34	14821	0.41
0.135	2.00	2.00	300.00	300.54	40.54	300.60	0.13	0.87	35.17	22.73	15783	0.42
0.140	2.00	2.00	300.00	300.56	42.04	300.63	0.14	0.89	37.37	24.15	16770	0.42
0.145	2.00	2.00	300.00	300.58	43.54	300.65	0.14	0.91	39.62	25.60	17780	0.42
0.150	2.00	2.00	300.00	300.60	45.05	300.67	0.15	0.93	41.92	27.09	18813	0.42
0.155	2.00	2.00	300.00	300.62	46.55	300.69	0.15	0.95	44.27	28.61	19870	0.43



Spadafora Drainage Channel Depth Calculation

Enter Channel Width, Mannings n and Slope

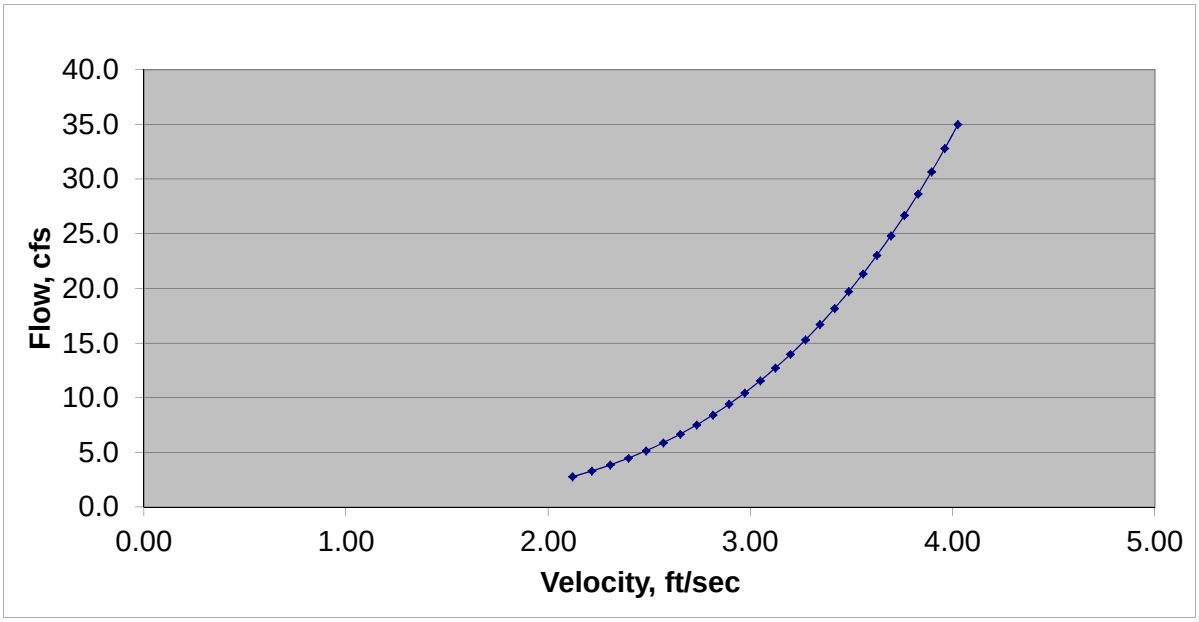
Mannings n 0.025

Slope 0.005 ft/ft

**** Assumes channel has side slopes of 1/side.**

Fr<1, Subcritical
Fr = 1, Critical
Fr > 1, Supercritical

Depth ft	Side 1 feet	Side 2 feet	Base feet	Surface feet	Area ft^2	Wetted Perimeter feet	Rh** ft	V ft/sec	Q cfs	Q mgd	Q gpm	Fr
0.600	2.00	2.00	1.00	3.40	1.32	3.68	0.36	2.12	2.80	1.81	1256	0.48
0.650	2.00	2.00	1.00	3.60	1.50	3.91	0.38	2.22	3.31	2.14	1486	0.48
0.700	2.00	2.00	1.00	3.80	1.68	4.13	0.41	2.31	3.88	2.51	1740	0.49
0.750	2.00	2.00	1.00	4.00	1.88	4.35	0.43	2.40	4.49	2.90	2017	0.49
0.800	2.00	2.00	1.00	4.20	2.08	4.58	0.45	2.48	5.17	3.34	2319	0.49
0.850	2.00	2.00	1.00	4.40	2.30	4.80	0.48	2.57	5.90	3.81	2647	0.49
0.900	2.00	2.00	1.00	4.60	2.52	5.02	0.50	2.65	6.69	4.32	3001	0.49
0.950	2.00	2.00	1.00	4.80	2.76	5.25	0.52	2.73	7.53	4.87	3382	0.49
1.000	2.00	2.00	1.00	5.00	3.00	5.47	0.55	2.82	8.45	5.46	3791	0.50
1.050	2.00	2.00	1.00	5.20	3.26	5.70	0.57	2.89	9.42	6.09	4228	0.50
1.100	2.00	2.00	1.00	5.40	3.52	5.92	0.59	2.97	10.46	6.76	4695	0.50
1.150	2.00	2.00	1.00	5.60	3.80	6.14	0.62	3.05	11.57	7.48	5193	0.50
1.200	2.00	2.00	1.00	5.80	4.08	6.37	0.64	3.12	12.75	8.24	5721	0.50
1.250	2.00	2.00	1.00	6.00	4.38	6.59	0.66	3.20	13.99	9.04	6280	0.50
1.300	2.00	2.00	1.00	6.20	4.68	6.81	0.69	3.27	15.31	9.90	6872	0.51
1.350	2.00	2.00	1.00	6.40	5.00	7.04	0.71	3.34	16.71	10.80	7497	0.51
1.400	2.00	2.00	1.00	6.60	5.32	7.26	0.73	3.42	18.17	11.74	8156	0.51
1.450	2.00	2.00	1.00	6.80	5.66	7.48	0.76	3.49	19.72	12.74	8849	0.51
1.500	2.00	2.00	1.00	7.00	6.00	7.71	0.78	3.56	21.34	13.79	9577	0.51
1.550	2.00	2.00	1.00	7.20	6.36	7.93	0.80	3.63	23.04	14.89	10341	0.51
1.600	2.00	2.00	1.00	7.40	6.72	8.16	0.82	3.69	24.82	16.04	11141	0.51
1.650	2.00	2.00	1.00	7.60	7.10	8.38	0.85	3.76	26.69	17.25	11979	0.52
1.700	2.00	2.00	1.00	7.80	7.48	8.60	0.87	3.83	28.64	18.51	12854	0.52
1.750	2.00	2.00	1.00	8.00	7.88	8.83	0.89	3.90	30.68	19.82	13767	0.52
1.800	2.00	2.00	1.00	8.20	8.28	9.05	0.91	3.96	32.80	21.20	14720	0.52
1.850	2.00	2.00	1.00	8.40	8.70	9.27	0.94	4.03	35.01	22.63	15712	0.52



Slopes:

6 acres	973 ft	flow line	*slope =*
start 8179 end 8099		diff = 80	***0.0822199***

Channel Flow via SCS Method (6 acre parcel ONLY)

Eqtn (i) $T_f = L_f/(60*V_f)$

Eqtn (ii) $V_f = K(\sqrt{S_f})$

Eqtn (iii) $T_C = T_0 + T_f$ *(However, note that* T_0 *is equal to zero)*

Eqtn (iv) $Q_p = CIA$

Step 1 V_f = **1.29** and

Step 2 T_f = **12.57** w/ T_0 = **0**

Step 3 T_C = **12.57** min

Step 4 Gunnison County Stormwater Management Manual states that the lowest time of concentration (T_C) value calculated between (A) the Regional Method and (B) the SCS Method, be used for flow rate and volume calculations.

(A) When using the Regional Method, T_C = **0.00**

VS.

(B) When using the SCS Method, T_C = **12.57**

Therefore, we should use Method (B), the SCS Method.

Given the new T_C value of 12.5 min. the, intensity value also changes; the new Intensity (I) value = **4.2** in/hr.

Step 5 Calculate the final value, flowrate (Q_p); Q_p = CIA =>

C = **0.5** [--]
I = **4.2** [in/hr]
A = **6** [acres]

Q_p = 12.6 cfs

DG unit conversion, Acre is 43,560 sf, inch per hour is 0.000231 cfs so flow rate is 12.71 cfs.

Terms		Values Applied	Values Calculated
T_f =	channel flow time [min]		**12.57**
L_f =	flow length [ft]	**973**	
V_f =	flow velosity [ft/sec]		**1.29**
K =	conveyance coefficient	**4.5**	
S_f =	slope of reach [ft/ft]	**0.0822**	
T_C =	time of concentration [min]		**12.57**
T_0 =	overland flow time [min]	**0**	
Q_p =	flowrate [cfs]		**12.6**
C =	runoff coefficient	**0.5**	
I =	intensity [in/hr]		**4.2**
A =	area [ac]	**6**	

Per 2012 Gunnison Stormwater Management Manual:

- ✓ 1. Delineate the basin boundary. Measure its area (acres). See Section 3.6.1.
- ✓ 2. Identify the soil types(s) See Figure 4 Soil Types
- ✓ 3. Determine Runoff Coefficient (C). See Section 3.6.2.
- ✓ 4. Define the flow path from the upper-most portion of the basin to the design point. This flow path must be divided into reaches of similar flow type (e.g. overland flow, shallow swale flow, gutter flow, etc.). The length and slope of each reach must be measured.
- ✓ 5. Determine the time of concentration (T_C) for the catchment. See Section 3.6.3.
- ✓ 6. Find the rainfall intensity (I) for the design storm using the calculated T_C and the rainfall intensity-duration-frequency curve. See §3.1.
- ✓ 7. Calculate the peak flow rate (Q_p)from the watershed. See Equation 3-3.

Applied Values

=> $Area_1$ = **6** [ac]

=> Soil Type Selected = D [--]

=> Runoff Coefficent (C) = **0.5**

=> $Flowpath_1$ = **973** [ft]

*No slope yet => Must have it to calc T_f and T_C. Emailed CP.

Regional Formula => $T_R = 10 + L/180$; (manual says use lowest value of the two).

=> T_{R1} = **15.41** [min]

=> I_1 = **3.75** [in/hr]

=> $Q_p = CIA$

=> Q_{p1} = **11.3** [cfs]

Total Runoff => Q_{p1} + = 11.3 [cfs]

DG unit conversion, Acre is 43,560 sf, inch per hour is 0.000231 cfs so flow rate is 11.34 cfs.

*Note 1: For flowpaths longer then 500 ft. in rural settings, overland flow should not be used (see manual pg. 20). Instead Channel Flow should be used. I am still waiting on ave. slope for each flowpath from CP. The value shown above uses Regional Formula in place of Time of Concentration.

*Note 2: All values used were referenced from the 2012 Gunnison Manual, which in turn were pulled from the Colorado section of the National Atmospheric Adminstration Precipitation-Frequency Atlas of the Western United States, Vol. III-Colorado (NOAA Atlas).

*Note 3: Rainfall IDF curve used for Gunnison, CO (NOAA Atlas) for 100-yr. return storm event.

*Note 4: Soil Type selected = D. Soil Type D is defined as, "Soils having low to very low infiltration", per Natural Resource Conservation Service (NRCS).

*Note 5: The runoff coefficient is derived from the selected soil type (D) and the % of imprevious surface (for a 100-yr. return storm event curve). Assumtion for watershed => 0% impervious surface, i.e. no paved/concrete surfaces.

Calc for Culvert Sizing on South Drainage Channel

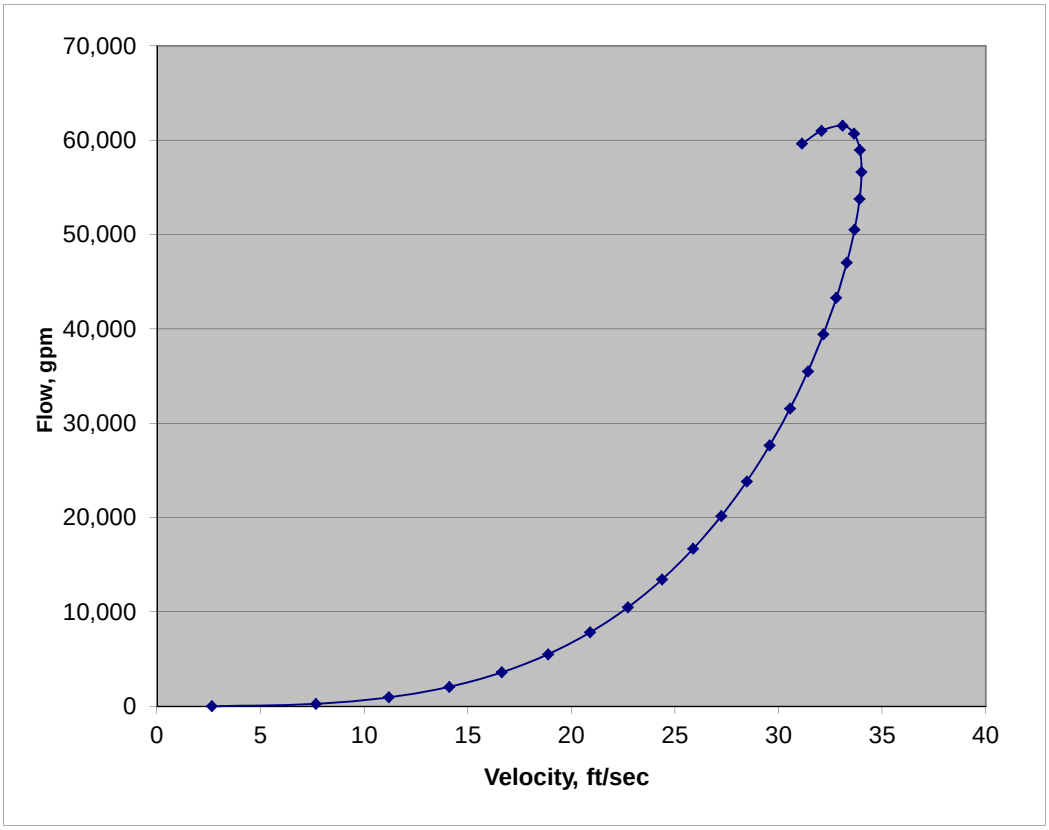
Mannings Equation

Enter Diameter, Mannings n and Slope

Diameter	**18**	**inches**
Mannings n	**0.011**	
Slope	**0.1**	**ft/ft**

Fr < 1, Subcritical
Fr = 1, Critical
Fr > 1, Supercritical

Percent Full	Depth ft	Angle radians	Area ft^2	Rh ft	V ft/sec	Q cfs	Q mgd	Q gpm	Fr
1%	0.02	0.40	0.00	0.01	1.98	0.01	0.00	3	2.84
5%	0.08	0.90	0.03	0.05	5.71	0.19	0.12	85	3.67
9%	0.14	1.22	0.08	0.09	8.33	0.66	0.42	295	4.00
13%	0.20	1.48	0.13	0.12	10.51	1.42	0.92	637	4.19
17%	0.26	1.70	0.20	0.16	12.39	2.47	1.60	1108	4.32
21%	0.32	1.90	0.27	0.19	14.06	3.79	2.45	1703	4.42
25%	0.38	2.09	0.35	0.22	15.57	5.38	3.48	2413	4.48
29%	0.44	2.27	0.43	0.25	16.92	7.20	4.65	3231	4.52
33%	0.50	2.45	0.51	0.28	18.15	9.23	5.97	4144	4.55
37%	0.56	2.62	0.59	0.30	19.27	11.46	7.40	5141	4.56
41%	0.62	2.78	0.68	0.33	20.29	13.84	8.94	6211	4.56
45%	0.68	2.94	0.77	0.35	21.20	16.35	10.57	7339	4.55
49%	0.74	3.10	0.86	0.37	22.02	18.96	12.26	8511	4.53
53%	0.80	3.26	0.95	0.39	22.76	21.64	13.99	9713	4.50
57%	0.86	3.42	1.04	0.41	23.40	24.35	15.74	10927	4.46
61%	0.92	3.59	1.13	0.42	23.95	27.05	17.48	12138	4.41
65%	0.98	3.75	1.22	0.43	24.42	29.69	19.19	13327	4.36
69%	1.04	3.92	1.30	0.44	24.80	32.25	20.84	14473	4.30
73%	1.10	4.10	1.38	0.45	25.08	34.66	22.40	15556	4.22
77%	1.16	4.28	1.46	0.45	25.26	36.88	23.83	16551	4.14
81%	1.22	4.48	1.53	0.46	25.33	38.83	25.10	17428	4.05
85%	1.28	4.69	1.60	0.45	25.27	40.45	26.14	18155	3.94
89%	1.34	4.93	1.66	0.45	25.06	41.63	26.90	18684	3.82
93%	1.40	5.21	1.71	0.44	24.64	42.21	27.28	18943	3.68
97%	1.46	5.59	1.75	0.42	23.88	41.84	27.04	18777	3.49
99%	1.49	5.88	1.76	0.40	23.19	40.90	26.44	18358	3.35



Spadafora Hydrology and Culvert Sizing

Hydrology

They hydrologic analysis was done using the U.S. Geological Survey (USGS) regression equations for Colorado, and checked using a simple single basin model using the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) software. The design storm was a 100-year, 6-hour event.

USGS Regression Equations

The USGS Regression Equations developed in the *Regional Regression Equations for Estimation of Natural Streamflow Statistics in Colorado* report, dated 2009, were used for the hydrologic calculation. The project site is located within the Mountain Region of the USGS analysis. The Peak Streamflow Equation for the 100-year storm in the Mountain Region is:

$$Q_{100} = 10^{-0.46} A^{0.75} S^{0.14} P^{1.35}$$

Where, Q_{100} = 100-year Peak Flow Rate, in cubic feet per second (cfs)
A = Drainage Area, in square miles (sq. mi.)
S = Mean Watershed Slope, in percent (%)
P = Mean Annual Precipitation, in inches (in)

From the design drawings, a drainage area of 0.583 sq. mi. was delineated, and a mean watershed slope of the longest drainage path was estimated to be 0.0362 foot per foot (ft/ft), or 3.62 %. The project site is located between two of the USGS stream gauges used in developing the regression equations, 6 miles from one (USGS Gauge 09130600, Muddy Creek Near Ragged Mountain), and 8 miles from the other (USGS Gauge 09130500, Muddy Creek near Bardine). The average value of the mean annual precipitations for these two gauges is approximately 29.3 inches. Using this information, the 100-year peak flow rate was calculated:

$$Q_{100} = 10^{-0.46} A^{0.75} S^{0.14} P^{1.35} = 10^{-0.46} (0.583\ sq.mi.)^{0.75} (3.62\ \%)^{0.14} (29.3\ in)^{1.35} = 26.5\ cfs$$

The specific USGS regression equation used was developed using drainage areas of 1 to 1,060 sq. mi., therefore this basin is below the intended range. As a check of the equation's sensitivity, the drainage area was increased to 1 sq. mi. (within the intended range) and all other variables were unchanged:

$$Q_{100} = 10^{-0.46} A^{0.75} S^{0.14} P^{1.35} = 10^{-0.46} (1.0\ sq.mi.)^{0.75} (3.62\ \%)^{0.14} (29.3\ in)^{1.35} = 39.7\ cfs$$

A 72% increase in drainage area resulted in a 50% increase in peak flow rate. Although the equation is not linear, the increases show a reasonable result, and using a basin area of 0.583 sq. mi. does not seem to be invalid.

HEC-HMS Model

As a check of the USGS regression equation results, a HEC-HMS model was created. The following pieces of information were collected while creating the model:

- Basin Area = 0.583 sq. mi.
- Longest flow path length = 5,247
- Flow path is from an elevation of approximately 8,210 feet above mean sea level (ft amsl) to 8,020 ft amsl, which results in a slope of 0.0362 ft/ft (3.62 %).
- Project area soil types were determined using a Web Soil Survey on the National Resource Conservation Service (NRCS) website. All soils were determined to be of the Hydrologic Soil Group C. The Soil Report is attached.
- Using the values in Table 2-2c from *Urban Hydrology for Small Watersheds, Technical Release 55* (TR-55) developed by NRCS, the Curve Number (CN) of the watershed was estimated to be approximately 72. This is an average between the land use types of:
    - Meadow, Fair Condition, Hydrologic Soil Group C = 71
    - Woods, Fair Condition, Hydrologic Soil Group C = 73
- Based on aerial imagery, it was assumed that the % impervious area is zero.
- Precipitation depths were obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 data, using the latitude and longitude of the project site. A copy of the precipitation data is attached. The rainfall values used were the following:
    - 2-year, 24-hour rainfall (P_2) = 1.40 inches
    - 100-year, 6-hour rainfall = 1.79 inches
- The Lag Time (T_L) was calculated using the methods in TR-55 as the following:
    - Sheet Flow. Used a flow length (L) of 300 feet, a Manning's roughness (n) of 0.40, a slope (s) of 0.0362 ft/ft, and a 2-Year, 24-hour rainfall (P_2) of 1.40 inches from NOAA Atlas 14. The following equation from TR-55 is for sheet flow:

$$Travel\ Time, T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}} = \frac{0.007[(0.13)(300\ ft)]^{0.8}}{(1.40\ in)^{0.5}(0.0362\ ft/ft)^{0.4}} = 0.42\ hr = 25\ min$$

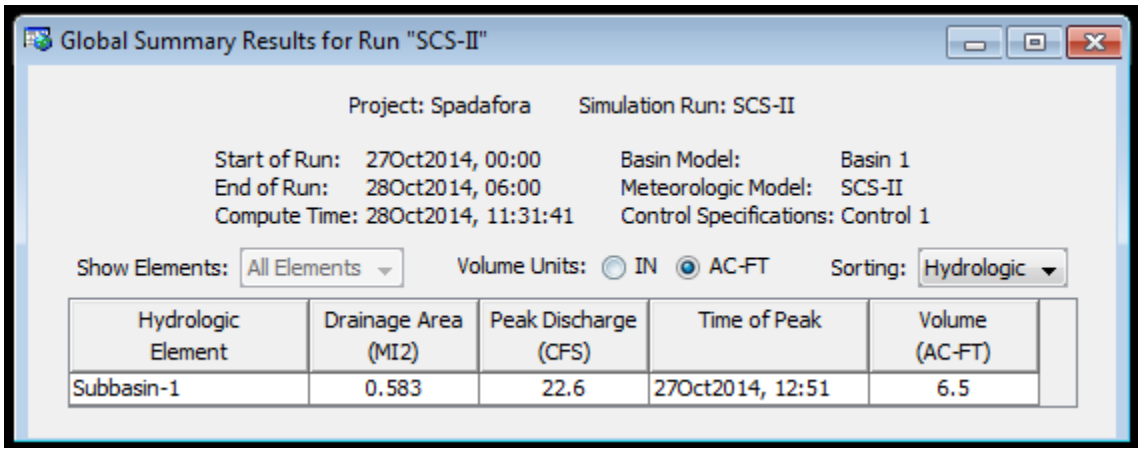
    - Shallow Concentrated Flow. Used a flow length of 1,000 feet, a slope of 0.0362 ft/ft, and determined the average velocity using Figure 3-1 in TR-55 for an unpaved surface to be 3 feet per second (ft/s).

$$Travel\ Time, T_t = \frac{Length}{Velocity} = \frac{1{,}000\ ft}{3\ ft/s} \times \frac{1\ min}{60\ s} = 6\ min$$

    - Channel Flow. Assumed a channel with 4 ft bottom width, 3:1 (H:V) side slopes, slope of 3.62%, with 27 cfs (from USGS regression). Manning's calculation using FlowMaster software resulted in a velocity of approximately 5 ft/s. The FlowMaster output file is attached. The remaining flow length is 3,948 ft, therefore the travel time is:

$$Travel\ Time, T_t = \frac{Length}{Velocity} = \frac{3{,}948\ ft}{5\ ft/s} \times \frac{1\ min}{60\ s} = 13\ min$$

  - Total travel time (Time of Concentration, T_C) is = 25 min + 6 min + 13 min = 44 min
  - T_L is approximately 0.6 of T_C, therefore, T_L = 26 min
- The Soil Conservation Service (SCS, now NRCS) method was used in HEC-HMS. The project site is located within the SCS Type II rainfall distribution area, and the 100-year, 6-hour rainfall depth was 1.79 in. The following is the output results of HEC-HMS:



HEC-HMS resulted in a 100-year, 6-hour peak flow rate of approximately 23 cfs, which is in close agreement with the 27 cfs predicted by the USGS regression equation. The design flow rate used for sizing the culvert was 27 cfs.

Culvert Sizing

To size the road crossing culvert, the Federal Highway Administration (FHWA) HY-8 software was used, which employs the culvert hydraulics nomographs developed in the *Hydraulics of Highway Culverts, Hydraulic Design Series Number 5* (HDS-5) developed by FHWA. In addition to all of the data presented above, it was assumed that the culvert length would be 40 feet, have drop of 1 foot, have an allowable headwater depth of 5 ft before overtopping the road, and have a manufactured end section on the inlet of the pipe. A detailed HY-8 culvert hydraulics and energy dissipation output is attached.

Based on the HY-8 results, a corrugated metal pipe (CMP) culvert with a minimum diameter of 36 inches is recommended. At 27 cfs, the inlet will be about 81% submerged, and it has an overtopping capacity of 63 cfs. On the outlet, a 14-foot long by 12-foot wide loose riprap apron comprised of rock with a D_{50} of 6 inches is recommended.

Mannings Equation

SWSF French Drain Flow Rate

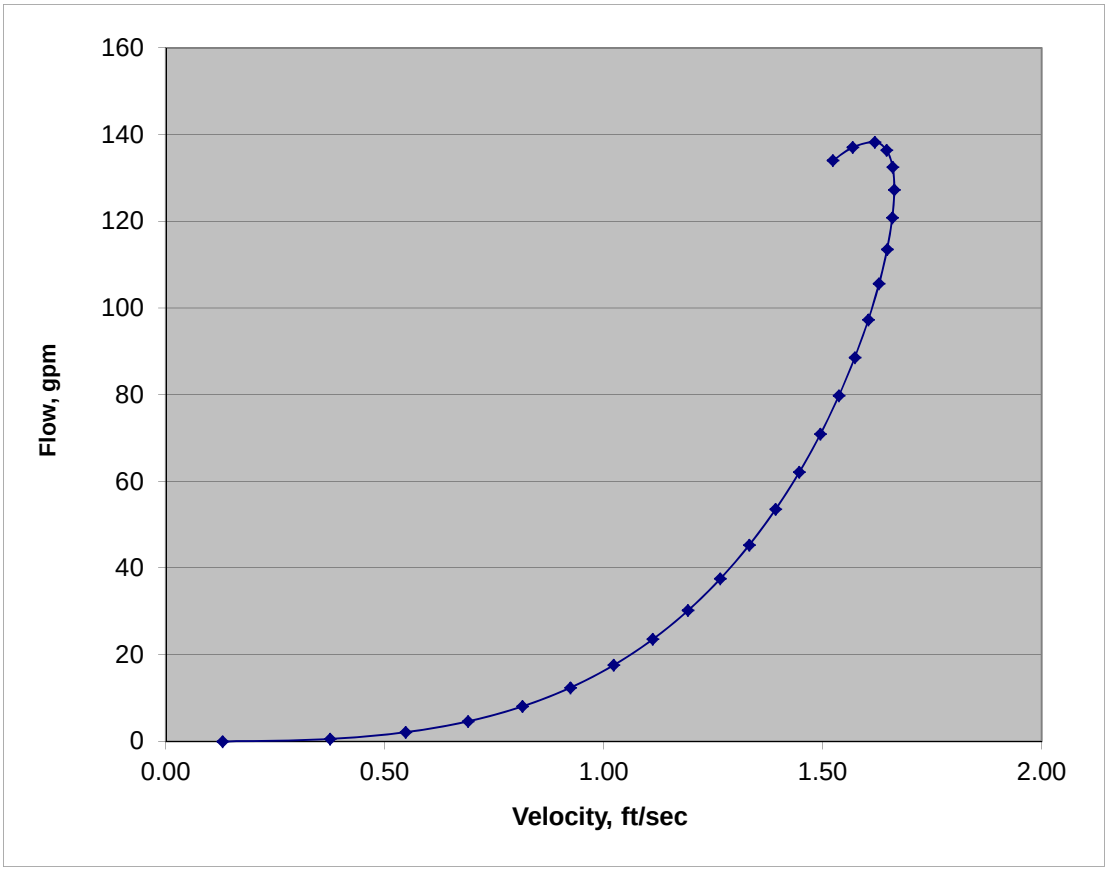
Enter Diameter, Mannings n and Slope

DAG 1/28/15

Diameter	**6**	**inches**
Mannings n	**0.018**	
Slope	**0.005**	**ft/ft**

Fr < 1, Subcritical
Fr = 1, Critical
Fr > 1, Supercritical

Percent Full	Depth ft	Angle radians	Area ft^2	Rh ft	V ft/sec	Q cfs	Q mgd	Q gpm	Fr
1%	0.01	0.40	0.00	0.00	0.13	0.00	0.00	0	0.32
5%	0.03	0.90	0.00	0.02	0.37	0.00	0.00	1	0.42
9%	0.05	1.22	0.01	0.03	0.55	0.00	0.00	2	0.45
13%	0.07	1.48	0.01	0.04	0.69	0.01	0.01	5	0.48
17%	0.09	1.70	0.02	0.05	0.81	0.02	0.01	8	0.49
21%	0.11	1.90	0.03	0.06	0.92	0.03	0.02	12	0.50
25%	0.13	2.09	0.04	0.07	1.02	0.04	0.03	18	0.51
29%	0.15	2.27	0.05	0.08	1.11	0.05	0.03	24	0.51
33%	0.17	2.45	0.06	0.09	1.19	0.07	0.04	30	0.52
37%	0.19	2.62	0.07	0.10	1.27	0.08	0.05	38	0.52
41%	0.21	2.78	0.08	0.11	1.33	0.10	0.07	45	0.52
45%	0.23	2.94	0.09	0.12	1.39	0.12	0.08	54	0.52
49%	0.25	3.10	0.10	0.12	1.45	0.14	0.09	62	0.52
53%	0.27	3.26	0.11	0.13	1.49	0.16	0.10	71	0.51
57%	0.29	3.42	0.12	0.14	1.54	0.18	0.11	80	0.51
61%	0.31	3.59	0.13	0.14	1.57	0.20	0.13	89	0.50
65%	0.33	3.75	0.14	0.14	1.60	0.22	0.14	97	0.50
69%	0.35	3.92	0.14	0.15	1.63	0.24	0.15	106	0.49
73%	0.37	4.10	0.15	0.15	1.65	0.25	0.16	114	0.48
77%	0.39	4.28	0.16	0.15	1.66	0.27	0.17	121	0.47
81%	0.41	4.48	0.17	0.15	1.66	0.28	0.18	127	0.46
85%	0.43	4.69	0.18	0.15	1.66	0.30	0.19	133	0.45
89%	0.45	4.93	0.18	0.15	1.65	0.30	0.20	136	0.43
93%	0.47	5.21	0.19	0.15	1.62	0.31	0.20	138	0.42
97%	0.49	5.59	0.19	0.14	1.57	0.31	0.20	137	0.40
99%	0.50	5.88	0.20	0.13	1.52	0.30	0.19	134	0.38



Calculation of Maximum Inflow/Foot

Flow at 80% full. 127 gpm

Lengths of Slotted Pipes from Plan Set
Calculation for both drain flowing south and drain flowing north.

Drain flowing North

FD-3 to 6	384	feet
FD-8	108	feet
Total	492	feet

Max inflow is 0.25813 gpm/foot

Drain flowing South

FD-10	96	feet
FD-12-13	288	feet
Total	384	feet

Max inflow is 0.330729 gpm/foot

DAG 1/28/15

Huddleston-Berry
Engineering & Testing, LLC

640 White Avenue
Grand Junction, CO 81501
Phone: 970-255-8005
Fax: 970-255-6818
HuddlestonBerry@bresnan.net
www.HBET-GJ.com

January 24, 2014
Project#01302-0001

Weston Solutions, Inc.
1435 Garrison Street, Suite 100
Lakewood, Colorado 80215

Attention: Mr. Dave Goertz

Subject: Cut Slope Stability
Water Impoundments
Paonia, Colorado

Reference: *Geotechnical and Geologic Hazards Investigation, Water Impoundments, Paonia, Colorado* by Huddleston-Berry Engineering & Testing, LLC for Weston Solutions, Inc., December 2, 2013.

Dear Mr. Goertz,

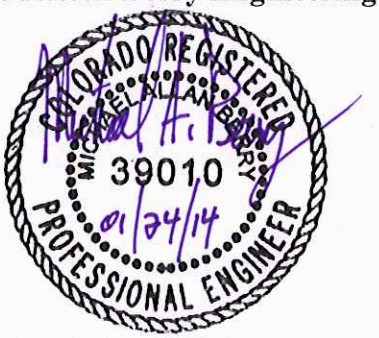
At your request, Huddleston-Berry Engineering & Testing, LLC (HBET) conducted slope stability analyses for cut slopes for the proposed water impoundments project near Paonia, Colorado. HBET understands that 2H:1V to 3H:1V cut slopes are proposed.

In order to evaluate cut slope stability, limit equilibrium analyses were conducted using the GSTABL7 computer software program. The results of the analyses indicate that the overburden soils are stable at a slope of 2.5H:1V and that the weathered shale bedrock is stable at a slope of 2H:1V. In addition, HBET evaluated a generalized cross section of a 25 feet cut through the existing overburden and shale bedrock materials based upon the results of the referenced geotechnical investigation. The results of this analysis indicate that the overall slope is stable at 2H:1V. However, the soils above the shale may experience surface sloughing at 2H:1V.

It is important to note that the stability results assumed moist, but not saturated soils/bedrock. Based upon information in the referenced report, groundwater is present in the subsurface at the site in some areas where preferential pathways exist. Where saturated materials are present, the recommended cut slopes may not be valid. However, the full nature and extent of saturated zones cannot be fully evaluated until construction. HBET should be contacted to provide oversight during construction in order to evaluate the impacts of groundwater and/or saturated zones on the cut slope stability.

We are pleased to be of service to your project. Please contact us if you have any questions or comments regarding the contents of this letter.

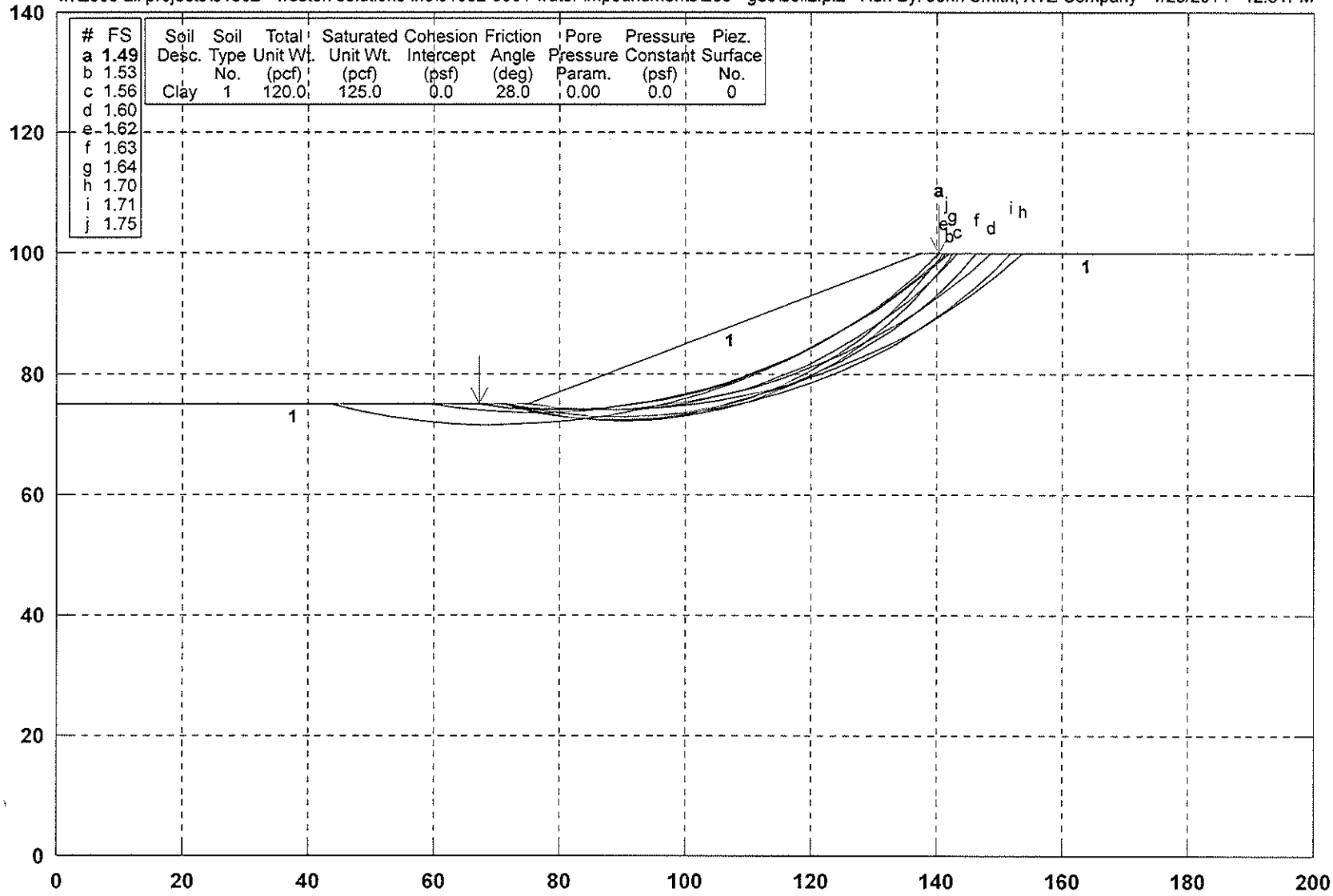
Respectfully Submitted:
Huddleston-Berry Engineering and Testing, LLC



Michael A. Berry, P.E.
Vice President of Engineering

Paonia Ponds Overburden

w:\2008 all projects\01302 - weston solutions inc\01302-0001 water impoundments\200 - geo\soil2.pl2 Run By: John Smith, XYZ Company 1/23/2014 12:51PM



#	FS
a	1.49
b	1.53
c	1.56
d	1.60
e	1.62
f	1.63
g	1.64
h	1.70
i	1.71
j	1.75

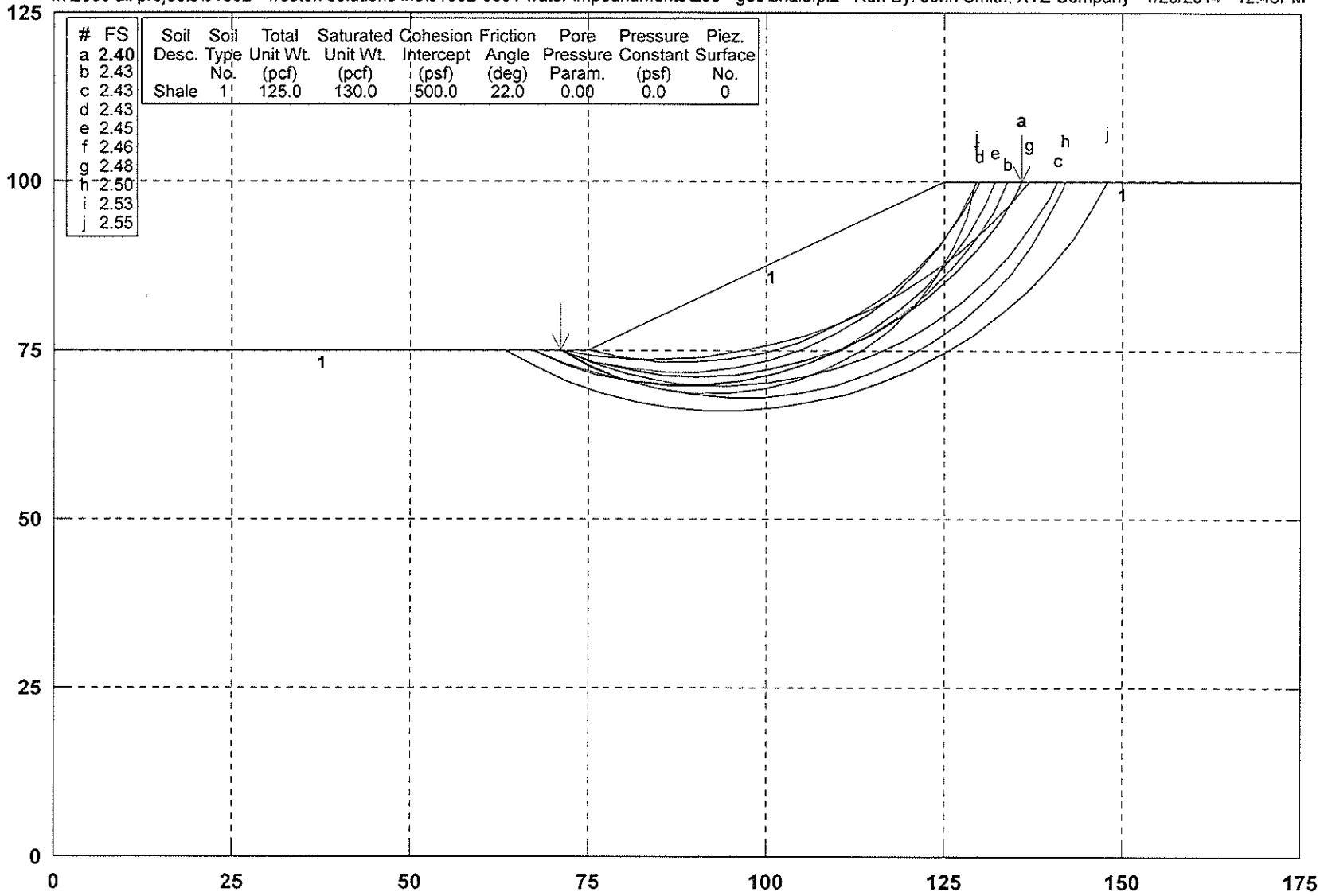
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Clay	1	120.0	125.0	0.0	28.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.49

Safety Factors Are Calculated By The Modified Bishop Method

Paonia Ponds Shale

w:\2008 all projects\01302 - weston solutions inc\01302-0001 water impoundments\200 - geo\shale.pl2 Run By: John Smith, XYZ Company 1/23/2014 12:46PM



#	FS
a	2.40
b	2.43
c	2.43
d	2.43
e	2.45
f	2.46
g	2.48
h	2.50
i	2.53
j	2.55

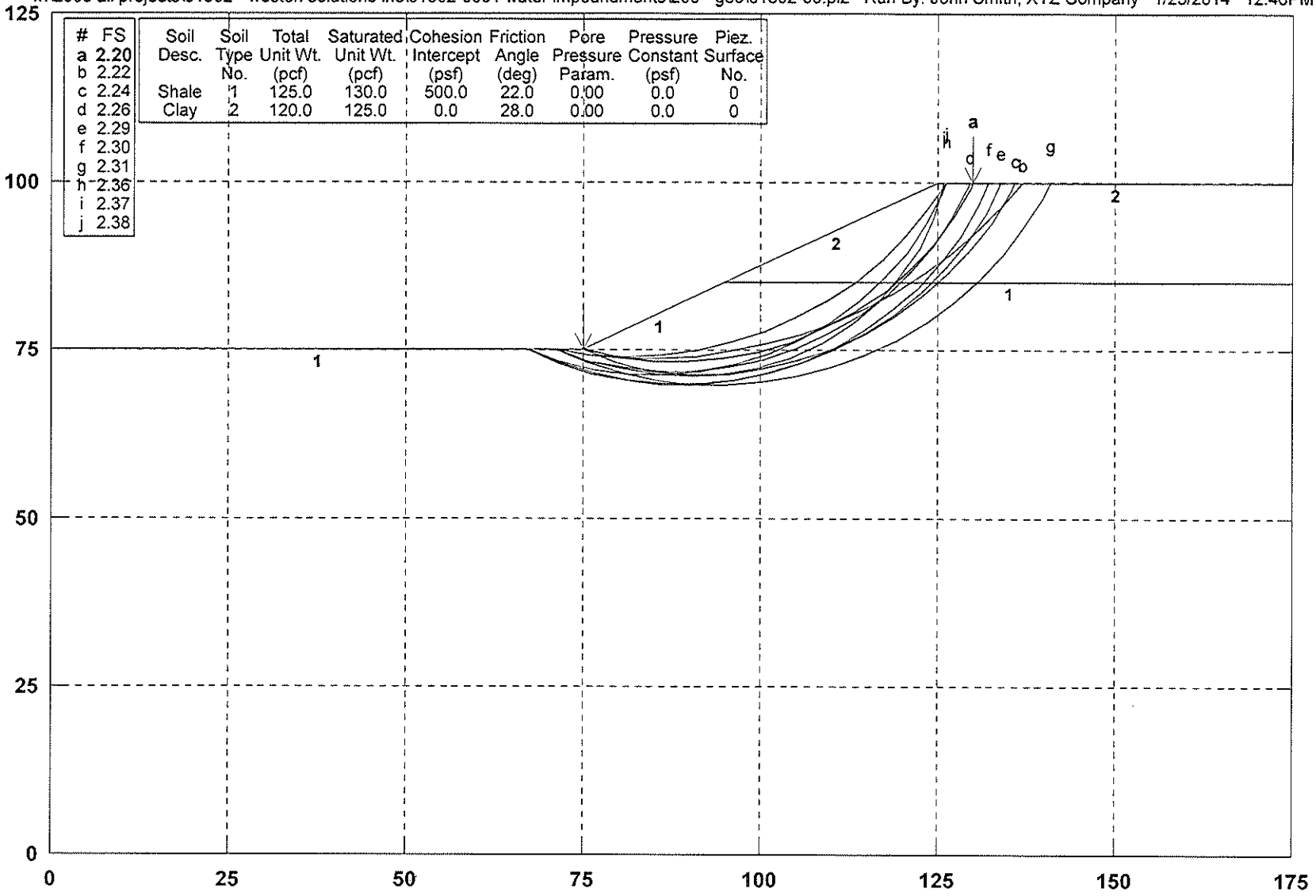
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Shale	1	125.0	130.0	500.0	22.0	0.00	0.0	0

GSTABL7 v.2 FSmin=2.40

Safety Factors Are Calculated By The Modified Bishop Method

Paonia Ponds Critical Section

w:\2008 all projects\01302 - weston solutions inc\01302-0001 water impoundments\200 - geo\01302-00.pl2 Run By: John Smith, XYZ Company 1/23/2014 12:46PM



GSTABL7 v.2 FSmin=2.20

Safety Factors Are Calculated By The Modified Bishop Method

ATTACHMENT H
STORM WATER MANAGEMENT PLAN

GUNNISON ENERGY CORPORATION
Spadafora Produced Water Management Facility

STORMWATER MANAGEMENT PLAN

1. PROJECT LOCATION

The Project property is located in SW ¼ of SE ¼ of Section 17 and NW ¼ NE ¼ of Section 20, Township 11 South, Range 90 West of the 6th PM Gunnison County, Colorado. The site is located approximately 12 miles north of Somerset, Colorado. The site is situated in Sheep Park which drains into West Muddy Creek through the seasonal Sheep Creek. West Muddy Creek is a tributary to Muddy Creek. The approximate latitude and longitude of the project are 39.092092 N latitude, 107.4675444 W longitude, NAD 83.

1.1 Facility Owner's Name and Address

Gunnison Energy LLC
1801 Broadway, Suite 1200
Denver, Colorado 80202
303-296-4222 TEL
303-296-4555 FAX
Local Contact: Mr. Dan McWilliams, 970-874-4333

1.2 Existing Site Conditions

The Spadafora Water Storage Facility (SWSF) is located in the Colorado Plateau physiographic province and the region is characterized by long, deep, narrow valleys with high, precipitous walls in an area with high local relief. The site slopes from east down toward the west at an inclination of about 3 to 10 percent. The subject area has historically been used for cattle grazing, mining and natural gas extraction as it is today.

The location is at an elevation of about 8,100 feet. The elevation of seasonal Sheep Creek adjacent to the site is about 8,020 feet in elevation. The Spadafora Water Storage Facility will occupy approximately nineteen (19) acres. Appendix A contains photographs of the proposed SWSF. The site is currently undisturbed except for geotechnical drilling which has occurred on the site. The subject site is falls away to the north, south, and east to private land owned by

Edward and Randy Spadafora. FS 851 is approximately 650 feet to the west. To the east the site slopes up and borders US National Forest Service land. The surrounding area is currently utilized for future oil and gas development and open rangeland. Current stormwater runoff at the subject site flows in a west-southwest direction to seasonal Sheep Creek.

Vegetation at the proposed location is comprised of various native grasses and sagebrush. The nearby adjacent slopes consist of a mountain shrub habitat that provides year round forage for wildlife. There is adequate open rangeland in the areas surrounding the proposed location to support cattle grazing and wildlife forage in the area following construction activities.

2. STORMWATER PERMITS

2.1 CDPHE Permit Information

In 2005 Gunnison Energy LLC (GE) applied to the Colorado Department of Public Health and Environment (CDPHE) for a Stormwater Discharge Permit for the Sheep Creek Gathering System near Delta, Colorado. A permit (**COR-035658**) was granted. GE submitted an amendment letter to CDPHE requesting the permit include construction activities associated with additional well pad sites and pipeline facilities. Correspondence, permit certification and general requirements are included in Appendix B.

Construction is anticipated to begin in May 1, 2015. Estimated surface disturbance for the project is 19 Acres. GE's existing master Stormwater Management Plan will be updated to reflect any changes under the approved permit.

3. SITE SPECIFIC STORMWATER MANAGEMENT PLAN

This Stormwater Management Plan (SWMP) covers methods and procedures of stormwater and erosion controls during the construction and operations phases associated with the Spadafora Water Storage Facility. Construction activities for the facility will involve clearing, grading, and excavation that will require erosion and sediment control measures to be implemented throughout. During operations stormwater will be diverted around the pits through permanent diversion channels on the perimeter of the pits and erosion will be minimized by means of permanent seeding of the area surrounding the pits. This SWMP identifies and describes the site

specific stormwater and erosion control best management practices (BMPs) that will be implemented to control stormwater quality and quantity during construction and operations. Details for construction BMPs discussed in the following section are shown in GEs master Stormwater Management Plan.

3.1 Construction Stormwater and Erosion Control Strategy

The erosion and sediment control strategy for a construction project is dynamic. As phases of construction progress, the strategy and measures implemented must evolve to remain effective. The general strategy for the Spadafora Water Storage Facility development is to use a multi-layered approach, beginning with practices and measures implemented by the supervisorial staff and subcontractors on the site. Additional BMPs are provided to reduce runoff velocity and to promote sedimentation along intended conveyances where applicable and erosion matting or interim seeding on slopes greater than or equal to 3H:1V. Silt fencing and check dam structures provide a final layer of protection. The initial construction BMPs are shown on Erosion Control Plans (ECPs) in Appendix C. As noted above, the BMPs may change as the project progresses through different stages of construction and any changes will be noted on the appropriate ECPs.

Because the site is developed in different stages of construction, different levels of controls are appropriate for each phase. The following measures will be used in phases of construction for erosion and sediment control and stormwater management. Details are presented in Appendix D for each BMP listed. The locations of the BMPs, along with construction details, are shown on the ECPs (Appendix C).

1) Sediment Control Logs (SCL) will be maintained around the perimeter of the site to prevent mass sediment transport onto and of off the site.

2) Erosion Control Blanket (ECB) will be utilized on the earthen berm slopes that do not receive the permanent pond liner material. The ECB will protect the slopes from erosion and aid in revegetation.

3) Diversion Channels (DC) will be installed around each pit to divert stormwater around the pits.

4) Check Dams (CD) will be placed in the Diversion Channels to dissipate energy (speed) of stormwater flows and to slow sediment transportation. CDs will remain in place for a minimum of 1 year following construction.

5) Riprap Outlet Protection (ROP) is currently in place on the outfalls of the existing culverts. Addition riprap will be added as needed.

6) Silt Fence (SF) will be maintained in appropriate locations as well as around the perimeter of the proposed stockpile area. As the area becomes successfully stabilized, silt fence may be removed.

7) Sediment Basins (SB) will be installed to capture and slow stormwater transmissions through the diversion channels. The SBs will remain in place following construction.

8) Seeding and Mulching (SM) will commence following construction to establish revegetation of the disturbed areas.

9) BMPs for erosion and sediment control shall be properly inspected and maintained throughout the duration of the construction activities to a level where BMP performance is not compromised.

Additional BMPs that may be implemented as necessary include:

1) Surface roughening with a blade and scarifier will be implemented for areas that will be inactive. These areas will be seeded, mulched, and crimped if areas are still inactive for an extended period of time (in excess of 14 days).

2) On dirt access roads, roadside street control may be necessary depending on weather conditions.

3) Temporary stream crossings will be placed with appropriate controls.

4) Areas that have not been successfully stabilized will be reseeded as soon as conditions are such that successful germination of native grasses will be possible. In the interim, surface

roughening and erosion matting or temporary seeding will be used to minimize erosion for these areas.

5) Appropriate vehicle tracking control will be utilized where necessary.

6) Blow trash will be picked up and properly disposed of and general good housekeeping practices will be implemented throughout construction activities.

7) GE will train employees and subcontractors on the importance of compliance with these BMPs and emphasize the importance of this compliance to the US EPA, CDPHE, and local jurisdictions as well as the proper implementation and maintenance procedures for controlling sediment, debris, and all other pollutants from entering the waterways as a result of construction operations.

8) The owner and designated agents shall ensure that all loads of cut and fill material imported or exported from the site shall be properly covered to prevent loss of the material during transport on public rights-of-way.

3.2 Operational Stormwater and Erosion Control Strategy

A hydrologic study of the drainage basin up-gradient of the location was completed and the resulting peak flow at the location is approximately 10.4 cubic feet per second (cfs) for a 100-year event. The Spadafora Water Storage Facility grading plan was designed based off of the model results. Grading and site drainage within the facility will divert onsite runoff away from the pits wherever possible. To accommodate a 100-year 24-hour run-on diversion channels were designed and will be constructed to intercept run-on stormwater and divert it around and away from the pits. Additionally earthen berms surrounding the pits will provide additional run-on diversion. All operational BMPs have been designed to maintain the existing west-drainage pattern to shed all stormwater flows to seasonal Sheep Creek.

The following operational BMPs will be used for erosion and sediment control and stormwater management during facility operation:

1) The cut and fill slopes and any permanent soil stockpiles will be potholed, tracked or furrowed for better seed and moisture retention to promote the establishment of desirable vegetation for erosion control and long-term soil stabilization. The well-drained, permeable soils and adequate vegetative buffer would prevent any remaining sediment from reaching nearby surface waters.

2) Armored diversion channels will route storm water away from the pits. The channels will be u-shaped ditches two to five feet deep, armored with one foot channel bottom with approximately a one foot deep erosion protection layer (i.e. rip-rap), and have armored side slopes of 2 horizontal to 1 vertical. The diversion channel locations and details are shown on the construction drawings included in Appendix C.

3) Diversion channels will contain check dams placed in the ditch to control any sedimentation and decrease runoff velocity in the channel.

4) Topsoil will be seeded and mulched using methods suitable for proper germination and establishment. The seed mix used will be the Spadafora Ranch owner approved seed mix that has been successfully used for the past 5 years at nearby sites. All areas disturbed by construction not scheduled to receive a final artificial surface treatment (i.e. pit lining, road base for roads, etc.) will be seeded with this seed mix.

4. INSPECTION AND MAINTENANCE

The Owner or Owner's Designee will inspect all temporary erosion and sediment control measures associated with construction every 14 days throughout construction and after each major storm event (a storm event that causes surface erosion). Routine maintenance of BMPs will occur and repair will be addressed in accordance with the permit.

Operational BMPs work will be inspected every 14 days following installation until the vegetative cover is established sufficiently to prevent erosion. After vegetative cover establishment has occurred, stormwater inspections will continue monthly until the site has reached final stabilization levels. Periodic stormwater, erosion and noxious weed inspections will

take place over the life of the facility. The periodic inspections will evaluate the operational BMPs' overall ability to adequately control stormwater and erosion. Adjustments and maintenance on operational BMPs will be made based on the results of the periodic inspections.

Appendix A

Site Photographs

Figure 1 GCR 265A Looking East

Figure 2 Center Looking North

Figure 3 North end Looking North

Figure 4 West Side Looking West

Figure 5 Southwest Corner Looking South

Figure 6 Center looking East

Figure 7 West Side Looking West

Appendix B

Correspondence and Certifications

GUNNISON ENERGY LLC
AN OXBOW COMPANY

September 3, 2014

Ms. Kathryn Dolan
Colorado Department of Public Health and Environment
WQCD-P-B2
4300 Cherry Creek Drive South
Denver, CO 80246-1430

RE: Amendment to Stormwater discharge Permit No.COR-035658 to Construct the Spadafora Water Storage Facility

Dear Ms. Dolan:

Gunnison Energy LLC (GE) requests amending the Stormwater Discharge Permit No. COR-035658 – Sheep Creek Gathering System to include the construction of the Spadafora Water Storage Facility in Section 17 and Section 20, Township 11 South, Range 90 West, Gunnison County.

The receiving waters would be West Muddy Creek located approximately 2.7 miles south of the proposed construction site. Construction is expected to start on or near May 1, 2015 and will continue through September 2016. Disturbance estimate for the facility is approximately 19 acres for the water storage pits. Reclamation will commence immediately upon completion of the facility.

If you have any questions concerning the project please contact me at 303-296-4222.

Sincerely,

Lee Fyock
Vice President

STATE OF COLORADO

Bill Ritter, Jr., Governor
James B. Martin, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

http://www.cdphe.state.co.us

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

Colorado Department
of Public Health
and Environment

June 20, 2007

Brad Robinson, Vice President
Gunnison Energy Corporation,
1801 Broadway Ste. 1200
Denver, CO 80202
303/296-4222

RE: Final Permit, Colorado Discharge Permit System – Stormwater
Certification No: COR-035658
Sheep Gas Gathering System
Gunnison ~~Delta~~ County
Local Contact: neal allen ~~Mark McCallister,~~ Manager, Operations
303/ 296-4222

Dear Sir or Madam:

Enclosed please find a copy of the new permit and certification which have been re-issued to you under the Colorado Water Quality Control Act.

Your old permit expires on June 30, 2007. This is a renewal to the permit, and replaces the old one. See page 2 of the Rationale (the pages in italics) for a summary of the changes to the permit.

Your Certification under the permit requires that specific actions be performed at designated times. You are legally obligated to comply with all terms and conditions of the permit.

Please read the permit and certification. If you have any questions please visit our website at : www.cdphe.state.co.us/wq/permitsunit/stormwater or contact Matt Czahor at (303) 692-3517.

Sincerely,

Kathryn Dolan
Stormwater Program Coordinator
Permits Unit
WATER QUALITY CONTROL DIVISION
xc: Regional Council of Governments
Local County Health Department
District Engineer, Technical Services, WQCD
Permit File

STATE OF COLORADO

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
WATER QUALITY CONTROL DIVISION
TELEPHONE: (303) 692-3500

CERTIFICATION TO DISCHARGE
UNDER
CDPS GENERAL PERMIT COR-030000
STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION

Certification Number **COR035658**

This Certification to Discharge specifically authorizes:

Gunnison Energy Corporation

LEGAL CONTACT:
Brad Robinson, Vice President

Gunnison Energy Corporation
1801 Broadway Ste. 1200
Denver, CO 80202
Phone # 303/296-4222

LOCAL CONTACT: Dan McWilliams
~~***Mark McCallister, Manager,***~~
Operations,
Phone # ~~303/296-4222~~
970-874-4333

During the Construction Activity: **Gas/Oil Field Exploration and/or Development**
to discharge stormwater from the facility identified as **Sheep Gas Gathering System**
which is located at:

FR 125 & FR 127
Various, Co

Latitude ~~**39/00/40,**~~ Longitude ~~**107/50/22**~~
In ~~**Delta County**~~ Gunnison County
to: Sheep Creek -- Colorado River

Anticipated Activity begins **09/15/2003** continuing through **11/30/2003**
On **30.13** acres (**30.13** acres disturbed)

Certification is effective: **07/01/2007** Certification Expires: **06/30/2012**

Annual Fee: $245.00 (**DO NOT PAY NOW** – A prorated bill will be sent shortly.)

Appendix C

Erosion Control Plans

PROPERTY BOUNDARY

FIRE ROAD

DRAINAGE SWALE

TREES

BUSHES

NORTH PIT

MIDDLE PIT

SOUTH PIT

TREES

TREES

NORTH
SEDIMENT
BASIN

SOUTH
SEDIMENT
BASIN

SPRING BOX

BUSHES

3" PIPE EXISTING

ACCESS ROAD

150-FOOT WETLAND
EXCLUSION ZONE
BOUNDARY

STOCK POND

STOCK POND

12" CMP EXISTING

12" CMP EXISTING

12" CMP EXISTING

ROAD

ROAD

W GAS

CONSTRUCTION NOTES

A. EROSION CONTROL BLANKET USED DURING CONSTRUCTION CAN BE RETAINED AS POST CONSTRUCTION PERMANENT EROSION BLANKET AT THE DISCRETION OF THE ENGINEER

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- CHECK DAM EC-6
- SILT FENCE SC-1
- EROSION CONTROL BLANKET EC-6
- RIPRAP PROTECTION

0 60' 120'

P:\Spadafora\101\EROSIONPLAN.dwg March 12, 2015 - 7:18am

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

CHECKED	DG	MAR15	
DES. ENG.	DG	MAR15	
PROJ. ENG.	DG	MAR15	
PROJ. MGR.	DG	MAR15	
APPROVED			
APPROVED			

CLIENT APPROVALS | DATE

NOT FOR CONSTRUCTION

EROSION CONTROL PLAN DURING CONSTRUCTION

DRAWN: CP	DATE: MAR15	DWG. NO.: EC101	REV. NO.: A
SCALE:	W.O. NO.: 14798.001.001	SHT. 32 OF 34	

PROPERTY BOUNDARY

FIRE ROAD

DRAINAGE SWALE

TREES

BUSHES

NORTH PIT

MIDDLE PIT

SOUTH PIT

TREES

TREES

NORTH SEDIMENT BASIN

SOUTH SEDIMENT BASIN

SPRING BOX

BUSHES

3" PIPE EXISTING

ACCESS ROAD

150-FOOT WETLAND EXCLUSION ZONE BOUNDARY

STOCK POND

12" CMP EXISTING

12" CMP EXISTING

12" CMP EXISTING

STOCK POND

ROAD

ROAD

W

GAS

CONSTRUCTION NOTES

A. ROAD BASE SHALL BE 4-INCHES THICK

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING WATERLINE
- EXISTING GAS LINE
- SEEDING AND MULCHING
- EROSION CONTROL BLANKET EC-6
- RIPRAP PROTECTION
- ROAD BASE

0 60' 120'

P:\Spadafora\101\EROSIONPLAN.dwg March 11, 2015 - 1:56pm

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY

GUNNISON COUNTY COLORADO

LAKEWOOD COLORADO

WESTON SOLUTIONS

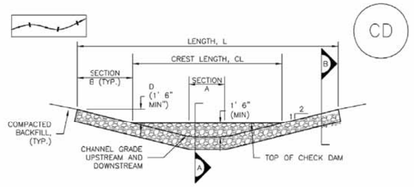
		DATE	CLIENT APPROVALS	DATE
CHECKED	DG	MAR15		
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

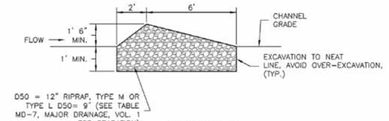
EROSION CONTROL PLAN
POST CONSTRUCTION

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	EC102	A
SCALE	W.O. NO.	SHT. 33 OF 34	
	14798.001.001		

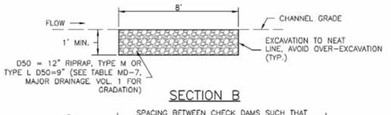
Check Dams (CD) EC-12



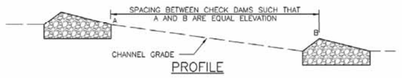
CHECK DAM ELEVATION VIEW



SECTION A



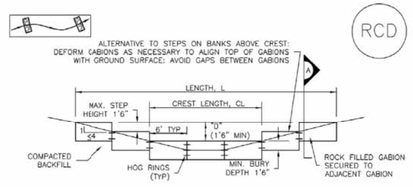
SECTION B



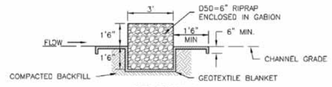
PROFILE

CD–1. CHECK DAM

Check Dams (CD) EC-12



REINFORCED CHECK DAM ELEVATION VIEW



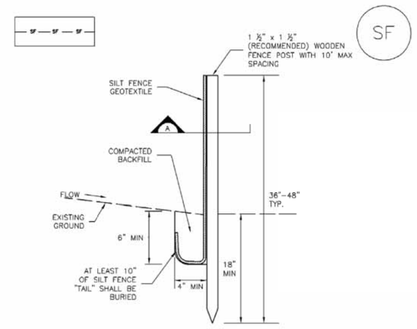
SECTION A

REINFORCED CHECK DAM INSTALLATION NOTES

1. SEE PLAN VEW FOR:
   –LOCATIONS OF CHECK DAMS.
   –CHECK DAM TYPE (CHECK DAM OR REINFORCED CHECK DAM).
   –LENGTH (L), CREST LENGTH (CL), AND DEPTH (D).
2. CHECK DAMS INDICATED ON THE SWMP SHALL BE INSTALLED PRIOR TO AN UPSTREAM LAND–DISTURBING ACTIVITIES.
3. REINFORCED CHECK DAMS, GABIONS SHALL HAVE GALVANIZED TWISTED WIRE NETTING WITH A MAXIMUM OPENING DIMENSION OF 4½" AND A MINIMUM WIRE THICKNESS OF 0.10". WIRE "HOG RINGS" AT 4" SPACING OR OTHER APPROVED MEANS SHALL BE USED AT ALL GABION SEAMS AND TO SECURE THE GABION TO THE ADJACENT SECTION.
4. THE CHECK DAM SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 1' 6".
5. GEOTEXTILE BLANKET SHALL BE PLACED IN THE REINFORCED CHECK DAM TRENCH EXTENDING A MINIMUM OF 1' 6" ON BOTH THE UPSTREAM AND DOWNSTREAM SIDES OF THE REINFORCED CHECK DAM.

CD–2. REINFORCED CHECK DAM

Silt Fence (SF) SC-1



SECTION A

SF–1. SILT FENCE

2005 PRODUCTION SYSTEM
For the Drilling and Construction of Three Wells

Table 2
Approved USFS Seed Mixes

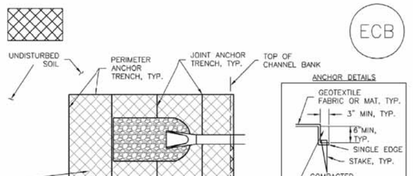
Habitat Type	Species	Pure-Live-Seed (PSL) lbs/acre	Percent of Mixture
Mountain Shrub (7,000 to 8,000 feet)	Mountain brome (*Bromus marginatus*)	4	20
	Prairie junegrass (*Koelerlacristata*)	3	15
	Western wheatgrass (*Agropyron smithii*)	4	20
	Indian ricegrass (*Oryzopsis hymenoides*)	3	15
	Sandberg bluegrass (*Poa sandbergii*)	3	15
	Bluebunch wheatgrass (*Pseudoroegneria spicata* spp. *spicata*)	3	15
Total		20	100
Aspen/Spruce-Fir (8,000 to 9,500 feet)	Mountain brome (*Bromus marginatus*)	5	26
	Slender wheatgrass (*Agropyron trachycaulum*)	3	16
	Thickspike wheatgrass (*Elymus lanceolatus* spp. *dasystachyum*)	3	16
	Canby bluegrass (*Poa canbyi*)	3	16
	Blue Wildrye (*Elymus glaucus*)	5	26
Total		19	100
Temporary Revegetation[1]	Species		lb/acre
Regreen (brand name)	Tall wheatgrass/winter wheatgrass (*Elytrigia elongata*)		20
Pioneer (brand name)	Tritacale/winter wheat (*Triticum aestivum*)		20

[1]For temporary revegetation to reduce noxious weed infestations.

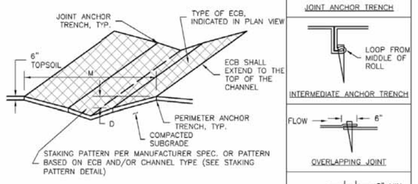
The Mountain Shrub Mix will be used for the Project area.

Seeding depth should be 0.5 to 1 inch. Planting dates should be planned from mid-September through October. Results are best if planting occurs after the first snowfall, generally in September or October.

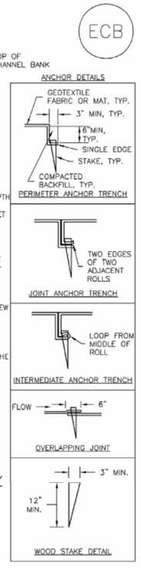
EC-6 Rolled Erosion Control Products (RECP)



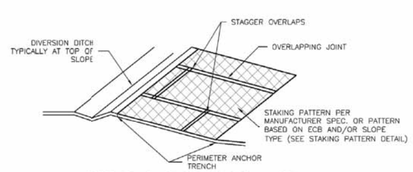
ECB–1. PIPE OUTLET TO DRAINAGEWAY



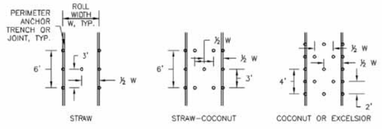
ECB–2. SMALL DITCH OR DRAINAGEWAY



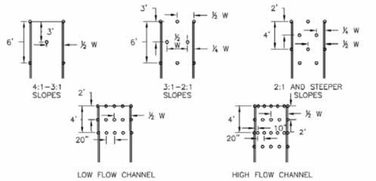
Rolled Erosion Control Products (RECP) EC-6



ECB–3. OUTSIDE OF DRAINAGEWAY

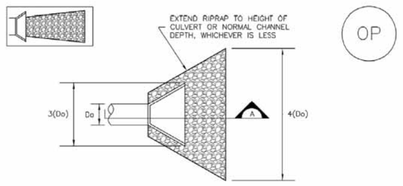


STAKING PATTERNS BY ECB TYPE

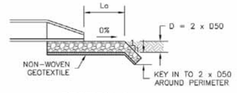


STAKING PATTERNS BY SLOPE OR CHANNEL TYPE

EC-8 Temporary Outlet Protection (TOP)



TEMPORARY OUTLET PROTECTION PLAN



SECTION A

TABLE OP–1. TEMPORARY OUTLET PROTECTION SIZING TABLE

PIPE DIAMETER, Do (INCHES)	DISCHARGE, Q (CFS)	APRON LENGTH, La (FT)	RIPRAP D50 DIAMETER MIN (INCHES)
8	2.5 5	5 10	4 6
12	5 10	10 13	4 6
18	10 20 30 40	10 16 23 26	6 9 12 16
24	30 40 50 60	16 26 26 30	9 9 12 16

OP–1. TEMPORARY OUTLET PROTECTION

P:\Spadafora\101\EROS\CNDETAIL.dwg March 11, 2015 - 1:46pm

NO.	DATE	APPR.	REVISION

GUNNISON ENERGY LLC
SPADAFORA WATER STORAGE FACILITY
GUNNISON COUNTY COLORADO

WESTON SOLUTIONS
LAKEWOOD COLORADO

	CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.	DG	MAR15		
PROJ. ENG.	DG	MAR15		
PROJ. MGR.	DG	MAR15		
APPROVED				
APPROVED				

NOT FOR CONSTRUCTION

EROSION CONTROL DETAILS

DRAWN	DATE	DWG. NO.	REV. NO.
CP	MAR15	EC103	A
SCALE	W.O. NO. 14798.001.001	SHT. 34 OF 34	

Appendix D

Erosion Control Details

Silt Fence (SF) SC-1

Description

A silt fence is a woven geotextile fabric attached to wooden posts and trenched into the ground. It is designed as a sediment barrier to intercept sheet flow runoff from disturbed areas.

Photograph SF-1. Silt fence creates a sediment barrier, forcing sheet flow runoff to evaporate or infiltrate.

Appropriate Uses

A silt fence can be used where runoff is conveyed from a disturbed area as sheet flow. Silt fence is not designed to receive concentrated flow or to be used as a filter fabric. Typical uses include:

- Down slope of a disturbed area to accept sheet flow.
- Along the perimeter of a receiving water such as a stream, pond or wetland.
- At the perimeter of a construction site.

Design and Installation

Silt fence should be installed along the contour of slopes so that it intercepts sheet flow. The maximum recommended tributary drainage area per 100 lineal feet of silt fence, installed along the contour, is approximately 0.25 acres with a disturbed slope length of up to 150 feet and a tributary slope gradient no steeper than 3:1. Longer and steeper slopes require additional measures. This recommendation only applies to silt fence installed along the contour. Silt fence installed for other uses, such as perimeter control, should be installed in a way that will not produce concentrated flows. For example, a "J-hook" installation may be appropriate to force runoff to pond and evaporate or infiltrate in multiple areas rather than concentrate and cause erosive conditions parallel to the silt fence.

See Detail SF-1 for proper silt fence installation, which involves proper trenching, staking, securing the fabric to the stakes, and backfilling the silt fence. Properly installed silt fence should not be easily pulled out by hand and there should be no gaps between the ground and the fabric.

Silt fence must meet the minimum allowable strength requirements, depth of installation requirement, and other specifications in the design details. Improper installation of silt fence is a common reason for silt fence failure; however, when properly installed and used for the appropriate purposes, it can be highly effective.

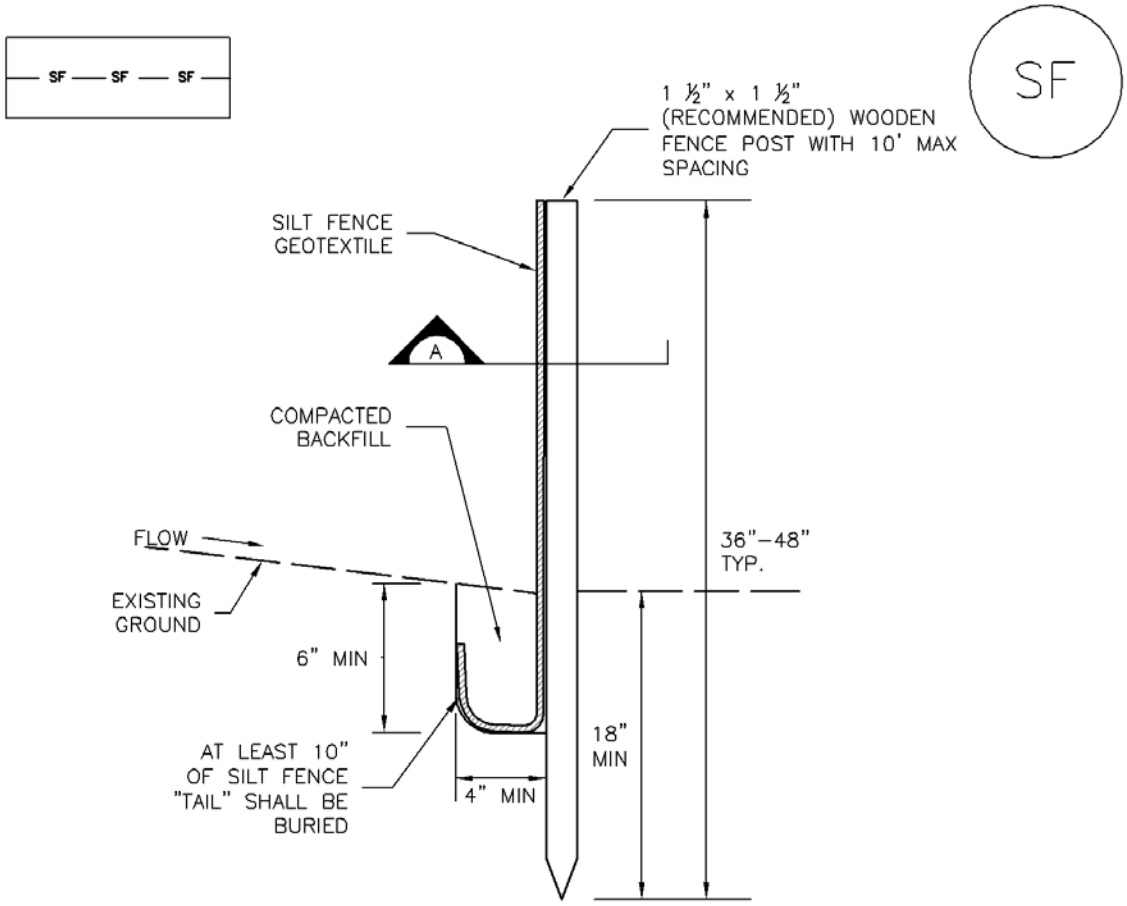
Silt Fence	
Functions	
Erosion Control	No
Sediment Control	Yes
Site/Material Management	No

Maintenance and Removal

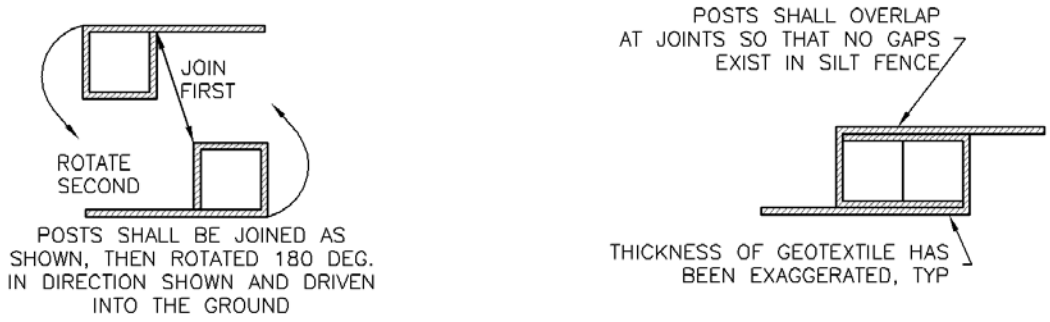
Inspection of silt fence includes observing the material for tears or holes and checking for slumping fence and undercut areas bypassing flows. Repair of silt fence typically involves replacing the damaged section with a new section. Sediment accumulated behind silt fence should be removed, as needed to maintain BMP effectiveness, typically before it reaches a depth of 6 inches.

Silt fence may be removed when the upstream area has reached final stabilization.

Photograph SF-2. When silt fence is not installed along the contour, a "J-hook" installation may be appropriate to ensure that the BMP does not create concentrated flow parallel to the silt fence. Photo courtesy of Tom Gore.



SILT FENCE



SECTION A

SF–1. SILT FENCE

SILT FENCE INSTALLATION NOTES

1. SILT FENCE MUST BE PLACED AWAY FROM THE TOE OF THE SLOPE TO ALLOW FOR WATER PONDING. SILT FENCE AT THE TOE OF A SLOPE SHOULD BE INSTALLED IN A FLAT LOCATION AT LEAST SEVERAL FEET (2–5 FT) FROM THE TOE OF THE SLOPE TO ALLOW ROOM FOR PONDING AND DEPOSITION.

2. A UNIFORM 6" X 4" ANCHOR TRENCH SHALL BE EXCAVATED USING TRENCHER OR SILT FENCE INSTALLATION DEVICE. NO ROAD GRADERS, BACKHOES, OR SIMILAR EQUIPMENT SHALL BE USED.

3. COMPACT ANCHOR TRENCH BY HAND WITH A "JUMPING JACK" OR BY WHEEL ROLLING. COMPACTION SHALL BE SUCH THAT SILT FENCE RESISTS BEING PULLED OUT OF ANCHOR TRENCH BY HAND.

4. SILT FENCE SHALL BE PULLED TIGHT AS IT IS ANCHORED TO THE STAKES. THERE SHOULD BE NO NOTICEABLE SAG BETWEEN STAKES AFTER IT HAS BEEN ANCHORED TO THE STAKES.

5. SILT FENCE FABRIC SHALL BE ANCHORED TO THE STAKES USING 1" HEAVY DUTY STAPLES OR NAILS WITH 1" HEADS. STAPLES AND NAILS SHOULD BE PLACED 3" ALONG THE FABRIC DOWN THE STAKE.

6. AT THE END OF A RUN OF SILT FENCE ALONG A CONTOUR, THE SILT FENCE SHOULD BE TURNED PERPENDICULAR TO THE CONTOUR TO CREATE A "J–HOOK." THE "J–HOOK" EXTENDING PERPENDICULAR TO THE CONTOUR SHOULD BE OF SUFFICIENT LENGTH TO KEEP RUNOFF FROM FLOWING AROUND THE END OF THE SILT FENCE (TYPICALLY 10' – 20').

7. SILT FENCE SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES.

SILT FENCE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF THE SILT FENCE SHALL BE REMOVED AS NEEDED TO MAINTAIN THE FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY 6".

5. REPAIR OR REPLACE SILT FENCE WHEN THERE ARE SIGNS OF WEAR, SUCH AS SAGGING, TEARING, OR COLLAPSE.

6. SILT FENCE IS TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION, OR IS REPLACED BY AN EQUIVALENT PERIMETER SEDIMENT CONTROL BMP.

7. WHEN SILT FENCE IS REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAIL ADAPTED FROM TOWN OF PARKER, COLORADO AND CITY OF AURORA, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Sediment Control Log (SCL) SC-2

Description

A sediment control log is a linear roll made of natural materials such as straw, coconut fiber, or other fibrous material trenched into the ground and held with a wooden stake. Sediment control logs are also often referred to as "straw wattles." They are used as a sediment barrier to intercept sheet flow runoff from disturbed areas.

Photographs SCL-1 and SCL-2. Sediment control logs used as 1) a perimeter control around a soil stockpile; and, 2) as a "J-hook" perimeter control at the corner of a construction site.

Appropriate Uses

Sediment control logs can be used in the following applications to trap sediment:

- As perimeter control for stockpiles and the site.
- As part of inlet protection designs.
- As check dams in small drainage ditches. (Sediment control logs are not intended for use in channels with high flow velocities.)
- On disturbed slopes to shorten flow lengths (as an erosion control).
- As part of multi-layered perimeter control along a receiving water such as a stream, pond or wetland.

Sediment control logs work well in combination with other layers of erosion and sediment controls.

Design and Installation

Sediment control logs should be installed along the contour to avoid concentrating flows. The maximum allowable tributary drainage area per 100 lineal feet of sediment control log, installed along the contour, is approximately 0.25 acres with a disturbed slope length of up to 150 feet and a tributary slope gradient no steeper than 3:1. Longer and steeper slopes require additional measures. This recommendation only applies to sediment control logs installed along the contour. When installed for other uses, such as perimeter control, it should be installed in a way that will not produce concentrated flows. For example, a "J-hook" installation may be appropriate to force runoff to pond and evaporate or infiltrate in multiple areas rather than concentrate and cause erosive conditions parallel to the BMP.

Sediment Control Log	
Functions	
Erosion Control	Moderate
Sediment Control	Yes
Site/Material Management	No

Although sediment control logs initially allow runoff to flow through the BMP, they can quickly become a barrier and should be installed is if they are impermeable.

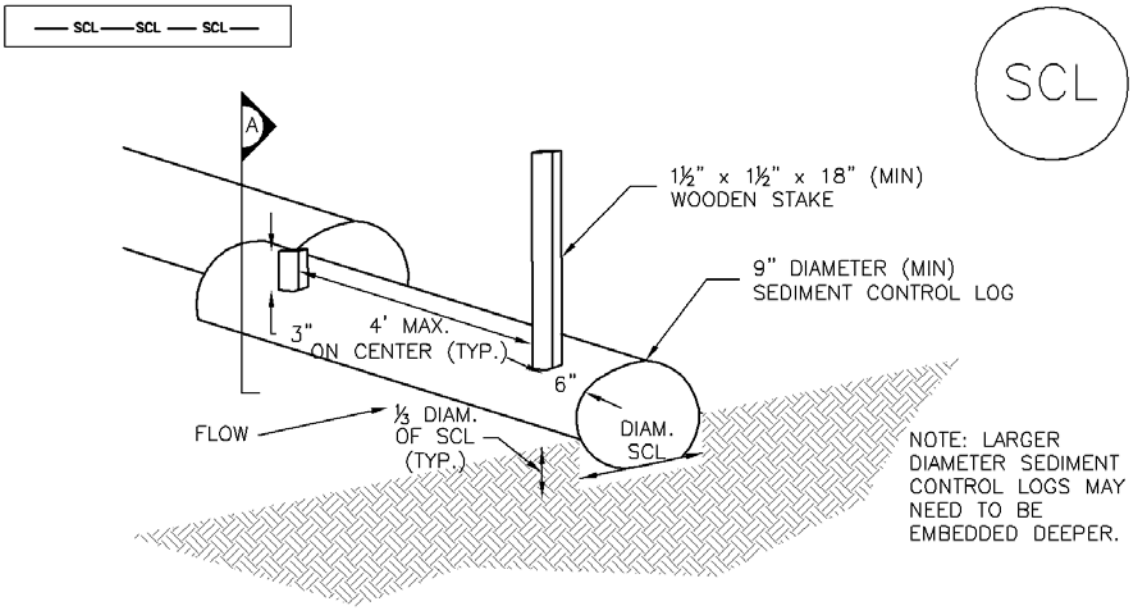
Design details and notes for sediment control logs are provided in Detail SCL-1. Sediment logs must be properly trenched and staked into the ground to prevent undercutting, bypassing and displacement. When installed on slopes, sediment control logs should be installed along the contours (i.e., perpendicular to flow).

Improper installation can lead to poor performance. Be sure that sediment control logs are properly trenched, anchored and tightly jointed.

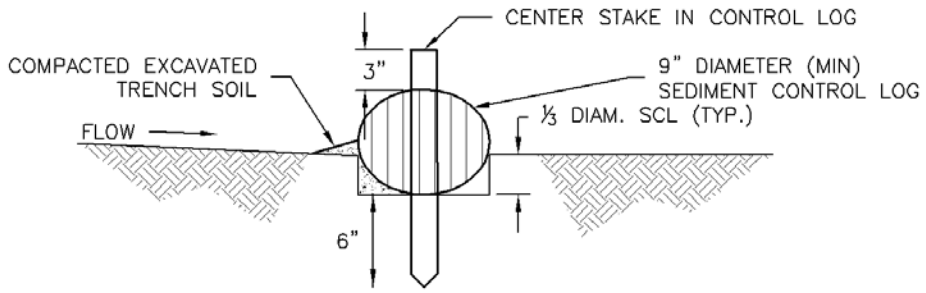
Maintenance and Removal

Be aware that sediment control logs will eventually degrade. Remove accumulated sediment before the depth is one-half the height of the sediment log and repair damage to the sediment log, typically by replacing the damaged section.

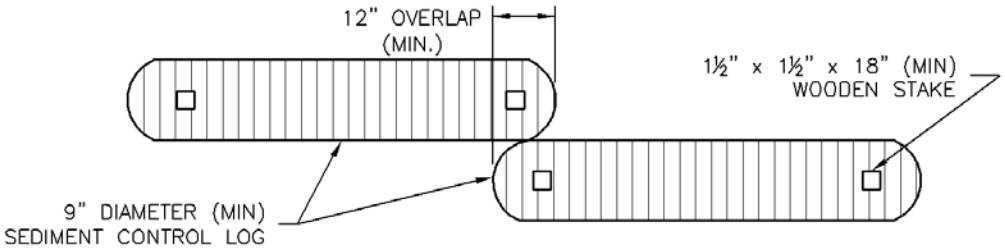
Once the upstream area is stabilized, remove and properly dispose of the logs. Areas disturbed beneath the logs may need to be seeded and mulched. Sediment control logs that are biodegradable may occasionally be left in place (e.g., when logs are used in conjunction with erosion control blankets as permanent slope breaks). However, removal of sediment control logs after final stabilization is typically recommended when used in perimeter control, inlet protection and check dam applications.



SEDIMENT CONTROL LOG

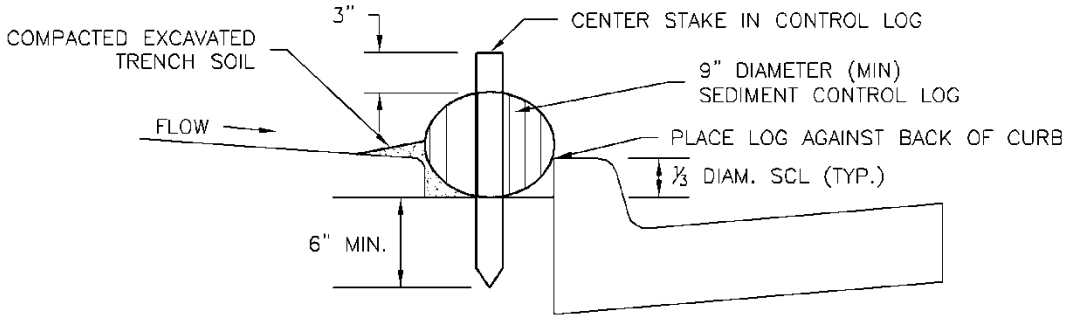


SECTION A

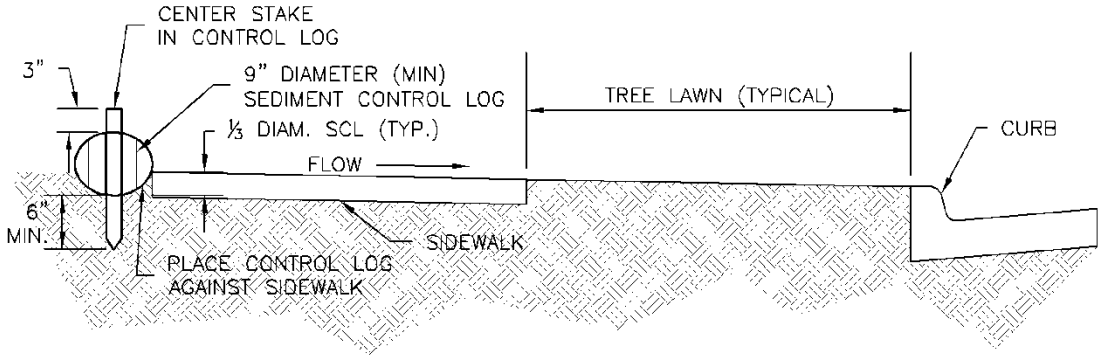


SEDIMENT CONTROL LOG JOINTS

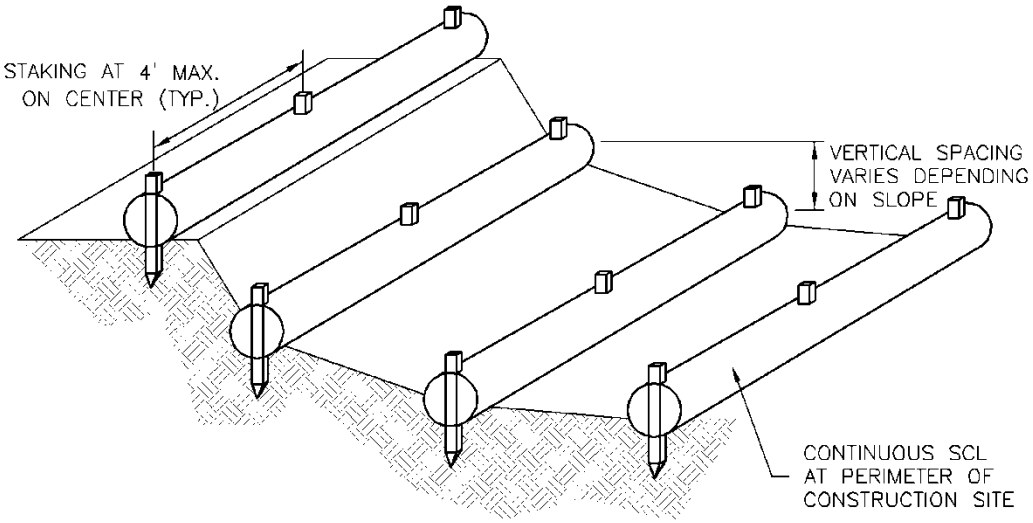
SCL–1. SEDIMENT CONTROL LOG



SCL–2. SEDIMENT CONTROL LOG AT BACK OF CURB



SCL–3. SEDIMENT CONTROL LOG AT SIDEWALK WITH TREE LAWN



SCL–4. SEDIMENT CONTROL LOGS TO CONTROL SLOPE LENGTH

SEDIMENT CONTROL LOG INSTALLATION NOTES

1. SEE PLAN VIEW FOR LOCATION AND LENGTH OF SEDIMENT CONTROL LOGS.

2. SEDIMENT CONTROL LOGS THAT ACT AS A PERIMETER CONTROL SHALL BE INSTALLED PRIOR TO ANY UPGRADIENT LAND-DISTURBING ACTIVITIES.

3. SEDIMENT CONTROL LOGS SHALL CONSIST OF STRAW, COMPOST, EXCELSIOR OR COCONUT FIBER, AND SHALL BE FREE OF ANY NOXIOUS WEED SEEDS OR DEFECTS INCLUDING RIPS, HOLES AND OBVIOUS WEAR.

4. SEDIMENT CONTROL LOGS MAY BE USED AS SMALL CHECK DAMS IN DITCHES AND SWALES. HOWEVER, THEY SHOULD NOT BE USED IN PERENNIAL STREAMS OR HIGH VELOCITY DRAINAGE WAYS.

5. IT IS RECOMMENDED THAT SEDIMENT CONTROL LOGS BE TRENCHED INTO THE GROUND TO A DEPTH OF APPROXIMATELY ⅓ OF THE DIAMETER OF THE LOG. IF TRENCHING TO THIS DEPTH IS NOT FEASIBLE AND/OR DESIRABLE (SHORT TERM INSTALLATION WITH DESIRE NOT TO DAMAGE LANDSCAPE) A LESSER TRENCHING DEPTH MAY BE ACCEPTABLE WITH MORE ROBUST STAKING

6. THE UPHILL SIDE OF THE SEDIMENT CONTROL LOG SHALL BE BACKFILLED WITH SOIL THAT IS FREE OF ROCKS AND DEBRIS. THE SOIL SHALL BE TIGHTLY COMPACTED INTO THE SHAPE OF A RIGHT TRIANGLE USING A SHOVEL OR WEIGHTED LAWN ROLLER.

7. FOLLOW MANUFACTURERS' GUIDANCE FOR STAKING. IF MANUFACTURERS' INSTRUCTIONS DO NOT SPECIFY SPACING, STAKES SHALL BE PLACED ON 4' CENTERS AND EMBEDDED A MINIMUM OF 6" INTO THE GROUND. 3" OF THE STAKE SHALL PROTRUDE FROM THE TOP OF THE LOG. STAKES THAT ARE BROKEN PRIOR TO INSTALLATION SHALL BE REPLACED.

SEDIMENT CONTROL LOG MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF SEDIMENT CONTROL LOG SHALL BE REMOVED AS NEEDED TO MAINTAIN FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY ½ OF THE HEIGHT OF THE SEDIMENT CONTROL LOG.

5. SEDIMENT CONTROL LOG SHALL BE REMOVED AT THE END OF CONSTRUCTION. IF DISTURBED AREAS EXIST AFTER REMOVAL, THEY SHALL BE COVERED WITH TOP SOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAILS ADAPTED FROM TOWN OF PARKER, COLORADO, JEFFERSON COUNTY, COLORADO, DOUGLAS COUNTY, COLORADO, AND CITY OF AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Sediment Basin (SB) SC-7

Description

A sediment basin is a temporary pond built on a construction site to capture eroded or disturbed soil transported in storm runoff prior to discharge from the site. Sediment basins are designed to capture site runoff and slowly release it to allow time for settling of sediment prior to discharge. Sediment basins are often constructed in locations that will later be modified to serve as post-construction stormwater basins.

Photograph SB-1. Sediment basin at the toe of a slope. Photo courtesy of WWE.

Appropriate Uses

Most large construction sites (typically greater than 2 acres) will require one or more sediment basins for effective management of construction site runoff. On linear construction projects, sediment basins may be impractical; instead, sediment traps or other combinations of BMPs may be more appropriate.

Sediment basins should not be used as stand-alone sediment controls. Erosion and other sediment controls should also be implemented upstream.

When feasible, the sediment basin should be installed in the same location where a permanent post-construction detention pond will be located.

Design and Installation

The design procedure for a sediment basin includes these steps:

- **Basin Storage Volume**: Provide a storage volume of at least 3,600 cubic feet per acre of drainage area. To the extent practical, undisturbed and/or off-site areas should be diverted around sediment basins to prevent "clean" runoff from mixing with runoff from disturbed areas. For undisturbed areas (both on-site and off-site) that cannot be diverted around the sediment basin, provide a minimum of 500 ft^3/acre of storage for undeveloped (but stable) off-site areas in addition to the 3,600 ft^3/acre for disturbed areas. For stable, developed areas that cannot be diverted around the sediment basin, storage volume requirements are summarized in Table SB-1.

- **Basin Geometry:** Design basin with a minimum length-to-width ratio of 2:1 (L:W). If this cannot be achieved because of site space constraints, baffling may be required to extend the effective distance between the inflow point(s) and the outlet to minimize short-circuiting.

- **Dam Embankment**: It is recommended that embankment slopes be 4:1 (H:V) or flatter and no steeper than 3:1 (H:V) in any location.

Sediment Basins	
Functions	
Erosion Control	No
Sediment Control	Yes
Site/Material Management	No

- **Inflow Structure**: For concentrated flow entering the basin, provide energy dissipation at the point of inflow.

Table SB-1. Additional Volume Requirements for Undisturbed and Developed TributaryAreas Draining through Sediment Basins

Imperviousness (%)	Additional Storage Volume (ft^3) Per Acre of Tributary Area
Undeveloped	500
10	800
20	1230
30	1600
40	2030
50	2470
60	2980
70	3560
80	4360
90	5300
100	6460

- **Outlet Works**: The outlet pipe shall extend through the embankment at a minimum slope of 0.5 percent. Outlet works can be designed using one of the following approaches:

  - **Perforated Riser/Plate**: Follow the design criteria for Full Spectrum Detention outlets in the EDB BMP Fact Sheet provided in Chapter 4 of this manual for sizing of outlet perforations with an emptying time of approximately 72 hours. In lieu of the well-screen trash rack, pack uniformly sized 1½ - to 2-inch gravel in front of the plate. This gravel will need to be cleaned out frequently during the construction period as sediment accumulates within it. The gravel pack will need to be removed and disposed of following construction to reclaim the basin for use as a permanent detention facility. If the basin will be used as a permanent extended detention basin for the site, a well-screen trash rack will need to be installed once contributing drainage areas have been stabilized and the gravel pack and accumulated sediment have been removed.

  - **Floating Skimmer**: If a floating skimmer is used, install it using manufacturer's recommendations. Illustration SB-1 provides an illustration of a Faircloth Skimmer Floating Outlet™, one of the more commonly used floating skimmer outlets. A skimmer should be designed to release the design volume in no less than 48 hours. The use of a floating skimmer outlet can increase the sediment capture efficiency of a basin significantly. A floating outlet continually decants cleanest water off the surface of the pond and releases cleaner water than would discharge from a perforated riser pipe or plate.

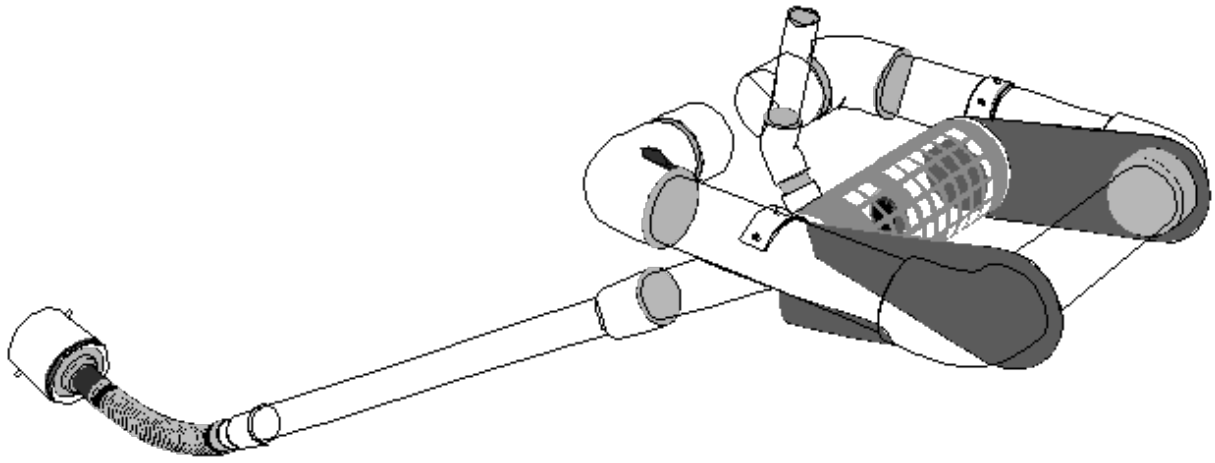


Illustration SB-1. Outlet structure for a temporary sediment basin - Faircloth Skimmer Floating Outlet. Illustration courtesy of J. W. Faircloth & Sons, Inc., FairclothSkimmer.com.

- **Outlet Protection**: Outlet protection should be provided where the velocity of flow will exceed the maximum permissible velocity of the material of the waterway into which discharge occurs. This may require the use of a riprap apron at the outlet location and/or other measures to keep the waterway from eroding.

- **Emergency Spillway**: Provide a stabilized emergency overflow spillway for rainstorms that exceed the capacity of the sediment basin volume and its outlet. Protect basin embankments from erosion and overtopping. If the sediment basin will be converted to a permanent detention basin, design and construct the emergency spillway(s) as required for the permanent facility. If the sediment basin will not become a permanent detention basin, it may be possible to substitute a heavy polyvinyl membrane or properly bedded rock cover to line the spillway and downstream embankment, depending on the height, slope, and width of the embankments.

Maintenance and Removal

Maintenance activities include the following:

- Dredge sediment from the basin, as needed to maintain BMP effectiveness, typically when the design storage volume is no more than one-third filled with sediment.

- Inspect the sediment basin embankments for stability and seepage.

- Inspect the inlet and outlet of the basin, repair damage, and remove debris. Remove, clean and replace the gravel around the outlet on a regular basis to remove the accumulated sediment within it and keep the outlet functioning.

- Be aware that removal of a sediment basin may require dewatering and associated permit requirements.

- Do not remove a sediment basin until the upstream area has been stabilized with vegetation.

Final disposition of the sediment basin depends on whether the basin will be converted to a permanent post-construction stormwater basin or whether the basin area will be returned to grade. For basins being converted to permanent detention basins, remove accumulated sediment and reconfigure the basin and outlet to meet the requirements of the final design for the detention facility. If the sediment basin is not to be used as a permanent detention facility, fill the excavated area with soil and stabilize with vegetation.

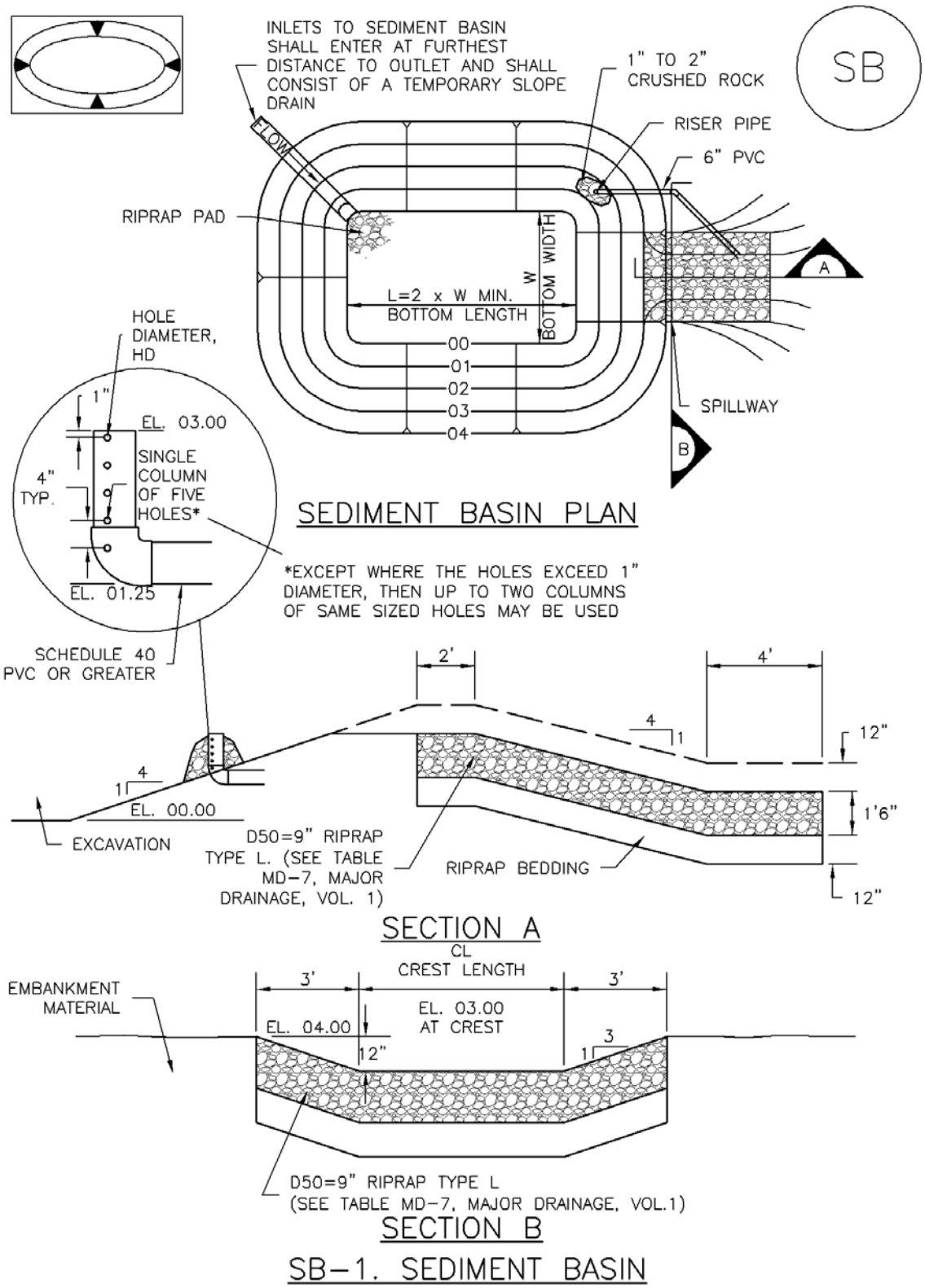

INLETS TO SEDIMENT BASIN SHALL ENTER AT FURTHEST DISTANCE TO OUTLET AND SHALL CONSIST OF A TEMPORARY SLOPE DRAIN
FLOW
1" TO 2" CRUSHED ROCK
SB
RISER PIPE
6" PVC
RIPRAP PAD
W BOTTOM WIDTH
L=2 x W MIN. BOTTOM LENGTH
00
01
02
03
04
A
B
SPILLWAY
HOLE DIAMETER, HD
1"
EL. 03.00
SINGLE COLUMN OF FIVE HOLES*
4" TYP.
EL. 01.25
SEDIMENT BASIN PLAN
*EXCEPT WHERE THE HOLES EXCEED 1" DIAMETER, THEN UP TO TWO COLUMNS OF SAME SIZED HOLES MAY BE USED
SCHEDULE 40 PVC OR GREATER
2'
4'
4
1
12"
4
1
EL. 00.00
1'6"
EXCAVATION
D50=9" RIPRAP TYPE L. (SEE TABLE MD-7, MAJOR DRAINAGE, VOL. 1)
RIPRAP BEDDING
12"
SECTION A
CL
CREST LENGTH
3'
3'
EMBANKMENT MATERIAL
EL. 04.00
EL. 03.00 AT CREST
12"
3
1
D50=9" RIPRAP TYPE L (SEE TABLE MD-7, MAJOR DRAINAGE, VOL.1)
SECTION B
SB-1. SEDIMENT BASIN

TABLE SB–1. SIZING INFORMATION FOR STANDARD SEDIMENT BASIN			
Upstream Drainage Area (rounded to nearest acre), (ac)	Basin Bottom Width (W), (ft)	Spillway Crest Length (CL), (ft)	Hole Diameter (HD), (in)
1	12 ½	2	9/32
2	21	3	13/16
3	28	5	½
4	33 ½	6	9/16
5	38 ½	8	21/32
6	43	9	21/32
7	47 ¼	11	25/32
8	51	12	27/32
9	55	13	⅞
10	58 ¼	15	15/16
11	61	16	31/32
12	64	18	1
13	67 ½	19	1 1/16
14	70 ½	21	1 ⅛
15	73 ¼	22	1 3/16

SEDIMENT BASIN INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - –LOCATION OF SEDIMENT BASIN.
   - –TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN).
   - –FOR STANDARD BASIN, BOTTOM WIDTH W, CREST LENGTH CL, AND HOLE DIAMETER, HD.
   - –FOR NONSTANDARD BASIN, SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT H, NUMBER OF COLUMNS N, HOLE DIAMETER HD AND PIPE DIAMETER D.

2. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.

3. SEDIMENT BASINS SHALL BE INSTALLED PRIOR TO ANY OTHER LAND–DISTURBING ACTIVITY THAT RELIES ON ON BASINS AS AS A STORMWATER CONTROL.

4. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.

5. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.

6. PIPE SCH 40 OR GREATER SHALL BE USED.

7. THE DETAILS SHOWN ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY, OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.

SEDIMENT BASIN MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED IN BASIN SHALL BE REMOVED AS NEEDED TO MAINTAIN BMP EFFECTIVENESS, TYPICALLY WHEN SEDIMENT DEPTH REACHES ONE FOOT (I.E., TWO FEET BELOW THE SPILLWAY CREST).

5. SEDIMENT BASINS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND GRASS COVER IS ACCEPTED BY THE LOCAL JURISDICTION.

6. WHEN SEDIMENT BASINS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Rolled Erosion Control Products (RECP) EC-6

Description

Photograph RECP-1. Erosion control blanket protecting the slope from erosion and providing favorable conditions for revegetation.

Rolled Erosion Control Products (RECPs) include a variety of temporary or permanently installed manufactured products designed to control erosion and enhance vegetation establishment and survivability, particularly on slopes and in channels. For applications where natural vegetation alone will provide sufficient permanent erosion protection, temporary products such as netting, open weave textiles and a variety of erosion control blankets (ECBs) made of biodegradable natural materials (e.g., straw, coconut fiber) can be used. For applications where natural vegetation alone will not be sustainable under expected flow conditions, permanent rolled erosion control products such as turf reinforcement mats (TRMs) can be used. In particular, turf reinforcement mats are designed for discharges that exert velocities and sheer stresses that exceed the typical limits of mature natural vegetation.

Appropriate Uses

RECPs can be used to control erosion in conjunction with revegetation efforts, providing seedbed protection from wind and water erosion. These products are often used on disturbed areas on steep slopes, in areas with highly erosive soils, or as part of drainageway stabilization. In order to select the appropriate RECP for site conditions, it is important to have a general understanding of the general types of these products, their expected longevity, and general characteristics.

The Erosion Control Technology Council (ECTC 2005) characterizes rolled erosion control products according to these categories:

- **Mulch control netting**: A planar woven natural fiber or extruded geosynthetic mesh used as a temporary degradable rolled erosion control product to anchor loose fiber mulches.
- **Open weave textile**: A temporary degradable rolled erosion control product composed of processed natural or polymer yarns woven into a matrix, used to provide erosion control and facilitate vegetation establishment.
- **Erosion control blanket (ECB)**: A temporary degradable rolled erosion control product composed of processed natural or polymer fibers which are mechanically, structurally or chemically bound together to form a continuous matrix to provide erosion control and facilitate vegetation establishment. ECBs can be further differentiated into rapidly degrading single-net and double-net types or slowly degrading types.

Rolled Erosion Control Products	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	No

- **Turf Reinforcement Mat (TRM)**: A rolled erosion control product composed of non-degradable synthetic fibers, filaments, nets, wire mesh, and/or other elements, processed into a permanent, three-dimensional matrix of sufficient thickness. TRMs, which may be supplemented with degradable components, are designed to impart immediate erosion protection, enhance vegetation establishment and provide long-term functionality by permanently reinforcing vegetation during and after maturation. Note: TRMs are typically used in hydraulic applications, such as high flow ditches and channels, steep slopes, stream banks, and shorelines, where erosive forces may exceed the limits of natural, unreinforced vegetation or in areas where limited vegetation establishment is anticipated.

Tables RECP-1 and RECP-2 provide guidelines for selecting rolled erosion control products appropriate to site conditions and desired longevity. Table RECP-1 is for conditions where natural vegetation alone will provide permanent erosion control, whereas Table RECP-2 is for conditions where vegetation alone will not be adequately stable to provide long-term erosion protection due to flow or other conditions.

Table RECP-1. ECTC Standard Specification for Temporary Rolled Erosion Control Products
(Adapted from Erosion Control Technology Council 2005)

Product Description	Slope Applications*		Channel Applications*	Minimum Tensile Strength[1]	Expected Longevity
	Maximum Gradient	C Factor[2,5]	Max. Shear Stress[3,4,6]		
Mulch Control Nets	5:1 (H:V)	≤0.10 @ 5:1	0.25 lbs/ft^2 (12 Pa)	5 lbs/ft (0.073 kN/m)	Up to 12 months
Netless Rolled Erosion Control Blankets	4:1 (H:V)	≤0.10 @ 4:1	0.5 lbs/ft^2 (24 Pa)	5 lbs/ft (0.073 kN/m)	
Single-net Erosion Control Blankets & Open Weave Textiles	3:1 (H:V)	≤0.15 @ 3:1	1.5 lbs/ft^2 (72 Pa)	50 lbs/ft (0.73 kN/m)	
Double-net Erosion Control Blankets	2:1 (H:V)	≤0.20 @ 2:1	1.75 lbs/ft^2 (84 Pa)	75 lbs/ft (1.09 kN/m)	
Mulch Control Nets	5:1 (H:V)	≤0.10 @ 5:1	0.25 lbs/ft^2 (12 Pa)	25 lbs/ft (0.36 kN/m)	24 months
Erosion Control Blankets & Open Weave Textiles (slowly degrading)	1.5:1 (H:V)	≤0.25 @ 1.5:1	2.00 lbs/ft^2 (96 Pa)	100 lbs/ft (1.45 kN/m)	24 months
Erosion Control Blankets & Open Weave Textiles	1:1 (H:V)	≤0.25 @ 1:1	2.25 lbs/ft^2 (108 Pa)	125 lbs/ft (1.82 kN/m)	36 months

* C Factor and shear stress for mulch control nettings must be obtained with netting used in conjunction with pre-applied mulch material. (*See Section 5.3 of Chapter 7 Construction BMPs for more information on the C Factor*.)

[1] Minimum Average Roll Values, Machine direction using ECTC Mod. ASTM D 5035.

[2] C Factor calculated as ratio of soil loss from RECP protected slope (tested at specified or greater gradient, H:V) to ratio of soil loss from unprotected (control) plot in large-scale testing.

[3] Required minimum shear stress RECP (unvegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in) soil loss) during a 30-minute flow event in large-scale testing.

[4] The permissible shear stress levels established for each performance category are based on historical experience with products characterized by Manning's roughness coefficients in the range of 0.01 - 0.05.

[5] Acceptable large-scale test methods may include ASTM D 6459, or other independent testing deemed acceptable by the engineer.

[6] Per the engineer's discretion. Recommended acceptable large-scale testing protocol may include ASTM D 6460, or other independent testing deemed acceptable by the engineer.

Table RECP-2. ECTC Standard Specification for Permanent[1] Rolled Erosion Control Products
(Adapted from: Erosion Control Technology Council 2005)

Product Type	Slope Applications	Channel Applications	
TRMs with a minimum thickness of 0.25 inches (6.35 mm) per ASTM D 6525 and UV stability of 80% per ASTM D 4355 (500 hours exposure).	Maximum Gradient	Maximum Shear Stress[4,5]	Minimum Tensile Strength[2,3]
	0.5:1 (H:V)	6.0 lbs/ft^2 (288 Pa)	125 lbs/ft (1.82 kN/m)
	0.5:1 (H:V)	8.0 lbs/ft^2 (384 Pa)	150 lbs/ft (2.19 kN/m)
	0.5:1 (H:V)	10.0 lbs/ft^2 (480 Pa)	175 lbs/ft (2.55 kN/m)

[1] For TRMs containing degradable components, all property values must be obtained on the non-degradable portion of the matting alone.

[2] Minimum Average Roll Values, machine direction only for tensile strength determination using ASTM D 6818 (Supersedes Mod. ASTM D 5035 for RECPs)

[3] Field conditions with high loading and/or high survivability requirements may warrant the use of a TRM with a tensile strength of 44 kN/m (3,000 lb/ft) or greater.

[4] Required minimum shear stress TRM (fully vegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in.) soil loss) during a 30-minute flow event in large scale testing.

[5] Acceptable large-scale testing protocols may include ASTM D 6460, or other independent testing deemed acceptable by the engineer.

Design and Installation

RECPs should be installed according to manufacturer's specifications and guidelines. Regardless of the type of product used, it is important to ensure no gaps or voids exist under the material and that all corners of the material are secured using stakes and trenching. Continuous contact between the product and the soil is necessary to avoid failure. Never use metal stakes to secure temporary erosion control products. Often wooden stakes are used to anchor RECPs; however, wood stakes may present installation and maintenance challenges and generally take a long time to biodegrade. Some local jurisdictions have had favorable experiences using biodegradable stakes.

This BMP Fact Sheet provides design details for several commonly used ECB applications, including:

ECB-1 Pipe Outlet to Drainageway

ECB-2 Small Ditch or Drainageway

ECB-3 Outside of Drainageway

Staking patterns are also provided in the design details according to these factors:

- ECB type
- Slope or channel type

For other types of RECPs including TRMs, these design details are intended to serve as general guidelines for design and installation; however, engineers should adhere to manufacturer's installation recommendations.

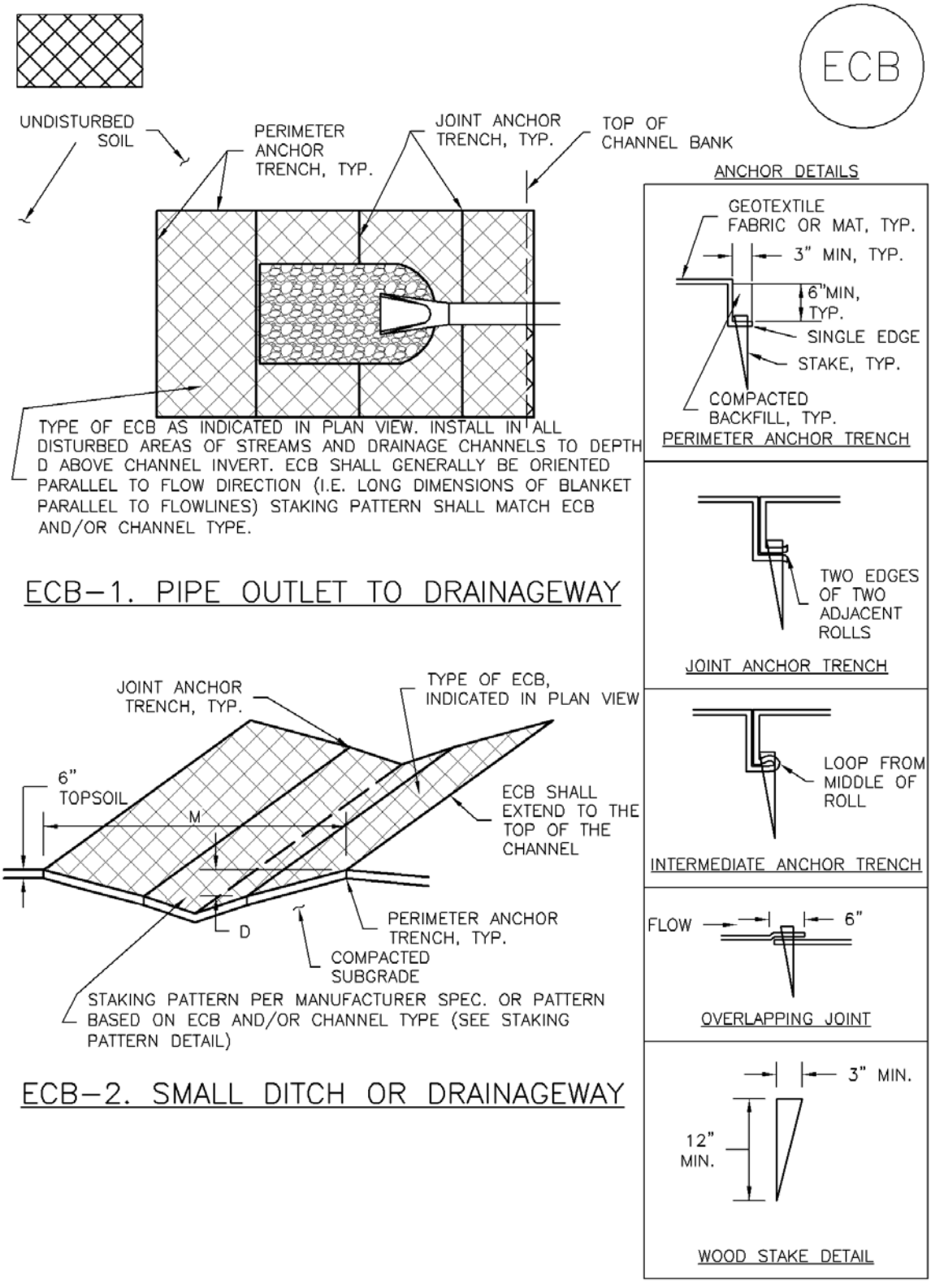
Maintenance and Removal

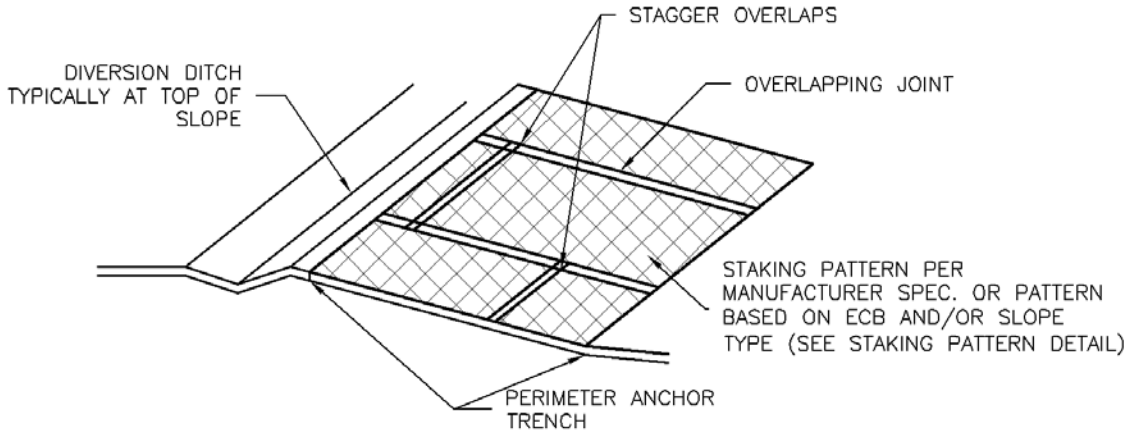
Inspection of erosion control blankets and other RECPs includes:

- Check for general signs of erosion, including voids beneath the mat. If voids are apparent, fill the void with suitable soil and replace the erosion control blanket, following the appropriate staking pattern.
- Check for damaged or loose stakes and secure loose portions of the blanket.

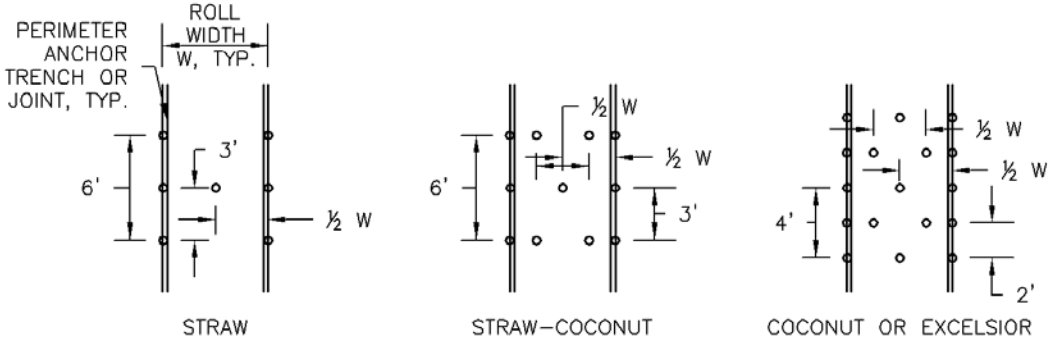
Erosion control blankets and other RECPs that are biodegradable typically do not need to be removed after construction. If they must be removed, then an alternate soil stabilization method should be installed promptly following removal.

Turf reinforcement mats, although generally resistant to biodegradation, are typically left in place as a dense vegetated cover grows in through the mat matrix. The turf reinforcement mat provides long-term stability and helps the established vegetation resist erosive forces.

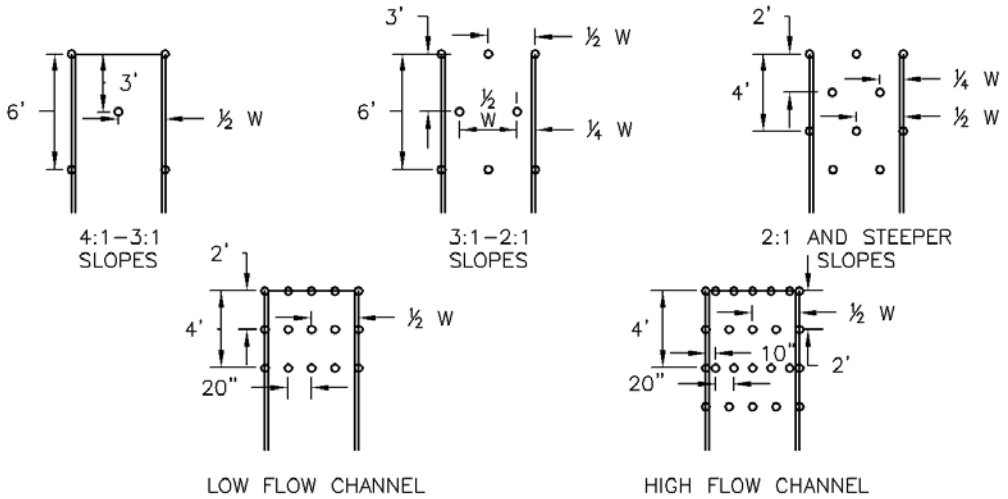

ECB
UNDISTURBED SOIL
PERIMETER ANCHOR TRENCH, TYP.
JOINT ANCHOR TRENCH, TYP.
TOP OF CHANNEL BANK
TYPE OF ECB AS INDICATED IN PLAN VIEW. INSTALL IN ALL DISTURBED AREAS OF STREAMS AND DRAINAGE CHANNELS TO DEPTH D ABOVE CHANNEL INVERT. ECB SHALL GENERALLY BE ORIENTED PARALLEL TO FLOW DIRECTION (I.E. LONG DIMENSIONS OF BLANKET PARALLEL TO FLOWLINES) STAKING PATTERN SHALL MATCH ECB AND/OR CHANNEL TYPE.
ECB–1. PIPE OUTLET TO DRAINAGEWAY
JOINT ANCHOR TRENCH, TYP.
TYPE OF ECB, INDICATED IN PLAN VIEW
6" TOPSOIL
M
ECB SHALL EXTEND TO THE TOP OF THE CHANNEL
D
PERIMETER ANCHOR TRENCH, TYP.
COMPACTED SUBGRADE
STAKING PATTERN PER MANUFACTURER SPEC. OR PATTERN BASED ON ECB AND/OR CHANNEL TYPE (SEE STAKING PATTERN DETAIL)
ECB–2. SMALL DITCH OR DRAINAGEWAY
ANCHOR DETAILS
GEOTEXTILE FABRIC OR MAT, TYP.
3" MIN, TYP.
6" MIN, TYP.
SINGLE EDGE STAKE, TYP.
COMPACTED BACKFILL, TYP.
PERIMETER ANCHOR TRENCH
TWO EDGES OF TWO ADJACENT ROLLS
JOINT ANCHOR TRENCH
LOOP FROM MIDDLE OF ROLL
INTERMEDIATE ANCHOR TRENCH
FLOW
6"
OVERLAPPING JOINT
3" MIN.
12" MIN.
WOOD STAKE DETAIL



ECB–3. OUTSIDE OF DRAINAGEWAY



STAKING PATTERNS BY ECB TYPE



STAKING PATTERNS BY SLOPE OR CHANNEL TYPE

EROSION CONTROL BLANKET INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - –LOCATION OF ECB.
   - –TYPE OF ECB (STRAW, STRAW–COCONUT, COCONUT, OR EXCELSIOR).
   - –AREA, A, IN SQUARE YARDS OF EACH TYPE OF ECB.

2. 100% NATURAL AND BIODEGRADABLE MATERIALS ARE PREFERRED FOR RECPs, ALTHOUGH SOME JURISDICTIONS MAY ALLOW OTHER MATERIALS IN SOME APPLICATIONS.

3. IN AREAS WHERE ECBs ARE SHOWN ON THE PLANS, THE PERMITTEE SHALL PLACE TOPSOIL AND PERFORM FINAL GRADING, SURFACE PREPARATION, AND SEEDING AND MULCHING. SUBGRADE SHALL BE SMOOTH AND MOIST PRIOR TO ECB INSTALLATION AND THE ECB SHALL BE IN FULL CONTACT WITH SUBGRADE. NO GAPS OR VOIDS SHALL EXIST UNDER THE BLANKET.

4. PERIMETER ANCHOR TRENCH SHALL BE USED ALONG THE OUTSIDE PERIMETER OF ALL BLANKET AREAS.

5. JOINT ANCHOR TRENCH SHALL BE USED TO JOIN ROLLS OF ECBs TOGETHER (LONGITUDINALLY AND TRANSVERSELY) FOR ALL ECBs EXCEPT STRAW WHICH MAY USE AN OVERLAPPING JOINT.

6. INTERMEDIATE ANCHOR TRENCH SHALL BE USED AT SPACING OF ONE–HALF ROLL LENGTH FOR COCONUT AND EXCELSIOR ECBs.

7. OVERLAPPING JOINT DETAIL SHALL BE USED TO JOIN ROLLS OF ECBs TOGETHER FOR ECBs ON SLOPES.

8. MATERIAL SPECIFICATIONS OF ECBs SHALL CONFORM TO TABLE ECB–1.

9. ANY AREAS OF SEEDING AND MULCHING DISTURBED IN THE PROCESS OF INSTALLING ECBS SHALL BE RESEEDED AND MULCHED.

10. DETAILS ON DESIGN PLANS FOR MAJOR DRAINAGEWAY STABILIZATION WILL GOVERN IF DIFFERENT FROM THOSE SHOWN HERE.

TABLE ECB–1. ECB MATERIAL SPECIFICATIONS

TYPE	COCONUT CONTENT	STRAW CONTENT	EXCELSIOR CONTENT	RECOMMENDED NETTING**
STRAW*	–	100%	–	DOUBLE/ NATURAL
STRAW–COCONUT	30% MIN	70% MAX	–	DOUBLE/ NATURAL
COCONUT	100%	–	–	DOUBLE/ NATURAL
EXCELSIOR	–	–	100%	DOUBLE/ NATURAL

*STRAW ECBs MAY ONLY BE USED OUTSIDE OF STREAMS AND DRAINAGE CHANNEL.
**ALTERNATE NETTING MAY BE ACCEPTABLE IN SOME JURISDICTIONS

EROSION CONTROL BLANKET MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. ECBs SHALL BE LEFT IN PLACE TO EVENTUALLY BIODEGRADE, UNLESS REQUESTED TO BE REMOVED BY THE LOCAL JURISDICTION.

5. ANY ECB PULLED OUT, TORN, OR OTHERWISE DAMAGED SHALL BE REPAIRED OR REINSTALLED. ANY SUBGRADE AREAS BELOW THE GEOTEXTILE THAT HAVE ERODED TO CREATED A VOID UNDER THE BLANKET, OR THAT REMAIN DEVOID OF GRASS SHALL BE REPAIRED, RESEEDED AND MULCHED AND THE ECB REINSTALLED.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO AND TOWN OF PARKER COLORADO, NOT AVAILABLE IN AUTOCAD)

Temporary Outlet Protection (TOP) EC-8

Description

Outlet protection helps to reduce erosion immediately downstream of a pipe, culvert, slope drain, rundown or other conveyance with concentrated, high-velocity flows. Typical outlet protection consists of riprap or rock aprons at the conveyance outlet.

Photograph TOP-1. Riprap outlet protection.

Appropriate Uses

Outlet protection should be used when a conveyance discharges onto a disturbed area where there is potential for accelerated erosion due to concentrated flow. Outlet protection should be provided where the velocity at the culvert outlet exceeds the maximum permissible velocity of the material in the receiving channel.

Note**:** This Fact Sheet and detail are for temporary outlet protection, outlets that are intended to be used for less than 2 years. For permanent, long-term outlet protection, see the *Major Drainage* chapter of Volume 1.

Design and Installation

Design outlet protection to handle runoff from the largest drainage area that may be contributing runoff during construction (the drainage area may change as a result of grading). Key in rock, around the entire perimeter of the apron, to a minimum depth of 6 inches for stability. Extend riprap to the height of the culvert or the normal flow depth of the downstream channel, whichever is less. Additional erosion control measures such as vegetative lining, turf reinforcement mat and/or other channel lining methods may be required downstream of the outlet protection if the channel is susceptible to erosion. See Design Detail OP-1 for additional information.

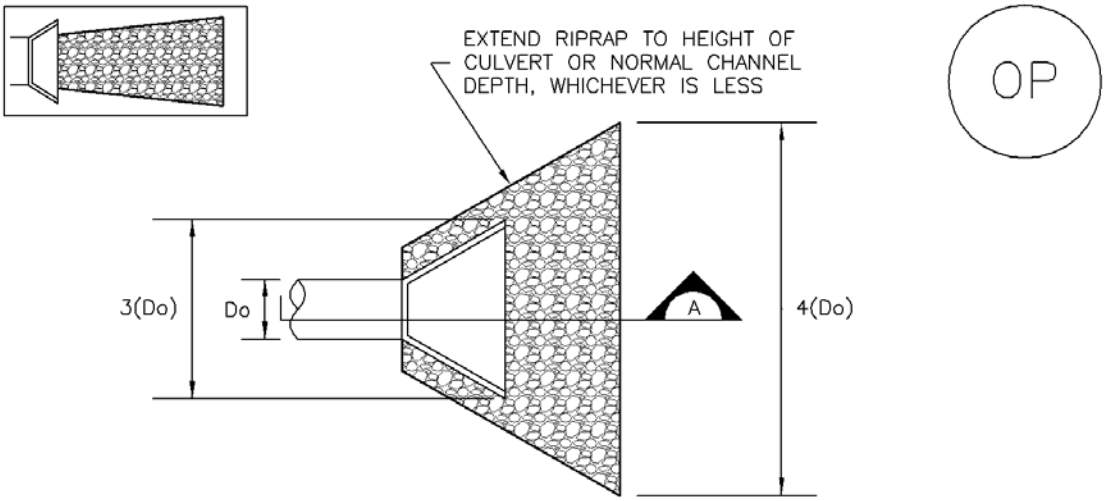
Maintenance and Removal

Inspect apron for damage and displaced rocks. If rocks are missing or significantly displaced, repair or replace as necessary. If rocks are continuously missing or displaced, consider increasing the size of the riprap or deeper keying of the perimeter.

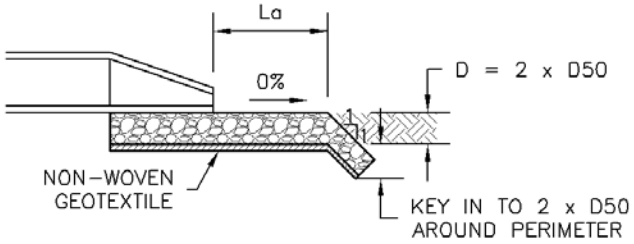
Remove sediment accumulated at the outlet before the outlet protection becomes buried and ineffective. When sediment accumulation is noted, check that upgradient BMPs, including inlet protection, are in effective operating condition.

Outlet protection may be removed once the pipe is no longer draining an upstream area, or once the downstream area has been sufficiently stabilized. If the drainage pipe is permanent, outlet protection can be left in place; however, permanent outlet protection should be designed and constructed in accordance with the requirements of the *Major Drainage* chapter of Volume 2.

Outlet Protection	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No



TEMPORARY OUTLET PROTECTION PLAN



SECTION A

TABLE OP-1. TEMPORARY OUTLET PROTECTION SIZING TABLE			
PIPE DIAMETER, Do (INCHES)	DISCHARGE, Q (CFS)	APRON LENGTH, La (FT)	RIPRAP D50 DIAMETER MIN (INCHES)
8	2.5 5	5 10	4 6
12	5 10	10 13	4 6
18	10 20 30 40	10 16 23 26	6 9 12 16
24	30 40 50 60	16 26 26 30	9 9 12 16

OP-1. TEMPORARY OUTLET PROTECTION

TEMPORARY OUTLET PROTECTION INSTALLATION NOTES

1. SEE PLAN VIEW FOR
   –LOCATION OF OUTLET PROTECTION.
   –DIMENSIONS OF OUTLET PROTECTION.

2. DETAIL IS INTENDED FOR PIPES WITH SLOPE ≤ 10%. ADDITIONAL EVALUATION OF RIPRAP SIZING AND OUTLET PROTECTION DIMENSIONS REQUIRED FOR STEEPER SLOPES.

3. TEMPORARY OUTLET PROTECTION INFORMATION IS FOR OUTLETS INTENDED TO BE UTILIZED LESS THAN 2 YEARS.

TEMPORARY OUTLET PROTECTION INSPECTION AND MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM AURORA, COLORADO AND PREVIOUS VERSION OF VOLUME 3, NOT AVAILABLE IN AUTOCAD)

Check Dams (CD) EC-12

Description

Check dams are temporary grade control structures placed in drainage channels to limit the erosivity of stormwater by reducing flow velocity. Check dams are typically constructed from rock, gravel bags, sand bags, or sometimes, proprietary devices. Reinforced check dams are typically constructed from rock and wire gabion. Although the primary function of check dams is to reduce the velocity of concentrated flows, a secondary benefit is sediment trapping upstream of the structure.

Photograph CD-1. Rock check dams in a roadside ditch. Photo courtesy of WWE.

Appropriate Uses

Use as a grade control for temporary drainage ditches or swales until final soil stabilization measures are established upstream and downstream. Check dams can be used on mild or moderately steep slopes. Check dams may be used under the following conditions:

- As temporary grade control facilities along waterways until final stabilization is established.
- Along permanent swales that need protection prior to installation of a non-erodible lining.
- Along temporary channels, ditches or swales that need protection where construction of a non-erodible lining is not practicable.
- Reinforced check dams should be used in areas subject to high flow velocities.

Design and Installation

Place check dams at regularly spaced intervals along the drainage swale or ditch. Check dams heights should allow for pools to develop upstream of each check dam, extending to the downstream toe of the check dam immediately upstream.

When rock is used for the check dam, place rock mechanically or by hand. Do not dump rocks into the drainage channel. Where multiple check dams are used, the top of the lower dam should be at the same elevation as the toe of the upper dam.

When reinforced check dams are used, install erosion control fabric under and around the check dam to prevent erosion on the upstream and downstream sides. Each section of the dam should be keyed in to reduce the potential for washout or undermining. A rock apron upstream and downstream of the dam may be necessary to further control erosion.

Check Dams	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No

Design details with notes are provided for the following types of check dams:

- Rock Check Dams (CD-1)
- Reinforced Check Dams (CD-2)

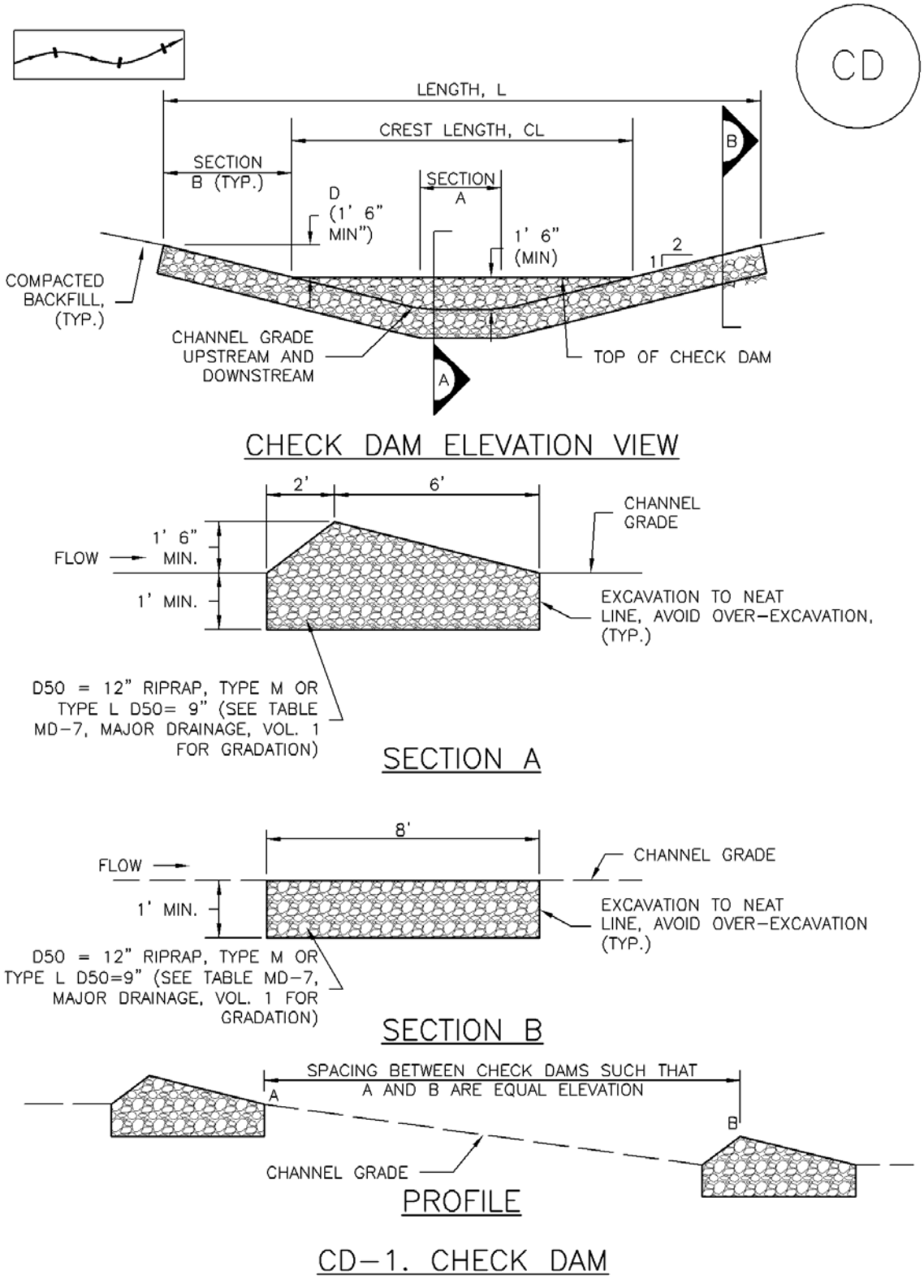
Sediment control logs may also be used as check dams; however, silt fence is not appropriate for use as a check dam. Many jurisdictions also prohibit or discourage use of straw bales for this purpose.

Maintenance and Removal

Replace missing rocks causing voids in the check dam. If gravel bags or sandbags are used, replace or repair torn or displaced bags.

Remove accumulated sediment, as needed to maintain BMP effectiveness, typically before the sediment depth upstream of the check dam is within ½ of the crest height. Remove accumulated sediment prior to mulching, seeding, or chemical soil stabilization. Removed sediment can be incorporated into the earthwork with approval from the Project Engineer, or disposed of at an alternate location in accordance with the standard specifications.

Check dams constructed in permanent swales should be removed when perennial grasses have become established, or immediately prior to installation of a non-erodible lining. All of the rock and accumulated sediment should be removed, and the area seeded and mulched, or otherwise stabilized.



CD-1. CHECK DAM

CHECK DAM INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   –LOCATION OF CHECK DAMS.
   –CHECK DAM TYPE (CHECK DAM OR REINFORCED CHECK DAM).
   –LENGTH (L), CREST LENGTH (CL), AND DEPTH (D).

2. CHECK DAMS INDICATED ON INITIAL SWMP SHALL BE INSTALLED AFTER CONSTRUCTION FENCE, BUT PRIOR TO ANY UPSTREAM LAND DISTURBING ACTIVITIES.

3. RIPRAP UTILIZED FOR CHECK DAMS SHOULD BE OF APPROPRIATE SIZE FOR THE APPLICATION. TYPICAL TYPES OF RIPRAP USED FOR CHECK DAMS ARE TYPE M (D50 12") OR TYPE L (D50 9").

4. RIPRAP PAD SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 1'.

5. THE ENDS OF THE CHECK DAM SHALL BE A MINIMUM OF 1' 6" HIGHER THAN THE CENTER OF THE CHECK DAM.

CHECK DAM MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

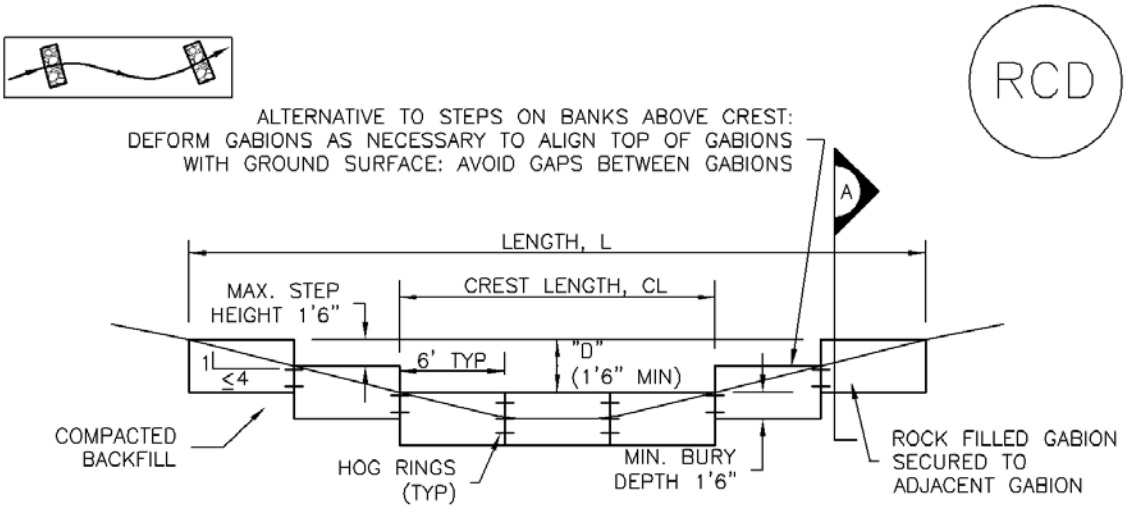
4. SEDIMENT ACCUMULATED UPSTREAM OF THE CHECK DAMS SHALL BE REMOVED WHEN THE SEDIMENT DEPTH IS WITHIN ½ OF THE HEIGHT OF THE CREST.

5. CHECK DAMS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.

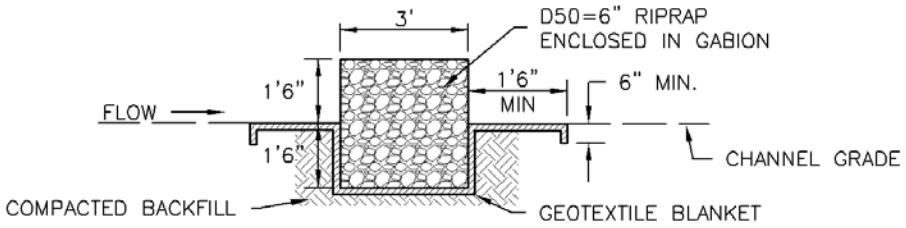
6. WHEN CHECK DAMS ARE REMOVED, EXCAVATIONS SHALL BE FILLED WITH SUITABLE COMPACTED BACKFILL. DISTURBED AREA SHALL BE SEEDED AND MULCHED AND COVERED WITH GEOTEXTILE OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.



REINFORCED CHECK DAM ELEVATION VIEW



SECTION A

REINFORCED CHECK DAM INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - –LOCATIONS OF CHECK DAMS.
   - –CHECK DAM TYPE (CHECK DAM OR REINFORCED CHECK DAM).
   - –LENGTH (L), CREST LENGTH (CL), AND DEPTH (D).

2. CHECK DAMS INDICATED ON THE SWMP SHALL BE INSTALLED PRIOR TO AN UPSTREAM LAND–DISTURBING ACTIVITIES.

3. REINFORCED CHECK DAMS, GABIONS SHALL HAVE GALVANIZED TWISTED WIRE NETTING WITH A MAXIMUM OPENING DIMENSION OF 4½" AND A MINIMUM WIRE THICKNESS OF 0.10". WIRE "HOG RINGS" AT 4" SPACING OR OTHER APPROVED MEANS SHALL BE USED AT ALL GABION SEAMS AND TO SECURE THE GABION TO THE ADJACENT SECTION.

4. THE CHECK DAM SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 1' 6".

5. GEOTEXTILE BLANKET SHALL BE PLACED IN THE REINFORCED CHECK DAM TRENCH EXTENDING A MINIMUM OF 1' 6" ON BOTH THE UPSTREAM AND DOWNSTREAM SIDES OF THE REINFORCED CHECK DAM.

CD–2. REINFORCED CHECK DAM

REINFORCED CHECK DAM MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF REINFORCED CHECK DAMS SHALL BE REMOVED AS NEEDED TO MAINTAIN THE EFFECTIVENESS OF BMP, TYPICALLY WHEN THE UPSTREAM SEDIMENT DEPTH IS WITHIN ½ THE HEIGHT OF THE CREST.

5. REPAIR OR REPLACE REINFORCED CHECK DAMS WHEN THERE ARE SIGNS OF DAMAGE SUCH AS HOLES IN THE GABION OR UNDERCUTTING.

6. REINFORCED CHECK DAMS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.

7. WHEN REINFORCED CHECK DAMS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED, AND COVERED WITH A GEOTEXTILE BLANKET, OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAIL ADAPTED FROM DOUGLAS COUNTY, COLORADO AND CITY OF AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

conducted by qualified individuals to determine the presence of the species. It was determined that project activities will not affect any federal or state listed threatened or endangered species.

4.0 BMPS FOR STORMWATER POLLUTION PREVENTION

4.1 Erosion and Sediment Controls

The objective of soil erosion and sediment controls is to minimize the release of solids and sediments in stormwater runoff. This will be accomplished through both structural and nonstructural controls. This section of the SWMP describes erosion and sediment controls to be utilized at the active construction sites to minimize possible impacts to stormwater runoff resulting from sediment. The proposed erosion control mechanisms include:

- Installation of drainage swales and hay bale check dams on perimeter of site;
- Permanent seeding of disturbed areas after completion of drilling activities; and
- Revegetation of the exposed soils at the end of construction.

These efforts will minimize erosion during construction and restore a vegetative cover to the construction site once construction activities have been completed. Details for the typical installations of erosion and sediment control BMPs are included in Appendix C.

4.1.1 Permanent Seeding

To reduce erosion and excessive runoff from the site, all disturbed areas will be seeded immediately following disturbance. The following species (Table 2) are suggested for high elevation or montane seed mixes and should be used according to their availability.

Table 2
Approved USFS Seed Mixes

Habitat Type	Species	Pure-Live-Seed (PSL) lbs/acre	Percent of Mixture
Mountain Shrub (7,000 to 8,000 feet)	Mountain brome (*Bromus marginatus*)	4	20
	Prairie junegrass (*Koeleriacristata*)	3	15
	Western wheatgrass (*Agropyron smithii*)	4	20
	Indian ricegrass (*Oryzopsis hymenoides*)	3	15
	Sandberg bluegrass (*Poa sandbergii*)	3	15
	Bluebunch wheatgrass (*Pseudoroegneria spicata* spp. *spicata*)	3	15
Total		20	100
Aspen/Spruce-Fir (8,000 to 9,500 feet)	Mountain brome (*Bromus marginatus*)	5	26
	Slender wheatgrass (*Agropyron trachycaulum*)	3	16
	Thickspike wheatgrass (*Elymus lanceolatus* spp. *dasystachyum*)	3	16
	Canby bluegrass (*Poa canbyi*)	3	16
	Blue Wildrye (*Elymus glaucus*)	5	26
Total		19	100
Temporary Revegetation[1]	Species		lb/acre
Regreen (brand name)	Tall wheatgrass/winter wheatgrass (*Elytrigia elongata*)		20
Pioneer (brand name)	Tritacale/winter wheat (*Triticum aestivum*)		20

[1]For temporary revegetation to reduce noxious weed infestations.

The Mountain Shrub Mix will be used for the Project area.

Seeding depth should be 0.5 to 1 inch. Planting dates should be planned from mid-September through October. Results are best if planting occurs after the first snowfall, generally in September or October.

ATTACHMENT I
DATA TABLES

Gunnison Energy LLC
Spadafora Water Storage Facility
Well Locations Within 1-Mile

Table 1

Permit Number	Well Name	Well Usecode / Use	Owner	Depth (ft bgs)	Current Status
API # 05-051-06119	Spadafora 1190 #20-21	Industrial / Production	Gunnison Energy	*tbd*	*permit only*
250836	Bar K Ranch	Domestic	Roger Cesario	487	Well Constructed

Notes:
bgs = below ground surface
N/A = Not Available
* = Verification of well construction required

Gunnison Energy LLC
Spadafora Water Storage Facility
Waste Profile Samples
Laboratory Results

Table 2

Organic Compounds In Groundwater	Sample ID / Date Collected / Units	Table 910-1 Concentration Levels	Injection Well HKF1289#18-22D 09/17/12	Flowback Well HKF1289#17-11 06/26/14	Flowback Well HKF1289#20-12D 12/07/10	Flowback Well HKF1289#20-12D 03/31/11	HKF1289#18-43 03/31/11	HKF1289#17-13 03/31/11	HKF1289#18-31 03/31/11
Benzene	mg/L	**0.005** [1]	**BDL**	**0.73**	**0.002**	**0.0745**	0.001 U	**0.008**	**0.0047**
Toluene	mg/L	**1** [1]	**BDL**	**0.44**	**0.003**	**0.0298**	0.002 U	**0.0021**	0.002 U
Ethylbenzene	mg/L	**0.7** [1]	0.11	BDL U	0.001 U	0.002 U	0.002 U	0.002 U	0.002 U
Xylenes (Total)	mg/L	**10** [2]	**0.96**	**0.11**	**0.002**	**0.0052**	0.002 U	**0.0061**	**0.0042**
Inorganics in Groundwater									
Total Dissolved Solids (TDS)	mg/L	**<1.2 x BKG** [1]	**5300**	**140**	**61115**	**76500**	**2840**	**2620**	**3490**
Total Suspended Solids (TSS)	mg/L	--	**30.7**		**432**	**155**	5 U	**10.7**	**48.9**
Chlorides	mg/L	**<1.2 x BKG** [1]	**2200**	**1.7**	**21780.48**	**45400**	**320**	**293**	**484**
Methane	mg/L	--			--	**2.5**	**2.88**	**2.72**	**1.72**
Sulfates	mg/L	**<1.2 x BKG** [1]	BDL U	**BDL**	**34986**	50 [a] U	5 [a] U	2.5 [a] U	2.5 [a] U
Liquid Hydrocarbons									
TVH - GRO (Gasoline)	mg/L	**BDL**			0.1 U	**0.23**	0.2 U	0.2 U	0.2 U
TVH - DRO (Diesel)	mg/L	**BDL**	--	--	--	--	--	--	--
Cations and anions									
Bromide	mg/L	--			**0.266**	**299**	**2.2**	**2**	**3.3**
Fluoride	mg/L	--			**5.95**	**0.57**	**4.1**	**5**	**2.9**
Hydrogen Sulfide	mg/L	--			0.2 U	0.5 U	0.5 U	0.5 U	0.5 U
Dissolved Metals									
Aluminum	mg/L	--			**0.73**	1 U	0.1 U	0.1 U	0.13
Arsenic	mg/L	--			**0.343**	**0.48**	**0.0068**	**0.0053**	**0.0081**
Barium	mg/L	--			**1.67**	**102**	**2.3**	**2.4**	**3.3**
Boron	mg/L	--			**194**	**13.1**	**1.4**	**1.3**	**1.9**
Calcium	mg/L	--			**4940**	**3850**	**6.6**	**19.1**	**23.8**
Copper	mg/L	--			**0.84**	**0.28**	**0.014**	**0.11**	**0.021**
Iron	mg/L	--			**52.8**	**56.9**	**2**	**23.3**	**12.1**
Lead	mg/L	--			**1.01**	**0.013**	0.001 U	**0.019**	0.0025 U
Magnesium	mg/L	--			**1022.09**	**322**	**2.3**	**2.6**	**5.1**
Manganese	mg/L	--			**1.448**	**0.77**	**0.028**	**0.34**	**0.18**
Nickel	mg/L	--			**3.71**	**0.084**	0.004 U	**0.036**	0.01 U
Potassium	mg/L	--			**3230**	**54.5**	**6.7**	**6.3**	**7**
Selenium	mg/L	--			**0.675**	**1.9**	**0.024**	**0.018**	**0.029**
Sodium	mg/L	--			**15675**	**21400**	**1110**	**1040**	**1320**
Strontium	mg/L	--			**435**	**537**	**1.5**	**2.4**	**3.6**
Zinc	mg/L	--			**0.205**	0.2 U	0.02 U	**0.13**	0.02 U
Nutirents									
Ammonia	mg/L	--			**68**	**71.4**	**1.2**	**0.78**	**1.4**
Nitrates	mg/L	--			**9.51**	0.1 [a] U	0.1 [a] U	0.1 [a] U	0.1 [a] U
Nitrites	mg/L	--			0.01 U	0.4 [a] U	0.04 [a] U	0.02 [a] U	0.04 [a] U
Nitrate + Nitrite	mg/L	--			**9.51**	0.5 [b] U	0.14 [b] U	0.12 [b] U	0.14 [b] U
General Chemisty									
Specific Conductivity	umhos/cm	--			**96000**	**111**	**4260**	**4090**	**5350**
Alkalinity	mg/L	--			**236.1**	**317**	**1970**	**1870**	**2330**
Bicarbonate	mg/L	--			**236.1**	**317**	**1900**	**1870**	**2330**
Carbonate	mg/L	--			**0**	5 U	5 U	5 U	5 U
Turbidity	ntu	--			**0.71**	**518**	**7.1**	**21.1**	**298**

Notes:
Bold = Analyte was detected above detection limit
Value exceeds Table 910-1 Concentration Level
BDL = Below Detection Level
mg/L = milligrams per liter
umhos/cm = micromhos per centimeter
ntu = nephelometric turbidity unit

U = Not detected above Reporting Limit (RL)
[1] = Concentration taken from CDPHE-WQCC Regulation 41 - The Basic Standards for Groundwater
[2] = Maximum Concentration Level (MCL) established under the Federal Safe Drinking Water Act
[a] = Elevated detection limit due to matrix interference
[b] = Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

Gunnison Energy LLC
Spadafora Water Storage Facility
Baseline Water Quality Evaluation
Shallow Groundwater
Laboratory Results

Table 3

Organic Compounds In Groundwater	Sample ID / Date Collected / Units	Table 910-1 Concentration Levels	SPADAFORA B-3 10/08/13
Benzene	mg/L	**0.005** [1]	ND
Toluene	mg/L	**1** [1]	ND
Ethylbenzene	mg/L	**0.7** [1]	ND
Xylenes (Total)	mg/L	**10** [2]	ND
Inorganics in Groundwater			
Total Dissolved Solids (TDS)	mg/L	**<1.2 x BKG** [1]	**270**
Chlorides	mg/L	**<1.2 x BKG** [1]	**8.8**
Sulfates	mg/L	**<1.2 x BKG** [1]	**ND**
Liquid Hydrocarbons			
TVH - GRO (Gasoline)	mg/L	**BDL**	--
TVH - DRO (Diesel)	mg/L	**BDL**	--
Cations and anions			
Bromide	mg/L	--	BDL
Fluoride	mg/L	--	--
Hydrogen Sulfide	mg/L	--	--
Dissolved Metals			
Iron	mg/L	--	10
Manganese	mg/L	--	0.31
Selenium	mg/L		BDL
Nutirents			
Nitrate + Nitrite	mg/L	--	--
Nitrates	mg/L	--	0.18
Nitrites	mg/L	--	BDL
pH			
pH	--	--	8.1
Lab Specific Conductance			
Specific Conductance	umhos/cm	--	460
Field Specific Conductance			
Specific Conductance	umhos/cm	--	--

Notes:
Bold = Analyte was detected above detection limit
Value exceeds Table 910-1 Concentration Level
mg/L = milligrams per liter
BDL = Below Detection Level
U = Not detected above Re
umhos/cm = micromhos pe
[1] = Concentration taken fro
[2] = Maximum Concentratio

Gunnison Energy LLC
Spadafora Water Storage Facility
Baseline Water Quality Evaluation
Shallow Groundwater
Laboratory Results

Organic Compounds In Groundwater	Sample ID / Date Collected / Units	Table 910-1 Concentration Levels	1289#20-12 05/13/10		1289#20-12 09/23/10		1289#20-12 11/11/10		1289#20-12 06/26/14	
Benzene	mg/L	**0.005** [1]	0.001	U	0.001	U	0.001	U	0.001	U
Toluene	mg/L	**1** [1]	0.002	U	0.002	U	0.002	U	0.005	U
Ethylbenzene	mg/L	**0.7** [1]	0.002	U	0.002	U	0.002	U	0.001	U
Xylenes (Total)	mg/L	**10** [2]	0.002	U	0.002	U	0.002	U	0.003	U
Inorganics in Groundwater										
Total Dissolved Solids (TDS)	mg/L	**<1.2 x BKG** [1]	**328**		**274**		**264**		**290**	
Chlorides	mg/L	**<1.2 x BKG** [1]	**9.5**		**6.9**		**10.1**		**22**	
Sulfates	mg/L	**<1.2 x BKG** [1]	**25.5**		**18.3**		**13.1**		**BDL**	
Liquid Hydrocarbons										
TVH - GRO (Gasoline)	mg/L	**BDL**	0.2	U	0.2	U	0.2	U	BDL	U
TVH - DRO (Diesel)	mg/L	**BDL**	3.2	U	0.4	U	0.4	U	BDL	U
Cations and anions										
Bromide	mg/L	--	--		--		--		--	
Fluoride	mg/L	--	--		--		--		--	
Hydrogen Sulfide	mg/L	--	0.5	U	0.5	U	0.5	U	BDL	U
Dissolved Metals										
Iron	mg/L	--	--		--		--		--	
Manganese	mg/L	--	--		--		--		--	
Selenium	mg/L		0.002	U	0.0008	U	0.0008	U	0.001	U
Nutirents										
Nitrate + Nitrite	mg/L	--	--		--		--		0.1	U
Nitrates	mg/L	--	0.01	U	0.05	U	0.02	U		U
Nitrites	mg/L	--	0.004	U	0.004	U	0.004	U		U
pH										
pH	--	--	**7.45**		--		**7.52**		**7.2**	
Lab Specific Conductance										
Specific Conductance	umhos/cm	--	--		--		--		480	
Field Specific Conductance										
Specific Conductance	umhos/cm	--	**527**		--		**458**			

Notes:
Bold = Analyte was detected above detection limit
Value exceeds Table 910-1 Concentration Level
mg/L = milligrams per liter
BDL = Below Detection Level

porting Limit (RL)
r centimeter
m CDPHE-WQCC Regulation 41 - The Basic Standards for Groundwate
n Level (MCL) established under the Federal Safe Drinking Water A

Gunnison Energy LLC
Spadafora Water Storage Facility
Baseline Water Quality Evaluation
Surface Water
Laboratory Results

Table 4

Organic Compounds In Groundwater	Sample ID	Table 910-1 Concentration Levels	Stock Pond SW-1	Stock Pond SW-2	Stock Pond SW-3	WM-CK01 (WMC01 [1])	MC-CK01 (MC01)	MC-CK01	MC-CK01	MC-CK01	MC-CK02	MC-CK02	WM-CK01 [3]	WM-CK01	WM-CK01	WM-CK01	WM-CK01	WM-CK01	WM-CK02 (WMC02)	WM-CK02 (WMC02 [1])	WM-CK02 (WMC02)	WM-CK02 (WMC02)
	Date Collected		10/8/2013	10/8/2013	10/8/2013	9/21-25/10	9/21-25/10	07/21/04	09/18/09	09/24/10	06/28/05	07/26/05	09/18/08	08/12/09	09/18/09	05/03/10	09/24/10	09/24/10	09/18/08	09/18/09	09/24/10	9/21-25/10
	Units																					
Benzene	mg/L	**0.005** [4]	0.0005 U	0.0005 U	0.0005 U	U	U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	U
Toluene	mg/L	**1** [4]	0.005 U	0.005 U	0.005 U	U	U	--	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.004 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	U
Ethylbenzene	mg/L	**0.7** [4]	0.0005 U	0.0005 U	0.0005 U	U	U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	U
Xylenes (Total)	mg/L	**10** [4]	0.0015	0.0015	0.0015	U	U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	U
Inorganics in Groundwater																						
Total Dissolved Solids (TDS)	mg/L	**<1.2 x BKG** [4]	**220**	**200**	**250**	**186**	**128**	--	--	**207**	--	**256**	--	**241**	--	**181**	**260**	**258**	--	--	**250**	U
Chlorides	mg/L	**<1.2 x BKG** [4]	**17**	**8.5**	**12**	**2.1**	**2.3**	--	**1.8**	**2.3**	0.5 U	**1.9**	**1.4**	**1.5**	**1.8**	**1.5**	**2.1**	**2.1**	**1.4**	**1.9**	**1.8**	**1.8**
Sulfate	mg/L	**<1.2 x BKG** [4]	**11**	**<5.0**	**15**	**5.1**	**4.2**	**0**	**4.1**	**4.2**	**2.8**	**4**	**4.2**	**4.2**	**4.6**	**4.2**	**5.1**	**5.1**	**4.2**	**4.6**	**5.2**	**5.2**
Liquid Hydrocarbons																						
TPH - GRO (C6-C10)	mg/L	**BDL**				U	U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	--	--	0.2 U	U
TPH - DRO (C10-C28)	mg/L	**BDL**				U	U	--	3.2 U	3.2 U	--	--	**5.6**	--	3.2 U	--	3.2 U	3.2 U	**3.9**	3.2 U	3.2 U	U
Cations and anions																						
Bromide	mg/L	--				U	U	--	--	0.2 U	0.05 U	0.05 U	--	0.1 U	0.05 U	0.2 U	0.2 U	0.05 U	--	--	0.2 U	U
Fluoride	mg/L	--				U	U	**0**	--	--	--	--	--	--	--	--	--	--	--	--	--	U
Hydrogen Sulfide	mg/L	--				U	U	**0**	--	0.2 U	--	0.4 U	--	0.17 J	--	0.2 U	0.2 U	0.2 U	--	--	0.2 U	U
Dissolved Metals																						
Iron	mg/L	--	1.9	1.3	0.62	**0.182**	**0.718**	**0**	**0.039 U**	**0.718**	--	**19**	0.039 U	**0.26**	0.039 U	**1.9**	**0.182**	**0.167**	**0.1**	0.039 U	**0.0874**	**0.087**
Manganese	mg/L	--	0.14	0.071	0.064	**0.0046**	**0.0122**	**0**	0.0019 U	**0.0122**	--	**0.59**	**0.002 J**	**0.0108**	**0.0016 J**	**0.047**	**0.0046**	**0.0043**	**0.013**	**0.0038 J**	**0.0038**	**0.0038**
Selenium	mg/L	--	<0.020	<0.020	<0.020	U	U	**0**	0.072 U	0.0008 U	--	0.002 U	0.072 U	0.001 U	0.072 U	0.0008 U	0.0008 U	0.0008 U	0.072 U	0.072 U	0.0008 U	U
Nutirents																						
Nitrates (Nitrate + Nitrite)	mg/L	--				**0.02**	U	--	--	**0.11 G**	0.076 U	0.076 U	--	0.03 U	--	--	**0.11 G**	**0.11 G**	--	--	**0.11 G**	U
Nitrate	mg/L	--	<0.10	<0.10	<0.10	U	U	--	0.1 U	0.045 U	0.056 U	0.056 U	0.1 U	0.02 U	0.1 U	0.01 U	0.045 U	0.045 U	0.1 U	0.1 U	0.045 U	U
Nitrites	mg/L	--	<0.10	<0.10	<0.10	**0.02**	U	--	--	0.061 U	0.076 U	0.076 U	--	0.03 U	--	0.004 U	0.061 U	0.061 U	--	--	0.061 U	U
Field pH																						
pH	--	--				**7.58**	**8**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**8.55**
Lab Specific Conductance																						
Specific Conductance	umhos/cm	--	260	250	360	**260**	**207**	0	--	0.1 U	--	0.8 U	--	0.1 U	--	0.1 U	0.1 U	0.1 U	--	--	0.1 U	**250**
Field Specific Conductance																						
Specific Conductance	µS	--				**1252**	**336**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**692**

Notes:
Bold = Analyte was detected above detection limit
Value exceeds Table 910-1 Concentration Level
BDL = Below Detection Level
mg/L = milligrams per liter
umhos/cm = micromhos per centimeter

U = Not detected above Reporting Limit (RL)
"G" Flag qualifier not defined
[1] = Concentration taken from CDPHE-WQCC Regulation 41 - The Basic Standards for Groundwater
[2] = Maximum Concentration Level (MCL) established under the Federal Safe Drinking Water Act
[3] = Two samples collected at Site. Highest value reported when different.

U = Not detected above Reporting Limit (RL)
"G" Flag qualifier not defined
[1] = Concentration taken from CDPHE-WQCC Regulation 41 - The Basic Standards for Groundwater
[2] = Maximum Concentration Level (MCL) established under the Federal Safe Drinking Water Act
[3] = Two samples collected at Site. Highest value reported when different.

U = Not detected above Reporting Limit (RL)
"G" Flag qualifier not defined
[1] = Concentration taken from CDPHE-WQCC Regulation 41 - The Bas
[2] = Maximum Concentration Level (MCL) established under the Federa
[3] = Two samples collected at Site. Highest value reported when differe

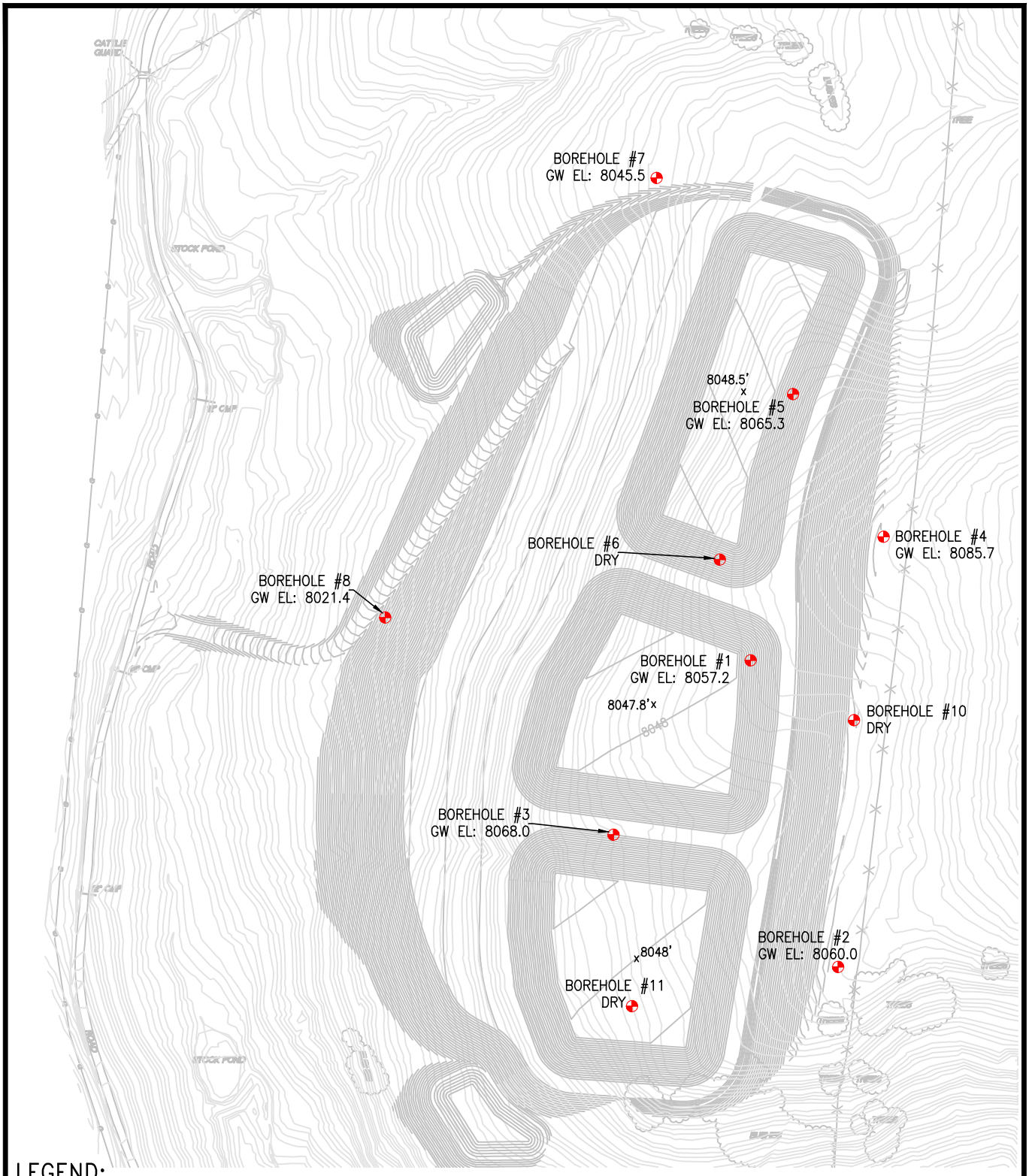
ATTACHMENT J
WASTE PROFILE

CHEMICAL USED IN OIL AND GAS OPERTIONS

THE CHEMICAL PRODUCTS LISTED BELOW MAY BE UTILIZED DURING THE DRILLING AND PRODUCTION OF OIL AND GAS OPERATIONS. OPERATIONAL CONDITIONS MAY REQUIRE CHEMICAL PRODUCTS NOT PRESENTED HERE, LIKEWISE SOME PRODUCTS LISTED MAY NOT BE UTILIZED AT ALL. AVAILABLE CHEMICAL ABSTRACT NUMBERS ARE PRESENTED ON THE PARTICULAR MATERIAL SAFETY DATA SHEET (MSDS).

1. Barite – barium sulfate and crystalline silica, quartz CAS #s 7727-43-7 & 14808-60-7
2. CI-31- Corrosion inhibitor – CAS #s 000067-56-1, 000067-63-0, 000064-18-6, & 000100-44-7
3. ClayCare – Choline Chloride and water CAS #s 67-48-1 and 7732-18-5
4. Defoamer 530 – Propane-1,2-diol propoxylated CAS 25322-69-4
5. DWP-621-1 – Anionic water soluble polymer- Friction Reducer- CAS Not Provide
6. DPW913-1- Quaternized – KCL Substitute – CAS Not provided
7. DWP-944-3 Biocide CAS#s 25322-68-3 and 10222-01-2
8. DynaDet – Detergent – CAS – Not provided
9. EvoCon II – Surfactant – CAS - Proprietary
10. EvoLube DPE II – Drilling Performance Enhancer – CAS - Proprietary
11. EvoMod – Viscosifier – Synthetic inorganic polymer
12. ExWATE – Barium Sulfate – CAS#s 7727-43-7, 1332-58-7, 14808-60-7, & 471-34-1
13. FERROTROL 300L – Citric acid - CAS 77-92-9
14. FlexFirm KA – Anhydrous Potassium silicate powder – CAS #s 1312-76-1 and 14808-60-7
15. HAI-40M – Corrosion Inhibitor – CAS #s 15619-48-4, 67-56-1, & 67-63-0
16. Hydrochloric Acid – CAS 7647-01-0
17. HR-601 (Lignosulfonate) Cement Retarder
18. LoSurf-300D – Surfactant - CAS#s 64-17-5, 64742-94-5, 91-20-3, 95-63-6 & 127087-87-0
19. Methyl alcohol – CAS 67-56-1
20. NEWCARB – Calcium Carbonate – CAS 471-34-1
21. NEWPAC B – Celulose
22. NewPhalt – Sulfonated asphalt – CAS Proprietary
23. NewPHPA D – Shale control – Anionic water-soluble polymer – CAS Not Provided
24. NEWZAN D – Xartnar Gum – CAS 11135-66-2
25. NoFoam X – Defoamer – CAS - Proprietary
26. PHENO SEAL – Melamine & phenolic resins – CAS Not Provided
27. Potassium Chloride – Inorganic salt – CAS 7447-40-7
28. SAPP - Sodium acid Pyrophosphate - CAS 7758-16-9
29. Caustic Soda – Caustic Soda Anhydrous – CAS Not Provided

ATTACHMENT K
POTENTIOMETRIC SURFACE MAP



LEGEND:

8078' PROPOSED SPOT ELEVATION AT CENTER OF PIT

BOREHOLE

*GW EL MEASURED 10/8/13.

NO TRUE STATIC GROUND WATER SURFACE.

N

SCALE: 1"=200'

WESTON SOLUTIONS	GUNNISON ENERGY LLC	POTENTIOMETRIC SURFACE MAP	FIGURE A

B8X10A2

ATTACHMENT L
OPERATION PLAN

Spadafora Water Storage Facility Operation Plan

Overview

The Spadafora Water Storage facility will be used to store produced water for hydraulic fracturing of both shale and coal production wells. The proposed facility is being designed to consist of three pits (Addendum No. 1, Sheet C101). The three pits will be used to manage coalbed methane produced water, natural gas well produced water, and hydraulic fracturing (frac) flowback water. Management of these three streams will allow maximum reuse potential of stored water. The proposed pits will have a total volume capacity of approximately 660,000 bbls.

Operating Plan

Details on all associated manifolds, piping, and instrumentation for the pits are presented on the engineering drawings. Operational characteristics and features are best identified on the Process and Instrumentation Diagram (P&ID) presented in the engineering drawings. Following standard engineering practices, at construction completion a fully comprehensive Operations and Maintenance (O&M) plan will be developed for the facility and will include details on the SCADA system that will be used to control and operate the facility. The SCADA system will contain display monitors to show real-time operational settings and allow for user control of system components.

Spill control measures for truck loading/unloading is described in the SPCC plan (Appendix A).

Updates to the plan will be provided to the COGCC with a Form 4, Sundry Notice.

Water Source, Treatment and Flow Rates

There will be three sources of water stored in the pits. The first will be the produced water from coalbed methane production wells. Although development of the well field has not begun, Gunnison Energy LLC, (GELLC) is predicted to produce between 2000-2500 bwpd of production water. Future development of the field will include a disposal well, location currently unknown, for excess water to be injected to the subsurface. Due to the large volumes of water necessary to frac the shale production wells, this production water will be managed in the storage pits. The water will not be treated until it is ready to be utilized in a frac, at which time it will be filtered to remove any solids which may have accumulated in the pit. The only potential treatment needed will be the application of biocide in the summer months to prevent algae blooms.

The second source of water in the storage pits will be well fracing flowback water. After the fracturing procedure of a shale well is complete, the wells will flow back at rates between 500-4000 barrels of water per day (bwpd) for some brief period of time. This water will be pumped in our existing water pipelines to the water storage facility. This water will be treated in the same way as the produced water.

Currently, GELLC has installed and will operate as the field is developed both water and gas pipelines to every producing well in the field. These same water lines will be used to move water both from existing producing wells and to new wells when being drilled.

Details on all associated manifolds, piping, and instrumentation for the pits are presented on the engineering drawings. Operational characteristics and features are best identified on the Process and Instrumentation Diagram (P&ID) presented in the engineering drawings. Following standard engineering practices, at construction completion a fully comprehensive Operations and Maintenance (O&M) plan will be developed for the facility and will include details on the SCADA system that will be used to control and operate the facility. The SCADA system will contain display monitors to show real-time operational settings and allow for user control of system components.

Stormwater Controls

Stormwater runoff at the subject site flows in a southwest direction to the seasonal Sheep Creek. The Facility location is graded to divert onsite runoff away from the pits wherever possible. Armored surface water diversion channels will intercept runon stormwater and divert it around and away from the pits into sedimentation ponds prior to discharging to stormwater culverts under the access road to the south of the site.

Following stormwater flow transmissions through the diversion channels and connecting sedimentation ponds, the stormwater will outlet from the sedimentation ponds to culverts under the access roads to the southwest of the site. The culvert outfalls contain energy dissipation devices (rip-rap blankets) to prevent surface degradation caused by stormwater flows.

Where stormwater diversion channels intersect the proposed facility access roads within the fenced perimeter, culverts installed under the roadways will transmit flows under the roads. The access roads are graded at slopes to direct surface water flows across the road into the surrounding diversion channels.

All cut and fill slopes will be either developed as working access pad or potholed, tracked or furrowed for better seed and moisture retention to promote the establishment of desirable vegetation for erosion control and long-term soil stabilization. The well-drained, permeable soils, adequate vegetative buffer, and sedimentation ponds would prevent any remaining sediment from reaching seasonal Sheep Creek. T

An addendum (Site Specific Stormwater Management Plan) to the existing master GELLC Stormwater Management Plan further describing permanent erosion and sedimentation measures and a copy of the Colorado Discharge Permit System (CDPS) correspondence and certifications for the facility is provided in as Appendix B.

Dust and Moisture Control

During normal facility operations, dust control will not be needed except in the rare event that water has to be trucked to the storage facility. In that event, a water truck will be utilized to assist in dust suppression on the haul roads. Existing water pipelines will normally be used to transport the water where needed.

During facility construction, a soil stockpile location is for cut material excavated has been proposed. It is not anticipated that construction activities will create conditions requiring for dust control measures to be implemented; however, should conditions be present that would require dust control measures, a water truck will be utilized to assist in dust suppression. Following construction of the facility, the stockpile will

be maintained as a pit access pad with the sideslopes permanently seeded and maintained for use in final reclamation. Following establishment of traffic area with road base and vegetation on the soil stockpile, the potential for dust will be miniscule and dust control measures are not anticipated to be necessary. Normal facility maintenance operations will monitor for any deteriorating vegetation which may expose stockpiled soils and potentially create dust due to exposed areas.

Sampling

For this facility, groundwater will be sampled from the leak detection system within the liner system. Confirmation of leaks in the primary liner system will be reported to COGCC immediately. Quarterly samples will be collected from the storage pits and will be analyzed for the complete list of waste profile constituents as provided in the Sampling and Analysis Plan (Appendix C).

In addition to the storage pit sample collection, monitoring programs for site specific shallow groundwater, shallow groundwater within 1-mile of the site, and surface water in the surrounding area will be implemented to monitor for potential impacts associated with the facility. Prior to facility operation, five site-specific monitoring wells will be installed. These five wells, along with monitoring the adjacent Stock pond, will comprise the site specific shallow groundwater monitoring network. Measurement of water levels and collection of samples from the site specific monitoring network will be conducted on a quarterly basis, barring special circumstances that warrant additional sampling (e.g., known leak in the primary liner), to monitor for potential impacts, if any, associated with the facility. Groundwater samples collected from the site specific monitoring well network will initially be analyzed for the parameters listed in 908.b.(9).A; however, after the initial two to four quarters of sampling, the site specific monitoring well network samples will be analyzed solely for parameters listed in COGCC Table 910-1.

According to Colorado Oil and Gas Information System (COGIS) Well database and the Department of Natural Resources Oil and Gas Well Locations database, permits have been issued for 1 well located within a 1-mile radius of the site; however, this well has not been drilled. There is also a domestic well within 1 mile of the facility. Permits for both of these wells are included in Attachment H of the COGCC Form 28. All verified wells within the 1-mile radius if accessible will be included in the shallow groundwater monitoring program for the facility. The shallow groundwater monitoring network will be sampled annually to monitor for potential impacts, if any, associated with the facility.

A monitoring network of five surface water stations placed in locations up-gradient and down-gradient of the facility along West Muddy Creek and Muddy Creek, along with the three Spadafora Stock Ponds located adjacent to the site, will be sampled annually to monitor for potential impacts, if any, associated with the facility.

Any exceedance of these allowable will be immediately reported to the COGCC and any deficiency noted. Details of each monitoring program, including sampling frequency and constituent lists, are presented in the Sampling and Analysis Plan (Appendix C).

Inspection and Maintenance

As part of the inspection, operation and maintenance of the facility (O&M), some of the tasks (but not limited to) GELLC will perform on a routine basis (specific timing and frequency of conducting O&M tasks will be determined after construction of the facility) are provided below:

- GELLC operators will be at the pits on a daily basis and will do basic pit inspection.
- GELLC will provide operators with an inspection check list to be conducted once per week.
- GELLC operators will ensure all facility monitoring systems are operating correctly and reporting critical information in real-time.
- GELLC operators will be responsible for ensuring all equipment and system components are inspected and serviced per manufacturer's instruction.
- Maintenance will be done on the facility as recommended by the manufacturer of the liners and as needed based on weekly inspections.
- All reporting requirements will be imposed per the COGCC standard.

As previously mentioned the O&M manual that will be prepared for the site will be finalized pending construction of the facility and all systems are up and running. Included within the O&M manual will also be a training schedule for all personnel that will be involved in running the system. Training will be held periodically (schedule TBD) and will consist of utilizing component specifications and trouble-shooting guidance to instruct all site personnel, both new and as a refresher.

Spills

A copy of GELLCs general Spill Prevention Control and Countermeasures plan is provided as Appendix A.

Discovery, Response and Cleanup of Releases

Inspections of the facility will be conducted as described above. In addition, employees are trained in the appropriate operation and maintenance of equipment and to look for, report and clean up releases. All recovered materials are disposed of in accordance with all applicable federal, state and local laws and regulations as described under the response and reporting section.

Notification Contacts

The list of individuals and organizations to contact should a release occur is provided Appendix D.

Notification Forms

Appendix E contains the appropriate forms which must be completed when reporting a spill. These forms will help the operator with the procedures which must be followed and the information which must be furnished.

Response Plan

Generally, each GELLC employee and contractor is responsible for taking any immediate steps necessary to respond to a spill or release noted during a site visit. If a spill is discovered, the employee/contractor is instructed to isolate or shutdown the source of the release, either by closing valves to the affected pit, tank or other production vessel, or taking other actions deemed appropriate. After the source of the spill has been abated, the employee/contractor will contact the Response Coordinator to report the event. The contact list included in Appendix D provides the names of the primary and secondary personnel accountable for oil spill prevention and facility response. The contact list also includes important agency numbers.

In general, recovered fluids are either returned to the production pit for eventual reuse or recovered using a vacuum truck and transported offsite for disposal at a permitted commercial disposal facility. Hydrocarbon impacted soil is placed in a lined containment area then transported for disposal off-site or allowed to dry and tested to confirm no residual hydrocarbon contamination of concern. Upon receipt of acceptable analytical results, the soil is used onsite.

Spill Reporting

As described in above, the Response Coordinator will be notified in the event of a release. Notification forms are provided in Appendix E. These forms are designed to assist in providing information in the event of a discharge/release/spill. The forms will document the event, identify information that needs to be obtained, and list site specific information. Depending on the size and site conditions of the spill, the Response Coordinator may have to report the release to various state and federal regulatory agencies. The contact information is contained in Appendix D. The following paragraphs summarize the notification requirements for various regulatory programs.

The reporting requirements for spills from COGCC-regulated facilities are:

1. Spills/releases of E&P waste or produced fluid exceeding one (1) barrel, including those contained within lined or unlined berms shall be reported on COGCC Spill/Release Report, Form 19. See Appendix E.
2. Spills/releases which exceed twenty (20) barrels of an E&P waste shall be reported on COGCC Spill/Release Report, Form 19, and shall also be verbally reported to the Director as soon as practicable, but not more than twenty-four (24) hours after discovery.
3. Spills/releases of any size which impact or threaten to impact any waters of the state, residence or occupied structure, livestock, or public byway shall be reported on COGCC Spill/Release Report, Form 19, and shall also be verbally reported to the Director as soon as practicable, but not more than twenty-four (24) hours, after discovery.
4. Spills/releases of any size which impact or threaten to impact any surface water supply area shall be reported to the COGCC Director and to the Environmental Release/Incident Report Hotline (1-877-518-5608). Spills and releases that impact or threaten a surface water intake shall be verbally reported to the emergency contact for that facility immediately after discovery.
5. For all reportable spills, operators shall submit a Spill/Release Report, Form 19, within ten (10) days after discovery. An 8.5 x 11 inch topographic map showing the governmental section and location of the spill shall be included. Such report shall also include information relating to initial mitigation, site investigation, and remediation. The Director may require additional information.
6. Chemical spills and releases shall be reported in accordance with applicable state and federal laws, including the Emergency Planning and Community Right-to-Know Act, the Comprehensive Environmental Response, Compensation, and Liability Act, the Oil Pollution Act, and the Clean Water Act, as applicable.

In addition to the spill reporting requirements listed above:

1. If the spill is less than 1 bbl and it does not threaten to impact a residence or occupied structure, livestock, public byway, or waters of the State of Colorado, it is not reportable to COGCC.

However, it shall be controlled and contained immediately upon discovery and cleaned up as soon as practicable.

If a spill that threatens waters of the State occurs on land owned by Bureau of Land Management (BLM) or the Forest Service (USFS), it is reportable in quantities over 10 bbl. Similarly, if a spill threatens fish or wildlife, it must be reported to the U.S. Fish and Wildlife Service. See NTL 3-A Form in Appendix E.

Emergency Response

GELLC maintains and existing Emergency Response Plan (ERP) for their operations. The current plan includes emergency response procedures and contacts, fire protection procedures, personal work rules and procedures, personal injury and first aid procedures, and maps for emergency response personnel. Also incorporated are the emergency contact numbers of Gunnison County, Delta County, Montrose County, the Colorado Oil and Gas Conservation Commission, Colorado Department of Public Health, the National Response Center and various private emergency response organizations. The existing ERP is provided as Appendix F.

Record-keeping

Record keeping will include weekly inspection logs, water analyses (groundwater and pit water) and records of throughput. All records will be made available to COGCC upon request.

Site Security

The water storage facility will be located in an area which is behind a security fence and locked gate. The gates at the facility are proposed as two 12 foot panels, spanning 24 feet, and will be 8 feet tall to match the surrounding site fence. Additionally, an 8-foot high security chain link fence will also be constructed around the water management pits proper. In summary there will be two fenced between the private property and the water storage facility pits. No additional security needed.

Hours of Operation

Water may be flowing into and out of pits 24 hours per day, 7 days per week. The site will be manned as needed during normal operations as well as during completion operations.

During the winter shutdown, water levels at the facility during will be left at approximately 10% of capacity which will be adequate to contain greater than a 25-year annual precipitation event. Stage storage curves have been developed and can be used during winter months as an additional resource. The stage storage curves are provided as an Appendix G.

GELLC maintains access to the facility, and surrounding facilities throughout the winter by means of snowmobiles, snowcats, dozers, etc. Therefore, the facility will never be inaccessible to GE personnel.

Noise and Odor Mitigation

No odor anticipated, thus no odor mitigation should be needed. This site is located in a remote location therefore will likely qualify for the light industrial standard. However, low noise levels are anticipated. All pumps specified for installation will comply with all COGCC noise requirements stated in section 802 of the regulations. Any electric pumps will be powered by an electric genset. Genset will meet all COGCC noise abatement requirements.

Waste Management

Water no longer needed for operations will be pumped via pipeline to a future disposal well. Should any additional disposal wells to be used, the well(s) will be submitted to the director for approval on a Form 4, Sundry Notice prior to use for disposal. The only other waste material would be used motor oil which will disposed of by company which changes oil in all our gensets. Additionally, a leak detection system that monitors the space between the liners will be operating on a 24-hour basis, and will ensure that any water that is detected in the sump between the liners will be removed and pumped back into the pit or to the disposal well.

If additional disposal wells are used, they will be submitted for pre-approval by the director on a Form 4, Sundry Notice.

An operational flow chart for disposing of pit bottom sediments is included as Appendix H. Liner disposal, along with additional waste disposal during closure is addressed in the closure and reclamation plan provided as an Appendix I.

NOTE: Following standard engineering practices, at construction completion a fully comprehensive Operations and Maintenance (O&M) plan will be developed for the facility. Updates to the plan as recorded will be provided to the COGCC with a Form 4, Sundry Notice.

Appendix A

SPCC Plan

SPILL PREVENTION, CONTROL AND COUNTERMEASURE (SPCC) PLAN

Gas Production Wells
&
Collection System

GUNNISON ENERGY CORPORATION
1801 Broadway, Suite 1200
Denver, Colorado 80202

Prepared by

Weston Solutions, Inc.
1435 Garrison Street, Suite 100
Lakewood, CO 80215

July 2012

TABLE OF CONTENTS

APPENDICES

LIST OF ACRONYMS

bbl	barrel
BLM	Bureau of Land Management
BOP	blowout prevention
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
COGCC	Colorado Oil & Gas Conservation Commission
EPA	Environmental Protection Agency
GEC	Gunnison Energy Corporation
LEPC	Local Emergency Response Committee
NRC	National Response Center
OCP	Oil Spill Contingency Plan
PE	Professional Engineer
SOP	Summary of Operating Procedures
SPCC	Spill Prevention Control and Countermeasure
USFS	US Forest Service
VOC	volatile organic compound

CROSS REFERENCE MATRIX FOR ONSHORE PRODUCTION FACILITY

40 CFR 112 Requirements (amended 2010) vs. SPCC Plan Section

Regulation	Description	Page #
§112.3(b)(2)	SPCC Plan prepared within six months after becoming operational (effective 11/10/2010)	ix
§112.3(d)(1)	Professional Engineer (PE) certification with five, or six (if applicable for produced water containers) elements	vii
§112.5(a)	Amendment of SPCC Plan	ix
§112.5(b)	Review of Plan at least every 5 years with documentation (*i.e*. a log)	ix
§112.6	Qualified Facilities: meets qualification criteria	N/A
§112.6(a) or (b)	Tier I or Tier II Self Certification with 8 elements	N/A
§112.6(a)(2)	Technical amendments self-certified	N/A
§112.6(a)(3)(i)	Template has failure analysis	N/A
§112.6(a)(3)(ii)	Template has adequate secondary containment	N/A
§112.6(a)(3)(iii)	Template has overfill protection	N/A
§112.6(b)(2) / (i)	Technical amendment Self-Certified or PE certification for deviations from Plan requirements	N/A
§112.6(c)(3)(i)	Environmental Equivalence certified by PE	N/A
§112.6(c)(3)(ii)	Impracticability determination certified by PE	N/A
§112.6(c)(3)(iii)	Any alternative procedures for skimming produced water containers in lieu of sized secondary containment certified by PE	N/A
§112.6(c)(4)	PE certification with three elements	N/A
§112.7	General requirements for SPCC Plans for all facilities & all oil types	2-1
§112.7	Management approval of Plan	viii
§112.7	Discussion of facilities, procedures, methods or equipment not yet fully operational with details of installation and operational start-up	2-2
§112.7(a)(1)	General requirements; discussion of facility's conformance with rule requirements	2-2
§112.7(a)(2)	Deviations from Plan requirements	N/A
§112.7(a)(3)	Facility description and diagram, type of oil and capacity of each container, transfer stations and piping, buried containers on diagram	Facility Diagrams
§112.7(a)(3)(ii)	Discharge prevention measures	2-5
§112.7(a)(3)(iii)	Discharge drainage controls	2-3
§112.7(a)(3)(iv)	Countermeasures for discharge discovery, response and cleanup	2-7
§112.7(a)(3)(v)	Methods of disposal of recovered materials in accordance with legal requirements	2-7, Appx. B
§112.7(a)(3)(vi)	Contact list and phone numbers for facility response coordinator, National Response Center, cleanup contractors, all Federal, State, and local agencies who must be contacted in case of a discharge	Appx. B

Regulation	Description	Page #
§112.7(a)(4)	Spill reporting information	2-8, Appx B
§112.7(a)(5)	Discharge procedures	2-7, Appx. B
§112.7(b)	Failure prediction (sources, quantities, rates, and directions)	2-3
§112.7(c)	Secondary containment for all areas from which a discharge of oil could occur (i.e. mobile refuelers, loading/unloading areas, transformers, oil filled operational equipment, etc.) other than bulk containers	Facility Diagrams
§112.7(d)	Explanation of impracticability of secondary containment	N/A
§112.7(d)(1)	Oil Spill Contingency Plan (OCP) per part 109	Appx. B
§112.7(d)(2)	Commitment of manpower, equipment & materials to remove a discharge	Appx. F
§112.7(e)	Written procedures for inspections and tests	2-7
§112.7(e)	Records of inspections and tests signed and kept 3 years	2-6, Appx. C
§112.7(f)(1)	Employee training	2-9
§112.7(f)(2)	Designated individual accountable for discharge prevention	viii, Appx B
§112.7(f)(3)	Discharge prevention briefings scheduled and conducted annually	2-9
§112.7(h)	Loading/unloading rack (excluding offshore facilities)	N/A
§112.7(h)(1)	Containment for contents of largest compartment	Containment Tables
§112.7(h)(2)	Warning light/sign, barrier system, wheel chocks, or break interlock system to prevent departure with connected lines	2-5
§112.7(h)(3)	Inspect drains and outlets of vehicles	2-5
§112.7(i)	Brittle fracture or catastrophic failure evaluation requirements	2-3
§112.7(j)	Conformance with State requirements	2-1
§112.3(k)(1)	Qualified Oil-Filled Operational Equipment: meets criteria	2-3
§112.7(k)(2)(i)	Inspection procedures or monitoring program	2-6, Appx. C
§112.7(k)(2)(ii)(A)	OCP per part 109	Appx.B
§112.7(k)(2)(ii)(B)	Written commitment of resources	Appx F
§ 112.9	Requirements for onshore production facilities	All
§ 112.9(a)	Meet general and specific requirements	All
§ 112.9(b)(1)	Oil production facility drainage: Restrain drainage from diked areas; remove accumulated oil	2-6
§ 112.9(b)(2)	Oil production facility drainage: Inspect field drainages, oil traps, sumps or skimmers for accumulations of oil, remove oil	2-6
§ 112.9(c)	Oil production facility bulk storage containers:	2-3
§ 112.9(c)(1)	Containers compatible with material and conditions of storage	2-3
§ 112.9(c)(2)	Secondary containment for tank battery, separation and treating units with capacity of largest container & freeboard for precipitation	2-3
§ 112.9(c)(2)	Drainage from undiked areas with potential to discharge oil directed to catchment basin or holding pond	2-2
§ 112.9(c)(3)	Visually inspect containers, foundations and supports	2-6
§ 112.9(c)(4)	Engineered to prevent discharges	2-3

Regulation	Description	Page #
§ 112.9(c)(5)	Flow-through Process Vessel Alternative in lieu of compliance with 112.9(c)(2) and (3)	2-7
§ 112.9(c)(5)(i)	Flow-through Process Vessel Alternative: On a regular schedule visually inspect and/or test flow-through process vessels and associated components (such as dump valves) for leaks, corrosion, or other conditions that could lead to a discharge	N/A
§ 112.9(c)(5)(ii)	Flow-through Process Vessel Alternative: Take corrective action or make repairs to flow-through process vessels and any associated components as indicated by regularly scheduled visual inspections, tests, or evidence of an oil discharge	N/A
§ 112.9(c)(5)(iii)	Flow-through Process Vessel Alternative: Promptly remove or initiate actions to stabilize and remediate any accumulations of oil discharges associated with flow-through process vessels	N/A
§ 112.9(c)(5)(iv)	Flow-through Process Vessel Alternative: Within six months of facility discharging more than 1,000 U.S. gallons of oil in a single discharge, or discharging more than 42 U.S. gallons of oil in each of two discharges as described in §112.1(b) within any twelve month period, from flow-through process vessels (excluding discharges that are the result of natural disasters, acts of war, or terrorism), facility complied with §112.9(c)(2) and (c)(3)	N/A
§ 112.9(c)(6)	Produced Water Containers comply with §112.9(c)(1) and (c)(4); and §112.9(c)(2) and (c)(3),	2-3
§ 112.9(c)(6)	Produced Water Containers Alternative in lieu of compliance with §112.9(c)(2) and (c)(3)	N/A
§ 112.9(c)(6)(i)	Produced Water Containers Alternative: Implement, on a regular schedule, a procedure for each produced water container that is designed to separate the free-phase oil that accumulates on the surface of the produced water.	N/A
§ 112.9(c)(6)(i)	Produced Water Containers Alternative: A description of the procedures, frequency, amount of free-phase oil expected to be maintained inside the produced water container is included	N/A
§ 112.9(c)(6)(i)	Produced Water Containers Alternative: PE certification	N/A
§ 112.9(c)(6)(i)	Produced Water Containers Alternative: Procedures to maintain records for three years	N/A
§ 112.9(c)(6)(ii)	Produced Water Containers Alternative: On a regular schedule, visually inspect and/or test produced water containers and associated piping for leaks, corrosion, or other conditions that could lead to a discharge as described in §112.1(b) in accordance with good engineering practice.	N/A
§ 112.9(c)(6)(iii)	Produced Water Containers Alternative: Take corrective action or make repairs to the produced water container and any associated piping as indicated by regularly scheduled visual inspections, tests, or evidence of an oil discharge	N/A
§ 112.9(c)(6)(iv)	Produced Water Containers Alternative: Promptly remove or initiate actions to stabilize and remediate any accumulations of oil discharges associated with the produced water container	N/A

Regulation	Description	Page #
§ 112.9(c)(6)(v)	Produced Water Containers Alternative: Within six months of facility discharging more than 1,000 U.S. gallons of oil in a single discharge, or discharging more than 42 U.S. gallons of oil in each of two discharges as described in §112.1(b) within any twelve month period, from produced water containers (excluding discharges that are the result of natural disasters, acts of war, or terrorism) facility complied with §112.9(c)(2) and (c)(3)	N/A
§ 112.9(d)	Facility transfer operations, oil production facilities	2-5
§ 112.9(d)(1)	Inspect aboveground valves, piping, drip pans, supports, pumping, and etc.	2-6
§ 112.9(d)(2)	Inspect salt water disposal facilities	2-6
§ 112.9(d)(3)	Flowlines and intra-facility gathering lines are provided with secondary containment per 112.7(c)	2-3
§ 112.9(d)(3)(i)	For flowlines and intra-facility gathering lines that are not provided with secondary containment, a Contingency Plan following the provisions of Part 109 is included	Appx. A
§ 112.9(d)(3)	For flowlines and intra-facility gathering lines that are not provided with secondary containment, a written commitment of manpower, equipment, and materials required to expeditiously control and remove any quantity of oil discharged that might be harmful is provided	Appx. F
§ 112.9(d)(4)	A written program of flowline/intra-facility gathering line maintenance has been prepared and implemented	2-7
§ 112.9(d)(4)(i)	Flowlines and intra-facility gathering lines and associated valves and equipment are compatible with the type of production fluids, their potential corrosivity, volume, and pressure, and other conditions expected in the operational environment	2-3
§ 112.9(d)(4)(ii)	Procedures to visually inspect and/or test flowlines and intra-facility gathering lines and associated appurtenances on a periodic and regular schedule for leaks, oil discharges, corrosion, or other conditions that could lead to a discharge are included. For flowlines and intra-facility gathering lines that are not provided with secondary containment in accordance with §112.7(c), the frequency and type of testing must allow for the implementation of a contingency plan as described under Part 109	2-3, Appx. D
§ 112.9(d)(4)(iii)	Take corrective action or make repairs to any flowlines and intra-facility gathering lines and associated appurtenances as indicated by regularly scheduled visual inspections, tests, or evidence of a discharge.	2-7
§ 112.9(d)(4)(iii)	Procedures to promptly remove or initiate actions to stabilize and remediate any accumulations of oil discharges associated with flowlines, intra-facility gathering lines, and associated appurtenances	Appx. B
§112.20(e)	Completed and signed certification of substantial harm form	Facility Diagrams

Note: N/A indicates the section is not applicable.

CROSS REFERENCE MATRIX FOR OIL DRILLING AND WORKOVER FACILITIES

Regulation	Description	Page #
§112.3(b)(2)	SPCC Plan prepared within six months after becoming operational (effective 11/10/2010)	ix
§112.3(d)(1)	PE certification with five, or six (if applicable for produced water containers) elements	vii
§112.5(a)	Amendment of SPCC Plan	ix
§112.5(b)	Review of Plan at least every 5 years with documentation (*i.e.* a log)	ix
§112.6	Comply with Qualified Facilities if applicable	N/A
§112.7	Comply General requirements for SPCC Plans	All
§ 112.10	Requirements for onshore oil drilling and workover facilities	3-1
§ 112.10(a)	Meet general and specific requirements	All
§ 112.10(b)	Position or locate mobile drilling or workover equipment so as to prevent a discharge as described in §112.1(b)	3-1
§ 112.9(c)	Provide catchment basins or diversion structures to intercept and contain discharges of fuel, crude oil, or oily drilling fluids	3-1
§ 112.9(d)	Procedures for Installation of a blowout prevention (BOP) assembly and well control system before drilling below any casing string or during workover operations.	3-1
§112.20(e)	Completed and signed certification of substantial harm form	Facility Diagrams

Note: N/A indicates the section is not applicable.

Please note that although each of the pertinent regulatory sections has been addressed, portions of this Plan may have additional information provided to clarify and supplement required information.

PROFESSIONAL ENGINEER CERTIFICATION

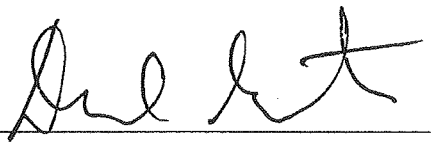
40 CFR 112.3(d)

By means of this Professional Engineer Certification, I hereby attest to the following:

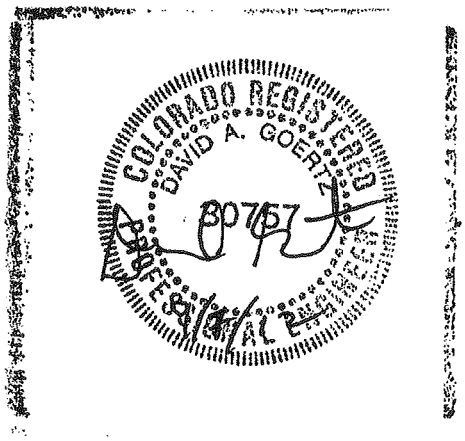
- I am familiar with the requirements of 40 CFR Part 112 (July, 1 2009) and have verified that this Plan has been prepared in accordance with the requirements of this Part.
- I or my agent have visited and examined the facilities.
- I have verified that this Plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards, and the requirements of this Part.
- I have verified that the required inspection and testing procedures have been established.
- I have verified that the Plan is adequate for the facility.

David A. Goertz

Printed Name of Registered Professional Engineer



Signature of Registered Professional Engineer



Date: 9/7/12 **Registration No**: 30757 **State:** Colorado

GUNNISON ENERGY CORPORATION – MANAGEMENT CERTIFICATION

40 CFR 112.7

Statement of Owner/Operator Responsible for Facilities:

The management of Gunnison Energy Corporation (GEC) fully supports and will implement this Plan and amend it, as required, due to expansions, modifications at the facilities and regulatory changes.

I, M. Brad Robinson, am President of GEC. I understand that I am responsible for overall implementation of GEC's SPCC Plan. My office is located at 1801 Broadway, Suite 1200, Denver, Colorado 80202. The telephone number is (303) 296-4222.

Facilities covered in this plan (Name and Location):

- See Containment Tables section; Facilities With Bulk Hydrocarbon Storage Containers

I hereby certify that the necessary resources to implement this SPCC Plan have been committed.

8/24/12

Signature **Date**

M. Brad. Robinson President

Name **Title**

Designated person accountable for oil spill prevention at the facilities and plan implementation:

Lee Fyock – Director of Environment and Permitting

LOCATION OF SPCC PLAN

40 CFR 112.3(e)
In accordance with 40 CFR 112.3(e)(1): because each facility is normally unattended for four hours per day, a complete copy of the Plan is located at the nearest field office in Delta, Colorado. A complete copy of this SPCC Plan is also maintained at any facility attended at least four hours per day including active development sites. Copies will also be kept at GEC's offices in Denver, Colorado, and Oxbow Corporate Headquarters in West Palm Beach, Florida.

PLAN REVIEW AND AMENDMENTS

40 CFR 112.5
NON-TECHNICAL AMENDMENTS ▪ Non-technical amendments are not required to be certified by a PE. ▪ Examples of changes include, but are not limited to, phone numbers, name changes, or non-technical text change(s).
TECHNICAL AMENDMENTS ▪ Technical amendments are certified by a PE. ▪ Examples of changes include, but are not limited to, commissioning or decommissioning containers; replacement, reconstruction, or movement of containers; reconstruction, replacement, or installation of piping systems; construction or demolition that might alter secondary containment structures; changes of product or service; or addition/deletion of standard operation or maintenance procedures related to discharge prevention measures. It is the responsibility of the facility to determine, and confirm with the regulatory authority as necessary, what constitutes a technical amendment. The preamble of the rule states that an amendment is required only "when there is a change that materially affects the facility's potential to discharge oil" (67 FR 47091). ▪ An amendment made under this section will be prepared within six (6) months of the change and implemented as soon as possible but not later than six (6) months following preparation of the amendment. ▪ Technical amendments affecting various pages within the plan can be PE certified on those pages, certifying those amendments only, and will be documented on the log form on the following page.
MANAGEMENT REVIEW ▪ Management will review and amend this SPCC Plan at least each five (5) years or when there is a change in the facility design, construction, operation, or maintenance that materially affects its potential for a discharge. The review will be documented on the form on the following page. ▪ Management will review and amend this SPCC whenever there is a discharge of more than 1000 gallons of oil into or upon navigable waters in a single discharge or a discharge of more than 42 gallons of oil in each of two discharges occurring within any twelve month period.

REVIEW AND AMENDMENT LOG					
Review/ Amend Date	**Signature * (Specify)**	**Amend Plan (will/will not)**	**Description of Review Amendment**	**Affected Page(s)**	**PE Certification (Y/N)**
July 2004			Initial Plan Preparation		
January 2006	See records	WILL	Revised for generic application to all GEC Drill Pads; Gathering Lines; Compressor Stations and Mobile Gas Well Drilling Rigs operated by GEC.	ALL	YES
July 2010		WILL	Revised language per 2009 regulations, added new facility diagrams, added new containment calculations, etc.	ALL	YES
August 2012	See PE Certification	Will	Remove dry gas facilities. Update Contact List. Add flow-through process inspections.	ALL	YES
January 2014	David Goertz, P.E. CO #30757 See PE Certification	Will	Update Facility Diagrams Update Contact List. Update inspections Section 2.3.2	All	Yes
November 2014	David Goertz, P.E. CO #30757 See PE Certification	Will	Update Facility Diagrams Update Contact List. Update Reporting Section 2.4.2	All	Yes

**Typically signed by Manager, Professional Engineer or plan reviewer.*

DEFINITIONS

Use of this Spill Prevention Control and Countermeasure (SPCC) Plan requires an understanding of several significant regulatory terms and definitions. The terms listed below are used in accordance with definitions found in federal and state regulations *40 CFR 110; and 40 CFR 112*, where CFR is the Code of Federal Regulations.

Bulk Storage Container means any container used to store oil. These containers are used for purposes including, but not limited to, the storage of oil prior to use, while being used, or commerce. Oil-filled electrical, operating, or manufacturing equipment are not bulk storage containers.

Discharge includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying or dumping of oil.

Navigable Waters, as defined under Section 502(7) of the Clean Water Act, has been interpreted to include all surface waters, including any waterway or adjoining shoreline within the United States. In addition, groundwater may also be included under the definition of navigable waters, if groundwater is directly connected hydrologically with surface waters.

Oil is defined to include any kind or in any form, including, but not limited to: fats, oils, or greases of animals, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse or oil mixed with wastes other than dredged spoil. It has been interpreted that dielectric fluid and other types of oil products associated with electrical transformers and equipment are included in this definition.

Spill *or* **Spill Event** means a discharge of oil into or upon the navigable waters of the United States or adjoining shorelines in harmful quantities, as defined at 40 CFR 110. Hence, a *discharge* may occur without resulting in a *spill*. This difference can be significant with regard to regulatory reporting responsibilities.

As defined in 40 CFR 110.3, "*harmful discharges of oil into navigable waters of the United States***"** include discharges of oil that:

- Violate applicable water quality standards; or
- Cause a film or sheen upon, or discoloration of, the surface of the water or adjoining shorelines, or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines.

Spill Prevention Control and Countermeasure (SPCC) Plan is designed to prevent any discharge of oil into or upon navigable waters of the United States or adjoining shorelines as opposed to response and cleanup after a spill occurs. The SPCC Plan must be prepared by the owner or operator of the subject facility and certified by a licensed Professional Engineer (PE)

1.0 INTRODUCTION AND BASIC PLAN INFORMATION

This Spill Prevention Control and Countermeasure (SPCC) Plan, hereinafter referred to as 'the Plan' has been completed in accordance with requirements of the July, 2009 revisions to Part 112 from the United States Code of Federal Regulations (CFR), Title 40 (40 CFR 112), entitled *Oil Pollution Prevention*. The Plan is applicable to onshore facilities put into operation since April 16, 2002, as well as mobile gas well drilling rigs operated by Gunnison Energy Corporation (GEC). The Plan is a controlled document and is issued with numbered copies to facilitate consistent updates. All official Plan updates will be issued through the Environmental and Permitting Manager for GEC and approved by the Oxbow Corporation LLC (parent company) Environmental Department.

Revision 1 (January 2006) of this Plan encompasses site development of proposed natural gas well system pads and private access roads, drilling of the wells, product testing, pre-production isolation (shutting in) of the well heads and pipeline, and the production phase of operations. Revision 1 of the Plan is also applicable to mobile gas well drilling rigs operated by GEC. Revision 1 of the Plan includes status updates on previously reported drilling sites; newly proposed sites; production and shut-in sites previously covered under separate SPCC Plans; and compressor stations.

Revision 2 (July 2010) of this Plan is consistent with 112.5(b) requirement for review of the Plan at least every 5 years with documentation. Much of the language has been revised. Additionally, this revision has added new production facilities and bulk hydrocarbon storage containers to the Plan. New maps and facility diagrams have also been created.

Subsequent to, and contingent upon establishing each of the proposed wells as an economically viable component of the natural gas well systems, productive wells will be connected to an area-wide infrastructure to collect, compress and transport natural gas to and through one or more commercially operated gas pipeline(s). As additional wells are developed and other wells are put into production or shut-in, periodic amendments or revisions to this Plan will be prepared and appropriate changes made and certified by a PE, as required.

Plan coverage is in general conformance with document requirements specified in 40 CFR 112.7, although its organization has been modified to suit the nature of this Plan. To assure coverage of pertinent regulatory sections, a matrix has been prepared and is presented at the beginning of the Plan. The matrix identifies salient sections of the regulation versus the Plan section in which it is addressed.

The area currently in production or under development by GEC is in a mountainous region of western Colorado and has a number of intermittent and perennial streams with associated drainages that could potentially be impacted by oil spills from drilling, construction and production operations (see Surface Water Proximity Map). This Plan is designed to be applicable to all stages of development including drilling, production, and gas treatment and compression. Pertinent information regarding each of the wells, related infrastructure, and compressor station(s) is summarized in the Containment Tables section. More detailed spatial information related to each of the sites is provided in the Facility Diagrams, Tank Tables, Containment Calculations, and No Harm Certifications section. Discussions provided in the remainder of this Plan refer to both existing and/or planned facilities, unless specifically stated otherwise in the text.

Technical amendments, such as the addition of hydrocarbon storage containers, will be issued within 6 months as mandated by 40 CFR 112.5. Such amendments will be certified by a PE. In accordance with pertinent regulations, non-technical Plan amendments / reviews and revisions will also be issued on a timely basis by personnel with the appropriate level of authority.

2.0 SPCC PLAN POLICIES AND PROCEDURES

This Plan is a dynamic document prepared to address multiple onshore oil production facilities operated by GEC in Gunnison County, CO and Delta County, CO; that are subject to the federal SPCC regulations. A complete list of facilities covered by this Plan can be found in the Containment Tables section. This Plan was written and developed to satisfy U.S. Environmental Protection Agency (EPA) oil pollution prevention regulations (40 CFR 112). In doing so, it also conforms with Colorado Code of Regulations: 7 CCR 1101 (Division of Oil and Public Safety), and 2 CCR 404 (Oil and Gas Conservation Commission).

Specifically, this Plan was developed to:

- Communicate oil pollution prevention requirements to GEC employees;
- Document GEC SPCC procedures and measures;
- Enable GEC employees to report a spill and provide all the necessary information in the event of a release;
- Assist GEC in contacting the appropriate agencies;
- Provide site-specific information quickly and easily.

Based on the type of operating facilities, the Plan addresses both the general SPCC plan regulatory requirements specified in 40 CFR 112.7 and those specific to onshore oil production facilities included in 40 CFR 112.9. General requirements applicable to each facility and to the overall management of SPCC-related activities are included in the main text portion of this Plan. The Facility Diagrams, Tank Tables, Containment Calculations, and No Harm Certifications section of the Plan provide site specific information for each individual facility covered by this Plan. This information includes a site layout with tank locations, description of equipment, volume and type of material stored, surface water flow directions, and spill prevention controls.

This Plan conforms to the SPCC Regulations and was developed in accordance with sound engineering practices. Any deviations from regulatory requirements that were noted during the development of this Plan are noted in the Tables section.

2.1 Facility and Owner Information

Name:	Gunnison Energy Corporation (An Oxbow Company)
Address:	1801 Broadway Suite 1200 Denver, CO 80202
Facility Contact:	Lee Fyock Director of Environment and Permitting Main Office: (303) 296-4222 Direct: (303) 293-2913

Field Office	18389 H Road
Address:	Delta, CO 81416 Office: (970) 874-4358
Facility Location:	This SPCC Plan covers multiple onshore production facilities and rigs located in Gunnison and Delta Counties, Colorado.

2.1.1 Facility Layout

Specific details for each facility covered by this plan are provided as Facility Diagrams, Tank Tables, Containment Calculations, and No Harm Certifications. In general, the physical layout of each production facility consists of one or more 400 barrel (bbl) welded steel above ground storage tank(s) containing produced water and some hydrocarbon condensate, one or more oil/water separators, one or more volatile organic compound (VOC) combustion unit(s) and one or more wellheads. The wellheads and all the production equipment are connected with buried flowlines.

Many of GEC's wellheads are shut-in, or non-producing at this time. These production locations have remaining infrastructure such as tanks, separators, and containment structures. This infrastructure does not contain hydrocarbons; however, it has been included in the Plan for potential re-commissioning at a future date not yet determined. There is also the potential that additional well pads will be added. Tankage and equipment will vary but be within the realm of the existing pads. These new pads will be added to the plan within 6 months from the start of production. There is also the possibility of decommissioning pads and compressor stations and permanently removing them. These would then be removed from the plan.

Each facility occupies a cleared and graded area that is initially bermed on all sides for secondary containment during drilling operations. Pads are engineered with a 1 degree slope toward the cut slope, where the reserve pit would ideally capture hydrocarbon spills. As drilling operations subside and production infrastructure is added, the secondary containment is targeted to surround tanks and separator locations. Additional infrastructure at each facility may include meter house(s), access road, combustion unit(s), and vehicle turn-around area.

The geographical area of GEC infrastructure experiences a high amount of annual precipitation for Colorado. Therefore the production facilities have been engineered with stormwater controls such as diversion ditches around pads and detention ponds. The engineering is such that runoff/drainage across uncontained portions of the sites is not anticipated to come into contact with hydrocarbons. Visual inspections of the entire location are performed on a regular basis by the pumper, as described in Section 2.3.2.

Due to the amount of precipitation, portions of the initial pad-surrounding berms are deconstructed after wells are completed to facilitate drainage of precipitation from the pad itself. If, during workover activities, secondary containment immediately around temporary tanks (such as frac tanks) is unfeasible; then pad-surrounding berms are reconstructed to provide secondary containment for the entire pad.

2.1.2 Tanks, Piping and Equipment

The hydrocarbon containing condensate tanks and produced water tanks are considered bulk storage tanks/containers under SPCC regulations. All produced water tanks are cylindrical, factory constructed of welded steel and built in accordance with API-12F *Shop Welded Tanks for Storage of Production Liquids* specifications. Separators, and heater/treaters are considered flow-through process equipment.

The brittle fracture evaluation is not applicable as no field-erected tanks are present.

All produced water tanks are equipped with Enardo relief valves and 16 oz springs in the thief hatch to relieve any pressure that might build up inside the tank. The tanks have been sized to provide sufficient capacity to prevent overfilling. When multiple tanks are present they are equipped with equalizing lines to prevent overfilling. Tanks are gauged daily with radar sensors to monitor liquid levels to ensure that sufficient tank capacity is available. The level sensors can be remotely monitored at all times. As described in Section 2.3.2, tanks are visually inspected on a regular basis for leaks, corrosion, and any other malfunctions or deterioration. The equipment materials and construction and associated piping are compatible with the fluids stored and storage conditions such as pressure and temperature.

Gathering lines are buried and constructed of steel. The steel has been coated with 12-15 mil fusion-bond epoxy powder and/or wrapped to prevent corrosion. Treatment lines, including the oil and water dump lines, are constructed of PVC to prevent corrosion.

2.1.3 Containment Structures/Berms

Unless otherwise specified, sufficiently impervious (lined) corrugated steel containment structures are utilized for the majority of secondary containment. Corrugated steel berms are present at most tank batteries. Sufficiently impervious earthen berms are utilized at most separators. The storage volume of each containment structure/bermed-area is large enough to contain the entire capacity of the largest single container in the secondary containment plus sufficient freeboard to allow for precipitation. The Containment Tables section summarizes any deficiencies in containment structures. Containment Tables consist of secondary containment calculations at each tank battery and separator location. The Facility Diagrams, Tank Tables, Containment Calculations, and No Harm Certifications section contains a diagram of each secondary containment structure. All discharges or excess precipitation is removed by vacuum trucks and properly disposed of as described in Section 2.4.1.

2.1.4 Potential Discharge Volume and Direction of Flow

One scenario for release of oil is the loss of containment of the largest tank at any particular facility due to rupture (400bbl average tank size). This could result in the release of up to 16,800 gallons of oil within one hour. Oil would spill into the secondary containment. In this scenario, oil would be contained within the secondary containment surrounding the tank battery.

Another possible scenario would be the release of oil outside the secondary containment during truck loading/unloading activities; such as a ruptured hose connection on the water truck. This could result in the release of approximately 0 gallons of oil per minute, until the attendant could access the shutoff valve. This instance could potentially allow 0 gallons of oil to be released.

A third possible scenario would be the rupture of a flowline outside of secondary containment due to corrosion. This could result in the release of approximately 0 gallons of oil per hour, until the pumper notices the failure during daily inspections. This instance could potentially allow 0 gallons of oil to be released.

In all instances, the spill response and notification procedures provided in the Oil Spill Contingency Plan (OCP) (Appendix B) would be implemented and appropriate action taken.

In the event of any discharge outside of secondary containment structures, oil would flow from the facility in the direction shown on the relevant facility diagram included in the Facility Specific section of this Plan.

2.1.5 Proximity to Navigable Waters

All facilities are located within the Gunnison River watershed. Several of the facilities are in close proximity to navigable waters. The Surface Water Proximity map shows the location of each facility in relation to surrounding tributaries of the Gunnison River, with an aerial imagery background. In the event of an uncontrolled discharge from the wells, gathering line, or the tank battery areas, oil would follow the natural topography. Additionally, each Facility Specific section depicts the perceived direction of runoff from the facility and the Tank Tables present the estimated distance relative to the potentially impacted navigable waterway.

2.1.6 Site Specific Facility Diagrams

Site specific facility diagrams are included in Facility Diagrams, Facilities Specific section with the following detail and location information as applicable:

- Process equipment;
- Aboveground storage tank location;
- Direction of surface water runoff;
- Gathering lines;
- Drum and portable container storage areas;
- The contents of all hydrocarbon containers;
- Proximity and direction of flow to navigable waters.

2.2 General Requirements

2.2.1 Discovery, Response, and Cleanup of Releases

Inspections of facilities are routinely conducted as described in Section 2.3.2. In addition, employees are trained in the appropriate operation and maintenance of equipment as well as to look for, report, and clean up releases as described in Section 2.5.1. All recovered materials are disposed of in accordance with all applicable federal, state and local laws and regulations as described in Section 2.4.1.

2.2.2 Notification Contacts

The list of individuals and organizations to contact should a release occur is provided in the OCP, Appendix B of the Plan.

2.2.3 Notification Forms

Appendix C contains the appropriate forms which must be completed when reporting a spill. These forms will help the operator with the procedures that must be followed and the information that must be furnished.

2.2.4 Response Plan

General information on the response to, and reporting of, oil discharges can be found in Section 2.4 of this plan. Detailed information can be found in GEC's OCP, a copy of which is provided in Appendix B. This plan describes procedures that will be used under various emergency scenarios, including when an oil discharge occurs. The plan is also designed to address releases from areas such as gathering lines where secondary containment is not practical. Reporting requirements and contact information is also provided in the OCP.

2.3 Routine Facility Operations, Inspections and Maintenance

GEC's oil spill prevention program is described in this section of the Plan and includes routine facility operations, periodic inspections and maintenance activities. It addresses all routine activities associated with the oil production facilities as required by 40 CFR 112.7 and 112.9.

2.3.1 Facility Operations

All production equipment is operated to prevent and contain spills. Load line and drain valves are maintained in a closed position when not in use, and loadouts are contained within the secondary containment structures. The facility is visited frequently by the pumper, who gauges the fluid level in each tank and arranges for offloading of produced fluids when the inventory approaches the tank capacity. Fluid levels are not allowed to exceed 80 percent of tank capacity. The pumper also performs a visual inspection of all above ground storage tanks, separators, lines, tank hatches, valves, and secondary containment features to promptly identify and respond to leaks or other mechanical issues as described in Section 2.3.2.

Tank truck loading/unloading occurs at all the facilities covered in this plan. The oil and produced water tanks are connected to one or more loadout points contained within the tank battery's secondary containment berms. Trucks used to offload oil and produced water are positioned adjacent to the lined secondary containment structures and are attended by the pumpers during all loading and unloading activities. The maximum volume of hydrocarbons that could potentially be released from overfilling a truck is approximately 130 bbl.

All loading and unloading activities are conducted by qualified contract personnel who are trained in proper loading and spill prevention techniques and procedures. Pumper truck personnel inspect tank

truck and transfer lines including drains and outlets on the tank trucks prior to filling and before departure to ensure that there are no leaks or discharges. If necessary, truck personnel tighten, adjust, or replace equipment that is leaking. Premature vehicular departures are prevented with a manual air brake system and oversight. A Summary of Operating Procedures (SOP) can be found in Appendix E.

2.3.2 Facility Inspection Program

Tanks at production batteries are visited, gauged, and visually inspected as necessary. These visual inspections are conducted at a minimum weekly. Saltwater disposal facilities are inspected often, especially following a sudden change in atmospheric pressure. Pumpers are trained to look for and report any leaks, or detect possible system upsets capable of causing a discharge.

In addition, on a quarterly basis, a complete inspection of each facility is conducted and documented. The quarterly inspection includes review of all above ground equipment, tanks, valves, hatches, and lines; the site drainage system; and the entire tank battery, including the area within the containment structures and earthen berms. Specifically, each storage vessel, separator, and miscellaneous equipment is visually inspected for deterioration and maintenance needs, including the foundation and support of each tank/container located on or above the ground surface. The inspection also includes visual check of facility transfer equipment including transfer piping and valves, drip pans, pumping well polish rod stuffing boxes, tanks, separators, heater/treaters, valves, pipe supports, and bleeder and gauge valves. Inspection of conditions associated with buried flowlines is accomplished by observing the ground surface above the lines for evidence of leaks on a routine basis. Observations made during the quarterly inspections are documented on forms which are stored at the Delta, Colorado office. A copy of the quarterly inspection form is provided in Appendix D. These forms are retained in the Delta Field Office. Mechanical, integrity, and spill-related issues are addressed as they are identified.

Level detection equipment for storage tanks is also inspected and tested quarterly. Testing is performed by manually gauging tank levels with a tank strap and comparing to the measured level with the output from the electronic sensing/radar gauging equipment. If a discrepancy in the measurements exceeds 0.1 feet, maintenance and cleaning is performed on the electronic sensing equipment and the test is repeated. Testing data is recorded on the form included in Appendix D. These forms are retained in the Delta Field Office.

In addition to equipment, the entire tank battery, including the area within the secondary containment structures and earthen containment berms, is visually inspected quarterly. Site drainage systems such as drainage ditches, road ditches, and intermittent creeks in the vicinity of the facility are inspected for accumulations of oil. Rainwater and other precipitation that accumulates within the berm is either allowed to evaporate, infiltrate into soil, or is removed using a vacuum truck. If rainwater with hydrocarbon content is removed by vacuum truck it is returned to storage tank, transported for offsite disposal at a permitted non-hazardous disposal facility or sent to a GEC injection well. Some drains are present in the secondary containment structures, but not earthen berms. Following visual evaluation of liquids within the containment structure (obvious oil layer or sheen), contents may be drained to the adjacent ground (assuming no evidence of oil or saltwater) and allowed to infiltrate/evaporate. If an oil sheen is evident on the liquid surface, and the containment structure is equipped with a drain valve, liquid will be very slowly drained from the containment ensuring all the hydrocarbons remain contained.

Remaining contents will be removed (vacuum truck; pump; etc.) and appropriately disposed of as oily waste. Otherwise, discharge of precipitation from the secondary containment structures cannot occur unless the structure fails or is breached.

Oil accumulating within the secondary containment area is removed using absorbent pads or is removed with excess rainwater using a vacuum truck as described above. Accumulated oil is not discharged outside of the secondary containment areas. Evidence of hydrocarbon spills are noted and remediated as described in Section 2.4.

2.3.3 Maintenance Program

GEC has a maintenance program aimed at eliminating releases of oil and minimizing unplanned downtime. Preventative maintenance on mechanical equipment is performed according to manufacturer recommendations to ensure proper operation and elimination of leaks. Any items requiring maintenance identified by visual inspections of the facilities are addressed by either GEC staff or outside contractors. Lines are pressure tested upon installation. Equipment repairs are made in accordance with the relevant codes and industry standards. Flowline maintenance is performed on an as-needed basis by qualified personnel. If flowline failure occurs, the affected section of line is replaced with the appropriate pipe.

2.3.4 Flow-Through Process Equipment Program

In lieu of sized secondary containment, all flow-through process equipment is subject to a program aimed at addressing any potential releases. Additionally, there is an OCP in Appendix B which will be implemented in the event of a release. The program will inspect the flow-through process equipment on the same schedule as the bulk storage and piping. In response to any deficiencies observed during the inspections, immediate repairs will be implemented. Any accumulated oils from the deficiencies will be immediately remediated.

2.4 Response and Reporting Information

Detailed spill reporting and response procedures are provided in the OCP included in Appendix B. The specific response activities taken will depend on the size and nature of the release.

2.4.1 Spill Response and Cleanup

Generally, each GEC employee and contractor is responsible for taking any immediate steps necessary to respond to a spill or release noted during a site visit. If a spill is discovered, the employee/contractor is instructed to isolate or shutdown the source of the release, either by closing valves to the affected tank or other production vessel, or taking other actions deemed appropriate. After the source of the spill has been abated, the employee/contractor will contact the Response Coordinator to report the event. The contact list included in the OCP (Appendix B) provides the names of the primary and secondary personnel accountable for oil spill prevention and facility response. The contact list also includes important agency numbers.

In general, recovered fluids are either returned to the production tank for eventual sale or recovered using a vacuum truck and transported offsite for disposal at a permitted commercial disposal facility.

Hydrocarbon impacted soil is placed in a lined containment area then transported for disposal off-site or allowed to dry and tested to confirm no residual hydrocarbon contamination of concern. Upon receipt of acceptable analytical results, the soil is used onsite.

2.4.2 Spill Reporting

As described in the OCP, the Response Coordinator will be notified in the event of a release. Notification forms are provided in Appendix C. These forms are designed to assist in providing information in the event of a discharge/release/spill. The forms will document the event, identify information that needs to be obtained, and list site specific information. Depending on the size and site conditions of the spill, the Response Coordinator may have to report the release to various state and federal regulatory agencies. The contact information is contained in Appendix B. The following paragraphs summarize the notification requirements for various regulatory programs.

The reporting requirements for spills under the Clean Water Act, Colorado Water Pollution Control Act, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) are as follows:

- If a spill threatens waters of the State of Colorado (causes a sheen or film on surface water or staining of adjoining shorelines), the spill must be reported to the National Response Center, Colorado Department of Public Health and Environment (CDPHE) and the appropriate Local Emergency Response Committee (LEPC) immediately.
- Furthermore, a spill must also be reported to the EPA Regional Administrator when there is a discharge of:
  - More than 1,000 U.S. gallons of oil in a single discharge to navigable waters, or,
  - More than 42 U.S. gallons of oil in each of two discharges to navigable waters occurring within any twelve-month period.

The additional reporting requirements for spills from COGCC-regulated facilities are:

- Spills/releases of Exploration & Production (E&P) waste or produced fluid exceeding one (1) barrel, including those contained within lined or unlined berms, shall be reported on COGCC Spill/Release Report, Form 19. See Appendix C.
- Spills/releases which exceed twenty (20) barrels of an E&P waste shall be reported on COGCC Spill/Release Report, Form 19, and shall also be verbally reported to the Director as soon as practicable, but not more than twenty-four (24) hours after discovery.
- Spills/releases of any size which impact or threaten to impact any waters of the state, residence or occupied structure, livestock, or public byway shall be reported on COGCC Spill/Release Report, Form 19, and shall also be verbally reported to the Director as soon as practicable, but not more than twenty-four (24) hours, after discovery.
- Spills/releases of any size which impact or threaten to impact any surface water supply area shall be reported to the COGCC Director and to the Environmental Release/Incident Report Hotline (1-877-518-5608). Spills and releases that impact or threaten a surface water intake shall be verbally reported to the emergency contact for that facility immediately after discovery.
- For all reportable spills, operators shall submit a Spill/Release Report, Form 19, within ten (10) days after discovery. An 8.5 x 11 inch topographic map showing the governmental section and location of the spill shall be included. Such report shall also include information relating to initial mitigation, site investigation, and remediation. The Director may require additional information.

- Chemical spills and releases shall be reported in accordance with applicable state and federal laws, including the Emergency Planning and Community Right-to-Know Act, CERCLA, Oil Pollution Act, and Clean Water Act, as applicable.

In addition to the spill reporting requirements listed above:

- If the spill is less than 1 bbl and does not threaten to impact a residence or occupied structure, livestock, public byway, or waters of the State of Colorado, it is not reportable to COGCC. However, it shall be controlled and contained immediately upon discovery and cleaned up as soon as practicable.
- If a spill that threatens waters of the State occurs on land owned by Bureau of Land Management (BLM) or the US Forest Service (USFS), it is reportable in quantities over 10 bbl. Similarly, if a spill threatens fish or wildlife, it must be reported to the U.S. Fish and Wildlife Service. See NTL 3-A Form in Appendix C.

2.4.3 Annual Training

GEC provides the following minimum training to oil-handling personnel:

- Operation and maintenance of equipment to prevent oil discharges;
- Oil discharge procedure protocols;
- Applicable oil spill prevention (State and Federal) laws, rules, and regulations;
- General facility operations, and
- The contents of the facility SPCC Plan.

Training is conducted prior to assignment of job responsibilities and then again annually. Training includes operation and maintenance of equipment to prevent discharges; discharge procedure protocols; applicable pollution control laws, rules, and regulations; general facility operations; and, the contents of the facility SPCC Plan.

2.4.4 Discharge Prevention Briefings

The facility conducts discharge prevention briefings for oil-handling personnel at least once a year to assure adequate understanding of the Plan for the facility. At a minimum, this is conducted via annual SPCC and spill response refresher training describing the contents of the SPCC regulations and plans, spill response techniques, and a review of spill reporting requirements. These briefings also include discussion of potential discharges or component failures and precautionary measures. If a spill has occurred, GEC will also summarize the spill events and the measures implemented to prevent future releases.

2.4.5 Training Records

Copies of training and discharge prevention logs can be found in Appendix D. Training records and Discharge Prevention Briefing logs are maintained for a minimum period of three (3) years at GEC's offices. Each contractor organization providing oil-handling personnel maintains training records for its employees in its respective office.

3.0 OIL DRILLING AND WORKOVER RIGS

This section of the Plan is intended to comply with 40 CFR 112.10, Requirements for *Onshore Oil Drilling and Workover* facilities.

3.1 Drilling Rigs

During drilling operations, there is potential for an accidental release associated with limited quantities of various oils stored in tank(s) or drums on the pad. As previously mentioned, temporary oil storage at each drill site will be limited. Diesel fuel storage tank(s) used to fuel the drill rigs typically have capacities ranging from 500 to 2400 gallons, depending on the particular site and rig requirements. The diesel tanks are placed within temporary containment structures designed to contain a minimum of 110 percent of capacity for the largest tank within the containment. Temporary containment is typically constructed by placing a plastic liner over earthen berms (other materials such as wood may substitute for the earthen berms) or commercially available stock tanks. Should rain fall into the containment, it will be pumped into the reserve pit using portable pumps located on site. As indicated above, appropriate areas of the drill pad are sloped to the reserve pit such that were the tank to fail catastrophically and release all its contents, excess diesel fuel that might escape the tank containment would flow to the reserve pit and be captured prior to leaving the site. In addition to the diesel fuel tank, 55 gallon drums of material, such as diesel fuel, various hydraulic fluids and lube oils may be brought on-site from time to time as required by operational needs during the drilling phase. Typically the material is used quickly, and the drums are not on-site for long periods of time. As operations during the drilling phase are conducted on a 24/7 basis (24 hours a day, 7 days a week) and the sites are small, drums are generally under constant surveillance. Drums delivered to and used on site are placed on the drill pad, usually with no containment. If a spill occurred, it would almost certainly be quickly noticed. However, if the spill was not quickly detected and it was of sufficient volume, spilled liquids would drain towards the reserve pit. Drilling rigs used at the sites have fuel and lube oil tanks with drip pans placed under the rigs to catch any minor drips. Should there be a leak of sufficient magnitude to overflow the drip pan, if not detected by site personnel, the material would again drain towards the reserve pit.

There is also a reasonable potential for leaks/spills associated with the drilling rigs. The total quantity of material that might be discharged, before discovery, is assumed to be approximately 100 gallons. The general direction of flow would be toward the reserve pit and at a very minimal flow rate. A spill of this nature is not expected to escape the facility.

GEC will install a blowout prevention (BOP) assembly and well control system before drilling below any casing string or during workover operations. The BOP assembly and well control system must be capable of controlling any well-head pressure that may be encountered while that BOP assembly and well control system are on the well.

APPENDIX A: FACILITY SPECIFIC DATA

HYDROLOGY MAPS

GEC SPCC HYDROLOGY OVERVIEW

N

Legend

- WELL POINT
- RIVERS & TRIBUTARIES
- SEPARATOR
- TANK
- COUNTIES
- TOWNSHIPS

Surface Water Proximity Map

Gunnison Energy Corporation (GEC)

Site Name:	Multiple Onshore O&G Production Facilities
Date:	8/12/2010
Drawn By:	D. Simon
Prepared for:	Gunnison Energy Corporation

GEC

GEC SPCC HYDROLOGY OVERVIEW

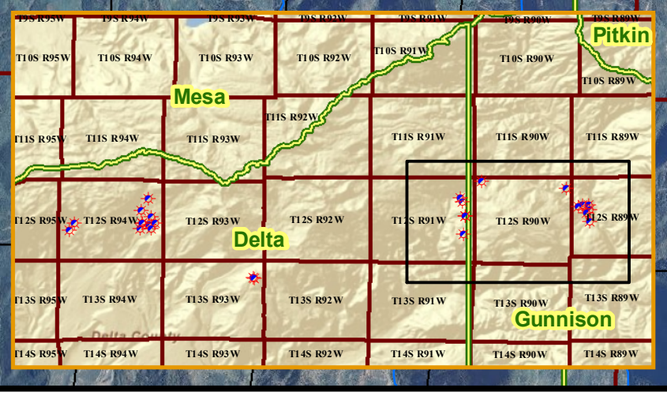
T11S R91W
T11S R90W
T11S R89W
T12S R91W
T12S R90W
T12S R89W
T13S R90W

JACOBS 6-32
ALLAN 12-13
ALLAN 12-24
HOTCHKISS RANCH 13-24
IRON POINT U 13-24
LONE PINE #1
HOTCHKISS FED 1-34
HOTCHKISS FED 18-31
HOTCHKISS FED 17-11
HOTCHKISS FED 18-22D
HOTCHKISS 17-13
HOTCHKISS FED 18-43
DEADMANS GULCH 20-12D_ GEC

Delta
Gunnison

Muddy Creek
un-named
Ault Creek
Buck Creek
East Muddy Creek
Spring Creek
Big Alder Creek
Willow Creek
Alder Creek
Main Hubbard Creek
Cottonwood Creek
Buzzard Creek
Dugout Creek
Bear Creek
Iron Point Gulch
Deadman Gulch
North Fork Gunnison
Williams Creek
Dry Creek
Elk Creek
Hawk Creek

N



Legend

- WELL POINT
- RIVERS & TRIBUTARIES
- SEPARATOR
- TANK
- COUNTIES
- TOWNSHIPS
- SECTIONS

Well Status

- DRILLING
- PRODUCING
- PLUGGED & ABANDONED
- PERMITTED
- SHUT IN

Surface Water Proximity Map

Gunnison Energy Corporation (GEC)

0 0.25 0.5 1 1.5 2 Miles

Site Name: Multiple Onshore O&G Production Facilities
Date: 8/14/2010
Drawn By: DMM
Prepared for: Gunnison Energy Corporation

Data Source: Imagery- NAIP 2009,
Hydrology- Colorado Decision Support System

GEC

PFS LLC Petroleum Field Services

GEC SPCC HYDROLOGY OVERVIEW

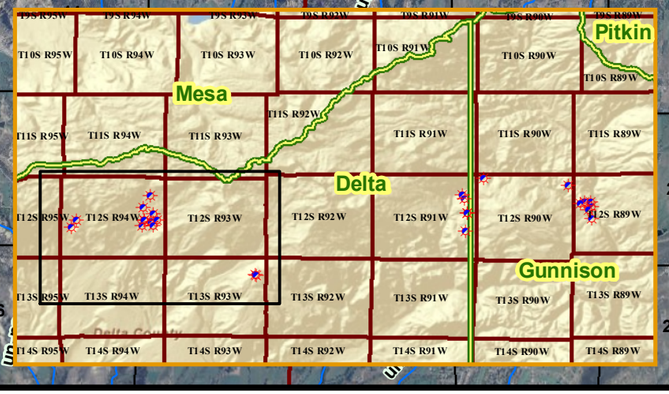
N

LEON LAKE #1
LEON LAKE #2
LEON LAKE #5
SCOTT 19-1A
SCOTT 19-33
SPALDING PEAK 23-41
SPALDING PEAK 23-41D
SPALDING P 23-33
SPALDING PEAK 24-31
SPALDING PEAK 24-23
DEVER #1
OAK MESA HUGHES 12-22

T12S R95W
T12S R94W
T12S R93W
T12S R92W
T13S R95W
T13S R94W
T13S R93W
T13S R92W

Delta

Bonita Creek
Milk Creek
Beaver Creek
Marcott Creek
Caesar Creek
West Leroux Creek
Middle Creek
East Leroux Creek
Current Creek
Ward Creek
Horse Creek
Yongs Creek
Surface Creek
Cottonwood Creek
Kiser Creek
Williams Creek
Dry Creek
Leroux Creek
Cow Creek
un-named



Legend

- WELL POINT
- RIVERS & TRIBUTARIES
- SEPARATOR
- TANK
- COUNTIES
- TOWNSHIPS
- SECTIONS

Well Status

- DRILLING
- PRODUCING
- PLUGGED & ABANDONED
- PERMITTED
- SHUT IN

Surface Water Proximity Map

Gunnison Energy Corporation (GEC)

0 0.375 0.75 1.5 2.25 3 Miles

Site Name: Multiple Onshore O&G Production Facilities
Date: 8/14/2010
Drawn By: DMM
Prepared for: Gunnison Energy Corporation

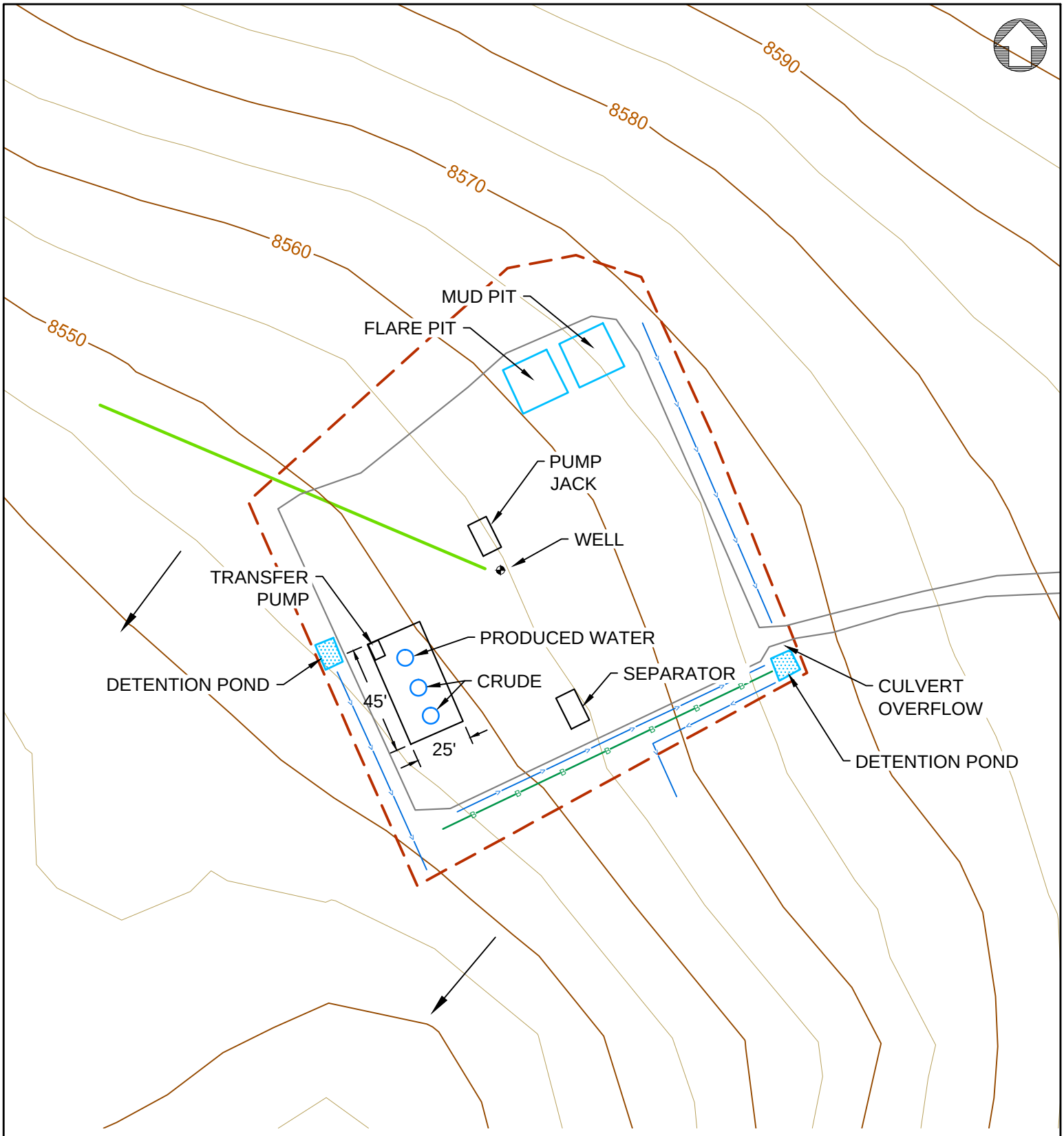
Data Source: Imagery- NAIP 2009,
Hydrology- Colorado Decision Support System

GEC

PFS Petroleum Field Services

FACILITY SPECIFIC INFORMATION

FACILITY DIAGRAMS, TANK TABLES, CONTAINMENT CALCULATIONS, AND NO HARM CERTIFICATIONS



NEAREST POTENTIALLY IMPACTED SURFACE WATER IS AN INTERMITTENT STREAM APPROX. 200 FT. SOUTH. (PER PFS, JULY 2010)

0 100' 200' FEET

WESTON SOLUTIONS
1435 GARRISON ST. SUITE 100
LAKEWOOD, CO 80215
(303) 729-6100

SPCC FACILITY DIAGRAM

SPAULDING PEAK 23-41

T12S R94W S23

WO#:	14798.001.001	APPROVED BY:	DG
DATE:	JULY2012	DRAWN BY:	CP

FILENAME: SPCC.dwg

LEGEND

- WELL
- SCALE INHIBITOR
- GENERATOR
- TANK, VERTICAL
- TANK, HORIZONTAL
- METAL BERM
- SURFACE WATER FLOW
- ACCESS ROAD
- ABOVE GROUND PIPE
- UNDERGROUND PIPE
- DRAINAGE POND
- BERM
- FENCE
- BUILDING

Facility: Spaulding Peak 23-41

Produced Water Tanks-Black Tank

	Rectangular				Round Ends		
Dike Area:	**Length (ft)**	**Width (ft)**	**Height (ft)**		**Length SS (ft)**	**Width (ft)**	**Height (ft)**
	45	25	3		**0**	**0**	**0**
Volume of Dike Area:		**Volume (ft^3)**	**Volume (gal.)**	**Volume (bbls)**	**Volume (ft^3)**	**Volume (gal.)**	**Volume (bbls)**
		3,375	25,245	601	0.0	0.0	**0.0**
Displacement Volume:		**Tank Diameter (ft)**	**Dike Height (ft)**		**Volume (ft^3)**	**Volume (gal.)**	**Volume (bbls)**
		12	3		339.3	2537.8	60.4
		12	3		339.3	2537.8	60.4
		12	3		339.3	2537.8	60.4
					0.0	0.0	0.0
					0.0	0.0	0.0
					0.0	0.0	0.0
					0.0	0.0	0.0
					0.0	0.0	0.0
Total Displacement Volume:							181.3
Volume of Dike Area - Displacement Volume:				**BBLs**			420

Facility: Spaulding Peak 23-41

Oil Source	Associated Substance (Contents) *(Oil)*	Source Capacity *(bbls)*	Potential Failure	Rate of Flow *(bbls/day)*	Containment System(s)
Aboveground Fixed Containers					
Crude Oil Tank 1	Crude	400	Rupture, Valve left open.	0	Steel Containment Berm
Produced Water Tank 1	Produced Water	400	Rupture, Valve left open.	0	Steel Containment Berm
Produced Water Tank 2	Produced Water	400	Rupture, Valve left open.	0	Steel Containment Berm
Completely and Partially Buried Tanks (Not Covered by 40 CFR Parts 280/281)					
N/A					
Mobile and Portable Containers					
N/A					
Operational Equipment (Transformers, Manufacturing Equipment, Process Vessels, etc.)					
Separator	Crude/Produced Water	Approximately 50	Rupture, Fittings	0	Earthen Berm
Truck or Rail Loading/Unloading Rack					
N/A					
Truck or Rail Loading/Unloading Areas					
Loading/Unloading	Crude/Produced Water	N/A	Overfill, Leaking Hose	0	N/A
Other Potential Spill Sources (Piping, Surface Impoundments, etc.)					
Wellhead/Flowlines			Leaks/Piping Rupture		None

SUBSTANTIAL HARM CERTIFICATION

FACILITY-GEC Spaulding Peak 23-41

40 CFR 112.20(e), 40 CFR 112.20(f)(1)

This certification is applicable to the following facilities: Table 1

1. Does the facility transfer oil over water to or from vessels and does the facility have a total oil storage capacity of greater than or equal to 42,000 gallons?

   ☐ Yes ☒ No

2. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and does the facility lack secondary containment that is sufficiently large to contain the capacity of the largest aboveground oil storage tank plus sufficient freeboard to allow for precipitation within any aboveground oil storage tank area?

   ☐ Yes ☒ No

3. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III to this appendix or a comparable formula[1]) such that a discharge from the facility could cause injury to fish and wildlife and sensitive environments? For further description of fish and wildlife and sensitive environments, see Appendices I, II, and III to DOC/NOAA's "Guidance for Facility and Vessel Response Plans: Fish and Wildlife and Sensitive Environments" (59 FR 14713, March 29, 1994) and the applicable Area Contingency Plan.

   ☐ Yes ☒ No

4. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III to this appendix or a comparable formula[1]) such that a discharge from the facility would shut down a public drinking water intake[2]?

   ☐ Yes ☒ No

5. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and has the facility experienced a reportable oil spill in an amount greater than or equal to 10,000 gallons within the last 5 years?

   ☐ Yes ☒ No

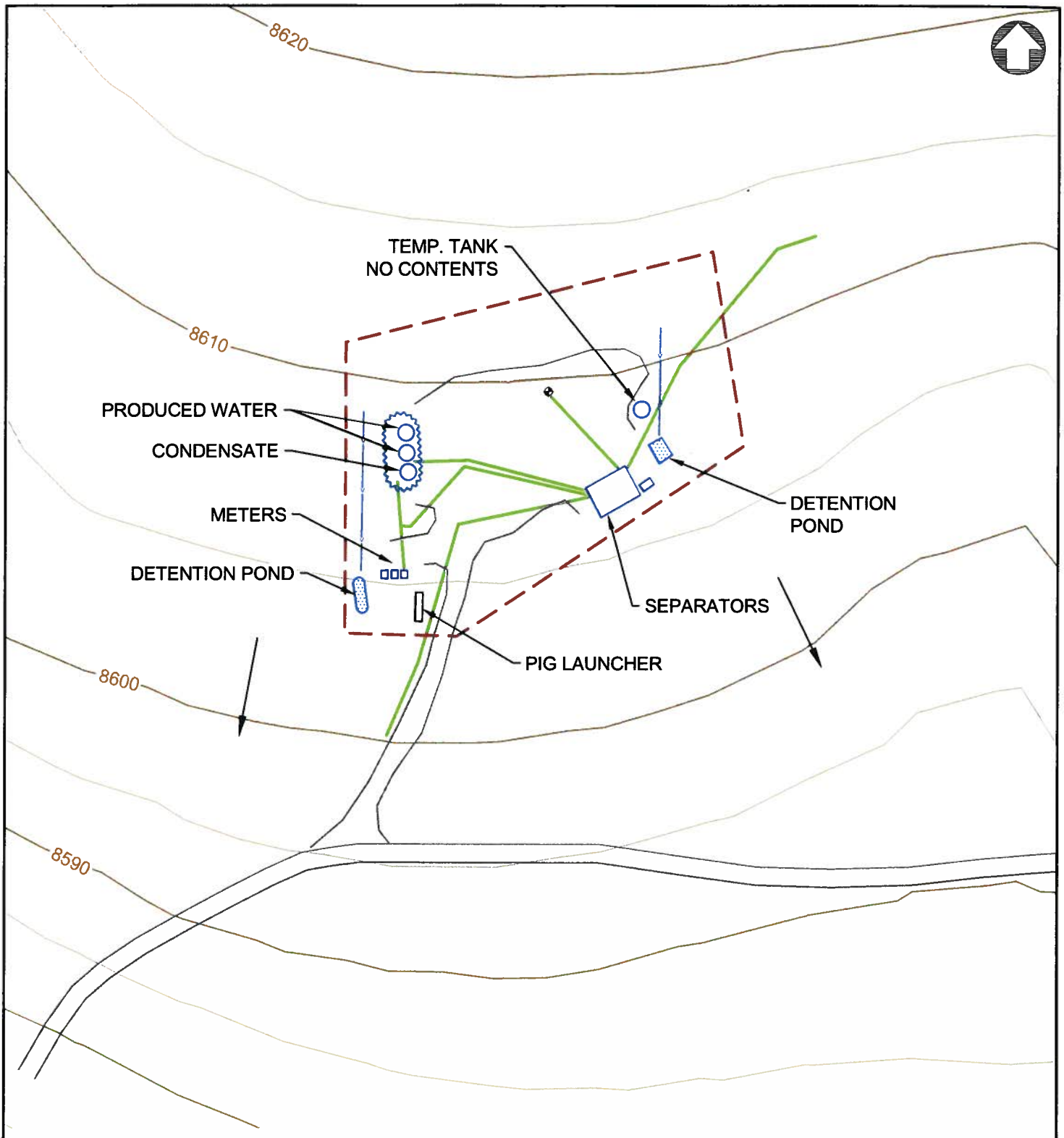
CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document, and that based on my inquiry of those individuals responsible for obtaining this information, I believe that the submitted information is true, accurate, and complete.

Signature — Date: Sept 7, 2012

Lee Fyock — Name

Director of Environment and Planning — Title



NEAREST POTENTIALLY IMPACTED SURFACE WATER IS AN INTERMITTENT STREAM APPROX. 310 FT. EAST. (PER PFS, JULY 2010)

0 100' 200'
FEET

WESTON SOLUTIONS
1435 GARRISON ST. SUITE 100
LAKEWOOD, CO 80215
(303) 729-6100

SPCC FACILITY DIAGRAM

SPAULDING PEAK 24-12

T12S R94W S24

WO#:	14798.001.001	APPROVED BY:	DG
DATE:	JULY2012	DRAWN BY:	CP

FILENAME: SPCC.dwg

LEGEND

- WELL
- SCALE INHIBITOR
- GENERATOR
- TANK, VERTICAL
- TANK, HORIZONTAL
- METAL BERM
- SURFACE WATER FLOW
- FLOWLINE
- FACILITY PERIMETER
- ACCESS ROAD
- ABOVE GROUND PIPE
- UNDERGROUND PIPE
- DRAINAGE POND
- BERM
- FENCE
- BUILDING

Facility: Spaulding Peak 24-12

Produced Water Tanks-Set of 3

	Rectangular				Round Ends		
Dike Area:	**Length (ft)**	**Width (ft)**	**Height (ft)**		**Length SS (ft)**	**Width (ft)**	**Height (ft)**
	0	0	0		**38**	**27.5**	**2.4**
Volume of Dike Area:		**Volume (ft^3)**	**Volume (gal.)**	**Volume (bbls)**	**Volume (ft^3)**	**Volume (gal.)**	**Volume (bbls)**
		0	0	0	3933.5	29422.2	**700.5**
Displacement Volume:		**Tank Diameter (ft)**	**Dike Height (ft)**		**Volume (ft^3)**	**Volume (gal.)**	**Volume (bbls)**
		13.5	2.4		343.5	2569.6	61.2
		13.5	2.4		343.5	2569.6	61.2
		13.5	2.4		343.5	2569.6	61.2
					0.0	0.0	0.0
					0.0	0.0	0.0
					0.0	0.0	0.0
					0.0	0.0	0.0
					0.0	0.0	0.0
Total Displacement Volume:							183.5
Volume of Dike Area - Displacement Volume:				**BBLs**			517

Facility: Spaulding Peak 24-12

Oil Source	Associated Substance (Contents) *(Oil)*	Source Capacity *(bbls)*	Potential Failure	Rate of Flow *(bbls/day)*	Containment System(s)
Aboveground Fixed Containers					
Produced Water Tank 1	Produced Water-Exempt for Dry Gas	400	Rupture, Valve left open.	0	Metal Containment with HDPE Liner
Produced Water Tank 2	Produced Water-Exempt for Dry Gas	400	Rupture, Valve left open.	0	Metal Containment with HDPE Liner
Condensate Tank 3	Condensate	400	Rupture, Valve left open.	0	Metal Containment with HDPE Liner
Completely and Partially Buried Tanks (Not Covered by 40 CFR Parts 280/281)					
N/A					
Mobile and Portable Containers					
Produced Water Tank 4	Produced Water-Exempt for Dry Gas	400	Rupture, Valve left open.	0	None
Operational Equipment (Transformers, Manufacturing Equipment, Process Vessels, etc.)					
Separator	Produced Water-Exempt for Dry Gas	10	Rupture	0	None
Truck or Rail Loading/Unloading Rack					
N/A					
Truck or Rail Loading/Unloading Areas					
Other Potential Spill Sources (Piping, Surface Impoundments, etc.)					
Wellhead/Flowlines			Leaks/Piping Rupture		None

SUBSTANTIAL HARM CERTIFICATION

FACILITY-GEC Spaulding Peak 24-12

40 CFR 112.20(e), 40 CFR 112.20(f)(1)

This certification is applicable to the following facilities: Table 1

1. Does the facility transfer oil over water to or from vessels and does the facility have a total oil storage capacity of greater than or equal to 42,000 gallons?

   ☐ Yes ☒ No

2. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and does the facility lack secondary containment that is sufficiently large to contain the capacity of the largest aboveground oil storage tank plus sufficient freeboard to allow for precipitation within any aboveground oil storage tank area?

   ☐ Yes ☒ No

3. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III to this appendix or a comparable formula[1]) such that a discharge from the facility could cause injury to fish and wildlife and sensitive environments? For further description of fish and wildlife and sensitive environments, see Appendices I, II, and III to DOC/NOAA's "Guidance for Facility and Vessel Response Plans: Fish and Wildlife and Sensitive Environments" (59 FR 14713, March 29, 1994) and the applicable Area Contingency Plan.

   ☐ Yes ☒ No

4. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III to this appendix or a comparable formula[1]) such that a discharge from the facility would shut down a public drinking water intake[2]?

   ☐ Yes ☒ No

5. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and has the facility experienced a reportable oil spill in an amount greater than or equal to 10,000 gallons within the last 5 years?

   ☐ Yes ☒ No

CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document, and that based on my inquiry of those individuals responsible for obtaining this information, I believe that the submitted information is true, accurate, and complete.

Signature — Date: Sept 7, 2012

Lee Fyock — Name

Director of Environment and Planning — Title

APPENDIX B: OIL SPILL CONTINGENCY PLAN

1.0 PURPOSE AND SCOPE

This Oil Spill Contingency Plan (OCP) was prepared in accordance with 40 CFR 112.7(a)(5) to address discharges of oil from the facilities covered by the Spill Prevention Control and Countermeasure (SPCC) Plan. The Plan also addresses the requirements of Colorado Oil and Gas Conservation Commission (COGCC) Rule 906. Spills and Releases. The Plan addresses oil discharges from field operations where secondary containment is impracticable, per 40 CFR 112.7(d). This Plan complements the prevention and control measures presented in the SPCC Plan by defining procedures and tactics for reporting and responding to discharges of oil.

The Plan is intended to protect the public and minimize damage to the environment by providing a timely, efficient, coordinated and effective action plan to respond to oil discharges. The plan is consistent with the National Oil and Hazardous Materials Pollution Contingency Plan and follows the guidelines provided in 40 CFR 109.

2.0 DEFINITION OF AUTHORITY, 40 CFR 109.5(A)

Gunnison Energy Corporation (GEC) will have primary responsibility for response actions required by releases that might occur at the GEC production facilities in Delta and Gunnison County. Regulatory personnel will be notified as required by the size and potential impact of the release. Verbal notifications to the EPA and COGCC will include discussions of GECs response and capabilities to address the reported release. At GECs request, regulatory personnel, likely the EPA, will be enlisted to assist in the response effort. Based on the facility locations as well as GEC and GEC contractor's capabilities, assistance will not likely be required. In addition to the EPA and COGCC, surface landowners would be notified during the primary response. The primary responsibilities assigned to GEC personnel are defined in the following lists.

<u>GEC Response Authority</u>:

GEC Management is responsible for:

- Ensuring the necessary resources for control and cleanup are available;
- Ensuring that personnel are adequately trained to notice, report and respond to oil discharges.

GEC's designee, serving as the Response Coordinator, is responsible for:

- Overall coordination of the control and cleanup of the oil discharge;
- Committing the necessary resources (including monetary);
- Requesting additional assistance from outside contractors and/or the Federal authorities if necessary;
- Ensuring repairs are made prior to putting equipment back in service;
- Ensuring that proper notifications are made to Federal, State and Local agencies, including any follow up documentation;
- Providing site safety plan if necessary;
- Coordinating disposal of contaminated material;
- Being familiar with the SPCC and OCP;

- Being alert for oil discharges and responding to them as appropriate;
- Assisting, as required, in the control and cleanup of the oil discharge.

3.0 NOTIFICATION PROCEDURES, 40 CFR 109.5(B)

Field personnel are trained to look for and report any oil discharge. A contact list is provided in Section 3.2 Depending on the size and nature of the oil discharge some or all of these contacts will be notified.

3.1 Critical Waters

The critical waters for the GEC Delta and Gunnison Counties fields are all tributaries to the Gunnison River. The affected tributary creeks include Kiser Creek, Yongs Creek, Milk Creek, and Surface Creek. The likely response location would be Tongue Creek with tributaries Kiser Creek, Yongs Creek, and Milk Creek before the confluence with the Gunnison River. Additionally, the Surface Creek response location would be before the confluence with the Gunnison River. These creeks would only be affected during worst case discharges and major storm events. The likelihood of responding at these locations is very small.

3.2 Contact Information

Following is a table listing all potential reporting agencies with contact telephone numbers. GEC contact numbers are at the bottom of the list, but should be the first contacts made as described in Section 5. Emergency notifications (within 24 hours) include all GEC personnel and contractors based on GEC assessment of GEC's response capability. The EPA Region 8 shall be notified within 24 hours if the spill exceeds 1 barrel to navigable water and the COGCC if any spill exceeds 20 barrels of oil. Any releases to navigable water must be reported to the National Response Center immediately. Other notifications should be made to the Agencies and numbers listed in the Spill Response Numbers in the following table. Additional reporting requirements are listed in the SPCC Plan Section 2.4.2 Spill Reporting.

Colorado Oil and Gas Conservation Commission (COGCC)		
Colorado Oil and Gas Conservation Commission		Denver 303-894-2100
Dave Andrews, Lead Engineer: (Rifle)		Cell 970-456-5262
Carl Colby, Contract Inspector for Gunnison County		Office 970-326-5776 Cell 970-326-5776
Chuck Browning, Field Inspector (White Water)		Office 970-242-3348 Cell 970-433-41396
Bureau of Land Management (BLM)		
Montrose Field Office		970-240-5300
Thane Stranathan, Natural Resource Specialist		Office 970-240-5304
John Pecor, Petroleum Engineer		Office (970) 385-1356 Cell 970-799-1360
US Forest Service (USFS)		
Dan Grey, Gunnison National Forest		Main 970-527-4151
Linda Bledsoe, Grand Mesa National Forest		Main 970-242-8211 Desk 970-263-5802
Gunnison Energy LLC		
Main Office - Denver, CO Field Office - Delta, CO		303-296-4222 970-874-4333
Dan McWilliams, Construction Engineer		Office 970-874-4333 Cell 970-986-2927
Lee Fyock, VP Environmental & Permitting		Cell 720-272-5871 Office 303-293-2913
Mike Cleary, VP Operations		Cell 303-324-8855 Office 302-296-3549
Brad Robinson, President		Cell 775-848-1878 Office 303-296-8806
Oxbow Corporation- Environmental Affairs		561-640-8711
GEC Contractors		
Ken Miller, Weston Solutions, Inc., Spill Coordinator Contractor		Office 303-729-6149 Cell 303-882-8087 Cell 678-516-7299 (Eric Sandusky)
Rob Nessler, Safety Kleen, Oil Spill Response Contractor,		Emergency 888-375-5336 Office 970-241-1343 Cell 970-260-9346
Cudd Well Control (well fire/blowouts)		713-849-2769
Delta County - CALL 911		
Delta County Emergency Dispatch Delta County Hazardous Materials Team Delta County Office of Emergency Management		970-874-2015
Bruce Bertram, Delta County Local Government Designee		Office 970-874-5905

		Alt. 970 856-7688
Air Life at St. Mary's Hospital		970-244-2551 800-332-4923
Delta County Memorial Hospital		970-874-7681
Delta County Memorial Hospital – ER		970-874-2222
North Fork Valley Ambulance Association		970-872-4303
Delta County Sheriff – Dispatch Sheriff		970-874-2015 970-874-2000
Delta County Health Department		970-874-2165
North Fork Medical Clinic(s): Paonia Hotchkiss		970-527-4103 970-872-3121
Gunnison County		
Emergency-Delta Dispatch Gunnison Dispatch		970-874-2015 970-641-8000
Gunnison County Sheriff (non-emergency)		970-641-1113
Scott Morrill, Emergency Management		970-641-2481
Gunnison Valley Hospital		970-641-1456
David Baumgarten, Gunnison County Local Government Designee		Office 970-641-0248 After hours 970-641-8000
Montrose County		
Montrose County Dispatch/Emergency Services		970-252-4010
Hazardous Materials Team – (State Patrol)		970-249-4392
Spill Response Numbers		
Colorado Emergency Spill Report - 24 Hr Hotline		877-518-5608
National Response Center (NRC) - 24 Hr Hotline		800-424-8802
US DOT-Office of Pipeline Safety-Western Region		720-963-3160
CO Public Utilities-Pipeline Safety & Enforcement		303-894-2000
CO Department of Labor – Oil and Public Safety Division		303-318-8547
Environmental Protection Agency (EPA) Region 8		800-227-8917
CO Department of Public Health & Environment, Water Quality Division		303-692-3500 877-518-5608 – spill reporting
CO Division of Wildlife (SW Region) Durango, Colorado		970-247-0855

3.3 Communication System

The field personnel responsible for discovery and notification of releases communicate via GEC radio or satellite telephones. Cell reception is not available in the field so alternate communication methods are required. The first response will be to the Delta Colorado office by radio or satellite phone. Subsequently the Response Coordinator will be notified based on the contact information provided above. All further required notification will be made through the Response Coordinator or their designee.

3.4 Response Assistance

GEC will verbally or through written report contact the EPA and COGCC as required upon determination that a spill was of a reportable volume. GEC will assess the GEC resources as well as those of the spill contractor to determine if adequate response capabilities are present. If GEC deems necessary, GEC will request response assistance and from EPA or other agencies listed in Section 3.2.

4.0 RESOURCE CAPABILITIES, 40 CFR 109.5(C)

Following are GEC's resource availabilities.

4.1 Equipment and Capabilities

All field operation personnel are familiar with response strategies, and with the SPCC and OCPs. Sufficient equipment to respond to the majority of oil discharges is kept at the Delta, Colorado field office. Spill response equipment is also located at select well and compressor locations. The GEC equipment consists of spill kits and a response trailer. Contents of these kits are as follows:

Response Trailer Contents List

River Booms
Absorbent Pads/Pillows/Socks
Fire Extinguisher (ABC type)
Tyvek Suits
Goggles/Shields
Gloves
Booties
PFDs
Rescue Lanyard and Harness
Spark-free tools
Shovels/Pick
Oilsorb
Extension Ladder
Overpack drums
Plastic bags and ties
Spill Response Guidebook

Portable Spill Kits (poly drum Can be 30 to 65 gallons)

25 pads

4 pillows
4 socks
Goggles
Nitrile gloves
Tyvek/booties
Poly drum for soil/spent pads
Plastic bags and ties
Spill Response Guidebook

Each kit is capable of cleaning up of a spill of up to 1 barrel.

Locations:

- Hotchkiss Federal 18-22D-Response Trailer and 1 Portable Spill Kit
- Deadman Gulch Unit 20-12D pad-1 Portable Spill Kit
- Ragged Mountain Compressor Station-1 Portable Spill Kit
- Delta Field Office-3 Portable Spill Kits
- Spaulding Peak Unit 23-41-1 Portable Spill Kit

In addition to the GEC equipment housed in Delta and field sites, additional equipment is available regionally from Safety Kleen in Grand Junction, Colorado with satellite operations in Delta Colorado.

4.2 Required Equipment for Maximum Oil Spill

Currently, the maximum spill volume outside of containment (for which this OCP was developed) would be from produced water piping. The maximum flow of the piping would not be in excess of 0 gallons per hour. If the release is not detected for 12 hours, the release volume would be 0. Because the only liquids that could be released are produced water from wet gas wells, the release would be mainly water. Based on this, all fluids released would soak into the ground. Response equipment to protect Waters of the State will be minimal. GEC's equipment in Delta, Colorado will be adequate to respond to a pipe release.

4.3 Contractor Agreements

GEC has identified Safety Kleen as its Oil Spill Response Contractor. Their contact information is included on the contact table in Section 3.2. Weston Solutions, Inc. (WESTON) has been retained as the Response Coordinator Contractor which will coordinate, investigate, and remediate any releases that occur.

GEC has the primary responsibility to provide the initial response to oil discharge incidents originating from its operations. To accomplish this, GEC has designated Lee Fyock as the qualified Response Coordinator.

5.0 DISCOVERY, NOTIFICATION, AND RESPONSE, 40 CFR 109.5(D)

The following sections describe GEC's approach to discovery, notification, and response to oil spill releases in the Delta and Gunnison County fields. Much of this material has been presented previously but in these sections more detail is added.

Upon the discovery of an oil discharge the Response Coordinator will be notified so that appropriate action can be taken. The Response Coordinator has the authority to direct and coordinate response operations and may request assistance from Federal authorities as necessary. Containment and clean-up operations will be managed out of GEC's Denver Office. Operations personnel are equipped with cellular phones to assist with communications.

In the event of a discharge, the first priority is to stop the product flow and to shut off all ignition sources, followed by the containment, control, and mitigation of the discharge. Specifically, the following response procedures will be implemented:

- LOCATE – Locate the spill source.
- ESTIMATE – If possible, personnel identifying the spill should estimate the volume (gallons) of material spilled and identify flow direction.
- IDENTIFY – Identify the extent of spill and contaminated surface area. If applicable, and spill is of a sufficient size, identify flow path to the reserve pit (or other areas).
- STOP LEAK – If possible, personnel identifying the spill should safely close valves, plug holes (non-pressurized systems), or implement other measures, as appropriate, to inhibit or stop additional material from being released to the environment.
- COMMUNICATE – Personnel identifying the spill should immediately notify the immediate supervisor or other nearby personnel that will relay a message to the supervisor on duty.
- CONTAIN – Personnel identifying the spill, in conjunction with others (as necessary), should take preliminary steps and utilize onsite containment equipment (as appropriate) to contain spilled material to the smallest possible area.
- NOTIFY – The On-Site Supervisor on duty should immediately notify the operations manager if a significant spill occurs. The On-Site Supervisor will determine whether the spill can be partially or completely managed by onsite personnel or if additional assistance will be required in containment and cleanup. The On-Site Supervisor will make other notifications, as necessary.
- FINAL CONTAINMENT – In the event of a significant spill, personnel should take additional actions, as directed by the Onsite Supervisor.
- CLEANUP and DISPOSAL – Personnel and/or trained contractors should cleanup the spilled and contaminated materials. Disposal of these materials should be in accordance with the appropriate local, State and Federal regulations.
- REPORT – The On-Site Supervisor or approved designee should prepare and submit Spill/Release Forms as appropriate

5.1 Oil Spill Operating Team

In the event of a spill, the following team/personnel responsibilities include:

<u>First Responder</u>

1. Protect Personnel:
    - Evaluate situation for safety hazards;
    - Warn personnel in the immediate area; and

- Protect yourself and other personnel from injury.

2. Safely identify the source of the unauthorized discharge, *if possible*.
3. Shut off ignition sources near the spill.
   - If spilled material is known to be flammable, shutoff or de-energize potential ignition sources in the affected area (e.g., open flames, motors, electric circuits, etc.). ***NOTE:*** *If possible, contact onsite supervisor prior to de-energizing major equipment.*
4. Control the Spill:
   - At the source:
     a. Stop the release: Close valves; turn off pumps; plug a leaking drum; etc. ***NOTE:*** *If the situation at the source is considered to be unsafe, do not go into the spill or spill impacted area(s) unless trained to do so and adequate support is provided.*
   - At or adjacent to the impacted area:
     a. Contain the spill as close to its origin as possible;
     b. Scatter hay, sand, or other sorbent material in flow path of released material to prevent expansion of the impacted area;
     c. Protect waterways (drains; drainage ditches; adjacent surface waters; etc) as necessary by using spill containment kits, onsite equipment or other means to provide or construct an obstacle to flow of the spilled material into the waterway.
5. Notify the onsite supervisor (or designated alternate):
   - Communicate the date and time of spill, as well as the type of spill, location, and estimated amount.
6. Describe the extent of spill:
   - Provide initial judgment of potential for offsite migration, and
   - Communicate the number of injured personnel, if any.
7. Contain Spill:
   - Request spill kit;
   - Contain spill using all immediately available equipment and resources.

<u>On-Site Supervisor</u>

1. Notify the GEC President and / or Environmental Manager that a spill or discharge has occurred. Identify yourself, the time and date of the discharge, and whatever information may be available from first responders. Indicate you will provide them with additional information after personally surveying the incident location and gathering or confirming pertinent details.
2. Survey the incident location and assure that all onsite personnel have been accounted for.
3. Ensure that first responder activities are consistent with appropriate safety procedures, and that

personnel have taken proper precautions to use personal protective equipment (PPE) and isolation of the discharge or spill area.

4. Evaluate situation for additional safety hazards and, if necessary, implement appropriate countermeasures.
5. Verify the source(s) of the release.
6. Ensure that operations potentially impacted by the spill or discharge have been shut down and/or appropriate safety measures have been taken.
7. Gather and confirm information about the spill or discharge. Reports provided in Appendix C of the SPCC Plan may be used as a guide.

    a. Type of material released.

    b. Estimated time of release and time of discovery.

    c. Quantity discharged and potential maximum quantity that may be discharged.

    d. Location of the spill relative to the nearest surface water body.

    e. Size of area impacted or with potential to be impacted.

    f. Response actions underway and safety precautions taken.

    g. Identity of personnel conducting response actions.

    h. Potential impact to nearby environmentally sensitive areas.

    i. Injuries or potential health risks associated with the release.

8. If reportable quantities (RQ) of material have been spilled or discharged to the land or surface water, immediately notify the GEC Senior Vice President and/or Environmental Manager. In addition to the information provided above, emphasize that the volume released is in excess of the RQ, an NRC - National Response Center – notification is required immediately. ***Note****: Upon learning of a qualified discharge or spill to Waters of the State or US, it is a federal reporting requirement that the NRC be immediately notified if the oil discharge or spill is in violation of the federal Clean Water Act and/or applicable state water quality regulations.)*
9. As necessary, contact the GEC President and/or Environmental Manager to request assistance from offsite sources.
10. Obtain 55-gallon containers or other DOT approved containers for storage and disposal of used oil and waste materials generated during cleanup operations.
11. Coordinate remaining onsite spill response, containment, and cleanup activities.
12. Ensure all oil-soaked cleanup materials (e.g., sand, dirt, hay, and straw and other solvents, in addition to rags used to remove excess oil from equipment), as well as contaminated PPE, have been placed in appropriate disposal containers and removed from the contaminated area. ***Note:***

Assuming the spilled material was something other than a solvent, petroleum based solvents used in the cleanup process (and any associated solvent contaminated materials) must be segregated from other wastes.

13. Coordinate disposal of oily waste material (and solvents) generated from cleanup activities in accordance with approved Used Oil Disposal Procedures.
14. Following completion of all cleanup activities, ensure all appropriate reports and forms have been completed and filled out properly. Forward copies to the GEC Senior Vice President and Environmental Manager.

5.2 Designated Response Coordinator-GEC Environmental Manager

Following are tasks assigned to the Response Coordinator:

1. Notify the Oxbow Corporate Environmental Department (West Palm Beach, Florida) that a spill has occurred.
2. Coordinate with the GEC President and confirm appropriate written and/or verbal notification of external agencies has been completed.
3. Update files and provide written recommendations for spill response plan modifications, if necessary. Forward copies to the Oxbow Corporate Environmental Department If an RQ of oil has been spilled or discharged to the ground or waters of the State / US, immediately notify the NRC and appropriate State agencies.
4. Coordinate ongoing communications with Oxbow's Corporate Environmental Department.
5. Coordinate necessary or required notification of regulatory agencies and groups.
6. As required, coordinate necessary actions with response contractor(s) and ensure all appropriate information related to the spill has been provided.
7. Address or location and phone number of the site where the spill occurred.
8. Date and time of the discharge.
9. Type of material and estimated amount of material discharged.
10. Estimated amount of "offsite" discharge, if any.
11. Source of the discharge.
12. Description of affected media (ground, water, etc).
13. Actions taken to stop, remove or mitigate the effects of the discharge.
14. Is an evacuation necessary?
15. Names of other individuals, organizations and/or regulatory agencies also contacted.
16. Forms provided in Appendix C of the SPCC Plan may be used as a guideline to gather the required information.

5.3 Oil Spill Response Center

The Oil Spill Response Center will be at the GEC office in Delta, Colorado. The office is located at 18380 H Rd, Delta, Colorado 81416. The Delta office will be capable of providing communication to the field as well as a staging location for spill response equipment.

5.4 Provision for Release Magnitude, 40 CFR 109.5(e)

1. The person detecting a spill, or nearby personnel, immediately notifies on duty supervisor.
2. Onsite Supervisor notifies the GEC President and Environmental Manager.
3. The onsite supervisor will determine if the spill can be managed by onsite personnel.
4. If yes, onsite personnel will implement control, containment, cleanup and disposal procedures consistent with the type of material and magnitude of the spill.
5. The onsite supervisor, GEC President and/or Environmental Manager notifies agencies as appropriate and prepares pertinent forms.
6. If no, onsite supervisor, or approved designee, contacts other spill response resources for cleanup and disposal. The onsite supervisor, or approved designee, notifies agencies as appropriate and prepares pertinent forms.

A. Detection:

1. Notify the Response Coordinator that an oil spill has occurred (provide location, source, amount, nearby areas of concern, etc.).
2. Shut off ignition sources (motors, electrical circuits, open flames).
3. Turn off pumping unit that charges or provides flow to the flowlines.
4. Locate the source of flowline leak.
5. Attempt to stop the source of the leak, if it can be done safely.
6. Initiate containment.

B. Assessment and Notifications:

1. Investigate the discharge to assess the actual or potential threat to human health or the environment. Document size (BBLs).
2. Mobilize the clean-up company if necessary.
3. Make appropriate notifications to Federal, State, and Local agencies.
4. Request outside assistance from local emergency responders, as needed.
5. Communicate with property owners regarding the discharge and actions taken to mitigate the damage.

C. Control and Recovery:

1. Prevent the spread of oil by deploying absorbents (i.e. booms), by building diversion structures

(i.e. berms), or digging temporary containment pits.

2. Direct clean-up of the oil and oil contaminated material.
3. Arrange to have soil and/or water samples analyzed. If contaminants are below the COGCC's allowable concentrations, clean-up is complete.
4. Containerize contaminated material (soil, water, absorbent material, etc.).

D. Disposal of Recovered Product and Contaminated Response Material:

1. Recovered product can either be added to another tank or disposed of at an approved commercial disposal facility.
2. Properly characterize, label and store all contaminated material.
3. Dispose of contaminated material in accordance with all applicable solid and hazardous waste regulations using a licensed waste hauler and disposal facility.

E. Termination:

1. Arrange for necessary repairs to equipment or flowlines.
2. Review circumstances that led to the discharge and take necessary precautions to prevent a recurrence.
3. Submit any required follow-up reports to the authorities.
4. Update the SPCC and OCP, as necessary.

APPENDIX C: DISCHARGE NOTIFICATION FORMS

- COGCC: Form 19 Spill/Release Report
- Submittal of Information to Regional Administrator for EPA Reportable Discharge(s)
- BLM/USFS: NTL-3A

FORM 19 Rev 6/99

State of Colorado
Oil and Gas Conservation Commission

1120 Lincoln Street, Suite 801, Denver, Colorado 80203 (303)894-2100 Fax:(303)894-2109

FOR OGCC USE ONLY

Spill report taken by:

FACILITY ID:

SPILL/RELEASE REPORT

This form is to be submitted by the party responsible for the oil and gas spill or release. Any spill or release which may impact waters of the State must be reported as soon as practicable; any spill over 20 bbls must be reported within 24 hours and all spills over five bbls must be reported within ten days. Submit a Site Investigation and Remediation Workplan (Form 27) when requested by the Director.

OPERATOR INFORMATION

Name of Operator: _____ OGCC Operator No: _____

Address: _____

City: _____ State: ____ Zip: _____

Contact Person: _____

Phone Numbers

No: _____

Fax: _____

E-Mail: _____

DESCRIPTION OF SPILL OR RELEASE

Date of Incident _____ Facility Name & No.: _____

Type of Facility (well, tank battery, flow line, pit): _____

Well Name and Number: _____

API Number: _____

County: _____

Qtr Qtr: _____ Section: _____

Township: _____ Range: _____

Meridian: _____

Specify volume spilled and recovered (in bbls) for the following materials:

Oil spilled: _____ Oil recov'd: _____ Water spilled: _____ Water recov'd: _____ Other spilled: _____ Other recov'd: _____

Ground Water impacted? ☐ Yes ☐ No Surface Water impacted? ☐ Yes ☐ No

Contained within berm? ☐ Yes ☐ No Area and vertical extent of spill: _____ x _____

Current land use: _____ Weather conditions: _____

Soil/geology description: _____

IF LESS THAN A MILE, report distance **IN FEET** to nearest .... Surface water: _____ wetlands: _____ buildings: _____

Livestock: _____ water wells: _____ Depth to shallowest ground water: _____

Cause of spill (e.g., equipment failure, human error, etc.): _____ Detailed description of the spill/release incident:

CORRECTIVE ACTION

Describe immediate response (how stopped, contained and recovered):

Describe any emergency pits constructed:

How was the extent of contamination determined:

Further remediation activities proposed (attach separate sheet if needed):

Describe measures taken to prevent problem from reoccurring:

OTHER NOTIFICATIONS

List the parties and agencies notified (County, BLM, EPA, DOT, Local Emergency Planning Coordinator or other).

Date	Agency	Contact	Phone	Response

Spill/Release Tracking No: _____

Submittal of Information to EPA Regional Administrator (for Reportable Discharges)

In the event of a reportable discharge or discharges, this page can be utilized to provide official notification to the Regional Administrator. If the Facility has had a discharge or discharges which meet one of the following two criteria, then this report must be submitted to the Regional Administrator within 60 days.

(Check as appropriate)

☐ This Facility has experienced a reportable spill as referenced in 40 CFR Part 112.1(b) of 1,000 gallons or more.

☐ This Facility has experienced two (2) reportable spills (as referenced in 40 CFR Part 112.1(b) of greater than 42 gallons each within a 12-month period.

Facility Name and Location: _____
_____
_____

Facility Contact Person (Name, address/phone Number):_____
_____
_____

Facility maximum storage or handling capacity:_____

_____

_____

Facility normal daily throughput:_____

_____

_____

Describe the corrective action and countermeasures taken (include description of equipment repairs and replacements):_____

_____

_____

Describe the Facility (maps, flow diagrams and topographical maps attached as necessary)_____

_____

Describe cause of discharge (as referenced in 40 CFR Part 112.1(b)) including failure analysis of the system is:_____

_____

Describe the preventative measures taken or contemplated to be taken to minimize the possibility of recurrence: _____
_____
_____

Other pertinent information:_____

_____

A copy of this report is also to be sent to Colorado Department of Public Health and Environment.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION

Notice to Lessees and Operators of Onshore Federal and
Indian Oil and Gas Leases
(NTL-3A)

Reporting of Undesirable Events

This Notice, which supersedes NTL-3 dated January l, 1975, is issued pursuant to the authority prescribed in Title 30 CFR 221.5, 221.7, and 221.36. Operators of onshore Federal and Indian oil and gas leases shall report all spills, discharges, or other undesirable events in accordance with the requirements of this Notice. All such events which occur on State or private land leases within federally supervised unit or communitized areas must likewise be reported in accordance with the requirements of this Notice. However, compliance with this Notice does not relieve an operator from the obligation of complying with the applicable rules and regulations of any State or any other Federal Agencies regarding notification and reporting of undesirable events.

As used in this Notice, the term District Engineer means that officer of the United States Geological Survey (GS) having supervisory jurisdiction for the geographic area in which the undesirable event occurs.

I. Major Undesirable Events Requiring Immediate Notification

Major undesirable events are defined as those incidents listed below in subsections A through F. These incidents, when occurring on a lease supervised by the GS, must be reported to the appropriate District Engineer as soon as practical but within a maximum of 24 hours:

A. Oil, saltwater, and toxic liquid spills, or any combination thereof, which result in the discharge (spilling) of 100 or more barrels of liquid; however, discharges of such magnitude, if entirely contained within the facility firewall, may be reported only in writing pursuant to Section III. of this Notice;

B. Equipment failures or other accidents which result in the venting of 500 or more MCF of gas;

C. Any fire which consumes the volumes as specified in I.A. and I.B. above;

D. Any spill, venting, or fire, regardless of the volume involved, which occurs in a sensitive area, e.g., areas such as parks, recreation sites, wildlife refuges, lakes, reservoirs, streams, and urban or suburban areas;

E. Each accident which involves a fatal injury; and F. Every blowout (loss of control of any well) that occurs.

II. Written Reports

A written report shall be submitted in duplicate to the District Engineer no later than 15 days following all major undesirable events identified in Section I. When required by the District Engineer, interim reports will be submitted until final containment and cleanup operations have been accomplished. The final written report for each such event shall, as appropriate, provide.

A. The date and time of occurrence, and the date and time reported to USGS;

B. The location where the incident occurred, including surface ownership and lease number:

C. The specific nature and cause of the incident;

D. A description of the resultant damage;

E. The action taken and the length of time required for control of the incident, for containing the discharged fluids, and for subsequent cleanup;

F. The estimated volumes discharged and the volumes lost;

G. The cause of death when fatal injuries are involved;

H. Actions that have been or will be taken to prevent a recurrence of the incident;

I. Other Federal or State agencies notified of the incident; and

J. Other pertinent comments or additional information as requested by the District Engineer.

III. Other-Than-Major Undesirable Events

Other-than-major undesirable events, as identified below in subsections A through D, do not have to be reported orally within 24 hours; however, a written report, as required for major undesirable events in Section II of this Notice, must be provided for the following incidents:

A. Oil, saltwater, and toxic liquid spills, or any combination thereof, which result in the discharge (spilling) of at least 10 but less than 100 barrels of liquid in nonsensitive areas, and all discharges of 100 or more barrels when the spill is entirely contained by the facility firewall;

B. Equipment failures or other accidents which result in the venting of at least 50 but less than 500 MCF of gas in nonsensitive areas; C. Any fire which consumes volumes in the ranges specified in III.A. and III.B. above; and

D. Each accident involving a major or life threatening injury.

Spills or discharges in nonsensitive areas involving less than 10 barrels of liquid or 50 MCF of gas do not require an oral or written report; however, the volumes discharged or vented as a result of all such minor incidents must be reported in accordance with Section V hereof.

IV. Contingency Plans

Upon request of the District Engineer, a copy of any Spill Prevention Control and Countermeasure Plan (SPCC Plan), required by the Environmental Protection Agency (EPA) pursuant to Title 40 CFR 112, or other acceptable contingency plan must be submitted. All plans shall provide the names, addresses, and telephone numbers (both business and private) of at least two technically competent company or contract personnel authorized to order equipment or supplies and to expend funds necessary to control emergencies.

V. Monthly Report of Operations/Monthly Report of Sales and Royalty

All volumes of oil spilled, gas vented, and all hydrocarbons consumed by fire or otherwise lost must be reported monthly on the Monthly Report of Operations (Form 9-329). The volume and value of such losses must also be reported in the Monthly Report of Sales and Royalty (Form 9-361).

VI. Liquidated Damages

Failure to provide the necessary notification, reports, or contingency plan (when required) as provided for by this Notice, may result in other measures being taken to secure compliance, such as those provided by Title 30 CFR 221.53 and 221.54.

March 1, 1979 /s/ Don E. Cash

Date Don E. Cash
Chief, Conservation Division

Approved:

/s/ C.J. Curtis _____
C. J. Curtis
Oil and Gas Supervisor
Northern Rocky Mountain Area

APPENDIX D: SPCC FORMS

- Quarterly SPCC Field Inspection Form
- Personnel Training Log
- Discharge Prevention Log

Quarterly Gunnison Energy Corporation Field Inspection Form

Version 12.3.09

GENERAL INFORMATION	
Date:	Operator/Well Name:
Inspector Name:	Photo #:

Equipment	Satisfactory	Unsatisfactory	Comments
1) Storage Tanks – Check shell, roof, valves, transfer pump/connections, hatches, seals, foundation/supports			
Drip marks			
Discoloration on tanks			
Puddles of spilled material			
Corrosion			
Cracks			
2) Separation Equipment – check oil/water separator, pipes, valves, pressure regulators, supports			
Leaks			
Corrosion			
Condition of equipment			
Excess of oil in separator			
3) Flowlines – Check connections, valves, seals, supports			
Leaks			
Corrosion			
Condition of pipes			
Stained soil			
Bowing of pipe			
Localized dead vegetation			
4) Well Heads – Check valves, connections, pumping units			
Leaks			
Corrosion			
Condition of equipment			
5) Secondary Containment – Check berm			
Level of precipitation in berm			
Presence of oil/water in berm			
Condition of berm walls			
Accumulation of debris			
Erosion of walls, floor, etc.			
Stained soil – check drainages			
Weeds/vegetation			
6) Loading & Unloading Areas – Check connections, valves, flowlines			
Leaks			
Stained soil			
7) General Housekeeping – Check for overall organization, clean operations			
Overall facility condition			

Proximity and direction to surface water: _____

Quarterly Tank Level Sensing Test

Date:_____

Tank	Time	Electronic Level (ft)	Manual Level (ft)	Difference (ft)

Gunnison Energy Corporation Personnel Training Log

Trainer: _____ _____ Date: _____

Subjects discussed: _____

_____

_____

_____

Name	Signature
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Discharge Prevention Training Log

Date: _____

Attendees: _____ _____

_____ _____

_____ _____

_____ _____

Subject/Issue Identified	Required Action	Implementation Date

APPENDIX E: TANK LOADING SUMMARY OF OPERATING PROCEEDURES

Standard Operating Procedure for Produced Fluid Transfers to Tanks

1. Initial Tank Inspection - Valves and Overflow (Gooseneck) Caps

A. Prior to any fluid transfers, the water handling contractor will perform an initial inspection of the tanks to confirm that all valves on tanks are closed and that the overflows (gooseneck) have caps.

B. Initial inspection includes the valve which is located at the back of the tank in front of the wheel axles.

C. All man hatches will be inspected to confirm that they are tight.

2. Initial Tank Inspection to Confirm Tank Fluid Levels

A. Prior to any fluid transfers, identify the full tanks and the empty tanks.

B. Tanks with closed thief hatches located at the top of the stairs are considered full. These tanks can't accept produced fluids.

C. Tanks with open thief hatches located at the top of the stairs are considered empty. The tanks can accept produced fluids.

D. Fluid Gauges Don't Work – Check tank status prior to pumping or transferring fluids.

F. ***Make sure that your tank has room before you begin unloading!***

3. Visual Tank Inspection after Fluid Transfer Begins

A. Visually check each tank for leaks (valves, overflow/gooseneck caps) immediately after tank filling begins.

B. Continue watching the tank until your truck is completely unloaded.

C. Tank fluid transfers are immediately stopped if a leak is found or tank is overfilled.

4. Spill Reporting and Cleanup

A. If a spill occurs the contractor/driver will contact their immediate supervisor.

B. Contractor will stop all fluid transfers during a spill event.

C. Truck driver will reverse his pump and begin vacuuming up the free liquids that spilled if transfer by truck.

5. Final Inspection after Fluid Transfer is Completed

A. Confirm that tank flex hose is drained of fluids prior to disconnecting the hose from the tanks – Do Not Drain Liquids on the Ground.

B. For pipeline fluid transfers, flex hoses must be left connected to the manifold in front of the frac tanks – Flex hoses should not be disconnected.

C. Contractor will close the tank thief hatches on the tanks that are full to prevent overfilling.

STANDARD OPERATING PROCEDURE FOR REMOVING PRODUCTION WATER FROM TANKS

1. Pull truck onto the location.
2. Inspect the location.
3. Note unusual situations and report the issue to the dispatcher.
4. Wear appropriate personal protective equipment: fire retardant clothing, hardhat, safety glasses and steel-toed shoes.
5. Plan an escape route, park facing the exit.
6. When possible park as close to the stairs as possible.
7. Observe the area for additional leaks, spills, releases, equipment damage, etc.
8. Gauge the tank.
9. Watch your footing and utilize the handrail.
10. Attach the bondstrap to as close to the unloading operation as possible.
11. Connect the hose to the tank and the truck.
12. Break the seal on the tank valve and record the seal number on the field ticket.
13. Place the truck pump in the vacuum position.
14. Open the valve on the truck first.
15. Open the valve on the tank next.
16. Ensure that the vacuum on the truck is operating properly.
17. Open valve on the truck slowly.
18. Remove material from the tank.
19. While using the clear site glass note when oil appears or when the tank domes and close the valve on the tank.
20. Open the bleeder valve (if present) on the load line.
21. Pull material from the hose into the truck.
22. If the truck is too full, then push some of the material back into the tank so that the hose can be effectively drained.
23. Shut off the pump.
24. Gage the tank again.
25. Record the amount of material withdrawn from the tank and document results on field ticket.
26. Install new seal on the tank valve.
27. Record the new seal number on the field ticket.

28. Disconnect the hose from the tank.
29. Disconnect the hose from the truck.
30. Collect remaining fluids in 5 gallon bucket.
31. Inspect the hose, fittings and piping for damage.
32. Properly place the hose in trays and secure all fittings.
33. Replace the dust caps on the back of the truck valves.
34. Remove the bondstrap.
35. Leave copy of the field ticket for the pumper.
36. Again, note any unusual occurrences.
37. Leave location and drive to disposal site.

APPENDIX F: WRITTEN COMMITMENT OF MANPOWER, EQUIPMENT, AND MATERIALS

Written Commitment of Manpower, Equipment, and Materials

In addition to implementing the preventive measures described in this Plan, Gunnison Energy Corporation will also specifically:

- In the event of a discharge:

  i. Make available all trained personnel and contractors to perform response actions
  ii. Collaborate fully with local, state, and federal authorities on response and cleanup operations

- Maintain on-site oil spill control equipment.

- Maintain all communications equipment in operating condition at all times.

- Ensure that facilities are accessible.

- Review the adequacy of on-site and third-party response capacity with pre-established response/cleanup contractors on an annual basis and update response/cleanup contractor list as necessary.

- Maintain formal agreements/contracts with response and cleanup contractors who will provide assistance in responding to an oil discharge and/or completing cleanup.

Authorized Facility Representative: Lee Fyock

Date: August 23, 2012

Signature: L Fyock

Title: Director of Environment and Permitting

Appendix B

Permit Certification and Notifications

COLORADO
Division of Water Resources
Department of Natural Resources

Water Division 4 - Main Office
P.O. Box 456
Montrose, CO 81402

December 31, 2014

Lee Fyock, Vice President of Environmental Permitting
Gunnison Energy LLC
1801 Broadway, Suite 1200
Denver, CO 80202

Re: Notice of Intent to Construct a Non-Jurisdictional Dam: Spadafora Storm Water Detention-North Pit, Spadafora Storm Water Detention-South Pit, Spadafora Water Storage Facility -North Pit, Spadafora Water Storage Facility-South Pit, Spadafora Water Storage Facility-Middle Pit

Our office is in receipt of a *Notice of Intent to Construct a Non-Jurisdictional Water Impoundment Structure* (Notice) for the above referenced structures. We have completed our review of the Notices and have no objections or conditions to the structures as you have proposed.

The final constructed dam(s) must be non-jurisdictional in size as defined by the *State of Colorado's Rules and Regulations for Dam Safety and Dam Construction*.

Our office may perform periodic inspections of each dam after it is constructed to verify the structure was constructed per the approved Notice and to non-jurisdictional size. A copy of the accepted Notice is enclosed for your information and use. Your cooperation is appreciated. If you have any questions, please contact our office at (970) 249-6622.

Sincerely,

Bob W. Hurford, P.E.
Division Engineer

Enclosure

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES
303-866-3581

FOR OFFICE USE ONLY

DAM NAME _____ NO. _____ WATER DIV: 4 DIST: 40

NOTICE OF INTENT TO CONSTRUCT A NON-JURISDICTIONAL WATER IMPOUNDMENT STRUCTURE[1]

This notice is required per Section 37-87-125, C.R.S. (1998).

This notice must be submitted to the Division Engineer's Office a minimum of 45 days prior to construction.

(PLEASE PRINT OR TYPE NOTICE)

OWNER INFORMATION

Name: **Gunnison Energy LLC** Telephone: **(303) 296-4222**

Address: **1801 Broadway, Suite 1200** **Denver** **Colorado** **80202**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Responsible Person: **Lee Fyock, Vice President of Environmental Permitting** Telephone: **(303) 296-4222**

Address: **same as above**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Contractor: **Weston Solutions, Inc. (Design Contractor);** Telephone: **(303) 729-6100**
Construction Contractor to be determined

STRUCTURE INFORMATION

Name of Dam: **Spadafora Storm Water Detention-North Pit** Water Division: **4** Water District: **40**

Location[2]:
- Option 1
  OR
- Option 2 →

¼ / ¼ Sect: ____ ¼ of the ____ ¼, Sect: ___, Township: ___, Range: P.M.
Distance of dam from Section lines _____ ft from ☐N ☐S, _____ ft from ☐E ☐W

Utilizing GPS: Set to UTM Datum. Measured on crest of dam above streamline/outlet.
N39 05' 37.92" W107 28' 09.49"
Note: GPS settings must be NAD83 CONUS (NAD83 Zone 13N used).

Dam Dimensions: Vertical Height[3]: 5.63 max., Length: 331 **LF,** ft., Slopes: U/S: **3** H:1V, D/S **3** H:1V
Reservoir: Surface Area[1]:0.29 acres, Capacity[1]:0.87 acre feet, Drainage Area: **3** acres

AEmergency Spillway: Width: **6** ft., Side Slopes: **3:1** H:1V, Freeboard[4]: **1** ft

Outlet Drain: Type: **PVC Stand Pipe**, Size: **6** inches, Location: **near emergency spillway**

Stream Name or Water Source[5]: **stormwater**

Proposed Water Use: **stormwater detention** Water Court Case No. (If applicable) **n/a**

Lee Fyock 10/16/14
Signature of Owner Date

DIVISION ENGINEER'S REQUIREMENTS: _____

Brian Sanford 12/30/14
Signature of Division Engineer Date

DWR (03/07)

[1] A "Non-Jurisdictional Structure" is a dam creating a reservoir with a capacity of 100 acre-feet or less *and* a surface area of 20 acres or less *and* a vertical height (see footnote 3) of 10 feet or less.

[2] Please see example on reverse side (or page 2) of this form.

[3] "Vertical Height" is measured from the elevation of the lowest point of the natural surface of the ground where that point occurs along the longitudinal centerline of the dam up to the crest of the emergency spillway of the dam.

[4] "Freeboard" is the vertical distance from the bottom of spillway to the crest of the dam.

[5] If construction in reservoir intercepts groundwater, a well permit is required. (Well permit applications can be found at www.water.state.co.us/pubs/forms.asp)

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES
303-866-3581

FOR OFFICE USE ONLY

DAM NAME _____ NO. _____ WATER DIV: 4 DIST: 40

NOTICE OF INTENT TO CONSTRUCT A NON-JURISDICTIONAL WATER IMPOUNDMENT STRUCTURE[1]

This notice is required per Section 37-87-125, C.R.S. (1998).

This notice must be submitted to the Division Engineer's Office a minimum of 45 days prior to construction.

(PLEASE PRINT OR TYPE NOTICE)

OWNER INFORMATION

Name: **Gunnison Energy LLC** Telephone: **(303) 296-4222**

Address: **1801 Broadway, Suite 1200** **Denver** **Colorado** **80202**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Responsible Person: **Lee Fyock, Vice President of Environmental Permitting** Telephone: **(303) 296-4222**

Address: **same as above**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Contractor: **Weston Solutions, Inc. (Design Contractor);** Telephone: **(303) 729-6100**
Construction Contractor to be determined

STRUCTURE INFORMATION

Name of Dam: **Spadafora Storm Water Detention-South Pit** Water Division: **4** Water District: **40**

Location[2]:
- Option 1 / *OR*
- Option 2 →

¼ / ¼ Sect: ____ ¼ of the ____ ¼, Sect: ___, Township: ___, Range: P.M.
Distance of dam from Section lines _____ ft from ☐N ☐S, _____ ft from ☐E ☐W

Utilizing GPS: Set to UTM Datum. Measured on crest of dam above streamline/outlet.
N39 05' 27.46" W107 28' 08.52"
Note: GPS settings must be NAD83 CONUS (NAD83 Zone 13N used).

Dam Dimensions: Vertical Height[3]: 7.37' max., Length: 303 **LF,** ft., Slopes: U/S: **3** H:1V, D/S **3** H:1V
Reservoir: Surface Area[1]:**0.27** acres, Capacity[1]:0.84 acre feet, Drainage Area: **3** acres

AEmergency Spillway: Width 6_ ft., Side Slopes: **1:2** H:1V, Freeboard[4]: **1** ft

Outlet Drain: Type: **PVC**, Size: **6** inches, Location: **near emergency spillway**

Stream Name or Water Source[5]: **Storm water**

Proposed Water Use: **Stormwater Detention** Water Court Case No. (If applicable) **n/a**

Signature of Owner — Date: 10/16/14

DIVISION ENGINEER'S REQUIREMENTS: _____

Signature of Division Engineer — Date: 12/30/14

DWR (03/07)

[1] A "Non-Jurisdictional Structure" is a dam creating a reservoir with a capacity of 100 acre-feet or less *and* a surface area of 20 acres or less *and* a vertical height (see footnote 3) of 10 feet or less.

[2] Please see example on reverse side (or page 2) of this form.

[3] "Vertical Height" is measured from the elevation of the lowest point of the natural surface of the ground where that point occurs along the longitudinal centerline of the dam up to the crest of the emergency spillway of the dam.

[4] "Freeboard" is the vertical distance from the bottom of spillway to the crest of the dam.

[5] If construction in reservoir intercepts groundwater, a well permit is required. (Well permit applications can be found at www.water.state.co.us/pubs/forms.asp)

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES
303-866-3581

FOR OFFICE USE ONLY

DAM NAME _____ NO. _____ WATER DIV: 4 DIST: 40

NOTICE OF INTENT TO CONSTRUCT A NON-JURISDICTIONAL WATER IMPOUNDMENT STRUCTURE[1]

This notice is required per Section 37-87-125, C.R.S. (1998).

This notice must be submitted to the Division Engineer's Office a minimum of 45 days prior to construction.

(PLEASE PRINT OR TYPE NOTICE)

OWNER INFORMATION

Name: **Gunnison Energy LLC** Telephone: **(303) 296-4222**

Address: **1801 Broadway, Suite 1200** **Denver** **Colorado** **80202**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Responsible Person: **Lee Fyock, Vice President of Environmental Permitting** Telephone: **(303) 296-4222**

Address: **same as above**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Contractor: **Weston Solutions, Inc. (Design Contractor);** Telephone: **(303) 729-6100**
Construction Contractor to be determined

STRUCTURE INFORMATION

Name of Dam: **Spadafora Water Storage Facility-North Pit** Water Division: **4** Water District: **40**

Location[2]:
- Option 1
  OR
- Option 2 →

¼ / ¼ Sect: ____ ¼ of the ____ ¼; Sect: ___, Township: ___, Range: P.M.
Distance of dam from Section lines _____ ft from ☐N ☐S, _____ ft from ☐E ☐W

Utilizing GPS: Set to UTM Datum. Measured on crest of dam above streamline/outlet.
N39 05' 38.09" W107 28' 04.98".
Note: GPS settings must be NAD83 CONUS (NAD83 Zone 13N used).

Dam Dimensions: Vertical Height[3]: 9.76' max., Length: **950 LF,** ft., Slopes: U/S: **3** H:1V, D/S **3** H:1V
Reservoir: Surface Area[1]: **2.32** acres, Capacity[1]: **27.2** acre feet, Drainage Area: **NA** acres

Emergency Spillway: Width: **see Attachment 1** ft., Side Slopes: **3:1** H:1V, Freeboard[4]: **2** ft

Outlet Drain: Type: **not required**, Size: **n/a** inches, Location: **n/a**

Stream Name or Water Source[5]: **produced water from oil and gas exploration activities**

Proposed Water Use: **beneficial reuse and disposal** Water Court Case No. (If applicable) **n/a**

C. Fyock 10/16/14
Signature of Owner Date

DIVISION ENGINEER'S REQUIREMENTS: _____

Robert Hafford 12/30/14
Signature of Division Engineer Date

DWR (03/07)

[1] A "Non-Jurisdictional Structure" is a dam creating a reservoir with a capacity of 100 acre-feet or less *and* a surface area of 20 acres or less *and* a vertical height (see footnote 3) of 10 feet or less.

[2] Please see example on reverse side (or page 2) of this form.

[3] "Vertical Height" is measured from the elevation of the lowest point of the natural surface of the ground where that point occurs along the longitudinal centerline of the dam up to the crest of the emergency spillway of the dam.

[4] "Freeboard" is the vertical distance from the bottom of spillway to the crest of the dam.

[5] If construction in reservoir intercepts groundwater, a well permit is required. (Well permit applications can be found at www.water.state.co.us/pubs/forms.asp)

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES
303-866-3581

FOR OFFICE USE ONLY

DAM NAME _____ NO. _____ WATER DIV: _____ DIST: _____

NOTICE OF INTENT TO CONSTRUCT A NON-JURISDICTIONAL WATER IMPOUNDMENT STRUCTURE[1]

This notice is required per Section 37-87-125, C.R.S. (1998).

This notice must be submitted to the Division Engineer's Office a minimum of 45 days prior to construction.

(PLEASE PRINT OR TYPE NOTICE)

OWNER INFORMATION

Name: **Gunnison Energy LLC** Telephone: **(303) 296-4222**

Address: **1801 Broadway, Suite 1200** **Denver** **Colorado** **80202**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Responsible Person: **Lee Fyock, Vice President of Environmental Permitting** Telephone: **(303) 296-4222**

Address: **same as above**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Contractor: **Weston Solutions, Inc. (Design Contractor);** Telephone: **(303) 729-6100**
Construction Contractor to be determined

STRUCTURE INFORMATION

Name of Dam: **Spadafora Water Storage Facility-South Pit** Water Division: **4** Water District: **40**

Location[2]:
- Option 1: ¼ / ¼ Sect: ____ ¼ of the ____ ¼ Sect: ___, Township: ___, Range: P.M.
  Distance of dam from Section lines _____ ft from ☐N ☐S, _____ ft from ☐E ☐W
  OR
- Option 2: Utilizing GPS: Set to UTM Datum. Measured on crest of dam above streamline/outlet.
  N39 05' 29.72" W107 28' 07.55"
  Note: GPS settings must be NAD83 CONUS (NAD83 Zone 13N used).

Dam Dimensions: Vertical Height[3]: 9.76' max., Length: **920 LF,** ft., Slopes: U/S: **3** H:1V, D/S **3** H:1V
Reservoir: Surface Area[1]: **2.21** acres, Capacity[1]: **27.7** acre feet, Drainage Area: **NA** acres

Emergency Spillway: Width: **see Attachment 1** ft., Side Slopes: **n/a** H:1V, Freeboard[4]: **2** ft

Outlet Drain: Type: **not required**, Size: **n/a** inches, Location: **n/a**

Stream Name or Water Source[5]: **produced water from oil and gas exploration activities**

Proposed Water Use: **beneficial reuse and disposal** Water Court Case No. (If applicable) **n/a**

C.F. Fyock 10/16/14
Signature of Owner Date

DIVISION ENGINEER'S REQUIREMENTS: _____

Byron Ford 12/30/14
Signature of Division Engineer Date

DWR (03/07)

[1] A "Non-Jurisdictional Structure" is a dam creating a reservoir with a capacity of 100 acre-feet or less *and* a surface area of 20 acres or less *and* a vertical height (see footnote 3) of 10 feet or less.

[2] Please see example on reverse side (or page 2) of this form.

[3] "Vertical Height" is measured from the elevation of the lowest point of the natural surface of the ground where that point occurs along the longitudinal centerline of the dam up to the crest of the emergency spillway of the dam.

[4] "Freeboard" is the vertical distance from the bottom of spillway to the crest of the dam.

[5] If construction in reservoir intercepts groundwater, a well permit is required. (Well permit applications can be found at www.water.state.co.us/pubs/forms.asp)

GUNNISON ENERGY LLC
AN OXBOW COMPANY

September 3, 2014

Ms. Kathryn Dolan
Colorado Department of Public Health and Environment
WQCD-P-B2
4300 Cherry Creek Drive South
Denver, CO 80246-1430

RE: Amendment to Stormwater discharge Permit No.COR-035658 to Construct the Spadafora Water Storage Facility

Dear Ms. Dolan:

Gunnison Energy LLC (GE) requests amending the Stormwater Discharge Permit No. COR-035658 – Sheep Creek Gathering System to include the construction of the Spadafora Water Storage Facility in Section 17 and Section 20, Township 11 South, Range 90 West, Gunnison County.

The receiving waters would be West Muddy Creek located approximately 2.7 miles south of the proposed construction site. Construction is expected to start on or near May 1, 2015 and will continue through September 2016. Disturbance estimate for the facility is approximately 19 acres for the water storage pits. Reclamation will commence immediately upon completion of the facility.

If you have any questions concerning the project please contact me at 303-296-4222.

Sincerely,

Lee Fyock
Vice President

STATE OF COLORADO

Bill Ritter, Jr., Governor
James B. Martin, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

http://www.cdphe.state.co.us

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

Colorado Department
of Public Health
and Environment

June 20, 2007

Brad Robinson, Vice President
Gunnison Energy Corporation,
1801 Broadway Ste. 1200
Denver, CO 80202
303/296-4222

RE: Final Permit, Colorado Discharge Permit System – Stormwater
Certification No: COR-035658
Sheep Gas Gathering System
Gunnison ~~Delta~~ County
Local Contact: neal allen ~~Mark McCallister,~~ Manager, Operations
303/ 296-4222

Dear Sir or Madam:

Enclosed please find a copy of the new permit and certification which have been re-issued to you under the Colorado Water Quality Control Act.

Your old permit expires on June 30, 2007. This is a renewal to the permit, and replaces the old one. See page 2 of the Rationale (the pages in italics) for a summary of the changes to the permit.

Your Certification under the permit requires that specific actions be performed at designated times. You are legally obligated to comply with all terms and conditions of the permit.

Please read the permit and certification. If you have any questions please visit our website at : www.cdphe.state.co.us/wq/permitsunit/stormwater or contact Matt Czahor at (303) 692-3517.

Sincerely,

Kathryn Dolan
Stormwater Program Coordinator
Permits Unit
WATER QUALITY CONTROL DIVISION
xc: Regional Council of Governments
Local County Health Department
District Engineer, Technical Services, WQCD
Permit File

STATE OF COLORADO

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
WATER QUALITY CONTROL DIVISION
TELEPHONE: (303) 692-3500

CERTIFICATION TO DISCHARGE
UNDER
CDPS GENERAL PERMIT COR-030000
STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION

Certification Number **COR035658**

This Certification to Discharge specifically authorizes:

Gunnison Energy Corporation

LEGAL CONTACT:
Brad Robinson, Vice President

Gunnison Energy Corporation
1801 Broadway Ste. 1200
Denver, CO 80202
Phone # 303/296-4222

LOCAL CONTACT: Dan McWilliams
~~***Mark McCallister, Manager,***~~
Operations,
Phone # ~~303/296-4222~~
970-874-4333

During the Construction Activity: **Gas/Oil Field Exploration and/or Development**
to discharge stormwater from the facility identified as **Sheep Gas Gathering System**
which is located at:

FR 125 & FR 127
Various, Co

Latitude ~~**39/00/40,**~~ Longitude ~~**107/50/22**~~
In ~~**Delta County**~~ Gunnison County
to: Sheep Creek -- Colorado River

Anticipated Activity begins **09/15/2003** continuing through **11/30/2003**
On **30.13** acres (**30.13** acres disturbed)

Certification is effective: **07/01/2007** Certification Expires: **06/30/2012**

Annual Fee: $245.00 (**DO NOT PAY NOW** – A prorated bill will be sent shortly.)

Appendix C

Sampling and Analysis Plan

Sampling and Analysis Plan

GUNNISON ENERGY LLC

SPADAFORA WATER STORAGE FACILITY

TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

The sample and analysis program is designed to collect analytical data to monitor surface water and groundwater quality at the site and in the vicinity. The data collected will be evaluated against baseline conditions to monitor the surface water and groundwater for potential human health and environmental risks as it relates to facility operations. A list of the storage pit samples is presented in Table 1. A network of new monitoring wells to be installed will be used in the evaluation of the site specific shallow groundwater bearing unit (GWBU) conditions. A list of the wells which comprise the site-specific monitoring well network is presented in Table 2. A combination of domestic wells within a 1-mile radius of the site and select pre-defined surface water sampling stations will be sampled to monitor for adverse environmental affects to shallow groundwater and surface waters in the area. A list of the wells which comprise the surrounding area shallow groundwater monitoring well network is presented in Table 3. A list of the surface water stations which comprise the surface water monitoring network is presented in Table 4. This document provides a summary of the standard operating procedures utilized in the field for sample collection, the sampling locations, and the sample analyses to be conducted by the laboratory.

2.0 EQUIPMENT MAINTENANCE AND CALIBRATION

The types of field measurement equipment to be used include a photoionization detector (PID), a flow through cell with field parameter meter, and an oil/water interface probe. Field measurement equipment will be calibrated as necessary. The PID and field parameter meter will be calibrated before use each day. The oil/water interface probe will be maintained and calibrated according to the manufacturer's operational manuals.

3.0 WELL DEVELOPMENT

Subsequent to installation of a new monitoring well, the well will be developed in accordance with EPA SOP#: 2044, Well Development guidelines. Development of a well will be performed utilizing a submersible pump or dedicated/disposable bailer. Development methods (i.e., over pumping, jetting, surging, etc.) will be determined based on site conditions. The following is a summary of the steps conducted in the development process:

1. Assemble necessary equipment on a plastic sheet around the well.

2. Record pertinent information in field logbook (personnel, time, location ID, etc.).

3. Open monitor well, take air monitoring reading at the top of casing and breathing zone as appropriate.

4. Measure depth to water and the total depth of the monitoring well. Calculate borehole volume using the following equation:

$$\text{Borehole Volume} = (\pi)(r^2)(h)(cf)$$

where:
$\pi = 3.14$
r = radius of borehole (feet)
h = height of the water column (feet)
This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]
cf = conversion factor (gal/ft3) = 7.48 gal/ft3 [In this equation, 7.48 gal/ft3 is the necessary conversion factor.]

5. Measure the initial pH, temperature, and specific conductivity of the water and record in logbook.

6. Develop the well until 7 borehole volumes of water have been removed and/or the water is clear and free of sediments. Note the initial color, clarity, and odor of the water.

7. All water produced by development in contaminated or suspected contaminated areas must be containerized or treated. Each container must be clearly labeled with the location ID.

8. No water shall be added to the well to assist development without prior approval by appropriate personnel. If a well cannot be cleaned of mud to produce formation water because the aquifer yields insufficient water, small amounts of potable water may be injected to clean up this poorly yielding well. This may be done by dumping in buckets of water. When most of the mud is out, continue development with formation water only. It is essential that at least five times the amount of water injected must be produced back from the well in order to assure that all injected water is removed from the formation.

9. Note the final color, clarity and odor of the water.

10. Measure the final pH, temperature and specific conductance of the water and record in the site logbook.

11. Record the following data in the site logbook:

- Well designation (location ID)
- Date(s) of well installation
- Date(s) and time of well development
- Static water level before and after development
- Quantity of water removed and time of removal
- Type and size/capacity of pump and/or bailer used
- Description of well development techniques used

4.0 SAMPLING PROCEDURES

4.1 Sample Labeling

Each sample will be assigned a unique identification based on its location and media. At a minimum, labels on each collected sample will contain the following information:

- Sample Name;
- Date sampled (*mm/dd/yyyy*);
- Time sampled (using 24 hour military time);
- Analysis to be conducted; and
- Initials of the individual collecting the sample.

This information will also be record on the chain-of-custody form and in the appropriate field notes.

4.2 Storage Pit Sampling Procedures

Storage Pit samples will be collected using the EPA Direct Method where possible or using the Dip Method where the transfer from a decontaminated dipper to the appropriate sampling container is required. It is unlikely that access will be an issue; however, if so, a pole will be utilized for the dip method. The samples will be collected from the most accessible edge of the pit. The sample should be collected from a depth which is not less than six inches above the bottom of the pit so as to avoid disturbing any sediment present during sample collection.

If needed, the storage pit sample will be transferred to laboratory-supplied containers with the preservative appropriate to the analysis requested. Disposal gloves will be used during sample collection procedures. The sample container will be labeled in accordance with Section 4.1, placed in a cooler with ice (cooled to 4°C), and transported to the laboratory accompanied by chain-of-custody documentation.

Please refer to Table 1 for the samples to be collected and laboratory analyses for storage pit samples. All reusable sampling equipment will be decontaminated in accordance with decontamination procedures provided in Section 4.6 prior to mobilizing to the next sampling location or at the end of the activity.

4.3 Groundwater Well Sampling Procedures

4.3.1 Depth to Groundwater Measurements

Prior to completing any well development/purging activities, depth to groundwater measurements and total depth measurements will be taken in all existing monitoring wells within 8-hours to determine groundwater elevations. Static water level will be measured to 0.01 foot from a marked point (MP) at the top of the casing. Data from these static water level measurements will be utilized to construct groundwater flow maps for the site. All water levels will be measured using an electronic oil/water interface probe that distinguishes between Non-Aqueous Phase Liquids (NAPL) and water. This information will be recorded in appropriate field notes. Where NAPL is encountered an equivalent potentiometric surface elevation (head) will be calculated using the following formula:

(TOC – DTW) + (NAPL Thickness X Specific Gravity)

where:
TOC = Top of Casing (Top of PVC)
DTW = Depth to Water

4.3.2 Well Purging

Prior to collecting groundwater samples, wells will be purged using either low flow or traditional bailing methods.

Low-Flow Method

Monitoring wells or piezometers will be pumped at a low flow rate utilizing a low-flow bladder pump, disposable tubing, and flow through cell. Disposable tubing is to be placed in the middle of the screened interval. Each well is to be purged until the indicator field parameters of pH, temperature, conductivity, redox potential, dissolved oxygen, and turbidity have stabilized or the well is pumped dry. An indicator field parameter is considered stable after three consecutive readings within 10% variance. Measurements will be taken every three minutes during purging or after each well casing volume is removed. All purged groundwater will be containerized in 55-gallon, DOT-approved, steel drums, labelled, and stored at a location designated by GELLC until disposal is arranged.

Traditional Method

When low flow methods are not utilized, the monitoring wells or piezometers will be purged of a minimum of three casing volumes of water utilizing disposal bailers prior to sampling. Also, prior to sampling, indicator field parameters of pH, temperature, conductivity, redox potential, dissolved oxygen, and turbidity must stabilize. An indicator field parameter is considered stable after three consecutive readings within 10% variance. If these parameters are not stable following the removal of three casing volumes, then additional purging will be required until these parameters become stable. All purged groundwater will be containerized in 55-gallon,

DOT-approved, steel drums, labelled, and stored at a location designated by GELLC until disposal is arranged.

4.3.3 Groundwater Sample Collection

After a well has been purged, groundwater sampling will be in accordance with ASTM Standard D 4448, Sampling Guide for Sampling Ground Water Monitoring Wells. Samples will be collected using dedicated, disposable, Teflon bailers or low-flow bladder pump. The method used to obtain samples will be noted. Lab protocols will be followed specific to each analytical parameter to ensure proper sampling and handling of the samples.

The groundwater sample will be transferred to laboratory-supplied containers with the preservative appropriate to the analysis requested. Disposal gloves will be used during sample collection procedures. The sample container will be labeled in accordance with Section 4.1, placed in a cooler with ice (cooled to 4°C), and transported to the laboratory accompanied by chain-of-custody documentation.

Please refer to Tables 2 and 3 for a summary of the groundwater monitoring well samples to be collected and laboratory analyses for the site specific and surrounding area monitoring networks. All reusable sampling equipment will be decontaminated in accordance with decontamination procedures provided in Section 4.6 prior to mobilizing to the next sampling location or at the end of the activity.

4.4 Surface Water Sampling Procedures

Surface water samples will be collected using the EPA Direct Method where possible or using the Dip Method where the transfer from a decontaminated dipper to the appropriate sampling container is required. It is unlikely that access will be an issue; however, if so, a pole will be utilized for the dip method. The samples will be collected from the most accessible edge of the body of water. The sample should be collected from a depth which is not less than six inches above the sediment so as to avoid disturbing the sediments during sample collection.

If needed, the surface water sample will be transferred to laboratory-supplied containers with the preservative appropriate to the analysis requested. Disposal gloves will be used during sample collection procedures. The sample container will be labeled in accordance with Section 3, placed in a cooler with ice (cooled to 4°C), and transported to the laboratory accompanied by chain-of-custody documentation.

Please refer to Table 4 for the samples to be collected and laboratory analyses for the surface water monitoring network. All reusable sampling equipment will be decontaminated in accordance with decontamination procedures provided in Section 4.6 prior to mobilizing to the next sampling location or at the end of the activity.

4.5 QA/QC Samples

One groundwater sample from each monitoring well will be collected. As part of the regular sampling program for groundwater, QA and QC samples will be collected. The QA/QC samples may consist of field blanks, equipment blanks, trip blanks, duplicates, and/or matrix spike (MS)/matrix spike duplicate (MSD) samples. QA/QC sample collection frequency will be based upon the total number of groundwater samples collected.

4.6 Decontamination Procedures

Where applicable, all reusable equipment utilized in invasive sampling programs will be properly decontaminated prior to coming on the site, between sampling location, and prior to leaving the site. All fluids generated during decontamination procedures will be transferred into 55-gallon, DOT drums, labelled, and stored onsite until disposal is arranged. The following steps detail the decontamination procedure:

1. Gross contamination removal;
2. Non-phosphate detergent wash;
3. Rinse;
4. Distilled/deionized water rinse, and,
5. Air dry.

Table 1 – Storage Pit Samples

Storage Pit	Current Status	Sampling Frequency
North Storage Pit	To Be Constructed	Quarterly
Middle Storage Pit	To Be Constructed	Quarterly
South Storage Pit	To Be Constructed	Quarterly

Timeframe	Constituent List	
Quarterly Sampling (Waste Profile Constituent List)	**Organic Compounds In Groundwater**	Benzene Toluene Ethylbenzene Xylenes (Total)
	Inorganics in Groundwater	Total Dissolved Solids (TDS) Total Suspended Solids (TSS) Chlorides Methane Sulfates
	Liquid Hydrocarbons	TVH - GRO (Gasoline) TVH - DRO (Diesel)
	Cations and Anions	Bromide Fluoride Hydrogen Sulfide
	Dissolved Metals	Aluminum Arsenic Barium Boron Calcium Copper Iron Lead Magnesium Manganese Nickel Potassium Selenium Sodium Strontium Zinc
	Nutrients	Ammonia Nitrates Nitrites Nitrate + Nitrite
	General Chemistry	Alkalinity Bicarbonate Carbonate Turbidity Specific Conductance

Table 2 – Site Specific Shallow Groundwater Monitoring Well Network

Monitoring Well	Current Status	Sampling Frequency
Site Specific Monitoring Well #1	To Be Installed Prior to Facility Operation	Quarterly
Site Specific Monitoring Well #2	To Be Installed Prior to Facility Operation	Quarterly
Site Specific Monitoring Well #3	To Be Installed Prior to Facility Operation	Quarterly
Site Specific Monitoring Well #4	To Be Installed Prior to Facility Operation	Quarterly
Site Specific Monitoring Well #5	To Be Installed Prior to Facility Operation	Quarterly

Timeframe	Constituent List	
Initial 2 to 4 Quarters of Sampling (Constituent list per 908.b.(9).A)	**Organic Compounds In Groundwater**	Benzene Toluene Ethylbenzene Xylenes (Total)
	Inorganics in Groundwater	Total Dissolved Solids (TDS) Chlorides Sulfates
	Liquid Hydrocarbons	TVH - GRO (Gasoline) TVH - DRO (Diesel)
	Cations and Anions	Bromide Fluoride Hydrogen Sulfide
	Dissolved Metals	Iron Manganese Selenium
	Nutrients	Nitrate + Nitrite Nitrates Nitrites
	General Chemistry	pH Specific Conductance
Subsequent Routine Quarterly Sampling (Constituent list per Table 910-1)	**Organic Compounds In Groundwater**	Benzene Toluene Ethylbenzene Xylenes (Total)
	Inorganics in Groundwater	Total Dissolved Solids (TDS) Chlorides Sulfates
	Liquid Hydrocarbons	TVH - GRO (Gasoline) TVH - DRO (Diesel)

Table 3 - Shallow Groundwater Monitoring Well Network

Monitoring Well Name / Owner	Current Status	Sampling Frequency
Spadafora Domestic Well	Well Constructed	Annually
* = Verification of well construction required GELLC = Gunnison Energy LLC		

Timeframe	Constituent List			
Annual Sampling (Constituent list per 908.b.(9).A)	**Organic Compounds In Groundwater**	Benzene Toluene Ethylbenzene Xylenes (Total)	**Dissolved Metals**	Iron Manganese Selenium
	Inorganics in Groundwater	Total Dissolved Solids (TDS) Chlorides Sulfates	**Nutrients**	Nitrates Nitrites Nitrate + Nitrite
	Liquid Hydrocarbons	TVH – GRO (Gasoline) TVH - DRO (Diesel)	**General Chemistry**	pH Specific Conductance
	Cations and Anions	Bromide Fluoride Hydrogen Sulfide		

Table 4 – Surface Water Monitoring Network

Surface Water Station	Surface Water Body / Location in Relation to Facility	Sampling Frequency
Stock Pond SW-1	Spadafora Stock Pond/Upgradient	Annually
Stock Pond SW-2	Spadafora Stock Pond/Down Gradient	Annually
Stock Pond SW-3	Spadafora Stock Pond/Down Gradient	Annually
MC-CK01	Muddy Creek / Down-gradient	Annually
WMC-CK01	West Muddy Creek / Down-gradient	Annually
WMC-CK02	West Muddy Creek / Up-gradient	Annually

Timeframe	Constituent List	
Annual Sampling (Constituent list per 908.b.(9).A)	**Organic Compounds In Groundwater**	Benzene Toluene Ethylbenzene Xylenes (Total)
	Inorganics in Groundwater	Total Dissolved Solids (TDS) Chlorides Sulfates
	Liquid Hydrocarbons	TVH - GRO (Gasoline) TVH - DRO (Diesel)
	Cations and Anions	Bromide Fluoride Hydrogen Sulfide
	Dissolved Metals	Iron Manganese Selenium
	Nutrients	Nitrate + Nitrite Nitrates Nitrites
	General Chemistry	pH Specific Conductance

Appendix D

Contact List

GUNNISON ENERGY CORPORATION EMERGENCY CALL NUMBERS

Delta County - CALL 911		
Delta County Emergency Dispatch **Delta County Hazardous Materials Team** **Delta County Office of Emergency Management**		**970-874-2015**
Bruce Bertram, Delta County Local Government Designee		**Office 970-874-5905** **Alt. 970 856-7688**
Air Life at St. Mary's Hospital		**970-244-2551** **800-332-4923**
Delta County Memorial Hospital		**970-874-7681**
Delta County Memorial Hospital – ER		**970-874-2222**
North Fork Valley Ambulance Association		**970-872-4303**
Delta County Sheriff – Dispatch **Sheriff**		**970-874-2015** **970-874-2000**
Delta County Health Department		**970-874-2165**
North Fork Medical Clinic(s): Paonia **Hotchkiss**		**970-527-4103** **970-872-3121**
Gunnison County		
Emergency-Delta Dispatch **Gunnison Dispatch**		**970-874-2015** **970-641-8000**
Gunnison County Sheriff (non-emergency)		**970-641-1113**
Scott Morrill, Emergency Management		**970-641-2481**
Gunnison Valley Hospital		**970-641-1456**
David Baumgarten, Gunnison County Local Government Designee		**Office 970-641-0248** **After hours 970-641-8000**
Montrose County		
Montrose County Dispatch/Emergency Services		**970-252-4010**
Hazardous Materials Team – (State Patrol)		**970-249-4392**
Spill Response Numbers		
Colorado Emergency Spill Report - 24 Hr Hotline		**877-518-5608**
National Response Center (NRC) - 24 Hr Hotline		**800-424-8802**
US DOT-Office of Pipeline Safety-Western Region		**720-963-3160**
CO Public Utilities-Pipeline Safety & Enforcement		**303-894-2000**
CO Department of Labor – Oil and Public Safety Division		**303-318-8547**
Environmental Protection Agency (EPA) Region 8		**800-227-8917**
CO Department of Public Health & Environment, Water Quality Division		**303-692-3500** **877-518-5608 – spill reporting**
CO Division of Wildlife (SW Region) Durango, Colorado		**970-247-0855**

Colorado Oil and Gas Conservation Commission (COGCC)		
Colorado Oil and Gas Conservation Commission		**Denver 303-894-2100**
Dave Andrews, Lead Engineer: (Rifle)		**Cell 970-456-5262**
Linda Spry O'Rourke, Environmental Specialist		**Cell 970-309-3356**
Chuck Browning, Field Inspector (White Water)		**Office 970-242-3348** **Cell 970-433-41396**
Bureau of Land Management (BLM)		
Montrose Field Office		**970-240-5300**
Thane Stranathan, Natural Resource Specialist		**Office 970-240-5304**
Bob Hartman, Petroleum Engineer		**Office 970-244-3041** **Cell 970-250-7002**
US Forest Service (USFS)		
Ryan Taylor, Gunnison National Forest		**Main 970-527-4151** **Cell 970-527-7058**
Linda Bledsoe, Grand Mesa National Forest		**Main 970-242-8211** **Desk 970-263-5802**
Liane Mattson, GMUG Supervisors Office		**Main 970 874-6600** **Desk 970-874-6697**
Gunnison Energy Corporation (GEC)		
Main Office - Denver, CO **Field Office - Delta, CO**		**303-296-4222** **970-874-4333**
Steve Shelbourne, Field Safety		**Office 970-874-4333** **Direct 970-874-4258** **Cell 970-596-4302**
Lee Fyock, Environmental & Permitting		**Cell 720-272-5871** **Office 303-293-2913**
Mike Cleary, Operations		**Cell 720-883-2774** **Office 303-296-4222** **Direct 303-296-8807**
Dan McWilliams, Field Manager		**Office 970-874-4333** **Cell 970-986-2927**
Brad Robinson, President		**Cell 775-848-1878** **Office 303-296-8806**
Oxbow Corporation- Environmental Affairs		**561-640-8711**
WPB Spill Response-Trish Diehl		**561-907-5711**
GEC Contractors		
Ken Miller, Weston Solutions, Inc., Spill Coordinator Contractor		**Office 303-729-6149** **Cell 303-882-8087** **Cell 678-516-7299 (Eric Sandusky)**
Rob Nessler, Safety Kleen, Oil Spill Response Contractor,		**Emergency 888-375-5336** **Office 970-241-1343** **Cell 970-260-9346**
Cudd Well Control (well fire/blowouts)		**713-849-2769**

Appendix E

Spill Notification Forms

FORM 19 Rev 6/99

State of Colorado
Oil and Gas Conservation Commission

1120 Lincoln Street, Suite 801, Denver, Colorado 80203 (303)894-2100 Fax:(303)894-2109

FOR OGCC USE ONLY

Spill report taken by:

FACILITY ID:

SPILL/RELEASE REPORT

This form is to be submitted by the party responsible for the oil and gas spill or release. Any spill or release which may impact waters of the State must be reported as soon as practicable; any spill over 20 bbls must be reported within 24 hours and all spills over five bbls must be reported within ten days. Submit a Site Investigation and Remediation Workplan (Form 27) when requested by the Director.

OPERATOR INFORMATION

Name of Operator: _____ OGCC Operator No: _____

Address: _____

City: _____ State: ____ Zip: _____

Contact Person: _____

Phone Numbers

No: _____

Fax: _____

E-Mail: _____

DESCRIPTION OF SPILL OR RELEASE

Date of Incident _____ Facility Name & No.: _____

Type of Facility (well, tank battery, flow line, pit): _____

Well Name and Number: _____

API Number: _____

County: _____

Qtr Qtr: _____ Section: _____

Township: _____ Range: _____

Meridian: _____

Specify volume spilled and recovered (in bbls) for the following materials:

Oil spilled: _____ Oil recov'd: _____ Water spilled: _____ Water recov'd: _____ Other spilled: _____ Other recov'd: _____

Ground Water impacted? ☐ Yes ☐ No Surface Water impacted? ☐ Yes ☐ No

Contained within berm? ☐ Yes ☐ No Area and vertical extent of spill: _____ x _____

Current land use: _____ Weather conditions: _____

Soil/geology description: _____

IF LESS THAN A MILE, report distance **IN FEET** to nearest .... Surface water: _____ wetlands: _____ buildings: _____

Livestock: _____ water wells: _____ Depth to shallowest ground water: _____

Cause of spill (e.g., equipment failure, human error, etc.): _____ Detailed description of the spill/release incident:

CORRECTIVE ACTION

Describe immediate response (how stopped, contained and recovered):

Describe any emergency pits constructed:

How was the extent of contamination determined:

Further remediation activities proposed (attach separate sheet if needed):

Describe measures taken to prevent problem from reoccurring:

OTHER NOTIFICATIONS

List the parties and agencies notified (County, BLM, EPA, DOT, Local Emergency Planning Coordinator or other).

Date	Agency	Contact	Phone	Response

Spill/Release Tracking No: _____

Submittal of Information to EPA Regional Administrator (for Reportable Discharges)

In the event of a reportable discharge or discharges, this page can be utilized to provide official notification to the Regional Administrator. If the Facility has had a discharge or discharges which meet one of the following two criteria, then this report must be submitted to the Regional Administrator within 60 days.

(Check as appropriate)

☐ This Facility has experienced a reportable spill as referenced in 40 CFR Part 112.1(b) of 1,000 gallons or more.

☐ This Facility has experienced two (2) reportable spills (as referenced in 40 CFR Part 112.1(b) of greater than 42 gallons each within a 12-month period.

Facility Name and Location: _____
_____
_____

Facility Contact Person (Name, address/phone Number):_____
_____
_____

Facility maximum storage or handling capacity:_____

_____

_____

Facility normal daily throughput:_____

_____

_____

Describe the corrective action and countermeasures taken (include description of equipment repairs and replacements):_____

_____

_____

Describe the Facility (maps, flow diagrams and topographical maps attached as necessary)_____

_____

Describe cause of discharge (as referenced in 40 CFR Part 112.1(b)) including failure analysis of the system is:_____

_____

Describe the preventative measures taken or contemplated to be taken to minimize the possibility of recurrence: _____
_____
_____

Other pertinent information:_____

_____

A copy of this report is also to be sent to Colorado Department of Public Health and Environment.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION

Notice to Lessees and Operators of Onshore Federal and
Indian Oil and Gas Leases
(NTL-3A)

Reporting of Undesirable Events

This Notice, which supersedes NTL-3 dated January l, 1975, is issued pursuant to the authority prescribed in Title 30 CFR 221.5, 221.7, and 221.36. Operators of onshore Federal and Indian oil and gas leases shall report all spills, discharges, or other undesirable events in accordance with the requirements of this Notice. All such events which occur on State or private land leases within federally supervised unit or communitized areas must likewise be reported in accordance with the requirements of this Notice. However, compliance with this Notice does not relieve an operator from the obligation of complying with the applicable rules and regulations of any State or any other Federal Agencies regarding notification and reporting of undesirable events.

As used in this Notice, the term District Engineer means that officer of the United States Geological Survey (GS) having supervisory jurisdiction for the geographic area in which the undesirable event occurs.

I. Major Undesirable Events Requiring Immediate Notification

Major undesirable events are defined as those incidents listed below in subsections A through F. These incidents, when occurring on a lease supervised by the GS, must be reported to the appropriate District Engineer as soon as practical but within a maximum of 24 hours:

A. Oil, saltwater, and toxic liquid spills, or any combination thereof, which result in the discharge (spilling) of 100 or more barrels of liquid; however, discharges of such magnitude, if entirely contained within the facility firewall, may be reported only in writing pursuant to Section III. of this Notice;

B. Equipment failures or other accidents which result in the venting of 500 or more MCF of gas;

C. Any fire which consumes the volumes as specified in I.A. and I.B. above;

D. Any spill, venting, or fire, regardless of the volume involved, which occurs in a sensitive area, e.g., areas such as parks, recreation sites, wildlife refuges, lakes, reservoirs, streams, and urban or suburban areas;

E. Each accident which involves a fatal injury; and F. Every blowout (loss of control of any well) that occurs.

II. Written Reports

A written report shall be submitted in duplicate to the District Engineer no later than 15 days following all major undesirable events identified in Section I. When required by the District Engineer, interim reports will be submitted until final containment and cleanup operations have been accomplished. The final written report for each such event shall, as appropriate, provide.

A. The date and time of occurrence, and the date and time reported to USGS;

B. The location where the incident occurred, including surface ownership and lease number:

C. The specific nature and cause of the incident;

D. A description of the resultant damage;

E. The action taken and the length of time required for control of the incident, for containing the discharged fluids, and for subsequent cleanup;

F. The estimated volumes discharged and the volumes lost;

G. The cause of death when fatal injuries are involved;

H. Actions that have been or will be taken to prevent a recurrence of the incident;

I. Other Federal or State agencies notified of the incident; and

J. Other pertinent comments or additional information as requested by the District Engineer.

III. Other-Than-Major Undesirable Events

Other-than-major undesirable events, as identified below in subsections A through D, do not have to be reported orally within 24 hours; however, a written report, as required for major undesirable events in Section II of this Notice, must be provided for the following incidents:

A. Oil, saltwater, and toxic liquid spills, or any combination thereof, which result in the discharge (spilling) of at least 10 but less than 100 barrels of liquid in nonsensitive areas, and all discharges of 100 or more barrels when the spill is entirely contained by the facility firewall;

B. Equipment failures or other accidents which result in the venting of at least 50 but less than 500 MCF of gas in nonsensitive areas; C. Any fire which consumes volumes in the ranges specified in III.A. and III.B. above; and

D. Each accident involving a major or life threatening injury.

Spills or discharges in nonsensitive areas involving less than 10 barrels of liquid or 50 MCF of gas do not require an oral or written report; however, the volumes discharged or vented as a result of all such minor incidents must be reported in accordance with Section V hereof.

IV. Contingency Plans

Upon request of the District Engineer, a copy of any Spill Prevention Control and Countermeasure Plan (SPCC Plan), required by the Environmental Protection Agency (EPA) pursuant to Title 40 CFR 112, or other acceptable contingency plan must be submitted. All plans shall provide the names, addresses, and telephone numbers (both business and private) of at least two technically competent company or contract personnel authorized to order equipment or supplies and to expend funds necessary to control emergencies.

V. Monthly Report of Operations/Monthly Report of Sales and Royalty

All volumes of oil spilled, gas vented, and all hydrocarbons consumed by fire or otherwise lost must be reported monthly on the Monthly Report of Operations (Form 9-329). The volume and value of such losses must also be reported in the Monthly Report of Sales and Royalty (Form 9-361).

VI. Liquidated Damages

Failure to provide the necessary notification, reports, or contingency plan (when required) as provided for by this Notice, may result in other measures being taken to secure compliance, such as those provided by Title 30 CFR 221.53 and 221.54.

March 1, 1979 /s/ Don E. Cash

Date Don E. Cash
Chief, Conservation Division

Approved:

/s/ C.J. Curtis _____
C. J. Curtis
Oil and Gas Supervisor
Northern Rocky Mountain Area

Appendix F

Emergency Response Plan (ERP)

GUNNISON ENERGY LLC

FIRE/EMERGENCY/HEALTH AND SAFETY PLAN

Delta and Gunnison Counties, Colorado

August 2012

TABLE OF CONTENTS

- **Emergency Contact Numbers & Wall Placard With Spill Reporting Procedures**
- **Site Locations/Addresses & Access Road Drawings**

EMERGENCY CONTACT NUMBERS
WALL PLACARD
SPILL REPORTING PROCEDURES

PROJECT LOCATIONS
with
ACCESS ROAD
and
HELIPAD COORDINATES

1.0 INTRODUCTION

Gunnison Energy Corporation (GEC) operates numerous natural gas facilities including wells, pipelines and compression facilities on the south flank of the Grand Mesa and in the North Fork Valley of Delta and Gunnison Counties on various public and private lands. This Fire/Emergency/Health & Safety Plan has been written in accordance with local, state and federal requirements to address operations and response throughout both Counties.

The Plan is divided up into six (6) Project Areas presented on the attached FIRE AND EMERGENCY BASE MAP (1:100,000) scale. The Project Areas include:

- **SPAULDING PEAK**
- **ALLEN/IRON POINT**
- **HOTCHKISS RANCH**
- **RAGGED MOUNTAIN**
- **SHEEP PARK**

Each of the Project Areas are presented separately on a 1"=2000' scale and provides the latitude and longitude (in decimal degrees) of the facility, major access roads and emergency helipad locations.

The remainder of the Plan provides procedures for Communications, Emergency Reporting, Fire Prevention, General Safe Work Rules and Personal Injury First Aid Procedures. The plan is not a stand alone document in that it is to complement GEC's safety program and the Spill Prevention Control and Countermeasure (SPCC) plan.

2.0 EMERGENCY RESPONSE PLAN

2.1 Communications

Efficient and reliable communication is one of the foundations of successful emergency response efforts. Standard telephone service ("landline") is generally not currently available in the vicinity of the sites where Gunnison Energy is pursuing well operation and drilling activity. Site communications will be provided via trunked radio service, cellular telephone and/or satellite telephone, as appropriate to each location; although different equipment and systems are used for each method, all three methods provide a communications path that interconnects with the public telephone network. However, these communications methods are generally not compatible with the nationwide 911 reporting system and will usually result in mis-routing of any emergency service requests that are initiated by a 911 call. Therefore, all requests for emergency services must be dialed to the appropriate Emergency Dispatch number.

All personnel working at field locations will be provided with a laminated placard that includes the applicable Emergency Dispatch telephone numbers. Additionally the placard provides the numbers of federal, state, and county agency authorities as well as GEC contacts including emergency contractors. This placard shall generally be distributed at the time of contracting services or at the initial site safety briefing meeting.

Prior to commencement of work at each site, communications testing will be conducted to determine which communication method (trunked radio, cellular telephone, and satellite telephone) will be used at each site. During tests of the various methods, the appropriate Emergency Dispatch will be contacted to confirm the viability of the method; at the time of each test, the caller will advise the Emergency Dispatch operator that GEC is conducting a test of emergency communications.

The site access road entry from the nearest county road and drill pad locations and addresses are presented on the individulal **Project Area Maps** for each well or facility.

This Fire/Emergency/Health and Safety Plan is designed to be straightforward and useable at the various types of GEC facilities. It is based on applicable established standards from the U.S. Forest Service (USFS); the Bureau of Land Management (BLM); Colorado Oil and Gas Conservation Commission (COGCC), including any USFS or BLM directive (Appendix A) and COGCC Rules Section 600 (Appendix B); Colorado State Forest Service (CSFS); and National Fire Protection Association (NFPA) as appropriate.

2.2 Emergency Reporting

During site construction and reclamation operations, GEC employees or contractors would generally be the party initiating any emergency response call. The **Project Area Maps** provide the latitude and longitude along with other location data for the calling party to use in communicating with the Emergency Dispatch.

During well drilling and completion operations, GEC will maintain an office trailer at the well site. The communications equipment for emergency response will be located in GEC's mobile office

and will be accessible at all times. Emergency response calls may be initiated by GEC personnel or contractor personnel. A laminated placard posted adjacent to the communications equipment will provide a format to use in communicating with the Emergency Dispatch and other parties requiring notification.

During well testing operations, the GEC contractors monitoring the test would generally be the party initiating any emergency response call. The placard will provide the location data for the calling party to use in communicating with the Emergency Dispatch.

2.3 Emergency Response Personnel Orientation

GEC will ensure that each employee, subcontractor, or any other individual or company working on the project site is made familiar with the fire and emergency response procedures and the location and proper use of fire fighting and emergency response equipment in order to minimize the threat to human safety and the environment.

Orientation will be conducted after the construction of drilling pads and access and before mobilization of drilling equipment. Typical drill pad layouts are included in Appendix C. Orientation will include a review of the access path, the general surrounding terrain, the intended equipment layout, and the planned location for fuels and other flammables and the planned locations and identification methods for any hazardous materials to be used on site.

Fundamental Rules

Personnel must:

- Travel on designated roads.
- Obey posted speed limits.
- Stay in designated work areas
- NOT enter exclusion zones.
- NOT feed wildlife.
- NOT bring firearms or other weapons to the work area nor hunt.
- Use only those containers/locations designated for specific wastes.
- Use proper handling of oils and hazardous waste.
- Stop spill or fire, notify supervisor.
- Recycle, and NOT litter.
- NOT smoke in areas designated as “No Smoking.”
- NOT dispose of any materials or perform activities that could generate hazardous waste.
- Use sanitary facilities as provided.

3.0 FIRE PROTECTION PLAN

3.1 Fire Reporting

In consideration of the fact that most operations of GEC will be conducted in wildfire hazard areas, the importance of early fire reporting shall be emphasized to all personnel during safety orientation.

All fires, no matter how small, must be reported to the designated GEC site supervisor or engineer. Small fires which have already been extinguished while in the manageable stage should be reported to the immediate supervisor and the GEC site supervisor or engineer as soon as practical.

Small fires which are beyond control, or are expected to go beyond immediate control, should be reported immediately according to the procedures established for each work crew, such that a designated person will contact Emergency Dispatch while others attempt extinguishment or containment of the fire pending arrival of fire department personnel. In this process, all personnel known to be on the site must be accounted for as soon as possible and continuously throughout the event, with a priority placed upon preventing injury or fatality.

The person that contacts Emergency Dispatch will provide the following information:

Site address
Site name
Type of fire (i.e., wildfire, fuel fire, electrical fire, etc.)
Name of person reporting

If the fire is successfully extinguished before fire department personnel arrive at the site, then Emergency Dispatch should be advised of same.

In the event of a large and uncontrollable fire on the site, all site personnel shall evacuate the site to a predetermined upwind assembly area (preferably on the site access road or similar cleared area); all site personnel shall be accounted for prior to initiating any other action beyond notification of Emergency Dispatch.

3.2 Well Fires/ Blowouts & Explosions

COGCC Rule 327 Loss of Well Control – The operator shall take all reasonable precautions, in addition to fully complying with Rule 327 to prevent any oil, gas or water from blowing uncontrolled and shall take immediate steps and exercise due diligence to bring under control any such well, and shall report such occurrence to the Director as soon as practicable, but no later than twenty four (24) hours following the incident.

GEC will utilize only blowout preventer equipment (“BOPE”) approved by the COGCC and BLM and will conduct testing at startup and daily as required to insure the proper use and maintenance of the equipment.

In the extremely unlikely event of a well fire (a fire that includes a discharge of flammable gas and/or liquid from the well bore), emergency response personnel should not attempt to extinguish the fire, since special resources may be required to completely contain the fire and discharge and to prevent re-ignition. In these circumstances, the GEC site supervisor will determine if any fire containment or cooling flow efforts might be appropriate in the interim.

Depending upon the location, Delta County, Gunnison County Emergency Dispatch or both will be notified immediately of the incident and the type of response necessary as described in 3.1 above. A GEC employee or representative will be sent to the nearest county access road to lead the emergency response personnel to the site.

3.3 Wildfires

Wildfires in brush and grasslands are a potential event in the vicinity of GEC's operations. In the event of a wildfire sighting in the general vicinity of its operations, GEC personnel will notify Emergency Dispatch of the approximate fire location, unless it is obvious that fire department personnel have already responded to the event. If wildfire actually threatens the site of GEC operations, as determined by the GEC site supervisor or an order of the County Sheriff, operations at the site will be suspended and the site evacuated after the equipment and the wellbore are appropriately secured.

In the event of wildfire adjacent to the GEC site, all available site fire suppression equipment and materials and site personnel shall be immediately employed to contain and/or extinguish the fire, to the extent that this can be accomplished without risk of injury to site personnel.

3.4 Fire Prevention

USFS, BLM and Colorado Oil and Gas Conservation rules and regulations with respect to fire prevention are to be strictly followed and will be enforced on all GEC sites, access roads and other operations. Section 600 of the COGCC rules is provided in Appendix B. There are normally no fire restrictions from the USFS or BLM for the surrounding area of the project locations. In the event any fire restrictions are issued, they will be forwarded to the Operations Manager for distribution to the site locations. BLM fire restrictions can be viewed online at: www.co.blm.gov/fire/firerestrictions.

Smoking and/or the possession of smoking materials shall be permitted on GEC sites ONLY in areas specifically designated as a "Smoking Area". The entire site, other than designated smoking areas, shall be considered as a "NO SMOKING" area. Do not throw lit matches or cigarettes onto the ground – use an ashtray.

No material shall be disposed of by burning on GEC sites except with written authorization by the appropriate regulatory agency, specifying the date, location and circumstances where the burning is authorized.

In the extremely unlikely event of a well fire (a fire that includes a discharge of flammable gas and/or liquid from the wellbore) or explosion, all personnel will gather at a predetermine safe

briefing area. A head count will be taken and all personnel will be accounted for. The situation will be accessed with immediate response and emergency calls as needed. An employee or other representative will be sent to the nearest county road access to keep unauthorized persons from entering the location and to direct emergency response personnel to the site. Emergency response personnel should not attempt to extinguish the fire since special resources may be required to completely contain the fire and discharge and to prevent re-ignition. In these circumstances, GEC's site supervisor will determine if any fire containment or flow cooling efforts might be appropriate in the interim.

Gas and water pipelines are not normally associated with new well drilling or completion operations. Pipelines may or may not built afterwards. In the event that these pipelines are in the immediate area, the location and operation of block valves and shut-in procedures will be make available to appropriate personnel. If warranted, these lines will be shut-in and depressurized prior to and during operations.

Hydrogen Sulfide gas (H2S), also known as "sour gas", is not known to exist in this geographic area nor in any of the formations that will be encountered in this wellbore. Contingency planning for drilling in sour gas areas and formations is very specific and requires specialized training, certification, equipment and programs and does not apply to operations in this area.

GEC will maintain first aid kits in its vehicles and site offices. Contractors maintain first aid kits in their vehicles and site facilities appropriate to their operations and in conformance with their internal policies. Site personnel with current training in first aid will be identified as such by hard hat markings or other means.

Exhaust systems of vehicles shall be complete, generally as originally manufactured and in proper working condition, intact without leaks or cracks. All catalytic converters shall be regularly inspected to assure that they are free of any accumulated silt, mud or debris.

Vehicles shall be parked only in designated areas that are completely clear of vegetation. Do not park your vehicle in tall vegetation.

All portable gasoline-powered equipment and tools must have approved spark arrestors. Be sure you place hot equipment on non-flammable material like rocks or dirt; the high temperature of your saw can ignite a fire even in green vegetation.

Fireworks are prohibited on public land. The flames, sparks, and high temperatures involved with fireworks can easily ignite vegetation and start a wildfire. Leave the fireworks at home.

Hazardous Spills: All hazardous materials (reactive, flammable, corrosive and toxic) will be clearly labeled and stored in appropriate containers and within secondary containment. In the event fuel or lubricants are spilled, absorbent materials will be kept on location for immediate clean up. Service company vehicles carrying hazardous materials and performing work on the location, set secondary containment and provide absorbent materials for the immediate clean of such materials in the event of an accident or spill. Disposal of any such materials will be in compliance with COGCC Rules and Regulations as well as Federal and local requirements. Should spills or releases occur, they will be reported per COGCC Rules and Regulations 337

and 906 and to the Forest Service and BLM if applicable or as otherwise required. GEC has filed required SARA Title III reports with the Colorado Emergency Planning Commission, Colorado Department of Public Health & Environment, Denver, Colorado and with Region 10 Emergency Planning Committee, Gunnison, Colorado and Delta County and maintains an active Spill Prevention Control and Countermeasures Plan (SPCC) at their Denver and Delta offices. MSDS (Material Safety Data Sheets) will be available on location as required.

3.5 Welding Requirements

On all GEC sites, welding operations (defined as any use of electric arc or hydrocarbon fuel for welding, cutting, heating or forging, and including grinding) will be considered "hot work" when any of the following conditions exist:

a) Welding within 50 ft. of fuel or flammables storage.
b) Welding at an elevation exceeding 15 ft. above grade
c) Winds exceed 20 mph.
d) Welding within 30 feet of vegetation or other combustibles.
e) Welding within 75 ft. of wellbore or process equipment

All hot work shall be carried out with a dedicated fire watch person and with fire extinguishers and water at hand. The dedicated fire watch shall be assigned continuously to the monitoring of the hot work until such time as all surfaces have cooled sufficiently to allow touching by the bare hand. All hot work shall also require a hot work permit issued by the responsible GEC supervisor, specifying the date, location and circumstances of the permitted work and any special safety requirements.

Any welding on GEC sites shall also require that a fire suppression rig (as described in the Fire Suppression Equipment section) be on site, within hose reach of the hot work and ready for operation.

Carbon arc-compressed air gouging operations will not be permitted on GEC sites, due to the extreme distance that sparks travel from this process.

3.6 Flaring

1) All natural gas flaring, if necessary, will be through a steel flowline into an earthen pit located at least 100' from the well head and from all flammable materials. The flowline will enter the pit at a depth of 2-3' below the surface of the drillpad. The pit will be constructed such that there will be an earthen berm and/or cut slope located on the downstream side of the pit. For production test flaring, a flare stack may be used.

2) Operators shall **notify the local emergency dispatch, the local government designee**, and **the local COGCC field inspector** of any natural gas flaring. In addition, if on federal wells, the BLM and if appropriate, the USFS will be notified of flaring as well. Notice shall be given **prior** to flaring when flaring can be reasonably anticipated, or as

soon as possible, but in no event more than two (2) hours after the flaring occurs. All flaring shall be continuously monitored by personnel onsite.

3.7 Fire Suppression Equipment

During all drilling, completion and well-testing operations, GEC will maintain dedicated fire suppression equipment on site, including the following:

1) Portable fire suppression rig, consisting of a minimum 300 gallon capacity water tank, pump rated at 100 psi discharge pressure at 20 gpm flow and 300 ft. of 1" diameter fire hose with combination nozzle.
2) Portable fire extinguishers, minimum of two (2) 20 lb. dry chemical.
3) Sand and water buckets, filled and ready for use.
4) Backpack water pumps and hand tools
5) Foam mixers, foam applicators, and foam concentrate

The above complement of fire suppression equipment should be available on the site effective with the arrival of the first rig package.

The fire suppression rig may be used for site dust suppression, equipment washdown and other uses, as long as the water tank level is regularly restored and maintained near full. The fire suppression rig shall include hose connections for taking suction from site water tanks or water tankers.

In the event of elevated fire dangers, GEC will provide an additional water storage tank at site, for immediate replenishment of the portable fire suppression rig. This tank would have a maximum capacity of 300 to 400 barrels; the quantity of water stored would vary with the site and the current conditions.

All GEC trucks and contractor trucks will carry the following minimum fire suppression equipment:

1) Dry chemical extinguisher, 5 lb.
2) One shovel
3) Gloves and goggles

3.8 Flammables Handling and Storage

Flammable fuel or other flammable liquids, in quantities greater than 10 gallons (and other than that in the inbuilt tanks of vehicles and mobile equipment), will be stored in an area, marked as a Fuel Storage area, and surrounded by an area cleared of all vegetation and other combustible substances for a radius of 30 feet. Other flammable and combustible liquids may be stored in the Fuel Storage area, as long as they are properly identified. No oxidizers may be stored within 50 ft. of the Fuel Storage area. A berm will be constructed around the fuel storage area, sufficient to contain the total volume +10% of fuel in the event of a spill.

Fueling of portable equipment shall be only via portable metal fuel cans with safety spouts, not exceeding 5 gallons capacity, approved per 29 CFR 1910.106(a)(35). A maximum of three of these portable fuel cans may be carried on any vehicle or unit of mobile equipment; the metal fuel cans must be adequately secured in the open bed of the vehicle or in a suitable vented toolbox or storage compartment. When not being used to fuel portable equipment, the fuel cans will be re-secured on board the carrying vehicle or returned to a designated Fuel Storage area.

3.9 Personnel Training

All site personnel shall be trained in the proper use of portable fire extinguishers. Selected personnel will also be trained in the proper use of the other fire suppression equipment.

3.10 Access Road and Drill Site Construction

During the construction of site access roads, pipelines and drill sites, fire protection procedures and fire suppression equipment shall be maintained on site appropriate to the conditions of the surrounding vegetation. Generally, the requirements for site construction will be the same as for drilling, completion and testing operations; however, the dedicated fire suppression rig may not be mobilized if site construction is completed while fire danger is posted as “low”.

Approximately 30 ft. of defensible space will be prepared around the perimeter of the well site, consisting of either cleared ground and/or low-lying, fire resistant grasses, as determined by the surface land owner or surface management authority.

3.11 Hydrocarbons Storage

GEC’s expected operations will not likely result in the production of a significant amount of liquid hydrocarbons. However, should any liquid hydrocarbons be produced during well testing operations, those liquids will be accumulated in a tank that would be located at least 75 ft. from the wellbore and 75 ft. from any source of ignition. The tank would be provided with secondary containment. The liquid hydrocarbons produced during testing would be transported off site by tank truck.

If temporary fuel storage becomes necessary, a berm will be constructed around the fuel storage area sufficient to contain the total volume of fuel in the event of a spill.

4.0 SAFE WORK RULES/PRACTICES

Good Neighbors

We want to be good neighbors. Be sensitive to community issues such as noise, traffic, exhaust fumes. Pleasant behavior toward all, both on and off the job site, is expected.

Wildlife

All wildlife is to be left alone. Do NOT feed or hunt animals. Do not go into Protected Area Exclusion Zone.

4.1 Environmental Protection

Many common substances like gasoline, diesel fuel, lubricants, paints, and cleaners contain hazardous materials. Handling these substances responsibly is important for environmental protection and the health and safety of you, your co-workers, and community.

a. All hazardous materials (reactive, flammable, corrosive and toxic) are to be clearly labeled.

b. Know which materials are hazardous. If you have any questions, ask your supervisor.

c. Read the label instructions on storage, handling and disposal of hazardous materials you may encounter. Comply with all the instructions. Find out where the designated storage areas are for containers that are in use and for containers being held for safe disposal. Obey all security and inventory control requirements.

d. All hazardous material shall be placed in secondary containment to avoid spills.

e. No smoking signs shall be placed near drums of flammable materials.

f. Smoking, welding, and open flames are prohibited near a vehicle that is being refueled. Refueling may only occur in designated areas. The operator of the vehicle must remain with the vehicle during the refueling operation.

g. Do not transfer hazardous materials or soils from one container to another near open water. This includes fueling of vehicles.

h. Material Safety Data Sheets (MSDS) are to be made available through the GEC supervisory personnel and on-site.

4.2 General

a. All employees shall follow safety rules and immediately report all unsafe conditions or practices to his/her supervisor.

b. When in doubt, ask the supervisor the safe way to do a job.

c. Ignorance of safety rules and practices is no excuse for violation.

d. Help new or inexperienced employees by pointing out potential hazards.

e. Employees are to be alert and immediately report any deficiency in the way of defective tools, equipment, guards, or protective devices to the supervisor.

f. Careful investigation as to possible danger to other persons is necessary before beginning any operation.

g. Operate only the equipment you are trained and authorized to use.

h. Warning, prohibition, and command signs shall not be removed or changed.

i. Before doing any climbing, inspect the soles of your shoes and clean them of any slippery substances such as mud or oil.

4.3 Housekeeping

a. Work areas are to be kept free of all debris and waste material.

b. Pieces of lumber with protruding nails are to be promptly piled out of the way, and the nails withdrawn or bent over.

c. All scrap is to be removed and deposited in proper containers. Keep all materials stacked neatly.

d. All tools and other equipment are to be returned to their proper place after use.

e. Special attention is to be given to the removal and disposal of oily rags and any container that may have flammable liquids.

f. Eliminate slipping or falling hazards caused by oil and liquid spills by immediately wiping up or spreading an absorbing material on the area.

g. Walkways must be kept clear of welding cords, power cords, hoses, small tools, and equipment.

h. Welding rods and stubs are to be removed from the ground or pad.

i. Sanitary facilities must be kept clean. Place lunch bags, paper, drinking cups, and other refuse in containers provided for their disposal.

4.4 Solid Waste Management

Proper handling of wastes is essential:

a. Recycling

- ❖ Many items can be recycled. Separate drums will be set up to collect such items for recycling,. These include glass, cardboard/paper products, metallic items, plastic and woodscraps.
- ❖ Waste oil can be recycled. Oil from various activities should be collected and containerized in drums. All drums should be labeled, “Used Oil.” Assure that proper documentations of recycling is careful and accurate.

b. Food Wastes

- ❖ Good sanitary procedures must be adhered to throughout the duration of the job. Employees will have a designated area for all meals.
- ❖ Proper disposal of food trash is important. It serves to protect the workers and community from disease. It is a good housekeeping measure not to litter the area. It protects wild-life from attraction to food.

c. Other Material

- ❖ Materials that cannot be recycled must be disposed of in a proper manner. This includes land filling or hazardous waste disposal via an authorized vendor.

4.5 Personal Protection

a. *Authorized hard hats and safety glasses shall be worn by all employees and authorized visitors at all locations on the site.*

b. Proper work shoes or boots, in good repair, shall be worn on the jobsite. Leather work boots or work shoes with a heavy sole shall be worn by employees at all times while on the job site. Any other type of shoe (i.e., athletic shoes, deck shoes, sandals, etc.) is improper.

c. Loose or frayed clothing, shirt tails, sleeves, etc., shall not be worn when working around moving machinery or other sources of entanglement. Long hair must be secured under a hard hat, enclosed in a hair net or some other similar device.

d. Approved ear protection shall be worn when required.

e. Gloves shall be worn when engaged in activities where danger of hand injury exists.

f. Compressed air is not to be used for blowing dust from body parts or clothing. Never point an open air house at another person(s).

g. Use safety belts and life lines when working from high places.

h. Ground holes shall be roped off or covered.

i. Gasoline shall not be used for cleaning purposes.

4.6 Material Handling

a. When lifting, use the large muscles of your legs rather than the small muscles of your back. Take a firm grip, secure a good footing, place the feet a comfortable distance apart, keep the load close, keep your back straight, bend your knees, and lift with your legs. If the load is too heavy, get help.

b. Never use defective ropes, chains, or slings. Make sure all loads are centered and use care when removing the rope, chain, or sling.

c. Don't stand or walk under loads. Areas under suspended loads must be roped off and danger signs posted.

d. Lifting of personnel by a crane is prohibited, unless done by means of a crane basket with safety belt or harness.

e. Only one signalman is allowed to signal a load at a time.

f. Chokers, when not in use, shall be kept on a rack or a suitable storage place. Damaged chokers shall be removed from service and destroyed.

4.7 Transportation

a. The maximum speed on the work site is 10 miles per hour.

b. Employees are not allowed to ride on running boards, fenders, side rails, tailgates, or tops of vehicles; extend legs over the side of a truck bed; or stand up in the bed of a truck while the vehicle is in motion.

c. All vehicles parked within the jobsite must be left unlocked with the ignition key in place.

4.8 Electrical

a. Electrical work shall only be undertaken by persons familiar with the requirements and qualified for the work to be performed.

b. All equipment shall be de-energized prior to any work being done. De-energizing and repairs shall be made only by qualified personnel.

c. Metal ladders shall NOT be used for energized electrical work or where they may contact electrical conductors.

d. Don't carry material on your shoulders while working around energized equipment.

e. For safety, handle all wires at all times as though they were energized.

4.9 Welding

a. Only experienced persons are allowed to do welding and cutting.

b. Welding or cutting should not be done on drums, barrels, tanks, or other containers, unless they have been purged and are free of all explosive gases.

c. Do not weld in confined spaces. Make sure there is plenty of fresh air.

d. Wear proper eye and face protection when welding and make sure your helper is properly protected also.

4.10 Ladders and Scaffolds

a. Ladders are not to be placed on unstable objects, such as boxes, loose lumber, etc., and do not place them at blind corners or doorways.

b. Ladders are to be securely fastened, anchored, or tied off with ropes when being used.

c. Metal ladders are NOT to be used around electrical nor while working on or near electrical equipment.

d. Face the ladder when going up or down and use both hands.

e. Inspect any scaffolding or ladders on which you are to work and make certain they are safe. Broken or deficient scaffolds or ladders are to be withdrawn from service and tagged “DO NOT USE” until repaired.

f. Suitable handrails for personnel shall be on all scaffolds and platforms. Guardrails and toe boards shall be installed on all open sides and ends.

4.11 Hand Tools

a. All electrical equipment must be properly grounded and inspected periodically,

b. All hand-held power tools such as drills, grinders, etc., shall be equipped with a trigger-type, dead-man switch and not an “on-off” switch.

c. Do not use electrical cords for lifting tools or materials and inspect them regularly.

d. Do not use defective tools. Report them to your supervisor.

e. Do not leave tools lying in elevated places or walkways.

f. Do not through tools or another other materials from high places. Use a rope or tool bag to raise and lower these items.

4.12 Equipment and Machinery

a. Only trained, experienced people are allowed to operate power equipment.

b. Do not operate unsafe equipment. Repairs or defects are to be reported immediately to the supervisor.

5.0 PERSONNEL INJURY/FIRST AID PROCEDURES

GEC will maintain appropriate first aid kits in its vehicles and site offices, including a current edition of the American Red Cross First Aid and Safety Handbook.

GEC contractors will maintain first aid kits in their vehicles and site facilities appropriate to their operations and in conformance with their own internal policies.

Site personnel with current training in first aid will be identified as such by hard hat markings or other means.

The following Personnel Injury/First Aid Procedures contain general suggestions/information. In the event of a serious injury or illness, consult a physician immediately!

5.1 Head Injuries – First Aid

a. Obtain medical assistance as quickly as possible. Call for an ***ambulance*** equipped with oxygen and medical assistance.

b. Continuously maintain an open airway.

c. Keep the victim lying down.

- Treat for shock (refer to Section 4.15, “Mouth-to-Mouth Resuscitation and CPR”).
- If there is no evidence of neck injury and the victim is unconscious, place a small pillow or a pillow substitute (e.g., rolled-up blanket or overcoat) under ***shoulders and head***.
- Turn head toward the side so that saliva and secretions may exit from the corner of the mouth.
- Never position the victim so that the head is lower than the rest of the body.
- Remove the pillow if mouth-to-mouth resuscitation is used.

d. Give particular attention to ensuring an open airway. Administer mouth-to-mouth resuscitation when necessary. Refer to Section 4.15.

e. Control hemorrhage (bleeding).

f. Do not give the victim fluids by mouth.

g. If a scalp wound is present, apply a large dressing over the injury and bandage it in place with a full head bandage.

h. Record the extent and duration of unconsciousness.

5.2 Back Injuries – First Aid

a. Obtain medical assistance as quickly as possible.

b. Do not move the victim until an ambulance arrives. If the victim requires mouth-to-mouth resuscitation, the victim should be turned onto his/her back as a unit, protecting the neck and back before beginning CPR. Refer to Section 4.15.

5.3 Bone and Joint Injuries – First Aid

a. Obtain medical assistance as quickly as possible.

b. Maintain and open airway and apply mouth-to-mouth resuscitation as necessary. Refer to Section 4.15.

c. Prevent motion of injured parts and adjacent points.

d. Elevate involved extremities (if possible) without disturbing the suspected fracture.

e. Apply splints prior to moving the victim unless life is in immediate danger.

5.4 Burns

A. FIRST DEGREE BURNS

- Signs and symptoms:
  1. Redness or discoloration
  2. Mild swelling and pain
  3. Rapid healing
- First aid:

  The objective of first aid for burns is to relieve pain, prevent infection, and treat for shock. Usually, medical treatment is not required.
  1. Use the burn pack supplies as needed. If additional supplies are required, apply cold water applications or submerge the burned area in cold water from, first, the bottled water supply and then, second, from the non-potable water supply in the restrooms.
  2. Apply a dry dressing if necessary.

B. SECOND DEGREE BURNS

- Signs and symptoms
  1. Greater depth than first-degree burns
  2. Red or mottled appearance
  3. Development of blisters
  4. Considerable swelling over a period of several days

5. Wet appearance of the surface of the skin due to the loss of plasma through the damaged layers of skin

- First aid:
  1. Do not remove adhered particles of charred clothing.
  2. Cover burns with thick, sterile dressing that may be found in burn packs located in the _____ or a freshly laundered sheet or other household linen.
  3. If the hands are involved, keep them above the level of the victim's heart.
  4. Keep burned feet or legs elevated. (The victim should not be allowed to walk.)
  5. Have victims with face burns sit up or prop them up and keep them under continuous observation for breathing difficulty. If respiration problems develop, an open airway must be maintained.
  6. Do not immerse an extensive burned area or apply ice water to it; cold may intensify the shock reaction.
  7. Arrange transportation to the hospital as quickly as possible. Call **911** for an ambulance.
  8. If medical help or trained ambulance personnel will not reach the scene for an hour or more and the victim is conscious and not vomiting, give him a weak solution of salt and soda onsite and enroute: **1 level teaspoon of salt and ½ level teaspoon of baking soda to a quart of water, neither hot nor cold. Allow the victim to sip slowly. Give about 4 ounces (a half glass) over a period of 15 minutes. Discontinue fluid if vomiting occurs.**

  If medical help will not be available within an hour or more, fluids may be given if not otherwise contra-indicated. ***Do not give alcohol.***

  9. Do not apply ointment, commercial preparations, grease, or other home remedy. (Such substances may cause further complications and interfere with treatment by the physician.)

5.5 Chemical Burns of the Skin – First Aid

a. Wash away the chemical with large amounts of water, using a shower or hose, if available, as quickly as possible and for at least 15 minutes. Remove the victim's clothing from the burned areas involved.

b. If first aid directions for burns caused by specific chemicals (MSDS's) are available, follow these directions after the initial flushing with water.

c. Apply a dressing bandage and get medical help.

5.6 Chemical Burns of the Eye – First Aid

a. Acid Burns – First Aid

First aid for acid burns of the eye should begin as quickly as possible by thoroughly washing the face, eyelids, and eye for at least 15 minutes. If the victim is lying down, turn his head to the side, hold the eyelids open, and pour water from the inner corner of the eye outward. Make sure the chemical does not wash into the other eye.

- If a ***weak soda solution (1 teaspoon of baking soda added to 1 quart of water)*** can be made quickly, use the solution after first washing the eye with tap water.
- Cover the eye with a dry, clean, protective dressing ***(do not use cotton)*** and bandage in place.
- Caution the victim against rubbing his eye.
- Get medical help immediately (preferably from an eye specialist).

5.7 Alkali Burns of the Eye – First Aid

a. Flood the eye thoroughly with water for 15 minutes.

b. If the victim is lying down, turn his head to the side. Hold the lids open and pour the water from the inner corner outward.

c. Remove any loose particles of dry chemicals floating in the eye, by lifting them off gently with a sterile gauze or a clean handkerchief.

d. Seek immediately medical aid. Call the appropriate Emergency Dispatch for an ambulance and medical assistance.

5.8 Heat Stroke

a. Signs and symptoms:

- Body temperature is high (maybe 106°F or higher).
- The skin is characteristically hot, red, and dry. The sweating mechanism is blocked.
- The pulse is rapid and strong.
- The victim may be unconscious.

b. First aid:

First aid should be directed toward immediate measures to cool the body quickly. Take care, however, to prevent over-chilling of the victim once his temperature is reduced below 102°F.

The following first aid measures are applicable whenever the body temperature reaches 105°F:

- Remove victim to a cool, shaded area.
- Undress the victim and, using a small bath towel to maintain modesty, repeatedly sponge the bare skin with cool water or rubbing alcohol; or apply cold packs continuously; or place victim in a tub of cold water ***(do not add ice)*** until his temperature is lowered sufficiently. When the victim's temperature has been reduced enough, dry him off.
- Use fans or air conditioners, if available, because drafts will promote cooling.

5.9 Heat Exhaustion

a. Signs and symptoms:

- Approximately normal body temperature.
- Pale and clammy skin.
- Profuse perspiration.
- Tiredness, weakness.
- Headache, perhaps cramps.
- Nausea – dizziness (possible vomiting).
- Possible fainting (but the victim will probably regain consciousness as his head is lowered).

b. First aid:

- Give the victim sips of salt water ***(1 teaspoon of salt per glass, half a glass every 15 minutes)*** over a period of 1 hour.
- Have the victim lie down and raise his feet from 8 to 12 inches.
- Loosen the victim's clothing.
- Apply, cool, wet cloths, and fan the victim or move him to an air-conditioned room.
- If the victim vomits, do not give him any more fluids. Take the victim as soon as possible to a hospital, where an intravenous salt solution can be given.
- After an attack of heat exhaustion, see that the victim is protected from exposure to abnormally warm temperatures.

5.10 Snake Bites

a. Signs and symptoms:

- Extremely painful.
- Characterized by rapid swelling.
- Identified by one or more puncture wounds created by the fangs.

- Usually marked with general discoloration of the skin.
- General weakness.
- Rapid pulse.
- Nausea and vomiting.
- Shortness of breath.
- Dimness of vision.
- Shock.

b. First aid:

The most important step is to get the snake-bite victim to the hospital quickly. Meanwhile, take the following first aid measures:

- Calm and reassure the patient. Place the patient on his back and explain that staying quiet will decrease the spread of any venom through the system.
- Locate the bit area; clean it gently with soap and water or a mild antiseptic.
- Wrap soft rubber tubes about the extremity above and below the fang marks and tighten them just enough to stop the venom from circulating (a venous tourniquet). The pulse in the extremity should not disappear.

  The purpose of this maneuver is to limit the spread of the venom throughout the veins of the extremity.
- Immobilize the extremity with a splint.
- Monitor the vital signs: blood pressure, pulse, and respiration.
- If there are any signs of shock, place the patient in the shock position and give oxygen.
- If the snake has been killed, which is often the case, bring it with you. Identification of the offending snake is extremely important in administering the correct antivenom.
- Transport the patient promptly to the hospital. Notify the hospital that you are bringing in a snake-bit patient and, if possible, describe the snake.
- Be alert for vomiting. Patients may often do so from anxiety rather than from the effects of the toxin itself.
- Do not give anything by mouth, especially alcohol.
- In the relatively rare instance of the bit occurring on the trunk rather than on the extremity, it will be impossible to use tourniquets and splinting. Keep the patient on his back and as quiet as possible and transport as quickly as possible.

If the patient shows early signs of a poisonous snake bite, basic life support should be provided as needed, a sterile dressing should be placed over the suspected bite area, venous constricting bands should be put above and below the bite, and the

patient should be immobilized. The same procedure applies for the patient who shows early signs of a poisonous snake bite but who can be delivered to the hospital in less than 30 minutes.

Several other factors must be considered in cases of snake bite:

- ***Shock*** – Keep the victim lying down and comfortable and maintain his body temperature.
- ***Breathing and heartbeat*** – If breathing stops, give mouth-to-mouth resuscitation. If breathing stops and there is no pulse, perform cardiopulmonary resuscitation (CPR) if you have been trained to do so. Refer to Section 4.15..
- ***Identifying the snake*** – If you can kill the snake without risk or delay, bring it to the hospital for identification, but exercise extreme caution in handling the snake.
- ***Cleaning the bitten area*** – You may wash the bitten area with soap and water and blot it dry with sterile gauze. You may apply dressings and bandages but only for a short period of time.

It is not recommended that cold compresses, ice, dry ice, chemical ice packs, spray refrigerants, or other methods of cold therapy be used in the first aid treatment of snake bits.

5.11 Insect Bites – First Aid

a. Minor bites and stings.
   - Cold applications.
   - Soothing lotions, such as calamine.

b. Severe reactions
   - Give artificial respiration if required.
   - Apply a constricting band above the injection site on the victim's arm or leg (between the site and the heart). Do not apply tightly. You should be able to slip your index finger under the band when it is in place.
   - Keep the affected part down, below the level of the victim's heart.
   - If medical care is readily available, leave the band in place; otherwise, remove it after 30 minutes.
   - Apply ice contained in a towel or plastic bag, or cold cloths, to the site of the sting or bite.
   - Give pain relievers such as aspirin for pain.
   - If the victim has a history of allergic reaction to insect bites or is subject to attacks of hay fever or asthma or if he is not promptly relieved of symptoms, call physician or take the victim immediately to the nearest location where medical treatment is available. In a highly sensitive person, do not wait for symptoms to appear since delay can be fatal.

- In the case of a bee sting, remove and discard the stinger and venom sac.

5.12 Scorpion Stings

a. Signs and symptoms: Similar to snake bites, Part 4.10.

b. First aid:

The most important step is to get the victim to the hospital quickly. Meanwhile, take the following first aid measures:

- Give artificial respiration if needed. Keep the victim from moving around.
- Keep the victim as calm as possible and preferably in a prone position.
- Immobilize the affected extremity and keep it at or below heart level.
- Apply a constricting band above the wound between the wound and the heart. Do not apply tightly. You should be able to slip your finger under the band when it is in place.
- Apply ice contained in a towel or plastic bag, or cold cloths, to the site of the sting to slow the movement of venom.

5.13 Traumatic Shock

a. Signs and symptoms:

- Pale or bluish, cold skin (sometimes clammy).
- Weakness.
- Rapid, faint pulse.
- Faint, rapid breathing.
- Restlessness (due to lack of oxygen).
- Nausea and vomiting.

b. Advanced symptoms:

- Unresponsiveness.
- Dilated pupils.
- Loss of consciousness.

c. First aid:

- Keep person lying down.
- Maintain normal body temperature. Do not add extra heat, just prevent chilling.
- Elevate feet to improve circulation, unless:

1. Injury to back or neck is suspected: ***do not move victim.***

2. Unconscious and/or vomiting. Roll victim on side to allow for drainage of fluids.
3. Suspected head injury. Prop victim up by neck and shoulders.

- Administer fluids by mouth only if:
  1. Medical care will be delayed by more than one hour and it is not contra-indicated by vomiting, unconsciousness, convulsions, or the likelihood of surgery.
  2. If giving liquids, provide only 4 ounces of tepid water every 15 minutes, preferably with 1 teaspoon of salt or ½ teaspoon of baking soda per quart of water.
- Reassure victim to keep him calm.

5.14 Electric Shock

a. General

- ***Do Not*** attempt to move a victim of electric shock until the source of electricity has been removed from the victim.
- If the source cannot be moved, push the victim away with a long, dry, wooden board.

b. First aid:

- Call for an ambulance or medical assistance as quickly as possible.
- Check for breathing and pulse.\
- Administer CPR, if you have been trained to do so, when appropriate. Refer to Section 4.15.
- Keep the victim lying down.
- Maintain normal body temperature.
- Treat burns (same as thermal burns).

5.15 Mouth-to-Mouth Resuscitation and CPR

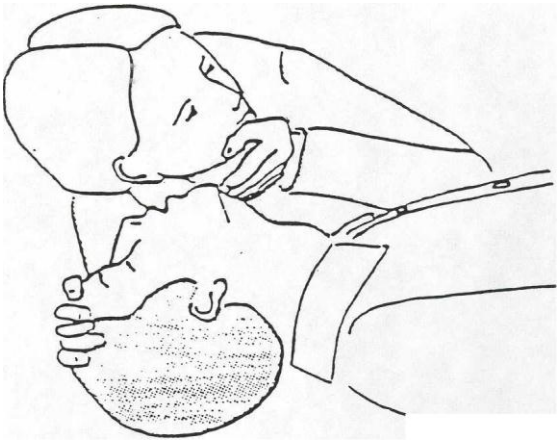
The following section describes several techniques utilized in administering mouth-to-mouth resuscitation and CPR and is not intended to substitute for a certified first air/CPR course.

DO NOT ATTEMPT TO ADMINISTER CPR IF YOU HAVE NOT BEEN TRAINED TO DO SO!!!

MOUTH-TO-MOUTH RESUSCITATION

The Airway Step

- The first step is to immediately determine whether the unconscious victim is breathing.
- Tap or gently shake the shoulder and shout, “Are you OK?” Position the victim. Turn onto back as a unit, if necessary, supporting head and neck.
- Tip the head back while lifting the chin to open the airway and check for breathing for five seconds.



- Look, listen and feel for breathing.

Breathing

If the person is not breathing, give 2 full breaths. Pinch nose, take a deep breath, and cover victim's mouth with your mouth. Make a tight seal. Breathe into victim's mouth 2 times with complete refilling of your lungs after each breath. Watch for victim's chest to rise. If you cannot give breaths, begin obstructed airway first aid.

The Check Step

- After the 2 full breaths, check for a pulse and breathing.
- Check pulse on the side of the neck, while maintaining head tilt.

- If the person is not breathing, but ***has*** a pulse, continue mouth-to-mouth breathing.

    1. Be sure head is still tipped.
    2. Pinch nose shut.
    3. Take a deep breath and make a tight seal over victim's mouth.
    4. Do steps once every 5 seconds.

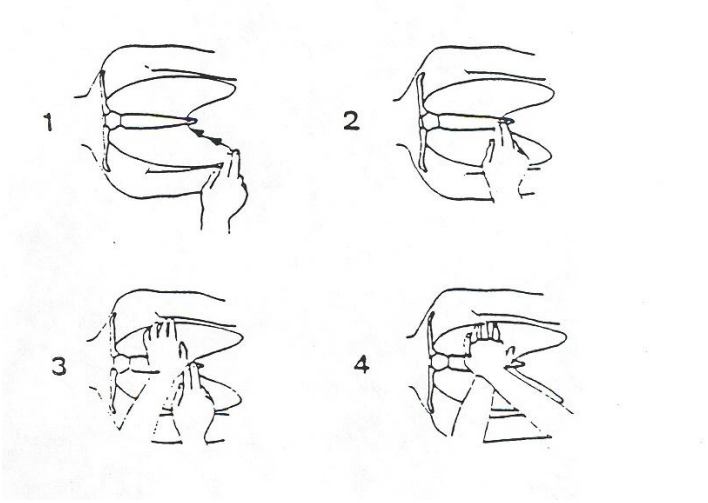
- If the person is not breathing and ***does not have a pulse***, administer CPR ***IF YOU HAVE BEEN TRAINED TO DO SO.***

CPR

CPR is the combination of mouth-to-mouth breathing and chest compressions. The following discussion outlines the techniques used in one-rescuer and two-rescuer CPR.

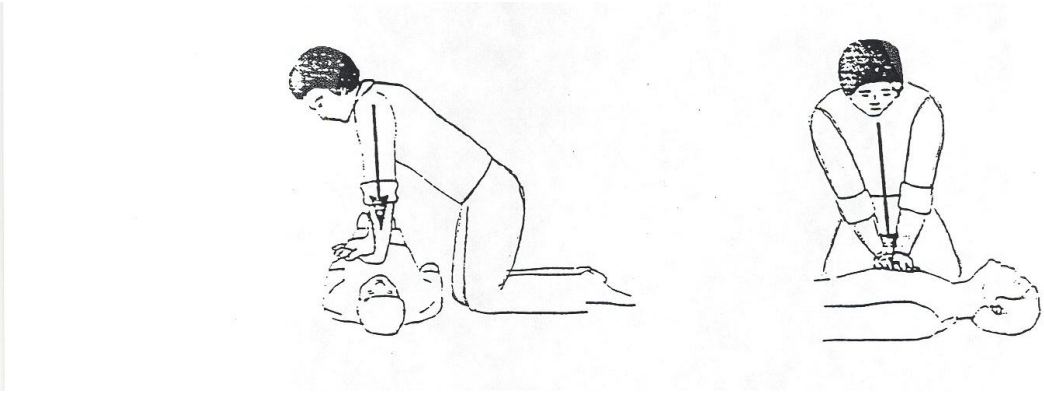
Finding Where to Give Chest Compressions

Trace 2 fingers along the victim's rib cage to the center of the chest. Keep your fingers on the notch and place the heel of your other hand on the sternum next to your fingers.



How to Give Compressions

Put your other hand on top, lift fingers off chest. Push straight down with your elbows straight and shoulders over your hands. Do not rock back and forth. Compress the chest 1-1/2 to 2 inches.



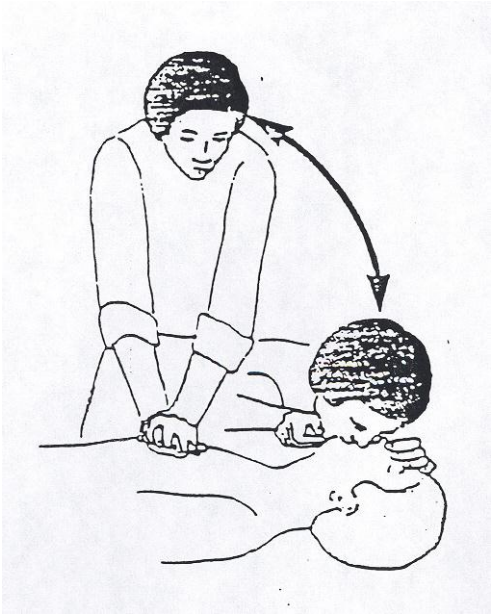
Compress at the rate of 80-100 compressions per minute. Count out loud, “one and, two and, etc.”

One Rescuer CPR

Start CPR immediately after determining there is no pulse (check for 5 seconds). Give 15 compressions at the rate specified above and then 2 quick, full breaths. After one minute check for a pulse and breathing again.

If still not breathing, but there is a pulse, administer mouth-to-mouth breathing (giving one breath every 5 seconds) and **DO NOT GIVE CHEST COMPRESSIONS**.

Remember: If the pulse returns, discontinue chest compressions.

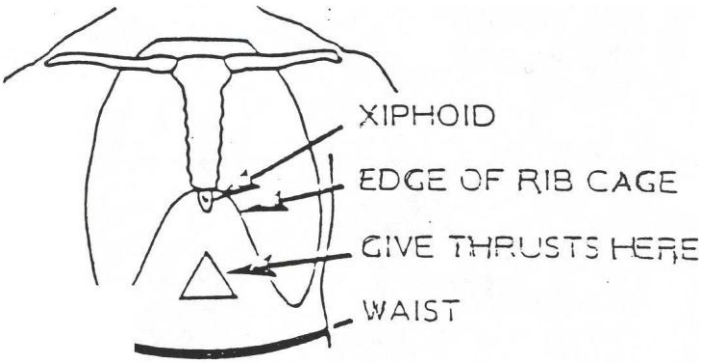


OBSTRUCTED AIRWAY FIRST AID

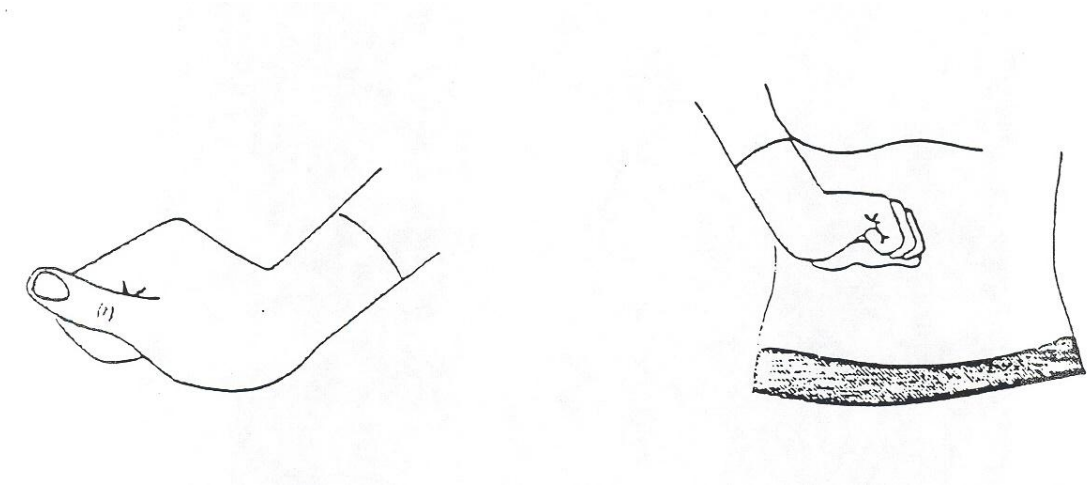
Conscious Victim

If the person can speak or is coughing, watch them carefully but do not try to remove an object from the airway. Encourage the victim to cough – this is more effective than anything you can do.

If someone is choking and *cannot breath, cough, or speak,* their airway is probably blocked. Give abdominal thrusts in the midline of the abdomen, between the waist and the bottom edge of the rib cage.



To give thrusts, put the side of your fist against the midline of the abdomen.

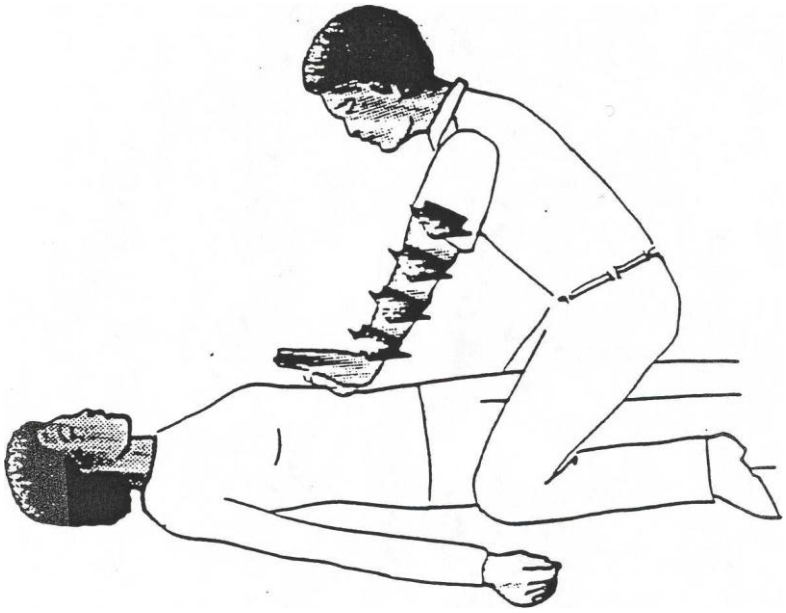


Grasp your fist with your other hand and press into victim's abdomen with a *quick, inward and upward* thrust. Repeat four times if needed.

Unconscious Victim

If, after doing the Airway Step, you determine that the victim is not breathing and when giving 4 breaths in the Quick Step, you see that the air is ***not*** going into the lungs, re-tip the head and try again. If you still cannot inflate the lungs, give the person abdominal thrusts.

Put the heel of one hand on the victim's midline at the abdomen, slightly above the navel and well below the top of xiphoid (see Conscious Victim discussion), then put your other hand on top of the first. Press inward and upward with 6-10 quick thrusts.



Look and see if you have dislodged the object, sweep deeply into the mouth along cheek with hooked finger and try again to inflate the lungs.

If the airway remains obstructed, continue the following sequence rapidly:

- Abdominal thrusts
- Finger sweep
- Attempt to ventilae

Appendix A

Fire Restrictions/Directives from USFS, BLM, COGCC

*Forthcoming as provided by agencies

Appendix B
COGCC Rules Section 600

606A. FIRE PREVENTION AND PROTECTION

a. Gasoline-fueled engines shall be shut down during fueling operations if the fuel tank is an integral part of the engine.

b. Handling, connecting and transfer operations involving liquefied petroleum gas (LPG) shall conform to the requirements of the State Oil Inspector.

c. Flammable liquids storage areas within any building or shed shall:

(1) be adequately vented to the outside air;

(2) have two (2) unobstructed exits leading from the building in different directions if the building is in excess of five hundred (500) square feet.

(3) be maintained with due regard to fire potential with respect to housekeeping and materials storage;

(4) be identified as a hazard and appropriate warning signs posted;

d. Flammable liquids shall not be stored within fifty (50) feet of the wellbore, except for the fuel in the tanks of operating equipment or supply for injection pumps. Where terrain and location configuration do not permit maintaining this distance, equivalent safety measures should be taken.

e. Liquefied petroleum gas (LPG) tanks larger than two hundred fifty (250) gallons and used for heating purposes, shall be placed as far as practical from and parallel to the adjacent side of the rig or wellbore as terrain and location configuration permit. Installation shall be consistent with provisions of NFPA 58, “Standards for the Storage and Handling of Liquid Petroleum Gases”.

f. Smoking shall be prohibited at or in the vicinity of operations which constitute a fire hazard and such locations shall be conspicuously posted with a sign, “No Smoking or Open Flame”. Matches and all smoking equipment may not be carried into “No Smoking” areas.

g. No source of ignition shall be permitted in an area where smoking has been prohibited unless it is first determined to be safe to do so by the supervisor in charge or his designated representative.

h. Open fires, transformers, or other sources of ignition shall be permitted only in designated areas located at a safe distance from the wellhead or flammable liquid storage areas. 600-10 As of March 30, 2009

i. Only approved heaters for Class I Division 2 areas, as designated by API RB 500B, shall be permitted on or near the rig floor. The safety features of these heaters shall not be altered.

j. Combustible materials such as oily rags and waste shall be stored in covered metal containers.

k. Material used for cleaning shall have a flash point of not less than one hundred (100° F) degrees Fahrenheit. For limited special purposes, a lower flash point cleaner may be used when it is specifically required and should be handled with extreme care.

l. Firefighting equipment shall not be tampered with and shall not be removed for other than fire protection and firefighting purposes and services. A firefighting water system may be used for wash down and other utility purposes so long as its firefighting capability is not compromised. After use, water systems must be properly drained or properly protected from freezing.

m. An adequate amount of fire extinguishers and other firefighting equipment shall be suitably located, readily accessible, and plainly labeled as to their type and method of operation.

n. Fire protection equipment shall be periodically inspected and maintained in good operating condition at all times.

o. Firefighting equipment shall be readily available near all welding operations. When welding, cutting or other hot work is performed in locations where other than a minor fire might develop, a person shall be designated as a fire watch. The area surrounding the work shall be inspected at least one (1) hour after the hot work is completed.

p. Portable fire extinguishers shall be tagged showing the date of last inspection, maintenance or recharge. Inspection and maintenance procedures shall comply with the latest edition of the National Fire Protection Association's publication NFPA 10.

q. Personnel shall be familiarized with the location of fire control equipment such as drilling fluid guns, water hoses and fire extinguishers and trained in the use of such equipment. They shall also be familiar with the procedure for requesting emergency assistance as terrain and location configuration permit. Installation shall be consistent with provisions of NFPA 58, “Standards for the Storage and Handling of Liquefied Petroleum Gases”.

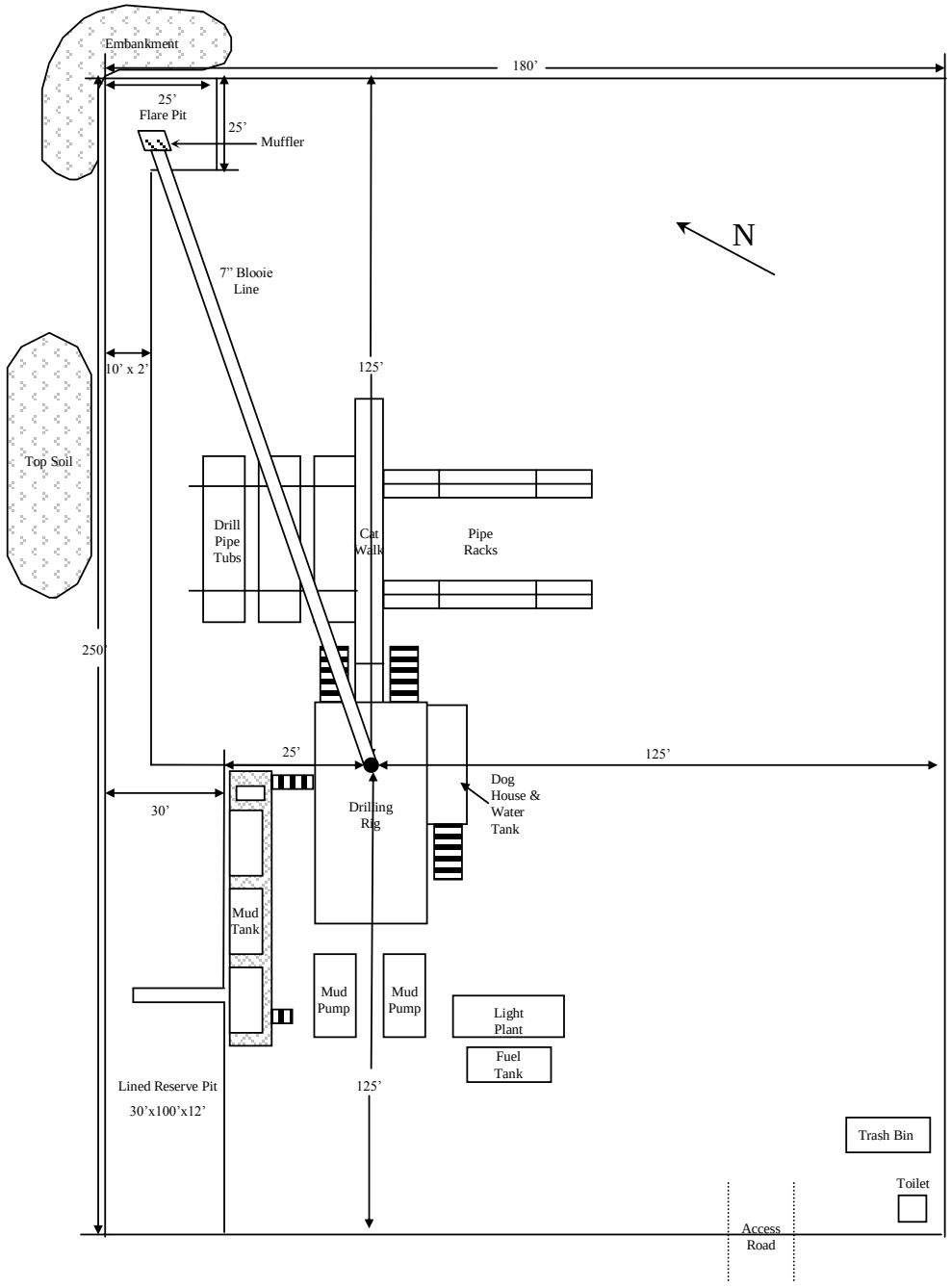
Appendix C

Typical Drill Pad Layouts

Standard & Closed Loop

Typical Standard

Drill Pad Layout

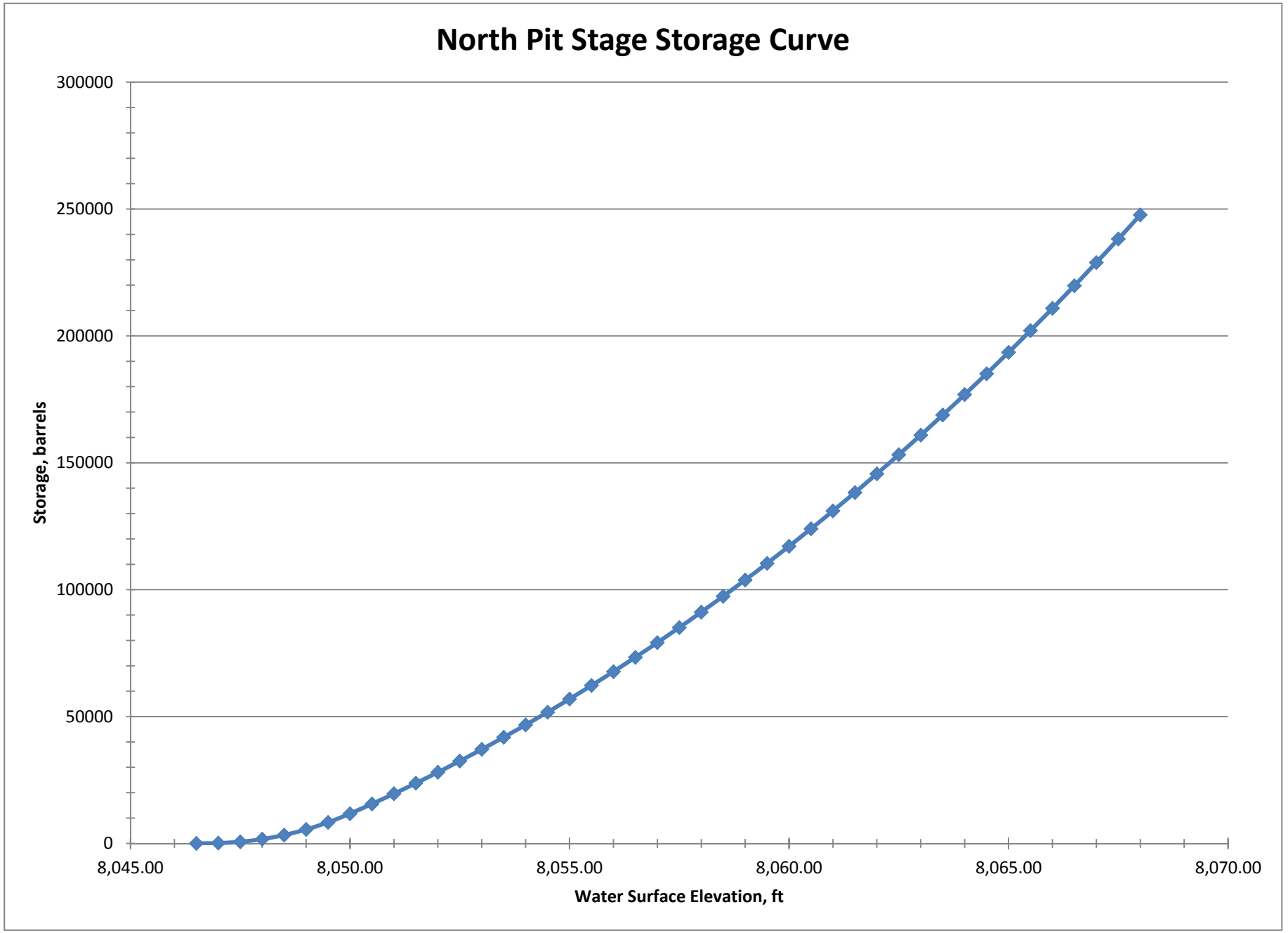


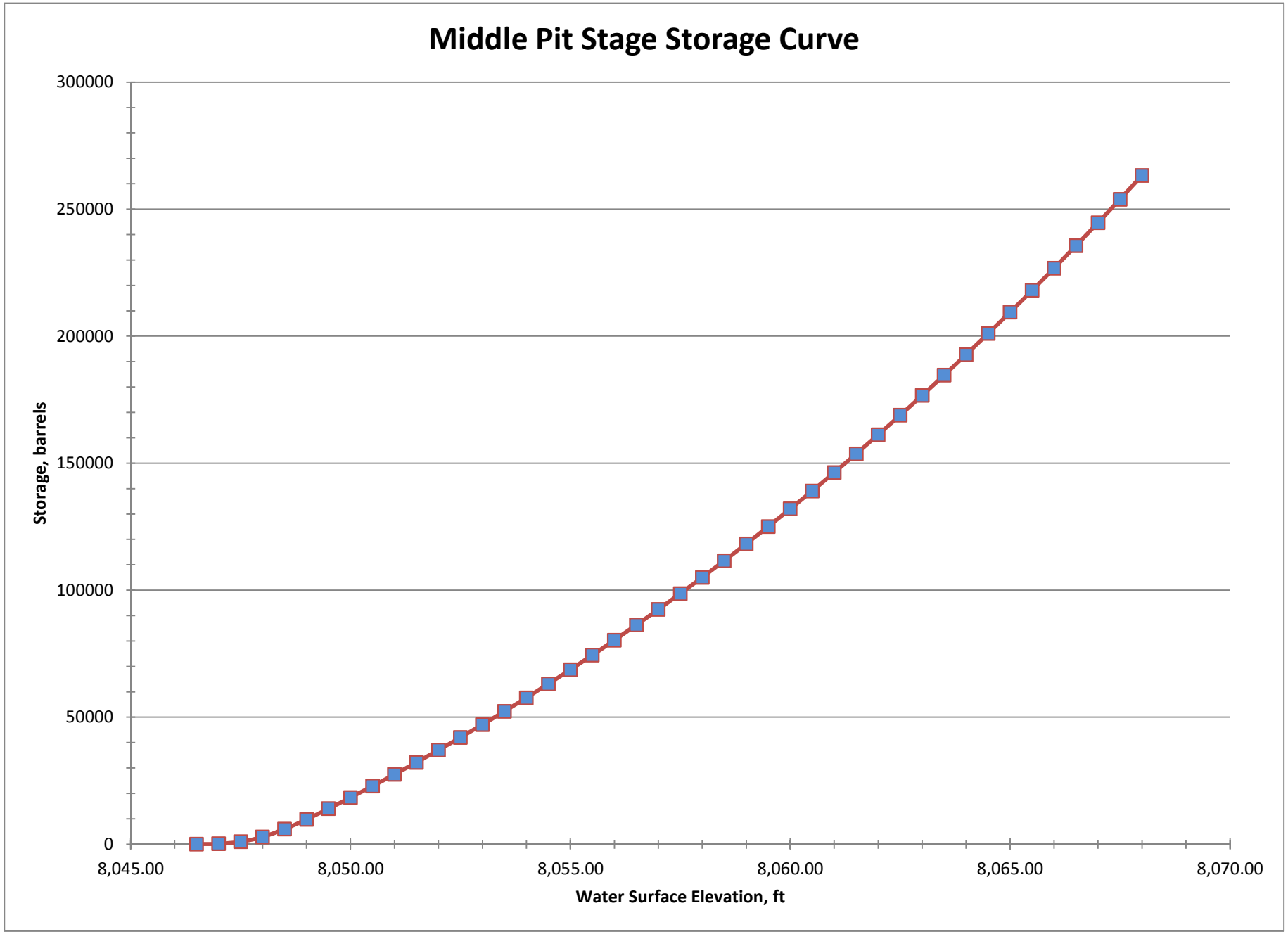
Drawing Not to Scale

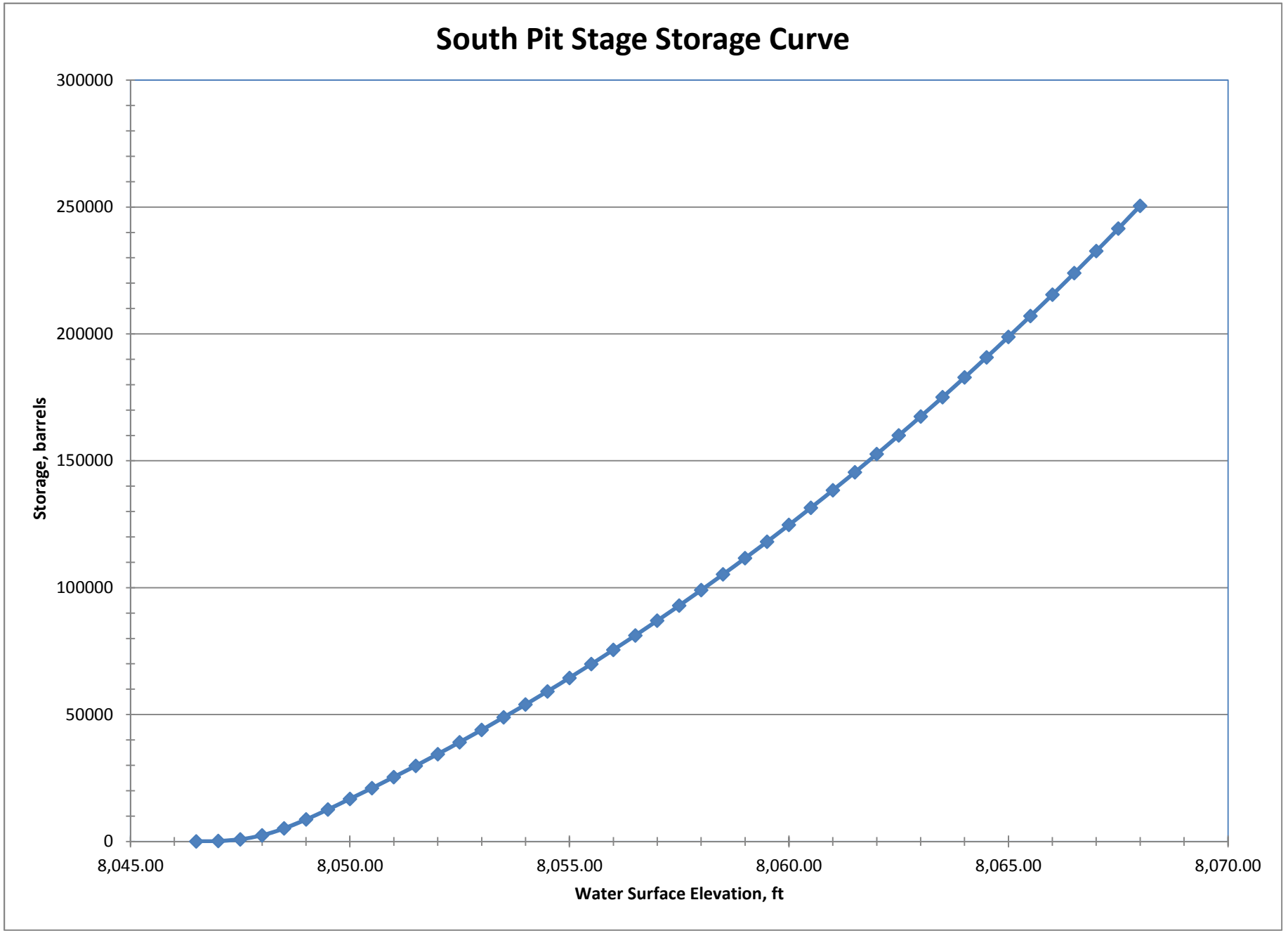
Appendix D
Spill Reporting Forms

Appendix G

Stage Storage Curves


North Pit Stage Storage Curve
300000
250000
200000
150000
100000
50000
0
Storage, barrels
8,045.00
8,050.00
8,055.00
8,060.00
8,065.00
8,070.00
Water Surface Elevation, ft

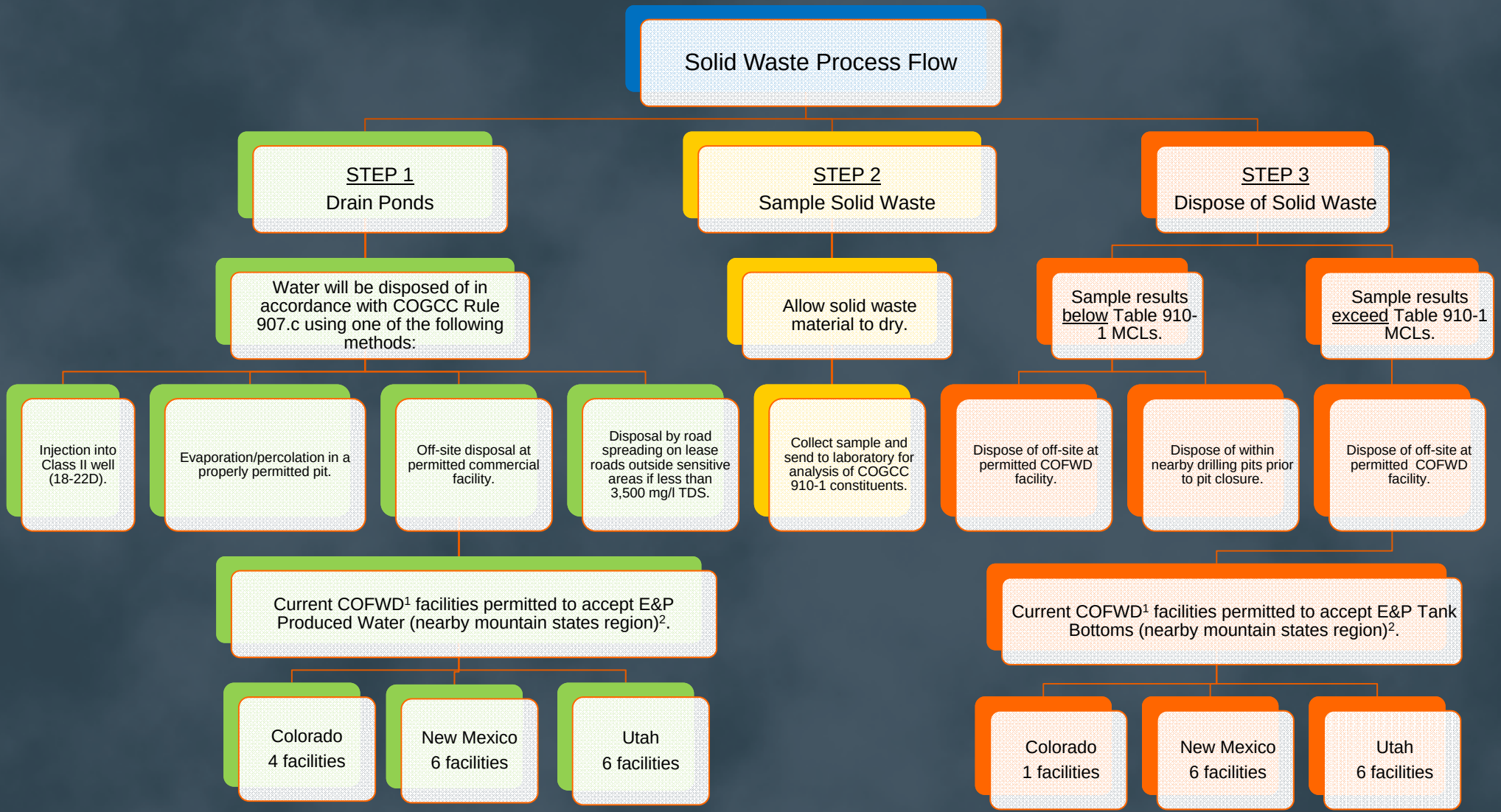

Middle Pit Stage Storage Curve
300000
250000
200000
150000
100000
50000
0
Storage, barrels
8,045.00
8,050.00
8,055.00
8,060.00
8,065.00
8,070.00
Water Surface Elevation, ft


South Pit Stage Storage Curve
300000
250000
200000
150000
100000
50000
0
Storage, barrels
8,045.00
8,050.00
8,055.00
8,060.00
8,065.00
8,070.00
Water Surface Elevation, ft

Appendix H

Pit Bottoms Sediment Flowchart

Pit Closure/Maintenance



[1] Commercial Oil-Field Waste Disposal (COFWD)

[2] Puder, M.G. and Veil, J.A., 2006, "Offsite Commercial Disposal of Oil and Gas Exploration and Production Waste: Availability, Options, and Costs," prepared for U.S. Department of Energy's Office of Fossil Energy and National Energy Technology Laboratory, prepared by Argonne National Laboratory Environmental Science Division(, Available at: http://www.evs.anl.gov/pub/doc/ANL-EVS-R-06-5.pdf).

Appendix I

Closure Reclamation Plan

1 Interim Reclamation

Interim reclamation work will begin as soon as practicable throughout phases of construction and will be fully implemented at the completion of construction of the facility. Areas disturbed during construction including cut and fill slopes, access roads, and equipment lay-down areas will be graded to eliminate abrupt angular or linear transitions and tracked to prevent erosion. Where required to establish seed growth during re-vegetation of bare soil, topsoil will be placed over the finished grade.

The topsoil will be seeded and mulched using methods suitable for proper germination and establishment. For example, on slopes that are greater than three percent, the seed bed will be imprinted by methods including drilled holes, tracking, or furrows to improve seed and moisture retention. The seed mix will be the Gunnison Energy mix given in the SWMP.

Temporary stormwater controls; such as armored drains, sediment ponds, straw wattles, and/or silt fence will be placed at the appropriate locations around the job site to prevent erosion and sediment transport. Soil from the pit excavation stockpiled as a access pad for the pits will have side slopes prepared and seeded and the top of the access pad will be treated as a road surface. This stockpile will preserve the soils for use in final closure and reclamation of the pits.

The reclamation work will be inspected every 14 days until such time as the vegetative cover is established sufficiently to prevent erosion. After vegetative cover establishment has occurred, stormwater inspections will continue monthly until the site has stabilized. Periodic stormwater, erosion and noxious weed inspections will take place over the life of the facility.

2 Pit Closure

The proposed Produced Water Management Facility will be in operation at this location for the productive life of the nearby production wells or until Gunnison Energy LLC (GE) determines that the facility is no longer necessary or until the facility becomes incapable of supporting operations. GE anticipates the useful operational life of the proposed facility to be 20 years.

The facility will undergo final reclamation within six months following cessation of permanent operations. Final closure will include removal of all mechanical and electrical equipment, removal and disposal of synthetic liners, filling and grading of the pits, and final reclamation.

Closure Sequence

Following cessation of permanent operations of the facility and upon decommissioning of the pits, the facility will be closed and reclaimed as outlined below:

- Stormwater and erosion control Best Management Practices (BMPs) will be installed prior to closure construction activities (per the NPDES general construction permit) and will remain in place until final stabilization occurs. The site will be monitored until final stabilization as described in Section 1.

- Water remaining in the pits and transmission piping will be removed and disposed of in accordance with the COGCC 900 Series rules;

- All equipment, structures, appurtenances and fencing will be disassembled and or demolished and removed from the site;

- Pit sediment will be removed and stockpiled for drying, testing, characterization and final disposal determination;

- The containment liners will be removed and recycled or otherwise disposed of at a permitted waste facility;

- The aggregate surfacing materials from access roads will be removed, stockpiled at an appropriate location, and re-used as surfacing material elsewhere or mixed with fill soil;

- Compacted soils will ripped and re-graded to the approximate pre-construction grades;

- After the pit liners have been removed, the compacted surfaces will be ripped to loosen the soil and to mix subgrade materials. The pit depressions will then be backfilled with stockpiled soil and soil the earth berms surrounding the pits. The backfill will occur in lifts that allow proper moistening and compaction, up to the pre-excavation grade.

- Topsoil that was stockpiled from initial excavation will be distributed across the pit area and seeded as described in Section 1;

All transmission piping to be decommissioned and demolished will be disconnected and tested prior to proper disposal or recycling at a permitted facility.

Any lubricants or other maintenance chemicals stored onsite will be relocated for other facility use, properly disposed, or recycled according to federal, state and local regulations.

Equipment and support structures will be hauled offsite for reuse elsewhere, or otherwise properly disposed of according to federal, state, and local regulations.

Following removal of the synthetic liner system, the underlying soil will be tested for the presence or absence of regulated contaminants. If testing indicates chemical contamination, the affected soil will be excavated, stockpiled, tested, and; either properly disposed of or treated onsite and reused as fill material.

Aggregate surfacing material will be removed and stockpiled for reuse or mixed with fill soil. The earthen containment berms will be bulldozed and stockpiled for use as fill material and the rest of the site will be ripped and de-compacted. Stockpiled and ripped soils will be redistributed over the site during reclamation activities.

Following demolition and de-compaction, the site will be graded to match original pre-construction grades and contours. Topsoil would then be evenly spread over the disturbed area and seeded with a native seed mix for final stabilization. Stormwater and erosion control BMPs will be implemented accordingly to reduce and control the volume of runoff as well as to prevent and sediment transport offsite during reclamation activities. All stormwater and erosion control BMPs will remain in place, as appropriate, until the site reaches final stabilization.

To verify compliance with WQCC standards, following facility closure groundwater samples will be collected from site monitoring wells within one mile of the site. Samples will also be collected from any nearby surface water bodies present at the time of closure.

Per COGCC 900 Rules, a Site Investigation and Remediation Workplan, Form 27, will be provided to the Director for approval at least sixty (60) days prior to closure. If it is determined that soils and or surface and ground water were detrimentally impacted by the facility, and the necessary remediation efforts will be implemented immediately. Implementation details for site remediation and emergency response procedures and contacts are included in the preliminary Operating Plan which is appended to this application as Appendix E.

3 Final Reclamation

Following the removal of all structures, appurtenances, equipment, and materials described above, final reclamation activities will be initiated. All final site reclamation activities will be conducted in accordance with COGCC 1000 Series Rules and Gunnison County Standards as well as any other state and local agency requirements. The site will be graded as near as possible to original contours following the ripping and de-compaction and any remaining stockpile will be evenly distributed over the disturbed area. Grading will match

pre-construction contours as close as practicable and or to contours desired for the future land use. The area will be seeded with native or adapted vegetation using an appropriate distribution method to that will provide proper establishment and soil stabilization.

The goal of the final site reclamation is to return the disturbed area to as close to pre-disturbance conditions as practical. Following all site reclamation activities, the site will be monitored for erosion caused by the elements as well as any weeds or uncharacteristic vegetation growth until the site reaches final stabilization levels.

Estimate of Probable Final Closure and Reclamation Cost
Gunnison Energy LLC
Spadafora Water Storage Facility
Estimate of Probable Pit Closure Cost

Table F-1. Pit Closure/Reclamation Estimate of Probable Cost

Item	Description	Quantity	Unit of Measure	Unit Cost	Amount
A.	**Construction Contractor Costs**				
1	Mobilization/Demobilization	2	Lump Sum	$16,900	$ 33,800
2	Remove & Dispose Pond Fluids	548,213	Gallons	$ 0.03	$15,400
3	Remove & Dispose Operating Equipment	40	Hours	$252.5	$ 10,100
4	Remove & Dispose Pond Liners	1,095,201	Square feet	$0.21	$228,200
5	Test Soils for Contamination	30	Borings	450.00	$13,500
6	Backfill & Compact Pits	432,295	Cubic yards	$4.94	$2,135,900
7	Site Restoration (Grading/Seeding)	20	Acres	$3,392.86	$66,500
8	Site Management	10	months	$11,560	$115,600
Subtotal - Construction					***$2,619,000***
B.	**Administrative and Engineering Costs**				
1	**Project Management Fee (5% of construction)**				**$130,950**
2	**Workplans, Engineering Design, and Bid Documents (15% of Construction)**				**$392,850**
3	**Contingency (20% of Construction Costs)**				**$523,800**
Total Estimate of Probable Closure Cost					**$3,666,600**

Notes:

1 Pond disposal assumes 90% of fluids are pumped to a future injection well. The remaining 10% is hauled.
2 Pond liners include two 60-mil HDPE and one geonet layer at 365,067 sf each
3 Restoration includes the fenced area at 750-ft x750-ft.
4 Assumes 548,213 gallons for fluids
5 Unit Costs have been rounded

The cost estimate is based on the following data, information, and assumptions:

- General Approach: The costs were developed based upon estimating the direct cost of labor, equipment, materials, and subcontractors and applied to quantity take-offs. Costs are based on calendar year 2010. Allowances for escalation due to economic factors are applied at two (2) percent per year.

- Labor Rates: Applicable labor rates are based on the Colorado Wage Decision per the U.S. Department of Labor for Gunnison County "Heavy Construction" effective September 2014. These rates include the base pay and fringe benefits. Allowances were added to the labor rates to for FICA/Medicare (7.65%), Workman's Compensation Insurance (12.85%), and contractor's liability insurance (1.5%).

- Equipment Rates: The equipment rates were developed from Equipment Watch Custom Cost Evaluator and include fuel, lubrications, and non-labor operating costs. Fuel cost is estimated at $3.34 per gallon.

- Where provided, production rates for pit liner removal, soil backfill, and site restoration are based on the R.S. Means Heavy Construction Cost Data (17th Edition). Pit liner removal is assumed to occur at the same production rate as installation.

- Mobilization/Demobilization Costs: Mobilization and demobilization travel is assumed to be to and from Denver, Colorado.

- Disposal Costs: All disposal costs are assumed to include transportation and tipping fees based on a permitted facility near Denver, Colorado.

- Pre-closure operation of the pits will divert fluids from the pits such that at the time of closure 2% of the fluids will be remaining.

- Miscellaneous Unit Costs: Miscellaneous unit costs were obtained from R.S. Means New Mexico Heavy Construction Cost Data.

- Soil Material Swell: Volumes of bank cut soil were increased by 20 percent to account for bulking or swell.

- Site Management: Site Management was estimated separately to support construction for the duration of the

closure/restoration work. Labor includes a full-time superintendent, construction clerk, field engineer, quality control engineer, laborer, and heavy equipment mechanic. Support equipment includes a four wheel drive crew-cab pickup, water truck, motor grader, and mechanics truck with portable welder. Support facilities include an office trailer, portable toilets, fueling area, and erosion control supplies.

- Re-vegetation Unit Costs: The revegetation unit cost is based on quotes in similar estimates provided by Rocky Mountain Reclamation.

- Indirect Cost Allowances: Indirect cost allowances were applied to the construction contractor's direct costs as follows: Contingency (10.0%), Payment and Performance Bond (1.5%), and Contractor Profit and Overhead (15.0%). Contractor overhead includes home office salaried and clerical personal, shop and facilities, fees and Insurance (except those applicable to labor and equipment), training, and quality assurance/quality control.

- Administrative and Engineering Cost Allowances: Project Management Fee (5.0%), engineering for final reclamation work plans, design, and preparation of bid documents (15.0%).

- State and local taxes were excluded.

ATTACHMENT M
PERMIT APPLICATIONS AND NOTIFICATIONS

COLORADO
Division of Water Resources
Department of Natural Resources

Water Division 4 - Main Office
P.O. Box 456
Montrose, CO 81402

December 31, 2014

Lee Fyock, Vice President of Environmental Permitting
Gunnison Energy LLC
1801 Broadway, Suite 1200
Denver, CO 80202

Re: Notice of Intent to Construct a Non-Jurisdictional Dam: Spadafora Storm Water Detention-North Pit, Spadafora Storm Water Detention-South Pit, Spadafora Water Storage Facility -North Pit, Spadafora Water Storage Facility-South Pit, Spadafora Water Storage Facility-Middle Pit

Our office is in receipt of a *Notice of Intent to Construct a Non-Jurisdictional Water Impoundment Structure* (Notice) for the above referenced structures. We have completed our review of the Notices and have no objections or conditions to the structures as you have proposed.

The final constructed dam(s) must be non-jurisdictional in size as defined by the *State of Colorado's Rules and Regulations for Dam Safety and Dam Construction*.

Our office may perform periodic inspections of each dam after it is constructed to verify the structure was constructed per the approved Notice and to non-jurisdictional size. A copy of the accepted Notice is enclosed for your information and use. Your cooperation is appreciated. If you have any questions, please contact our office at (970) 249-6622.

Sincerely,

Bob W. Hurford, P.E.
Division Engineer

Enclosure

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES
303-866-3581

FOR OFFICE USE ONLY

DAM NAME _____ NO. _____ WATER DIV: 4 DIST: 40

NOTICE OF INTENT TO CONSTRUCT A NON-JURISDICTIONAL WATER IMPOUNDMENT STRUCTURE[1]

This notice is required per Section 37-87-125, C.R.S. (1998).

This notice must be submitted to the Division Engineer's Office a minimum of 45 days prior to construction.

(PLEASE PRINT OR TYPE NOTICE)

OWNER INFORMATION

Name: **Gunnison Energy LLC** Telephone: **(303) 296-4222**

Address: **1801 Broadway, Suite 1200** **Denver** **Colorado** **80202**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Responsible Person: **Lee Fyock, Vice President of Environmental Permitting** Telephone: **(303) 296-4222**

Address: **same as above**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Contractor: **Weston Solutions, Inc. (Design Contractor);** Telephone: **(303) 729-6100**
Construction Contractor to be determined

STRUCTURE INFORMATION

Name of Dam: **Spadafora Storm Water Detention-North Pit** Water Division: **4** Water District: **40**

Location[2]:
- Option 1
  OR
- Option 2 →

¼ / ¼ Sect: ____ ¼ of the ____ ¼, Sect: ___, Township: ___, Range: P.M.
Distance of dam from Section lines _____ ft from ☐N ☐S, _____ ft from ☐E ☐W

Utilizing GPS: Set to UTM Datum. Measured on crest of dam above streamline/outlet.
N39 05' 37.92" W107 28' 09.49"
Note: GPS settings must be NAD83 CONUS (NAD83 Zone 13N used).

Dam Dimensions: Vertical Height[3]: 5.63 max., Length: 331 **LF,** ft., Slopes: U/S: **3** H:1V, D/S **3** H:1V
Reservoir: Surface Area[1]:0.29 acres, Capacity[1]:0.87 acre feet, Drainage Area: **3** acres

AEmergency Spillway: Width: **6** ft., Side Slopes: **3:1** H:1V, Freeboard[4]: **1** ft

Outlet Drain: Type: **PVC Stand Pipe**, Size: **6** inches, Location: **near emergency spillway**

Stream Name or Water Source[5]: **stormwater**

Proposed Water Use: **stormwater detention** Water Court Case No. (If applicable) **n/a**

Lee Fyock 10/16/14
Signature of Owner Date

DIVISION ENGINEER'S REQUIREMENTS: _____

Brian Sanford 12/30/14
Signature of Division Engineer Date

DWR (03/07)

[1] A "Non-Jurisdictional Structure" is a dam creating a reservoir with a capacity of 100 acre-feet or less *and* a surface area of 20 acres or less *and* a vertical height (see footnote 3) of 10 feet or less.

[2] Please see example on reverse side (or page 2) of this form.

[3] "Vertical Height" is measured from the elevation of the lowest point of the natural surface of the ground where that point occurs along the longitudinal centerline of the dam up to the crest of the emergency spillway of the dam.

[4] "Freeboard" is the vertical distance from the bottom of spillway to the crest of the dam.

[5] If construction in reservoir intercepts groundwater, a well permit is required. (Well permit applications can be found at www.water.state.co.us/pubs/forms.asp)

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES
303-866-3581

FOR OFFICE USE ONLY

DAM NAME _____ NO. _____ WATER DIV: 4 DIST: 40

NOTICE OF INTENT TO CONSTRUCT A NON-JURISDICTIONAL WATER IMPOUNDMENT STRUCTURE[1]

This notice is required per Section 37-87-125, C.R.S. (1998).

This notice must be submitted to the Division Engineer's Office a minimum of 45 days prior to construction.

(PLEASE PRINT OR TYPE NOTICE)

OWNER INFORMATION

Name: **Gunnison Energy LLC** Telephone: **(303) 296-4222**

Address: **1801 Broadway, Suite 1200** **Denver** **Colorado** **80202**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Responsible Person: **Lee Fyock, Vice President of Environmental Permitting** Telephone: **(303) 296-4222**

Address: **same as above**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Contractor: **Weston Solutions, Inc. (Design Contractor);** Telephone: **(303) 729-6100**
Construction Contractor to be determined

STRUCTURE INFORMATION

Name of Dam: **Spadafora Storm Water Detention-South Pit** Water Division: **4** Water District: **40**

Location[2]:
- Option 1 / *OR*
- Option 2 →

¼ / ¼ Sect: ____ ¼ of the ____ ¼, Sect: ___, Township: ___, Range: P.M.
Distance of dam from Section lines _____ ft from ☐N ☐S, _____ ft from ☐E ☐W

Utilizing GPS: Set to UTM Datum. Measured on crest of dam above streamline/outlet.
N39 05' 27.46" W107 28' 08.52"
Note: GPS settings must be NAD83 CONUS (NAD83 Zone 13N used).

Dam Dimensions: Vertical Height[3]: 7.37' max., Length: 303 **LF,** ft., Slopes: U/S: **3** H:1V, D/S **3** H:1V
Reservoir: Surface Area[1]:**0.27** acres, Capacity[1]:0.84 acre feet, Drainage Area: **3** acres

AEmergency Spillway: Width 6_ ft., Side Slopes: **1:2** H:1V, Freeboard[4]: **1** ft

Outlet Drain: Type: **PVC**, Size: **6** inches, Location: **near emergency spillway**

Stream Name or Water Source[5]: **Storm water**

Proposed Water Use: **Stormwater Detention** Water Court Case No. (If applicable) **n/a**

Signature of Owner — Date: 10/16/14

DIVISION ENGINEER'S REQUIREMENTS: _____

Signature of Division Engineer — Date: 12/30/14

DWR (03/07)

[1] A "Non-Jurisdictional Structure" is a dam creating a reservoir with a capacity of 100 acre-feet or less *and* a surface area of 20 acres or less *and* a vertical height (see footnote 3) of 10 feet or less.

[2] Please see example on reverse side (or page 2) of this form.

[3] "Vertical Height" is measured from the elevation of the lowest point of the natural surface of the ground where that point occurs along the longitudinal centerline of the dam up to the crest of the emergency spillway of the dam.

[4] "Freeboard" is the vertical distance from the bottom of spillway to the crest of the dam.

[5] If construction in reservoir intercepts groundwater, a well permit is required. (Well permit applications can be found at www.water.state.co.us/pubs/forms.asp)

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES
303-866-3581

FOR OFFICE USE ONLY

DAM NAME _____ NO. _____ WATER DIV: 4 DIST: 40

NOTICE OF INTENT TO CONSTRUCT A NON-JURISDICTIONAL WATER IMPOUNDMENT STRUCTURE[1]

This notice is required per Section 37-87-125, C.R.S. (1998).

This notice must be submitted to the Division Engineer's Office a minimum of 45 days prior to construction.

(PLEASE PRINT OR TYPE NOTICE)

OWNER INFORMATION

Name: **Gunnison Energy LLC** Telephone: **(303) 296-4222**

Address: **1801 Broadway, Suite 1200** **Denver** **Colorado** **80202**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Responsible Person: **Lee Fyock, Vice President of Environmental Permitting** Telephone: **(303) 296-4222**

Address: **same as above**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Contractor: **Weston Solutions, Inc. (Design Contractor);** Telephone: **(303) 729-6100**
Construction Contractor to be determined

STRUCTURE INFORMATION

Name of Dam: **Spadafora Water Storage Facility-North Pit** Water Division: **4** Water District: **40**

Location[2]:
- Option 1
  OR
- Option 2 →

¼ / ¼ Sect: ____ ¼ of the ____ ¼; Sect: ___, Township: ___, Range: P.M.
Distance of dam from Section lines _____ ft from ☐N ☐S, _____ ft from ☐E ☐W

Utilizing GPS: Set to UTM Datum. Measured on crest of dam above streamline/outlet.
N39 05' 38.09" W107 28' 04.98".
Note: GPS settings must be NAD83 CONUS (NAD83 Zone 13N used).

Dam Dimensions: Vertical Height[3]: 9.76' max., Length: **950 LF,** ft., Slopes: U/S: **3** H:1V, D/S **3** H:1V
Reservoir: Surface Area[1]: **2.32** acres, Capacity[1]: **27.2** acre feet, Drainage Area: **NA** acres

Emergency Spillway: Width: **see Attachment 1** ft., Side Slopes: **3:1** H:1V, Freeboard[4]: **2** ft

Outlet Drain: Type: **not required**, Size: **n/a** inches, Location: **n/a**

Stream Name or Water Source[5]: **produced water from oil and gas exploration activities**

Proposed Water Use: **beneficial reuse and disposal** Water Court Case No. (If applicable) **n/a**

C. Fyock 10/16/14
Signature of Owner Date

DIVISION ENGINEER'S REQUIREMENTS: _____

Robert Hafford 12/30/14
Signature of Division Engineer Date

DWR (03/07)

[1] A "Non-Jurisdictional Structure" is a dam creating a reservoir with a capacity of 100 acre-feet or less *and* a surface area of 20 acres or less *and* a vertical height (see footnote 3) of 10 feet or less.

[2] Please see example on reverse side (or page 2) of this form.

[3] "Vertical Height" is measured from the elevation of the lowest point of the natural surface of the ground where that point occurs along the longitudinal centerline of the dam up to the crest of the emergency spillway of the dam.

[4] "Freeboard" is the vertical distance from the bottom of spillway to the crest of the dam.

[5] If construction in reservoir intercepts groundwater, a well permit is required. (Well permit applications can be found at www.water.state.co.us/pubs/forms.asp)

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES
303-866-3581

FOR OFFICE USE ONLY

DAM NAME _____ NO. _____ WATER DIV: _____ DIST: _____

NOTICE OF INTENT TO CONSTRUCT A NON-JURISDICTIONAL WATER IMPOUNDMENT STRUCTURE[1]

This notice is required per Section 37-87-125, C.R.S. (1998).

This notice must be submitted to the Division Engineer's Office a minimum of 45 days prior to construction.

(PLEASE PRINT OR TYPE NOTICE)

OWNER INFORMATION

Name: **Gunnison Energy LLC** Telephone: **(303) 296-4222**

Address: **1801 Broadway, Suite 1200** **Denver** **Colorado** **80202**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Responsible Person: **Lee Fyock, Vice President of Environmental Permitting** Telephone: **(303) 296-4222**

Address: **same as above**
Street / P.O. Box/ Rural Route | City | State | Zip Code

Contractor: **Weston Solutions, Inc. (Design Contractor);** Telephone: **(303) 729-6100**
Construction Contractor to be determined

STRUCTURE INFORMATION

Name of Dam: **Spadafora Water Storage Facility-South Pit** Water Division: **4** Water District: **40**

Location[2]:
- Option 1: ¼ / ¼ Sect: ____ ¼ of the ____ ¼ Sect: ___, Township: ___, Range: P.M.
  Distance of dam from Section lines _____ ft from ☐N ☐S, _____ ft from ☐E ☐W
  OR
- Option 2: Utilizing GPS: Set to UTM Datum. Measured on crest of dam above streamline/outlet.
  N39 05' 29.72" W107 28' 07.55"
  Note: GPS settings must be NAD83 CONUS (NAD83 Zone 13N used).

Dam Dimensions: Vertical Height[3]: 9.76' max., Length: **920 LF,** ft., Slopes: U/S: **3** H:1V, D/S **3** H:1V
Reservoir: Surface Area[1]: **2.21** acres, Capacity[1]: **27.7** acre feet, Drainage Area: **NA** acres

Emergency Spillway: Width: **see Attachment 1** ft., Side Slopes: **n/a** H:1V, Freeboard[4]: **2** ft

Outlet Drain: Type: **not required**, Size: **n/a** inches, Location: **n/a**

Stream Name or Water Source[5]: **produced water from oil and gas exploration activities**

Proposed Water Use: **beneficial reuse and disposal** Water Court Case No. (If applicable) **n/a**

C.F. Fyock 10/16/14
Signature of Owner Date

DIVISION ENGINEER'S REQUIREMENTS: _____

Byron Ford 12/30/14
Signature of Division Engineer Date

DWR (03/07)

[1] A "Non-Jurisdictional Structure" is a dam creating a reservoir with a capacity of 100 acre-feet or less *and* a surface area of 20 acres or less *and* a vertical height (see footnote 3) of 10 feet or less.

[2] Please see example on reverse side (or page 2) of this form.

[3] "Vertical Height" is measured from the elevation of the lowest point of the natural surface of the ground where that point occurs along the longitudinal centerline of the dam up to the crest of the emergency spillway of the dam.

[4] "Freeboard" is the vertical distance from the bottom of spillway to the crest of the dam.

[5] If construction in reservoir intercepts groundwater, a well permit is required. (Well permit applications can be found at www.water.state.co.us/pubs/forms.asp)

GUNNISON ENERGY LLC
AN OXBOW COMPANY

September 3, 2014

Ms. Kathryn Dolan
Colorado Department of Public Health and Environment
WQCD-P-B2
4300 Cherry Creek Drive South
Denver, CO 80246-1430

RE: Amendment to Stormwater discharge Permit No.COR-035658 to Construct the Spadafora Water Storage Facility

Dear Ms. Dolan:

Gunnison Energy LLC (GE) requests amending the Stormwater Discharge Permit No. COR-035658 – Sheep Creek Gathering System to include the construction of the Spadafora Water Storage Facility in Section 17 and Section 20, Township 11 South, Range 90 West, Gunnison County.

The receiving waters would be West Muddy Creek located approximately 2.7 miles south of the proposed construction site. Construction is expected to start on or near May 1, 2015 and will continue through September 2016. Disturbance estimate for the facility is approximately 19 acres for the water storage pits. Reclamation will commence immediately upon completion of the facility.

If you have any questions concerning the project please contact me at 303-296-4222.

Sincerely,

Lee Fyock
Vice President

STATE OF COLORADO

Bill Ritter, Jr., Governor
James B. Martin, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

http://www.cdphe.state.co.us

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

Colorado Department
of Public Health
and Environment

June 20, 2007

Brad Robinson, Vice President
Gunnison Energy Corporation,
1801 Broadway Ste. 1200
Denver, CO 80202
303/296-4222

RE: Final Permit, Colorado Discharge Permit System – Stormwater
Certification No: COR-035658
Sheep Gas Gathering System
Gunnison ~~Delta~~ County
Local Contact: neal allen ~~Mark McCallister,~~ Manager, Operations
303/ 296-4222

Dear Sir or Madam:

Enclosed please find a copy of the new permit and certification which have been re-issued to you under the Colorado Water Quality Control Act.

Your old permit expires on June 30, 2007. This is a renewal to the permit, and replaces the old one. See page 2 of the Rationale (the pages in italics) for a summary of the changes to the permit.

Your Certification under the permit requires that specific actions be performed at designated times. You are legally obligated to comply with all terms and conditions of the permit.

Please read the permit and certification. If you have any questions please visit our website at : www.cdphe.state.co.us/wq/permitsunit/stormwater or contact Matt Czahor at (303) 692-3517.

Sincerely,

Kathryn Dolan
Stormwater Program Coordinator
Permits Unit
WATER QUALITY CONTROL DIVISION
xc: Regional Council of Governments
Local County Health Department
District Engineer, Technical Services, WQCD
Permit File

STATE OF COLORADO

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
WATER QUALITY CONTROL DIVISION
TELEPHONE: (303) 692-3500

CERTIFICATION TO DISCHARGE
UNDER
CDPS GENERAL PERMIT COR-030000
STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION

Certification Number **COR035658**

This Certification to Discharge specifically authorizes:

Gunnison Energy Corporation

LEGAL CONTACT:
Brad Robinson, Vice President

Gunnison Energy Corporation
1801 Broadway Ste. 1200
Denver, CO 80202
Phone # 303/296-4222

LOCAL CONTACT: Dan McWilliams
~~***Mark McCallister, Manager,***~~
Operations,
Phone # ~~303/296-4222~~
970-874-4333

During the Construction Activity: **Gas/Oil Field Exploration and/or Development**
to discharge stormwater from the facility identified as **Sheep Gas Gathering System**
which is located at:

FR 125 & FR 127
Various, Co

Latitude ~~**39/00/40,**~~ Longitude ~~**107/50/22**~~
In ~~**Delta County**~~ Gunnison County
to: Sheep Creek -- Colorado River

Anticipated Activity begins **09/15/2003** continuing through **11/30/2003**
On **30.13** acres (**30.13** acres disturbed)

Certification is effective: **07/01/2007** Certification Expires: **06/30/2012**

Annual Fee: $245.00 (**DO NOT PAY NOW** – A prorated bill will be sent shortly.)