



OXY USA WTP LP
A subsidiary of Occidental Petroleum Corporation

760 Horizon Drive, Suite 101
Grand Junction, CO 81506

OXY USA WTP LP

DRILL CUTTINGS MATERIALS MANAGEMENT PLAN

**MESA CUTTINGS DISPOSAL AREA
FOR DRILL CUTTINGS GENERATED AT
OXY's 697-04D, 608-41, 608-43-31, 609-33,
697-16-28, and 697-05C PADS**

MAY 2011

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Figure 1 Location Map Aerial

Figure 2 Location Map Topo

Figure 3 Cutting Reclamation Area

Attachment A Analytical Data

Attachment B Hydrology/Geology Report (Prepared by Olsson Associates)

Attachment C Drainage Report (Prepared by Olsson Associates)

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Materials Management Plan Overview

OXY USA WTP LP (Oxy) developed this Materials Management Plan (MMP) to address storage, management, and disposal of drill cuttings at the Mesa Cuttings Disposal Area (MCDA). The MCDA is located at a previously disturbed area where Oxy owns both the surface and minerals (see Figure 1, Location Map). Oxy is requesting review and approval of the proposed disposal area from the Colorado Oil and Gas Conservation Commission (COGCC). Oxy met with COGCC Staff on December 21, 2010 regarding this proposal and was directed to prepare a Form 2A and an MMP for the proposed disposal area. Also, based on follow-up discussions with the COGCC and changes to Oxy’s drilling operations, Oxy has made updated this plan. The MCDA is located within Oxy’s Cascade Creek operation area, specifically:

- SWNW, Section 9, Township 6 South, Range 97 West, 6th PM, Garfield County, Colorado (39.534710N, 108.224245W).

Drill Cuttings Generation

Oxy’s 2011 oil and gas development activities in the Piceance Basin consist of drilling at multiple mesa locations, including Oxy’s 697-04D, 608-41, 608-43-31, 609-33, 697-05C, and 697-16-28 pads which are located on Oxy surface and minerals. Oxy’s 2011 drilling plans were initially designed for drilling activities to occur first followed by completions activities. Revisions to the development plan requires drilling and completions operations to occur simultaneously at these locations. Conducting both activities at the same time is commonly referred to as SimOps. Pad space normally used to store cuttings for disposal would now be used for SimOps. In order to accommodate SimOps without increasing the pad size, Oxy is proposing to permanently dispose drill cuttings generated from the above-mentioned pads at the proposed MCDA cuttings area to ensure that all activities are completed safely.

Oxy has/or proposes to drill the multiple wells from the following pads:

Drilling Location	Number of Wells	Approximate Drilling and/or SimOps Timeframe
608-43-31	17	Nov 2010 – March 2011
608-41	20	March – Jul 2011
609-33	22	April – Aug 2011
697-04D	21	Oct 2011 – Feb 2012
697-05C	22	Sept 2011 – Jan 2012
697-16-28	9	Aug – Sept 2011

Oxy anticipates that on average, approximately 330 cubic yards per well, using a conservative 50 percent swelling factor. Oxy will update the COGCC regarding the approximate volume amount that the newly implemented closed loop system is generating.

Oxy employs a skidable rig capable of drilling up to 24 wells from a single pad. Oxy’s drilling rig now utilizes a closed loop system for mud cycling and reuse. The rig air drills the surface hole and then air injected with mud for the production hole. As drill cuttings are returned to the surface they are deposited into a de-gasser. The de-gassing process allows the cuttings and mud to better separate in the next phase. The cuttings and mud are then sent to four rig shakers, which

drains out fluids and mud from the cuttings. The cuttings separated in this phase consist of a larger aggregate size and constitute the bulk of the cuttings to be stored off site. In addition to the rig shakers, the cuttings are also sent to four additional drying shakers, which removes another 20 percent of fluids from the cuttings. The separated fluids and mud collected are reused in the drilling process. Finer aggregate cuttings are then separated by sending the cuttings/mud mixture to a settling tank (mud trap), from which the cuttings are then sent to two centrifuges to remove low gravity solids (cuttings). These low gravity solids will also be hauled off site for storage and disposal. Any low gravity solids containing cement will be diverted to tanks for reuse or to an on-site reserve pit, when the cement can no longer be recycled. Contents sent to the on-site reserve pit will be tested in accordance with COGCC regulations and disposed of properly, prior to pit closure.

Drill Cuttings Sampling Procedures

In accordance with COGCC regulations for storage and permanent disposal, samples shall be collected throughout the drilling process to document that the cuttings meet the standards which have been established by COGCC. To accomplish this, Oxy will:

- **Background Samples:** Initially, three (3) background samples were collected from undisturbed locations around the MCDA location. All background samples were analyzed for COGCC Table 910-1 constituents excluding Hot Water Soluble Boron and Barium will be analyzed via method SW-846.
- **Cuttings Samples:** In an effort to define the concentrations of Table 910-1 constituents which may be encountered on each pad, samples will be collected to determine the geologic source. On each of the first 3 well pads, beginning with the first well drilled, Oxy will collect multiple composite samples from both the surface and production strings, collecting samples of each major formation. Thus, for example, if there are The cuttings samples generated from the first well will be analyzed for the above mentioned analysis. Following the initial well, Oxy will collect cuttings samples from every 4th well (the 4th, 8th, 12th, 16th, and 20th) wells (based on a 22 well pad), targeting composites of surface and production string formations. Oxy will continue to use this numbered well sampling strategy for well pads which have fewer than 22 wells. In general, the samples will be collected in the following manner:
 - Initial well (well 1): Collect three to four composite samples from the surface string; targeting the Uinta, Green River, and Wasatch formations. Then collect six to seven samples from the production string; targeting the Fort Union, Williams Fork (four to five zones), and the Illes formations.
 - Additional wells (wells 4, 8, 12, 16, and 20 for a multi-well pad): Collect one composite sample from the surface string and three composite samples from the production string.
 - These composite samples will be collected from the cuttings storage bin which will consist of cuttings that have been processed and mixed with sawdust, used to absorb *de minimus* amounts of water present in the cuttings, and are ready for storage and disposal.
 - Oxy employs a drilling technique commonly referred to as “batch drilling”, where the surface string is drilled for the first 6, 8 or 10 wells, prior to returning to the initial well to drill the production string, where the production string of the 6, 8 or 10 wells will be drilled out. Batch drilling increases Oxy’s efficiency by not having to switch out surface and production section tools between each well. Oxy typically batch drills every six wells. Batch drilling will stagger when surface and production string cuttings samples are collected for each well. Oxy will take this staggering into consideration when reviewing and tabulating the analytical data.
- **Analysis of Samples:** The samples collected from the initial well of each pad will be tabulated to characterize cuttings generated from the specific formations and/or

combined formations within Oxy's Cascade Creek operating area. Oxy will be looking for any variations or leading indicators in the cuttings to allow Oxy to make recommendations on the sampling frequency of future wells or pads. The samples collected from the additional wells, will also be tabulated characterize cuttings generated from combined formations within in Oxy's Cascade Creek operating area to determine if statistical trends can be identified from the cuttings samples. All samples analyzed will be used to determine if more or less sampling should be required for future wells or pads.

Cuttings samples shall be collected directly from the blended cuttings storage bin. At a minimum, three composite samples will be collected from cuttings generated by the drilling of each well. This composite sample will represent concentrations found in the processed cuttings for each well.

The composite sample will consist of cuttings samples taken from at least five random locations on the blended cuttings bin pile and placed in the stainless steel bowl for blending. The blended composite cuttings sample found in the stainless steel bowl will then be packaged in laboratory provided glass jars for sample shipment and analysis. After filling of the appropriate number of jars, sample labels will be prepared and placed over the lid to provide a permanent seal to take the sample through chain-of-custody to the specified laboratory.

The individual collecting the sample should wear a new pair of disposable nitrile gloves for each sample collected to prevent cross-contamination of the samples. The samples should be collected using a stainless steel spoon, trowel or other appropriate equipment. The sampling equipment used will need to be thoroughly cleaned and rinsed with distilled water between each discrete sample. Appropriate sampling containers should be used for each sample. Each discrete sample should be placed into the specified container, and a log generated to identify the date, time, and identification of the person collecting the samples. The containers must be stored in a temperature controlled area which will maintain at or near 40 degrees F. (i.e. a refrigerator).

Each composite sample will be sent to a laboratory for analysis, samples should be given a distinct identification number (for example: 01 cuttings), labeled with the date and time of the sample collection, and the initials of the sampler, placed in a cooler with ice or back into the refrigerator under chain of custody protocol. The samples must be kept on ice and cool, during transportation from the field to the laboratory.

Background samples shall be collected immediately adjacent to the existing pad, in an undisturbed area.

After the lab has analyzed the samples, the lab will provide Oxy with the results in a written report per the specified turn-around time. Oxy will tabulate the results for statistical analysis and trending.

Cuttings Storage and Disposal

Transportation of dry cuttings from the above-mentioned pads to the MCDA location for permanent disposal:

1. Each cuttings delivery will be offloaded into the 50' by 50' receiving/mixing area located immediately adjacent to the permanent disposal area; the permanent disposal area will be approximately 60' by 250'. Oxy will ensure the permanent disposal location will be surrounded by earthen berms, see Attachment C – Drainage Report.
2. After cuttings have been mixed they will be carried over to the permanent disposal area and stacked until approximately 14,189 cubic yards of cuttings are laid there. The cuttings will be set back so that they do not over-run the earthen berm serving as containment for the permanent disposal area.
3. A final 3' cap consisting of native material will be placed on top of the cuttings and seeded.

Transportation of Cuttings to Disposal Areas

Dry cuttings will be placed onto transport trucks (16 cubic yard dump trucks) and hauled to the MCDA location. The transport trucks will travel on Oxy owned and maintained roads, a short distance from each pad. All approximate distances reported below are based on driving distances. The 608-43-31 pad is approximately 7,025 feet from the proposed disposal area. The 609-33 pad is approximately 530 feet from the proposed disposal area. The 608-41 pad is approximately 5,800 feet from the proposed disposal area. The 697-16-28 pad is approximately 11,395 feet from the proposed disposal area. The 697-05C pad is approximately 16,005 feet from the proposed disposal area. The 697-04D pad is approximately 10,500 feet from the proposed disposal area. The transport trucks will offload the dry cuttings initially at the designated permanent disposal area and once this permanent disposal area is full, cuttings will be transported to another approved disposal facility. Oxy will track the volume of dry cuttings hauled for disposal and storage at this location.

The above-mentioned transportation routes accessing the cuttings disposal area use existing access roads and cross Cascade Canyon and an unnamed drainage. In the event that a transport truck over turns along the transport route, Oxy will implement spill response and cleaned procedures (see below).

Cuttings Disposal Areas

The cuttings disposal area will be located at a proposed COGCC facility and will be managed in accordance with COGCC regulations and comply with COGCC Table 910-1 standards. The initial cuttings batch sample shows elevated sodium adsorption ratio (SAR), pH, and arsenic (see attached analytical results). To address the elevated SAR and pH, the cuttings will be buried and capped with three feet of native soil. Oxy believes the elevated arsenic concentrations found in the cuttings samples are due to documented naturally occurring arsenic known to be in the native sub-surface formations. Although natural variability is known to occur within the region, Oxy will default to naturally occurring background sample concentrations known to exist within the area. Prior to being capped, a final sample will be collected to ensure compliance with COGCC Table 910-1 standards. The final disposal locations shall be documented to include the final volume of cuttings disposed.

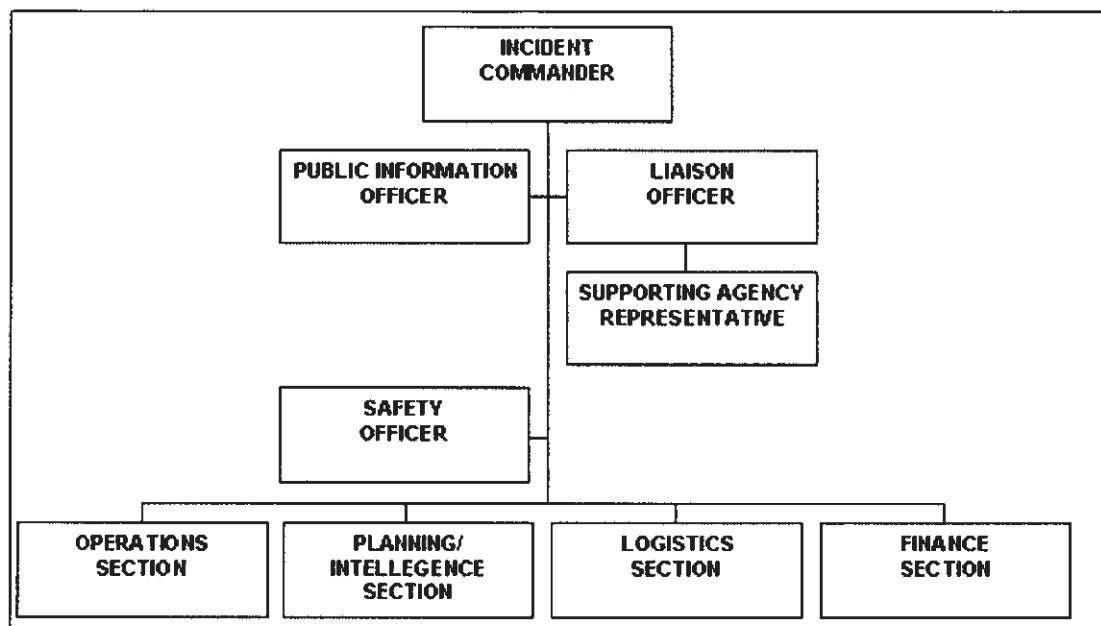
The dry cuttings will be hauled to the site via transport trucks. The trucks will deliver the cuttings at a designated off-loading area where mixing and final disposal will occur.

After the disposal areas have been capped with 3 feet of native fill material; the areas will be prepped for seeding. However, reseeding will generally occur in the early spring or fall which ever comes first to ensure seed germination. The disposal area will be monitored at the next growing season for revegetation efforts.

Spill Response and Cleanup Procedures

In the event that a transport truck overturns and discharges cuttings materials, the site will be secured and Oxy will employ the Incident Command System (ICS), see next page. The ICS is the organization and assignment of key personnel to facilitate the control and removal of an incident which has the potential to harm the public health, safety, and the environment. Oxy emergency response personnel following the ICS will ensure that the area is safe and that no fuel or hydraulic fluid has been released. If fuel, hydraulic fluid or other refined chemical has released, then the release will be contained, cleaned up, and if applicable reported to the necessary agencies. Please refer to the Oxy's Emergency Response Plan to identify individual roles and responsibilities associated with the ICS.

Any processed cuttings that have discharged from the truck will be contained, collected, and taken to the disposal area. The cuttings shall be transported in a dry state and therefore will not run-off or generate an impact beyond the release area.



Following control and removal of the incident, Oxy will ensure that any and all required governmental and non-governmental agencies will be contacted. Please refer to Table 1 of the Emergency Response Plan for Agency emergency contact information.

Proposed Facility Modifications

Oxy will notify the COGCC in writing if proposed modifications to the facility design, operating plan, permit data, or permit conditions change following applicable COGCC rules.

Facility Closure

Oxy will comply with established COGCC rules by submitting a detailed Site Investigation and Remediation Workplan, Form 27, prior to facility closure to the Director for approval. Outlined below are operations and activities which Oxy assumes could be associated with the preliminary closure of the proposed MCDA location:

- Stacking of the processed cuttings;
- Capping the cuttings with at least 3 feet of native fill material;
- Composite sample collection of disposal area to ensure adequate capping of the cuttings;
- Final contour and seed bed preparation, followed by seeding during the appropriate season;
- Monitor seeding efforts and stormwater best management practices on the cuttings disposal area.

Surface Water Monitoring

Oxy has included a hydrogeologic report prepared by Olsson Associates for the proposed cuttings disposal area (see attached report). Water quality sampling will be conducted from the unnamed intermittent drainage located approximately 1,000 feet south of the proposed cuttings disposal location (see Figure 1). Oxy will collect one sample from the unnamed creek down-

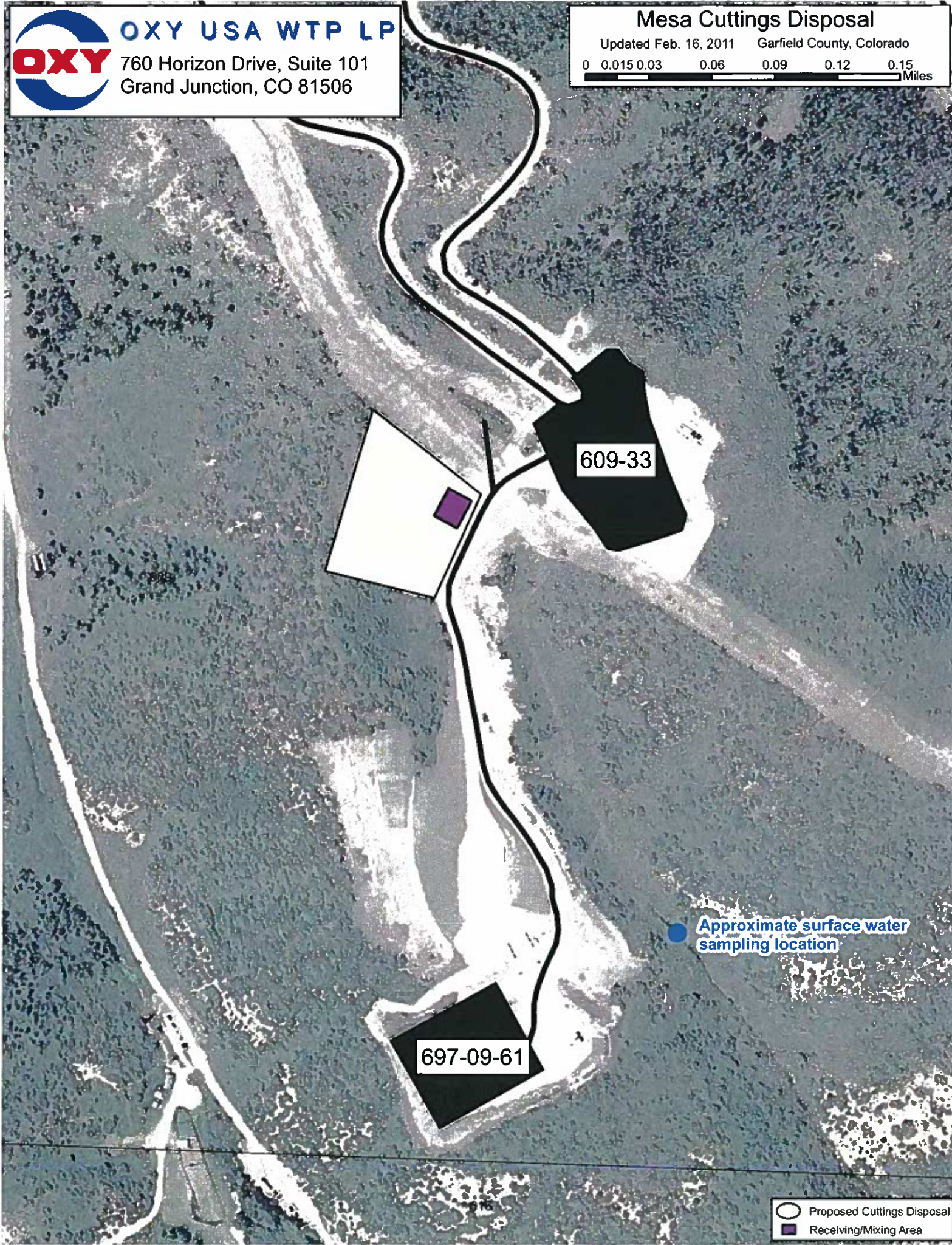
gradient of the disposal area prior to commencing disposal operations at the proposed location to serve as a background assessment of water quality parameters in the area. When water is present, quarterly water samples will be collected during disposal operations and will continue for an additional four quarters following capping and completion of the disposal operations. Whenever achievable, quarterly samples during operation and post-operations will be conducted during peak flow and/or considerable seasonal flow. Whenever this is not achievable, Oxy will continue to conduct quarterly sampling during normal season weather events to ensure adequate water quality data is analyzed. Background, quarterly during operation, and quarterly post-operation samples will be collected as grab samples from the same location of the unnamed creek to ensure reproducible data is collected and analyzed. All water samples will be collected and analyzed for COGCC Table 910-1 water standards to include; benzene, toluene, ethylbenzene, and total xylenes (BTEX), total dissolved solids, dissolved metals, chlorides, and sulfates.

The individual collecting the sample will wear a new pair of disposable nitrile gloves for each sample collected to prevent cross-contamination of the samples. The individual collecting the surface water sample will fill, cap, and seal all laboratory provided containers using laboratory provided labels. The individual collecting the samples will follow all storage, shipment, and chain-of-custody procedures implemented by Oxy in this MMP and outlined in Appendix A.

Mesa Cuttings Disposal

Updated Feb. 16, 2011 Garfield County, Colorado

0 0.015 0.03 0.06 0.09 0.12 0.15 Miles



● Approximate surface water sampling location

697-09-61

609-33

- Proposed Cuttings Disposal
- Receiving/Mixing Area



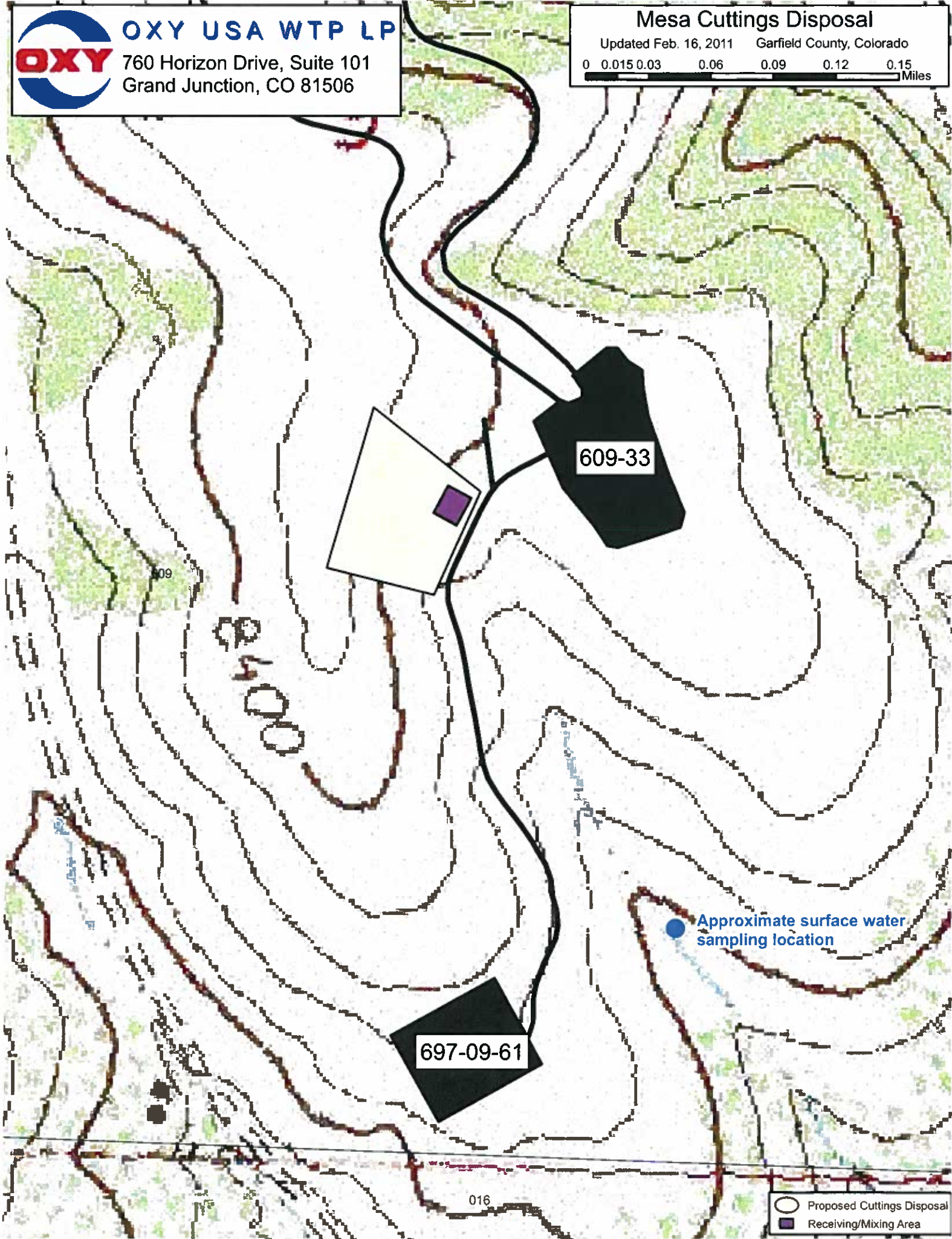
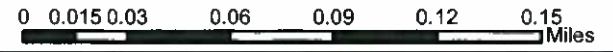
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Mesa Cuttings Disposal

Updated Feb. 16, 2011

Garfield County, Colorado



09

609-33

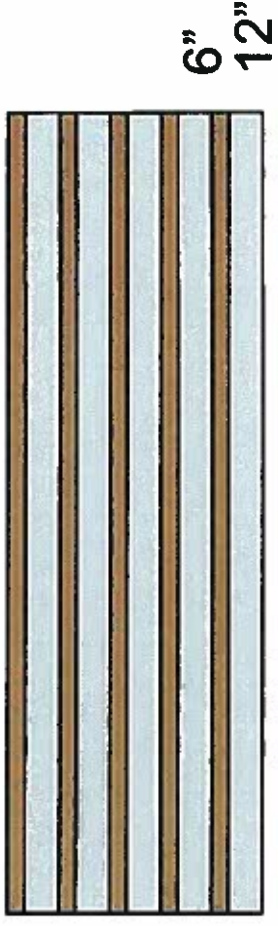
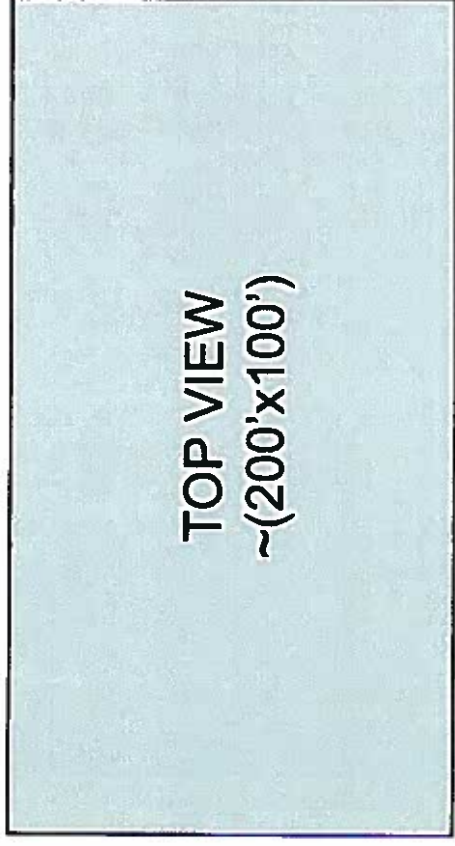
697-09-61

Approximate surface water sampling location

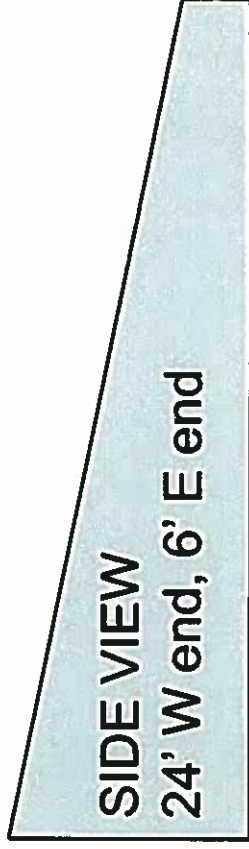
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- Proposed Cuttings Disposal
- Receiving/Mixing Area

CUTTING RECLAIM AREA



Concept: Cuttings will be reclaimed on area utilizing layered mixing and reclamation in order to stack multiple layers. Once height reaches over 6' it will require use of excavator to lift cuttings onto site. Final layer will be capped with 3' cover and seeded.



$V = 6 * 200 * 100 + 18 * 200 * 100 / 2 = 300000 \text{ cf} = 11,000 \text{ cy}$
2:1 of cuttings mixed (12" lift), 100% virgin stabilizer (6" lift)
 $V = 7400 \text{ cy}$ cuttings capacity

Drill Cutting Management Plan Laboratory Data

	MCL (mg/kg)	Sample Identification (mg/Kg)					
		609-33 (1) 1/15/11	609-33 (2) 1/15/11	609-33 (3) 1/15/11	608-43-31 (1) 1/15/11	608-43-31 (2) 1/15/11	608-43-31 (3) 1/15/11
Organics in Soil							
TPH (GRO and DRO)							
Benzene	500	18.0	16.3	26.8	294.6	293.8	232.0
Toluene	85	0.0054	0.0060	0.0087	0.025	0.029	0.022
Ethylbenzene	100	0.03	0.0320	0.04	0.09	0.10	0.074
Xylenes	175	0.01	0.0140	0.02	0.03	0.03	0.0180
		0.09	0.0960	0.13	0.16	0.17	0.12
Organics in Soil (PAH's)							
Acenaphthene	1000	BDL	BDL	BDL	BDL	BDL	BDL
Anthracene	1000	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(A)anthracene	0.22	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(B)fluoranthene	0.22	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(K)fluoranthene	2.2	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(A)pyrene	0.022	BDL	BDL	BDL	BDL	BDL	BDL
Chrysene	22	BDL	BDL	BDL	BDL	BDL	BDL
Dibenzo(A,H)anthracene	0.022	BDL	BDL	BDL	BDL	BDL	BDL
Fluoranthene	1000	BDL	BDL	BDL	BDL	BDL	BDL
Flourene	1000	BDL	BDL	BDL	BDL	BDL	BDL
Indeno(1,2,3-C,D)pyrene	0.22	BDL	BDL	BDL	BDL	BDL	BDL
Naphthalene	23	0.092	0.086	0.067	0.047	0.059	0.06
Pyrene	1000	BDL	BDL	BDL	BDL	BDL	BDL
Inorganics in Soil							
EC	<4 mmhos/cm or 2X background	1.0	1.1	1.0	1.9	1.9	1.9
SAR	<12	31.0	57.0	31.0	52.0	27.0	55.0
pH	6-9	9.3	9.4	9.4	9.1	9.2	9.2
Metals in Soils							
Arsenic	0.39	3.5	3.4	3.8	9.9	10.0	8.6
Barium	15000	220.0	200.0	220	260	260	250
Cadmium	70	BDL	BDL	BDL	BDL	BDL	BDL
Chromium	12000	11.0	9.2	10.0	16.1	18.4	17.5
Chromium VI	23	1.1	1.2	1.4	1.1	1.4	1.5
Copper	3100	7.9	7.5	9.2	16.0	16.0	16.0
Lead	400	8.2	8.9	10.0	14.0	14.0	14.0
Mercury	23	0.01	0.01	0.013	0.010	0.010	0.010
Nickel	1600	5.9	6.6	7.9	11.0	11.0	13.0
Selenium	380	BDL	BDL	BDL	BDL	BDL	BDL
Silver	390	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	23000	21.0	21.0	25.0	33.0	38.0	32.0



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Alonzo Herandez
OXY USA Inc - Grand Junction, CO
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Report Summary

Thursday January 20, 2011

Report Number: L497659

Samples Received: 01/18/11

Client Project:

Description: 609-33/608-43-31/697-16A2

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By:

Mark W. Beasley, ESC Representative

Laboratory Certification Numbers

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT - PH-0197, FL - E87487
GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016, NC - ENV375/DW21704, ND - R-140
NJ - TN002, NJ NELAP - TN002, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ - 0612, MN - 047-999-395, NY - 11742, WI - 998093910, NV - TN000032008A,
TX - T104704245, OK-9915

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Note: The use of the preparatory EPA Method 3511 is not approved or endorsed by the CA ELAP.

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Est. 1970

REPORT OF ANALYSIS

January 20, 2011

Alonzo Hernandez
OXY USA Inc - Grand Junction, CO
760 Horizon Dr., Ste. 101
Grand Junction, CO 81506

Date Received : January 18, 2011
Description : 609-33/608-43-31/697-16A2
Sample ID : 609-33 1
Collected By : Jerry David
Collection Date : 01/15/11 19:00

ESC Sample # : L497659-01

Site ID :

Project # :

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Oil
Chromium, Hexavalent	1.1	0.31	2.0	mg/kg	J	3060A/7	01/18/11	1
Chromium, Trivalent	9.5	0.17	0.50	mg/kg		Calc.	01/19/11	1
ORP	5.0			mV		2560	01/18/11	1
pH	9.3			su		9045D	01/19/11	1
Sodium Adsorption Ratio	31.					Calc.	01/19/11	1
Specific Conductance	1000			umhos/cm		9050AMo	01/19/11	1
Mercury	0.013	0.0015	0.020	mg/kg	J	7471	01/19/11	1
Arsenic	3.5	0.32	1.0	mg/kg		6010B	01/19/11	1
Barium	220	0.050	0.25	mg/kg		6010B	01/19/11	1
Cadmium	U	0.040	0.25	mg/kg		6010B	01/19/11	1
Chromium	11.	0.085	0.50	mg/kg		6010B	01/19/11	1
Copper	7.9	0.21	1.0	mg/kg		6010B	01/19/11	1
Lead	8.2	0.090	0.25	mg/kg		6010B	01/19/11	1
Nickel	5.9	0.26	1.0	mg/kg		6010B	01/19/11	1
Selenium	U	0.32	1.0	mg/kg		6010B	01/19/11	1
Silver	U	0.16	0.50	mg/kg		6010B	01/19/11	1
Zinc	21.	0.34	1.5	mg/kg		6010B	01/19/11	1
Benzene	0.0054	0.00090	0.0025	mg/kg		8021/80	01/18/11	5
Toluene	0.029	0.0015	0.025	mg/kg		8021/80	01/18/11	5
Ethylbenzene	0.013	0.0013	0.0025	mg/kg	B	8021/80	01/18/11	5
Total Xylene	0.088	0.0028	0.0075	mg/kg		8021/80	01/18/11	5
TPH (GC/FID) Low Fraction	1.0	0.14	0.50	mg/kg		GRO	01/18/11	5
Surrogate Recovery-%								
a, a, a-Trifluorotoluene (FID)	102.			% Rec.		8021/80	01/18/11	5
a, a, a-Trifluorotoluene (PID)	99.5			% Rec.		8021/80	01/18/11	5
TPH (GC/FID) High Fraction	17.	0.77	4.0	mg/kg		3546/DR	01/19/11	1
Surrogate recovery(%)								
o-Terphenyl	89.9			% Rec.		3546/DR	01/19/11	1
Polynuclear Aromatic Hydrocarbons								
Anthracene	U	0.0062	0.033	mg/kg		8270C	01/19/11	1
Acenaphthene	U	0.0082	0.033	mg/kg		8270C	01/19/11	1
Acenaphthylene	U	0.0078	0.033	mg/kg		8270C	01/19/11	1
Benzo(a)anthracene	U	0.0077	0.033	mg/kg		8270C	01/19/11	1

U = ND (Not Detected)

MDL = Minimum Detection Limit = LOD

RDL = Reported Detection Limit = LOQ = PQL = EQL

Note:

The reported analytical results relate only to the sample submitted.

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Reported: 01/20/11 15:30 Printed: 01/20/11 15:30
L497659-01 (PH) - 9.3@20.0c



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Esc. 1970

REPORT OF ANALYSIS

Alonzo Hernandez
OXY USA Inc - Grand Junction, CO
760 Horizon Dr., Ste. 101
Grand Junction, CO 81506

January 20, 2011

Date Received : January 18, 2011
Description : 609-33/608-43-31/697-16A2

ESC Sample # : L497659-01

Sample ID : 609-33 1

Site ID :

Collected By : Jerry David
Collection Date : 01/15/11 19:00

Project # :

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Dil.
Benzo(a)pyrene	U	0.0073	0.033	mg/kg		8270C	01/19/11	1
Benzo(b)fluoranthene	U	0.0086	0.033	mg/kg		8270C	01/19/11	1
Benzo(g,h,i)perylene	U	0.0050	0.033	mg/kg		8270C	01/19/11	1
Benzo(k)fluoranthene	U	0.0074	0.033	mg/kg		8270C	01/19/11	1
Chrysene	U	0.0067	0.033	mg/kg		8270C	01/19/11	1
Dibenz(a,h)anthracene	U	0.0058	0.033	mg/kg		8270C	01/19/11	1
Fluoranthene	U	0.0069	0.033	mg/kg		8270C	01/19/11	1
Fluorene	U	0.0059	0.033	mg/kg		8270C	01/19/11	1
Indeno(1,2,3-cd)pyrene	U	0.0059	0.033	mg/kg		8270C	01/19/11	1
Naphthalene	0.092	0.0074	0.033	mg/kg		8270C	01/19/11	1
Phenanthrene	0.018	0.0067	0.033	mg/kg	J	8270C	01/19/11	1
Pyrene	U	0.0077	0.033	mg/kg		8270C	01/19/11	1
Surrogate Recovery								
Nitrobenzene-d5	80.5			% Rec.		8270C	01/19/11	1
2-Fluorobiphenyl	75.5			% Rec.		8270C	01/19/11	1
p-Terphenyl-d14	50.3			% Rec.		8270C	01/19/11	1

U = ND (Not Detected)

MDL = Minimum Detection Limit = LOD

RDL = Reported Detection Limit = LOQ = PQL = EQL

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L497659-01 (PH) - 9.3020.0c



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REPORT OF ANALYSIS

Alonzo Hernandez
 OXY USA Inc - Grand Junction, CO
 760 Horizon Dr., Ste. 101
 Grand Junction, CO 81506

January 20, 2011

Date Received : January 18, 2011
 Description : 609-33/608-43-31/697-16A2
 Sample ID : 609-33 2
 Collected By : Jerry David
 Collection Date : 01/15/11 19:00

ESC Sample # : L497659-02
 Site ID :
 Project # :

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Dil.
Chromium, Hexavalent	1.2	0.31	2.0	mg/kg	J	3060A/7	01/18/11	1
Chromium, Trivalent	6.0	0.17	0.50	mg/kg		Calc.	01/19/11	1
ORP	0.0			mV		2580	01/18/11	1
pH	9.4			su		9045D	01/19/11	1
Sodium Adsorption Ratio	57.					Calc.	01/19/11	1
Specific Conductance	1100			umhos/cm		9050AMp	01/19/11	1
Mercury	0.011	0.0015	0.020	mg/kg	J	747i	01/19/11	1
Arsenic	3.4	0.52	1.0	mg/kg		6010B	01/19/11	1
Barium	200	0.050	0.25	mg/kg		6010B	01/19/11	1
Cadmium	U	0.040	0.25	mg/kg		6010B	01/19/11	1
Chromium	9.2	0.085	0.50	mg/kg		6010B	01/19/11	1
Copper	7.5	0.21	1.0	mg/kg		6010B	01/19/11	1
Lead	8.9	0.090	0.25	mg/kg		6010B	01/19/11	1
Nickel	6.6	0.26	1.0	mg/kg		6010B	01/19/11	1
Selenium	U	0.32	1.0	mg/kg		6010B	01/19/11	1
Silver	U	0.16	0.50	mg/kg		6010B	01/19/11	1
Zinc	21.	0.34	1.5	mg/kg		6010B	01/19/11	1
Benzene	0.0060	0.00090	0.0025	mg/kg		8021/80	01/18/11	5
Toluene	0.032	0.0015	0.025	mg/kg		8021/80	01/18/11	5
Ethylbenzene	0.014	0.0013	0.0025	mg/kg	B	8021/80	01/18/11	5
Total Xylene	0.096	0.0028	0.0075	mg/kg		8021/80	01/18/11	5
TPH (GC/FID) Low Fraction	1.3	0.14	0.50	mg/kg		GRO	01/18/11	5
Surrogate Recovery-%								
a,a,a-Trifluorotoluene (FID)	103.			% Rec.		8021/80	01/18/11	5
a,a,a-Trifluorotoluene (PID)	98.6			% Rec.		8021/80	01/18/11	5
TPH (GC/FID) High Fraction	15.	0.77	4.0	mg/kg		3546/DR	01/19/11	1
Surrogate recovery(%)								
o-Terphenyl	90.4			% Rec.		3546/DR	01/19/11	1
Polynuclear Aromatic Hydrocarbons								
Anthracene	U	0.0082	0.033	mg/kg		8270C	01/19/11	1
Acenaphthene	U	0.0082	0.033	mg/kg		8270C	01/19/11	1
Acenaphthylene	U	0.0078	0.033	mg/kg		8270C	01/19/11	1
Benzo(a)anthracene	U	0.0077	0.033	mg/kg		8270C	01/19/11	1

U = ND (Not Detected)

MDL = Minimum Detection Limit = LOD

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 L497659-02 (PH) - 9 4020.7c



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REPORT OF ANALYSIS

Alonzo Hernandez
OXY USA Inc - Grand Junction, CO
760 Horizon Dr., Ste. 101
Grand Junction, CO 81506

January 20, 2011

Date Received : January 18, 2011
Description : 609-33/608-43-31/697-16A2

ESC Sample # : L497659-02

Sample ID : 609-33 2

Site ID :

Collected By : Jerry David
Collection Date : 01/15/11 19:00

Project # :

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Dil.
Benzo(a)pyrene	U	0.0073	0.033	mg/kg		8270C	01/19/11	1
Benzo(b)fluoranthene	U	0.0086	0.033	mg/kg		8270C	01/19/11	1
Benzo(g,h,i)perylene	U	0.0050	0.033	mg/kg		8270C	01/19/11	1
Benzo(k)fluoranthene	U	0.0074	0.033	mg/kg		8270C	01/19/11	1
Chrysene	U	0.0067	0.033	mg/kg		8270C	01/19/11	1
Dibenz(a,h)anthracene	U	0.0058	0.033	mg/kg		8270C	01/19/11	1
Fluoranthene	U	0.0069	0.033	mg/kg		8270C	01/19/11	1
Fluorene	U	0.0059	0.033	mg/kg		8270C	01/19/11	1
Indeno(1,2,3-cd)pyrene	U	0.0059	0.033	mg/kg		8270C	01/19/11	1
Naphthalene	0.086	0.0074	0.033	mg/kg		8270C	01/19/11	1
Phenanthrene	0.014	0.0067	0.033	mg/kg	J	8270C	01/19/11	1
Pyrene	U	0.0077	0.033	mg/kg		8270C	01/19/11	1
Surrogate Recovery								
Nitrobenzene-d5	76.5			% Rec.		8270C	01/19/11	1
2-Fluorobiphenyl	73.7			% Rec.		8270C	01/19/11	1
p-Terphenyl-d14	56.3			% Rec.		8270C	01/19/11	1

U = ND (Not Detected)

MDL = Minimum Detection Limit = LOD

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L497659-02 (PH) - 9.4@20.7c



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REPORT OF ANALYSIS

January 20, 2011

Alonzo Hernandez
OXY USA Inc - Grand Junction, CO
760 Horizon Dr., Ste. 101
Grand Junction, CO 81506

ESC Sample # : L497659-03

Date Received : January 16, 2011
Description : 609-33/608-43-31/697-16A2

Site ID :

Sample ID : 609-33 3

Project # :

Collected By : Jerry David
Collection Date : 01/15/11 19:00

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Dil.
Chromium, Hexavalent	1.4	0.31	2.0	mg/kg	J	3060A/7	01/18/11	1
Chromium, Trivalent	9.1	0.17	0.50	mg/kg		Calc.	01/19/11	1
ORP	-2.0			mV		2580	01/18/11	1
pH	9.4			su		9045D	01/19/11	1
Sodium Adsorption Ratio	31.					Calc.	01/19/11	1
Specific Conductance	1000			umhos/cm		9050AMo	01/19/11	1
Mercury	0.013	0.0015	0.020	mg/kg	J	7471	01/19/11	1
Arsenic	3.8	0.32	1.0	mg/kg		6010B	01/19/11	1
Barium	220	0.050	0.25	mg/kg		6010B	01/19/11	1
Cadmium	U	0.040	0.25	mg/kg		6010B	01/19/11	1
Chromium	10.	0.085	0.50	mg/kg		6010B	01/19/11	1
Copper	9.2	0.21	1.0	mg/kg		6010B	01/19/11	1
Lead	10.	0.090	0.25	mg/kg		6010B	01/19/11	1
Nickel	7.9	0.26	1.0	mg/kg		6010B	01/19/11	1
Selenium	U	0.32	1.0	mg/kg		6010B	01/19/11	1
Silver	U	0.16	0.50	mg/kg		6010B	01/19/11	1
Zinc	25.	0.34	1.5	mg/kg		6010B	01/19/11	1
Benzene	0.0087	0.00090	0.0025	mg/kg		8021/80	01/18/11	5
Toluene	0.039	0.0015	0.025	mg/kg		8021/80	01/18/11	5
Ethylbenzene	0.018	0.0013	0.0025	mg/kg	B	8021/80	01/18/11	5
Total Xylene	0.13	0.0028	0.0075	mg/kg		8021/80	01/18/11	5
TPH (GC/FID) Low Fraction	2.8	0.14	0.50	mg/kg		GRD	01/18/11	5
Surrogate Recovery-%								
a,a,a-Trifluorotoluene(FID)	102.			% Rec.		8021/80	01/18/11	5
a,a,a-Trifluorotoluene(PID)	96.5			% Rec.		8021/80	01/18/11	5
TPH (GC/FID) High Fraction	24.	0.77	4.0	mg/kg		3546/DR	01/19/11	1
Surrogate recovery(%)								
o-Terphenyl	65.8			% Rec.		3546/DR	01/19/11	1
Polynuclear Aromatic Hydrocarbons								
Anthracene	U	0.0082	0.033	mg/kg		8270C	01/19/11	1
Acenaphthene	U	0.0082	0.033	mg/kg		8270C	01/19/11	1
Acenaphthylene	U	0.0078	0.033	mg/kg		5270C	01/19/11	1
Benzo(a)anthracene	U	0.0077	0.033	mg/kg		8270C	01/19/11	1

U = ND (Not Detected)

MDL = Minimum Detection Limit = LOD

RDL = Reported Detection Limit = LOQ = PQL = EQL

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L497659-03 (PH) - 9.4@20.3c



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 Est. 1970

REPORT OF ANALYSIS

Alonzo Hernandez
 OXY USA Inc - Grand Junction, CO
 760 Horizon Dr., Ste. 101
 Grand Junction, CO 81506

January 20, 2011

Date Received : January 18, 2011
 Description : 609-33/608-43-31/697-16A2
 Sample ID : 609-33 3
 Collected By : Jerry David
 Collection Date : 01/15/11 19:00

ESC Sample # : L497659-03
 Site ID :
 Project # :

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Dil.
Benzo(a)pyrene	U	0.0073	0.033	mg/kg		8270C	01/19/11	1
Benzo(b)fluoranthene	U	0.0086	0.033	mg/kg		8270C	01/19/11	1
Benzo(g,h,i)perylene	U	0.0050	0.033	mg/kg		8270C	01/19/11	1
Benzo(k)fluoranthene	U	0.0074	0.033	mg/kg		8270C	01/19/11	1
Chrysene	U	0.0067	0.033	mg/kg		8270C	01/19/11	1
Dibenz(a,h)anthracene	U	0.0058	0.033	mg/kg		8270C	01/19/11	1
Fluoranthene	U	0.0069	0.033	mg/kg		8270C	01/19/11	1
Fluorene	U	0.0059	0.033	mg/kg		8270C	01/19/11	1
Indeno(1,2,3-cd)pyrene	U	0.0059	0.033	mg/kg		8270C	01/19/11	1
Naphthalene	0.067	0.0074	0.033	mg/kg		8270C	01/19/11	1
Phenanthrene	0.010	0.0067	0.033	mg/kg	J	8270C	01/19/11	1
Pyrene	U	0.0077	0.033	mg/kg		8270C	01/19/11	1
Surrogate Recovery								
Nitrobenzene-d5	71.6			% Rec.		8270C	01/19/11	1
2-Fluorobiphenyl	74.1			% Rec.		8270C	01/19/11	1
p-Terphenyl-d14	56.4			% Rec.		8270C	01/19/11	1

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 L497659-03 (PH) - 9.4020.3c



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REPORT OF ANALYSIS

January 20, 2011

Alonzo Hernandez
 OXY USA Inc - Grand Junction, CO
 760 Horizon Dr., Ste. 101
 Grand Junction, CO 81506

Date Received : January 18, 2011
 Description : 609-33/608-43-31/697-16A2
 Sample ID : 608-43-31 1
 Collected By : Jerry David
 Collection Date : 01/15/11 20:00

ESC Sample # : L497659-04
 Site ID :
 Project # :

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Dil.
Chromium, Hexavalent	1.1	0.31	2.0	mg/kg	J	3060A/7	01/18/11	1
Chromium, Trivalent	15.	0.17	0.50	mg/kg		Calc.	01/19/11	1
ORP	-3.0			mV		2580	01/18/11	1
pH	9.1			su		9045D	01/19/11	1
Sodium Adsorption Ratio	52.					Calc.	01/19/11	1
Specific Conductance	1900			umhos/cm		9050AMo	01/19/11	1
Mercury	0.0095	0.0015	0.020	mg/kg	J	7471	01/19/11	1
Arsenic	9.9	1.6	5.0	mg/kg		6010B	01/20/11	5
Barium	260	0.25	1.3	mg/kg		6010B	01/20/11	5
Cadmium	U	0.20	1.3	mg/kg	O	6010B	01/20/11	5
Chromium	16.	0.095	0.50	mg/kg		6010B	01/19/11	1
Copper	16.	0.21	1.0	mg/kg		6010B	01/19/11	1
Lead	14.	0.45	1.3	mg/kg		6010B	01/20/11	5
Nickel	11.	0.26	1.0	mg/kg		6010B	01/19/11	1
Selenium	U	0.32	1.0	mg/kg		6010B	01/19/11	1
Silver	U	0.16	0.50	mg/kg		6010B	01/19/11	1
Zinc	33.	0.34	1.5	mg/kg		6010B	01/19/11	1
Benzene	0.025	0.00090	0.0025	mg/kg		8021/80	01/18/11	5
Toluene	0.086	0.0015	0.025	mg/kg		8021/80	01/18/11	5
Ethylbenzene	0.025	0.0013	0.0025	mg/kg	B	8021/80	01/18/11	5
Total Xylene	0.16	0.0028	0.0075	mg/kg		8021/80	01/18/11	5
TPH (GC/FID) Low Fraction	4.6	0.14	0.50	mg/kg		GRO	01/18/11	5
Surrogate Recovery-%								
a, a, a-Trifluorotoluene (FID)	102.			% Rec.		8021/80	01/18/11	5
a, a, a-Trifluorotoluene (PID)	97.0			% Rec.		8021/80	01/18/11	5
TPH (GC/FID) High Fraction	290	0.77	4.0	mg/kg		3546/DR	01/19/11	1
Surrogate recovery (%)								
o-Terphenyl	2270			% Rec.	J1	3546/DR	01/19/11	1
Polynuclear Aromatic Hydrocarbons								
Anthracene	U	0.0082	0.033	mg/kg		8270C	01/19/11	1
Acenaphthene	U	0.0082	0.033	mg/kg		8270C	01/19/11	1
Acenaphthylene	U	0.0078	0.033	mg/kg		8270C	01/19/11	1
Benzo(a)anthracene	U	0.0077	0.033	mg/kg		8270C	01/19/11	1

U = ND (Not Detected)
 MDL = Minimum Detection Limit = LOD
 RDL = Reported Detection Limit = LOQ = PQL - EQL
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 L497659-04 (PH) - 9.1820 3c
 L497659-04 (DRO) - Previous run also had high SURR recovery. Matrix effect.



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REPORT OF ANALYSIS

Alonzo Herandez
 OXY USA Inc - Grand Junction, CO
 760 Horizon Dr., Ste. 101
 Grand Junction, CO 81506

January 20, 2011

Date Received : January 16, 2011
 Description : 609-33/608-43-31/697-16A2

ESC Sample # : L497659-04

Sample ID : 608-43-31 1

Site ID :

Collected By : Jerry David
 Collection Date : 01/15/11 20:00

Project # :

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Dil.
Benzo(a)pyrene	U	0.0073	0.033	mg/kg		8270C	01/19/11	1
Benzo(b)fluoranthene	U	0.0086	0.033	mg/kg		8270C	01/19/11	1
Benzo(g,h,i)perylene	U	0.0050	0.033	mg/kg		8270C	01/19/11	1
Benzo(k)fluoranthene	U	0.0074	0.033	mg/kg		8270C	01/19/11	1
Chrysene	U	0.0067	0.033	mg/kg		8270C	01/19/11	1
Dibenz(a,h)anthracene	U	0.0058	0.033	mg/kg		8270C	01/19/11	1
Fluoranthene	U	0.0069	0.033	mg/kg		8270C	01/19/11	1
Fluorene	U	0.0059	0.033	mg/kg		8270C	01/19/11	1
Indeno(1,2,3-cd)pyrene	U	0.0059	0.033	mg/kg		8270C	01/19/11	1
Naphthalene	0.047	0.0074	0.033	mg/kg		8270C	01/19/11	1
Phenanthrene	U	0.0067	0.033	mg/kg		8270C	01/19/11	1
Pyrene	U	0.0077	0.033	mg/kg		8270C	01/19/11	1
Surrogate Recovery								
Nitrobenzene-d5	73.5				Rec.	8270C	01/19/11	1
2-Fluorobiphenyl	69.6				Rec.	8270C	01/19/11	1
p-Terphenyl-d14	113.				Rec.	8270C	01/19/11	1

U = ND (Not Detected)
 MDL = Minimum Detection Limit = LOD
 RDL = Reported Detection Limit = LOQ = PQL = EQL
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Reported: 01/20/11 15:30 Printed: 01/20/11 15:30
 L497659-04 (PH) - 9.1820.3c
 L497659-04 (DRO) - Previous run also had high SURR recovery. Matrix effect.



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REPORT OF ANALYSIS

Alonzo Hernandez
OXY USA Inc - Grand Junction, CO
760 Horizon Dr., Ste. 101
Grand Junction, CO 81506

January 20, 2011

Date Received : January 18, 2011
Description : 609-33/608-43-31/697-16A2
Sample ID : 608-43-31 2
Collected By : Jerry David
Collection Date : 01/15/11 20:00

ESC Sample # : L497659-05

Site ID :

Project # :

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Dil.
Chromium, Hexavalent	1.4	0.31	2.0	mg/kg	JJ3	3060A/7	01/18/11	1
Chromium, Trivalent	17.	0.17	0.50	mg/kg		Calc.	01/19/11	1
ORP	-6.0			mV		2580	01/18/11	1
pH	9.2			su		9045D	01/19/11	1
Sodium Adsorption Ratio	27.					Calc.	01/19/11	1
Specific Conductance	1900			umhos/cm		9050A/MO	01/19/11	1
Mercury	0.010	0.0015	0.020	mg/kg	J	7471	01/19/11	1
Arsenic	10.	1.6	5.0	mg/kg		6010B	01/20/11	5
Barium	260	0.25	1.3	mg/kg		6010B	01/20/11	5
Cadmium	U	0.20	1.3	mg/kg	O	6010B	01/20/11	5
Chromium	18.	0.085	0.50	mg/kg		6010B	01/19/11	1
Copper	16.	0.21	1.0	mg/kg		6010B	01/19/11	1
Lead	14.	0.45	1.3	mg/kg		6010B	01/20/11	5
Nickel	11.	0.26	1.0	mg/kg		6010B	01/19/11	1
Selenium	U	0.32	1.0	mg/kg		6010B	01/19/11	1
Silver	U	0.16	0.50	mg/kg		6010B	01/19/11	1
Zinc	38.	0.34	1.5	mg/kg		6010B	01/19/11	1
Benzene	0.029	0.00090	0.0025	mg/kg		8021/80	01/18/11	5
Toluene	0.10	0.0015	0.025	mg/kg		8021/80	01/18/11	5
Ethylbenzene	0.026	0.0013	0.0025	mg/kg	B	8021/80	01/18/11	5
Total Xylene	0.17	0.0028	0.0075	mg/kg		5021/80	01/18/11	5
TPH (GC/FID) Low Fraction	3.8	0.14	0.50	mg/kg		GRO	01/18/11	5
Surrogate Recovery-%								
a,a,a-Trifluorotoluene (FID)	100.			% Rec.		8021/80	01/18/11	5
a,a,a-Trifluorotoluene (PID)	95.6			% Rec.		8021/80	01/18/11	5
TPH (GC/FID) High Fraction	290	0.77	4.0	mg/kg		3546/DR	01/19/11	1
Surrogate recovery(%)								
o-Terphenyl	2410			% Rec.	J1	3546/DR	01/19/11	1
Polynuclear Aromatic Hydrocarbons								
Anthracene	U	0.0082	0.033	mg/kg		8270C	01/19/11	1
Acenaphthene	U	0.0082	0.033	mg/kg		8270C	01/19/11	1
Acenaphthylene	U	0.0078	0.033	mg/kg		8270C	01/19/11	1
Benzo(a)anthracene	U	0.0077	0.033	mg/kg		8270C	01/19/11	1

U = ND (Not Detected)

MDL = Minimum Detection Limit = LOD

RDL = Reported Detection Limit = LOQ = PQL = EQL

Note:

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L497659-05 (DRO) - Previous run also had high SURR recovery. Matrix effect.

L497659-05 (PH) - 9.2@20.3c



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 1-800-767-5859
 FAX (615) 758-5839
 Tax I D. 62-0814289
 Est. 1970

REPORT OF ANALYSIS

Alonzo Herandez
 OXY USA Inc - Grand Junction, CO
 760 Horizon Dr., Ste. 101
 Grand Junction, CO 81506

January 20, 2011

Date Received : January 15, 2011
 Description : 609-33/608-43-31/697-16A2

ESC Sample # : L497659-05

Sample ID : 609-43-31 2

Site ID :

Collected By : Jerry David
 Collection Date : 01/15/11 20:00

Project # :

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Dil.
Benzo(a)pyrene	U	0.0073	0.033	mg/kg		8270C	01/19/11	1
Benzo(b)fluoranthene	U	0.0086	0.033	mg/kg		8270C	01/19/11	1
Benzo(g,h,i)perylene	U	0.0050	0.033	mg/kg		8270C	01/19/11	1
Benzo(k)fluoranthene	U	0.0074	0.033	mg/kg		8270C	01/19/11	1
Chrysene	U	0.0067	0.033	mg/kg		8270C	01/19/11	1
Dibenz(a,h)anthracene	U	0.0038	0.033	mg/kg		8270C	01/19/11	1
Fluoranthene	U	0.0069	0.033	mg/kg		8270C	01/19/11	1
Fluorene	U	0.0059	0.033	mg/kg		8270C	01/19/11	1
Indeno(1,2,3-cd)pyrene	U	0.0059	0.033	mg/kg		8270C	01/19/11	1
Naphthalene	0.059	0.0074	0.033	mg/kg		8270C	01/19/11	1
Phenanthrene	U	0.0067	0.033	mg/kg		8270C	01/19/11	1
Pyrene	U	0.0077	0.033	mg/kg		8270C	01/19/11	1
Surrogate Recovery								
Nitrobenzene-d5	71.6			% Rec.		8270C	01/19/11	1
2-Fluorobiphenyl	66.0			% Rec.		8270C	01/19/11	1
p-Terphenyl-d14	139.			% Rec.		8270C	01/19/11	1

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 L497659-05 (DRO) - Previous run also had high SURR recovery. Matrix effect.
 L497659-05 (PH) - 9.2@20.3c



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 Est. 1970

REPORT OF ANALYSIS

January 20, 2011

Alonzo Hernandez
 OKY USA Inc - Grand Junction, CO
 760 Horizon Dr., Ste. 101
 Grand Junction, CO 81506

Date Received : January 18, 2011
 Description : 609-33/608-43-31/697-16A2
 Sample ID : 608-43-31 3
 Collected By : Jerry David
 Collection Date : 01/15/11 20:00

ESC Sample # : L497659-06
 Site ID :
 Project # :

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Dil.
Chromium, Hexavalent	1.5	0.31	2.0	mg/kg	J	3060A/7	01/18/11	1
Chromium, Trivalent	16.	0.17	0.50	mg/kg		Calc.	01/19/11	1
ORP	-11.			mV		2580	01/18/11	1
pH	9.2			su		9045D	01/19/11	1
Sodium Adsorption Ratio	55.					Calc.	01/19/11	1
Specific Conductance	1900			umhos/cm		9050AMo	01/19/11	1
Mercury	0.010	0.0015	0.020	mg/kg	J	7471	01/19/11	1
Arsenic	8.6	1.6	5.0	mg/kg		6010B	01/20/11	5
Barium	250	0.25	1.3	mg/kg		6010B	01/20/11	5
Cadmium	U	0.20	1.3	mg/kg	O	6010B	01/20/11	5
Chromium	18.	0.085	0.50	mg/kg		6010B	01/19/11	1
Copper	16.	0.21	1.0	mg/kg		6010B	01/19/11	1
Lead	14.	0.45	1.3	mg/kg		6010B	01/20/11	5
Nickel	13.	0.26	1.0	mg/kg		6010B	01/19/11	1
Selenium	U	0.32	1.0	mg/kg		6010B	01/19/11	1
Silver	U	0.16	0.50	mg/kg		6010B	01/19/11	1
Zinc	32.	0.34	1.5	mg/kg		6010B	01/19/11	1
Benzene	0.022	0.00090	0.0025	mg/kg		8021/80	01/18/11	5
Toluene	0.074	0.0015	0.025	mg/kg		8021/80	01/18/11	5
Ethylbenzene	0.018	0.0013	0.0025	mg/kg		8021/80	01/18/11	5
Total Xylene	0.12	0.0028	0.0075	mg/kg	B	8021/80	01/18/11	5
TPH (GC/FID) Low Fraction	20	0.14	0.50	mg/kg		GRO	01/18/11	5
Surrogate Recovery-%								
a, a, a-Trifluorotoluene (FID)	100.			% Rec.		8021/80	01/18/11	5
a, a, a-Trifluorotoluene (PID)	96.3			% Rec.		8021/80	01/18/11	5
TPH (GC/FID) High Fraction	230	0.77	4.0	mg/kg	J5	3546/DR	01/19/11	1
Surrogate recovery (%)								
o-Terphenyl	1880			% Rec.	J1	3546/DR	01/19/11	1
Polynuclear Aromatic Hydrocarbons								
Anthracene	U	0.0052	0.033	mg/kg		8270C	01/19/11	1
Acenaphthene	U	0.0052	0.033	mg/kg		8270C	01/19/11	1
Acenaphthylene	U	0.0078	0.033	mg/kg		8270C	01/19/11	1
Benzo(a)anthracene	U	0.0077	0.033	mg/kg		8270C	01/20/11	1

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L497659-06 (PH) - 9.2020.2c

L497659-06 (DRO) - Previous run also had high SURR recovery. Matrix effect.



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REPORT OF ANALYSIS

Alonzo Hernandez
 OXY USA Inc - Grand Junction, CO
 760 Horizon Dr., Ste. 101
 Grand Junction, CO 81506

January 20, 2011

Date Received : January 18, 2011
 Description : 609-33/608-43-31/697-16A2
 Sample ID : 608-43-31 3
 Collected By : Jerry David
 Collection Date : 01/15/11 20:00

ESC Sample # : L497659-06
 Site ID :
 Project # :

Parameter	Result	MDL	RDL	Units	Qualifier	Method	Date	Dil.
Benzo(a)pyrene	U	0.0073	0.033	mg/kg		8270C	01/20/11	1
Benzo(b)fluoranthene	U	0.0086	0.033	mg/kg		8270C	01/20/11	1
Benzo(g,h,i)perylene	U	0.0050	0.033	mg/kg		8270C	01/20/11	1
Benzo(k)fluoranthene	U	0.0074	0.033	mg/kg		8270C	01/20/11	1
Chrysene	U	0.0067	0.033	mg/kg		8270C	01/20/11	1
Dibenz(a,h)anthracene	U	0.0058	0.033	mg/kg		8270C	01/20/11	1
Fluoranthene	U	0.0069	0.033	mg/kg		8270C	01/19/11	1
Fluorene	U	0.0059	0.033	mg/kg		8270C	01/19/11	1
Indeno(1,2,3-cd)pyrene	U	0.0059	0.033	mg/kg		8270C	01/20/11	1
Naphthalene	0.060	0.0074	0.033	mg/kg		8270C	01/19/11	1
Phenanthrene	U	0.0067	0.033	mg/kg		8270C	01/19/11	1
Pyrene	U	0.0077	0.033	mg/kg		8270C	01/20/11	1
Surrogate Recovery								
Nitrobenzene-d5	77.5				% Rec.	8270C	01/19/11	1
2-Fluorobiphenyl	72.4				% Rec.	8270C	01/19/11	1
p-Terphenyl-d14	144.				% Rec.	8270C	01/20/11	1

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 L497659-06 (PH) - 9.2@20.2c
 L497659-06 (DRO) - Previous run also had high SURR recovery. Matrix effect.

Attachment A
List of Analytes with QC Qualifiers

Sample Number	Work Group	Sample Type	Analyte	Run ID	Qualifier
L497659-01	WG517610	SAMP	Ethylbenzene	R1542829	B
	WG517315	SAMP	Chromium, Hexavalent	R1542389	J
	WG517636	SAMP	Mercury	R1543530	J
L497659-02	WG517694	SAMP	Phenanthrene	R1544570	J
	WG517610	SAMP	Ethylbenzene	R1542829	B
	WG517315	SAMP	Chromium, Hexavalent	R1542389	J
L497659-03	WG517636	SAMP	Mercury	R1543530	J
	WG517694	SAMP	Phenanthrene	R1544570	J
	WG517610	SAMP	Ethylbenzene	R1542829	B
L497659-04	WG517315	SAMP	Chromium, Hexavalent	R1542389	J
	WG517636	SAMP	Mercury	R1543530	J
	WG517694	SAMP	Phenanthrene	R1544570	J
L497659-05	WG517610	SAMP	Ethylbenzene	R1542829	B
	WG517658	SAMP	Cadmium	R1544529	O
	WG517795	SAMP	o-Terphenyl	R1544352	J1
L497659-06	WG517315	SAMP	Chromium, Hexavalent	R1542389	J
	WG517636	SAMP	Mercury	R1543530	J
	WG517610	SAMP	Ethylbenzene	R1542829	B
L497659-07	WG517658	SAMP	Cadmium	R1544529	O
	WG517795	SAMP	TPH (GC/FID) High Fraction	R1544352	J5
	WG517795	SAMP	o-Terphenyl	R1544352	J1
L497659-08	WG517315	SAMP	Chromium, Hexavalent	R1542389	J
	WG517636	SAMP	Mercury	R1543530	J
	WG517610	SAMP	Toluene	R1542829	J
L497659-09	WG517610	SAMP	Total Xylene	R1542829	B
	WG517658	SAMP	Selenium	R1544529	O
	WG517658	SAMP	Silver	R1544529	J
L497659-10	WG517795	SAMP	o-Terphenyl	R1544352	J1
	WG517315	SAMP	Chromium, Hexavalent	R1542389	J
	WG517694	SAMP	Fluorene	R1544570	J
L497659-11	WG517694	SAMP	Phenanthrene	R1544570	J
	WG517694	SAMP	p-Terphenyl-d14	R1544570	J1
	WG517610	SAMP	Toluene	R1542829	J
L497659-12	WG517610	SAMP	Ethylbenzene	R1542829	B
	WG517658	SAMP	Selenium	R1544529	O
	WG517658	SAMP	Silver	R1544529	J
L497659-13	WG517795	SAMP	o-Terphenyl	R1544352	J1
	WG517315	SAMP	Chromium, Hexavalent	R1542389	J
	WG517694	SAMP	Fluorene	R1544570	J
L497659-14	WG517694	SAMP	Phenanthrene	R1544570	J
	WG517694	SAMP	p-Terphenyl-d14	R1544570	J1
	WG517610	SAMP	Ethylbenzene	R1542829	B
L497659-15	WG517658	SAMP	Selenium	R1544529	O
	WG517658	SAMP	Silver	R1544529	J
	WG517795	SAMP	o-Terphenyl	R1544352	J1
L497659-16	WG517315	SAMP	Chromium, Hexavalent	R1542389	J
	WG517694	SAMP	Fluorene	R1544570	J
	WG517694	SAMP	Phenanthrene	R1544570	J
L497659-17	WG517694	SAMP	p-Terphenyl-d14	R1544570	J1

Attachment B
Explanation of QC Qualifier Codes

Qualifier	Meaning
B	(EPA) - The indicated compound was found in the associated method blank as well as the laboratory sample.
J	(EPA) - Estimated value below the lowest calibration point. Confidence correlates with concentration.
J1	Surrogate recovery limits have been exceeded; values are outside upper control limits
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high
J3	The associated batch QC was outside the established quality control range for precision.
O	(ESC) Sample diluted due to matrix interferences that impaired the ability to make an accurate analytical determination. The detection limit is elevated in order to reflect the necessary dilution.

Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC. Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods, it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable "unless qualified as 'R' (Rejected)."

Definitions

- Accuracy** - The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.
- Precision** - The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Difference.
- Surrogate** - Organic compounds that are similar in chemical composition, extraction, and chromatography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.
- TIC** - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Summary of Remarks For Samples Printed
01/20/11 at 15:30:52

TSR Signing Reports: 134
R3 - Rush: Two Day

Sample: L497659-01 Account: OXYGJCO Received: 01/18/11 08:30 Due Date: 01/20/11 00:00 RPT Date: 01/20/11 15:30
Sample: L497659-02 Account: OXYGJCO Received: 01/18/11 08:30 Due Date: 01/20/11 00:00 RPT Date: 01/20/11 15:30
Sample: L497659-03 Account: OXYGJCO Received: 01/18/11 08:30 Due Date: 01/20/11 00:00 RPT Date: 01/20/11 15:30
Sample: L497659-04 Account: OXYGJCO Received: 01/18/11 08:30 Due Date: 01/20/11 00:00 RPT Date: 01/20/11 15:30
Sample: L497659-05 Account: OXYGJCO Received: 01/18/11 08:30 Due Date: 01/20/11 00:00 RPT Date: 01/20/11 15:30
Sample: L497659-06 Account: OXYGJCO Received: 01/18/11 08:30 Due Date: 01/20/11 00:00 RPT Date: 01/20/11 15:30
Sample: L497659-07 Account: OXYGJCO Received: 01/18/11 08:30 Due Date: 01/20/11 00:00 RPT Date: 01/20/11 15:30
Sample: L497659-08 Account: OXYGJCO Received: 01/18/11 08:30 Due Date: 01/20/11 00:00 RPT Date: 01/20/11 15:30
Sample: L497659-09 Account: OXYGJCO Received: 01/18/11 08:30 Due Date: 01/20/11 00:00 RPT Date: 01/20/11 15:30



HYDROLOGY/GEOLOGY REPORT

CUTTINGS DISPOSAL FACILITY GARFIELD COUNTY, COLORADO

**PREPARED FOR:
OXY USA WTP LP
760 HORIZON DRIVE, SUITE 101
GRAND JUNCTION, CO 81506
PH: (970) 263-3637
CONTACT: CRAIG RICHARDSON**

**PREPARED BY:
OLSSON ASSOCIATES
826 21 ½ ROAD
GRAND JUNCTION, CO 81505
PH: (970) 263-7800
CONTACT: TIMOTHY DOBRANSKY**

FEBRUARY 7, 2011

**OLSSON ASSOCIATES
PROJECT No.: 010-2458**



GEOLOGIST'S STATEMENT

This report for the Cuttings Disposal Facility was prepared by me, or under my direct supervision, in accordance with the provisions of the *Colorado Oil and Gas Conservation Commission (COGCC)* for the owners thereof.

Karen O'Connor

2/15/11

Karen O'Connor, PG
Certified Professional Geologist
American Institute of Professional Geologists No. 10260

Date

Clint P Carney

2-15-11

Clint Carney, PG
Registered Professional Geologist
State of Nebraska No. 0286

Date

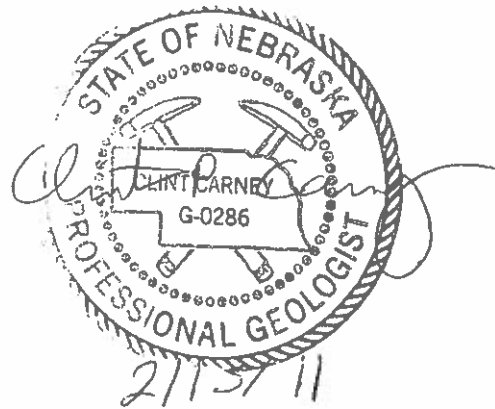
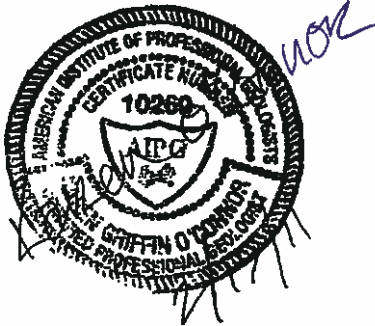


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Figure 1 – NRCS Soils Map

Figure 2 – Surface Geology Map

Figure 3 – Surface Water Map

Geologic Discussion

Soils

The location of the proposed Oxy Cuttings Disposal Facility is underlain by the Parachute-Irigul complex (PIC) with relatively gentle to modest slopes (5 to 30 percent). The Natural Resources Conservation Service (NRCS) describes a *complex* as consisting 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 Parachute, which comprises of about 60 percent of the soil in the PIC, is typically a loam in the upper foot and very channery to extremely channery loam to bedrock. The Parachute soil is derived from parent materials consisting of weathered shale, siltstone and residuum. The well drained soil in this area is estimated at 20 to 40 inches in thickness and has been defined as having no frequency of flooding or ponding. The Irigul, composed of channery to very channery loam with slopes of 5 to 30 percent is observed to be thinner than the Parachute with depths typically not exceeding 20 inches to bedrock. The parent material of the Irigul is residuum from sandstone and shale. Flooding or ponding of water on Irigul soils is not known to occur in this area as the soil is typically well-drained (NRCS, 2011).

Figure 1 provides the soils map for this project and a comprehensive report from the Natural Resources Conservation Service (NRCS) Colorado is provided in Attachment I.

Regional Geology

The proposed disposal facility is located near the southwestern rim of the Roan Plateau, an upland area demarcated regionally by cliffs of over 3,000 feet in height north of the Colorado River valley in Garfield County. The Roan Plateau is situated in the east-central part of the Piceance Basin, a northwest-southeast trending structural depression covering over 7,000 square miles in west central Colorado. The Piceance Basin lies within the Colorado Plateau physiographic province, a structurally stable, uplifted region of Precambrian- to Holocene-age geologic formations famous for high plateaus, thick sequences of Mesozoic stratigraphy, and deeply incised canyons in the Colorado River watershed (USGS, 2004). The Colorado Plateau province is also dotted with relatively younger volcanic features formed from uplift and exposure of intrusive igneous rock (lacoliths) during the Oligocene and Miocene Epochs and from extrusive volcanic activity during Miocene through Holocene Epochs that are visible in lava flows and cinder cones (Hunt, 1956).

Site Geology

The surficial topography in the immediate area of the proposed disposal facility is a relatively flat upland that slopes gently to the southeast towards Cascade Canyon and the Conn Creek drainage. Conn Creek is a tributary that discharges into the Roan Creek about seven miles upstream from where Roan Creek empties into the Colorado River.

The uplands of the Roan Plateau are incised by repeated shallow drainages that shed runoff from the plateau towards the Colorado River and its tributaries in this area of the Piceance Basin. The Eocene age Uinta Formation (Figure 2) is the uppermost (youngest) bedrock formation underlying the proposed facility. The Uinta Formation, which can be up to 1,400 feet at its thickest extent in the Piceance Basin (Robson and Saulnier Jr., 1981), consists primarily of sandstone and siltstone sequences deposited in fluvial and floodplain environments along with abundant volcanic deposits. The lower portion of the Uinta Formation contains light green shale and tan marlstone of the formerly defined Evacuation Creek Member of the Green River Formation (Porter, 1963, Tweeto, 1979 and Self and others, 2010). Underlying the Uinta Formation at the site are the Parachute Creek, Anvil Points, Garden Gulch, and Douglas Creek Members of the Green River Formation. These lacustrine and lacustrine-fluvial sedimentary members are composed of shale, sandstone, marlstone, and limestone deposited during the lifespan of Eocene Lake Uinta. The Parachute Creek and Garden Gulch members contain the highly sought after oil shales (Self and others, 2010). Completing the sequence of Tertiary age formations at the site are the Eocene-age variegated shales and lenticular sandstones of the Wasatch Formation and the Paleocene-age Fort Union (interbedded sandstones, shales, and thin coal beds) and Ohio Creek (conglomerates and sandstones) Formations. The Ohio Creek Formation straddles the Cretaceous-Tertiary boundary and past work had placed the formation in the late Cretaceous (Donnel, 1961, and Johnson and May, 1980), however, the USGS Geologic Map of Colorado (Tweeto, 1979) defines the unit as early Paleocene. Although the formations described in this section are mantled by soils and residuum at the site, over two thousand feet of the Uinta and Green River Formation members are exposed in the Roan Plateau cliffs.

Underlying the Tertiary deposits exposed in the Roan Plateau cliffs are thick sequences of Cretaceous formations, many of which also have energy production potential. Most notably are coalbeds and methane production within the Williams Fork and Illes Formations of the Mesa Verde Group.

Structural Geology

Regionally, the Piceance Basin trends northwest to southeast for over 100 miles with an asymmetrical axis oriented near the eastern edge of the basin. Geologic formations dip gently towards the axis on the western and southwestern areas of the basin, while strata dip sharply along the eastern basin rim. This sharply tilted strata forms the Grand Hogback, which is located approximately 25 miles east of the proposed disposal site. Within the basin, broad anticline (upwarp of strata) and synclines (downwarp of strata) parallel the basin axis. The highly faulted Douglas Creek Arch (regional uplift) forms the western flank of the basin. In the area of the proposed disposal facility, beds dip gently southwest and northeast off of the axis of the southern extension of the Douglas Creek Anticline.

Geologic Hazards

Minimum seismic activity near the proposed disposal facility has occurred in recent geologic time. Two earthquakes of magnitude greater than 5.0 occurred in Garfield County since the early 1960's when proper instrumentation was implemented in the state of Colorado. One occurred approximately 15 miles east of the project site and another occurred about 25 miles northwest of the proposed site. A third earthquake of between magnitudes 4.0-4.9 occurred during the same time span about 30 miles southwest of the project site (Kirkham and others, 2004).

According to the Colorado Geological Survey, no Quaternary age faults (the most recent 2 million years in geologic time) are present in the Roan Plateau area (Widmann and others, 1998). However, the Geologic Map of Colorado (Tweeto, 1979) indicates numerous northwest-southeast trending normal faults just south and southeast of the town of DeBeque. About 30 miles northwest of the project site, a large swath of northeast-southwest trending normal faults exist in the Cretaceous bedrock near the Douglas Creek Arch and the western fringe of the Piceance Basin. In addition, a series of normal faults trace along the eastern Piceance Basin boundary near the Grand Hogback. Although these faults are not always visible at the surface, this does not preclude the chance of an earthquake happening in the area at some point in the future. According to the Colorado Earthquake Hazard Mitigation Council (2008), "Earthquakes can also occur on faults that do not rupture the ground surface or on faults that are not yet recognized as being hazardous. These so called "random" earthquakes are considered in most hazard analyses to help account for faults that are not apparent at the earth's surface."

No surficial geologic hazards (landslide, mudflow, fan) or soils hazards have been mapped in the immediate vicinity of the proposed disposal facility. The location is not located in an area mapped as a floodplain Hazard by the Federal Emergency Management Agency (FEMA). However, because of the natural slope across the property within the northwest-to-southeast oriented drainage, overland flow is possible in the event of an extreme precipitation event. Although records of extreme rainfall events are unavailable for locations on top of the Roan Plateau, climate records since the mid-20th century indicate that the record 24-hour rainfall amounts at Grand Junction, Palisade, and Parachute have not exceeded 2 inches (Western Regional Climate Center, 2011). The duration of these events within a 24 hour period is not known, and it is possible that a short burst of intense rainfall event could cause local overland flow in the watershed that encompasses the project site if a precipitation rate exceeds the infiltration rate of the watershed soils.

Hydrologic Discussion

Surface Water Features

The well-pronounced drainages that sit atop the Roan Plateau are typically non-perennial except where springs provide consistent flow (Figure 3). The closest surface water features to the proposed disposal site are 3 mapped springs that transmit groundwater to the sub-drainage approximately 1,000 feet south of the southern property boundary. Flow measurement data is not currently available for these springs. Approximately 1,400 feet east of the property, a spring-fed drainage that empties into Cascade Canyon has been mapped to contain perennial flow according to Circle Dot Gulch 7.5' topographic map (USGS, 1971). However, more recent aerial imagery of the drainage indicates that the flow is likely ephemeral as no water was visible at the time the imagery was created (2009). The project location is not located in an area identified as a floodplain and as mentioned in the Geologic Hazards section, is not considered a flood hazard by FEMA.

No surface waters subject to COGCC Rule 317B are located near the proposed disposal site, and the area surrounding the proposed disposal facility contains no identifiable wetlands based on recent aerial imagery.

Shallow Groundwater

Spring flow at locations in close proximity to the proposed disposal site is indicative of shallow groundwater flow in the residuum mantling the Tertiary bedrock atop the Roan Plateau. As of January 2011, records from the Colorado Division of Water Resources indicate that no water production wells within a one mile radius around the site exist; therefore, it is difficult to assess the extent of shallow groundwater sources. However, because no wells exist within a one mile radius, no groundwater is used as a drinking water source down gradient of the proposed facility. If a well is drilled within one mile of this location and contains groundwater, Oxy will attempt to obtain permission and access from the landowner to collect a water sample from the well to provide a baseline status of water quality.

Based on surface topography, shallow groundwater movement in materials above the Tertiary bedrock is most likely to the south/southeast towards the mapped springs. Over half of the precipitation at higher elevations in the Piceance Basin falls as winter precipitation, of which serves as a groundwater recharge source in the form of snowpack (Taylor, 1987). The residuum material on the Roan Plateau acts as an absorptive veneer that transmits snowmelt as recharge to the underlying bedrock during the spring runoff period (Topper and others, 2003). The project site is included in an area defined by Glover and others (1998) as having "substantial natural recharge" in the northern province of the Piceance Basin. According to the U.S. Geological Survey, the Uinta-Animas aquifer, which contains the geologic units described in the previous section, receives approximately 24,000 acre-feet of recharge annually, and that discharge to surface water features down-gradient in the Piceance Basin approximately equals the annual aquifer recharge rate (Robson and Banta, 1995).

Major Aquifers

Although no water wells currently exist in the vicinity of the proposed disposal site, there is potential for groundwater development since the area is underlain by what has been defined as the Upper and Lower Piceance Basin aquifers. These aquifers exist primarily in the Piceance Basin north of the Colorado River, and much of the knowledge of aquifer characteristics has been gained by exploratory drilling for oil shale and coalbed methane development. The Upper Piceance Basin aquifer is comprised of the sandstone and fractured siltstone of the Uinta Formation and solution cavities and fractured marlstone of the upper portion of the Parachute Creek member of the Green River Formation (Robson and Saulnier Jr., 1981). A shallow, perched aquifer has also been observed in the uppermost extent of the Uinta Formation (Cole, Daub, and Weston, 1995). The lenticular sandstones of the Uinta Formation are typically discontinuous in nature. Because of the variable depositional pattern that formed these isolated sandstone lenses, consistent and reliable development of groundwater resources in the upper Piceance Basin aquifer is typically not an option.

Wells that are developed in the Uinta Formation are typically low yielding due to low matrix permeability of the sandstones and siltstones. According to the Colorado Ground Water Atlas, hydraulic conductivity for the Uinta Formation ranges from around 0.2 to 1.6 feet per day (ft/d), and wells yields in this region range from 1 to 900 gallons per minute (gpm). The lower Piceance Basin aquifer and the confining unit that separates it from the upper aquifer are entirely within the Parachute Creek member of the Green River Formation. The upper one-third of the Parachute Creek Member contains the oil shale-rich Mahogany Zone, an interval that acts as a confining unit between the upper and lower Piceance Basin aquifer. The Mahogany confining unit averages around 160 feet in thickness and is the principal target zone for potential oil shale development in the Piceance Basin. The fractured marlstone of the Parachute Creek Member underlying the Mahogany confining unit is the productive zone that forms the lower aquifer. Permeability and production capability in this interval is quite similar to the upper aquifer, as hydraulic conductivity ranges between 0.1 and 1.1 ft/d and production ranges from 1 to 1,000 gpm for wells tapping the fractures of the lower Parachute Creek Member marlstone (Glover and others, 1998). Thicknesses of the upper and lower aquifer at the proposed disposal facility is less than 500 feet for each unit. The lower Piceance Basin aquifer is bounded below by a confining unit composed of the remainder of the Green River Formation along with the Wasatch and Fort Union Formations.

Groundwater movement in the Tertiary aquifer units is generally from south to north across the northern province of the Piceance Basin towards the White River drainage. As previously mentioned, the southern rim of the Roan Plateau has been defined as an area of natural recharge. Groundwater levels (potentiometric surface) in the recharge areas of the Piceance Basin aquifers range from 8,000-8,400 feet and drop to around 6,000 feet on the northern end of the basin in the discharge area of the White River. Across the basin, the gradient of flow varies significantly. In the recharge area, the gradient in both the upper and lower aquifer units is generally flat.

The gradient steepens north of the project site in southern Rio Blanco County, and it is evident that the Piceance Creek drainage exerts influence on the flow regime as an area of discharge, particularly in the upper aquifer. This gradient pattern indicates upward movement of flow from the lower aquifer up through the Mahogany zone and the upper aquifer in the drainage area of the Piceance Creek. In other areas where both aquifer units sit above area drainages in elevation, the units emit water via springs that feed tributary streams to the main-stem drainages, such as in the Roan and Parachute Creek valleys (Glover and others, 1998).

Underlying the Tertiary confining units below the lower Piceance aquifer is the Cretaceous Mesa Verde Group, which approaches 7,000 feet in thickness near the center of the basin. The Mesa Verde is comprised of inter-layered sandstones, shales, siltstones and coals. The aquifer portions of the group create composite saturated thicknesses of less than 500 to 2,000 feet, however. The aquifer units of the Mesa Verde are typically not developed on the Roan Plateau due to economic factors of deep well installation and the availability of water in the overlying Tertiary units (Glover and others, 1998). Permeability of aquifers within the Mesa Verde Group is typically quite low, as hydraulic conductivity values range from 0.0001 to 0.001 ft/d in the project area (Topper and others, 2003).

Groundwater Quality

Water quality is variable in the Piceance aquifers across the northern province of the basin. The primary water quality concern is dissolved solids, which can exceed 10,000 milligrams (mg/l) per liter in some areas. In the upper aquifer, total dissolved solids (TDS) ranges from less than 500 mg/l in the south (including the proposed disposal site) to over 1,000 mg/l in the northern extent of the basin. In the lower aquifer, TDS values range from less than 1,000 mg/l in the south to over 10,000 mg/l near the White River Basin. Geochemical conditions in the recharge areas of the Tertiary aquifers typically enhance dissolution of calcite and dolomite, a process that enhances loading of TDS as groundwater moves down-gradient towards areas of discharge. TDS values in both aquifers at the project site are typically 1,000 mg/l or less, which are levels still suitable for potable use (Glover and others, 1998).

Water Wells and Water Use

As previously mentioned, no water production or monitoring wells exist within Section 9 of Township 6 South, Range 97 West as of November 2010. Within two sections in each direction of Section 9, 17 records exist within the Colorado Division of Water Resources registered well database. Of these, only one has a use status designated as a domestic/stock. The remaining records are categorized as monitoring wells or have not use indication at all. Most of the wells in operation in Garfield County are located along the Colorado River valley. As of 2005, 0.8 percent of the total fresh water used in Garfield County was from groundwater (Kenny and others, 2009). Although no specific use records for groundwater were available from the 2005 circular, categorized use from 1995 estimated that commercial and irrigation uses of groundwater were 37 and 27 percent of the annual total, respectively, with domestic withdrawals comprising the remaining 20 percent of Garfield County groundwater use (Solley and others, 1998).

Potential Impacts to Surface Water and Groundwater

As previously described, the proposed disposal facility is not located in an area identified as a floodplain and as mentioned in the Geologic Hazards section, is not considered a flood hazard by FEMA. No surface waters subject to COGCC Rule 317B are located near the proposed disposal site, and the area surrounding the proposed disposal facility contains no identifiable wetlands. No perennial streams exist within 0.25 miles of the proposed facility despite two intermittent drainages exist within 0.25 miles of the project site. Although shallow aquifer information is currently not available, the presence of springs down-gradient from the proposed site indicate that shallow groundwater flow can occur through the alluvium/colluvium mantling the dry channel southwest of the proposed disposal facility. The flow patterns of the springs are not known at this time, but recent aerial imagery of the site does not indicate active surface flow down-gradient from these springs under normal climatic conditions. As with all watersheds in the arid west with moderate slopes, heavy runoff events could temporarily create surface flow conditions and an elevated shallow water table at and down-gradient of the proposed facility.

Potential impacts to groundwater would likely involve shallow subsurface flow in the soil and colluvium above the competent Piceance Basin bedrock formations underlying the site. This local flow would likely follow the pattern of surface topography drainages which orient towards the south/southeast before emptying into Cascade Canyon. In a regional sense, the proposed facility exists in a recharge area for the Piceance Basin aquifers that underlie the Roan Plateau. Based on the depth to the water table, the presence of restrictive confining units, the length of travel to regional discharge areas, and the limited domestic/public use of water from these aquifers on the Roan Plateau, very little risk potential exists to the bedrock aquifers from the proposed disposal facility.

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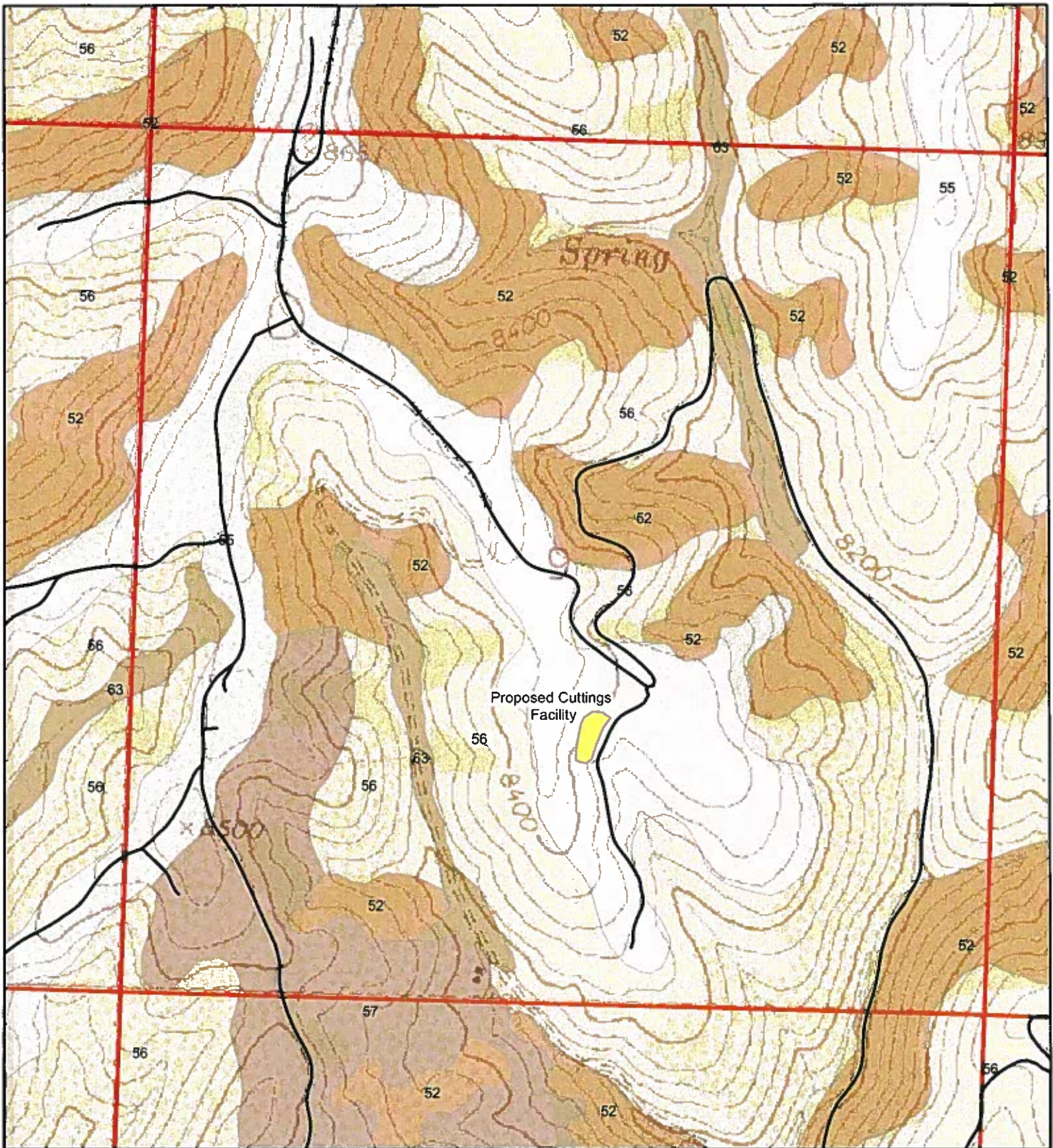
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NRCS Soils

- 52 - Northwater-Adel complex, 5 to 50 percent slopes
- 55 - Parachute-Ingul complex, 5 to 30 percent slopes
- 56 - Parachute-Ingul-Rhone association, 25 to 50 percent slopes
- 57 - Parachute-Rhone loams, 5 to 30 percent slopes
- 63 - Silas loam, 1 to 12 percent slopes

Refer to NRCS Soils Report for complete description of soil types



PROJECT NO:	010-2458
DRAWN BY:	JAS
DATE:	01/21/2011

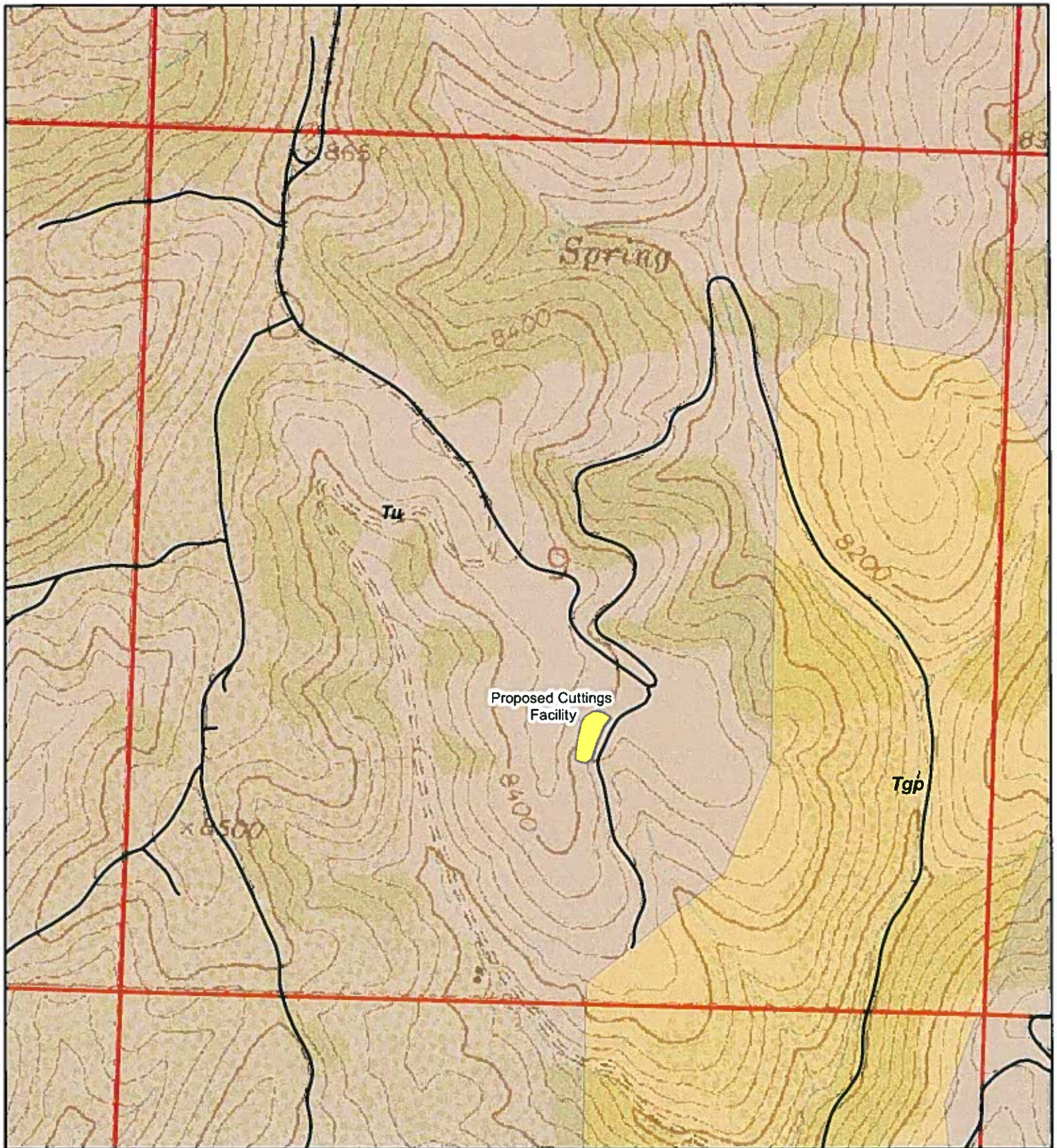
NRCS SOILS MAP
PROPOSED CUTTINGS FACILITY
OXY USA WTP LP
GARFIELD COUNTY, COLORADO



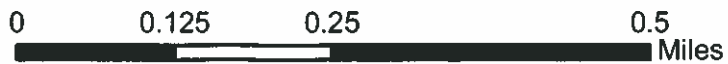
826 21-1/2 ROAD
 GRAND JUNCTION,
 CO 81505
 TEL 970.263 7800
 FAX 970.263 7456

FIGURE

1



- Legend**
- OXY Access Roads
 - Cuttings Area
- Surficial Geology**
- Tu - Uinla Formation
 - Tgp - Green River Formation



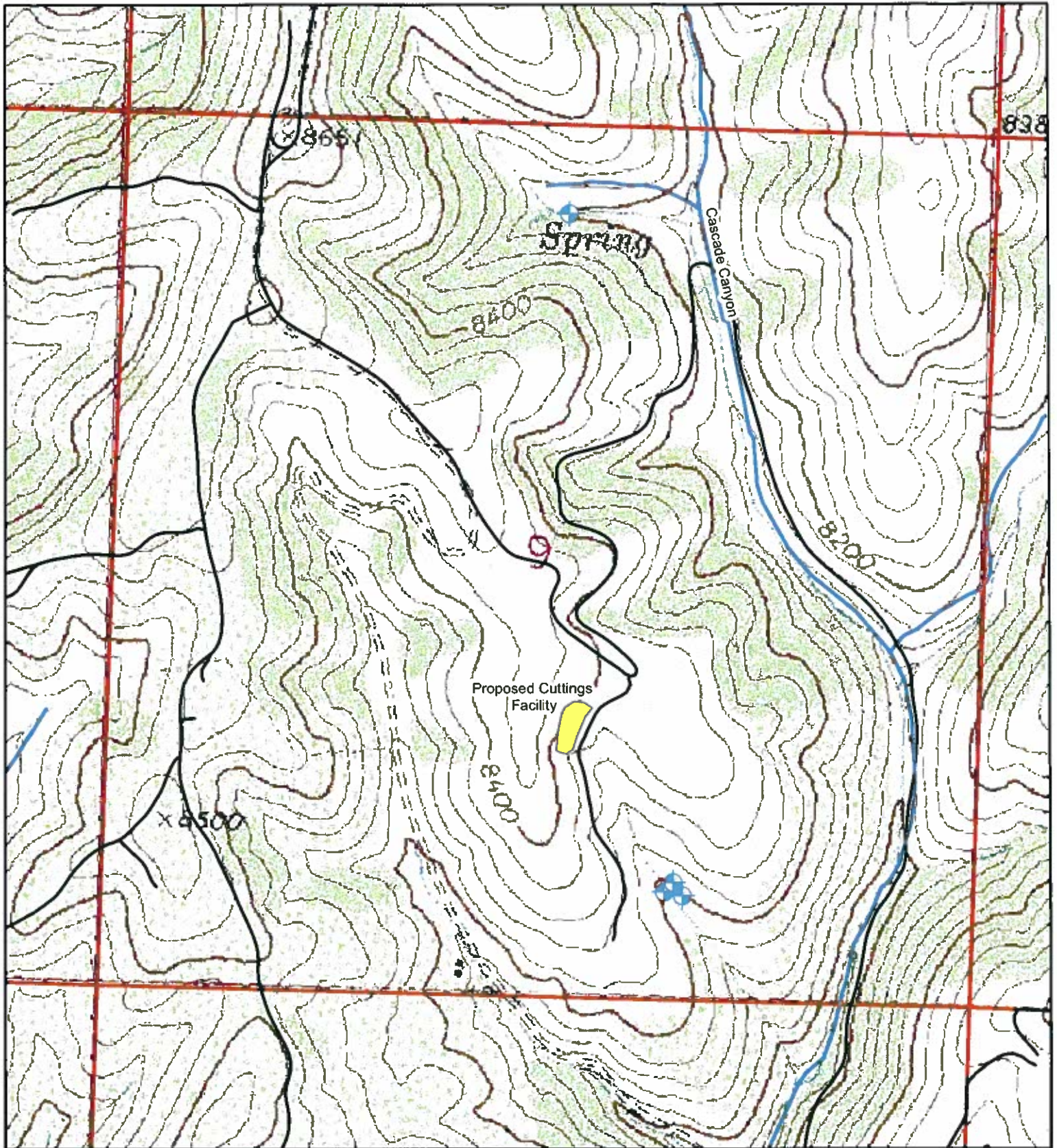
PROJECT NO:	010-2458
DRAWN BY:	JAS
DATE:	01/21/2011

SURFICIAL GEOLOGY
PROPOSED CUTTINGS FACILITY
OXY USA WTP LP
GARFIELD COUNTY, COLORADO



826 21-1/2 ROAD
 GRAND JUNCTION,
 CO 81505
 TEL 970.263.7800
 FAX 970.263.7456

FIGURE	2
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Legend

- Streams/Ditches
- OXY Access Roads
- Cuttings Area
- Spring

No wells within the area



PROJECT NO:	010-2458
DRAWN BY:	JAS
DATE:	01/21/2011

**SURFACE WATER
 PROPOSED CUTTINGS FACILITY
 OXY USA WTP LP
 GARFIELD COUNTY, COLORADO**



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FIGURE	3
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DRAINAGE REPORT

CUTTINGS RECLAMATION AREA GARFIELD COUNTY, COLORADO

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WYATT E. POPP, PE, LEED AP**

FEBRUARY 3, 2011

**OLSSON ASSOCIATES
PROJECT No.: 010-2458**



ENGINEER'S STATEMENT

This report and plan for the final drainage design of the Cuttings Reclamation Area was prepared by me, or under my direct supervision, in accordance with the provisions of the Colorado Oil and Gas Conservation Commission (COGCC) for the owners thereof.

Wyatt E. Popp
Wyatt E. Popp, PE
Registered Professional Engineer
State of Colorado No. 38514



2/16/11
Date

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APPENDIX B: SWALE ANALYSIS & DESIGN
APPENDIX C: RETENTION POND DESIGN
APPENDIX D: IMPROVEMENTS PLAN

A. INTRODUCTION

1. Purpose of Report

This Final Drainage Report has been prepared for OXY USA WTP LP for a Cuttings Reclamation Area in order to improve the site's ability to alleviate the impact of storm water run-on/run-off, and bring the site into compliance with the COGCC rule stating,

"Surface water diversion structures, including, but not limited to berms and ditches, shall be constructed to accommodate a one hundred (100) year, twenty-four (24) hour event. The facility shall be designed and constructed with a run-on control system to prevent flow onto the facility during peak discharge and a run-off control system to contain the water volume from a twenty-five (25) year, twenty-four (24) hour storm."

The design of proposed structures and associated recommendations presented herein are intended to satisfy site-specific storm water regulations of the COGCC.

2. Site Location

The Cuttings Reclamation Area project is located in the NWSE Section 9, Township 6 South, Range 97 West of the Sixth Principal Meridian, County of Garfield, State of Colorado. Refer to Figure 1 and the Drainage Improvements Plan in Appendix D for project location.

The project is bounded by a sloping hillside running from west to east, and bordered on the southeast side of the area by an existing natural gas service road. A Williams pipeline running from northwest to southeast borders the northeast side of the reclamation site, and an Oxy pipeline runs alongside the existing road. The Oxy 609-33 pad site is located approximately 200 feet northeast and across the existing road from the project area.

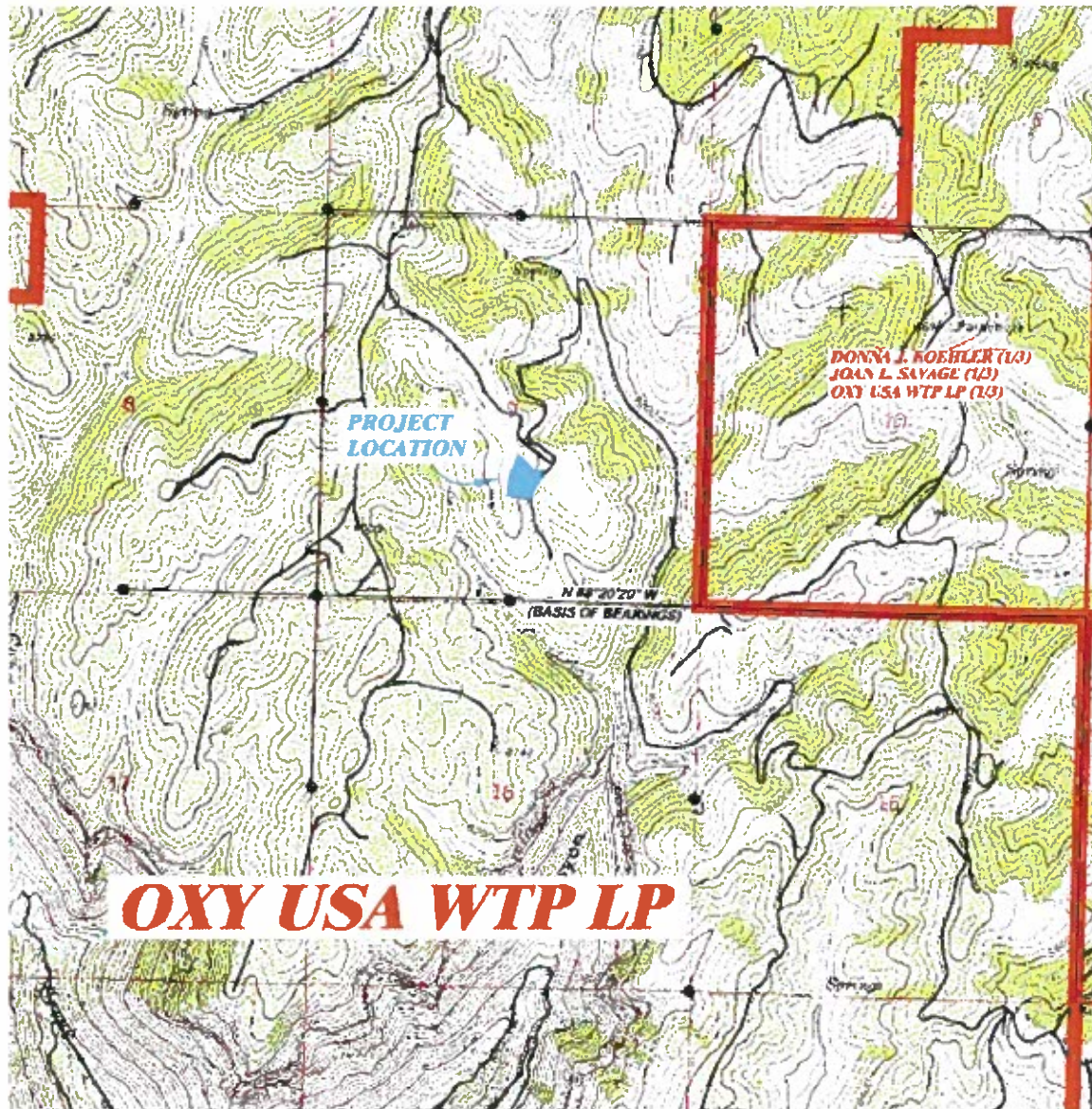


Figure 1: Vicinity Map

3. Site Description

The proposed cuttings reclamation area is on the Roan Plateau. Other roads and natural gas pads surround the area near the site. Access can be gained through Garden Gulch Road north of Parachute, CO. The existing area for the proposed site is undisturbed, and the surrounding area use is for grazing and rangeland.

4. Existing Drainage Facilities

There are no existing drainage facilities located on the project site. A roadside drainage conveyance swale is associated with the existing roadway immediately adjacent to the east

side of the site. The flow direction of the roadside swale is to the south.

5. Proposed Drainage Improvements

To improve the overall drainage design of the cuttings site, two flow mitigation/control measures are analyzed within this report. These measures consist of diverting 100 year/24-hour storm run-on flows by a swale/ berm above the site and a containment berm for a portion of the 25 year/24-hour storm run-off flows. The diversion swale will minimize run-on from entering the site, and the containment berm will minimize run-off from exiting the site.

A diversion berm/swale (refer to Appendix D, Drainage Improvements Plan, Section A-A) should be graded into the hillside immediately adjacent to the west side of the site to capture and divert run-on flows which are generated between the site and the uppermost portion of the basin. The top of the berm should be at least 1.7 ft above the existing grade, thus providing a swale with 2:1 (H:V) side slopes to convey potential run-on flows to Cascade Creek. Anticipated 100-year flow depth is 0.68 ft. Again, grade control structures should be placed within the swale at specified intervals to maintain a maximum longitudinal slope of 2.0 percent and a maximum flow velocity of 5.0 ft/sec. Lining the swale with adequate protection, i.e. riprap, could serve as an alternative to installing grade control structures.

Finally, a containment berm along the east side of the site should be constructed to capture the 25-year, 24-hour pad run-off volume, thus reducing and/or eliminating discharge to downstream basins during events up to the 25-year storm (refer to Appendix C for retention sizing calculations and Appendix D, Drainage Improvements Plan for berm location). The volume generated by the design storm is 13,874 ft³. Full containment of the run-off volume for this site is impractical as the required containment berm would need to be constructed over 8 ft in height. The project is not a development site but rather a location to reclaim cuttings. The operation will consist of placing fill on the existing hillside. Stormwater runoff should not be a primary concern for the site since the land use and run-off flow rates prior to construction and after construction are similar. A reasonable containment berm is recommended to be constructed in order to mitigate erosion during the construction process. A proposed berm is assumed to be approximately 360 ft long x 3 ft tall, thus providing 1,620 ft³ of storage. Ultimately, the berm acts as sediment control by serving as a water quality pond and providing retention.

B. HISTORIC (EXISTING) DRAINAGE SYSTEM

1. Major Basin

The site is tributary to Cascade Creek, into which all potential run-on flows are intended to be discharged.

2. Sub-Basin Run-On Flows

Based on the existing flow patterns, one drainage basin has been identified (for run-on flows) and existing 100-year flow rates have been calculated for this basin (refer to Appendix A for existing 100-year run-on rate calculations):

Basin X1

Basin X1 is located west of the site. Storm water within this basin generally flows east and south to the existing road, and empties into Cascade Creek.

Area = 0.69 acres

Estimated Time of Concentration = 10 minutes

Existing Imperviousness = 60%

Runoff Coefficient, C_{100} = 0.56

Existing run-on rate from Basin X1, Q_{100} = 1.76 cfs

C. PROPOSED (DEVELOPED) DRAINAGE SYSTEM

1. Criteria

A single sub-basin, P1, was used to model the site during the 25-year storm event. Refer to the Drainage Improvement Plan in Appendix D for basin delineation.

Hydrologic Method

The Rational Method was used to compute peak runoff flows and volumes. This method is defined as follows:

$$Q = CIA$$

Where: Q = Peak Discharge (cfs)

C = Runoff Coefficient

I = Rainfall Intensity (in/hr)

A = Drainage Area (ac)

Design Storm Frequencies (Rainfall Information)

The 25-year and 100-year design storm frequencies were used for the design of storm water facilities for this project. Point rainfall data and rainfall intensity information were taken from the NOAA Atlas 2, Volume III Colorado, 1973.

2. Sub-Basin Run-off Flows

Run-off from the pad during the 25-year event was analyzed and the volume of the 25-year, 24-hour storm was determined. A portion of the run-off from the site (Basin P1) during the 25-year storm should be captured and stored within the proposed containment berm.

Calculations for the 25-year run-off rate can be found in Appendix A.

3. Retention

A portion of the 25-year, 24-hour volume of site run-off should be captured within the proposed containment berm located along the eastern edge of the site. Refer to Appendix C for retention facility sizing and Appendix D, Drainage Improvements Plan, for the proposed

containment berm.

D. ANALYSIS OF UPSTREAM AND DOWNSTREAM EFFECT

The proposed drainage improvements consist of a system of diversion swales and a containment berm to divert potential run-on flows around the pad and reduce run-off flows from the pad. The berm/swales will divert 100-year run-on flows to downstream basins, while retention within the proposed containment berm will eliminate a portion of the 25-year pad run-off to downstream basins. The containment berm will function as a water quality pond, allowing sediment-laden pad run-off to separate before discharging to downstream basins. The diversion of run-on flows and reduction of run-off rates associated with these proposed improvements should help mitigate any erosion which may currently exist today.

E. CONCLUSIONS

Proper implementation of the proposed measures outlined in this report will alleviate the direct impacts of storm water run-on/run-off, and bring the site into compliance with the intent of current COGCC storm water regulations.

Full compliance for run-off mitigation is not achieved due to the limitations of construction. The intent of the rule is met through the retention of a portion of the 25-year, 24-hour event. No adverse impacts are expected since the site is not a development project. The construction activity associated with the project is adding fill to the existing terrain. Run-off rates prior to construction and after construction are expected to be the same since the land use is similar. The primary concern during construction will be sediment control. A containment berm is proposed to mitigate sediment transport and serve as a water quality pond by offering a portion of stormwater retention.

The proposed improvements contained herein will not adversely impact adjacent basins, and will reduce the impact of run-off flow on downstream basins. The analysis of the proposed systems for diverting run-on and capturing run-off are not intended to be mutually exclusive, and should be utilized in tandem to improve the overall drainage design for this project.

Regular maintenance should be performed on the diversion swale and containment berm. It is recommended that the sediment be removed once the capacity is reduced by half.

A registered licensed engineer in the state of Colorado should be consulted for the preparation of construction plans related to the recommendations outlined within this report.

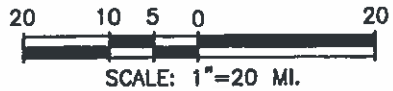
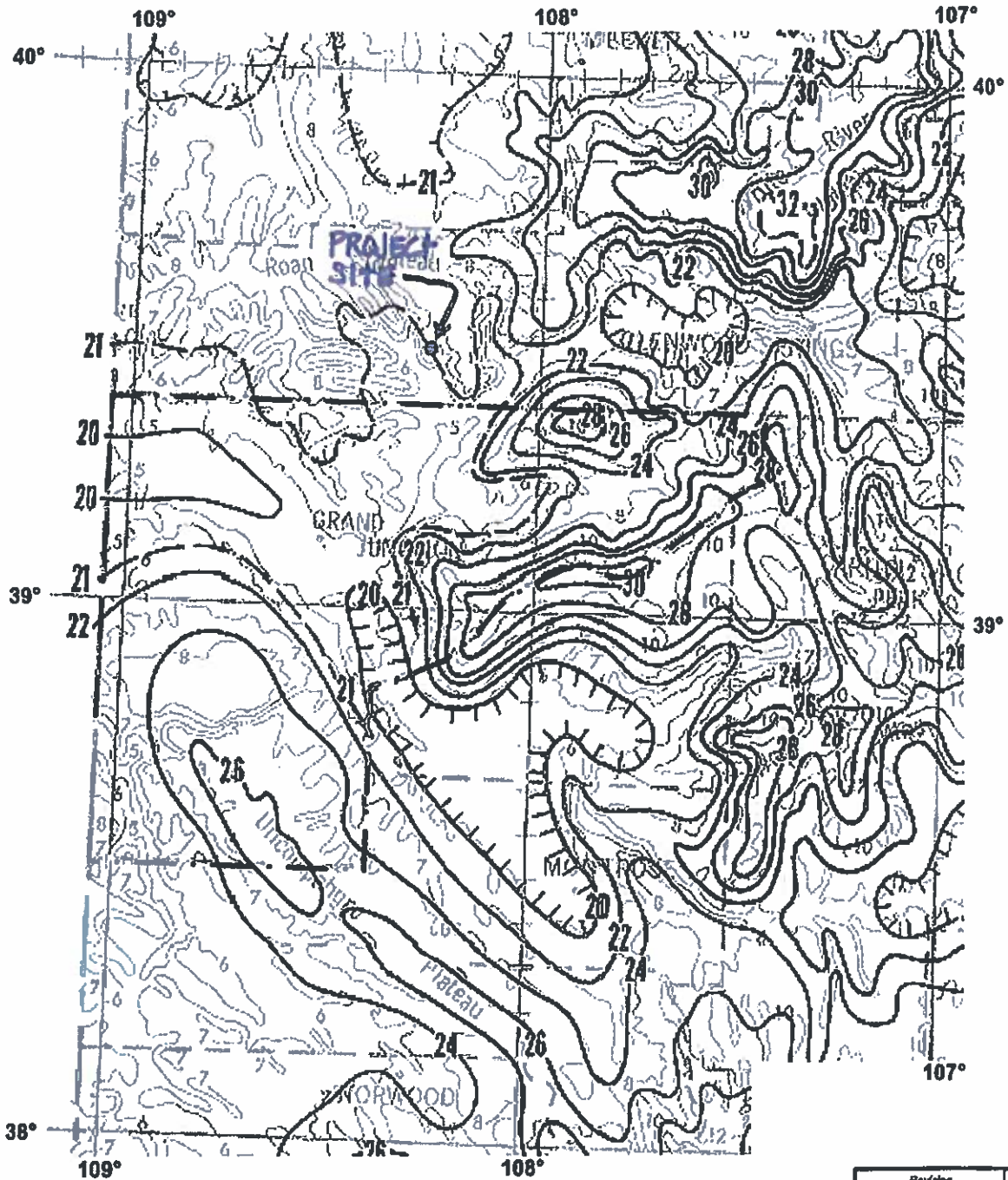
F. REFERENCES

- 1) Mesa County Storm Drainage Criteria Manual
- 2) Bently Flowmaster Software
- 3) NOAA Atlas No. 2, Volume III Colorado, 1973

APPENDIX A: RUNOFF CALCULATIONS

STORMWATER MANAGEMENT MANUAL

RAINFALL DEPTH-DURATION-FREQUENCY 25-YEAR, 24-HOUR (DEPTHS IN TENTHS OF INCHES)



— · — MESA COUNTY BOUNDARY

Revision	Date
ORIGINAL ISSUE	3/27/06

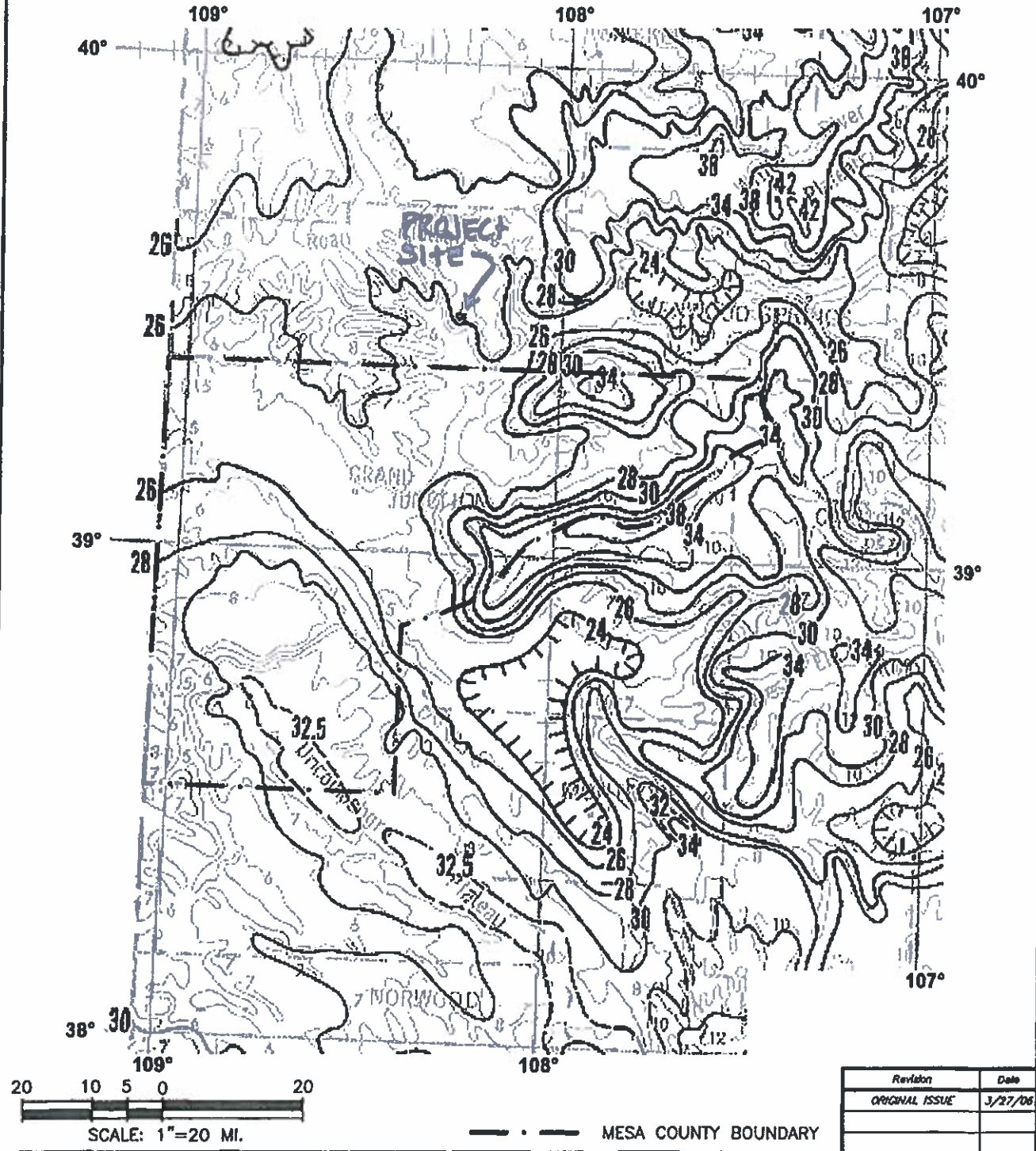
WRC ENGINEERING, INC.

REFERENCE:
NOAA ATLAS 2, VOLUME III COLORADO, 1973

FIGURE 611

STORMWATER MANAGEMENT MANUAL

RAINFALL DEPTH-DURATION-FREQUENCY 100-YEAR, 24-HOUR (DEPTHS IN TENTHS OF INCHES)



Revision	Date
ORIGINAL ISSUE	3/27/06

WRC ENGINEERING, PC

REFERENCE:
NOAA ATLAS 2, VOLUME III COLORADO, 1973

FIGURE 613

Precipitation Frequency Data Output

NOAA Atlas 2
Colorado 39.534710°N 108.224245°W
Site-specific Estimates

Map	Precipitation (inches)	Precipitation Intensity (in/hr)
2-year 6-hour	0.93	0.15
2-year 24-hour	1.31	0.05
100- year 6- hour	2.05	0.34
100- year 24-hour	2.72	0.11

Hydrometeorological Design Studies Center - NOAA/National Weather Service
1325 East-West Highway - Silver Spring, MD 20910 - (301) 713-1669
Fri Jan 21 12:53:11 2011

STANDARD FORM SF-2														
TIME OF CONCENTRATION (HISTORIC & DEVELOPED)														
LOCATION: Garfield County				Final Drainage Study				BY: WEP				DATE: 2/2/2011		REMARKS
SUB-BASIN DATA		INIT./OVERLAND TIME (TI)		TRAVEL TIME (TI)		Tc Check (Urbanized Basins)		TOTAL		FINAL Tc		FORMULAS:		
DESIGNATION	C _s	AREA (AC)	LENGTH (FT)	SLOPE %	T _i (Min.)*	GRASS/ PAVED	LENGTH (FT)	SLOPE %	VEL. (FPS)**	T _i (Min.)**	T _c = (L/180) * 10	T _c (minutes)	* T _i = 0.395 (1.1-C _s)L ^{0.5} /100 ^{1/3}	
X1	0.41	0.69	10	11.00	1.80	GRASS	86	11.00	2.32	0.62	10.53	10.00	** V = Cv*(S/100) ^{0.5}	
P1	0.41	1.77	10	25.00	1.37	GRASS	255	25.00	3.50	1.21	11.47	10.00		

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE, STANDARD FOR SF-3)
DESIGN STORM: 25-YEAR DEVELOPED

Calc. by: WEP
 Chkd by: WEP
 Date: 2/2/2011

OXY Cuttings Reclamation Area Final Drainage Study Garfield County REMARKS

DESIGN POINT	BASIN	DIRECT RUNOFF					TOTAL RUNOFF					REMARKS		
		AREA (AC)	COEFF. (C)	Tc (Min.)	C-A	I (in./hr.)	Q (cfs)	Sum Area	Tc (min)	I (in./hr.)	Sum C-A		Total Q (cfs)	
	X1	0.69	0.51	10.00	0.35	3.43	1.2							
	P1	1.77	0.51	10.00	0.90	3.43	3.1							Retain 25YR, 24HR volume on site

**STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE, STANDARD FOR SF-3)
DESIGN STORM: 100-YEAR DEVELOPED**

Calc. by: WEP
Chkd by: WEP
Date: 2/2/2011

DESIGN POINT	OXY Cuttings Reclamation Area		Final Drainage Study				Garfield County				REMARKS		
	BASIN	AREA (AC)	COEFF. (C)	Tc (Min.)	C.A	I (in./hr.)	Q (cfs)	Sum Area	Tc (min)	I (in./hr.)		Sum C.A	Total Q (cfs)
	X1	0.69	0.56	10.00	0.39	4.56	1.76						
	P1	1.77	0.56	10.00	0.99	4.56	4.52						

Flow is diverted around site via diversion swale

APPENDIX B: SWALE ANALYSIS & DESIGN

Diversion Swale/ Berm Worksheet for Triangular Channel

Project Description

Worksheet	Diversion Swale/ Berm
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.045
Channel Slope	1.60 %
Left Side Slope	2.00 H : V
Right Side Slope	2.00 H : V
Discharge	1.76 cfs

Results

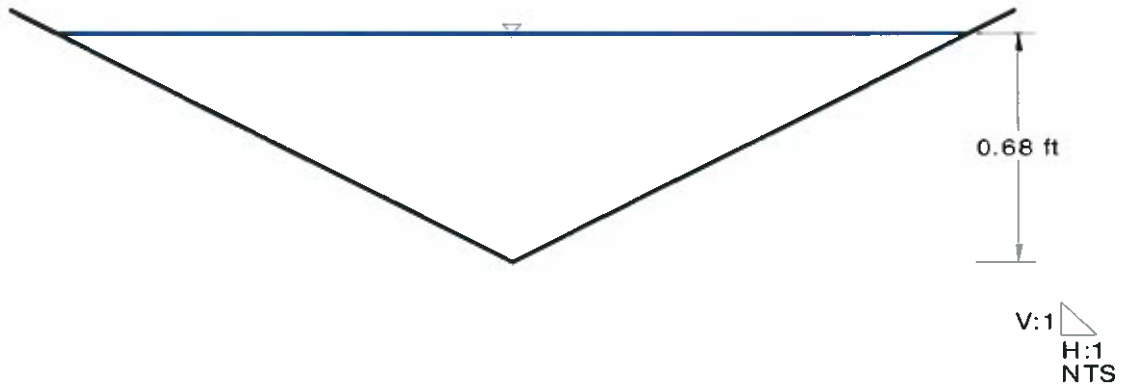
Depth	0.68 ft
Flow Area	0.9 ft ²
Wetted Perimeter	3.05 ft
Top Width	2.73 ft
Critical Depth	0.55 ft
Critical Slope	5.28 %
Velocity	1.89 ft/s
Velocity Head	0.06 ft
Specific Energy	0.74 ft
Froude Number	0.57
Flow Type	Subcritical

Cross Section

Cross Section for Triangular Channel

Project Description	
Worksheet	Diversion Swale/ I
Flow Element	Triangular Channel
Method	Manning's Formu
Solve For	Channel Depth

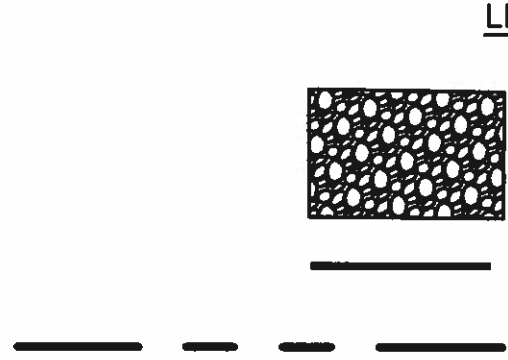
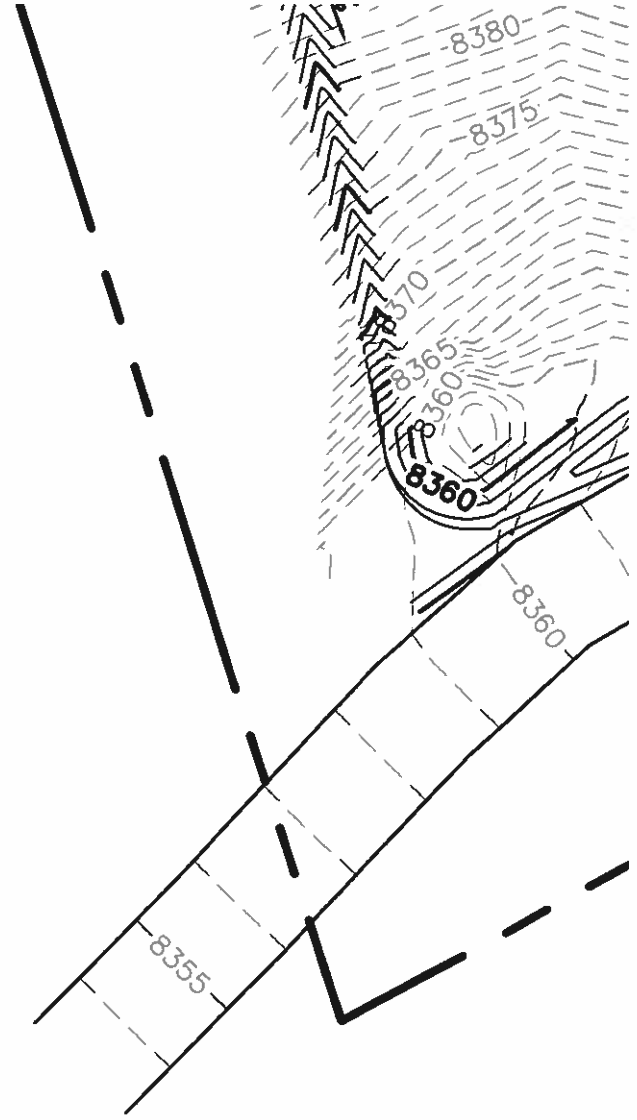
Section Data	
Mannings Coeff	0.045
Channel Slope	1.60 %
Depth	0.68 ft
Left Side Slope	2.00 H : V
Right Side Slope	2.00 H : V
Discharge	1.76 cfs



APPENDIX C: RETENTION DESIGN

APPENDIX D: IMPROVEMENTS PLAN

DWG: F:\Projects\010-2458_MUNI\Final_Plans\102458_SIT.dwg USER: dseeger
DATE: Feb 03, 2011 7:32am XREFS: 102458_TBLK 102458_XBASE



LEGEND

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DATE: Feb 03, 2011 7:35am XREFS: 102458_TBLK 102458_XBASE

SWALE @ 23%

