



State of Colorado Oil and Gas Conservation Commission



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

CENTRALIZED E&P WASTE MANAGEMENT FACILITY PERMIT

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

FOR OGCC USE ONLY

Surety ID: _____

OGCC Operator Number: 77330
Name of Operator: SG Interests I Ltd.
Address: PO Box 26
City: Montrose State: CO Zip: 81402

Contact Name and Telephone:
Catherine Dickert
No: 970-209-6464
Fax: 970-252-0636

Surface Owner (if different than above): Rock Creek Ranch I Ltd.
Address: 100 Waugh Drive, Suite 400
City: Houston State: TX Zip: 77007 Phone: 713-951-0100

Facility Name: McIntyre Flowback Pits #1 and #2
Address: NA
City: NA State: NA Zip: NA
Phone: NA Fax: NA

Location (QtrQtr, Sec, Twp, Rng, Mer):
SWNW Sec 24 and NESE Sec 23, T11S, R90W, 6th PM
Latitude: 39.085792
Longitude: -107.405528

Complete the Attachment Checklist

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

1. Is the site in a sensitive area? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N		2. What are the average annual precipitation and evaporation rates for the site? Precipitation: <u>14.02</u> inches/year Evaporation: <u>39.71</u> inches/year	
3. Has a description of the site's general topography, geology and hydrology been attached? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N			
4. Has a description of the adjacent land use been attached? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N		5. Has a 1:24,000 topographic map showing the site location been attached? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N	
6. Has a site plan showing drainage patterns, diversion or containment structures, roads, fencing, tanks, pits, buildings and any other pertinent construction details been attached? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N			
7. If site is not owned by the operator, is written authorization of the surface owner attached? <input type="checkbox"/> Y <input checked="" type="checkbox"/> N		8. Has a scaled drawing and survey showing the entire section(s) containing the proposed facility been attached? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N	
9. What measures have been implemented to limit access to the facility by wildlife, domestic animals or by members of the public? Briefly explain. <u>Facility is surrounded by 7' high fence, is off main road on private land, and pits are covered with bird netting. Fencing and bird netting is inspected and properly maintained at all times.</u>			
10. Is there a planned firelane of at least 10 feet in width around the active treatment areas and within the perimeter fence? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N		11. Is there an additional buffer zone of at least 10 feet within the perimeter firelane? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N	
12. Have surface water diversion structures been constructed to accommodate a 100-year, 24-hour event? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N		13. Has a waste profile been calculated according to Rule 908.b.6? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N	
14. Has facility design and engineering been provided as required by Rule 908.b.7? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N		15. Has an operating plan been completed as required by Rule 908.b.8? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N	
16. Has ground water monitoring for the site been provided? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N ***Attach Water Analysis Report, Form 25, for each monitoring well installed.***			
17. Has financial assurance been provided as required by Rule 704? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N		18. Has a closure plan been provided? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N	
19. Have local government requirements for zoning and construction been complied with? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N		20. Have permits and notifications required by local governments and other agencies been provided? <input type="checkbox"/> Y <input checked="" type="checkbox"/> N	

Print Name: Catherine Dickert

Signed: _____ Title: Environmental and Permitting Manager Date: _____

OGCC Approved: _____ Title: _____ Date: _____

CONDITIONS OF APPROVAL, IF ANY:

Facility Number: _____

Attachment A

Site Description

Site Description

McIntyre Flowback Pits 1 and 2

Geology

Soils at the flowback pit sites are Fughes loam, 15-25% slope (NRCS 2008). Geotechnical analysis indicated that these soils were of relatively uniform consistency and could be classified as medium stiff moist to very moist slightly silty to sandy clay (see attached geotechnical report for additional detail). Test bores encountered free subsurface water at a depth of 29 feet in both of two borings performed at this site.

Bedrock at this site is classified as Tertiary Wasatch formation (Tw). This unit consists of claystone, siltstone, and sandstone above the Kmv – Mesa Verde formation, which is primarily interbedded sandstone and claystone. The thickness of bedrock is not applicable to the proposed surface use of flowback pits.

No geologic hazards that would impact the proposed facility were identified in geotechnical investigations.

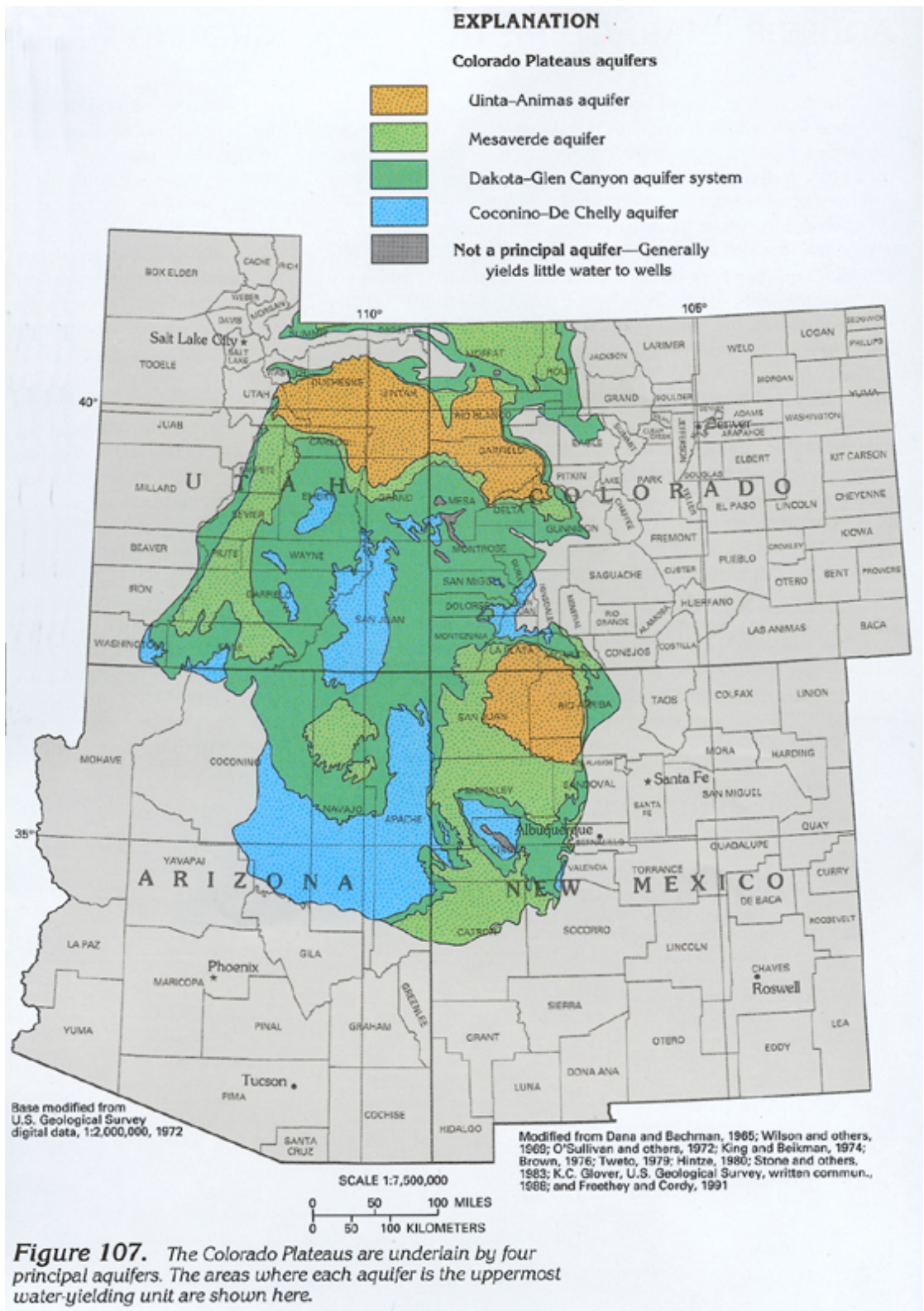
Hydrology

The depth to shallow groundwater was about 29 feet from the current ground surface elevation. The general hydraulic gradient is down to the northwest for shallow unconfined water.

Please see attached shallow water and surface water test point maps and water quality test results for information on quality of existing shallow groundwater and surface water in the pit vicinity (Attachment H).

Information on aquifers in the region is taken from “Ground Water Atlas of the United States, Arizona, Colorado, New Mexico, Utah, HA 730-C” published by the US Geological Service in 1995 (http://pubs.usgs.gov/ha/ha730/ch_c/index.html). The project area is underlain by the Colorado Plateaus Aquifers, which occur roughly beneath the Colorado Plateaus Physiographic Province. Specifically in the project area, the Mesaverde Aquifer, one of the principal aquifers that make up the Colorado Plateaus Aquifers, has been mapped. The Mesaverde Aquifer is underlain by the Mancos confining unit, which is comprised of Mancos Shale. The Mesaverde Group, in which the Mesaverde aquifer is found, is mostly sandstone with shale and coal interbedded. Mancos Shale thickness ranges from 1,000 to 6,000 feet. It is made up of marine shale, mudstone, and claystone with minor sandstone, siltstone, and limestone mixed in. Some sandstone strata are water-producing locally. In most places, however the Mancos Shale acts as a thick barrier to groundwater flow both vertically and laterally. The top of the aquifer ranges from sea level in the central Piceance Basin to 5,000 to 7,500 feet near the basin margins. The aquifer is about 2,500 to 5,000 feet thick in most area, but exceeds 7,000 feet in the eastern part of the basin. On the basin margins the aquifer may be only 1,000 feet thick. The aquifer is recharged in upland areas where there is more precipitation. In the Piceance, these areas are along the west flank of the West Elk Mountains, the Grand Mesa area, and along the Roan Plateau. Groundwater discharge occurs through direct movement from the aquifer to surface waters, such as the North Fork of the Gunnison River, through movement into other aquifers, and through withdrawal via wells. This groundwater withdrawal has been small in most areas of the Mesaverde Aquifer, therefore the potentiometric surface is similar to predevelopment conditions. The

altitude of this potentiometric surface ranges from 5,000 to 8,000 feet. Water quality is variable in the aquifer. In the region of the McIntyre Flowback Pits, dissolved solids concentration ranges from 3,000 to 10,000 mg/L. Maps of the aquifers in this region are also taken from “Ground Water Atlas of the United States, Arizona, Colorado, New Mexico, Utah, HA 730-C”.



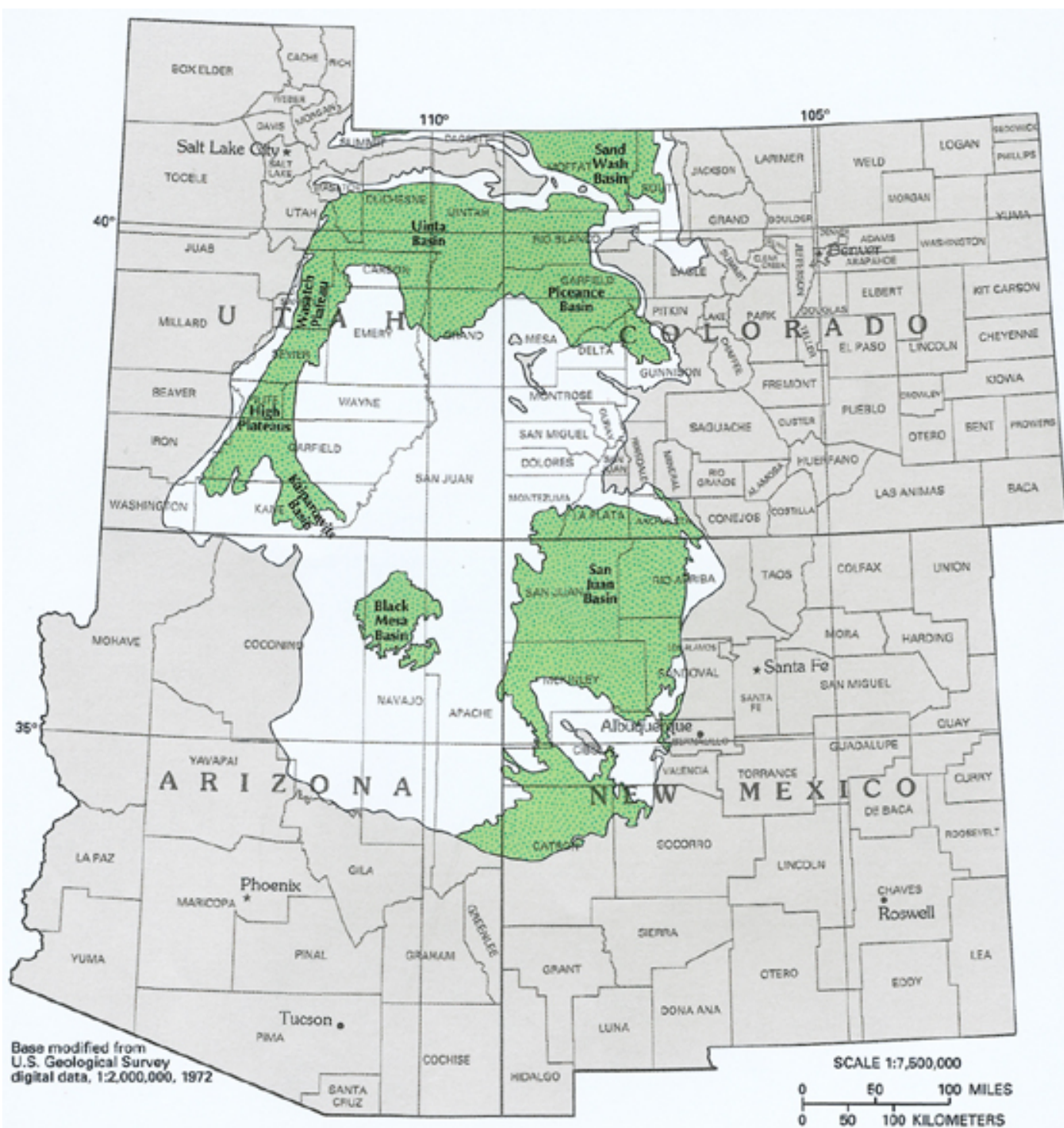
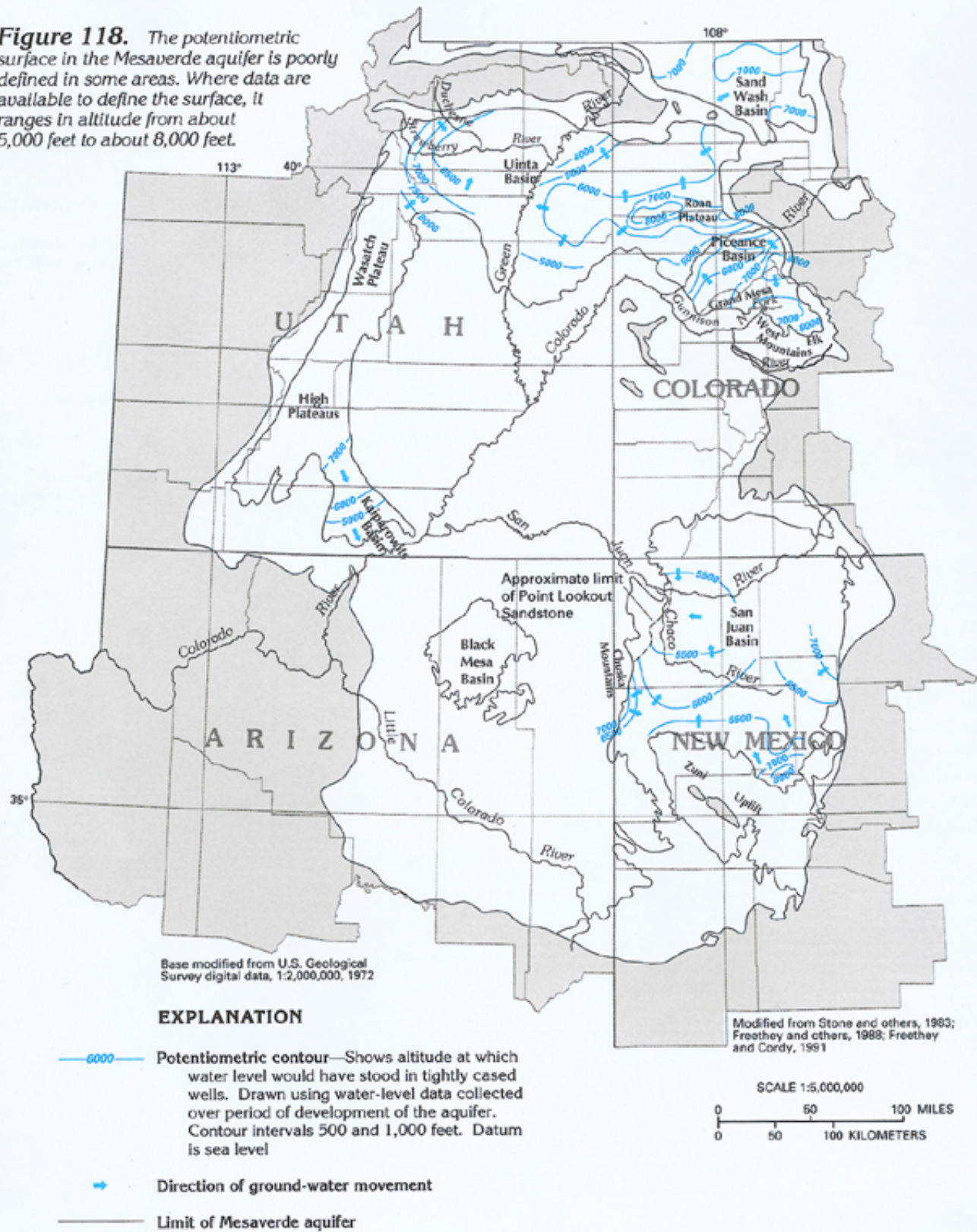


Figure 116. The Mesaverde aquifer is present in several parts of the area underlain by the Colorado Plateaus aquifers. The aquifer is most extensive in basins but also underlies plateaus in central Utah.

EXPLANATION

Mesaverde aquifer

Figure 118. The potentiometric surface in the Mesaverde aquifer is poorly defined in some areas. Where data are available to define the surface, it ranges in altitude from about 5,000 feet to about 8,000 feet.



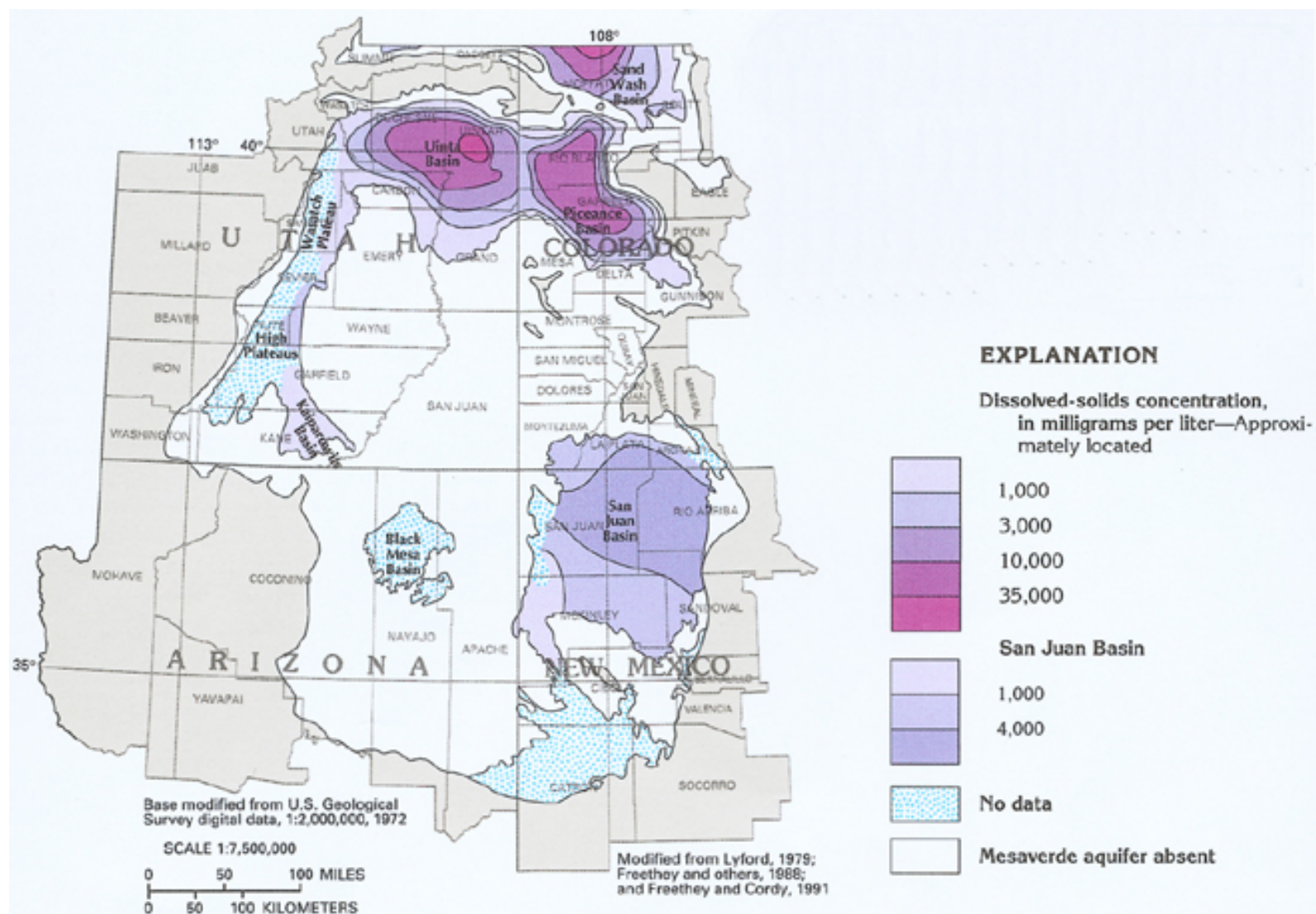


Figure 119. Concentration of dissolved solids in water from the Mesaverde aquifer is extremely variable; it is less than 1,000 milligrams per liter near many basin margins and exceeds 35,000 milligrams per liter near the center of the Uinta Basin.

Topography

SG proposes to construct the flowback pits in a region with rolling mountainous terrain (see Topo Map, Attachment C). The existing ground elevation is approximately 7,300'.

The average precipitation for the area is approximately 16.09 inches/year (Western Regional Climate Center for Meredith, Colorado, 7,772' elevation). The average pan evaporation rate for the area is estimated to be 39.71" (as measured at Meredith, CO, Western Regional Climate Center).

November 19, 2010

Ms. Catherine Dickert
Environmental and Permitting Manager
SG Interests, I Ltd.
1065 Main Avenue, Suite 209
Durango, CO 81301
Phone: 970-209-6464
cdickert@sginterests.com

PN: 52302GE

Subject: Proposed McIntyre #1, and #3 Ponds
Cursory Geotechnical Engineering Comments
Gunnison County, Colorado

Ms. Dickert,

This letter presents our cursory geotechnical engineering comments regarding the proposed McIntyre ponds project. We understand that the information requested is intended for your current effort and initiation of the permitting process. We are available to provide additional exploration and consultation as needed. Our field exploration work was completed on November 5, 2010. The logs of the test borings are attached.

We advanced one (1) test boring near the center stake parked at each of the four (4) proposed pond sites. The location of each test boring relative to the staked location is discussed on each of the logs. We met Mr. Eric Sanford at the project site at the initiation of our field work. The requested primary goal of the current exploration effort is to establish a based knowledge of the subsurface conditions at each of the proposed pond site included general subsurface soil and shallow subsurface water conditions. The response to the permit questions we provided in our November 12, 2010 e-mail to you are shown below. We have referred to the McIntyre #1 and #2 sites as "McIntyre #1" and the McIntyre #3 and #4 sites as "McIntyre #3" for clarity. The italic type is from the requested list of information provided to us by you.

Type and thickness of unconsolidated soils

McIntyre #1:

We advanced our test borings to a depth of thirty-nine (39) feet below the ground surface. We did not advance the test borings to a deeper depth due to encountering subsurface water at a depth of twenty-nine (29) feet below the ground surface in each of the test borings. The soils are relatively uniform consistency and classification of medium stiff moist to very moist slightly silty to sandy clay (CL)

McIntyre #3:

We advanced each of the test borings to a depth of forty-nine (49) feet. The soils encountered at the McIntyre #3 site are similar to those encountered at the McIntyre #1 site, that being of medium stiff, medium moist slightly silty clay with minor amounts of sand, (CL)

We did not encounter water or significantly moist soils in the borings at McIntyre #3

We encountered a stiff clay, or probably weathered claystone formational material at about forty (40) feet below the ground surface. Most likely this material is either derived from, or is the Tertiary Wasatch formation

General Comments On Unconsolidated Soil:

Both sites have about twelve (12) to eighteen (18) inches, or slightly more at the McIntyre #1 site of silty clay with organic soils (not necessarily topsoil, but silty clay with organics)

Type and Thickness of Bedrock

Tertiary Wasatch formation (Tw) This unit consists of claystone siltstone and sandstone above the Kmv – Mesa Verde formation which is primarily interbedded sandstone and claystone. The thickness is not applicable to the proposed surface use.

Local and Regional Geologic Structures

The Wasatch formation lies stratigraphically above of the Mesa Verde Group and is relatively flat lying at the McIntyre area. The site is on the western margin of a regional uplift from the Ragged Mountain laccolith to the east. The porosity and permeability of the regional sedimentary rocks decrease near the Ragged Mt laccolith and the possibility of preservation of oil or gas in that area is greatly reduced. The Ragged Mountain Lacolith is far enough east of the McIntyre site that it does not produce these effects on the underlying formations and does not have any effect on the proposed pond use.

Any Geologic hazards that may affect the design and operation of the facility

The only defined geologic hazard that may exist at this site as outline in House Bill 1041 (HB1041) is expansive soil, however this "hazard will not influence the design or operation of the lined pond structures. We do not feel that there is a geologic hazard that influences the design or operation of these proposed ponds.

Hydrologic properties of shallow ground water and major aquifers including flow direction, flow rate, and potentiometric surface

We are not ground water hydrologists, however we have provided some information regarding this topic below.

The depth to shallow water at the McIntyre #1 site is about twenty-nine (29) feet from the current ground surface elevation. The general hydraulic gradient is most likely down to the north-northwest for shallow unconfined water. We suspect that the Mesa Verde group sandstones and coal seams area aquifer in the area. Subsurface water flow rate is indeterminate at this stage of study and would take considerable study to determine as would developing factual data regarding the potentiometric surface. Since the proposed ponds will be lined with geotextile material any influence on the subsurface water and associated ground water flow characteristics is highly unlikely.

An evaluation of the potential for impacts to nearby surface water or ground water

As stated above, since the ponds will be lined they cannot influence anything in regard to the groundwater unless a leak occurs in the lining. Any impact on the surface water could only occur if the structure of the pond embankment berms is compromised, which also would likely require a failure of the lining, or a failure of the embankment design. It is our understanding that the current concept includes pond located primarily in an excavation cut into the site soils.

Generally the soils at both sites consist of slightly silty and slightly sandy clay. These soils likely have a low permeability and any leak from the ponds would be confined within the soil close to source of the leak. As the soils are influenced by a hypothetical leak the water migration through the soil will be defined by the soil permeability and porosity and will be limited by these and other considerations such as head loss due to frictional and other forces within the soil. Essentially a saturated zone, similar to that which develops around an unlined pond will develop near a leak. The extent of a saturation zone and the potential for future migration will require an additional understanding of the soil properties at each site. We did not encounter free subsurface water in our test borings at the McIntyre 3 site to a depth of fifty (50) feet below the ground surface, therefore the potential for the ponds to influence the ground water there is less than that of the McIntyre #1 site where we did encounter free subsurface water at a nominal depth of twenty-nine (29) feet below the ground surface.

We are available to provide additional information as this project progresses.

PN: 52302GE
November 19, 2010
Page 4

Please contact us if you have any questions, or if we may be of additional service.

Respectfully

TRAUTNER GEOTECH

David L. Trautner, PE, CPG

TRAUTNER GEOTECH LLC

Field Engineer : J. Butler
Hole Diameter : 4" solid
Drilling Method : Continuous Flight Auger
Sampling Method : None Requested
Date Drilled : 11/05/2010
Total Depth : 39 feet
Location : McIntyre #1
: 30' +/- S-SW of
: Center Stake

LOG OF BORING TB-1

McIntyre Storage Ponds

SG Interests

Project #52302GE

Depth in feet	Sample Type	Water Level	USCS	GRAPHIC	Samples	Blow Count	Water Level	REMARKS
	<div>⊠</div> Mod. California Sampler	<div>▼</div> Water Level During Drilling						
	<div>▨</div> Bag Sample							
	<div>■</div> Standard Split Spoon							
	DESCRIPTION							
0	SILT, SANDY soft, moist, dark brown, organics		MS	<div>⊠</div>	<div>▨</div>			Uniform soil type throughout depth of boring
2	CLAY, SANDY,medium stiff, moist to very moist, brown		CL	<div>▨</div>	<div>▨</div>			
4								
6								
8								
10								
12								
14								
16								
18								
20								
22								
24								
26								
28								
30	CLAY, Sandy, soft, wet, brown			CL	<div>▨</div>	<div>▨</div>		<div>▼</div>
32								
34								
36								
38								
40	Bottom of test boring at thirty-nine (39) feet							
42								
44								
46								
48								

Field Engineer : J. Butler
Hole Diameter : 4" solid
Drilling Method : Continuous Flight Auger
Sampling Method : None Requested
Date Drilled : 11/05/2010
Total Depth : 39 feet
Location : McIntyre #1
: 35' +/- S-SE of
: Lower Center Stake

LOG OF BORING TB-2

McIntyre Storage Ponds

SG Interests

Project #52302GE

Depth in feet	Sample Type	Water Level	USCS	GRAPHIC	Samples	Blow Count	Water Level	REMARKS
	<div><div><div></div><div>Mod. California Sampler</div></div><div><div></div><div>Bag Sample</div></div><div><div></div><div>Standard Split Spoon</div></div></div>	<div><div></div><div>Water Level During Drilling</div></div> <div><div></div><div>Water Level After Drilling</div></div>						
DESCRIPTION								
0	SILT, and Clay, Sandy, soft, moist, dark brown, organics		ML					Uniform soil type throughout depth of boring
2	CLAY, Slightly silty and sandy, meduium stiff, moist to very moist, brown							
4								Increase in moisture content with depth
6								
8								
10								
12								
14								
16								
18								
20								
22								
24								
26								
28								
30	CLAY, Sandy, soft, wet, brown							
32								
34								
36								
38								
40	Bottom of test boring at thirty-nine (39) feet							
42								
44								
46								
48								

Field Engineer : J. Butler
Hole Diameter : 4" solid
Drilling Method : Continuous Flight Auger
Sampling Method : None Requested
Date Drilled : 11/05/2010
Total Depth : 39 feet
Location : McIntyre #3
: 50' +/- SE of upper cell
: center stake

LOG OF BORING TB-3

McIntyre Storage Ponds

SG Interests

Project #52302GE

Depth in feet	Sample Type	Water Level	USCS	GRAPHIC	Samples	Blow Count	Water Level	REMARKS
	<div> <div> </div> Mod. California Sampler </div> <div> <div> </div> Bag Sample </div> <div> <div> </div> Standard Split Spoon </div>	<div> <div> </div> Water Level During Drilling </div> <div> <div> </div> Water Level After Drilling </div>						
DESCRIPTION								
0	CLAY and SILT, medium stiff, medium moist brown, 12 inches of organics		CL					Uniform soil type throughout depth of boring
2	CLAY, slightly silty, stiff, medium moist to moist, brown							
4								Increase in moisture content with depth
6								
8								
10								
12								
14								
16								
18								
20			CL					
22								
24								
26								
28								
30								
32								
34								
36								
38								
40	Stiff clay or possibly weathered formational material, slightly sandy claystone, firm to medium hard, may have isolated hard lenses, gray, Wasatch Formation							slight Increase in moisture at soil/fm contact, no free water
42								
44			CL					
46								
48								
50	Bottom of test boring at forty-nine (49) feet							

Field Engineer : J. Butler
Hole Diameter : 4" solid
Drilling Method : Continuous Flight Auger
Sampling Method : None Requested
Date Drilled : 11/05/2010
Total Depth : 39 feet
Location : McIntyre #3
: 75' +/- SE of lower cell
: center stake

LOG OF BORING TB-4

McIntyre Storage Ponds

SG Interests

Project #52302GE

Depth in feet	Sample Type	Water Level	USCS	GRAPHIC	Samples	Blow Count	Water Level	REMARKS
	<div> <div> </div> Mod. California Sampler </div> <div> <div> </div> Bag Sample </div> <div> <div> </div> Standard Split Spoon </div>	<div> <div> </div> Water Level During Drilling </div> <div> <div> </div> Water Level After Drilling </div>						
0	CLAY and SILT, medium stiff, medium moist brown, 12 inches of organics		CL					Uniform soil type throughout depth of boring
2	CLAY, silty, slightly sandy, medium stiff, medium moist to moist, brown							
4								Increase in moisture content with depth and at 15 feet
6								
8								
10								
12								
14								
16								
18								
20								
22			CL					
24								slight Increase in moisture at soil/fm contact, no free water
26								
28								
30								
32								
34								
36								
38								
40								
42								
44			CL					
46								
48								
50	Bottom of test boring at forty-nine (49) feet							

Attachment B

Land Use Description

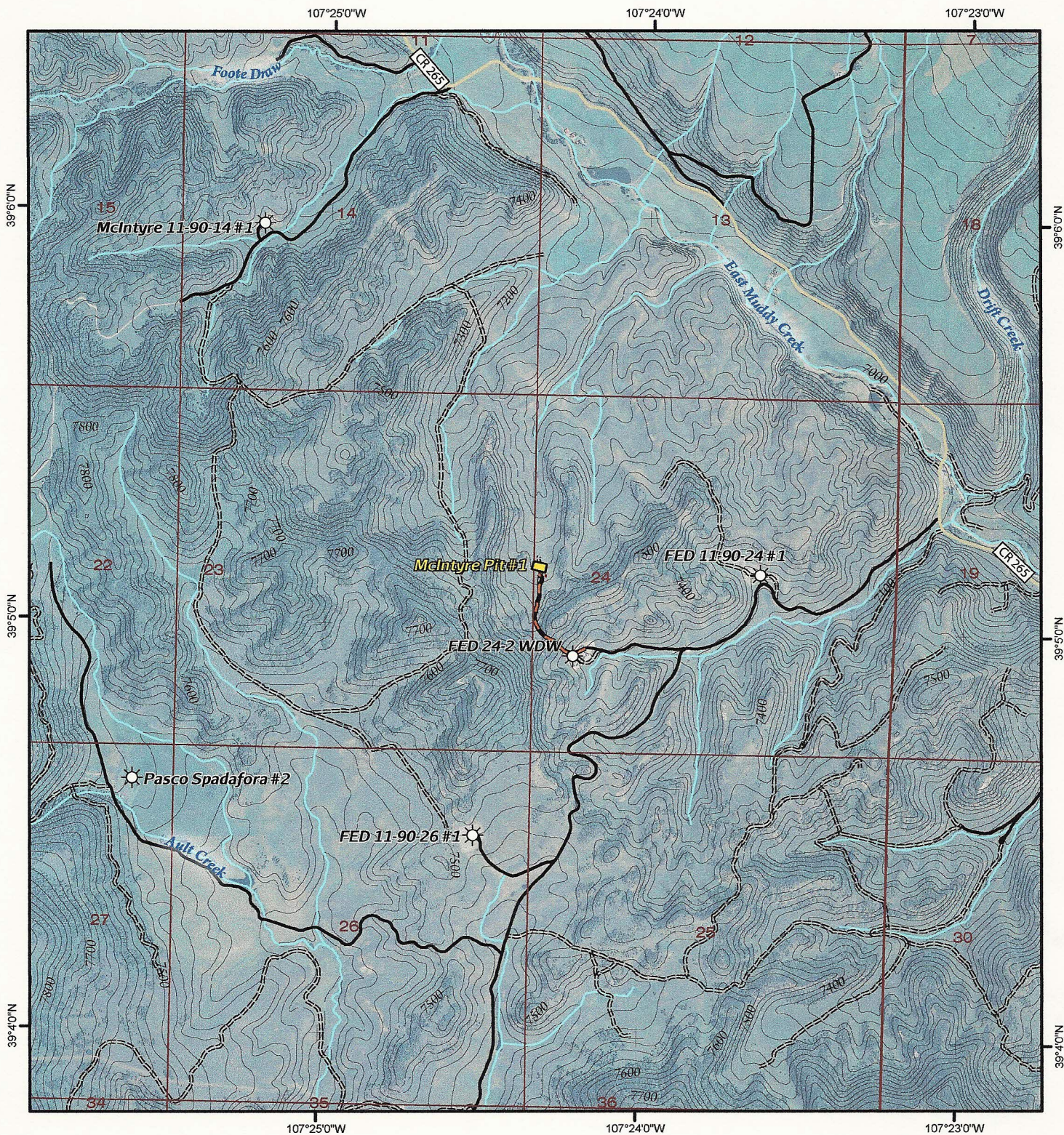
Adjacent Landuse Description

Until recently, this area sustained very high levels of both sheep and cattle grazing. Seasonal cattle grazing still occurs in this area, through leasing of grazing to another rancher. Grazing occurs from approximately June through September. Despite the extremely high grazing pressure in the past, the area has a very good distribution of grasses and forbs in the understory of the sagebrush and Gambel's oak habitat types. In the past few years, SG Interests and Gunnison Energy Corporation have begun to develop natural gas resources in the area, which has resulted in the improvement of existing roads and construction and reclamation of pipeline corridors. Road improvements and increased traffic has had some direct and indirect impacts on wildlife habitat in this area. Based on the current level of development, there have not been noticeable changes in wildlife use patterns. The direct impact to wildlife habitat is most noticeable in the loss of sagebrush canopy cover along pipeline corridors. Although some sagebrush is beginning to reclaim these pipeline corridors, sagebrush obligates such as Brewer's sparrow and mountain cottontail (*Sylvilagus nuttallii*) likely have reduced use of the existing pipeline corridors and nearby habitats.

The project area for the pits is located in a shallow north-facing gulch approximately 2 miles due west of the junction of County Road 265 and Highway 133. The site is dominated by two main vegetation types. Around the tops of the ridgelines surrounding the proposed pit site, Gambel's oak (*Quercus gambelii*) and serviceberry (*Amelanchier* sp.) dominate the shrub layer. Within the lower basin where the pits would be located, the site is dominated by sagebrush (*Artemisia tridentata* ssp. *pauciflora*), with a robust understory grass and forb layer.

Attachment C

Topo Map



LEGEND

- Proposed Pit
- Existing Well
- Proposed Access Road
- County Road
- Improved Road
- Unimproved Road
- Township Boundary
- Section Boundary
- Stream

Note:

25-ft contours interpolated from USGS DEM (Digital Elevation Model).

Disclaimer:

This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information. The maps are distributed "AS-IS" without warranties of any kind, either expressed or implied, including but not limited to warranties of suitability to a particular purpose or use.

McIntyre Flowback Pit #1

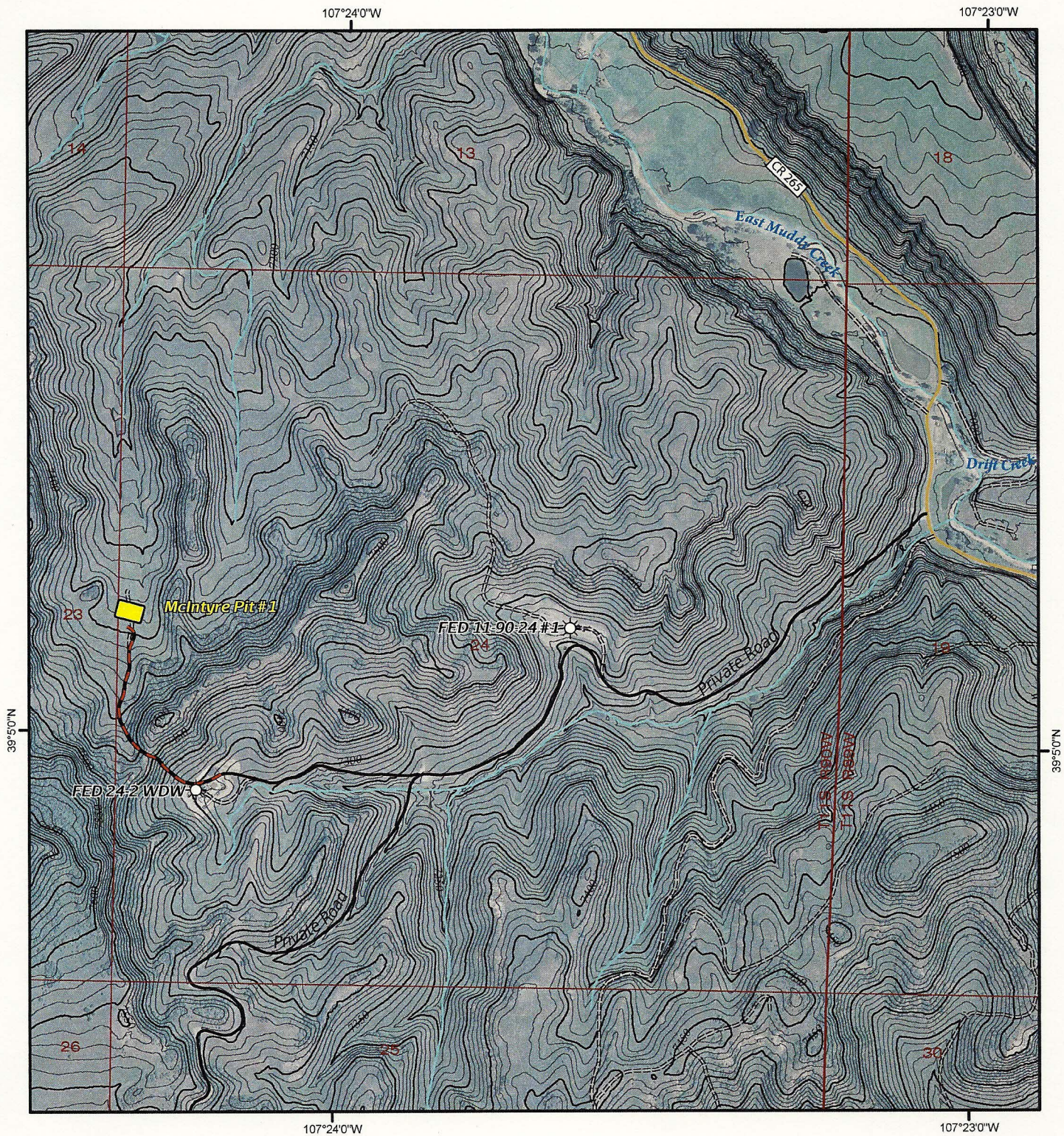
Topo Map
07.15.2010

0 1,000 2,000 4,000

Scale: 1" = 2,000'



Prepared By: ZDP
Prepared For: SG Interests, Ltd.
Contour Interval: 25 ft.



LEGEND

- | | |
|-------------------|-------------------|
| Proposed Pit | Township Boundary |
| Existing Gas Well | Section Boundary |
| Access Road | Stream |
| County Road | |
| Improved Road | |
| Unimproved Road | |

Note:

Disclaimer:

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McIntyre Flowback Pit #1

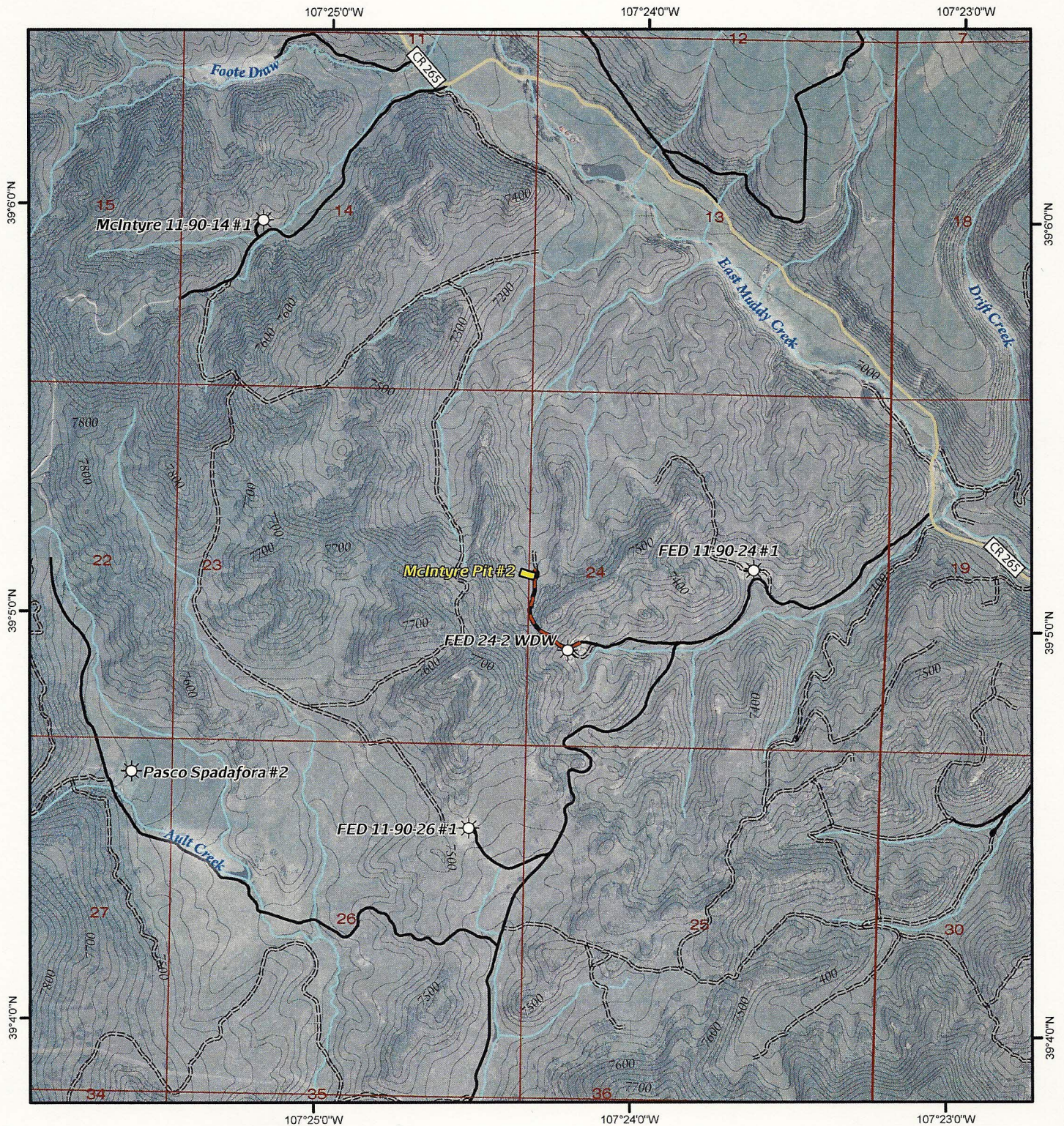
Access Road
10.03.2010

0 500 1,000 2,000

Scale: 1" = 1,000'



Prepared By: ZDP
Prepared For: SG Interests, Ltd.
Contour Interval: 10 ft.



LEGEND

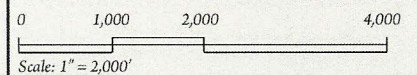
- Proposed Pit
- Existing Well
- Proposed Access Road
- County Road
- Improved Road
- Unimproved Road
- Township Boundary
- Section Boundary
- Stream

Note:
25-ft contours interpolated from USGS DEM (Digital Elevation Model).

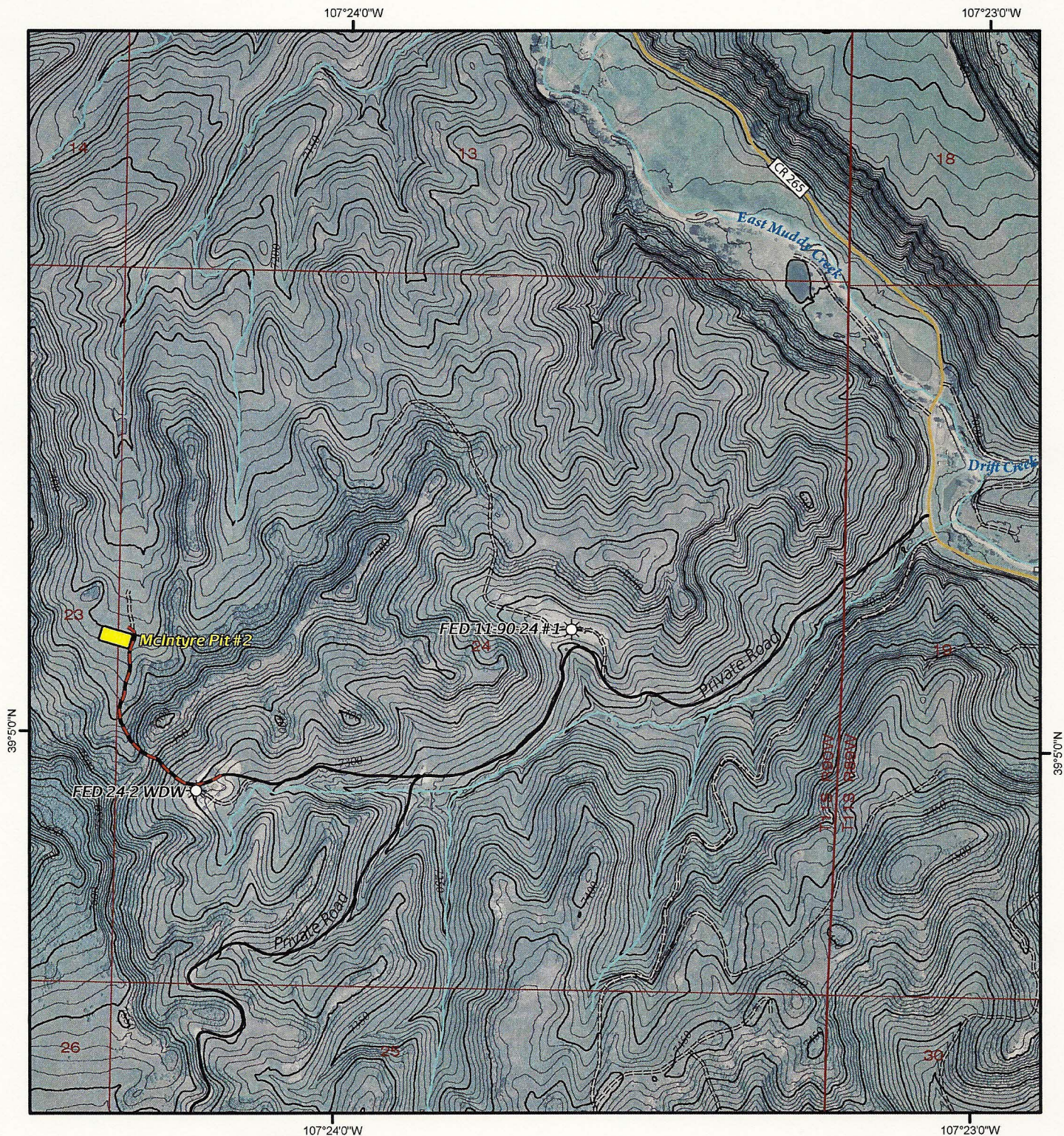
Disclaimer:
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McIntyre Flowback Pit #2

Topo Map
07.15.2010



Prepared By: ZDP
Prepared For: SG Interests, Ltd.
Contour Interval: 25 ft.



LEGEND

Proposed Pit

Existing Gas Well

Access Road

County Road

Improved Road

Unimproved Road

Township Boundary
 Section Boundary

Stream

Note:

Disclaimer:
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McIntyre Flowback Pit #2

Access Road
 10.03.2010

0 500 1,000 2,000
 Scale: 1" = 1,000'



Prepared By: ZDP
 Prepared For: SG Interests, Ltd.
 Contour Interval: 10 ft.

Attachment D

Site Drainage Map

Sedimentation Basin with two - 24" CMP outlets. Daylight to natural channel

Daylight Line Staging Area

24" CMP Culvert @ 10% grade. Install adjustable closure slide gates on CMP at inlet. Riprap discharge outlet area. Flow capacity = 29 cfs each.

Tributary Drainage Area = 10.72 acres
Pit 1 & 2 Surface Area = 1.79 acres
Net Drainage Area = 8.98 Acres

V-shaped borrowditch (typ.) diversion channel 18" deep with 2H:1V side slopes. Flow capacity = 27 cfs.

Edge of Proposed Staging Area

Extend synthetic liner 12" above finished pad grade around perimeter of all pits. (typ.).

Pump

Manifold

Proposed Flowback Pit #1

C 10.4'

Pump

Manifold

Proposed Flowback Pit #2

C 11.0'

24" CMP Culvert @ 2% minimum grade

10' Buffer Zone

Daylight Line Flowback Pit

Perimeter Fencing

Trapezoid shaped diversion channel 2 ft deep with 3 ft wide bottom and 2H:1V side slopes. Flow capacity = 82 cfs.

Daylight Line Flowback Pit

24" CMP Culvert @ 2% minimum grade

Trapezoid shaped diversion channel 2 ft deep with 2 ft wide bottom and 2H:1V side slopes

Pit 1: 130'x200'x12'
(8,377 cy. / 40,284 bbls.)
Pit 2: 110'x230'x12'
(7,959 cy. / 38,275 bbls.)

Note: No wells located on staging pad. Meter houses are located on the individual well pads.

Estimated Dirt Quantities (cy)

ITEM	CUT		FILL	EXCESS
	SUBSOIL	TOPSOIL		
Pit 1	14,169	1,041		15,210 (C)
Pit 2	13,860	1,057		14,917 (C)
Staging		2,687	28,029	25,342 (F)
TOTAL	28,029	4,785	28,029	4,785 (C)

Notes:

1. Subsoil from pits cuts (28,029 cy.) used to create staging area.
2. Topsoil (4,785 cy.) stored in separate pile from staging area.
3. Topsoil volumes based on 8" soil depth.
4. Total Disturbed Area = +/- 4.0 Ac.

SCALE: 1" = 100'
DATE: 10.22.2010



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Bull Mountain Unit

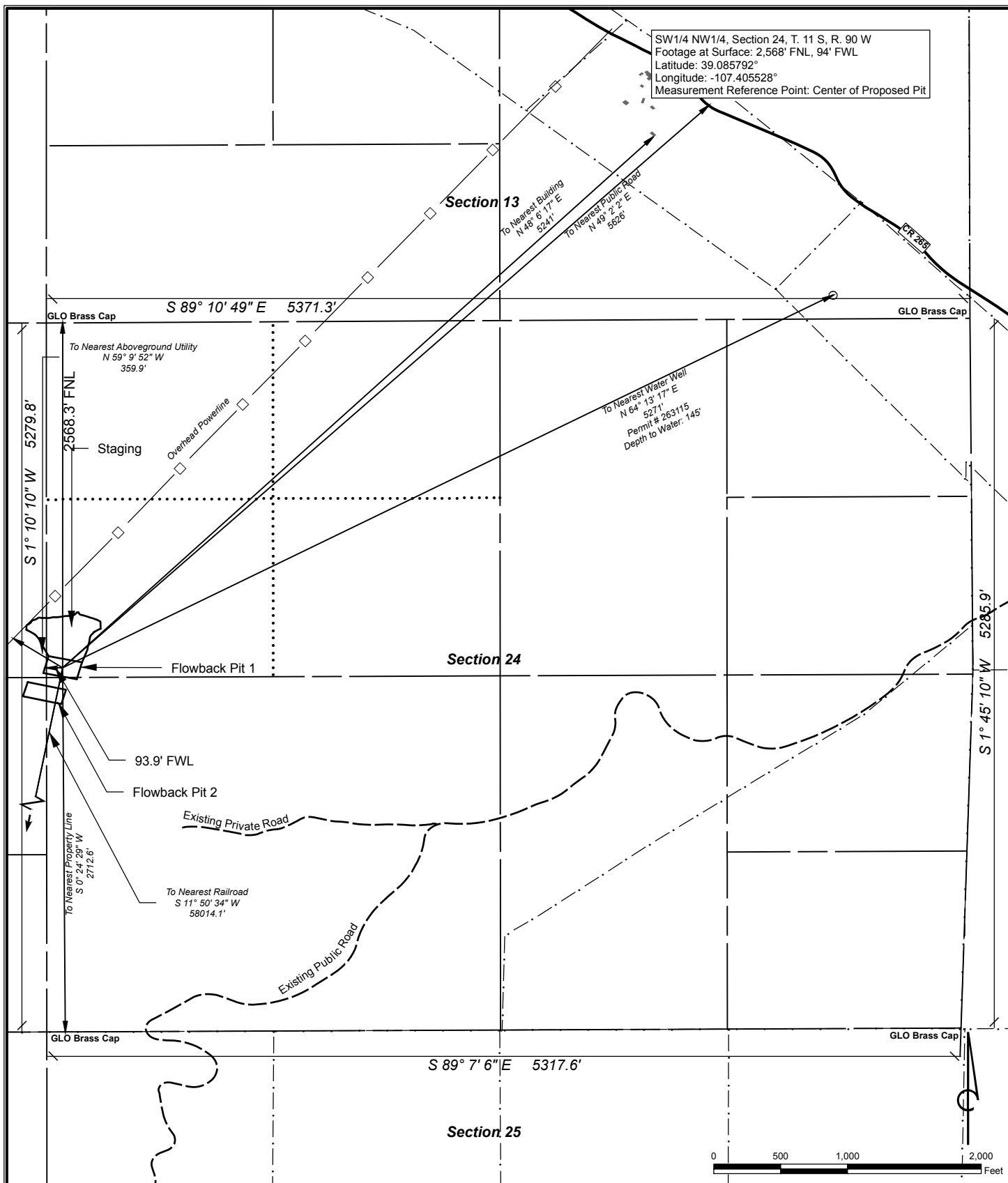
T. 11 S, R. 90 W, Sections 23 & 24


McIntyre Flowback Pits 1 & 2

CONSTRUCTION LAYOUT

Attachment E

Scaled Drawing



Visible Improvements to Pit Center			Current Land Use: NON-CROP LAND: Rangeland	 SG Interests PO Box 26 Montrose, CO 81402 970-252-0696
Description	Bearing	Distance (Ft.)		
Building	N 48° 6' 17" E	5,241	NAD 83 Datum SCALE: 1" = 1,000' DATE: 11.11.2010	Bull Mountain Unit T. 11 S, R. 90 W, Sections 23 & 24 McIntyre Flowback Pit 1 LOCATION
Public Road	N 49° 2' 2" E	5,626		
Railroad	S 11° 50' 34" W	58,014		
Aboveground Utility	N 59° 9' 52" W	360		
Property Line	S 0° 24' 29" E	2,713		
Well	N 64° 13' 17" E	5,271		

NE1/4 SE1/4, Section 23, T. 11 S, R. 90 W
 Footage at Surface: 2,523' FSL, 11' FEL
 Latitude: 39.085272°
 Longitude: -107.405900°
 Measurement Reference Point: Center of Proposed Pit

Section 14

Section 23

Section 26

GLO Brass Cap

S 88° 55' 53" E 5295.5'

GLO Brass Cap

S 1° 7' 25" W 5279.6'

S 1° 10' 10" W 5279.8'

To Nearest Building
 N 47° 38' 12" E
 5453.3'
 To Nearest Public Road
 N 48° 27' 58" E
 5838.4'

To Nearest Water Well
 N 63° 15' 10" E
 5461.5'
 Permit # 263115
 Depth to Water: 145'

To Nearest Aboveground Utility
 N 51° 20' 48" W
 391.1'

Flowback Pit 2

11.3' FEL

To Nearest Railroad
 S 11° 45' 2" W
 57810.3'

To Nearest Property Line
 S 0° 8' 43" W
 2523.9'

Overhead Powerline

GLO Brass Cap
 Witness Corner

S 88° 55' 48" E 5291.3'

GLO Brass Cap

0 500 1,000 2,000 Feet

Visible Improvements to Pit Center

Description	Bearing	Distance (Ft.)
Building	N 47° 38' 12" E	5,453
Public Road	N 48° 27' 58" E	5,838
Railroad	S 11° 45' 2" W	57,810
Aboveground Utility	N 59° 9' 52" W	391
Property Line	S 0° 8' 43" W	2,524
Well	N 63° 15' 10" E	5,462

Current Land Use:

NON-CROP LAND: Rangeland

NAD 83 Datum
 SCALE: 1" = 1,000'
 DATE: 11.11.2010



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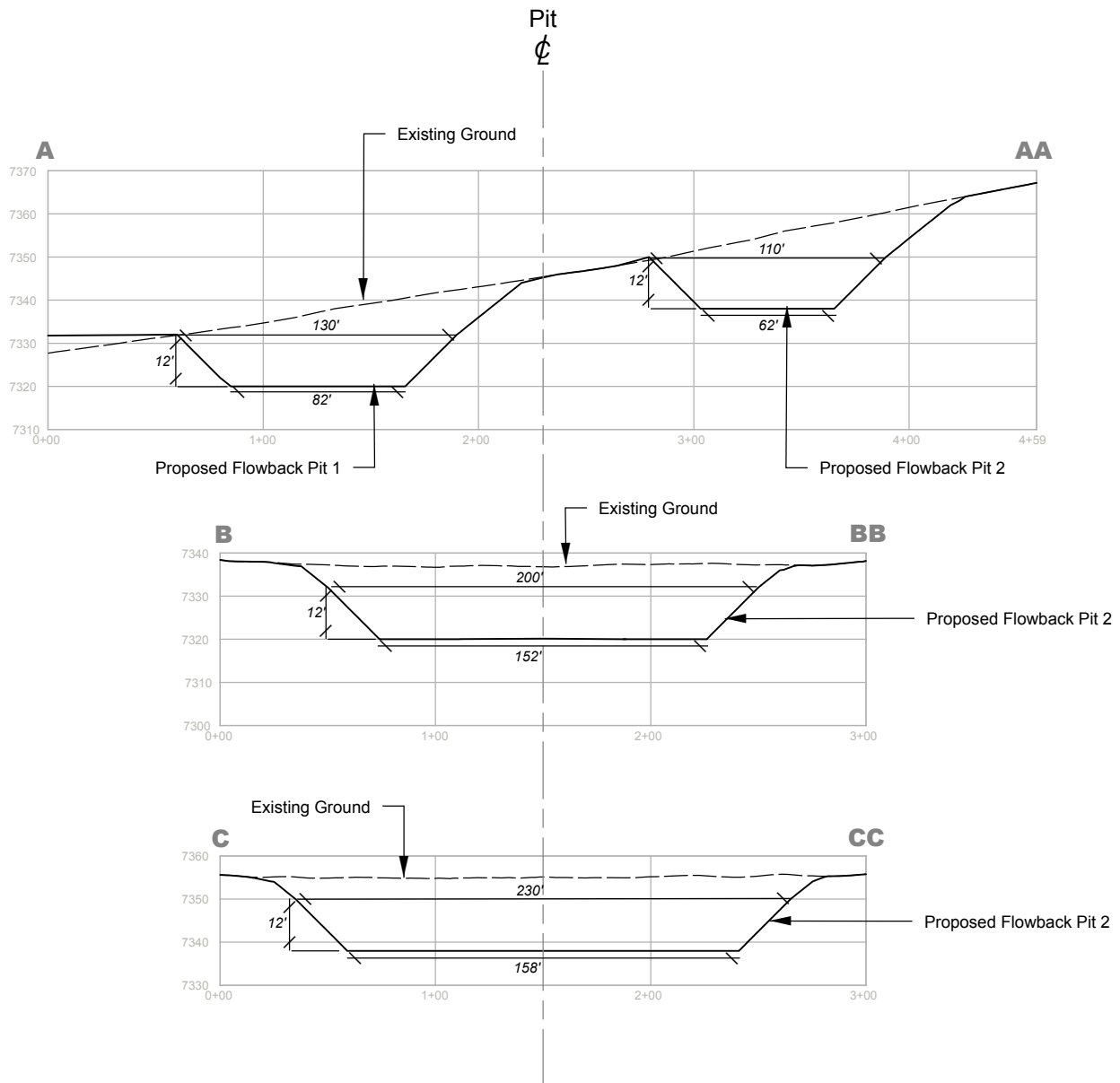
Bull Mountain Unit

T. 11 S, R. 90 W, Sections 23 & 24

**McIntyre Flowback Pit 2
 LOCATION**

Attachment F

Engineering Data



Notes:
 1. Inner perimeter cut slopes = 2:1.
 2. Outer perimeter cut slopes = 2.5:1.

SCALE: Horiz.: 1" = 80'
 Vert.: 1" = 20'
 DATE: 10.22.2010



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Bull Mountain Unit
 T. 11 S, R. 90 W, Section 23 & 24

McIntyre Flowback Pits 1 & 2
CONSTRUCTION CROSS SECTION

Liner and Leak Detection System

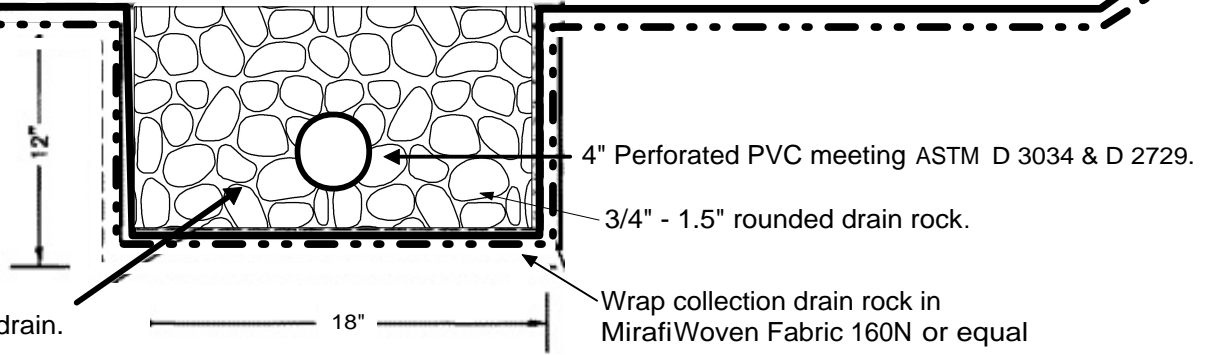
The leak detection system will be constructed at the low end (approximately 1 foot lower than the rest of the pit bottom) of the pit. The pit bottom will slope down toward this leak detection sump. The liner in the sump can be shaped into this rounded and sloped configuration and no special welding is required for the detection sump. All seams will be tested to the manufacturer's requirements. The following is a typical drawing of this leak detection system. Its actual shape will vary from this drawing based on field conditions.

Liner & Leak Detention System Details

Pit Liner System:

- * 60 milHDPE Liner (CL)
- * 200 milHypernetGeonetDrain Mat (GSE)
- * 36 milHDPE Liner (CL)
- * BentoMatDN Geosynthetic Bentonite Liner (CETCO)

Place pipe 2" above bottom of collection drain.
Slope pipe toward deep end of pit.



Monitoring Stand Pipe with 4" PVC
Removeable Cap to be located at
deep end of pit. Place steel fence
posts for protection.

Install Pocket Vents per manufacturer's
recommendations every 50 liner feet along
perimeter at top of liner. Vent to perforate
both HDPE liners.

4 ft. min.
Pad Grade

- * 60 milHDPE Liner
- * 200 milHypernetGeonetDrain Mat
- * MirafiNX160 Fabric Wrap

12" deep minimum anchor
trench per manufacturer's
instructions.

4" PVC meeting ASTM D 3034 & D 2729.

3/4" - 1.5" round drain rock.
(No crushed gravel allowed.)

4" Perforated PVC meeting ASTM D 3034 & D 2729.

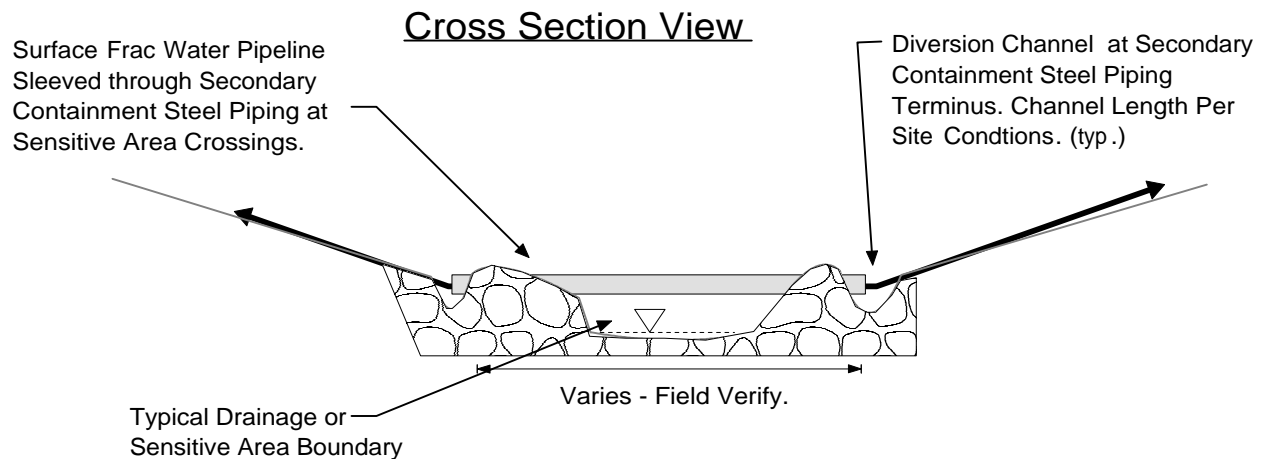
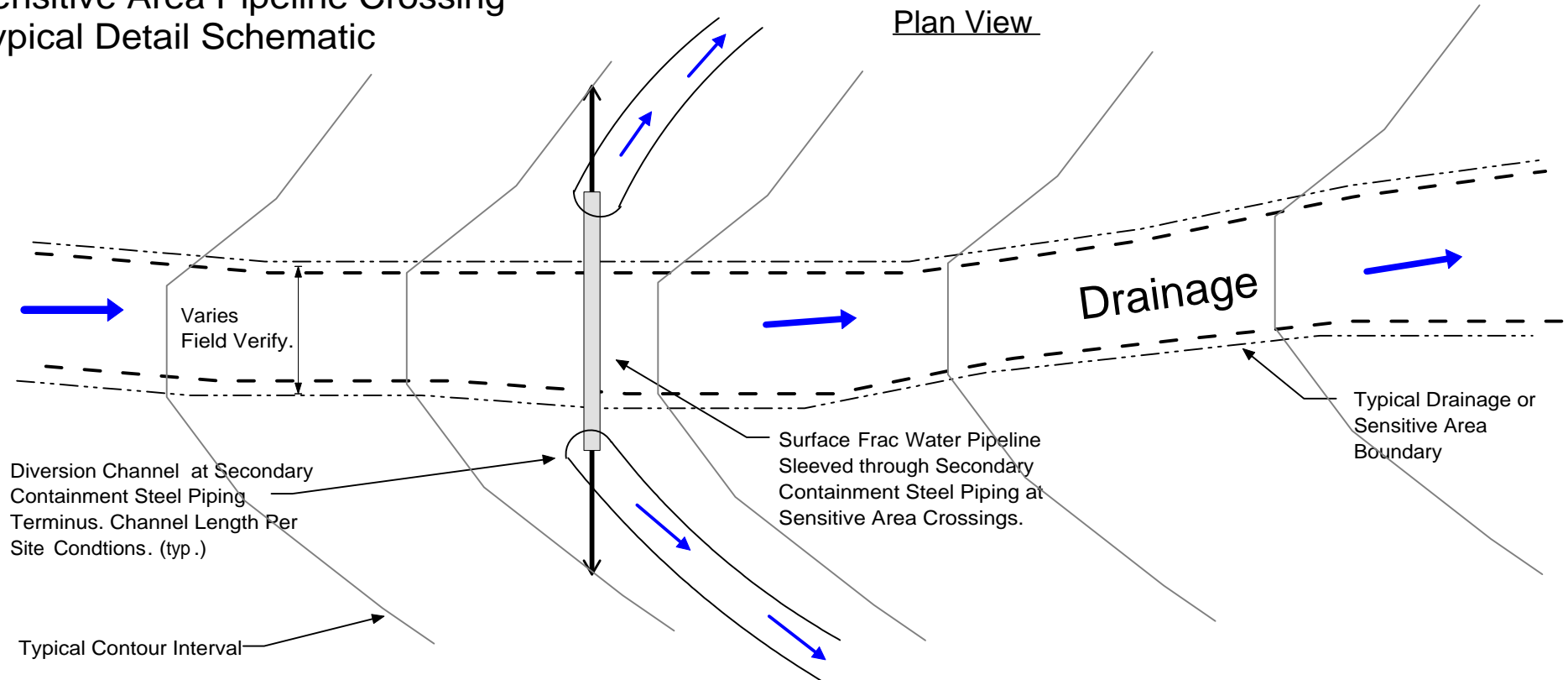
- * Mirafi160N Fabric Wrap
- * 36 milHDPE Liner
- * BentoMatDN Geosynthetic Bentonite Liner

* Install HPDE / Bentonite Liners;
Hypernetand Vent Pockets
per manufacturer's instructions.

Sensitive Area Pipeline Crossing

Where SG Interests uses a poly pipeline to transport water to or from the McIntyre Flowback Pits over a sensitive area (a stream, wetland or other waterbody), the poly pipe will be contained within a secondary containment system to prevent flowback fluids from contaminating the surface water in the event of a leak in the poly pipeline. The surface poly pipeline will be cased within a steel pipeline of larger diameter for the length of the sensitive area. The ends of the steel casing will extend from upland area to upland area through the entire sensitive area. At the ends of the steel casing, diversion channels will be constructed to direct fluid away from the sensitive area and into containment basins in the event of a leak in the surface poly line. The design of the diversion ditch and the containment basin will be site specific depending on local terrain in the vicinity of that particular crossing. These containment features will be designed by a qualified stormwater inspector with training and experience in sizing and designing these features. A qualified stormwater inspector will monitor and inspect all sensitive areas crossed by such poly pipelines on a daily basis during use and operation. A typical of this secondary containment system for use in sensitive area crossings follows this narrative.

SG Interest, I Ltd. Sensitive Area Pipeline Crossing Typical Detail Schematic



Notes:

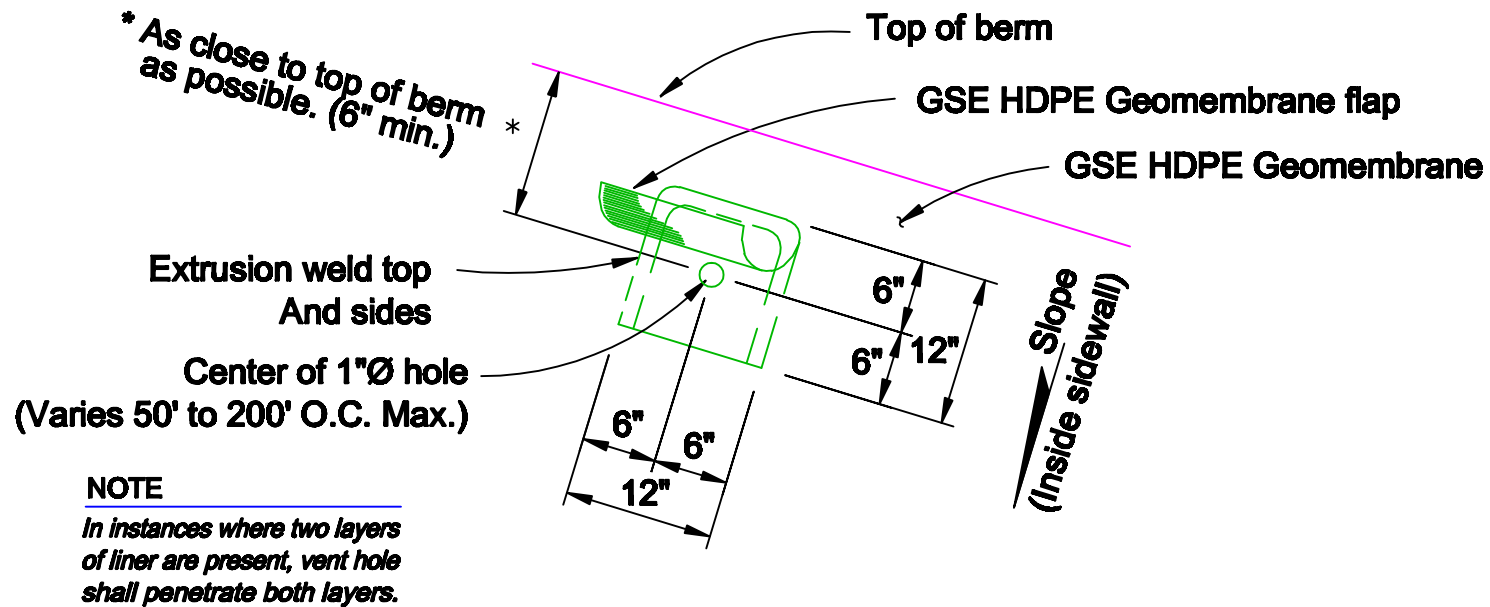
* Pipelines hydraulic including total dynamic and static head pressures shall be verified to insure that the allowable working pressure of the pipeline is not compromised.

* Storm water and erosion control BMP's shall be installed as necessary by SG Interest, I Ltd. or designated contractor.

* Field verify location of all underground utilities, gas, water, phone, cable and electric lines. Call Before You Dig. Statewide One Call 1-800-922-1987.

*Verify field grades and elevations.

* Not to Scale.



Typical Vent Pocket Detail

Not to scale



GSE Lining Technology, LLC
19103 Gundie Road
Houston, Texas 77073-3598
(800)435-2008 / (281)443-8564

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DRAWN

MG

DATE

01/10/2010

REVISION

0

DWG. NO.

GSE-030

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McIntyre Flowback Pit 1

Pit Volume Calculations

Date: 10.25.2010



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	Width	Length	Depth	Side Slopes		Total Pit Volume		Free Board		Usable Volume	
				Run	Rise			Required	Volume		
	<i>Ft.</i>	<i>Ft.</i>	<i>Ft.</i>	<i>Ft.</i>	<i>Ft.</i>	<i>cy.</i>	<i>bbls.</i>	<i>ft.</i>	<i>cy.</i>	<i>cy.</i>	<i>bbls.</i>
Flowback Pit 1	130	200	12	2	1	8,377	40,284	2	1,830	6,547	31,485

*Volume Calculation = (Area of top + Area of Bottom + (4 * Area at Middle Height)) / 6 * Height*

McIntyre Flowback Pit 2

Pit Volume Calculations

Date: 10.25.2010



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Montrose, CO 81402
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	Width	Length	Depth	Side Slopes		Total Pit Volume		Free Board		Usable Volume	
				Run	Rise			Required	Volume		
	<i>Ft.</i>	<i>Ft.</i>	<i>Ft.</i>	<i>Ft.</i>	<i>Ft.</i>	<i>cy.</i>	<i>bbls.</i>	<i>ft.</i>	<i>cy.</i>	<i>cy.</i>	<i>bbls.</i>
Flowback Pit 2	110	230	12	2	1	7,959	38,275	2	1,775	6,184	29,739

*Volume Calculation = (Area of top + Area of Bottom + (4 * Area at Middle Height)) / 6 * Height*

Polyethylene Geomembrane Product Specifications



Colorado Lining International, Inc.
Parker, CO 80138
(800) 524-8672/(303) 841-2022
Fax: (303) 841-5780
www.coloradolining.com

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PART I PURPOSE

This manual addresses the quality assurance and quality control of the installation of High Density Polyethylene (HDPE) geomembrane liners used by Colorado Lining Construction (CLC) in hazardous waste disposal landfills, surface impoundments or other installations as specified by the owner and/or engineer. This manual delineates the quality procedures and standards for installation.

1.1.0 Scope of Quality Assurance

The scope of this manual includes the quality assurance applicable to shipment, handling, and installation of High Density Polyethylene (HDPE) geomembrane liners also referred to Flexible Membrane Liners (FML's).

1.2.0 Units

In this manual, all properties and dimensions are expressed in English units, with "equivalent" Système International (SI)/metric units in parentheses. It should be noted that the conversion is typically only accurate within ten percent. In cases of conflict or clarifications, the U.S. units shall be deemed to govern. Since most field geomembrane testing equipment manufactured in the United States are equipped to measure in English units, required test result data are tabulated herein with such units.

1.3.0 References

The manual includes references to test procedures of the American Society for Testing and Materials (ASTM), the Federal Test Method Standards (FTMS) and the "Standards for Flexible Membrane Liners" of the National Sanitation Foundation (NSF).

PART II DELIVERY

2.1.0 Transportation and Handling

CLC through its own transportation or an independent trucking firm or other party as agreed upon by the Owner will perform transportation of the geomembrane. If the geomembrane arrives on site prior to CLC project personnel, the Owner is responsible for off-loading roll goods and any ancillary items shipped. The material received shall be matched against the freight bill of lading. Any discrepancies shall be immediately reported to CLC before the shipment is signed for. When off-loaded, geomembrane and any ancillary items should be placed on a smooth, well drained surface, free of rocks or any other protrusions which may damage the material. No special covering is necessary for geomembrane.

The following should be verified prior to and during off-loading geomembrane:

Handling equipment used on the site is adequate and does not pose any risk or damage to the geomembrane and that personnel handle the geomembrane with care. If slings are provided, the material should be lifted with such. In any event, materials shall be offloaded in a safe manner whereby the rolls are properly balanced and no personnel or property are at risk of being injured/damaged should loss of control of any roll(s) of material occur.

Upon arrival at the site, CLC shall conduct a surface observation of all rolls for

defects and for damage. This inspection shall be conducted without unrolling rolls unless defects or damages are found or suspected. CLC shall indicate any damage to the Owner's Representative. The Owner shall immediately report to CLC any damage known to exist prior to delivery or that may have occurred during off-loading/handling.

2.2.0 Storage

The Owner shall provide storage in location (or several locations) such that on-site transportation and handling are minimized. Storage space should be protected from theft, vandalism, passage of vehicles, and be adjacent to the area to be lined.

2.2.1 Special Consideration for Welding Rod or GCL Liner

Should any welding rod or geoclay (GCL) liner be delivered to the site prior to CLC arrival, such materials shall be immediately secured in a sheltered/dry condition and maintained in such condition until deployed by CLC personnel.

PART III SITE PREPARATION & INSPECTION

3.1.0 Anchor Trench Systems

All Anchor Trench Systems shall be excavated by others (unless otherwise specified) to the lines and widths shown on the design drawings, prior to geomembrane placement.

3.2.0 Site Inspection

Immediately prior to installation, the subgrade shall be jointly inspection walked by the Owner's Representative and CLC personnel to determine it's worthiness to accept the specified lining system. The decision to repair cracks, if any, should be made only by the Owner's Representative. Once properly prepared, CLC will sign acceptance of the surface condition of the subgrade. The integrity of the underlying soil shall remain the responsibility of the owner/earthwork contractor.

Subgrade Preparation Recommendations:

No liner shall be placed on surfaces not previously found acceptable by the CLC supervisor or his agent.

Surfaces to be lined shall be compacted, smooth, and free of all rocks greater than 3/8" in diameter, sharp angular stones, sticks, vegetation, roots, sharp objects, gravel, or debris of any kind. The surface shall provide a firm, unyielding foundation for the lining system with no sudden, sharp or abrupt changes or breaks in grade or geometry.

Part IV PANEL DEPOLYMENT AND TRACKING

4.1.0 Weather and Site Conditions

Panel placement shall not take place during precipitation, or in the presence of excessive winds (unless wind barriers are provided). In addition, deployment shall not take place in any areas of ponded water.

4.2.0 Panel Identification

Panels are portions of roll stock membrane that are field cut to size as required for

fitment and overlapped/welded in situ. In larger projects, a panel may consist of an entire uncut roll.

At the time of installation, the CLC Field Supervisor shall give each field panel an "identification code" (Number or letter-number). This field panel identification code shall be as simple and logical as possible.

4.3.0 Panel Placement

Panels are located by the CLC Field Supervisor in a manner consistent with the specification and best suited to existing site conditions. Field Panels shall be placed one at a time and each shall be seamed immediately after its placement for protection against wind action or rainwater infiltration.

CLC shall record the identification code, location, and date of installation of each geomembrane field panel.

4.4.0 Precautions During Panel Placement

CLC shall ensure that:

Any equipment used will not damage the geomembrane by handling, trafficking, excessive heat, leakage of fluids, or other means.

The prepared surface underlying the geomembrane has not deteriorated since previous acceptance and is still acceptable immediately prior to liner placement.

Any geosynthetic elements immediately underlying the geomembrane are clean and free of debris.

All personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane.

Methods used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil.

Methods used to place the panels minimize wrinkles (especially differential wrinkles between adjacent panels).

Adequate temporary ballast is placed over deployed lining panel edges to prevent wind uplift and is not likely to damage the geomembrane. In the event of high winds, continuous loading such as sandbags shall be placed end to end along edges of panels to minimize risk of wind effects.

Direct contact with the geomembrane is minimized. Geotextiles, extra liner or other suitable materials shall be used as protective buffers in areas where excessive traffic may be expected.

4.5.0 Damaged Material

CLC shall inspect the geomembrane after placement and prior to seaming for damage. Any damaged membrane that cannot be reasonably repaired shall be removed and replaced. Repairs to geomembrane shall be made according to procedures described in section 8.2.0.

PART IV SEAMING

5.1.0 Required Weather Conditions for Seaming

No seaming shall be conducted during periods of excessive moisture, blowing dust, or in the presence of excessive winds (unless wind barriers are provided). Seaming shall not take place in an areas of ponded water.

High temperature limits for welding are dependent upon crew safety and membrane material limits. Elevated temperatures can create conditions whereby seam strength may be compromised and an inferior installation may result. When elevated temperature conditions exist over 95° F/35° C, weld quality shall be closely monitored during seaming operations.

No seaming shall be conducted during rain or snow, unless the seam is covered with an enclosure permitting favorable seaming conditions.

No seaming shall be attempted at ambient temperatures below 5° F without proper pre-heating of material promoting favorable seaming conditions.

In all cases, geomembrane shall be dry and protected from wind.

CLC shall verify that favorable weather conditions exist and advise the Owner's Representative if they are not favorable.

5.2.0 Seaming and Related Equipment

Unless otherwise specified, all field seaming procedures shall be limited to two methods: extrusion welding and fusion (via hot wedge/"wedge welding"). The bulk of all panel to panel seaming shall be performed using the wedge weld technique. Extrusion welding shall limited to areas where wedge welders cannot practically be deployed such as patching and pipe penetration sealing. These machines typically require gas or diesel fueled generators as power sources.

Each extrusion welding apparatus shall be equipped with gauges giving the temperature of the apparatus at the nozzle and extruder barrel.

Each wedge welding apparatus shall be equipped with gauges giving the applicable temperatures.

Although welding over a frozen, wet or muddy subgrade is generally not encouraged, fusion welding may be possible under such conditions by deployment of a movable plastic slip-sheet placed directly below the overlapped membranes being seamed. Properly designed and deployed slip-sheets serve to prevent moisture buildup between the sheets being welded while providing conditions whereby wedge welding machines may be propelled at an uninterrupted rate of speed.

5.2.1 Equipment Preparation

Generator(s) shall be fueled outside the extents of the lining system and be inspected for fluid leakage and mechanical damage that may result in damage to the lining system. Should it be necessary to place the generator over the lining system a suitable buffer strip shall be placed between the tires and the membrane. Generators without inflated rubber tires shall not be introduced over the lining system. Tires shall be pre-inspected to be free of foreign matter that may damage the membrane. Generators shall be positioned within close proximity of the seaming region and have adequate extension cords to complete an entire seam without the necessity to move the machine.

Wedge welders shall be calibrated for ambient conditions and the material type/thickness to be welded. The front part of the seaming device should be inspected for sharp corners and irregular details, which may damage the liner. The major point for inspection is that no sharp edges should exist where FML sheet surfaces must pass over the heated wedge element. If a dual, or split, hot wedge seam is being made, the recessed space for the air track should be examined. Knurled pressure rollers shall be inspected for sharp surfaces. All wedge welder adjustments shall be checked daily. Cleaning of machine should be done at least daily.

Extrusion welders shall have an initial inspection before warm up to confirm that the insulation and covers are in good condition and that the welding nozzles (or Teflon shoes) are correct for the FML to be seamed. Teflon shoes should be checked for proper weld bead geometry and excessive wear and replaced if necessary. They shall then be heated to the correct welding temperature for thickness of the material to be welded and then purged of all heat-degraded resin from within the barrel. During the purge process temperature controllers shall be monitored for proper function and that the welding rod feed systems and rotating tips are operating properly.

5.2.2 Trial Seams

Before any welding is performed by either method on the actual membrane lining system, trial seam welds must first be performed yielding passing results.

CLC shall prepare trial seams made with test strips of the actual membrane being installed to verify that seaming conditions are adequate. Such trial seams shall be made at the beginning of each seaming period (start of the day and midday) for each seaming apparatus used. Trial seams shall be made under the same conditions as actual seams.

The trial seam sample shall be approximately 3 feet/1.0 m long by 1 foot/0.3 m wide (after seaming) with the seam centered lengthwise. Seam overlap shall be nominally 4 inches/10.2 cm, 3 inches/7.6 cm minimum.

Unless otherwise specified, five (5) seam sample coupons each measuring 1"/25mm wide x 6"/150mm long shall be cut from the trial seam sample in increments to span its length. The specimens shall be tested in peel (3 ea.) and shear (2 ea.) modes using a field tensiometer. No seaming apparatus shall be used for seaming until deficiencies are corrected and two consecutive trial welds are successfully achieved.

5.3.0 Seam Layout

In general, seams should be oriented parallel to the line of maximum slope, in the direction of slope, not across the slope (horizontal to slopes). Horizontal to slope seams should be no less than 5 feet (1.5 m) from the toe of the slope or areas of potential

stress concentrations unless otherwise approved by The Owner's Representative. When full roll lengths do not extend past the toe of the slope, panel ends may be seamed provided the panel end is cut at an angle greater than 45° to minimize seam stress. In corners and areas of irregular geometry, the number of seams should be minimized.

A seam numbering system compatible with a panel numbering system shall be employed.

5.4.0 Panel Overlap for Seaming

Controlled overlapping of adjacent sheets shall produce approximately 3 inches of overlap for extrusion welds and 4 inches of overlap between sheets for wedge welded seams.

5.5.0 Seam Preparation

CLC shall verify that:

Prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material, and seams are aligned with the fewest possible number of wrinkles or "fishmouths".

All areas to receive extrusion welds shall first be lightly/evenly ground with a hand held grinder with a 60 or 80 grit disc to roughen the surface while removing all surface shine. The grinding is performed parallel to the seam and controlled such that grinding marks do not extend more than 0.25 inches outside the area of the weld bead area. Sixty mil or thicker liners should have the edge of the top sheet beveled by grinding to approximately a 45° angle. This grinding preparation shall be completed no more than one (1) hour prior to extrusion welding. Grinding preparation does not apply to wedge welding.

5.6.0 Wedge Welder Seaming Procedure

A smooth insulating plate or fabric is shall be placed beneath the hot welding apparatus both before and after usage.

Unless otherwise specified, the general seaming procedure used by CLC shall be as follows:

The rolls of geomembrane shall be overlapped by approximately four inches (100 mm) for fusion welding and three inches for extrusion welding.

Welding can occur once the panels to be joined have been brought into their exact plan position for final installation.

"Fishmouths" or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut "fishmouths" or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 inches beyond the cut in all directions.

Power to the drive motor shall remain switched-off off when positioning the machine to make a seam.

When starting a new weld, the machine shall be manually placed into the overlapped sheet of material. The sheets shall then be guided between the idlers and the wedge element, and into the drive/nip rollers.

When starting a weld in the middle of two sheets, the material must be loaded from the sides. The machine is to be picked up a few inches, loading the bottom sheet first and top sheet second.

As soon as the wedge is in position and the nip rollers are engaged, the drive motor should be energized and the hot wedge moved into position and locked.

Welder alignment and temperature shall be monitored during the seaming process and any adjustments be made as necessary.

Should the machine tend to bulldoze the subgrade due to soil conditions, the operator shall take some of the weight off the front of the machine by lifting it slightly. Alternatively, a base for the machine to travel on could be provided consisting of strips of geotextile or geomembrane.

To avoid damaging membrane material, once the end of a seam is reached the drive and/or pressure rollers shall be immediately disengaged before the material runs completely out of the machine. The machine shall be withdrawn as quickly as possible to avoid damaging the membrane.

Seaming shall span the full panel length extend well into the anchor trench.

All cross seams or "T" intersections are to be extrusion welded where they intersect. The top flap of geomembrane shall be removed in the area to be extrusion welded and the weld area is ground prior to welding.

5.7.0 Extrusion Welder Seaming Procedure

A smooth insulating plate or fabric is shall be placed beneath the hot welding apparatus both before and after usage.

Using a hot air welders or hand held heat guns with seam rollers the overlapping materials to be welded must first be pre-bonded to hold the materials in place before actual extruding.

Welding operations should be observed to assure that the machines are properly aligned resulting in weld beads that are centered over the edges of the top FML sheets and that weld bead appearances are smooth and uniform.

PART VI

Non-Destructive Seam Continuity Testing

CLC shall non-destructively test all field seams over their full length using a vacuum test unit, air pressure testing, or other approved method. The purpose of non-destructive tests is to check the continuity of seams. It does not provide information on seam strength. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all field seaming.

6.1.0 Vacuum Box Testing

This test method is almost exclusively used for evaluating extrusion weld bead quality. In areas where vacuum boxes cannot practically be deployed, the welds shall be visually inspected and manually probed over their full length to check adhesion.

The equipment shall be comprised of the following:

A vacuum box assembly constructed from clear transparent plastic with a soft neoprene gasket attached to the bottom and a gauge to indicate vacuum chamber pressure.

A vacuum motor capable of creating a vacuum of 2.5 to 3 psi.

A bucket and wide brush, mop or spray assembly.

A soapy solution.

Procedure:

Wet a strip of geomembrane approximately 12 inches by 48 inches (0.3 m by 1.2 m) with the soapy solution;

Place the box over the wetted area.

Energize the vacuum apparatus; confirm 2.5 to 3psi.

Ensure that a leak tight seal is created.

For a period of approximately 5 to 10 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

All areas where soap bubbles appear shall be marked and repaired in accordance with Section 3.4.

If no bubbles appear, the vacuum shall be disengaged and the box indexed to the next test area with a minimum 6" overlap between indexes, and the process repeated.

Vacuum tested seams are recorded on Daily Progress Reports.

6.2.0 Air Channel Pressure Testing

This method is only applicable to seam continuity testing of air channels produced using dual track hot wedge welding equipment.

Testing equipment shall be comprised of the following:

An air pump (manual or motor driven) equipped with pressure gauge capable of generating and sustaining a pressure between 25 and 30 psi (160 and 200 kPa).

A air hose with fittings and connections.

A sharp hollow needle or other approved pressure feed device.

Procedure:

Seal both ends of the seam to be tested by tack welding and clamping with Vise Grips;

Insert needle into the air test channel created by the fusion weld.

Inflate the channel as applicable to pressure between 25 and 30 psi (160 and 200 kPa), close pressurized air source valve and monitor air pressure drop for five (5) minutes.

Remove needle or other approved pressure feed device and seal.

If pressure drop exceeds values tabulated herein or does not stabilize, locate faulty area and repair and re-test until defects are corrected and test values are passing.

Pressure tested seams are recorded on Daily Progress Reports.

**TABLE 6.2
SEAM PRESSURE TEST ALLOWANCE**

Material Thickness	Minimum psi Test Pressure	Maximum psi Test Pressure	Maximum psi Drop Allowed After 5 Minutes
30 mil	24	30	3 PSI
40 mil	24	30	3 PSI
60 mil	27	30	3 PSI
80 mil	27	30	3 PSI
100 mil & Thicker	30	32	3 PSI

6.2.1 Pressure Test Failure

Should excessive pressure drop occur, both ends of seam shall be checked to insure proper seal and be re-tested. Should failure reoccur, the top fusion seam shall be checked by applying a constant air pressure to the air channel and applying a soapy water solution over the weld length. Any failure or leak will be indicated by continuous bubbles appearing.

If no failure appears in the top fusion seam area the seam shall then be systematically isolated into in one hundred and fifty linear foot sections of seam which shall each be re-tested by pressure testing until the leak is located. Failed seam areas shall be repaired by extrusion welding the outside edge of the top fusion weld between areas of failure. The extruded edge shall be vacuum tested in accordance with this manual.

PART VII

Destructive Seam Testing

Destructive seam tests (if required by the project specification) shall be performed at random selected locations at a frequency of one sample per every 500 lineal feet of seam or as otherwise specified. Seam testing shall be conducted concurrent to the seaming work progress. The Owner's Representative if required, may select locations where seam samples are to be cut. If destructive seam tests are not required, representative seam samples may be substituted at a similar frequency using material samples of the actual material being installed so that no "damage" is done to the actual lining system requiring patching and testing, etc.

Procedure

Samples shall be cut by CLC as the seaming progresses. CLC shall:

Cut samples.

Assign a number to each sample, which is to be based upon seam and sample number and mark it accordingly.

Record sample location on daily report.

All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with repair procedures described in Section 8.2.0.

7.1.0 Sample and Coupon Size and Extraction

Unless otherwise specified, the following sample preparation guidelines shall govern:

Trial, representative or destructive seam samples cut from the installed liner shall measure 12"/30cm in width x 3'/1m in length with the width of the seam centered in the long axis of the sample. Coupons shall measure 1"/25mm wide by 6"/150mm long with the seam centered perpendicular to the length.

Coupon extractions shall occur in three paired locations along the length of the seam sample:

2 coupons at the beginning, 2 coupons in the center and 2 coupons at the end of the sample for a total of six (6) extractions. Coupons may be extracted and evaluated incrementally.

Sample Distribution

Remnant 12"/30 cm square samples shall be cut into parts, labeled as specified and distributed as applicable:

One portion for independent geosynthetic laboratory testing if previously specified and

One portion to the Owner for archive storage

7.2.0 Coupon Field Testing

Coupons shall be tested with a tensiometer and evaluated for bonded seam strength (shear) and peel using methods ASTM D4437. Tensiometer jaw separation rate for bonded seam strength/shear and peel test shall be 2"/minute (5cm/min.)

All shear strength samples shall yield Film Tearing Bond (FTB) as defined in NSF 54 Annex A,

If the initial sample coupon test passes shear analysis yielding a FTB, the sample qualifies for further testing to obtain quantitative results until three (3) each peel samples and three (3) each shear samples are evaluated from the beginning middle and end of each sample.

If more than one (1) of six coupons per sample fails, the seam should be repaired in accordance with Section 7.3.0.

TABLE 7.2
REQUIRED FUSION AND EXTRUSION SEAM TEST RESULTS
 Per NSF 54 1993 Standards

Material Thickness	Minimum Values Required (In Units of Pounds per inch of Width)			
	Peel Extrusion	Peel Fusion	Shear Extrusion	Shear Fusion
30 mil HDPE	35	49	63	63
40 mil HDPE	48	86	86	86
60 mil HDPE	70	98	126	126
80 mil HDPE	92	115	166	166
100 mil HDPE	115	143	207	207
Textured 30 mil HDPE	31	44	56	56
Textured 40 mil HDPE	42	60	76	76
Textured 60 mil HDPE	63	88	113	113
Textured 80 mil HDPE	84	115	151	151
Textured 100 mil HDPE	105	143	189	189

Notes: Textured values are applicable to membranes textured on one side of the sheet only.
 Only the inner weld track is peeled apart in this destructive test. The outer track (directly at sheet edge) is for the purpose of air pressure testing capabilities.

7.3.0 Procedures for Test Failure

Should a sample fail a destructive test, the defect may be remedied by:

Capping the respective seam in its entirety as described in this section,

or

If a defect is suspected to be local to a certain area it may be further investigated to isolate the defective are by:

Taking small coupon test samples located 10' on either side of the defective sample seam void area. If these additional samples pass tensiometer testing, then full samples are to be taken. If these samples pass the tests, then the seam is capped between these locations. If either sample fails, then the process is repeated to establish the zone in which the seam should be reconstructed. All acceptable seam areas must be bounded by two locations from which samples passing destructive tests have been taken.

Cap stripping of defective seams or isolated areas shall be performed using either wedge or extrusion welding techniques or combination thereof and re-testing the repaired area with applicable methods as described herein. Cap strips shall cover the defective seam by no less than 6"/15cm On either side of the original weld. Wider patches will be required to cover seam sample void areas.

CLC shall document all actions taken in conjunction with destructive test failures; e.g., capping of failed seam area.

PART VIII

Defects and Repairs

8.1.0 Identification

All seams and non-seam areas of the geomembrane shall be examined by CLC for identification of defects, holes, blisters, un-dispersed raw materials and any sign of contamination by foreign matter.

Defective/damaged materials shall be identified via a deficiency report, either separately or on the Daily Report. Actions taken to resolve or correct the problem will also be recorded on the similar form.

Defects, holes, blisters, un-dispersed raw materials, signs of contamination by foreign matter, unacceptable welds in geomembranes and other unsatisfactory conditions will be identified on the Daily Report form. The repair/corrective action to "fix" the problem will also be recorded on a similar form.

8.2.0 Repair Procedures

Available methods include:

Patching - used to repair large holes, tears, and contamination by foreign matter.

Grinding and re-welding - used to repair small sections of extruded seams.

Spot welding or seaming - used to repair pinholes or other minor localized flaws;

Capping - used to repair large lengths of failed seams;

Methods for patching lining system defects shall consist of welding patches or caps over such areas using the same membrane lining material as used on the specific project. Patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches.

Seaming, preparation and welding equipment deployment procedures previously addressed in this manual shall be adhered to during patching operations.

8.2.1 Verification of Repairs

Each repair shall be non-destructively tested using the methods described in Section 6 as appropriate. Repairs which pass the non-destructive test, shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be redone and re-tested until a passing test result is obtained.

Part IX

Ancillary Items and Final Acceptance

9.1.0 Pipe Penetrations

Pipes penetrating through the lined area shall be sealed using pipe boot details that are welded to the lining system via extrusion weld method and sealed the pipe with double stainless steel banding clamps and butyl sealant tape. Pipe boots shall be fabricated from the membrane material being installed and shall fit snugly over the pipe and pipe to grade interface without undue slack or bridging. In instances where piping is

manufactured from HDPE, the pipe boot sleeve may be extrusion welded directly to the pipe foregoing the need for banding clamps.

9.2.0 Backfilling of Anchor Trenches

Anchor trenches, if any, shall be adequately drained by others to prevent ponding or otherwise softening the adjacent soils while the trench is open. The anchor trench shall be back-filled by others or as outlined in the specifications and bid documents.

Since back-filling the anchor trench can affect material bridging at toe of slope, consideration should be given to backfill the liner at its most contracted state; preferably during the cool of the morning or extended period of overcast skies. Care shall be taken when back-filling the trenches to prevent any damage to the lining system.

9.3.0 Lining System Acceptance

Once the lining system is installed and all quality assurance testing has been completed with satisfactory results, and the system is approved by Owner's Representative, the Representative shall sign an acceptance form provided by CLC prior to demobilization.



Promoting Industry Growth • Providing Better Quality Workmanship

Approved Installation Contractor

This Certificate Recognizes That

Colorado Lining International, Inc.

Has achieved Approved Installation Contractor status through
the International Association of Geosynthetic Installers.

Valid through July 8, 2010



A blue ink signature of Carl Apicella, written in a cursive style.

Carl Apicella

A blue ink signature of Laurie Honnigford, written in a cursive style.

Laurie Honnigford
Managing Director, iAGI

GSE HyperNet, HF, HS and UF Geonet

GSE HyperNet geonets are synthetic drainage materials manufactured from a premium grade high density polyethylene (HDPE) resin. The structure of the HyperNet geonet is formed specifically to transmit fluids uniformly under a variety of field conditions. HDPE resins are inert to chemicals encountered in most of the civil and environmental applications where these materials are used. GSE geonets are formulated to be resistant to ultraviolet light for time periods necessary to complete installation. GSE HyperNet geonets are available in standard, HF, HS, and UF varieties.

The table below provides index physical, mechanical and hydraulic characteristics of GSE geonets. Contact GSE for information regarding performance of these products under site-specific load, gradient, and boundary conditions.

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE ROLL VALUE ^(b)			
			HyperNet	HyperNet HF	HyperNet HS	HyperNet UF
Product Code			XL4000N004	XL5000N004	XL7000N004	XL8000N004
Transmissivity ^(a) , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²	9.66 (2 x 10 ⁻³)	14.49 (3 x 10 ⁻³)	28.98 (6 x 10 ⁻³)	38.64 (8 x 10 ⁻³)
Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	200 (5)	250 (6.3)	275 (7)	300 (7.6)
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	0.94	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	1/50,000 ft ²	45 (7.9)	55 (9.6)	65 (11.5)	75 (13.3)
Carbon Black Content, %	ASTM D 1603, modified	1/50,000 ft ²	2.0	2.0	2.0	2.0
Roll Width ^(c) , ft (m)			15 (4.6)	15 (4.6)	15 (4.6)	15 (4.6)
Roll Length ^(c) , ft (m)			300 (91)	250 (76)	220 (67)	200 (60)
Roll Area, ft ² (m ²)			4,500 (418)	3,750 (348)	3,300 (305)	3,000 (278)

NOTES:

- ^(a)Gradient of 0.1, normal load of 10,000 psf, water at 70° F (20° C), between steel plates for 15 minutes.
- ^(b)These are MARV values that are based on the cumulative results of specimens tested by GSE.
- ^(c)Roll widths and lengths have a tolerance of ±1%.

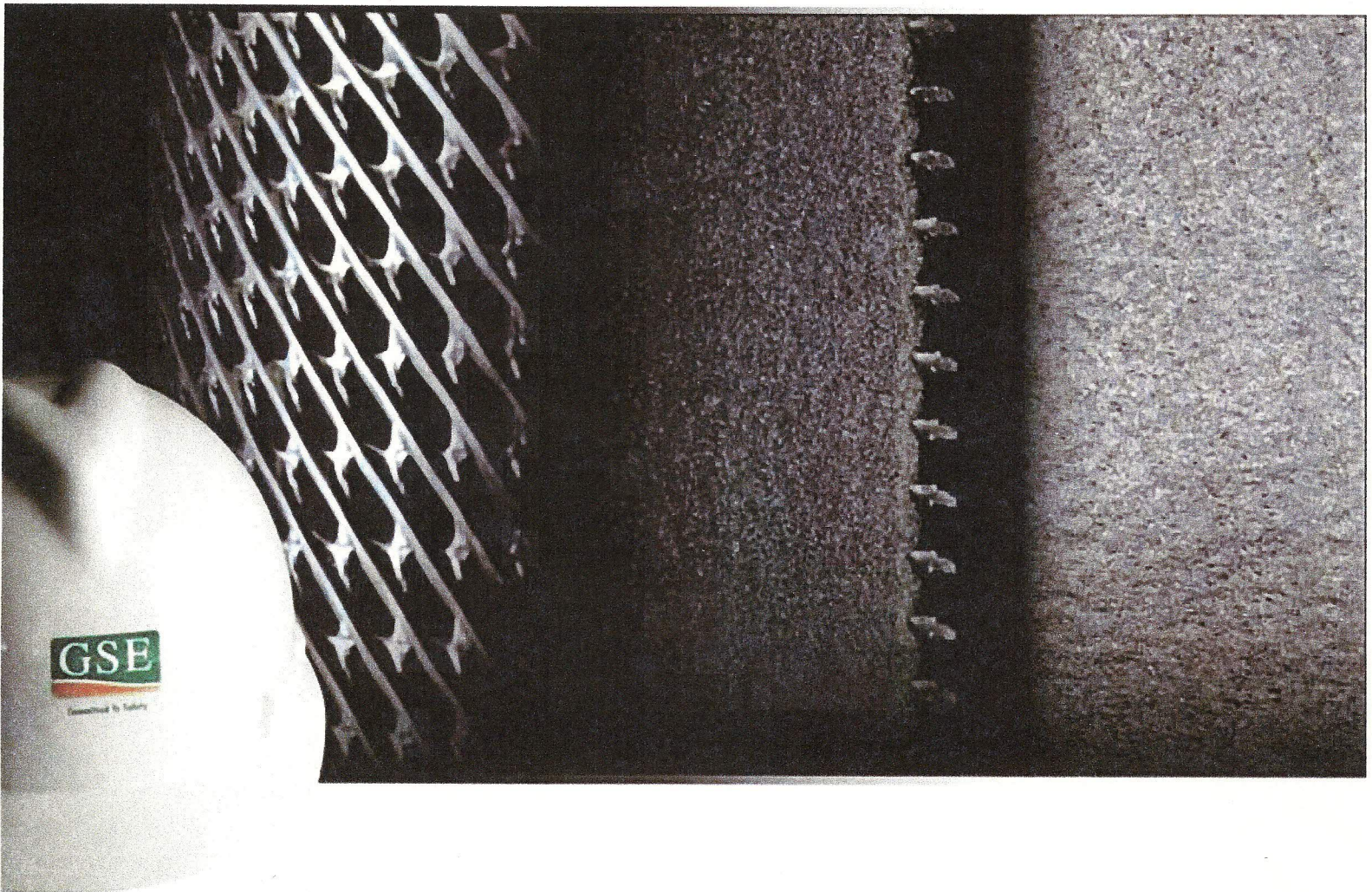
DS017 HyperNet R01/13/06

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North America	GSE Lining Technology, Inc.	Houston, Texas	800 435 2008	281 443 8564	Fax: 281 230 8650
South America	GSE Lining Technology Chile S.A.	Santiago, Chile		56 2 595 4200	Fax: 56 2 595 4290
Asia Pacific	GSE Lining Technology Company Limited	Bangkok, Thailand		66 2 937 0091	Fax: 66 2 937 0097
Europe & Africa	GSE Lining Technology GmbH	Hamburg, Germany		49 40 767420	Fax: 49 40 7674234
Middle East	GSE Lining Technology-Egypt	The 6th of October City, Egypt		202 2 828 8888	Fax: 202 2 828 8889

Installation Quality Assurance Manual



Geonet & Geocomposite Products





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1.0 INTRODUCTION

This manual provides an overview of the GSE Installation Quality Assurance procedures consistent with industry accepted practices to ensure that the geonet and geocomposite products installed will best perform for its intended purpose. In addition, all installation work will be performed in strict accordance per the customer's specifications. Please read the procedures below completely before you begin. If you need further clarification, contact the GSE Installation Department for assistance. Remember safety first and use safe practices always on every project.

2.0 ROLL PACKAGING

GSE geocomposite rolls shall be shipped from the factory in an opaque protective covering to prevent damage and UV degradation. However, GSE geonets do not need to be further protected from UV degradation during shipping or storage.

3.0 MATERIAL DELIVERY

- A. Upon arrival on site, QA personnel will inventory all materials on-site.
- B. Roll numbers of the geonet or geocomposite will be logged on the Inventory Check List (Appendix A) and cross-referenced with the Bill of Lading.
- C. Copies of the Inventory Check List and signed Bill of Lading should be sent to GSE corporate headquarters while the on-site QA personnel retains the original copies.
- D. Any visible damage to roll materials should be noted on the roll and Inventory Check List.

4.0 UNLOADING & STORAGE PROCEDURES

- A. Rolls of material shall be unloaded with equipment that will not damage the geonet or geocomposite.
- B. Fabric-straps, spreader bars, stinger bars, or other approved equipment shall be used for handling rolls of geonet and geocomposite.
- C. Materials should be stored in a flat, dry and well drained area.
- D. The surface shall be free of sharp rocks or other objects that could damage the materials.

5.0 SUBGRADE PREPARATION

The subgrade shall be free of sharp rocks or other objects that could otherwise cause damage to the materials.

6.0 DEPLOYMENT

Geonet and geocomposite shall be handled in a careful manner to ensure that it is not damaged in anyway.

- A. On slopes, the material shall be anchored in the anchor trench and then rolled down the slope in such a manner as to continually keep the material under tension.



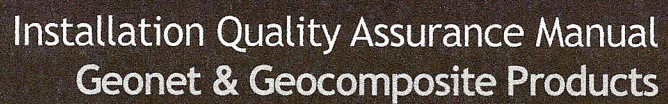
- B. In the presence of wind, the leading edge of the material shall be weighted with temporary ballasting, such as sandbags until the final cover is placed.
- C. Care shall be taken to assure that any underlying layers are not damaged during placement. Low ground pressure machines, such as ATV's to facilitate deployment over the geosynthetic layers is allowed. Low ground pressure machines are machines with a ground pressure less than 8 psi when carrying a driver weighing approximately 150 lbs.
- D. Care shall be taken to avoid entrapment of stones, mud and other materials during placement operations.

7.0 OVERLAPS & SEAMS

- A. The recommended geonet overlap in the machine direction is 3.0 in to 5.0 in. The recommended overlap in the transverse direction is 6.0 in to 12.0 in.
- B. On slopes the ends of the materials shall be shingled down in the direction of the slope.
- C. A plastic cable tie should be placed once per every five linear feet in the machine direction and once per every linear foot in the transverse direction.
- D. If the product is a geocomposite, the geotextile on the bottom shall be overlapped and the geotextile on top shall be overlapped, sewn or heat bonded. The exact seaming method or overlap is typically specified in project construction documents.

8.0 COVER SOIL PLACEMENT

- A. Prior to placement of cover soil, a Certificate of Acceptance (Appendix B) must be signed by a responsible party and an installer's representative.
- B. Any cover material, such as soil, that is placed over the drainage material shall be placed with care to assure the material is not damaged.
- C. Care shall be taken to minimize any movement of the geonet or geocomposite and to assure that no tensile stress is induced in the material.
- D. Cover soils deployed over the geonet or geocomposite should be free of all sharp objects, sharp rocks and sticks.
- E. Wide track equipment should be used to distribute cover soil over the geocomposite.
- F. A minimum of 12.0 in of cover soil is required to separate the equipment from the geocomposite to prevent damage.

[illegible]



Appendix B: Certificate of Acceptance

GSE Lining Technology, LLC

19103 Gundle Road
Houston Texas 77073
800-435-2008
281-443-8564
281-875-6010 Fax

Job No.: _____
Project: _____
Client: _____
Bill To: _____

Job Description: _____
% Complete of Total Job: _____

Certificate of Acceptance

Material	Estimated Square Feet	Final Quantity/Description

I, the undersigned, duly representative of:

Do hereby take over and accept the work described above from the date hereof and confirm to the best of my knowledge the work has been completed in accordance with specifications and the terms and conditions of the contract.

Name	Signature	Title	Date

Certificate accepted by GSE Lining Technology, LLC Representative.

Name	Signature	Title	Date



LINING TECHNOLOGIES

Quality

CETCO GCL

MANUFACTURING QUALITY ASSURANCE AND QUALITY CONTROL (MQC) MANUAL

Version 8.0, November 2009

CONFIDENTIALITY NOTICE

This manual contains confidential company information and is to be distributed exclusively to those personnel who are directly involved with the manufacturing and evaluation of Bentomat. THIS DOCUMENT SHALL NOT BE PUBLICLY DISTRIBUTED WITHOUT THE EXPRESS CONSENT (VERBAL OR WRITTEN) OF COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY.



POLICY STATEMENT

The Geosynthetic Clay Liner (GCL) Manufacturing Quality Assurance/Quality Control Manual has been prepared by Colloid Environmental Technologies Company (CETCO), a wholly owned subsidiary of AMCOL International, Inc. This policy states that our primary goal is to achieve optimum productivity while assuring full customer satisfaction. To reach this goal, CETCO is committed to the pursuit of continuous improvement of all processes and materials utilized in the manufacture of GCL.

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SECTION 1 INTRODUCTION

1.1 Definitions

This manual contains objectives and criteria for maintaining CETCO Geosynthetic Clay Liner (GCL) *Manufacturing Quality Control* and *Manufacturing Quality Assurance* as defined below:

Manufacturing Quality Control (MQC) refers to a planned system of inspections for directly monitoring and controlling the quality of the GCL product during the manufacturing process. MQC is performed by CETCO to ensure that the specified values for GCLs are achieved.

Manufacturing Quality Assurance (MQA) refers to a planned system of activities that provide assurance that the manufactured GCLs product actually meets its specified properties.

The above definitions, provided by Koerner and Daniel¹, imply that MQC procedures are implemented to control the product *during* manufacture, while MQA procedures are implemented to ensure the product meets specifications *after* manufacture. CETCO GCLs are assembled from three component materials, meaning that there are *four* materials streams (two geosynthetics, the clay, and the finished product) which are subject to either MQA or MQC. Quality control procedures are implemented on those components and finished products which are manufactured by CETCO. Quality assurance procedures are implemented on the components of GCL that are furnished by outside suppliers. Therefore, this manual contains an integrated series of procedures that may be classified as both MQA and MQC, as determined by the source of the component materials.

The organizational structure of the CETCO GCL MQA/MQC Program is depicted in Figure 1-1. The "core" quality personnel are shown in the center of the diagram, with peripheral quality support provided by the other personnel. For each project, the CETCO GCL Sales Manager is the key liaison between the manufacturer and the engineer, and any special MQA/MQC issues which deviate from this manual should be communicated between these two parties prior to production for the project. Figure 1-2 presents the Order Review Process for discrepancies between contract specifications and CETCO standard GCL specifications.

1.2 MQA/MQC Objectives

CETCO GCLs are utilized in a wide variety of important environmental and engineering applications which often provide protection of human health and the environment from contaminated soil or water. Accordingly, CETCO GCLs have been designed with certain engineering properties which make it suitable for use in these critical applications. The quality of CETCO GCLs has a direct influence on the degree of environmental protection they provide. It is therefore of paramount importance that the entire manufacturing process for CETCO GCLs is tightly controlled and monitored through the implementation of a comprehensive quality management system.

¹ Koerner, R.M. and D.E. Daniel (1992) *Manufacturing and Construction Quality Control and Quality Assurance of Geosynthetics*. Proceedings of the 6th GRI Seminar: MQC/MQA and CQC/CQA of Geosynthetics, December 10-11, 1992, Philadelphia, PA, pp. 1-14.

CETCO is registered with the International Organization for Standardization (ISO) and follows a quality management system in accordance with ISO 9001:2000. The intent of the quality management system is to ensure that we provide products and services that conform to the requirements of our customers and to deliver them on time and without defects. The Quality Manual and associated quality procedures, work instructions, calibration procedures, test procedures, and records, are saved electronically. The procedures outlined in this MQA/MQC manual are also described in the ISO Quality Manual.

This MQA/MQC manual establishes the manufacturing guidelines and product testing procedures necessary to ensure that CETCO GCLs meet all of their design specifications. Where applicable, established ASTM sampling and testing methodologies and protocols for GCLs or its components are specified for use.

The remainder of this manual is presented in three sections. Section 2 contains test procedures for GCLs and each of its components, and Section 3 describes the record keeping and reporting procedures which will document adherence to this plan and will verify the overall quality of the product. Lastly, Section 4 presents in tabular form an overall summary of the manufacturing QA/QC program.

1.3 Revisions

Because one of CETCO's corporate commitments is continual product improvement, the procedures specified in this manual may require some modifications as such improvements occur. Interim revisions to the existing manual will be issued as required, and the manual itself will be updated and reissued on a regular basis to incorporate recent revisions. It is every employee's responsibility to remain abreast of the continued revisions to the quality program.

1.4 Audits

Formal internal audits of the GCL manufacturing quality program will be conducted annually by CETCO and by a third-party ISO auditor in order to determine the adequacy of quality procedures and the degree of conformance with these procedures. Informal audits will be conducted on an as-needed basis by plant management.

Results of the audits will be distributed to the CETCO Management Representative, to the Plant Manager, and to corporate management. If the audit reveals that major corrective actions are required to achieve conformance with quality objectives, a quality improvement plan will be prepared and submitted to the CETCO Management Representative. A file of all audits and corrective action plans will be maintained by CETCO. Implementation of the quality improvement plan will be managed by the CETCO Management Representative and/or Plant Manager.

SECTION 2

MQA/MQC PROCEDURES

This section of the CETCO GCL Manufacturing QA/QC Manual describes specific procedures carried out to evaluate the quality of each GCL component (top geosynthetic, bottom geosynthetic, bentonite clay), the quality of the actual production process, and the quality of the finished GCL product. This program allows immediate verification of critical production parameters used to monitor production quality, while the laboratory test program will verify the specified engineering characteristics of the GCL.

2.1 Geosynthetic Components

Depending upon the type of GCL the top and bottom geosynthetic components may consist either of a woven geotextile, nonwoven geotextile, or flexible membrane liner laminated to a geotextile. ASTM D5889 states the minimum types of tests and their frequencies for the MQC of the geosynthetic materials used in the GCL.

2.1.1 Woven Geotextile

The woven geotextile is manufactured elsewhere and is delivered to the GCL plant in rolls up to 1,500 yards long, depending on the style being used. CETCO receives and maintains on file manufacturer's certifications stating that the products meet the engineering specifications listed in Table 2-1.

Each geotextile roll is labeled with a lot and roll number, and the date and time at which a roll is placed into GCL production is recorded on a daily operating log. This procedure allows the usage of the woven geotextile to be tracked such that its lot and roll number can be directly determined from the corresponding GCL lot and roll number.

If the overall quality of the of the woven geotextile roll is unknown (e.g., not certified by the manufacturer, lot and roll tag missing, or the data misplaced) full roll-width samples are obtained at a frequency of one per every 200,000 square feet to confirm that the geotextile is acceptable with respect to its required mass per unit area and grab strength values.

2.1.2 Non-Woven Geotextile

The non-woven needlepunched geotextile is manufactured in rolls up to 1,500 yards long by CETCO or elsewhere and is subjected to conformance tests at the plant of origin prior to delivery to the GCL plant. CETCO receives and maintains on file manufacturer's certifications stating that the products meet the engineering specifications listed in Table 2-1.

Each geotextile roll is labeled with a lot and roll number, and the date and time at which a roll is placed into GCL production is recorded on a daily operating log. This procedure allows the usage of the woven geotextile to be tracked such that its lot and roll number can be directly determined from the corresponding GCL lot and roll number.

If the overall quality of the of the woven geotextile roll is unknown (e.g., not certified by the manufacturer, lot and roll tag missing, or the data misplaced) full roll-width samples are obtained at a frequency of one per every 200,000 square feet to confirm that the geotextile is acceptable with respect to its required mass per unit area and grab strength values.

2.1.3 Geomembrane/Geofilm Laminated to Geosynthetic

When a geomembrane or geofilm is laminated to the GCL as in the CL Product Series, the geomembrane or geofilm shall be subjected to the MQC testing outlined in Table 2-2 either by the supplier or by CETCO.

2.2 Sodium Bentonite

ASTM D5889 identifies the minimum types of tests and their frequencies for the MQC of sodium bentonite prior to incorporation into GCLs. Granular sodium bentonite incorporated into the GCL is supplied by one or more bentonite plants. The bentonite manufacturer provides test data for each shipment received at the GCL plant.

The sodium bentonite is typically railed or conveyed to the GCL plants. Railcars hold approximately 90 tons. The clay testing is therefore performed twice per railcar, but a minimum of every 50 tons. QA procedures for bentonite shipped to the GCL plant primarily involves collecting and maintaining Certificates of Analysis (COAs) issued by the bentonite manufacturer with each bentonite shipment.

The quality parameters for the sodium bentonite are its swell index and fluid loss, which are indicators of GCL hydraulic performance. The clay in CETCO GCLs has a minimum swell index of 24 mL/2g, as determined in accordance with ASTM D5890. The clay in CETCO GCLs has a maximum fluid loss value of 18 mL, as determined in accordance with ASTM D5891. A summary of the bentonite MQA parameters is provided in Table 2-3.

Additionally, shipment COAs indicate moisture content and particle sizing. These properties do not pertain to final GCL quality. They pertain to properties needed for efficient processing of the bentonite into the GCL at CETCO plants. They are **not** part of the ASTM D5889 GCL Quality Control.

The CETCO bentonite COAs are received and retained at the GCL plant, and the accompanying clay lot numbers are recorded in the operations log using procedures similar to those described in Section 2.1 for the geosynthetic components. In order to coordinate the usage of the certified bentonite and the production of GCL, the lot number and the time/date of use is recorded in the daily log. Thus, the daily log allows every roll of GCL to be traced to the bentonite lot number. More information regarding the reporting and record keeping procedures is presented in Section 3.

2.3 Production Processes

The machinery utilized for the production of GCLs is highly controlled, and critical production parameters are automatically monitored. Human input into the manufacturing process is critical, however, to the extent necessary to maintain the machinery and the requisite QA/QC information. As described below, quality control procedures during production focus primarily on maintaining the calibration and operation of the production system.

2.3.1 Punch Density (Bentomat GCLs Only)

Punch density refers to the number of needlepunched fibers per unit area joining the top and bottom geotextiles of the Bentomat GCLs. The correct punch density has been determined to correspond to various operational parameters, which are maintained during production. Calibration of the needling machinery is performed regularly, and Bentomat peel test results provide a quantitative verification that the punch density meets minimum standards.

2.3.2 Lamination (CL/CLT Series)

Lamination refers to bonding a geomembrane or geofilm to the needlepunched geotextile with an adhesive.

2.3.3 Roll Length and Width

The dimensions of the GCL panels are directly evaluated. Length measurements are made through continuous monitoring by an electronic linear measuring device connected to the wind-up roll at the end of the production line. When the standard length of 150 feet is reached, the roll is cut and prepared for storage or shipment. Periodically, a GCL roll is manufactured to a length of 153 feet such that a full roll-width QA sample may be taken.

It is noted that shorter rolls are produced when production is temporarily suspended for materials re-supply. These short rolls are often useful for completing the square footage requirements for a particular job. The length of all short rolls is recorded as well. The correct width of either 14.5 or 15 feet is maintained by periodic width measurements are made prior to roll-up using a tape measure placed perpendicular to the machine direction of the GCL.

2.3.4 External Markings

GCLs are furnished with two dashed lines ("lap line" at 6 inches and "match line" at 9 inches) on each end of the upper geosynthetic to facilitate its installation. The lines are applied to the finished GCL as it passes by a system of rotating stationary inking devices. The ink reservoirs are checked frequently during each shift to ensure an adequate supply during production. Visual observations of lap line placement are also conducted by the shift supervisor. The system is automated and requires few adjustments, although the locations of the lines are measured at a frequency of at least once per shift. The lines on standard rolls of GCL are located within 1/4 inch of the 6 and 9-inch points as measured perpendicular from each edge.

The GCL product is marked with the word "CETCO" to facilitate product identification.

2.3.5 Equipment Inspection

The mechanical equipment and appurtenant devices used in the manufacture of GCL are regularly inspected and maintained in accordance with the overall plant maintenance program.

2.4 Finished GCL

This section of the manual describes the sampling and testing procedures implemented to ensure that each roll of GCL has been manufactured to meet its standard design specifications. **CETCO defines a lot of GCL as one week of production of a product at a particular plant.** ASTM D5889 outlines the minimum types of tests and their frequency for the MQC of the finished GCL. Besides the clay mass per unit area, clay moisture content, grab tensile strength and flux listed in ASTM D5889, CETCO also performs peel strength and shear strength testing on its Bentomat products. Based on testing frequency, rolls are identified during production so that their length may be extended by 3 feet in order to accommodate sampling. Table 2-4 presents the finished GCL MQA test specifications.

The bentonite mass per unit area test procedures are performed in accordance with ASTM D5993. It must be noted that an accurate bentonite mass per unit area determination requires that the moisture content of the finished product also be determined. In ASTM D5993, bentonite mass per unit area is defined as the *dried* mass per area of the *bentonite*, as opposed to the mass per area of the entire GCL. In other words, dried bentonite mass per area is calculated by subtracting out the weight of the water in a GCL sample *and* the weight of the geosynthetics. The geosynthetic weights are *typical* values because it is neither possible nor practical to attempt removal of the bentonite entirely from the GCL in order to weigh each component separately. Five test specimens are cut from each full roll-width sample as shown in Figure 2-1. The number of test specimens obtained per sample may be modified as variability data is generated.

The specimens for grab tensile testing are taken from the same full roll width samples at a frequency of one per 200,000 square feet and are tested according to the procedures in ASTM D6768 (grab strength per unit width, reported in lbs/in or N/cm). No fewer than five specimens per sampling event are tested. If requested on a particular project, results may be reported per method ASTM D4632, modified for GCLs with 4-inch grips (total grab strength, reported in lbs or N).

Index flux and hydraulic conductivity testing are performed at a rate of one per production lot (once per week). Index flux is run per ASTM D5887 and hydraulic conductivity is calculated by measuring the thickness and using the formulas presented in ASTM D5887.

Peel testing is performed on Bentomat needlepunched products at a minimum frequency of one per 40,000 square feet. Peel testing is performed following ASTM Method D6496, which reports average peel strength over the sample width, in lbs/in or N/cm. In the peel test, a Bentomat specimen is partly de-laminated by cutting the needlepunched bonds between the geotextiles just enough to allow each geotextile to be separately inserted into the grips of the tensile testing device. If requested on a particular project, results may be reported per method ASTM D4632, modified for GCLs with 4-inch grips (peak peel strength, reported in lbs or N).

Internal direct shear testing is performed per ASTM D5321 (Geosynthetics) or D6243 (GCLs) on Bentomat needlepunched products on a periodic basis, typically annually, at CETCO's Corporate Laboratory in Arlington Heights, IL. The GCL is hydrated under a load of 200 psf for 48 hours and then sheared at 0.004 in./min. Periodic direct shear testing is also performed under higher normal loads (10,800 psf) by an outside GAI-LAP accredited geosynthetic laboratory.

Specimens of finished GCL are archived for 12 months and then are discarded. These samples can be utilized for post-project testing if a dispute arises. However, it is the **purchaser's responsibility** to

ensure that representative samples of the GCL are retained if testing is requested after this one-year period has expired.

2.5 Needle Detection and Removal

The production of needlepunch-reinforced GCLs such as Bentomat, involves driving thousands of needles at hundreds of strokes per minute through the bentonite and encapsulating geotextiles. Significant forces are applied to the needles during this process. A few needles will inevitably break, and needle fragments must be removed. CETCO follows a three-part strategy of prevention, detection, and removal, to prevent the presence of needle fragments in the finished product.

Needle breakage is minimized by implementing several measures related to optimization of bentonite particle size, needle type selection, and the operation of the needling loom (including frequent bed plate and stripper plate cleaning). However, even with these measures, some breakage is inevitable. Therefore, a set of powerful magnets is arranged downstream from the loom, across the width of the GCL. Positioned just over the surface of the textiles, the magnets effectively remove needle fragments that break after striking a clay particle. Almost all needle fragments are removed by the magnets, but a few do remain in the product and must be detected and removed.

A system of magnetic metal detectors distributed across the width of the GCL is used to scan the product for needle fragments. Located after the magnets, the detectors divide the roll into discrete segments. If a needle fragment is detected in one of the segments, a production crewperson stops the material in-line and checks for needle fragment(s). Rolling of the material is then resumed and it passes a second metal detector. If metal is still detected, a tag is placed on the outside edge of the roll. Flagged rolls are set aside for a secondary detection and removal process, where a "re-roll station" is used to unroll the GCL to the spot where the tag was placed. This section of the roll is scanned with a hand-held detector and visually inspected until the needle fragment is found. Protruding needle fragments are removed, and the rolls is then wound and packaged. The needle detection and removal process is shown in Figure 2-2.

2.6 Plant Storage and Handling

Care is taken at the plant to handle and store the finished rolls of GCL in a manner that prevents damage to the product and its packaging. All handling of the product must be executed with a forklift or other suitable vehicle outfitted with a carpet pole or "stinger." The stinger must be strong enough to support the weight of a full roll of GCL with minimal bending.

GCL storage is limited to stacks no higher than 7 rolls. This provides easy equipment access and minimizes the chance for damage to the roll core and to the GCL itself. The inventories of GCL and its component materials will be rotated for additional protection against potential long-term, storage-related damage.

SECTION 3

RECORDING AND RECORD KEEPING

GCL is manufactured from three different raw materials, each requiring its own QA/QC testing and record keeping. The finished GCL product also requires testing, so comprehensive documentation of all GCL manufacturing activities is essential in order to properly manage the large amount of information generated during production. This section of the GCL MQA/MQC Manual lists the quality-related information recorded and provides the procedures for maintaining the records.

3.1 Plant Records

Daily Operations Log. Plant records include both a continuous daily operations log and a log of QA test data. Items included in the daily production log include:

- Current date and shift.
- Current lot and roll number in production.
- Length and width of each roll produced.
- A record of raw material usage, including lot/roll and railcar numbers.
- Documentation of relevant information affecting production.

QA Log. A separate log is maintained at the plant to record information pertaining to test data. Information included in the QA log includes:

- Date, time, lot, and roll number of all tested samples.
- QA test results summarized in tabular form.
- Name of person conducting the tests.
- Actions taken if test results were unsatisfactory.

The QA log may be kept electronically as data is tabulated directly on an available computer or may be kept in writing, at the discretion of the shift supervisor.

For future reference, both of these logs shall be maintained at the plant indefinitely. Copies of test results recorded on the QA log will be provided as required. The daily production log and the QA log are the most important means by which GCL quality is documented; therefore, these logs must be neatly and accurately maintained.

Product Labeling. Adhesive labels are placed on the outer wrap of every GCL roll and on the core. The labels themselves provide the following information:

- Length and width of roll.
- Total weight of roll.
- Product identification (material codes and type designation).
- Lot number and roll number.

Packing Slips. The plant provides the site manager or his designate with a packing slip for each shipment of GCL to the project site. The packing slip includes the following information:

- CETCO order number and customer P.O. number.
- GCL lot numbers, roll numbers, roll dimensions, and roll weights.
- Shipment address.

Copies of the packing slips shall be maintained at the plant.

3.2 Supplemental Laboratory Records

CETCO shall maintain complete records of all testing performed at its laboratories or outside laboratories in the event that supplemental MQA testing is required for a particular project. Using standard laboratory record keeping procedures, CETCO shall maintain records, as required for the project, of:

- Results of physical and hydraulic tests on geosynthetic components, bentonite, and GCL.
- Documentation of follow-up action, if any, after evaluation of test data.

3.3 GCL Manufacturing Certification Reports

Each shipment of GCL for which MQA/MQC documentation is required will be properly accompanied by a hard copy MQA/MQC Data Package. The package includes a certification statement indicating to the customer that the purchased GCL complies with all of the properties certified by CETCO Lining Technologies Group.

Additionally, as of September 2004, an E-Cert GCL MQC/MQA certification system was implemented. Electronic copies of MQC/MQA Data Packages are posted on the CETCO LT Engineering Web-site (<http://www.cetco.com/LTE/>), for direct retrieval by project technical contacts. The secure website is accessed by customers using a unique password/username, provided to the customer by either the Cartersville or Lovell Quality Assurance Coordinator. Each customer will only have access to their specific projects. The E-Cert packages are streamlined versions of the hard copy MQA/MQC packages – an example is included in Appendix B.

The supplier certifications for the bentonite clay for free swell and fluid loss will be included in the certification reports. Supplier MQA/MQC data on the geotextiles will be included, when required by the project specifications. The GCL MQA/MQC test data reports for bentonite mass per unit area, grab tensile strength and peel strength (for Bentomat orders) will be furnished, as well as the QA tracking forms identifying the raw material lots associated with each GCL lot and roll number for the order. Due to the time required to run the index flux, hydraulic conductivity and internal direct shear testing, this information, when required per the project specifications, will be forwarded under separate cover.

As each roll of material goes through the needle detection and removal system described in Section 2.5, each MQA/MQC package should also include the following needle detection certification statement:

"CETCO hereby affirms that all Bentomat geosynthetic clay liner material manufactured for this project is continually passed under a magnet for needle removal and then screened with a metal detection device. CETCO certifies Bentomat to be essentially free of broken needles and fragments of needles that would negatively effect the performance of the final product."

SECTION 4

SUMMARY OF GCL MQA/MQC PLAN

This section provides a tabular summary of the MQA/MQC plan for finished GCL and its component materials. Table 4-1 and Table 4-2 serve as convenient references for the overall scope of the plan but should not be used until the plan is read and understood in its entirety. The tables illustrate that the plan is designed to provide comprehensive verification of GCL quality. It is emphasized that the program will be amended as required to conform to future product/process improvement.

FIGURE 1-1
CETCO GCL MQA/MQC PROGRAM
ORGANIZATION CHART

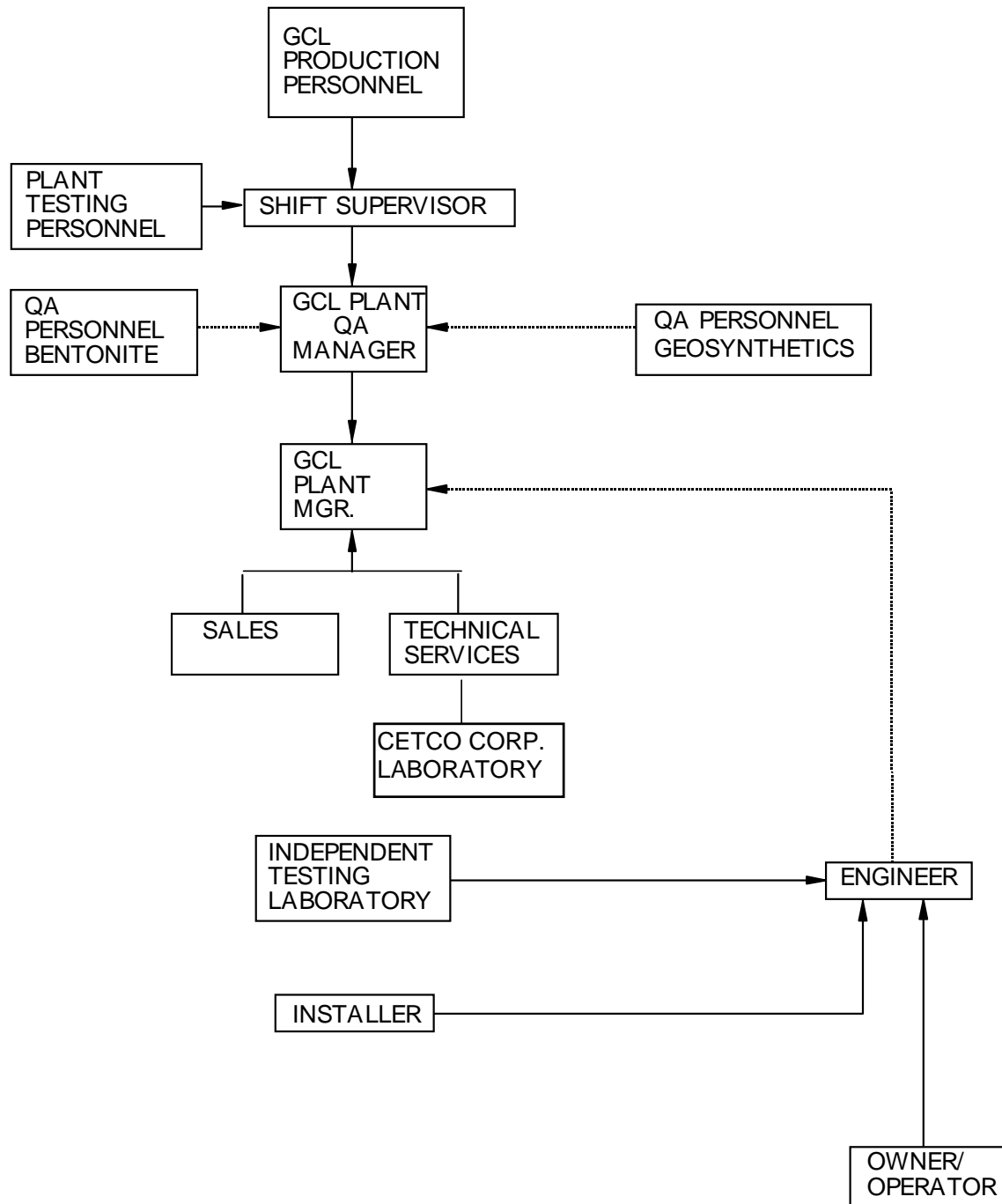
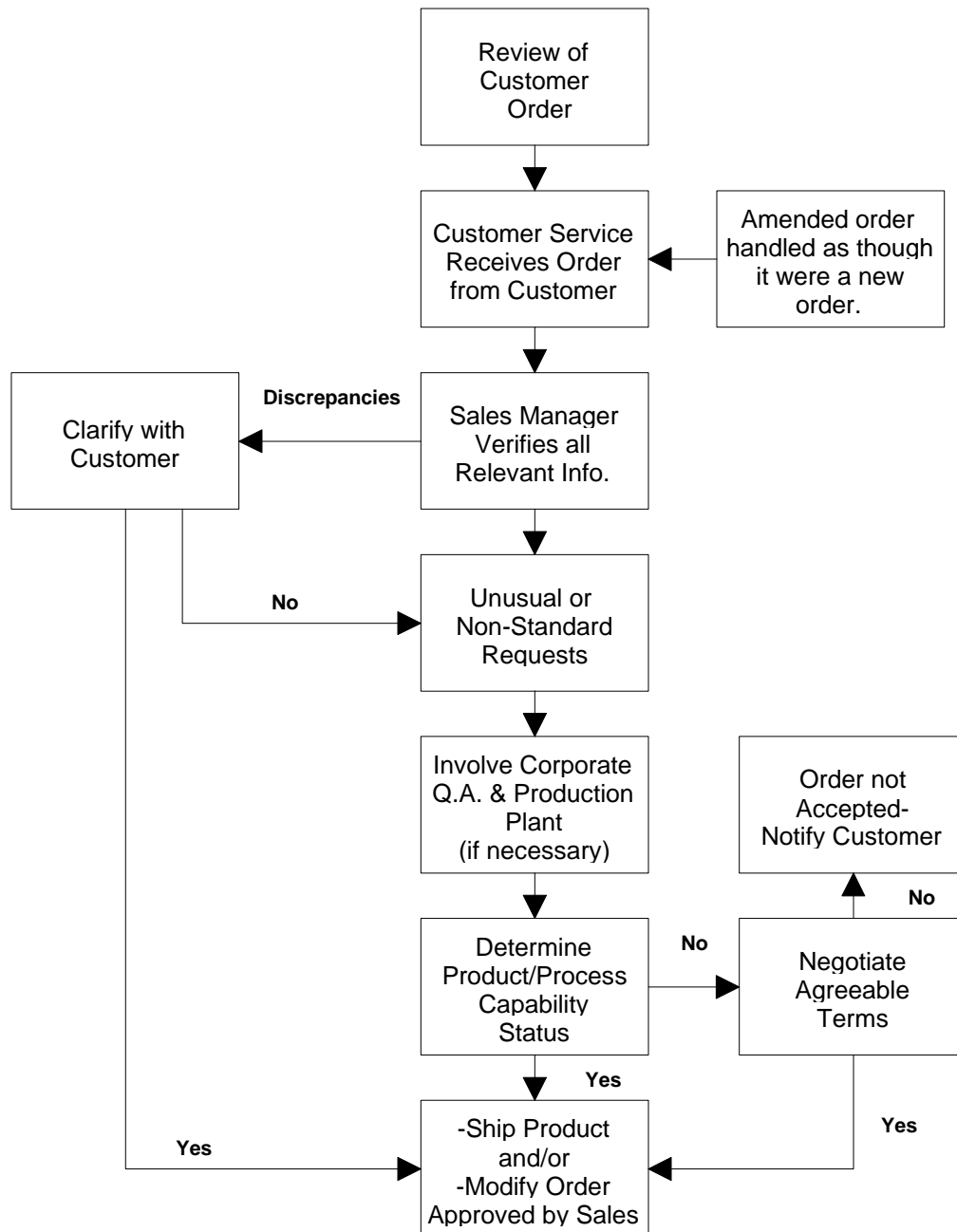
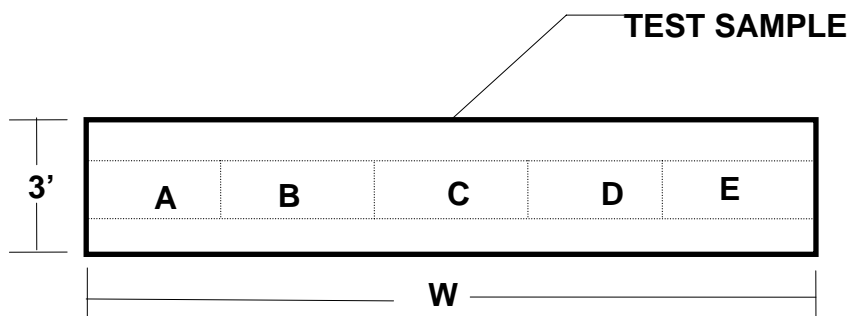


FIGURE 1-2
CETCO ORDER REVIEW PROCESS



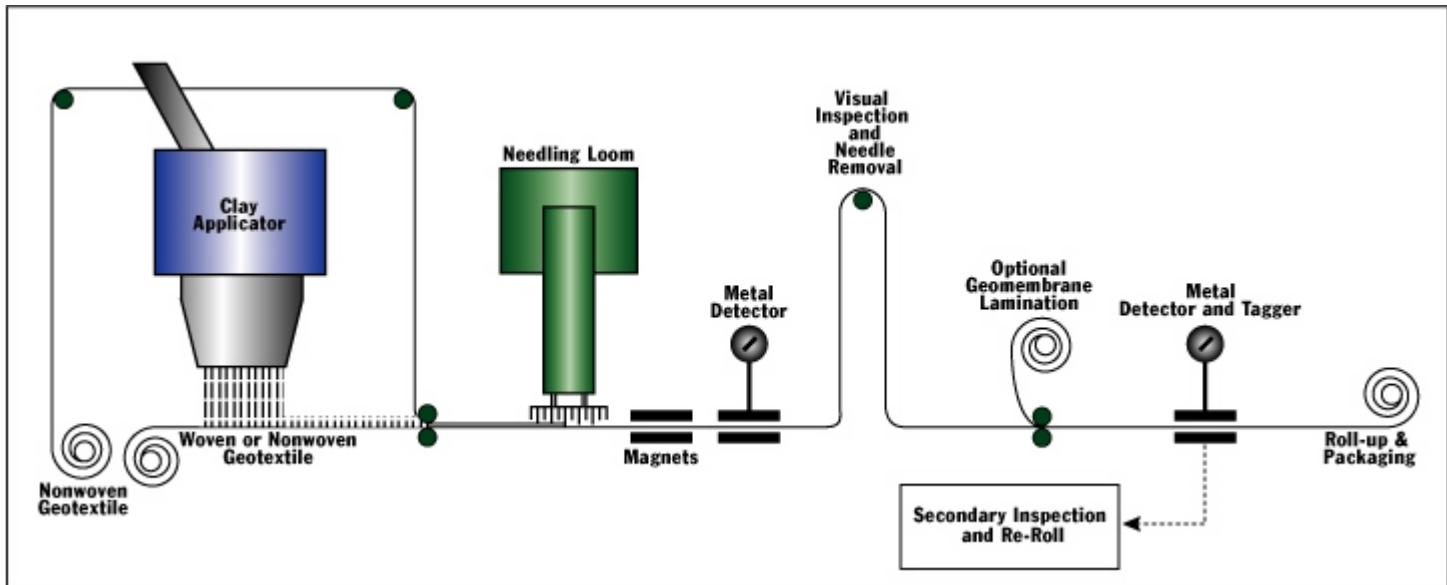
**FIGURE 2-1
GUIDE FOR OBTAINING SAMPLES
AND TEST SPECIMENS**



NOTES

1. Dashed lines represent acceptable "windows" from which test specimens A, B, C, D, and E are cut.
2. The specimens are cut at random locations within each window. For the standard 15-foot wide GCL product, the windows are 3 ft long and for standard 14.5 ft-wide GCL products, the windows are 2.9 ft long.
3. All samples must be cut using a die and hydraulic punch.
4. At least one 1' x 1' specimen is archived (see Section 3).
5. The above figure depicts sampling guidelines for nonwoven geotextile manufactured by CETCO as well as the finished GCL product.

FIGURE 2-2
SCHEMATIC OF NEEDLE DETECTION
AND REMOVAL SYSTEM



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TABLE 2-1
MQA PARAMETERS FOR
GEOTEXTILE COMPONENT OF GCL

PROPERTY	TEST METHOD	FREQUENCY	RECORDED VALUE ¹
Grab Strength	ASTM D 4632	200,000 sq. ft	Typical and MARV
Mass per Unit Area	ASTM D 5261	200,000 sq. ft	MARV

NOTES

1. Values represent geotextile prior to incorporation into GCL.

TABLE 2-2
MQC PARAMETERS FOR
GEOMEMBRANE/GEOFILM COMPONENT OF
CL GCL SERIES

PROPERTY	TEST METHOD	FREQUENCY	RECORDED VALUE ¹
Grab Strength	ASTM D 638 or D 882	200,000 sq. ft	Typical & MARV
Thickness	ASTM D 5199	200,000 sq. ft	Typical & MARV
Mass per Unit Area	ASTM D 5261	200,000 sq. ft	Typical & MARV

NOTES

1. Values represent geomembrane/geofilm laminate prior to incorporation into GCL.

TABLE 2-3
MQA PARAMETERS FOR
SODIUM BENTONITE COMPONENT OF GCL

PROPERTY ¹	TEST METHOD	FREQUENCY	REQUIRED VALUE
Swell Index	ASTM D 5890	every 50 tonnes	24 mL/2g minimum
Fluid Loss	ASTM D 5891	every 50 tonnes	18 mL maximum
Moisture Content	ASTM D 2216	every 50 tonnes	12% maximum
Particle Size ²	ASTM C136	every 50 tonnes	100 % typ. - #8 mesh 1 % typ. - #200 mesh

NOTES

1. These parameters are for the bentonite incorporated into the GCL and do not necessarily reflect the properties of the bentonite in the finished product. This is especially the case with moisture content.
2. Particle size range based on available bentonite supply. Particle size may change depending on bentonite availability.

TABLE 2-4
MQA/MQC PARAMETERS FOR FINISHED GCL

PROPERTY	TEST METHOD¹	FREQUENCY²	REQUIRED VALUE³
Bentonite Mass/Area ⁴	ASTM D 5993	40,000 sq. ft	0.75 lbs./sq. ft
Tensile Strength ⁵	ASTM D 6768	200,000 sq. ft	Product dependent (see Table 4-1 and Table 4-2)
Peel Strength ⁵	ASTM D 6496	40,000 sq. ft	For needlepunched GCL only; Product dependent (see Table 4-1 and Table 4-2)
Index Flux ⁶	ASTM D 5887	Weekly	Product dependent (see Table 4-1 and Table 4-2)
Permeability ⁶	ASTM D 5887	Weekly	Product dependent (see Table 4-1 and Table 4-2)
Internal Shear ⁷	ASTM D 5321 ASTM D 6243	Periodic	Product dependent (see Table 4-1 and Table 4-2)

NOTES

1. ASTM methods are also modified wherever necessary to facilitate the testing of a GCL rather than a geotextile.
2. The test frequency listed is based on ASTM D5889. Actual frequency may vary due to roll dimensions.
3. All values are minimum average roll values (MARVs) unless otherwise indicated.
4. Bentonite mass per unit area is exclusive of the average weight of the geotextiles and is normalized to 0 percent moisture content per ASTM D 5993.
5. Tensile values represent testing with the test specimens oriented in the machine direction. Results reported by D 6768 and D 6496 are in units of lbs/in or N/cm. If requested, results also be reported by D 4632, modified with 4-inch grips, in units of lbs or N.
6. Index flux and permeability with deaired distilled water at 5-psi maximum confining stress and 2 psi head. Frequency is whichever is greater.
7. Internal direct shear sample hydrated for 48 hours at 200 psf normal load and run at 0.004 in/min.

TABLE 4-1
BENTOMAT MQA/MQC PLAN SUMMARY¹
(Version 8.0, revised November 2009)

MATERIAL	QUALITY PARAMETER ¹	TEST METHOD ²	TEST FREQUENCY ³	CERTIFIED VALUE ⁴
Bentonite⁵	Swell Index	ASTM D 5890	50 tonnes	24 mL/2g min.
	Fluid Loss	ASTM D 5891	50 tonnes	18 mL max.
	Moisture Content	ASTM D 2216	50 tonnes	12 percent max.
	Particle Type: Granular ⁶	ASTM C 136	50 tonnes	100% typical- #8 1% typical - #200
Bentomat CL/CLT	Bentonite Mass/Area ⁷	ASTM D 5993	40,000 sq. ft	0.75 lb./sq. ft
	Tensile Strength ⁸	ASTM D 6768	200,000 sq. ft	45 lbs/in (CL/CLT)
	Peel Strength ⁸	ASTM D 6496	40,000 sq. ft	3.5 lbs/in (CL/CLT)
	Index Flux ⁹	ASTM D 5887	Periodic	1 x 10 ⁻⁹ m ³ /m ² /sec for CL/CLT
	Permeability ⁹	ASTM D 5887	Periodic	5 x 10 ⁻¹⁰ cm/sec for CL/CLT
	Internal Shear ¹⁰	ASTM D 5321 ASTM D 6243	Periodic	500 psf typical
Bentomat DN	Bentonite Mass/Area ⁷	ASTM D 5993	40,000 sq. ft	0.75 lb./sq. ft
	Tensile Strength ⁸	ASTM D 6768	200,000 sq. ft	50 lbs/in (DN)
	Peel Strength ⁸	ASTM D 6496	40,000 sq. ft	3.5 lbs/in (DN)
	Index Flux ¹¹	ASTM D 5887	Weekly	1 x 10 ⁻⁸ m ³ /m ² /sec
	Permeability ¹¹	ASTM D 5887	Weekly	5 x 10 ⁻⁹ cm/sec
	Internal Shear ¹⁰	ASTM D 5321 ASTM D 6243	Periodic	500 psf typical
Bentomat ST	Bentonite Mass/Area ⁷	ASTM D 5993	40,000 sq. ft	0.75 lb./sq. ft
	Tensile Strength ⁸	ASTM D 6768	200,000 sq. ft	30 lbs/in (ST)
	Peel Strength ⁸	ASTM D 6496	40,000 sq. ft	3.5 lbs/in (ST)
	Index Flux ¹¹	ASTM D 5887	Weekly	1 x 10 ⁻⁸ m ³ /m ² /sec
	Permeability ¹¹	ASTM D 5887	Weekly	5 x 10 ⁻⁹ cm/sec
	Internal Shear ¹⁰	ASTM D 5321 ASTM D 6243	Periodic	500 psf typical

MATERIAL	QUALITY PARAMETER ¹	TEST METHOD ²	TEST FREQUENCY ³	CERTIFIED VALUE ⁴
Bentomat SDN	Bentonite Mass/Area ⁷	ASTM D 5993	40,000 sq. ft	0.75 lb./sq. ft
	Tensile Strength ⁸	ASTM D 6768	200,000 sq. ft	25 lbs/in (SDN)
	Peel Strength ⁸	ASTM D 6496	40,000 sq. ft	3.0 lbs/in (SDN)
	Index Flux ¹¹	ASTM D 5887	Weekly	1 x 10 ⁻⁸ m ³ /m ² /sec
	Permeability ¹¹	ASTM D 5887	Weekly	5 x 10 ⁻⁹ cm/sec
	Internal Shear ¹⁰	ASTM D 5321 ASTM D 6243	Periodic	500 psf typical
Bentomat 200R	Bentonite Mass/Area ⁷	ASTM D 5993	40,000 sq. ft	0.75 lb./sq. ft
	Tensile Strength ⁸	ASTM D 6768	200,000 sq. ft	30 lbs/in (200R)
	Peel Strength ⁸	ASTM D 6496	40,000 sq. ft	1.0 lbs/in (200R)
	Index Flux ¹¹	ASTM D 5887	Weekly	1 x 10 ⁻⁸ m ³ /m ² /sec
	Permeability ¹¹	ASTM D 5887	Weekly	5 x 10 ⁻⁹ cm/sec
	Internal Shear ¹⁰	ASTM D 5321 ASTM D 6243	Periodic	150 psf typical
Bentomat 600CL	Bentonite Mass/Area ⁷	ASTM D 5993	40,000 sq. ft	0.75 lb./sq. ft
	Tensile Strength ⁸	ASTM D 6768	200,000 sq. ft	30 lbs/in (200R)
	Peel Strength ⁸	ASTM D 6496	40,000 sq. ft	1.0 lbs/in (200R)
	Index Flux ⁹	ASTM D 5887	Periodic	1 x 10 ⁻⁹ m ³ /m ² /sec for CL/CLT
	Permeability ⁹	ASTM D 5887	Periodic	5 x 10 ⁻¹⁰ cm/sec for CL/CLT
	Internal Shear ¹⁰	ASTM D 5321 ASTM D 6243	Periodic	150 psf typical

NOTES

- Please refer to the CETCO GCL MQA/MQC manual for additional details regarding this information. Also, the listed values of each parameter are subject to change as manufacturing processes are refined. Contact CETCO for confirmation of this information.
- ASTM procedures modified as necessary to facilitate the testing of a GCL instead of a geotextile.
- The listed test frequency is based on ASTM D 5889 *Standard Practice for Quality Control of Geosynthetic Clay Liners*. Actual frequency of all tests may vary slightly due to varying roll dimensions.
- All required values listed are minimum average roll values (MARVs) unless otherwise indicated.
- These parameters are for the bentonite before it is incorporated into the finished Bentomat/Claymax product.
- All bentonite is granular type. The particle size distribution may vary slightly.
- Mass per unit area of the bentonite component of the Bentomat/Claymax, obtained by weighing an oven-dried sample of known area and subtracting the typical geotextile mass per unit area values. The resulting values are normalized to reference moisture content of 0 percent.
- All tensile testing represent values with the test specimens oriented in the machine direction. Results reported by D 6768 and D 6496 are in units of lbs/in or N/cm. If requested, results also be reported by D 4632, modified with 4-inch grips, in units of lbs or N.
- ASTM D 5887 Index Flux and Hydraulic Conductivity test with deaired-distilled deionized water at 80 psi (551 kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 95 gal/acre/day. This flux value is equivalent to a permeability of 5 x 10⁻¹⁰ cm/sec for typical GCL thickness.
- ASTM D 5321 (geosynthetics) or D 6243 (GCLs) internal direct shear performed on GCL sample hydrated under 200 psf normal load and then sheared at 0.004 in./min.
- ASTM D 5887 Index Flux and Hydraulic Conductivity test with deaired-distilled deionized water at 80 psi (551 kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. This flux value is equivalent to a permeability of 5 x 10⁻⁹ cm/sec for typical GCL thickness.

TABLE 4-2
CLAYMAX MQA/MQC PLAN SUMMARY¹

(Version 8.0, November 2009)

MATERIAL	QUALITY PARAMETER¹	TEST METHOD²	TEST FREQUENCY³	CERTIFIED VALUE⁴
Bentonite⁵	Swell Index	ASTM D 5890	50 tonnes	24 mL/2g min.
	Fluid Loss	ASTM D 5891	50 tonnes	18 mL max.
	Moisture Content	ASTM D 2216	50 tonnes	12 percent max.
	Particle Type: Granular ⁶	ASTM D 421	50 tonnes	100% typical - #8 1% typical - #200
Claymax 200R	Bentonite Mass/Area ⁷	ASTM D 5993	40,000 sq. ft	0.75 lb./sq. ft
	Tensile Strength ⁸	ASTM D 6768	200,000 sq. ft	40 lbs/in
	Peel Strength ⁸	ASTM D 6496	N/A	N/A
	Index Flux ⁹	ASTM D 5887	Weekly	1 x 10 ⁻⁸ m ³ /m ² /sec
	Permeability ⁹	ASTM D 5887	Weekly	5 x 10 ⁻⁹ cm/sec
	Internal Shear ¹⁰	ASTM D 5321 ASTM D 6243	Periodic	100 psf

NOTES

- Please refer to the CETCO GCL MQA/MQC manual for additional details regarding this information. Also, the listed values of each parameter are subject to change as manufacturing processes are refined. Contact CETCO for confirmation of this information.
- ASTM procedures modified as necessary to facilitate the testing of a GCL instead of a geotextile.
- The listed test frequency is based on ASTM D 5889 *Standard Practice for Quality Control of Geosynthetic Clay Liners*.
- All required values listed are minimum average roll values (MARVs) unless otherwise indicated.
- These parameters are for the bentonite before it is incorporated into the finished Bentomat product.
- All bentonite is granular type. The particle size distribution may vary slightly.
- Mass per unit area of the bentonite component of the Bentomat, obtained by weighing an oven-dried sample of known area and subtracting the typical geotextile mass per unit area values. The resulting values are normalized to reference moisture content of 0 percent.
- All tensile testing represent values with the test specimens oriented in the machine direction. Results reported by D 6768 and D 6496 are in units of lbs/in or N/cm. If requested, results also be reported by D 4632, modified with 4-inch grips, in units of lbs or N.
- ASTM D 5887 Index Flux and Hydraulic Conductivity test with deaired-distilled deionized water at 80 psi (551 kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. This flux value is equivalent to a permeability of 5 x 10⁻⁹ cm/sec for typical GCL thickness.
- ASTM D5321 (Geosynthetics) or D6243 (GCLs) internal direct shear performed on GCL sample hydrated under 200 psf normal load and then sheared at 0.004 in./min.
- ASTM D 5887 Index Flux and Hydraulic Conductivity test with deaired-distilled deionized water at 80 psi (551 kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 95 gal/acre/day. This flux value is equivalent to a permeability of 5 x 10⁻¹⁰ cm/sec for typical GCL thickness.

APPENDIX A REFERENCED STANDARDS AND TEST METHODS

ASTM C136	Standard Practice for Sieve Analysis of Fine and Coarse Aggregates
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D2216	Standard Test Method for Laboratory Determination of Moisture Content of Soil and Rock
ASTM D4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D4643	Determination of Moisture Content of Soil by the Microwave Oven Method
ASTM D5199	Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
ASTM D5261	Standard Test Method for Measuring Mass Per Unit Area of Geotextiles
ASTM D5321	Standard Test Method for Direct Shear of Geosynthetics
ASTM D5887	Standard Test Method or Measurement of Index Flux Through Saturated GCL Specimens Using a Flexible Wall Permeameter
ASTM D5889	Standard Practice for Quality Control of GCLs
ASTM D5890	Standard Test Method for Swell Index Measurement of the Clay Mineral Component of GCLs
ASTM D5891	Standard Test Method for Measurement of Fluid Loss of Clay Mineral Component of GCLs
ASTM D5993	Standard Test Method for Measuring the Mass Per Unit of GCLs
ASTM D6243	Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method
ASTM D6496	Standard Test Method for Determining Average Bonding Peel Strength Between Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners
ASTM D6768	Standard Test Method for Tensile Strength of Geosynthetic Clay Liners



EXAMPLE

Date: 11/16/2009
Purchase Order: 000000000
ORDER NUMBER: 000000000

ABC Landfill

Example Certification Package

To Whom it May Concern:

Please find enclosed the MQA/MQC test data package for Geosynthetic Clay Liner shipments to ABC Landfill.

The enclosed data package includes results of all the MQC tests required by ASTM D5889, with the exception of index flux/hydraulic conductivity. This test, which is run according to ASTM D5887, is normally performed once per production lot (once per week), unless a higher frequency is required by the project specifications. Because of the GCL's low permeability, this test can take several weeks to complete. The index flux/hydraulic conductivity results associated with this lot of material will be provided under separate cover as soon as they are available.

Although the index flux/hydraulic conductivity test results are not yet available, CETCO accepts responsibility for our GCL should the index flux/hydraulic conductivity tests produce unacceptable results. If, upon delivery and prior to installation, individual rolls of GCL are found to be nonconforming to accepted project specifications, CETCO will replace the nonconforming material at no charge.

Questions regarding this information should be directed to Chris Athanassopoulos, Technical Support Engineer, at (847) 851-1831.

Sincerely,

Quality Assurance Coordinator
CETCO Cartersville Plant



**GEOSYNTHETIC CLAY LINER
MANUFACTURING QUALITY ASSURANCE DATA PACKAGE**

EXAMPLE

PROJECT NAME: ABC Landfill
CUSTOMER P.O.: 000000000
ORDER NUMBER: 000000000
PREPARED FOR: Example Certification Package

CONTENTS:

- Product Certifications
- GCL Order packing list and MQA tracking form
- GCL manufacturing quality control test data
- Bentonite clay certification
- Raw material test results

PREPARED BY: Melanie King
Quality Assurance Coordinator
CETCO
218 Industrial Park

Cartersville, GA 30121
Telephone: (770) 387-7773
E-Mail: melanie.king@cetco.com



EXAMPLE

PRODUCT CERTIFICATIONS

PROJECT NAME: ABC Landfill
CUSTOMER P.O.: 000000000
ORDER NUMBERS: 000000000
PREPARED FOR: Example Certification Package

The GCL manufactured for the above-referenced order number(s) is certified to meet the values listed in the tables below:

GCL PROPERTY SPECIFICATIONS FOR BENTOMAT ST

Test Method	Test Method Property	Test Frequency	Certified Value
ASTM D 5891	Bentonite Fluid Loss	1 per 50 Tons	18 ml Max
ASTM D 5993	Bentonite Mass/Area	40,000 sq ft (4000 sq m)	0.75 lb /sq ft Min
ASTM D 5890	Bentonite Swell Index	1 per 50 Tons	24 ml/2g Min
ASTM D 6768	GCL Grab Strength	200,000 sq ft (20,000 sq m)	30 lbs/in MARV
ASTM D 6243	GCL Hydrated Internal Shear Strength	Periodic	500 psf typ @ 200 psf normal load
ASTM D 5887	GCL Hydraulic Conductivity	Weekly	5.0E-9 cm/s Max
ASTM D 5887	GCL Index Flux	Weekly	1.0E-8 m3/m2/s Max
ASTM D 6496	GCL Peel Strength	40,000 sq ft (4000 sq m)	3.5 lbs/in Min

Bentonite property tests are performed at a bentonite processing facility before shipment to CETCO's production facility. All tensile testing is in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request tensile and peel results can be reported per modified ASTM D 4632 using 4 inch grips.

NEEDLE DETECTION AND REMOVAL PROCEDURE

CETCO hereby affirms that all Bentomat[®] geosynthetic clay liner material manufactured for this project is continually passed under a magnet for needle removal and then screened with a metal detection device. CETCO certifies Bentomat[®] to be essentially free of broken needles and fragments of needles that would negatively effect the performance of the final product.

Melanie King
Quality Assurance Coordinator



EXAMPLE

GCL PACKING LIST AND MQA TRACKING FORM

Listing of finished and raw materials used to produce certification package number 000000000

GCL								Geotextiles				Clay
CV-BENTOMAT ST								N/W-WHITE			WOVEN	CV-CG 50
Order	GCL Lot #	GCL Roll #	Length	Width	weight	sq ft	Roll # Tested	Cap Lot #	Cap Roll #	Roll # Tested	Base Roll #	Clay Lot #
025672604	200943CV	9383	150	15	2690	2250	9376	200943CV	00004325	00004318	WEA012199-2	934488B
025672604	200945CV	10188	150	15	2792	2250	10183	200943CV	00004191	00004186	F001125849	937006B
025672604	200945CV	10233	150	15	2840	2250	10232	200945CV	00004511	00004507	F001126171	937005A
025672604	200945CV	10234	150	15	2826	2250	10232	200945CV	00004511	00004507	F001126171	937005A
025672604	200945CV	10235	150	15	2832	2250	10232	200945CV	00004513	00004507	F001126171	937005A
025672604	200945CV	10237	150	15	2808	2250	10232	200945CV	00004513	00004507	F001126171	937005A
025672604	200945CV	10238	150	15	2824	2250	10232	200945CV	00004513	00004507	F001126171	937005A
025672604	200945CV	10239	150	15	2840	2250	10232	200945CV	00004513	00004507	F001126171	937005A
025672604	200945CV	10242	150	15	2838	2250	10232	200945CV	00004504	00004497	F001126171	937005A
025672604	200945CV	10246	150	15	2822	2250	10232	200945CV	00004504	00004497	F001126171	937005A
025672604	200945CV	10250	150	15	2830	2250	10247	200945CV	00004490	00004482	F001126171	937005A
025672604	200945CV	10258	150	15	2808	2250	10247	200945CV	00004496	00004492	F001309340	937005A
Total sq ft:							27000	Total Number of Rolls Certified: 12				



EXAMPLE

GCL MANUFACTURING QUALITY CONTROL TEST DATA

The following rolls in GCL certification package number 000000000 have been tested in our production facility lab.

Product	Lot # Tested	Roll # Tested	Mass Area	Grab Strength	Peel Strength 6496
ASTM Test Method:			D 5993	D 6768	D 6496
Required Value:			0.75 lb /sq ft Min	30 lbs/in MARV	3.5 lbs/in Min
CV-BENTOMAT ST	200943CV	9376	0.85	40.9	7.3
CV-BENTOMAT ST	200945CV	10183	0.87	37.4	10.6
CV-BENTOMAT ST	200945CV	10232	0.83	37.4	6.2
CV-BENTOMAT ST	200945CV	10247	0.86	37.4	4.8

BENTONITE CLAY CERTIFICATION

The Bentonite Clay used to produce package 000000000

has been tested by American Colloid Company and yielded the following test results.

Clay Lot #	Moist	Swell	Fluid Loss
ASTM Test Method:	D 2216	D 5890	D 5891
Required Value:	12% Max	24 ml/2g Min	18 ml Max
934488B	10.40	26.00	13.60
937005A	10.40	26.00	14.40
937006B	11.60	25.00	15.20



GEOTEXTILE TEST RESULTS FROM MATERIAL SUPPLIERS

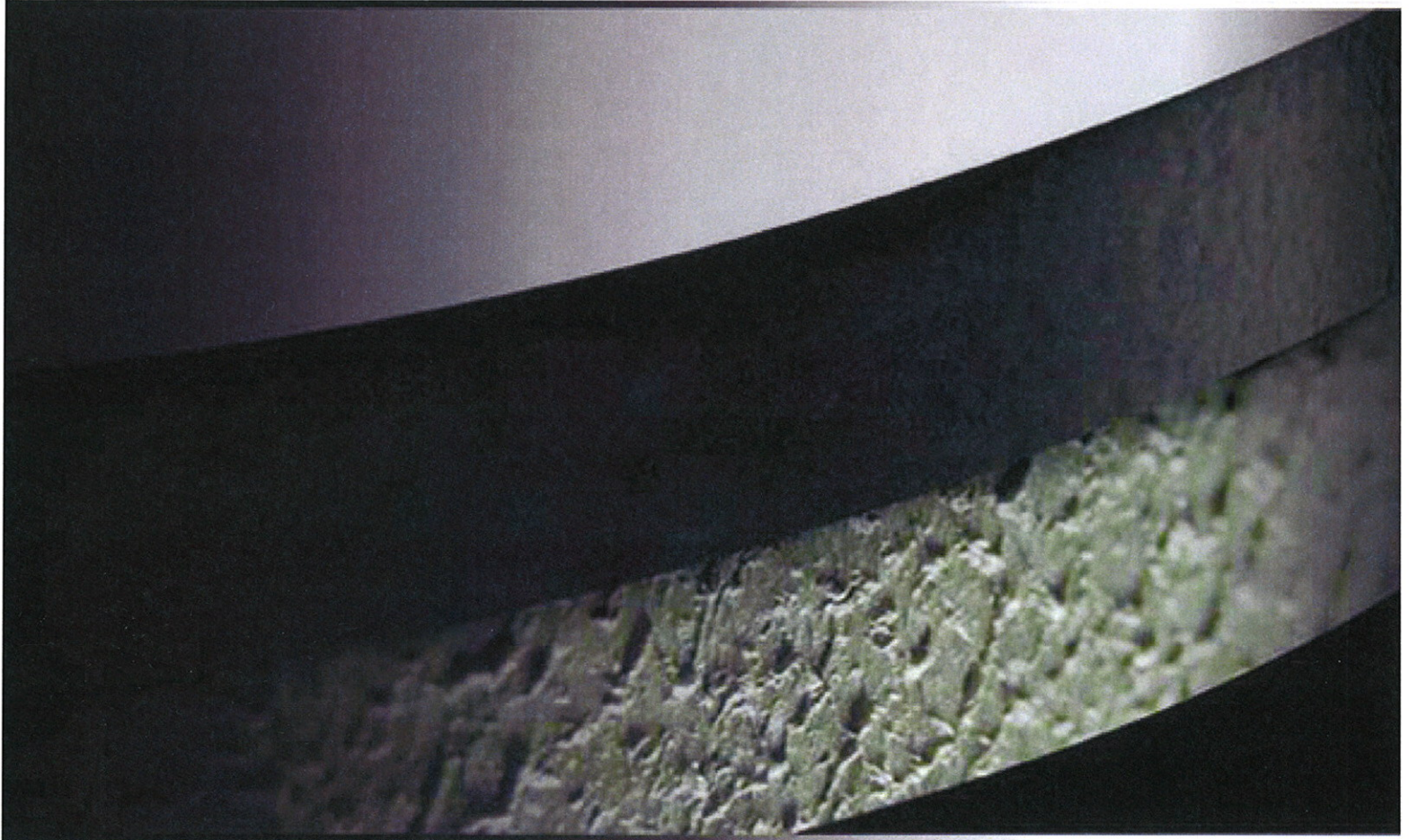
The GCL in certification package number 000000000 was manufactured with geotextiles which were tested with the following results.

BASE GEOTEXTILE				COVER GEOTEXTILE			
Material	Roll Number	Mass Area oz/yd2	Grab Strength lbs	Material	Roll Number	Mass Area oz/yd2	Grab Strength lbs
Thrace Linq	F001125849	3.3	139.4	CV-NON-WOVEN	00004186	6.6	43.8
Thrace Linq	F001126171	3.3	139.4	CV-NON-WOVEN	00004318	6.3	37.5
Thrace Linq	F001309340	3.3	173.3	CV-NON-WOVEN	00004482	6.4	49.7
MTX 1213	WEA012199-2	3.5	156.0	CV-NON-WOVEN	00004492	6.9	52.0
				CV-NON-WOVEN	00004497	6.6	36.2
				CV-NON-WOVEN	00004507	6.7	52.7

Certifications from our suppliers are on file at our production facility.

An '*' or 'PT' indicates supplier certifications were unavailable prior to shipping so testing was performed at a CETCO lab.

Manufacturing Quality Assurance Manual



Geomembrane Products





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1.0 INTRODUCTION

This manual provides an overview of the GSE Manufacturing Quality Assurance Program for geomembrane products. It is intended for use by GSE's customers to enhance their understanding of the quality system under which GSE geomembrane products are manufactured.

2.0 COMMITMENT TO QUALITY

GSE is committed to meeting or exceeding customer's requirements and industry standards. This commitment to quality is established through a documented quality management system, continuous employee training, investment in technology and emphasis on process control. GSE has allocated resources to ensure that this commitment to quality translates into the best products and services for its customers.

3.0 MANUFACTURING QUALITY ASSURANCE

GSE has an on-site quality assurance laboratory at each manufacturing facility worldwide. Each facility has a fully equipped, well staffed, dedicated laboratory with strict guidelines to maintain a high level of quality and up-to-the-minute results on GSE's finished products.

GSE has a rigorous set of minimum standards and an effective test program to assure compliance has been established. These procedures and requirements are frequently reviewed and adjusted to assure compliance with current market demands and/or predetermined project specifications. Also raw materials and process parameters are controlled to provide products complying with GSE's minimum characteristics and regulatory standards.

4.0 MANUFACTURING QUALITY ASSURANCE ORGANIZATION

GSE quality assurance department assures that only products meeting GSE and/or the customer's requirements are released for shipment. The quality assurance personnel are directly responsible for monitoring, testing, and providing feedback to the manufacturing department ensuring the production of the specified product quality. Each member of the quality assurance team must participate in detailed training that includes factory exposure.

The GSE quality assurance team consists of the manufacturing quality assurance laboratories, engineering staff and manufacturing personnel. The combination of expertise and experience from these groups provide GSE with the proper tools to maintain the highest level of product quality and customer service in the industry.

5.0 STAFF & SCHEDULING

The quality assurance laboratories are staffed during any manufacturing run. A continuous communication link is maintained between the laboratory and manufacturing personnel, maximizing production efficiency and product quality.



6.0 PRODUCT IDENTIFICATION & DOCUMENTATION

A. Roll Numbering

Each roll of geomembrane is assigned a unique roll number. The quality assurance laboratory maintains records documenting the raw materials and resulting product quality information.

B. Approval Procedure

Results for each tested roll of product are checked against GSE and/or customer's specifications for compliance. The quality assurance laboratory approves those materials that meet both of these requirements for shipment.

C. Non-Conformance

Material that does not meet GSE's minimum standards is given a roll number, but is rejected and separated from the approved material. The rejected material is identified as non-conforming and will not be used. Material that meets GSE's minimum standards, but does not meet a stricter customer's specifications will not be allocated to that customer, but will be placed into inventory as a GSE's standard material.

D. Documentation

Quality assurance certificates are generated and supplied for each roll of geomembrane product to include all relevant quality assurance information about the material.

7.0 RECORDS RETENTION

GSE maintains reports and/or samples for products produced and sold. Records and/or samples are maintained according to GSE's standard retention policy as outlined below.

MATERIAL	ITEM	YEAR
Raw Materials	Resin Supplier Test Reports and Certifications	≥ 2
	GSE Resin Test Reports	≥ 2
	Resin Sample Retain (Archive)	≥ 2
Geomembranes	Raw Test Data (in computer database)	≥ 5
	Quality Control Certificates	≥ 5
	Sample Retain (approximately one square foot)	≥ 5

8.0 TESTING CAPABILITIES

GSE maintains high capacity, state-of-the-art laboratory equipment suitable for performing the procedures listed in Appendixes A-H in Houston, Texas. The quality assurance laboratory is accredited by the GALAP Program. The appropriate certificates are maintained for review upon request by authorized parties.

A. Routine Testing

GSE has developed a strict and thorough quality assurance program, which exceeds all industry's standards and/or customer's specifications including GRI GM13, "Test Properties, Testing Frequency



and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes and GRI GM17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes. The testing program covers raw materials as shown in Appendix A and the finished goods as shown in Appendixes B-H and is adhered to by all GSE's quality assurance laboratories. The laboratory equipment used by GSE represents the most modern equipment available and meets or exceeds the requirements of all the test standards used.

B. Other Testing Capabilities

In addition to routine testing, GSE laboratories are equipped to perform a wide variety of other tests as required for unusual requests or product development. Further, although the GSE's laboratories are fully equipped and able to perform the most routinely specified tests in the industry, there are some tests that are more economically performed by a dedicated testing facility. GSE believes requirements for such testing should be carefully considered and defined in terms of specific design requirements if they are found to be necessary.

9.0 MATERIAL QUALITY ASSURANCE

GSE has established strict specifications for all raw materials and finished products. Test results must fall within the acceptable limits of GSE and customer's specifications.

A. Raw Material

GSE uses two types of raw materials in the manufacture of geomembrane products: natural resin and masterbatch. Natural resin is the base material that is used to make a geomembrane. It contains stabilizers to prevent degradation from occurring during and after extrusion. Masterbatch is the term referring to the concentrated carbon black material blended with the natural resin to produce the finished product. The natural resin and masterbatch are blended at the appropriate ratio at the manufacturing stage. The masterbatch can contain other additives depending upon the geomembrane product to be produced. GSE verifies the properties of each lot of raw material prior to their utilization.

When natural resin is received, samples are taken and subjected to the tests outlined in Appendix A. All test data are entered into the computer database and checked for accuracy, consistency and compliance with GSE's specifications. The material is not accepted unless all standard test requirements are met and the GSE's test values meet the requirements set forth in the raw material specifications.

Copies of the supplier's certificate of analysis (COA) for each lot of resin utilized in the production of the materials supplied to a specific project are supplied as standard documentation. In addition, the GSE's test results for each lot of resin are provided in a separate report upon request. Virgin resin is normally received in rail car lots. If resin is received by other transport and/or in other quantities, an equivalent suitable sampling procedure is provided (i.e. not less than one sample per shipment or one sample for each 50,000 lb, 23,000 kg).

B. Geomembrane Products



GSE has implemented a strict and thorough quality assurance program for all geomembrane products. The geomembrane product line can be broken into two primary categories: smooth and textured products. The tables contain GSE's minimum properties and test frequencies for all GSE geomembrane products, such as GSE Green (green surface geomembrane), GSE White (light-reflective geomembrane) and GSE Conductive (field spark-testable geomembrane) as shown in Appendixes B-H.

1. On-Line Manufacturing Quality Assurance

The quality assurance program for finished product begins during the manufacturing process. Each manufacturing line is equipped with state-of-the-art monitoring devices that provide feedback on the physical quality of the materials being produced. Each geomembrane production line is equipped with both a thickness gauge and spark-testing device.

a. Thickness Measurement

As geomembrane is being produced, thickness readings are taken continuously over the length and width of the roll. These data are used to establish the minimum, maximum and average thickness values for each roll and are verified by thickness testing upon sampling of the finished goods.

b. Spark Testing

An electrical spark detector is in place on each manufacturing sheet line. This apparatus provides immediate notification of holes in the finished product. If a hole is detected, an alarm is triggered and the hole is identified. Rolls containing holes are rejected from standard product inventory.

2. Smooth Geomembrane Materials

Smooth geomembrane products available include high density and linear low density polyethylene materials with 2-3% carbon black. Specialty materials include GSE White, GSE Conductive, and GSE Green geomembranes.

a. Sampling

Geomembrane rolls are sampled for QA testing according to the frequencies in Appendix B. An approximate one-foot by roll width sample is cut for quality assurance testing. Test specimens are taken from five positions across the width of the roll. A retain or archive sample approximately 12 in x 12 in (30 cm x 30 cm) is taken one of the five positions on an alternating basis from the laboratory sample. The retain is labeled and kept for future reference.

b. Evaluation of Results

All data are entered into a computer database for calculation and comparison to GSE and/or customer's specifications. If materials do not meet GSE's minimum requirements and/or the customer's specifications, the manufacturing personnel will appropriately make the adjustments. Only products meeting GSE's minimums and/or customer's specifications will be approved for shipment.



c. Reporting

Every roll of material has a quality assurance roll certificate or Roll Test Data Report (RTDR). This report identifies the standards on which the GSE's approval is based along with the actual test results demonstrated by the material.

3. Co-extruded Textured Geomembranes

Textured geomembrane is produced utilizing a round die with co-extrusion technology. The texture is produced in a process in which one or both of the outer layers of a three-layer extrusion are blended with nitrogen gas. Nitrogen bubbles form in the molten resin and escape upon exiting the die, creating a rough, textured surface. GSE standard, GSE White, GSE Green, and GSE Conductive geomembranes are available with co-extruded texturing.

a. Sampling

Geomembrane rolls are sampled for QA testing according to the frequencies in Appendixes B-H. An approximate one-foot by roll width sample is cut for quality assurance testing. Specimens for testing are taken from five positions across the width of the roll. Specimens for testing the machine and transverse direction tensile are cut from each of the five positions. A retain or archive sample approximately 12 in x 12 in (30 cm x 30 cm) is taken from the corresponding transverse direction position from the laboratory sample. The retain is labeled and kept for future reference. Evaluation of results and reporting practices are the same as for smooth geomembranes.

C. Third Party Conformance Sampling

Some specifications require independent quality assurance and/or conformance testing. GSE can provide assistance with the sampling of products by arranging for the conformance samples to be taken during production. By taking samples during production rather than on-site or after production, the customer can be assured that the samples are clean and available for conformance testing in a timely manner.

GSE encourages customers to audit GSE manufacturing and other manufacturing quality assurance facilities to collect samples and conduct independent conformance testing prior to shipment of materials.

D. Product Shipping

It is GSE's policy to ship only products that have been tested and approved. All shipments are packaged according to industry's standard practices and/or customer's specifications. Only approved handling methods are used to move rolls into and out of shipping containers, please see the GSE Installation Quality Assurance Manual for more details.



Appendix A: Minimum Testing Frequencies and Properties for GSE Raw Materials

TABLE 1. MINIMUM TESTING FREQUENCIES

Property	Test Method ⁽¹⁾	Natural Resin
Density	ASTM D 1505	once per rail car compartment
Melt Flow Index	ASTM D 1238 (190/2.16)	once per rail car compartment
OIT	ASTM D 3895 (1 ATM at 200° C)	once per resin lot ⁽²⁾
Carbon Black Content	ASTM D 1603, modified	N/A
Carbon Black Dispersion	ASTM D 5996	NA

NOTES:

¹GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

²OIT for LLDPE/VFPE resin is performed on a representative finished product for each lot of resin rather than on the natural (without carbon black) resin.

TABLE 2. MINIMUM PROPERTIES FOR GSE RAW MATERIALS

Property	Test Method ⁽¹⁾	HDPE	LLDPE/VFPE
Density [g/cm ³]	ASTM D 1505	0.932	0.915
Melt Flow Index [g/10 min]	ASTM D 1238 (190/2.16)	≤ 1.0	≤ 1.0
OIT [minutes]	ASTM D 3895 (1 ATM at 200° C)	100	100 ⁽²⁾

NOTES:

¹GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

²OIT for LLDPE/VFPE resin is performed on a representative finished product for each lot of resin rather than on the natural (without carbon black) resin.



Appendix B: GSE HD Smooth Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM13.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	30 (0.75)	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			27 (0.69)	36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV Dumbbell, 2 ipm	20,000 lb					
Strength at Break, lb/in-width (N/mm)			120 (21)	152 (26)	243 (42)	327 (57)	410 (71)
Strength at Yield, lb/in-width (N/mm)			66 (11)	84 (14)	132 (23)	177 (30)	212 (37)
Elongation at Break, %			700	700	700	700	700
Elongation at Yield, %			13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (124)	42 (186)	58 (257)	73 (324)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	85 (378)	125 (556)	160 (711)	195 (867)
Carbon Black Content, % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS							
Roll Length ⁽²⁾ , ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width ⁽²⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- ⁽¹⁾Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽²⁾Roll lengths and widths have a tolerance of ± 1%.
- GSE HD is available in rolls weighing approximately 3,900 lb (1,769 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix B: GSE HD Textured Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM13.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm) Lowest individual reading (-10%)	ASTM D 5994	every roll	30 (0.75) 27 (0.69)	40 (1.00) 36 (0.91)	60 (1.50) 54 (1.40)	80 (2.00) 72 (1.80)	100 (2.50) 90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		66 (11)	75 (13)	115 (20)	155 (27)	230 (40)
Strength at Yield, lb/in-width (N/mm)			68 (11)	90 (15)	132 (23)	177 (31)	225 (39)
Elongation at Break, %	G.L. 2.0 in (51 mm)		100	100	100	100	100
Elongation at Yield, %	G.L. 1.3 in (33 mm)		12	12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	24 (106)	32 (142)	45 (200)	60 (266)	75 (333)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	95 (422)	130 (578)	160 (711)	190 (845)
Carbon Black Content, % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾
Asperity Height, mil (mm)	ASTM D 7466	second roll	16 (0.40)	18 (0.45)	18 (0.45)	18 (0.45)	18 (0.45)
Notched Constant Tensile Load ⁽²⁾ , hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS							
Roll Length ⁽³⁾ , ft (m)	Double-Sided Textured		830 (253)	700 (213)	520 (158)	400 (122)	330 (101)
	Single-Sided Textured		840 (256)	650 (198)	420 (128)	320 (98)	250 (76)
Roll Width ⁽³⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)	Double-Sided Textured		18,675 (1,735)	15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)
	Single-Sided Textured		18,900 (1,755)	14,625 (1,359)	9,450 (878)	7,200 (669)	5,625 (523)

NOTES:

- ⁽¹⁾Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽²⁾NCTL for GSE HD Textured is conducted on representative smooth membrane samples.
- ⁽³⁾Roll lengths and widths have a tolerance of ± 1%.
- GSE HD Textured Double-Sided is available in rolls weighing approximately 4,000 lb (1,800 kg) and Single-Sided weighing approximately 3,000 lb (1,360 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix C: GSE Green Smooth Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM13.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	30 (0.75)	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			27 (0.69)	36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV Dumbell, 2 ipm G.L. 2.0 in (51 mm) G.L. 1.3 in (33 mm)	20,000 lb					
Strength at Break, lb/in-width (N/mm)			120 (21)	152 (26)	243 (42)	327 (57)	410 (71)
Strength at Yield, lb/in-width (N/mm)			66 (11)	84 (14)	132 (23)	177 (30)	212 (37)
Elongation at Break, %			700	700	700	700	700
Elongation at Yield, %			13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (124)	42 (186)	58 (257)	73 (324)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	85 (378)	125 (556)	160 (711)	195 (867)
Carbon Black Content ⁽¹⁾ , % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS							
Roll Length ⁽³⁾ , ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width ⁽³⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- ⁽¹⁾GSE Green may have an overall ash content greater than 3.0% due to the green layer. These values apply to the black layer only.
- ⁽²⁾Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽³⁾Roll lengths and widths have a tolerance of ± 1%.
- GSE Green is available in rolls weighing approximately 3,900 lb (1,769 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix C: GSE Green Textured Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM13.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm) Lowest individual reading (-10%)	ASTM D 5994	every roll	30 (0.75) 27 (0.69)	40 (1.00) 36 (0.91)	60 (1.50) 54 (1.40)	80 (2.00) 72 (1.80)	100 (2.50) 90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		66 (11)	75 (13)	115 (20)	155 (27)	230 (40)
Strength at Yield, lb/in-width (N/mm)			68 (11)	90 (15)	132 (23)	177 (31)	225 (39)
Elongation at Break, %	G.L. 2.0 in (51 mm)		100	100	100	100	100
Elongation at Yield, %	G.L. 1.3 in (33 mm)		12	12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	24 (106)	32 (142)	45 (200)	60 (266)	75 (333)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	95 (422)	130 (578)	160 (711)	190 (845)
Carbon Black Content ⁽¹⁾ , % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾
Asperity Height, mil (mm)	ASTM D 7466	second roll	16 (0.40)	18 (0.45)	18 (0.45)	18 (0.45)	18 (0.45)
Notched Constant Tensile Load ⁽³⁾ , hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS							
Roll Length ⁽⁴⁾ , ft (m)	Double-Sided Textured		830 (253)	700 (213)	520 (158)	400 (122)	330 (101)
	Single-Sided Textured		840 (256)	650 (198)	420 (128)	320 (98)	250 (76)
Roll Width ⁽⁴⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)	Double-Sided Textured		18,675 (1,735)	15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)
	Single-Sided Textured		18,900 (1,755)	14,625 (1,359)	9,450 (878)	7,200 (669)	5,625 (523)

NOTES:

- ⁽¹⁾ GSE Green Textured may have an overall ash content greater than 3.0% due to the green layer. These values apply to the black layer only.
- ⁽²⁾ Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽³⁾ NCTL for Green Textured is conducted on representative smooth membrane samples.
- ⁽⁴⁾ Roll lengths and widths have a tolerance of ± 1%.
- GSE Green Textured Double-Sided is available in rolls weighing approximately 4,000 lb (1,800 kg) and Single-Sided weighing approximately 3,000 lb (1,360 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix D: GSE White Smooth Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM13.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm) Lowest individual reading (-10%)	ASTM D 5199	every roll	30 (0.75) 27 (0.69)	40 (1.00) 36 (0.91)	60 (1.50) 54 (1.40)	80 (2.00) 72 (1.80)	100 (2.50) 90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		120 (21)	152 (26)	243 (42)	327 (57)	410 (71)
Strength at Yield, lb/in-width (N/mm)			66 (11)	84 (14)	132 (23)	177 (30)	212 (37)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (124)	42 (186)	58 (257)	73 (324)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	85 (378)	125 (556)	160 (711)	195 (867)
Carbon Black Content ⁽¹⁾ , % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS							
Roll Length ⁽³⁾ , ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width ⁽³⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- ⁽¹⁾GSE White may have an overall ash content greater than 3.0% due to the white layer. These values apply to the black layer only.
- ⁽²⁾Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽³⁾Roll lengths and widths have a tolerance of ± 1%.
- GSE White is available in rolls weighing approximately 3,900 lb (1,769 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix D: GSE White Textured Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM13.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm)	ASTM D 5994	every roll	30 (0.75)	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			27 (0.69)	36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV Dumbell, 2 ipm	20,000 lb					
Strength at Break, lb/in-width (N/mm)			66 (11)	75 (13)	115 (20)	155 (27)	230 (40)
Strength at Yield, lb/in-width (N/mm)			68 (11)	90 (15)	132 (23)	177 (31)	225 (39)
Elongation at Break, %			100	100	100	100	100
Elongation at Yield, %			12	12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	24 (106)	32 (142)	45 (200)	60 (266)	75 (333)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	95 (422)	130 (578)	160 (711)	190 (845)
Carbon Black Content ⁽¹⁾ , % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾
Asperity Height, mil (mm)	ASTM D 7466	second roll	16 (0.40)	18 (0.45)	18 (0.45)	18 (0.45)	18 (0.45)
Notched Constant Tensile Load ⁽³⁾ , hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS							
Roll Length ⁽⁴⁾ , ft (m)	Double-Sided Textured		830 (253)	700 (213)	520 (158)	400 (122)	330 (101)
	Single-Sided Textured		840 (256)	650 (198)	420 (128)	320 (98)	250 (76)
Roll Width ⁽⁴⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)	Double-Sided Textured		18,675 (1,735)	15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)
	Single-Sided Textured		18,900 (1,755)	14,625 (1,359)	9,450 (878)	7,200 (669)	5,625 (523)

NOTES:

- ⁽¹⁾ GSE White may have an overall ash content greater than 3.0% due to the white layer. These values apply to the black layer only.
- ⁽²⁾ Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽³⁾ NCTL for GSE White Textured is conducted on representative smooth membrane samples.
- ⁽⁴⁾ Roll lengths and widths have a tolerance of ± 1%.
- GSE White Textured Double-Sided is available in rolls weighing approximately 4,000 lb (1,800 kg) and Single-Sided weighing approximately 3,000 lb (1,360 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix E: GSE Conductive Smooth Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM13.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE			
			40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm) Lowest individual reading (-10%)	ASTM D 5199	every roll	40 (1.00) 36 (0.91)	60 (1.50) 54 (1.40)	80 (2.00) 72 (1.80)	100 (2.50) 90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		152 (26)	243 (42)	327 (57)	410 (71)
Strength at Yield, lb/in-width (N/mm)			84 (14)	132 (23)	177 (30)	212 (37)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (124)	42 (186)	58 (257)	73 (324)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	85 (378)	125 (556)	160 (711)	195 (867)
Carbon Black Content ⁽¹⁾ , % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS						
Roll Length ⁽³⁾ , ft (m)			870 (265)	560 (171)	430 (131)	340 (104)
Roll Width ⁽³⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- ⁽¹⁾GSE Conductive may have an overall ash content greater than 3.0%. These values apply to the non-conductive black layers.
- ⁽²⁾Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽³⁾Roll lengths and widths have a tolerance of ± 1%.
- GSE Conductive is available in rolls weighing approximately 3,900 lb (1,769 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LT8 of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix E: GSE Conductive Textured (Single-Sided) Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM13.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE			
			40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm) Lowest individual reading (-10%)	ASTM D 5994	every roll	40 (1.00) 36 (0.91)	60 (1.50) 54 (1.40)	80 (2.00) 72 (1.80)	100 (2.50) 90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		75 (13)	115 (20)	155 (27)	230 (40)
Strength at Yield, lb/in-width (N/mm)			90 (15)	132 (23)	177 (31)	225 (39)
Elongation at Break, %	G.L. 2.0 in (51 mm)		100	100	100	100
Elongation at Yield, %	G.L. 1.3 in (33 mm)		12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	32 (142)	45 (200)	60 (266)	75 (333)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	95 (422)	130 (578)	160 (711)	190 (845)
Carbon Black Content ⁽¹⁾ , % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾
Asperity Height, mil (mm)	ASTM D 7466	second roll	18 (0.45)	18 (0.45)	18 (0.45)	18 (0.45)
Notched Constant Tensile Load ⁽³⁾ , hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS						
Roll Length ⁽⁴⁾ , ft (m)			650 (198)	420 (128)	320 (98)	250 (76)
Roll Width ⁽⁴⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² , (m ²), ft			14,625 (1,359)	9,450 (878)	7,200 (669)	5,625 (523)

NOTES:

- ⁽¹⁾ GSE Conductive Textured may have an overall ash content greater than 3.0%. These values apply to the non-conductive black layers.
- ⁽²⁾ Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽³⁾ NCTL for GSE Conductive Textured is conducted on representative smooth membrane samples.
- ⁽⁴⁾ Roll lengths and widths have a tolerance of ± 1%.
- GSE Conductive Textured Single-Sided is available in rolls weighing approximately 3,000 lb (1,360 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix F: GSE Conductive White Smooth Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM13.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE			
			40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV Dumbbell, 2 ipm	20,000 lb				
Strength at Break, lb/in-width (N/mm)			152 (26)	243 (42)	327 (57)	410 (71)
Strength at Yield, lb/in-width (N/mm)			84 (14)	132 (23)	177 (30)	212 (37)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (124)	42 (186)	58 (257)	73 (324)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	85 (378)	125 (556)	160 (711)	195 (867)
Carbon Black Content ⁽¹⁾ , % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS						
Roll Length ⁽³⁾ , ft (m)			870 (265)	560 (171)	430 (131)	340 (104)
Roll Width ⁽³⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- ⁽¹⁾ GSE Conductive White may have an overall ash content greater than 3.0% due to the white and conductive outer layers. These values apply to the non-conductive black layers.
- ⁽²⁾ Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽³⁾ Roll lengths and widths have a tolerance of ± 1%.
- GSE Conductive White is available in rolls weighing approximately 3,900 lb (1,769 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LT B of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix F: GSE Conductive White Textured (Single-Sided) Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM13.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE			
			40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm) Lowest individual reading (-10%)	ASTM D 5994	every roll	40 (1.00) 36 (0.91)	60 (1.50) 54 (1.40)	80 (2.00) 72 (1.80)	100 (2.50) 90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		75 (13)	115 (20)	155 (27)	230 (40)
Strength at Yield, lb/in-width (N/mm)			90 (15)	132 (23)	177 (31)	225 (39)
Elongation at Break, %	G.L. 2.0 in (51 mm)		100	100	100	100
Elongation at Yield, %	G.L. 1.3 in (33 mm)		12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	32 (142)	45 (200)	60 (266)	75 (333)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	95 (422)	130 (578)	160 (711)	190 (845)
Carbon Black Content ⁽¹⁾ , % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾
Asperity Height, mil (mm)	ASTM D 7466	second roll	18 (0.45)	18 (0.45)	18 (0.45)	18 (0.45)
Notched Constant Tensile Load ⁽³⁾ , hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS						
Roll Length ⁽⁴⁾ , ft (m)			650 (198)	420 (128)	320 (98)	250 (76)
Roll Width ⁽⁴⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² , (m ²), ft			14,625 (1,359)	9,450 (878)	7,200 (669)	5,625 (523)

NOTES:

- ⁽¹⁾ GSE Conductive White Textured may have an overall ash content greater than 3.0% due to the white and conductive outer layers. These values apply to the non-conductive black layers.
- ⁽²⁾ Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽³⁾ NCTL for GSE Conductive White Textured is conducted on representative smooth membrane samples.
- ⁽⁴⁾ Roll lengths and widths have a tolerance of $\pm 1\%$.
- GSE Conductive White Textured Single-Sided is available in rolls weighing approximately 3,000 lb (1,360 kg).
- All GSE geomembranes have dimensional stability of $\pm 2\%$ when tested according to ASTM D 1204 and LTB of $< -77^{\circ}$ C when tested according to ASTM D 746.
- *Modified.



Appendix G: GSE UltraFlex Smooth Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM17.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE			
			40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			36 (0.91)	54 (1.40)	72 (1.80)	90 (2.28)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.92	0.92	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV Dumbell, 2 ipm G.L. 2.0 in (51 mm)	20,000 lb				
Strength at Break, lb/in-width (N/mm)			170 (29)	240 (42)	320 (56)	380 (66)
Elongation at Break, %			800	800	800	800
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (97)	33 (146)	44 (195)	55 (244)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	70 (311)	100 (444)	130 (578)	155 (689)
Carbon Black Content, % (Range)	ASTM D 1603*/4218	20,000 lb	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS						
Roll Length ⁽²⁾ , ft (m)			870 (265)	560 (171)	430 (131)	340 (103)
Roll Width ⁽²⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (710)

NOTES:

- ⁽¹⁾Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽²⁾Roll lengths and widths have a tolerance of ± 1%.
- GSE UltraFlex is available in rolls weighing approximately 3,900 lb (1,769 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix G: GSE UltraFlex Textured Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM17.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE			
			40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm)	ASTM D 5994	every roll	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			36 (0.91)	54 (1.40)	72 (1.80)	90 (2.28)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.92	0.92	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV Dumbell, 2 ipm G.L. 2.0 in (51 mm)	20,000 lb				
Strength at Break, lb/in-width (N/mm)			115 (20)	168 (29)	224 (39)	270 (47)
Elongation at Break, %			500	500	500	500
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	25 (111)	38 (169)	50 (222)	60 (266)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	95 (422)	125 (556)	140 (622)
Carbon Black Content, % (Range)	ASTM D 1603*/4218	20,000 lb	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾
Asperity Height, mil (mm)	ASTM D 7466	second roll	18 (0.45)	18 (0.45)	18 (0.45)	18 (0.45)
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS						
Roll Length ⁽²⁾ , ft (m)	Double-Sided Textured		700 (213)	520 (158)	400 (122)	330 (100)
	Single-Sided Textured		650 (198)	420 (128)	320 (98)	250 (76)
Roll Width ⁽²⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)	Double-Sided Textured		15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (689)
	Single-Sided Textured		14,625 (1,359)	9,450 (878)	7,200 (669)	5,625 (522)

NOTES:

- ⁽¹⁾Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽²⁾Roll lengths and widths have a tolerance of ± 1%.
- GSE UltraFlex Textured Double-Sided is available in rolls weighing approximately 4,000 lb (1,800 kg) and Single-Sided weighing approximately 3,000 lb (1,360 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LT8 of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix H: GSE UltraFlex White Smooth Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM17.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE			
			40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			36 (0.91)	54 (1.40)	72 (1.80)	90 (2.28)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.92	0.92	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV Dumbell, 2 ipm G.L. 2.0 in (51 mm)	20,000 lb				
Strength at Break, lb/in-width (N/mm)			170 (29)	240 (42)	320 (56)	380 (66)
Elongation at Break, %			800	800	800	800
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (97)	33 (146)	44 (195)	55 (244)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	70 (311)	100 (444)	130 (578)	155 (689)
Carbon Black Content ⁽¹⁾ , % (Range)	ASTM D 1603*/4218	20,000 lb	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS						
Roll Length ⁽³⁾ , ft (m)			870 (265)	560 (171)	430 (131)	340 (103)
Roll Width ⁽³⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (710)

NOTES:

- ⁽¹⁾GSE UltraFlex White may have an overall ash content greater than 3.0% due to the white layer. These values apply to the black layer only.
- ⁽²⁾Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽³⁾Roll lengths and widths have a tolerance of ± 1%.
- GSE UltraFlex White is available in rolls weighing approximately 3,900 lb (1,769 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.



Appendix H: GSE UltraFlex White Textured Data Sheet

Product Specifications

These product specifications meet or exceed GRI GM17.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE			
			40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm)	ASTM D 5994	every roll	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			36 (0.91)	54 (1.40)	72 (1.80)	90 (2.28)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.92	0.92	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV Dumbell, 2 ipm G.L. 2.0 in (51 mm)	20,000 lb				
Strength at Break, lb/in-width (N/mm)			115 (20)	168 (29)	224 (39)	270 (47)
Elongation at Break, %			500	500	500	500
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	25 (111)	38 (169)	50 (222)	60 (266)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	95 (422)	125 (556)	140 (622)
Carbon Black Content ⁽¹⁾ , % (Range)	ASTM D 1603*/4218	20,000 lb	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾	Note ⁽²⁾
Asperity Height, mil (mm)	ASTM D 7466	second roll	18 (0.45)	18 (0.45)	18 (0.45)	18 (0.45)
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS						
Roll Length ⁽³⁾ , ft (m)	Double-Sided Textured		700 (213)	520 (158)	400 (122)	330 (100)
	Single-Sided Textured		650 (198)	420 (128)	320 (98)	250 (76)
Roll Width ⁽³⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)	Double-Sided Textured		15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (689)
	Single-Sided Textured		14,625 (1,359)	9,450 (878)	7,200 (669)	5,625 (522)

NOTES:

- ⁽¹⁾GSE UltraFlex White Textured may have an overall ash content greater than 3.0% due to the white layer. These values apply to the black layer only.
- ⁽²⁾Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽³⁾Roll lengths and widths have a tolerance of ± 1%.
- GSE UltraFlex White Textured Double-Sided is available in rolls weighing approximately 4,000 lb (1,800 kg) and Single-Sided weighing approximately 3,000 lb (1,360 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.

Attachment G

Operating Plan

Operating Plan for McIntyre Flowback Pits #1 and #2 (908.B.8)

Project Introduction

SG Interests has planned two facilities at which they will store water, including flowback water, for use in frac'ing wells in their Bull Mountain Unit and at nearby wells outside the unit. McIntyre Flowback Pits 1 and 2 are located at one of these facilities and are the subject of this Operating Plan. Both facilities will be located on Rock Creek Ranch, a property owned by an affiliate of SG Interests, Rock Creek Ranch I Ltd. The Construction Layout drawings included in this application depict the general arrangement of the facility. The purpose of this Operating Plan is to provide a basis for developing and implementing the processes and procedures that will be used at the facility. This plan will be updated at regular intervals beginning prior to project construction and annually after that. This facility will have a Spill Prevention, Containment and Countermeasure Plan prepared within six months of project construction. The SPCC plan will include a Facility Response Plan due to the volume of water stored at the facility.

The basic plan for use of the facilities is to transport water to be stored in the pits via poly pipeline on the ground surface. Most produced water that will be stored in the pits will be piped through SG Interests' existing buried water pipeline gathering system to the Federal #24-2 WDW (05-051-06084, water disposal well) and from there via surface poly pipelines to the pits. Surface poly pipelines that cross sensitive areas will have secondary containment to prevent a leak in a poly line from contaminating surface waters. These temporary surface poly water pipes can be moved as needed to connect the pits with gas well sites or injection well sites for disposal.

Trailer-mounted pumps will be located near the edge of each pit to pump water into and out of the pits. Water pumps will have built-in secondary containment systems known as ecology rails. Ecology rails are built-in sump systems that are part of the skids of these pumps. It will not be possible to connect all wells supplying produced water for storage in the pits via pipe.

Some wells will have water trucked from tanks on these locations. Operators will use the permanent manifold structures located next to each pit, to deliver or remove water from pits by truck. This will prevent water hoses from being dropped into the pits and dragged over the liner, which could lead to liner damage. The manifold structure uses a hose that is left in place in each pit throughout the season to reach water stored in the pits. This hose will lay on an additional piece of 60 mil liner from its first contact with the pit liner to the bottom of the pit. Operators will only use the manifold structure to access the pit from the staging area. No operators will be allowed to approach the pit any closer than the manifold structure. Each manifold will have a galvanized or graded catch basin in case a leak occurs while operators are connecting or disconnecting hoses.

The pits will not be used during the winter season. Winterization of the pits will consist of removal of stationary equipment from the staging area. This equipment includes the pumps, poly pipes, and hose manifold. The stationary hose that extends from the manifold structure into the pit will also be removed for winter shut down. The volume of water stored in the pits over winter will be reduced to accommodate snow fall. Average total annual snow fall for Meredith, Colorado is 90.2" ($\approx 7.5'$) (Western Regional Climate Center data). In order to accommodate this snow, the pit water would be drawn down 1 foot in both pits 1 and 2. This draw down would accommodate all of the snow melt resulting from 7.5' of snow, which would approximately equal 7.5" of water. 4,061 bbls of water would be drained from Pit 1 and 3,918 bbls of water would be drained from Pit 2 each year if the pits were

filled to capacity (capacity calculated with two feet of freeboard). This water would be disposed of either at a commercial facility or at SG's water disposal well each year. The volume in the pits would be monitored daily during the winter. Bird netting would also be monitored daily over the winter shut down period. Any necessary maintenance for this netting would be performed as needed (damage from snow load etc.).

This operating plan will be updated prior to start-up of the facility, whenever a significant change in operations occurs, and annually thereafter. See Appendix A to this plan for the Facility Modification Checklist (FMC) to be used when updating this plan. Changes that should be recorded on the FMC include facility modifications, updates to the Operating Plan, permit reporting information. Whenever the FMC is filled out, it should be forwarded to COGCC for approval.

An Annual Review of operations will be provided to COGCC by December 31st each year that the facility is in operation. This review will summarize operations for the year and will include the volume of produced water handled at the facility, volume of produced water disposed of, and any results from surface and groundwater monitoring.

A. Method of Treatment and Loading Rates

The water to be stored in the McIntyre Pits will initially be comprised of a mixture of fresh water from the Bainard Reservoir No. 1 Augmentation Plan and produced water from several of SG Interests' wells in the area. A list of these wells and water analysis reports for the listed wells is attached to this application. Fresh water will be added as necessary utilizing the Bainard Reservoir No. 1 Augmentation Plan. SG re-built the existing Bainard Reservoir No. 1 and obtained an Augmentation Plan through State Water Court to use this water for commercial/industrial purposes. Once water has been drawn from a pit to be used for frac'ing a well, the resulting flowback water will be filtered through a series of filter vessels to remove solids, coal, hydrocarbons, and sediments. Water is then piped back into the pits for storage until it is reused. When the pits are being filled, water will flow into them at the rate of about 3,000 barrels per day. Water in the pits will be treated as necessary to prevent bacteria buildup using biocide developed for that purpose. Dead bacteria are filtered out of the water when the water is drawn from the pits for reuse. Bacteria treatment will prevent odor from emanating from the pits.

B. Dust and Moisture Control

The facility is not required to obtain a land disturbance permit from CDPHE since it is below the acreage threshold of 25 acres and construction will not last six months or more. Dust on the staging area adjacent to the pits and pit access roads will be controlled by application of fresh water as needed to keep dust down. SG expects dust treatment to be needed infrequently because trucks will not ordinarily be used to transport this water. There will be no dust or moisture control needed for the pits themselves.

C. Sampling

As new wells begin producing and are included in the list of wells contributing produced water to the pits, they will be added to the list of wells by Sundry Notice. Water analyses for this produced water will be included with this form. As new wells are frac'ed and contribute flowback water to the pits, these new wells will also be added to the list of wells through a Sundry Notice. Once flowback water has been added to the pits, analytical water testing will be conducted of the pit water (as per Linda

Spry-O'Rourke's email dated October 7, 2010 and attached to this plan). Analytical testing will be conducted four times per year of the pit water. The results of this testing will be included with the Sundry Notice within three months of testing. The current list of wells and analytical test results for this produced water are in Attachment H.

There are no water wells used by members of the public within one mile of the flowback pits. The State Engineer's Office shows one water well about one mile to the northeast of Flowback Pit #1 (Permit #263115). This well was not located in the field when water well sampling was conducted in 2010. Instead the landowners allowed access to the spigot from which they draw water. The source of this water is a spring box located off their property. This water was sampled and tested (WQ 11-90-13 #2, in Attachment H). The second spring box that was tested is WQ 11-90-27 #1 as depicted on the map of shallow groundwater test locations in Attachment H. Surface water in the vicinity of the pits has also been collected and tested (see attached map and test results in Attachment H). Shallow groundwater and surface water has been tested and analyzed according to the parameters listed in Table 910-1. Shallow groundwater and surface water test points are indicated on the maps attached to this application (Attachment H). This water testing provides a baseline of water quality in the area prior to construction and filling of the pits. Once the pits are operational, testing of the shallow groundwater and surface water will be conducted during the season following initial filling of the pits, on the third year of use, and on the sixth year of use. Sampling of surface water and shallow groundwater sites for TDS will be conducted twice per operating season annually while the pits are in use. If the leak detection system shows there has been a leak in the primary liner or if TDS levels in the water test locations are elevated, additional analytical testing of the surface and shallow groundwater sites will be conducted as per COGCC requirements. All test results will be provided to the COGCC within three months of sampling.

SG Interests has designed the flowback pit facilities to protect water resources. This project includes a liner system that consists of two synthetic liners separated by geonet, which are set on a protective geomat set over a smooth ground surface. This liner system has a leak detection system, which SG will use to discover any leak that has occurred in the primary liner before it can reach the ground surface below the pit. This liner and leak detection system will be installed in pits that will be constructed entirely in cut soils, therefore the risk of pit failure is minimized. The facility includes appropriately designed drainage features to prevent water from overflowing the pits due to a precipitation event or snow build up (see Attachment D, Drainage Plan and Item 12, Drainage Calculations for details). The drainage plan for the facility includes all relevant details, but some of these features are a 12" liner lip around each pit, an 8' high berm or cut soil face surrounding the facility to prevent water flow onto or off from the facility, and secondary containment for the water pumps and hose manifold structures. These features are designed to prevent leaks from the facility, but shallow groundwater and surface water monitoring sites have been identified in this permit application to verify that these waters are not being contaminated by any fluids stored at the facility. The water collected at these sites has been analytically tested. Over the life of the pits, the monitoring test results can be compared to their baseline test results as well as to analytical test results for the flowback pit water in order to verify that contamination of ground and surface waters has not occurred. If in addition to the liner system, leak detection, drainage plan, and surface and shallow groundwater monitoring, the COGCC stipulates groundwater monitoring wells be drilled as a condition of permit approval, the locations and depths of these monitoring wells will be included in these conditions and will be incorporated into the revised operating plan for this facility.

D. Inspection and Maintenance

Daily inspection at the facility will include visual inspection of the entire facility for any readily apparent problems. This will include watching for leaks in any equipment, damage to any fencing or netting, and checking the integrity and capacity of secondary containment systems. All equipment will be inspected weekly in greater detail. This weekly inspection will include checking fluid levels, safety features, etc. for all motorized equipment on site. Filters for water entering and exiting the pits will be checked before each use and will be replaced as needed.

Inspection of the pit liners will occur on a quarterly basis and after any object has contacted the liner.

The pits have been designed with leak detection systems between the primary and secondary liners. The leak detection system will be monitored regularly for water accumulation between these two liners. The leak detection system will be inspected in the spring prior to refilling of the pits, weekly through the active use season, and monthly during the winter shut down period. If water appears between the liners, it will be tested to determine if this water has leaked through the primary liner from the pit or if it is from another source.

Water level in the pits will be monitored daily. At least two feet of freeboard will be maintained in the pits at all times. The pit liner will be marked at the two foot depth line so that the inspector can easily verify that the water is being maintained at the correct depth. The pits will be covered with bird netting. This netting will be monitored daily and maintained in proper working condition at all times. This netting will also be monitored throughout the winter months when the pits are not operational. The fence surrounding the pits will be inspected visually daily and repaired as needed to keep livestock, wildlife, and unauthorized persons from entering the pit site.

Any abnormalities that are noticed during any inspection will be reported to the Field Superintendent immediately so that any necessary follow-up can be scheduled.

E. Emergency Response (908.b.11)

SG Interests has a 24-hour emergency answering service that will allow the Field Superintendent to be notified of any emergency situation related to the McIntyre Flowback Pits. Table 1 below lists the personnel, positions, duties, and contact information for all relevant personnel associated with the flowback pits.

Table 1: Contact Information for key personnel

Name	Contact	Position	General Duties	Specific Duties Related to Flowback Pits
24-Hour Answering Service	866-261-9766			Will immediately notify the field superintendent or his replacement in the event of an emergency situation related to the flowback pits.
Dennis Beasley	Office: 970-929-5313 Mobile: 505-947-3564	Field Superintendent	Manager of field operations.	Mr. Beasley has the authority to initiate emergency response actions and will oversee all work done on the pits including maintenance, monitoring, and pit closure.
Eric Sanford	Mobile: 970-259-2759	Operations and Land Manager	Oversees operations from SG Interests' Montrose office	Coordinate and communicate activities with agencies and landowners.
Brian Kimball	Mobile: 505-801-0006	Lease Operator	Responsible for daily operations of wells, water transportation, and water disposal facilities.	Will conduct the daily monitoring of the pits and associated facilities.
Brent Bizer	Mobile: 970-260-9039	Lease Operator	Responsible for daily operations of wells, water transportation, and water disposal facilities.	Will conduct the daily monitoring of the pits and associated facilities.
Dusty Carson, Beavers Construction	970-872-2323	Contract construction company	Earthwork	Spill Contractor, construction of facilities, reclamation of sites.
Catherine Dickert	970-209-6464	Environmental and Permitting Manager	Oversee environmental permitting and reporting requirements	Coordinate with agencies, environmental subcontractors for monitoring and compliance.
Eric Petterson, Rocky Mtn. Ecological Services	Office: 970-945-9558 Mobile: 970-309-4454	Consulting environmental scientist	Performs water and soil testing and reporting.	Will conduct testing of surface and ground water in vicinity of pits. Will conduct stormwater compliance inspections.

In the case of a spill, the following agencies may need to be notified:

Table 2: Pertinent Agencies

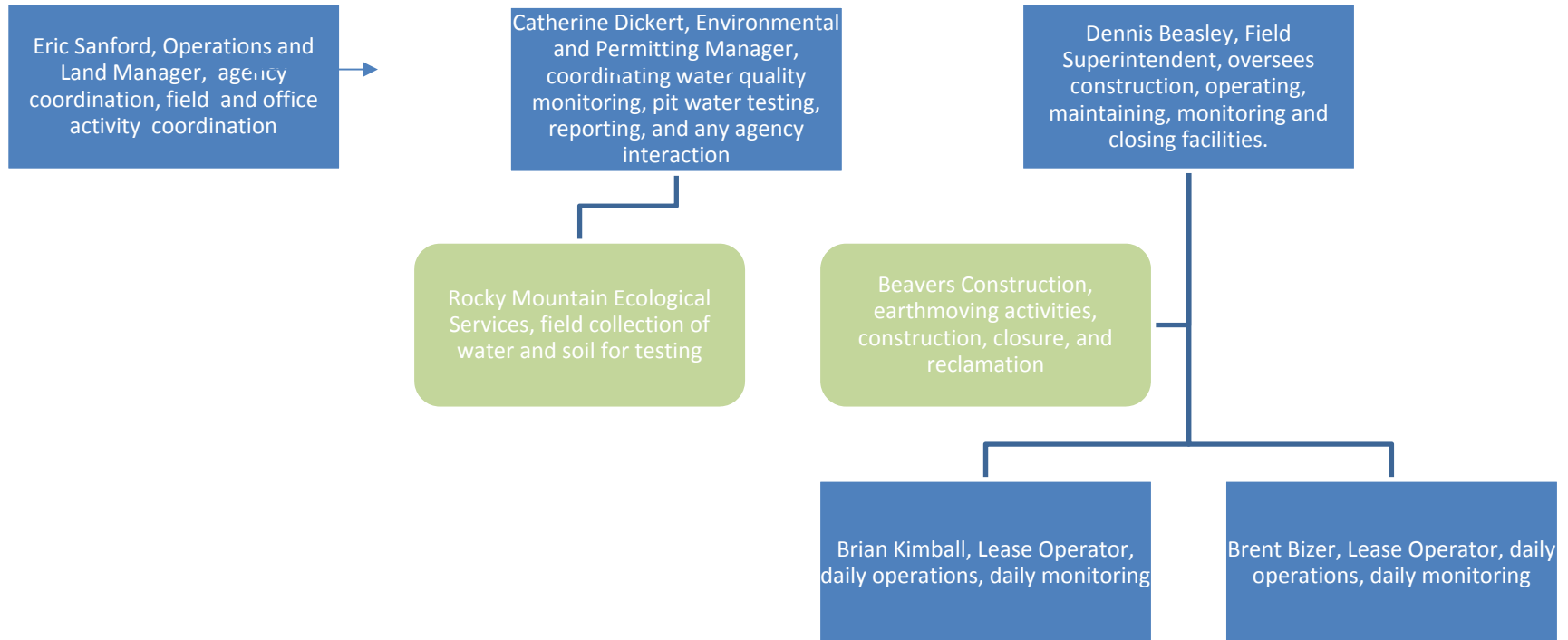
Agency	Contact Information	When to call
CDPHE Colorado Environmental Release and Incident Reporting Line	877-518-5608 (24-hour)	Any spill that has the potential to impact waters of the State of Colorado.
Colorado Oil and Gas Conservation Commission	303-894-2100 (business hours)	Spills of E&P waste (produced water and flowback fluid) on state or private lands in excess of 20 barrels, and spills of any size that impact or threaten to impact waters of the state, an occupied structure, or public byway must be reported to the COGCC as soon as practicable, but not more than 24 hours after discovery.
Bureau of Land Management	970-240-5300 (business hours)	Spills of waste materials must be reported to the BLM.

Table 3: Emergency Personnel

Responder	Contact
Gunnison County Emergency Dispatch	970-641-8000
Air Life @ St. Mary's Hospital	970-244-2551 800-332-4923
Colorado State Patrol	970-249-4392
Gunnison County Sheriff	970-641-1113

Responsibilities Flow Chart

The following flow chart illustrates the responsibilities of the various personnel associated with this facility. These activities include operating, maintaining, monitoring, and closing the facility.



Chemicals Stored and/or Used on Site

In the case of a spill of any chemical at the McIntyre Pit site, the Spill Prevention, Containment, and Countermeasure Plan should be consulted. There are two chemicals that SG expects to use on site; a biocide (EC6106A) and an anticorrosive agent (Enercept EC1317A). The Material Safety Data Sheets (MSDS) for these two chemicals are attached to this plan. The Emergency Overview sections of these two sheets should be reviewed prior to facility start up by all employees who will work on site. As new employees begin work at the site, they too should familiarize themselves with the safety information in these data sheets.

Water that cannot be used for frac'ing wells and cannot be stored at the pits, will be transferred to the water disposal well via pipeline or truck for disposal.

In the event that evacuation of the site is required, all personnel should immediately leave the pit site and report to the Federal 24-2 well pad. At this point, a head count of all personnel will be conducted to make sure everyone has left the facility. Under normal circumstances, only one or two truck drivers or personnel monitoring the pits will be on site at the same time.

F. Record-keeping

Record-keeping will be composed of the following elements: date water was transported, method of transportation (truck or pipeline), approximate volume of water, source of water, and number of the pit to which the water was transported. If the water is transported by truck, the name of the trucking company will be included in the records. SG will also maintain records to support the FMC and Annual Reports described at the beginning of this plan. These records will be kept by SG Interests for five years following final closure of the facility.

G. Site security

Perimeter security fencing will prevent livestock, wildlife, or unauthorized personnel from entering the pits (fence height will be 7'). The access road into the facility will be closed with a locked gate to prevent unauthorized personnel from entering the facility.

H. Hours of Operation

The pits could be in use 24-hours per day during the warm weather months in which they are operational. Normal operating hours will be approximately 0630 to 1730 each day. During the winter season, the pits will not be used, but will be inspected daily for any problems with bird netting, liner integrity, fluid level, etc.

I. Noise and Odor Mitigation

Most of the water stored in the pits will be delivered and removed for reuse via pipeline. Transportation of water to and from the pits by pipeline will be significantly quieter than transportation by truck. Odor will be mitigated by use of biocide to keep the water clean and reduce populations of bacteria in the pits that would otherwise produce odors.

J. Final Disposition of Waste

When the water level is drawn down at the end of the operational season and when the pits are no longer needed, the water will be disposed of at one of SG Interests' water disposal wells. Currently, there is one disposal well permitted near the pit locations; Federal #24-2 WDW (05-051-06084).

Appendix A

Facility Modification Checklist

This checklist must be filled out and submitted to COGCC whenever a change to the facility, operating plan, or permit compliance has occurred. An example of such a change is provided in the checklist below.

Facility Modifications

Facility Modification	Modification Description or Justification	Date of Modification	Comments	Permit Changes Triggered by Modification?
Example = modification to design of hose manifold	Use of existing manifold led to idea for better design	11/22/2010	None	No

Operating Plan Updates

Reason for Update	Date changed	Pages changed	Is revised plan attached?
Example = Contingency Plan updated to include new personnel	11/22/2010	6, Table of contact information 8, responsibilities flowchart	yes

Permit Compliance

Permit	Agency	Change/Amendment/Report
Example = stormwater management inspection reports for active construction period	CDPHE	Reports attached.

Additional Comments:

Appendix B
Annual Review Template

Write a narrative report to be submitted to COGCC that contains at least the following elements:

- a summary of the operations conducted at the facility in the past year
- a list of any FMOs that were submitted to the COGCC that year
- revised list of wells that contribute water to the pits
- pit water monitoring results for that year
- the volume of water that was recycled into the pits
- the volume and source of fresh water added to the pits
- the volume of produced water injected that year and the disposal well(s) API
- the total volume of water injected that year and disposal well(s) API
- any other waste associated with the pits that was disposed of that year (description of waste, reason it was generated, method of disposal)
- monitoring results from surface water testing from that year
- monitoring results from shallow groundwater testing from that year

This narrative will be submitted to COGCC by December 31st for each year the facility is in operation.

Catherine Dickert

From: Spry ORourke, Linda [Linda.SpryORourke@state.co.us]
Sent: Thursday, October 07, 2010 1:26 PM
To: Catherine Dickert
Cc: Eric Sanford
Subject: RE: list of components in analytical tests - pits
Attachments: COGCC Garfield Typical Waste Water Analytical Suite.xlsx

Catherine,

Attached is the list I would recommend. This is typically used in Garfield county, but it would apply to Gunnison/Delta counties, at least until I see what the water chemistry up there is like.

Thanks.

Linda Spry O'Rourke
Environmental Protection Specialist, Northwest Region
Colorado Oil & Gas Conservation Commission
707 Wapiti Court
Suite 204
Rifle, CO 81650

(970) 625-2497 Office
(970) 625-5682 Fax
(970) 309-3356 Cellular
linda.spryorourke@state.co.us

From: Catherine Dickert [<mailto:cdickert@sginterests.com>]
Sent: Thursday, October 07, 2010 1:27 PM
To: Spry ORourke, Linda
Cc: Eric Sanford
Subject: list of components in analytical tests - pits

Linda,

Please send me your list of tests for the frac water to be stored in the pits we are currently permitting. Thank you.

Catherine

Typical analytical list used by COGCC for domestic well sampling in Garfield County (variable subject to site specific conditions)

[illegible]



MATERIAL SAFETY DATA SHEET

PRODUCT

EC6106A

EMERGENCY TELEPHONE NUMBER(S)

(800) 424-9300 (24 Hours) CHEMTREC

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME : **EC6106A**

COMPANY IDENTIFICATION :
Nalco Company
1601 W. Diehl Road
Naperville, Illinois
60563-1198

EMERGENCY TELEPHONE NUMBER(S) : (800) 424-9300 (24 Hours) CHEMTREC

NFPA 704M/HMIS RATING

HEALTH : 3 / 3 FLAMMABILITY : 3 / 3 INSTABILITY : 0 / 0 OTHER :

0 = Insignificant 1 = Slight 2 = Moderate 3 = High 4 = Extreme

2. COMPOSITION/INFORMATION ON INGREDIENTS

Our hazard evaluation has identified the following chemical substance(s) as hazardous. Consult Section 15 for the nature of the hazard(s).

Hazardous Substance(s)	CAS NO	% (w/w)
Isopropanol	67-63-0	10.0 - 30.0
(C12-C18) N-Alkylpropylenediamine	68155-37-3	30.1

3. HAZARDS IDENTIFICATION

****EMERGENCY OVERVIEW****

DANGER

Flammable. Corrosive. May cause tissue damage. CORROSIVE. CAUSES EYE AND SKIN DAMAGE. Harmful or fatal if swallowed. Do not get in eyes, on skin or on clothing. Wear goggles or face shield, rubber gloves and protective clothing when handling. Avoid contamination of food.

Do not get in eyes, on skin, on clothing. Do not take internally. Avoid breathing vapor. Use with adequate ventilation. Keep container tightly closed. Keep away from heat. Keep away from sources of ignition - No smoking. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water.

Wear a face shield. Wear suitable protective clothing, gloves and eye/face protection.

May evolve oxides of carbon (COx) under fire conditions. Flammable Liquid; may release vapors that form flammable mixtures at or above the flash point. Empty product containers may contain product residue. Do not pressurize, cut, heat, weld, or expose containers to flame or other sources of ignition.

PRIMARY ROUTES OF EXPOSURE :
Eye, Skin

HUMAN HEALTH HAZARDS - ACUTE :

EYE CONTACT :
Corrosive. Will cause eye burns and permanent tissue damage.



MATERIAL SAFETY DATA SHEET

PRODUCT

EC6106A

EMERGENCY TELEPHONE NUMBER(S)

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SKIN CONTACT :

May cause severe irritation or tissue damage depending on the length of exposure and the type of first aid administered.

INGESTION :

Not a likely route of exposure. Corrosive, causes burns to gastro-intestinal tract. Nausea, vomiting and stomach pain may occur. In severe cases blood may be vomited.

INHALATION :

Irritating to the eyes, nose, throat and lungs.

SYMPTOMS OF EXPOSURE :

Acute :

A review of available data does not identify any symptoms from exposure not previously mentioned.

Chronic :

A review of available data does not identify any symptoms from exposure not previously mentioned.

AGGRAVATION OF EXISTING CONDITIONS :

A review of available data does not identify any worsening of existing conditions.

4. FIRST AID MEASURES

EYE CONTACT :

PROMPT ACTION IS ESSENTIAL IN CASE OF CONTACT. Immediately flush eye with water for at least 15 minutes while holding eyelids open. Get immediate medical attention.

SKIN CONTACT :

Immediately flush with plenty of water for at least 15 minutes. For a large splash, flood body under a shower. Remove contaminated clothing. Wash off affected area immediately with plenty of water. Get immediate medical attention. Contaminated clothing, shoes, and leather goods must be discarded or cleaned before re-use.

INGESTION :

DO NOT INDUCE VOMITING. If conscious, washout mouth and give water to drink. Get medical attention.

INHALATION :

Remove to fresh air, treat symptomatically. Get medical attention.

IF IN EYES: Hold eyes open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing. Call a poison control center or doctor for treatment advice.

IF SWALLOWED: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told by a poison control center or doctor.

IF ON SKIN: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

IF INHALED: Move person to fresh air. If person is not breathing, call 911 or ambulances, then give artificial respiration, preferably mouth-to-mouth, if possible. Call a poison control center or doctor for treatment advice,



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NOTE TO PHYSICIAN: Probable mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression and convulsion may be needed.

NOTE TO PHYSICIAN :

Probable mucosal damage may contraindicate the use of gastric lavage. Based on the individual reactions of the patient, the physician's judgement should be used to control symptoms and clinical condition.

5. FIRE FIGHTING MEASURES

FLASH POINT : 77 °F / 25 °C (PMCC)

EXTINGUISHING MEDIA :

Alcohol foam, Carbon dioxide, Dry powder, Other extinguishing agent suitable for Class B fires, For large fires, use water spray or fog, thoroughly drenching the burning material.
Keep containers cool by spraying with water.

FIRE AND EXPLOSION HAZARD :

May evolve oxides of carbon (COx) under fire conditions. Flammable Liquid; may release vapors that form flammable mixtures at or above the flash point. Empty product containers may contain product residue. Do not pressurize, cut, heat, weld, or expose containers to flame or other sources of ignition.

SPECIAL PROTECTIVE EQUIPMENT FOR FIRE FIGHTING :

In case of fire, wear a full face positive-pressure self contained breathing apparatus and protective suit.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS :

Restrict access to area as appropriate until clean-up operations are complete. Ensure clean-up is conducted by trained personnel only. Ventilate spill area if possible. Do not touch spilled material. Remove sources of ignition. Stop or reduce any leaks if it is safe to do so. Use personal protective equipment recommended in Section 8 (Exposure Controls/Personal Protection). Notify appropriate government, occupational health and safety and environmental authorities.

METHODS FOR CLEANING UP :

SMALL SPILLS: Soak up spill with absorbent material. Place residues in a suitable, covered, properly labeled container. Wash affected area. LARGE SPILLS: Contain liquid using absorbent material, by digging trenches or by diking. Reclaim into recovery or salvage drums or tank truck for proper disposal. Wash site of spillage thoroughly with water. Contact an approved waste hauler for disposal of contaminated recovered material. Dispose of material in compliance with regulations indicated in Section 13 (Disposal Considerations).

ENVIRONMENTAL PRECAUTIONS :

Prevent material from entering sewers or waterways.

7. HANDLING AND STORAGE

HANDLING :

Avoid eye and skin contact. Do not take internally. Do not breathe vapors/gases/dust. Do not get in eyes, on skin, on clothing. Have emergency equipment (for fires, spills, leaks, etc.) readily available. Ensure all containers are



MATERIAL SAFETY DATA SHEET

PRODUCT

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labeled. Keep the containers closed when not in use. Use with adequate ventilation. Do not use in locations where vapor is likely to travel to welding flames or arcs or to other hot surfaces. Vapors are much heavier than air, this can result in uneven distribution.

STORAGE CONDITIONS :

Store the containers tightly closed. Store in suitable labeled containers. Store away from heat and sources of ignition. Store separately from oxidizers. Have appropriate fire extinguishers available in and near the storage area.

SUITABLE CONSTRUCTION MATERIAL :

Stainless Steel 304, Stainless Steel 316L, Mild steel, Aluminum, Buna-N, Hastelloy C-276, Polyethylene, Nylon, HDPE (high density polyethylene), Polypropylene, EPDM, Ethylene propylene, PVC, Plexiglass, Alfax, Teflon, Kalrez, Hypalon

UNSUITABLE CONSTRUCTION MATERIAL :

Brass, Copper, Neoprene, Polyurethane, Viton, Natural rubber

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

OCCUPATIONAL EXPOSURE LIMITS :

Exposure guidelines have not been established for this product. Available exposure limits for the substance(s) are shown below.

ACGIH/TLV :

Substance(s)

Isopropanol

TWA: 200 ppm , 492 mg/m³

STEL: 400 ppm , 983 mg/m³

OSHA/PEL :

Substance(s)

Isopropanol

TWA: 200 ppm , 492 mg/m³

STEL: 400 ppm , 983 mg/m³

ENGINEERING MEASURES :

Use general ventilation with local exhaust ventilation.

RESPIRATORY PROTECTION :

If significant mists, vapors or aerosols are generated an approved respirator is recommended. Wear an organic vapor/mist respirator when spraying. In event of emergency or planned entry into unknown concentrations a positive pressure, full-facepiece SCBA should be used. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection.

HAND PROTECTION :

FACE SHIELD, NEOPRENE, NITRILE, NATURAL RUBBER OR PVC GLOVES

SKIN PROTECTION :

Wear chemical resistant apron, chemical splash goggles, impervious gloves and boots. A full slicker suit is recommended if gross exposure is possible.

**MATERIAL SAFETY DATA SHEET****PRODUCT****EC6106A****EMERGENCY TELEPHONE NUMBER(S)****(800) 424-9300 (24 Hours) CHEMTREC****EYE PROTECTION :**

Wear a face shield with chemical splash goggles.

HYGIENE RECOMMENDATIONS :

Eye wash station and safety shower are necessary. If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

HUMAN EXPOSURE CHARACTERIZATION :

Based on our recommended product application and personal protective equipment, the potential human exposure is: Low

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE	Liquid
APPEARANCE	Yellow Clear
ODOR	Mild
SPECIFIC GRAVITY	0.94 @ 68 °F / 20 °C
DENSITY	7.83 lb/gal
SOLUBILITY IN WATER	Complete
VISCOSITY	16 cst @ 100 °F /
BOILING POINT	205 °F /

Note: These physical properties are typical values for this product and are subject to change.

10. STABILITY AND REACTIVITY**STABILITY :**

Stable under normal conditions.

HAZARDOUS POLYMERIZATION :

Hazardous polymerization will not occur.

CONDITIONS TO AVOID :

Heat and sources of ignition including static discharges.

MATERIALS TO AVOID :

Contact with strong oxidizers (e.g. chlorine, peroxides, chromates, nitric acid, perchlorate, concentrated oxygen, permanganate) may generate heat, fires, explosions and/or toxic vapors.

HAZARDOUS DECOMPOSITION PRODUCTS :

Under fire conditions: Oxides of carbon

11. TOXICOLOGICAL INFORMATION

The following results are for the product along with results on the hazardous components.

**MATERIAL SAFETY DATA SHEET****PRODUCT****EC6106A****EMERGENCY TELEPHONE NUMBER(S)****(800) 424-9300 (24 Hours) CHEMTREC****ACUTE ORAL TOXICITY :**

Species LD50
Rat 5,840 mg/kg
Rating : Non-Hazardous

Test Descriptor
Hazardous component Isopropanol

ACUTE DERMAL TOXICITY :

Species LD50
Rabbit 13,000 mg/kg
Rating : Non-Hazardous

Test Descriptor
Hazardous component Isopropanol

ACUTE INHALATION TOXICITY :

Species LC50
Rat 12000 ppm (8 hrs)
Rating : Non-Hazardous

Test Descriptor
Hazardous component Isopropanol

CARCINOGENICITY :

None of the substances in this product are listed as carcinogens by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP) or the American Conference of Governmental Industrial Hygienists (ACGIH).

HUMAN HAZARD CHARACTERIZATION :

Based on our hazard characterization, the potential human hazard is: High

12. ECOLOGICAL INFORMATION**ECOTOXICOLOGICAL EFFECTS :**

The following results are for the product.

ACUTE INVERTEBRATE RESULTS :

Species	Exposure	LC50	EC50	Test Descriptor
Mysid Shrimp (Mysidopsis bahia)	96 hrs	> 9,999 mg/l		Product

ENVIRONMENTAL HAZARD AND EXPOSURE CHARACTERIZATION

Based on our hazard characterization, the potential environmental hazard is: Moderate

Based on our recommended product application and the product's characteristics, the potential environmental exposure is: Low

If released into the environment, see CERCLA/SUPERFUND in Section 15.

13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it could meet the criteria of a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Before disposal, it should be determined if the waste meets the criteria of a hazardous waste.

**MATERIAL SAFETY DATA SHEET****PRODUCT****EC6106A****EMERGENCY TELEPHONE NUMBER(S)****(800) 424-9300 (24 Hours) CHEMTREC**

Hazardous Waste: D001

Hazardous wastes must be transported by a licensed hazardous waste transporter and disposed of or treated in a properly licensed hazardous waste treatment, storage, disposal or recycling facility. Consult local, state, and federal regulations for specific requirements.

14. TRANSPORT INFORMATION

The information in this section is for reference only and should not take the place of a shipping paper (bill of lading) specific to an order. Please note that the proper Shipping Name / Hazard Class may vary by packaging, properties, and mode of transportation. Typical Proper Shipping Names for this product are as follows.

LAND TRANSPORT :

Proper Shipping Name :	FLAMMABLE LIQUID, CORROSIVE, N.O.S.
Technical Name(s) :	ISOPROPANOL, ALKYL AMINES
UN/ID No :	UN 2924
Hazard Class - Primary :	3
Hazard Class - Secondary :	8
Packing Group :	III

Flash Point :	25 °C / 77 °F
---------------	---------------

AIR TRANSPORT (ICAO/IATA) :

Proper Shipping Name :	FLAMMABLE LIQUID, CORROSIVE, N.O.S.
Technical Name(s) :	ISOPROPANOL, ALKYL AMINES
UN/ID No :	UN 2924
Hazard Class - Primary :	3
Hazard Class - Secondary :	8
Packing Group :	III
IATA Cargo Packing Instructions :	310
IATA Cargo Aircraft Limit :	60 L (Max net quantity per package)

MARINE TRANSPORT (IMDG/IMO) :

Proper Shipping Name :	FLAMMABLE LIQUID, CORROSIVE, N.O.S.
Technical Name(s) :	ISOPROPANOL, ALKYL AMINES
UN/ID No :	UN 2924
Hazard Class - Primary :	3
Hazard Class - Secondary :	8
Packing Group :	III

15. REGULATORY INFORMATION**NATIONAL REGULATIONS, USA :**



MATERIAL SAFETY DATA SHEET

PRODUCT

EC6106A

EMERGENCY TELEPHONE NUMBER(S)

(800) 424-9300 (24 Hours) CHEMTREC

OSHA HAZARD COMMUNICATION RULE, 29 CFR 1910.1200 :

Based on our hazard evaluation, the following substance(s) in this product is/are hazardous and the reason(s) is/are shown below.

Isopropanol : Flammable, Eye irritant
(C12-C18) N-Alkylpropylenediamine :

CERCLA/SUPERFUND, 40 CFR 117, 302 :
Notification of spills of this product is not required.

SARA/SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (TITLE III) - SECTIONS 302, 311, 312, AND 313 :

SECTION 302 - EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355) :
This product does not contain substances listed in Appendix A and B as an Extremely Hazardous Substance.

SECTIONS 311 AND 312 - MATERIAL SAFETY DATA SHEET REQUIREMENTS (40 CFR 370) :
Our hazard evaluation has found this product to be hazardous. The product should be reported under the following indicated EPA hazard categories:

- | | |
|---|-----------------------------------|
| X | Immediate (Acute) Health Hazard |
| - | Delayed (Chronic) Health Hazard |
| X | Fire Hazard |
| - | Sudden Release of Pressure Hazard |
| - | Reactive Hazard |

Under SARA 311 and 312, the EPA has established threshold quantities for the reporting of hazardous chemicals. The current thresholds are: 500 pounds or the threshold planning quantity (TPQ), whichever is lower, for extremely hazardous substances and 10,000 pounds for all other hazardous chemicals.

SECTION 313 - LIST OF TOXIC CHEMICALS (40 CFR 372) :
This product does not contain substances on the List of Toxic Chemicals.

TOXIC SUBSTANCES CONTROL ACT (TSCA) :
The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

FEDERAL INSECTICIDE, FUNGICIDE AND RODENTICIDE ACT (FIFRA) :
EPA Reg. No. 68708-6
In all cases follow instructions on the product label.

FEDERAL WATER POLLUTION CONTROL ACT, CLEAN WATER ACT, 40 CFR 401.15 / formerly Sec. 307, 40 CFR 116.4 / formerly Sec. 311 :
None of the substances are specifically listed in the regulation.

CLEAN AIR ACT, Sec. 112 (40 CFR 61, Hazardous Air Pollutants), Sec. 602 (40 CFR 82, Class I and II Ozone Depleting Substances) :
This product contains the following substances listed in the regulation:

**MATERIAL SAFETY DATA SHEET****PRODUCT****EC6106A****EMERGENCY TELEPHONE NUMBER(S)****(800) 424-9300 (24 Hours) CHEMTREC**

Substance(s)	Citations
• Isopropanol	Sec. 111

CALIFORNIA PROPOSITION 65 :

This product does not contain substances which require warning under California Proposition 65.

MICHIGAN CRITICAL MATERIALS :

None of the substances are specifically listed in the regulation.

STATE RIGHT TO KNOW LAWS :

This product is a registered biocide and is exempt from State Right to Know Labelling Laws.

NATIONAL REGULATIONS, CANADA :**WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS) :**

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS CLASSIFICATION :

B2 - Flammable Liquids, E - Corrosive Material

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) :

This product contains substance(s) which are not listed on the Domestic Substances List (DSL) or the Non-Domestic Substances List (NDSL).

16. OTHER INFORMATION

Due to our commitment to Product Stewardship, we have evaluated the human and environmental hazards and exposures of this product. Based on our recommended use of this product, we have characterized the product's general risk. This information should provide assistance for your own risk management practices. We have evaluated our product's risk as follows:

* The human risk is: Low

* The environmental risk is: Low

Any use inconsistent with our recommendations may affect the risk characterization. Our sales representative will assist you to determine if your product application is consistent with our recommendations. Together we can implement an appropriate risk management process.

This product material safety data sheet provides health and safety information. The product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to insure safe workplace operations. Please consult your local sales representative for any further information.



MATERIAL SAFETY DATA SHEET

PRODUCT

EC6106A

EMERGENCY TELEPHONE NUMBER(S)

(800) 424-9300 (24 Hours) CHEMTREC

REFERENCES

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists, OH., (Ariel Insight# CD-ROM Version), Ariel Research Corp., Bethesda, MD.

Hazardous Substances Data Bank, National Library of Medicine, Bethesda, Maryland (TOMES CPS# CD-ROM Version), Micromedex, Inc., Englewood, CO.

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, Geneva: World Health Organization, International Agency for Research on Cancer.

Integrated Risk Information System, U.S. Environmental Protection Agency, Washington, D.C. (TOMES CPS# CD-ROM Version), Micromedex, Inc., Englewood, CO.

Annual Report on Carcinogens, National Toxicology Program, U.S. Department of Health and Human Services, Public Health Service.

Title 29 Code of Federal Regulations, Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA), (Ariel Insight# CD-ROM Version), Ariel Research Corp., Bethesda, MD.

Registry of Toxic Effects of Chemical Substances, National Institute for Occupational Safety and Health, Cincinnati, OH, (TOMES CPS# CD-ROM Version), Micromedex, Inc., Englewood, CO.

Ariel Insight# (An integrated guide to industrial chemicals covered under major regulatory and advisory programs), North American Module, Western European Module, Chemical Inventories Module and the Generics Module (Ariel Insight# CD-ROM Version), Ariel Research Corp., Bethesda, MD.

The Teratogen Information System, University of Washington, Seattle, WA (TOMES CPS# CD-ROM Version), Micromedex, Inc., Englewood, CO.

Prepared By : Product Safety Department
Date issued : 01/29/2007
Version Number : 1.9

**MATERIAL SAFETY DATA SHEET**

PRODUCT

ENERCEPT® EC1317A

EMERGENCY TELEPHONE NUMBER(S)

(800) 424-9300 (24 Hours) CHEMTREC

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATIONPRODUCT NAME : **ENERCEPT® EC1317A**

APPLICATION : CORROSION INHIBITOR

COMPANY IDENTIFICATION :
Nalco Energy Services, L.P.
P.O. Box 87
Sugar Land, Texas
77487-0087

EMERGENCY TELEPHONE NUMBER(S) : (800) 424-9300 (24 Hours) CHEMTREC

NFPA 704M/HMIS RATING

HEALTH : 3 / 3 FLAMMABILITY : 3 / 3 INSTABILITY : 0 / 0 OTHER :

0 = Insignificant 1 = Slight 2 = Moderate 3 = High 4 = Extreme

2. COMPOSITION/INFORMATION ON INGREDIENTS

Our hazard evaluation has identified the following chemical substance(s) as hazardous. Consult Section 15 for the nature of the hazard(s).

Hazardous Substance(s)	CAS NO	% (w/w)
Methanol	67-56-1	15.0 - 40.0
Benzyl-Dimethyl-Dodecyl-Ammonium Chloride	139-07-1	1.0 - 5.0
Tall Oil, DETA Imidazoline Acetates	68140-11-4	5.0 - 10.0
Thioglycolic Acid	68-11-1	1.0 - 5.0

3. HAZARDS IDENTIFICATION****EMERGENCY OVERVIEW******DANGER**

Corrosive. May cause tissue damage. Flammable. Contains methanol. Methanol may cause central nervous system effects or permanent vision damage if inhaled, swallowed or absorbed through the skin in large amounts. Toxic to aquatic organisms.

Do not take internally. Keep away from heat. Keep away from sources of ignition - No smoking. Use with adequate ventilation. Keep container tightly closed and in a well-ventilated place. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water. If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label. If respiratory symptoms develop, remove to fresh air, rest, treat symptomatically.

Wear a face shield. Wear chemical resistant apron, chemical splash goggles, impervious gloves and boots.

Flammable Liquid; may release vapors that form flammable mixtures at or above the flash point. May evolve oxides of nitrogen (NO_x) under fire conditions. May evolve oxides of carbon (CO_x) under fire conditions. May evolve oxides of sulfur (SO_x) under fire conditions. May evolve HCl under fire conditions.

PRIMARY ROUTES OF EXPOSURE :

Eye, Skin



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HUMAN HEALTH HAZARDS - ACUTE :

EYE CONTACT :

Corrosive. Will cause eye burns and permanent tissue damage.

SKIN CONTACT :

May cause severe irritation or tissue damage depending on the length of exposure and the type of first aid administered. Methanol may be absorbed through the skin and cause central nervous system effects which may result in permanent visual changes including blindness. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.

INGESTION :

Corrosive; causes chemical burns to the mouth, throat and stomach. Can cause central nervous system depression, nausea, dizziness, vomiting, or unconsciousness. Can cause blindness.

INHALATION :

Irritating, in high concentrations, to the eyes, nose, throat and lungs. Methyl alcohol may cause central nervous system effects which may result in permanent visual changes including blindness.

SYMPTOMS OF EXPOSURE :

Acute :

Inhalation of high concentrations of organic solvents can cause nausea, dizziness, vomiting, stupor or unconsciousness.

Chronic :

Frequent or prolonged contact with product may defat and dry the skin, leading to discomfort and dermatitis.

AGGRAVATION OF EXISTING CONDITIONS :

Preexisting eye, skin, and respiratory conditions may be aggravated.

4. FIRST AID MEASURES

EYE CONTACT :

PROMPT ACTION IS ESSENTIAL IN CASE OF CONTACT. Immediately flush eye with water for at least 15 minutes while holding eyelids open. Get immediate medical attention.

SKIN CONTACT :

Immediately flush with plenty of water for at least 15 minutes. For a large splash, flood body under a shower. Remove contaminated clothing. Wash off affected area immediately with plenty of water. Get immediate medical attention. Contaminated clothing, shoes, and leather goods must be discarded or cleaned before re-use.

INGESTION :

DO NOT INDUCE VOMITING. If conscious, washout mouth and give water to drink. Get immediate medical attention.

INHALATION :

Remove to fresh air, treat symptomatically. Get medical attention.



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NOTE TO PHYSICIAN :

Probable mucosal damage may contraindicate the use of gastric lavage. Based on the individual reactions of the patient, the physician's judgement should be used to control symptoms and clinical condition.

5. FIRE FIGHTING MEASURES

FLASH POINT : 86 °F / 30 °C (PMCC)

EXTINGUISHING MEDIA :

Alcohol foam, Carbon dioxide, Dry powder, Other extinguishing agent suitable for Class B fires, For large fires, use water spray or fog, thoroughly drenching the burning material.
Water mist may be used to cool closed containers.

FIRE AND EXPLOSION HAZARD :

Flammable Liquid; may release vapors that form flammable mixtures at or above the flash point. May evolve oxides of nitrogen (NO_x) under fire conditions. May evolve oxides of carbon (CO_x) under fire conditions. May evolve oxides of sulfur (SO_x) under fire conditions. May evolve HCl under fire conditions.

SPECIAL PROTECTIVE EQUIPMENT FOR FIRE FIGHTING :

In case of fire, wear a full face positive-pressure self contained breathing apparatus and protective suit.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS :

Restrict access to area as appropriate until clean-up operations are complete. Ensure clean-up is conducted by trained personnel only. Ventilate spill area if possible. Do not touch spilled material. Eliminate ignition sources. Stop or reduce any leaks if it is safe to do so. Use personal protective equipment recommended in Section 8 (Exposure Controls/Personal Protection). Notify appropriate government, occupational health and safety and environmental authorities.

METHODS FOR CLEANING UP :

SMALL SPILLS: Soak up spill with absorbent material. Place residues in a suitable, covered, properly labeled container. Wash affected area. LARGE SPILLS: Contain liquid using absorbent material, by digging trenches or by diking. Reclaim into recovery or salvage drums or tank truck for proper disposal. Wash site of spillage thoroughly with water. Contact an approved waste hauler for disposal of contaminated recovered material. Dispose of material in compliance with regulations indicated in Section 13 (Disposal Considerations).

ENVIRONMENTAL PRECAUTIONS :

This product is toxic to fish and other water organisms. Do not discharge directly into lakes, ponds, streams, waterways or public water supplies.

7. HANDLING AND STORAGE

HANDLING :

Do not get in eyes, on skin, on clothing. Do not take internally. Use with adequate ventilation. Avoid release of vapors or mists into workplace air. Keep the containers closed when not in use. Do not use in locations where vapor is likely to travel to welding flames or arcs or to other hot surfaces. Vapors are much heavier than air, this can result in uneven distribution. Have emergency equipment (for fires, spills, leaks, etc.) readily available.



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STORAGE CONDITIONS :

Store away from heat and sources of ignition. Connections must be grounded to avoid electrical charges. Store the containers tightly closed. Store separately from oxidizers. Store in suitable labelled containers.

SUITABLE CONSTRUCTION MATERIAL :

Stainless Steel 304, Stainless Steel 316L, Nitrile, EPDM, Perfluoroelastomer, PTFE, TFE, FEP (encapsulated), Compatibility with Plastic Materials can vary; we therefore recommend that compatibility is tested prior to use.

UNSUITABLE CONSTRUCTION MATERIAL :

Viton, Neoprene, Carbon Steel C1018

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

OCCUPATIONAL EXPOSURE LIMITS :

Exposure guidelines have not been established for this product. Available exposure limits for the substance(s) are shown below.

ACGIH/TLV :

Substance(s)

Methanol

TWA: 200 ppm , 262 mg/m3 (Skin)

STEL: 250 ppm , 328 mg/m3 (Skin)

Thioglycolic Acid

TWA: 1 ppm , 3.8 mg/m3 (Skin)

OSHA/PEL :

Substance(s)

Methanol

TWA: 200 ppm , 260 mg/m3 (Skin)

STEL: 250 ppm , 325 mg/m3 (Skin)

Thioglycolic Acid

TWA: 1 ppm , 4 mg/m3 (Skin)

* A skin notation refers to the potential significant contribution to overall exposure by the cutaneous route, including mucous membranes and the eyes.

ENGINEERING MEASURES :

Use general ventilation with local exhaust ventilation.

RESPIRATORY PROTECTION :

Where concentrations in air may exceed the limits given in this section, the use of a half face filter mask or air supplied breathing apparatus is recommended. A suitable filter material depends on the amount and type of chemicals being handled. Consider the use of filter type: Multi-contaminant cartridge (Gold) with a Particulate pre-filter (Purple). In event of emergency or planned entry into unknown concentrations a positive pressure, full-facepiece SCBA should be used. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection.

HAND PROTECTION :

Nitrile gloves, Viton# gloves, Polyvinyl alcohol gloves



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SKIN PROTECTION :

Wear chemical resistant apron, chemical splash goggles, impervious gloves and boots. A full slicker suit is recommended if gross exposure is possible.

EYE PROTECTION :

Wear a face shield with chemical splash goggles.

HYGIENE RECOMMENDATIONS :

Eye wash station and safety shower are necessary. If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

HUMAN EXPOSURE CHARACTERIZATION :

Based on our recommended product application and personal protective equipment, the potential human exposure is: Low

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE	Liquid
APPEARANCE	Amber
ODOR	Alcoholic, Pungent
SPECIFIC GRAVITY	0.95 @ 60 °F / 15.6 °C
DENSITY	7.9 lb/gal
SOLUBILITY IN WATER	Complete
pH (100 %)	3.4
VISCOSITY	2 cst @ 100.4 °F / 38 °C
POUR POINT	-50 °F / -46 °C

Note: These physical properties are typical values for this product and are subject to change.

10. STABILITY AND REACTIVITY

STABILITY :

Stable under normal conditions.

HAZARDOUS POLYMERIZATION :

Hazardous polymerization will not occur.

CONDITIONS TO AVOID :

Heat and sources of ignition including static discharges.

MATERIALS TO AVOID :

Contact with strong oxidizers (e.g. chlorine, peroxides, chromates, nitric acid, perchlorate, concentrated oxygen, permanganate) may generate heat, fires, explosions and/or toxic vapors.



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HAZARDOUS DECOMPOSITION PRODUCTS :

Under fire conditions: Oxides of carbon, Oxides of nitrogen, Oxides of sulfur, May evolve toxic fumes., Hydrogen sulfide (H₂S)

11. TOXICOLOGICAL INFORMATION

No toxicity studies have been conducted on this product.

SENSITIZATION :

This product is not expected to be a sensitizer.

CARCINOGENICITY :

None of the substances in this product are listed as carcinogens by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP) or the American Conference of Governmental Industrial Hygienists (ACGIH).

HUMAN HAZARD CHARACTERIZATION :

Based on our hazard characterization, the potential human hazard is: High

12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL EFFECTS :

No toxicity studies have been conducted on this product.

MOBILITY :

The environmental fate was estimated using a level III fugacity model embedded in the EPI (estimation program interface) Suite TM, provided by the US EPA. The model assumes a steady state condition between the total input and output. The level III model does not require equilibrium between the defined media. The information provided is intended to give the user a general estimate of the environmental fate of this product under the defined conditions of the models. If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages;

Air	Water	Soil/Sediment
<5%	30 - 50%	30 - 50%

The portion in water is expected to be soluble or dispersible.

BIOACCUMULATION POTENTIAL

Component substances have a low potential to bioconcentrate.

ENVIRONMENTAL HAZARD AND EXPOSURE CHARACTERIZATION

Based on our hazard characterization, the potential environmental hazard is: High

Based on our recommended product application and the product's characteristics, the potential environmental exposure is: Low

If released into the environment, see CERCLA/SUPERFUND in Section 15.

**MATERIAL SAFETY DATA SHEET****PRODUCT****ENERCEPT® EC1317A****EMERGENCY TELEPHONE NUMBER(S)****(800) 424-9300 (24 Hours) CHEMTREC****13. DISPOSAL CONSIDERATIONS**

If this product becomes a waste, it could meet the criteria of a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Before disposal, it should be determined if the waste meets the criteria of a hazardous waste.

Hazardous Waste: D001

Hazardous wastes must be transported by a licensed hazardous waste transporter and disposed of or treated in a properly licensed hazardous waste treatment, storage, disposal or recycling facility. Consult local, state, and federal regulations for specific requirements.

14. TRANSPORT INFORMATION

The information in this section is for reference only and should not take the place of a shipping paper (bill of lading) specific to an order. Please note that the proper Shipping Name / Hazard Class may vary by packaging, properties, and mode of transportation. Typical Proper Shipping Names for this product are as follows.

LAND TRANSPORT :

Proper Shipping Name :	FLAMMABLE LIQUID, CORROSIVE, N.O.S.
Technical Name(s) :	METHANOL, QUATERNARY AMMONIUM COMPOUND
UN/ID No :	UN 2924
Hazard Class - Primary :	3
Hazard Class - Secondary :	8
Packing Group :	III
Flash Point :	30 °C / 86 °F
DOT Reportable Quantity (per package) :	14,290 lbs
DOT RQ Component :	METHANOL

AIR TRANSPORT (ICAO/IATA) :

Proper Shipping Name :	FLAMMABLE LIQUID, CORROSIVE, N.O.S.
Technical Name(s) :	METHANOL, QUATERNARY AMMONIUM COMPOUND
UN/ID No :	UN 2924
Hazard Class - Primary :	3
Hazard Class - Secondary :	8
Packing Group :	III
IATA Cargo Packing Instructions :	310
IATA Cargo Aircraft Limit :	60 L (Max net quantity per package)

MARINE TRANSPORT (IMDG/IMO) :

Proper Shipping Name :	FLAMMABLE LIQUID, CORROSIVE, N.O.S.
Technical Name(s) :	METHANOL, QUATERNARY AMMONIUM COMPOUND
UN/ID No :	UN 2924

**MATERIAL SAFETY DATA SHEET****PRODUCT****ENERCEPT® EC1317A****EMERGENCY TELEPHONE NUMBER(S)****(800) 424-9300 (24 Hours) CHEMTREC**

Hazard Class - Primary : 3
Hazard Class - Secondary : 8
Packing Group : III

15. REGULATORY INFORMATION

NATIONAL REGULATIONS, USA :

OSHA HAZARD COMMUNICATION RULE, 29 CFR 1910.1200 :

Based on our hazard evaluation, the following substance(s) in this product is/are hazardous and the reason(s) is/are shown below.

Methanol : Flammable, Target Organ Effect - Eye
Benzyl-Dimethyl-Dodecyl-Ammonium Chloride : Corrosive
Tall Oil, DETA Imidazoline Acetates : Irritant
Thioglycolic Acid : Corrosive

CERCLA/SUPERFUND, 40 CFR 117, 302 :

This product contains the following Reportable Quantity (RQ) Substance. Also listed is the RQ for the product.

<u>RQ Substance</u>	<u>RQ</u>
Methanol	14,200 lbs

SARA/SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (TITLE III) - SECTIONS 302, 311, 312, AND 313 :

SECTION 302 - EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355) :

This product does not contain substances listed in Appendix A and B as an Extremely Hazardous Substance.

SECTIONS 311 AND 312 - MATERIAL SAFETY DATA SHEET REQUIREMENTS (40 CFR 370) :

Our hazard evaluation has found this product to be hazardous. The product should be reported under the following indicated EPA hazard categories:

X	Immediate (Acute) Health Hazard
-	Delayed (Chronic) Health Hazard
X	Fire Hazard
-	Sudden Release of Pressure Hazard
-	Reactive Hazard

Under SARA 311 and 312, the EPA has established threshold quantities for the reporting of hazardous chemicals. The current thresholds are: 500 pounds or the threshold planning quantity (TPQ), whichever is lower, for extremely hazardous substances and 10,000 pounds for all other hazardous chemicals.

SECTION 313 - LIST OF TOXIC CHEMICALS (40 CFR 372) :

This product contains the following substance(s), (with CAS # and % range) which appear(s) on the List of Toxic Chemicals

<u>Hazardous Substance(s)</u>	<u>CAS NO</u>	<u>% (w/w)</u>
Methanol	67-56-1	15.0 - 40.0

**MATERIAL SAFETY DATA SHEET****PRODUCT****ENERCEPT® EC1317A****EMERGENCY TELEPHONE NUMBER(S)****(800) 424-9300 (24 Hours) CHEMTREC****TOXIC SUBSTANCES CONTROL ACT (TSCA) :**

The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

FEDERAL WATER POLLUTION CONTROL ACT, CLEAN WATER ACT, 40 CFR 401.15 / formerly Sec. 307, 40 CFR 116.4 / formerly Sec. 311 :

None of the substances are specifically listed in the regulation.

CLEAN AIR ACT, Sec. 111 (40 CFR 60, Volatile Organic Compounds), Sec. 112 (40 CFR 61, Hazardous Air Pollutants), Sec. 602 (40 CFR 82, Class I and II Ozone Depleting Substances) :

This product contains the following substances listed in the regulation:

Substance(s)	Citations
• Methanol	Sec. 111, Sec. 112

CALIFORNIA PROPOSITION 65 :

This product does not contain substances which require warning under California Proposition 65.

MICHIGAN CRITICAL MATERIALS :

None of the substances are specifically listed in the regulation.

STATE RIGHT TO KNOW LAWS :

The following substances are disclosed for compliance with State Right to Know Laws:

Methanol	67-56-1
Thioglycolic Acid	68-11-1

NATIONAL REGULATIONS, CANADA :**WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS) :**

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS CLASSIFICATION :

B2 - Flammable Liquids, E - Corrosive Material

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) :

The substances in this preparation are listed on the Domestic Substances List (DSL), are exempt, or have been reported in accordance with the New Substances Notification Regulations.

INTERNATIONAL CHEMICAL CONTROL LAWS**EUROPE**

The substances in this preparation have been reviewed for compliance with the EINECS or ELINCS inventories.



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JAPAN

All substances in this product comply with the Law Regulating the Manufacture and Importation Of Chemical Substances and are listed on the Ministry of International Trade & Industry List (MITI).

16. OTHER INFORMATION

Due to our commitment to Product Stewardship, we have evaluated the human and environmental hazards and exposures of this product. Based on our recommended use of this product, we have characterized the product's general risk. This information should provide assistance for your own risk management practices. We have evaluated our product's risk as follows:

* The human risk is: Low

* The environmental risk is: Low

Any use inconsistent with our recommendations may affect the risk characterization. Our sales representative will assist you to determine if your product application is consistent with our recommendations. Together we can implement an appropriate risk management process.

This product material safety data sheet provides health and safety information. The product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to insure safe workplace operations. Please consult your local sales representative for any further information.

REFERENCES

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists, OH., (Ariel Insight# CD-ROM Version), Ariel Research Corp., Bethesda, MD.

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Prepared By : Product Safety Department
Date issued : 02/20/2004
Version Number : 1.7

**STORM WATER MANAGEMENT PLAN
FOR S.G. INTERESTS I, LTD.**

**COVERING OIL AND GAS OPERATIONS
LOCATED IN GUNNISON
AND DELTA COUNTIES, COLORADO**

Prepared for:

S.G. Interests I, Ltd.
c/o Nika Energy Operating LLC
P.O. Box 2677
Durango, Colorado 81302

Prepared by:

Greystone Environmental Consultants, Inc.
An ARCADIS G&M, Inc. Company
5231 South Quebec Street
Greenwood Village, Colorado 80111

March 2006

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EXHIBITS

Exhibit A	Construction Sites
Exhibit B	General Site Map
Exhibit C	Surface Acreage Disturbance at each Construction Site
Exhibit D	Placement of Sediment Control Device at the Construction Site
Exhibit E	Stormwater Fact Sheet Issued by the CWQCD in February 2006

APPENDICES

Appendix A	Construction Site Storm Water Inspection Report
Appendix B	Corrective Action Report

STORM WATER MANAGEMENT PLAN FOR LANDS LOCATED IN GUNNISON AND DELTA COUNTY, COLORADO

1.0 INTRODUCTION

This Storm Water Management Plan (SWMP) identifies standards and best management practices (BMPs) for implementing erosion and sediment control measures for S.G. Interests I, Ltd.'s oil and gas operations covering lands located in Gunnison and Delta County, Colorado. S.G. Interests I, Ltd. plans to drill oil and gas wells in Gunnison and Delta County in 2006. This SWMP was prepared to comply with regulations imposed by the Colorado Water Quality Control Division (CWQCD) for obtaining a storm water discharge permit covering S.G. Interests I, Ltd.'s oil and gas operations in Gunnison and Delta County.

Greystone Environmental Consultants, Inc. (Greystone), acting on behalf of S.G. Interests I, Ltd., has simultaneously with the completion of this SWMP, submitted an application for a storm water discharge permit with the CWQCD. To comply with CWQCD regulations, this SWMP must: i) exist at the time the application for a storm water discharge permit is submitted to CWQCD, and ii) be available at the drill site during all oil and gas operations that S.G. Interests I, Ltd. conducts in Gunnison and Delta County, Colorado after the effective date of this SWMP.

This SWMP was prepared in accordance with good engineering, hydrologic, and pollution control practices, and is designed to constitute compliance with best available technology and best conventional technology, as mandated by the Federal Clean Water Act and the Federal Water Pollution Control Act as well as applicable regulations promulgated by CWQCD.

This SWMP is designed to provide general information about:

- S.G. Interests I, Ltd.'s planned oil and gas operations in Gunnison and Delta County.
- The term "Construction Site" and how that term is defined for purposes of this SWMP.
- BMPs for implementing effective storm water erosion control at each Construction Site.
- The necessary inspection work that needs to be performed on a regular basis to ensure the efficient operation of the Sediment Control Devices placed at each Construction Site.
- The process for removing a Construction Site from coverage under this SWMP when S.G. Interests I, Ltd. has fully stabilized the land at that particular Construction Site.
- The procedure for making minor changes to this SWMP that generally impact only one Construction Site subject to this SWMP.

Effective June 30, 2005, CWQCD implemented a rule change requiring that certain oil and gas operations must be covered by a SWMP. CWQCD views oil and gas operations as similar to a "construction activity" that occurs at a "construction site". To avoid confusion in determining S.G. Interests I, Ltd.'s intent under the terms of this SWMP, the term, "Construction Site" is defined below in Article 2.

CWCQD has stated in its guidance material for oil and gas operations that a single storm water discharge permit may cover all of a company's oil and gas operations within a single county, or all oil and gas wells that are drilled under a "Common Plan of Development". Based on CWQCD's guidelines, S.G. Interests I, Ltd.'s oil and gas operations in Gunnison and Delta County constitute a Common Plan of Development.

After the effective date noted in Article 17 of this SWMP, S.G. Interests I, Ltd. plans to drill oil and gas wells identified in the attached Exhibit A from drill sites located in Gunnison and Delta County, Colorado. The mere fact that the oil and gas wells are identified in Exhibit "A" does not impose any requirement on S.G. Interests I, Ltd. that it drill any of the oil and gas wells listed in Exhibit "A".

The oil and gas wells that S.G. Interests I, Ltd. plans to drill under the terms of this SWMP will be drilled on oil and gas leases that it owns or has a right to drill on pursuant to an operating agreement that is, or will be, in effect at the time the oil and gas well in question is spudded.

In most instances, S.G. Interests I, Ltd. will need to construct an access road to each drill site location. If the oil and gas wells covered by this SWMP are productive, then S.G. Interests I, Ltd. may need to construct additional facilities (such as a tank battery or a natural gas gathering line to store crude oil production or gather natural gas from the productive wells) or add to its existing crude oil storage facility located within the Common Plan of Development. S.G. Interests I, Ltd. plans to drill two water disposal wells to handle produced water from the oil and gas wells that it plans to drill in conjunction with this SWMP.

As soon as S.G. Interests I, Ltd. fully stabilizes the land at a particular Construction Site covered by this SWMP, it intends to drop that drill site location from further coverage by this SWMP. S.G. Interests I, Ltd. intends to periodically update (on an annual basis, or more frequently if it determines it is expedient to do so) the Construction Site locations identified in the attached Exhibit A, by: i) potentially adding new Construction Sites to this SWMP, ii) deleting old Construction Sites when the land for that Construction Site has been fully stabilized, or iii) S.G. Interests I, Ltd.'s management deciding not to drill a particular well included in the attached Exhibit A.

S.G. Interests I, Ltd. understands that any new Construction Site it constructs as part of this Common Plan of Development in Gunnison and Delta County will need to be separately identified in Exhibits A, B, C, and D of this SWMP when data for the Construction Sites is periodically updated.

2.0 DEFINITIONS

2.1 Active Construction Site. The term, Active Construction Site, as used in Article 10 of this SWMP, identifies a Construction Site, from the point in time when the surface location is initially disturbed until the point in time when 1) the oil and gas well drilled at the Construction Site has been determined to be a dry hole and the surface casing has been properly plugged and abandoned, and the Construction Site has been reseeded, or 2) the oil and gas well drilled at the drill site has been completed as a producing well and the areas that will be revegetated for interim reclamation have been reseeded, or 3) an oil and gas facility used in conjunction with one or more oil and gas wells has been constructed and the areas that will be revegetated for interim reclamation has been reseeded.

2.2 Common Plan of Development. The term, "Common Plan of Development", as used in Article 10 of this SWMP, identifies all of S.G. Interests I, Ltd.'s oil and gas exploration and production operations in Gunnison and Delta County, Colorado that are located within the geographic area covered by the General Site Map, attached hereto as Exhibit B to this SWMP. S.G. Interests I, Ltd.

understands that it may expand the size of the Common Plan of Development by increasing the amount of land identified in Exhibit B of this SWMP.

2.3 Completed Construction Site. The term, “Completed Construction Site”, as used in Article 10 of this SWMP, identifies a Construction Site that has been completed and the necessary preparation and seeding of areas that will be revegetated has occurred; however the Construction Site does not yet satisfy CWQCD’s land stabilization requirements highlighted in Article 12 of this SWMP and therefore the surface land is not yet considered fully stabilized.

2.4 Construction Site. The term, “Construction Site”, as used in this SWMP, identifies surface land disturbed to construct: 1) a new access road to a drill site location or other oil and gas facility, 2) a new oil and gas drill site location, 3) a gas gathering line to transport natural gas, and 4) any additional oil and gas related facility that S.G. Interests I, Ltd. deems necessary for its oil and gas operations in Gunnison and Delta County that are covered by this SWMP. A more detailed description of each type of Construction Site is located in Articles 6.3, 6.4, and 6.5 of this SWMP. Each new Construction Site will be designed and constructed to prevent the surface flow of storm water from entering or leaving the boundary of the Construction Site.

2.5 Runoff Coefficient. The term, “Runoff Coefficient”, as used in this SWMP, identifies the percentage of precipitation that will not typically be absorbed by the surface land, assuming a moderate rainfall of less than one inch of rain within a 24 hour period. The Runoff Coefficient is identified in Article 8 of this SWMP.

2.6 Sediment Control Device. The term, “Sediment Control Device”, as used in this SWMP, identifies a barrier or structure used to block storm waters or reduce the velocity of the storm water to control and/or minimize sediment or other pollutants from crossing outside the boundary of the Construction Site. A list of different Sediment Control Devices is identified below in Article 5 of this SWMP. The Sediment Control Devices are also referred to in this SWMP as “Best Management Practices,” or merely as “BMPs”.

2.7 Vegetative Ground Cover. The term, “Vegetative Ground Cover”, as used in Article 8 of this SWMP, refers to the percentage of existing ground cover that is present at each Construction Site identified in this SWMP.

3.0 EXHIBITS ATTACHED TO THIS SWMP

Exhibit A consists of a list of the oil and gas wells, or an oil and gas facility, each identified by name, with the corresponding location, that are subject to this SWMP.

When S.G. Interests I, Ltd. has fully stabilized the land at a Construction Site, it may proceed to delete coverage of the Construction Site (i.e. for any oil and gas well, access road, pipeline corridor, and/or oil and gas facility, etc.) from Exhibit A by following the procedures set forth below in Article 12 of this SWMP.

S.G. Interests I, Ltd. contemplates that additional Construction Sites will be added to Exhibit A as it decides to drill additional oil and gas wells, lay or replace pipelines, construct or replace additional facilities located within the Common Plan of Development.

Exhibit B is a general site map that shows the locations of:

- Initial oil and gas wells that are a part of S.G. Interests I, Ltd.'s Common Plan of Development for Gunnison and Delta County.
- New access road(s) that S.G. Interests I, Ltd. intends to construct to the initial oil and gas wells identified in Exhibit A.
- Pipelines that may eventually be constructed to the oil and gas wells identified in Exhibit A.
- Oil and gas facilities within the Common Plan of Development.
- The location of any major erosion control facilities.
- The location of all springs, streams, wetlands, and other surface water areas within the Common Plan of Development.
- The boundary of any 100-year flood plains, if the Federal Emergency Management Administration (FEMA) has mapped the flood plain area.

Exhibit B shall be printed over a U.S. Geological Survey quadrangle map showing the area within the Common Plan of Development.

Exhibit C. S.G. Interests I, Ltd. may, from time to time, decide to drill additional oil and gas wells, construct additional access roads, construct pipelines, and/or facilities within the Common Plan of Development. CWQCD requires that S.G. Interests I, Ltd. identify the area of surface land that will be disturbed at each Construction Site. To comply with this requirement, S.G. Interests I, Ltd. has included, as part of Exhibit C, a separate plat of each drill site location, pipeline, and/or oil and gas facility included within its Common Plan of Development.

The first Construction Site (i.e. drill site location, access road, pipeline, and/or oil and gas facility) that is included in this SWMP will be identified as C-1, the second such Construction Site will be identified as C-2, the third such Construction Site shall be identified as C-3, etc. in sequential order for each Construction Site included in this SWMP. To maintain continuity, the plat covering each separate Construction Site listed in Exhibit C will be retained as part of the SWMP. The plat prepared for each Construction Site will highlight the outside boundary of each Construction Site.

Exhibit D identifies the physical location where Sediment Control Devices have been placed at a Construction Site to minimize sediment discharge from the Construction Site. The operator's field employees or contract help will make notes on the Exhibit D for the specific Construction Site in question if the operator changes the location or type of Sediment Control Device used at the Construction Site.

Exhibit E. On February 3, 2006, the CWQCD issued a Stormwater Fact Sheet for use in conjunction with oil and gas operations. A copy of the Stormwater Fact Sheet is attached hereto as Exhibit E; however it is not intended to be a part of the SWMP. It is attached as an exhibit to this SWMP for two reasons, 1) it highlights certain requirements imposed by the Water Quality Control Division that are addressed in this SWMP, and 2) it is attached as a reference document so that the operator may review language contained in the Stormwater Fact Sheet. As an example, language found on page 5 of the Stormwater Fact Sheet discusses one instance when this SWMP needs to be revised.

Article 15 of this SWMP identifies a procedure for making minor revisions to this SMWP that generally pertain to only one Construction Site. S.G. Interests I, Ltd. wants a procedure for implementing minor changes to this SWMP that will be: 1) easy to implement, and 2) can be used to implement a change at a specific Construction Site without requiring any modification to the main text of this SWMP. S.G. Interests plans to use the Corrective Action Report, a sample form of which is attached hereto as **Appendix B**, to implement minor changes generally impacting only one Construction Site.

Exhibits A, B, C, D, and E are attached hereto and made a part hereof for all purposes until a replacement exhibit is prepared and added to this SWMP. When Exhibits A and B are periodically updated, the effective date of the revised exhibit will be noted on the exhibit.

4.0 DESCRIPTION OF OIL AND GAS OPERATIONS AND SEQUENCE OF MAJOR SOIL DISTURBANCE ACTIVITIES

Oil and gas operations are conducted in a fairly consistent pattern. Before drilling an oil and gas well, the oil and gas operator acquires oil and gas leases over a prospective area. A second option available to the operator is to acquire oil and gas leases in an existing oil and gas field that is producing oil and gas.

After acquiring the oil and gas leases, the operator may decide to obtain geophysical data for the prospect by: i) purchasing existing data if it is available, or by ii) conducting a “seismic shoot” over the prospect. If the geophysical data indicate a probability that oil and gas deposits are located underneath the prospect area, then the oil and gas operator will generally drill one or more oil and gas wells to determine if oil and gas reserves are located underneath the prospect area.

If one or more of the oil and gas wells are completed as a producing well, then the operator will generally need to construct a gas gathering system, and/or install one or more tank batteries to transport the natural gas, or temporarily store oil that is produced from each successfully completed well. If multiple oil and gas wells are completed and placed “on production”, then the operator will construct additional facilities as they are needed to facilitate the production, temporary storage, and/or transportation of the oil and/or gas from the oil and gas leases. During each of the actions identified above, the operator will frequently disturb soil at an existing or new Construction Site to complete the planned production activity.

The drilling of oil and gas wells covered by this SWMP will generally include the following surface disturbing activities:

- Constructing an access road to the planned oil and gas drill site location.
- The drilling of an oil and gas well (unless multiple wells are drilled from the same drill site location).
- The construction of a pipeline for transporting fluids or gases (e.g. water, natural gas, or some other substance).
- The construction of additional oil and gas facilities, such as a tank battery, compressor station for a gas gathering line, or a gas plant, where separate constituent liquids are stripped from the gas stream and used at the plant or separately sold.

For its operations in Gunnison and Delta County, S.G. Interests I, Ltd. plans to drill oil and gas wells and then, if the wells are productive, it will construct pipelines or other facilities as they are needed.

5.0 BEST MANAGEMENT PRACTICES - STORM WATER POLLUTION PREVENTION, EROSION AND SEDIMENT CONTROL

BMPs will be used to minimize erosion and sediment transport during construction activities at each Construction Site. BMPs and Sediment Control Devices will be used as temporary actions during construction to control erosion and as permanent measures after construction to stabilize disturbed areas. It is important that the Sediment Control Devices are selected based on site-specific characteristics. Topography plays a key role in determining what Sediment Control Devices will work best at each Construction Site.

The potential for erosion and sediment transport is greatest in areas where ground surfaces have been disturbed and soil is exposed to physical agents such as wind and water. To protect existing water quality, both temporary and permanent BMPs and other Sediment Control Devices have been designed to minimize soil erosion due to storm water runoff. In most cases, the operator will utilize a combination of vegetative and structural BMPs to control erosion and sediment transport.

The CWCQD takes a broad view of BMPs and considers training, inspections, maintenance schedules, and good house keeping rules to be “non-structural” BMPs. The following BMPs are examples of structural Sediment Control Devices that are all designed to minimize or eliminate sediment discharge outside of the Construction Site.

- Straw or hay bale barrier. This type of barrier is designed to reduce the speed of the water flow and to trap sediment, while allowing the water to flow through the straw bale. It is generally used to protect slopes or depressed land areas from incurring water based erosion.
- Silt Fence. This fence type design is used to trap or reduce sediment from being discharged outside of a surface disturbed area. The fence is attached to wooden stakes that are driven into the soil.
- Temporary seeding. Generally a quick growing grass planted to slow the discharge of water flowing across the seeded area. This barrier type is almost always used in combination with another Sediment Control Device to control sediment discharge.
- Fiber-filled barrier. This barrier generally consists of wood or other fiber that is placed in a sock like barrier designed to reduce the water flow and filter sediment from the water as it flows through the fiber filled barrier.
- Rock riprap. Generally placed along the sides of a stream, rock riprap is primarily used to control erosion during or immediately following a rain storm.
- Biofiltration swale. The biofiltration swale is an open and gently sloping vegetated channel that promotes pollutant removal by filtration through the use of properly selected vegetation and settling. It presents a relatively low cost means of controlling storm water runoff for sites less than five acres.
- Gravel. Gravel is often placed at an entrance or exit area adjacent to a paved road to act as an abrasive agent to remove mud or sediment from vehicles that are crossing onto a paved surface.

- Culverts. The most effective method to control erosion on roads is to keep water from accumulating on the road surface. Fast-moving water can easily erode soil from road surfaces and ditches, and can be controlled by installing culverts that allow water from roadside ditches to move from one side of the road to the other.
- Bridges constructed over a flowing stream. If the stream maintains a relatively constant flow of water on a year round basis, an effective way to control erosion and runoff is to minimize the disturbance of the stream channel by avoiding a stream crossing whenever possible. This can usually be accomplished by constructing a bridge over the flowing stream.
- Grade stabilization structure. These structures are installed to stabilize the channel grade and control erosion to prevent the formation or advance of gullies and headcuts. They come in many designs including concrete, metal and soil.
- Erosion control mats. The purpose of the mat is to reduce the effect of erosion and to assist in the establishment of permanent vegetation. The basic types include the permanent turf reinforcement mat, the 100% biodegradable mat or blanket, the extended or long-term degradable mat, and the short-term photodegradable mat. Mat selection depends on site conditions (slope, runoff speed, project duration), and the area where the mat will be installed.
- Water bar. A water bar is a shallow trench with a mound (or berm) which provides cross drainage and intercepts runoff from trails, firebreaks, or inactive roads. Constructing a water bar will minimize erosion and provide conditions for natural or artificial revegetation.

6.0 INITIAL SURFACE DISTURBANCE AREA

S.G. Interests I, Ltd. estimates that it will disturb approximately 15 acres of land to build the initial nine Construction Sites, including the necessary new access roads, subject to this SWMP. The initial nine Construction Sites are identified in Exhibit A of this SWMP and the amount of surface acreage that will be disturbed at each Construction Site can be determined by examining Exhibit C of this SWMP. If S.G. Interests I, Ltd. drills additional oil and gas wells within the Common Plan of Development in subsequent years, then additional surface land will be disturbed.

If the proposed oil and gas wells are productive, then a gathering system or an oil and gas facility will likely need to be constructed to transport the natural gas produced or temporarily store condensate, and/or crude oil produced from the oil and gas wells.

Surface disturbance and/or routine maintenance should only be performed when the soil can adequately support construction equipment. If the equipment creates ruts more than six inches deep, the soil is too wet to adequately support construction equipment.

6.1 Clearing and Grading Operations

The removal of vegetation at each Construction Site will be limited to the smallest area possible to provide safe and efficient work areas for all phases of the construction project.

During project construction, surface disturbance and vehicle travel will be limited to each access road, each drill site location and along each pipeline corridor. Travel within the pipeline corridor will be minimized to the extent possible to avoid unnecessary surface disturbance. In some cases, extra workspace may be necessary for special construction activities at various areas within the Common Plan of Development. Disturbance activities within these extra work areas may include removal of surface vegetation, clearing and grading areas for safe equipment operation, excavating larger trenches, or stockpiling topsoil, construction materials and/or spoils.

Grading will be required within the pipeline corridor to achieve a relatively level working area to provide adequate access to the pipeline corridor, and a safe working condition for the operation of equipment, and vehicles.

Vegetation removal will be confined to the limits of the actual Construction Site (i.e. the access road, the drill site location, new facility location and/or the pipeline corridor).

Cuts into a hill side will be kept to a minimum to protect existing vegetation while providing a safe and stable plane for the efficient and safe use of equipment. Sediment Control Devices, such as water bars, diversion channels, and terraces, will be constructed to divert water and to reduce soil erosion in disturbed areas.

Topsoil will be separately removed and segregated from other material. Topsoil will be windrowed at the drill site location and within the pipeline corridor along the uphill side of the road or stored in an approved manner. When the pipeline corridor is rehabilitated, the topsoil will then be used as a top coating for the seedbed.

Spoil (subsoil) obtained from grading and clearing operations will be stockpiled adjacent to the segregated topsoil in a manner to prevent the topsoil from mixing with the spoil. In some cases, additional storage space may be necessary for excessive amounts of spoil. In areas containing very steep slopes, grading will be minimized by detouring non-essential equipment around these areas by using a temporary access road or bypass. Two-toning may also be implemented to minimize grading for steep cuts. Two-toning involves grading two small cuts where the working side is higher than the spoil side.

6.2 Access Roads and Pipeline Corridors – Special Construction Methods in Sensitive Areas

S.G. Interests I, Ltd. will use special construction methods whenever it encounters a sensitive area, such as wetlands, ponds, dry creeks or washes, gullies, drainages, or flowing creeks. The BMP to minimize the potential impact to a sensitive area is to avoid disturbing these areas. Every effort will be made to avoid routing an access road or pipeline near or through sensitive areas such as wetlands, ponds, and dry or flowing creeks, as well as steep slopes. All of these areas are prone to erosion. If one of these areas cannot be avoided, the operator shall implement the following practices to minimize the impact to the sensitive area: i) during construction near streams, lakes or wetlands, sedimentation (detention) basins, straw bales, or fabric filters should be used to prevent suspended sediments from reaching downstream watercourses or lakes, ii) the construction of access roads and pipeline corridors will use silt fences, straw bale dikes or equivalent Sediment Control Devices installed to protect adjacent down slope surface waters, wetlands and roads from sediment flow due to runoff from a storm event.

6.3 Access Roads

In most instances, S.G. Interests I, Ltd. will need to construct a new segment of access road to each Construction Site. This is especially true for most drill site locations. Clearing vegetation and soil

materials will be limited to the required road alignment. Vegetation clearing and removal of topsoil should be limited to the road footprint and segregated from other material.

Access roads should be constructed with good drainage patterns. Sediment Control Devices, such as water bars and diversion channels, should be used to minimize erosion during construction of any new access road.

All new access roads will have water dispersal controls placed at all changes of slope. When the road is rehabilitated, the segregated topsoil will be used as a top coating for the seedbed.

6.4 Drill Site Locations

After each access road is constructed to the planned drill site location, the drill site will be constructed. This process involves leveling the location by using cut and fill construction techniques. The topography of each drill site location will dictate the amount of cut and fill needed. S.G. Interests I, Ltd. will attempt to spot each drill site location so that the cut and fill procedure and the associated surface disturbance are minimized.

Drill site locations will be designed to prevent water from entering or leaving the site. The pad will be sloped to drain spills and water into the reserve pit. The drill pad will be designed to disperse diverted overland flow and to regulate flow velocity so as to prevent or minimize erosion. Drill site diversion outlets will be equipped with rock energy brakes and gravel-bedded dispersion fans. Spills and leaks will be cleaned up to prevent pollution of surface or groundwater.

After each oil and gas well, or other Construction Site is completed, any disturbed area that is not needed for continuing operations will be reclaimed. Disturbed work areas will be graded to avoid creating a smooth, compacted surface.

6.5 Pipeline Corridor

Depending on the circumstances, S.G. Interests I, Ltd. may construct a gas gathering line or other pipeline for each oil and gas well it completes within the Common Plan of Development. A gas gathering line will generally be constructed along one side of the new access road constructed to the drill site location. Construction of a gas gathering line will generally require a 20 to 30-foot wide easement (pipeline corridor) that will generally parallel the existing access road.

Topsoil will be separately removed and segregated from other material within the pipeline corridor. Topsoil from the pipeline and/or utility easement will be windrowed along the uphill side of the road or stored in an approved manner. The pipeline trench will be dug to a sufficient depth below frost line to maintain sufficient cover over the pipeline.

Following installation of the pipeline, the soil within the pipeline corridor will be shaped to the pre-disturbance contour of the land. The windrowed topsoil will be distributed over the top of the pipeline corridor. The pipeline corridor will be re-vegetated based on a seed-mix recommended by the applicable governmental agency.

6.5.1 Pipeline Construction – Trenching and Laying the Pipe

Pipeline trenching techniques will be used to reduce erosion and sediment transport and to protect topsoil resources. In areas that do not require grading, a double-trenching procedure may be utilized and will

require segregation of topsoil from trench spoils. Topsoil will be removed and stored separately. Whenever possible, trench spoils will be stockpiled on the non-working side of the pipeline corridor. The trench spoils will be stockpiled adjacent to, but separately from the topsoil. During construction, gaps will be spaced at suitable intervals in the spoil and topsoil piles to avoid soil being discharged into streams and waterways.

Spoil materials excavated from the trench will be stored next to the trench where feasible, to facilitate using a minimum amount of the corridor, and to protect the material from vehicular and equipment traffic. Typically spoil materials will be placed on the upslope side of the trench to prevent surface water run-off from entering the trench.

S.G. Interests I, Ltd. will use BMPs for laying and burying all pipeline projects. Removal of solid rock from the pipeline trench may require the use of a hydraulic chisel or a rock saw. Where these procedures do not prove effective in rock removal, controlled blasting may be implemented. All blasting operations shall comply with all state and federal regulations.

Trench plugs will be placed within the ditch on steep slopes to control the movement of water along trench line.

6.5.2 Pipeline Construction – Backfilling the Trench

Backfilling procedures will incorporate techniques to protect the pipeline and coating from damage, to salvage topsoil, and to prevent erosion of backfill material. After the pipeline has been installed, the pipeline will be covered with spoil. After the trench has been backfilled to ground level, the backfill will be compacted using BMPs. Excess spoils from the pipeline trench will be spread evenly across graded portions of the pipeline corridor or transported to other areas needing additional fill.

Topsoil will not be used for padding or backfill. Topsoil will remain segregated during backfilling operations. Topsoil will be spread across the surface of the pipeline corridor as the final step of the backfilling procedure. The topsoil will facilitate the regeneration of grasses and plants as part of the final stabilization of the pipeline corridor.

6.6 Stream Crossings – Access Road or Pipeline Construction

The following special construction techniques will be followed in the event an access road or pipeline corridor needs to cross a stream.

All attempts will be made to avoid wetland and riparian areas. If disturbance to these areas is unavoidable, the clearing and installation operations will be limited to as narrow a disturbance as possible to minimize the effects. Approaches to streams will involve selective clearing of vegetation. Any trees cleared during construction will be reestablished as part of reclamation.

Extra workspace areas used for crossing creeks and highways and other special sites will be restored to approximate pre-construction conditions.

6.6.1 Dry or Flowing Stream Bed Crossing Procedure

In the event that a dry or flowing stream must be crossed for pipeline installation, the stream and any adjacent riparian zones will be subject to a trenched crossing.

Construction machinery will be properly cleaned and fueled outside of the streambed area prior to construction. If possible, construction will be accomplished during a seasonal period when there is generally low flow.

Sediment barriers will be installed across the pipeline corridor on either side of a stream bank, approximately 50 feet upland to the waterway. A 50-foot vegetative buffer will be maintained until actual stream-crossing construction begins, except where a crossing for vehicles and construction equipment is placed. The degree of grading and the width of corridor disturbance will be minimized along the stream bank.

Stream bank topsoil (sod) will be removed and stockpiled behind an earthen berm (or similar structure) in the adjacent upland area within the pipeline corridor or at an expanded staging area. Additional workspace may be needed adjacent to the waterway for staging equipment and materials. Channel contours and configuration will not be changed except in the case of bank contouring for stabilization purposes.

Excavated material and construction debris will not be placed in any stream channel or in flowing waters. Excess materials will be placed at an upland site well away from any stream channel. Materials used for or derived from construction, bedding, and/or excavation will not be stockpiled in a riparian or stream channel area.

6.6.2 Restoration for a Stream Crossing

Construction equipment and debris will be removed from the streambed and banks. Streambeds and banks will be restored to approximate pre-construction contours. Stream bank topsoil will be replaced. Stream banks will be seeded and mulched, as needed. Suitable erosion control materials such as riprap will be utilized to anchor stream bank areas with unstable soils.

If an access road or pipeline corridor crosses a stream, the banks of the stream will be stabilized to prevent erosion. Riprap or similar type material will be installed along stream banks subject to stream-flow erosion and generally where stream banks have a slope steeper than 2:1. Riprap will be placed from the streambed to the top of the stream bank. The riprap will be of sufficient size to prevent transport by the stream flow.

Loose earth and debris will be removed from drainages and floodplains. Earth and debris will not be stockpiled on drainage banks.

6.7 Reseeding and Seed Mixture

Whenever possible, seed should be planted using a drill equipped with a depth regulator to facilitate planting the seed at the optimum depth. If seed drilling is not possible, seed should be broadcast and the area raked or chained to cover the seed. When broadcasting the seed, the rate of seed application in pounds per acre should be increased by 50 percent.

Prior to reseeding, all disturbed areas, including access roads will be scarified and left with a rough surface. Seedbed preparation will be considered complete when the soil surface is completely rough.

Broadcast seeding will occur on steep terrain and on areas that are impracticable for drilling. Where broadcast seeding occurs, it will be harrowed or raked following application.

The recommended seed mixture should be planted in the fall (September to November) immediately after the topsoil is replaced.

Seed mixture(s) will be planted in the amount specified in pounds of pure live seed per acre, where necessary. There will be no noxious weed seed in the seed mixture. Commercial seed will be either certified or registered seed.

6.8 Post Construction Controls

Sediment Control Devices placed at each Construction Site during construction activities will remain in place until full stabilization is achieved at each Construction Site. Drainage structures (e.g. culverts, drainage dips, and water bars) constructed along an access road will remain in place for storm water management control until S.G. Interests I, Ltd. no longer needs to use the Construction Site.

All disturbed areas will be re-contoured to replicate the natural slope. When a disturbed area is being recontoured, care should be taken to avoid disturbing additional vegetation. Drainage control will be implemented as necessary to avoid soil erosion.

All vegetation and Sediment Control Devices and other protective devices will be maintained, repaired, or restored as necessary while the Construction Site is subject to this SWMP.

7.0 RECEIVING WATERS

Numerous small creeks (Little Henderson Creek, Baldy Creek, Gooseberry Creek, Deadhorse Creek, Coal Creek, Henderson Creek, Spring Creek, and Drift Creek) flow from the northwest and the northern portion of the Common Plan of Development into East Muddy Creek. Several smaller creeks flow from the east central portion of the Common Plan of Development into Lee Creek, which in turn empties into East Muddy Creek toward the southern end of the land area included in the Common Plan of Development. At a point roughly six miles south of the Common Plan of Development, East Muddy Creek flows into Paonia Reservoir.

Paonia Reservoir is located roughly 15 miles northeast of Paonia, Colorado in the northern portion of Gunnison County.

8.0 EXISTING VEGETATIVE GROUND COVER AND RUNOFF COEFFICIENT

The climate in the Common Plan of Development is generally dry, with an average annual precipitation of 15 inches. Winter precipitation is mostly in the form of snowfall. Existing vegetative ground cover at the different Construction Sites subject to this SWMP ranges from a low of approximately 20% to a high of roughly 45% to 55%. These percentages generally indicate marginal ground cover due to fairly low and sporadic rainfall. In the case of the Construction Sites identified in this SWMP, the limited vegetative ground cover is also commonly associated with dry climate zones typical of the southwestern United States.

The percentage of existing vegetative ground cover is important for determining when East Resources, Inc. has fully satisfied land stabilization requirements imposed by CWQCD at each Construction Site so that the site may be deemed fully stabilized and may thus be removed from the list of Construction Sites subject to this SWMP. The various methods for determining full stabilization of the disturbed surface area at each Construction Site are highlighted in Article 12 of this SWMP.

The relatively low runoff coefficient (less than 0.15) that exists at the Construction Sites identified in this SWMP is typical of generally flat or average sloping lands with 20% - 55% ground cover.

9.0 NOTICE TO CONTRACTORS THAT WILL DISTURB THE SURFACE AREA AT A CONSTRUCTION SITE

S.G. Interests I, Ltd. will provide a copy of this SWMP to each contractor or sub-contractor that will disturb surface lands (such as the contractor hired to construct any access road, a pipeline contractor, etc.) at any Construction Site covered by this SWMP. During drilling operations, S.G. Interests I, Ltd. will also post a copy of this SWMP at the drill site location for each oil and gas well covered by this SWMP. S.G. Interests I, Ltd. will review this SWMP with each contractor that will disturb surface lands at a Construction Site, and it will advise each contractor that the work it performs at the Construction Site must be consistent with the procedures listed in this SWMP. The contractors shall agree to follow the BMPs and procedures listed in this SWMP to minimize erosion and implement effective storm water control measures at each Construction Site.

10.0 INSPECTION AND MAINTENANCE

S.G. Interests I, Ltd. shall be responsible for implementing and maintaining compliance with this SWMP. Maintenance of the Sediment Control Devices will be performed based on periodic inspections conducted at each Construction Site.

Sediment Control Devices are designed to retain sediment within the Construction Site to the maximum extent possible. All Sediment Control Devices installed at each Construction Site subject to this SWMP will be maintained in proper working order until the Construction Site is fully stabilized. If site inspections indicate that BMPs are not operating effectively, maintenance will be performed promptly to ensure effective erosion control. Sediment will be removed from any sediment traps when capacity is reduced to fifty percent of the original volume.

10.1 Inspection Procedures

Visual inspection will be used to ensure that the Sediment Control Devices installed at each Construction Site are maintained in good and effective operating condition. If, during an inspection, it is determined that any measurable quantity of sediment has been blown or washed from the Construction Site, S.G. Interests I, Ltd. shall re-claim the sediment that was blown or washed from the Construction Site. Corrective action shall be taken within 24 hours of the discovery, or as soon as weather and/or ground surface conditions will allow.

10.1.1 Active Construction Site

The term, Active Construction Site is defined in Article 2.1 of this SWMP. In February, 2006, the Colorado Water Quality Control Division issued a "Stormwater Fact Sheet" (attached hereto as Exhibit E)

for review and use by oil and gas operators drilling oil and gas wells in Colorado. The Water Quality Control Division stated in the Stormwater Fact Sheet that the Sediment Control Devices installed at any Active Constructive Site need to be inspected at least “once every 14 days and after any precipitation or snowmelt event that causes surface erosion”.

10.1.2 Completed Construction Site

The term, Completed Construction Site is defined in Article 2.3 of this SWMP. The Water Quality Control Division stated in the Stormwater Fact Sheet (attached hereto as Exhibit E) that the Sediment Control Devices installed at any Completed Constructive Site need to be inspected “at least once every month”. A critical component of a Completed Construction Site is that it has been reseeded, but not been fully stabilized as described in Article 12 of this SWMP. Until such time as the surface land has been fully stabilized, a Completed Construction Site needs to be inspected once every month.

10.2 Inspection Requirements - Severe Weather Exception

If any inspection is not possible due to severe weather or other dangerous conditions, the inspection report must document why the inspection did not occur, and the inspection must be conducted as soon as improved weather conditions will allow.

10.3 Inspection Requirements – Sustained Snow Cover

The Water Quality Control Division stated in the Stormwater Fact Sheet (attached hereto as Exhibit E) that inspections of Sediment Control Devices are not required at Construction Sites if snow cover exists over the entire Construction Site for an extended period and melting conditions do not exist. This relaxed inspection requirement shall only apply when the snow cover is not melting. The fact that the surface area of a Construction Site has sustained snow cover should be noted in the inspection report filed for that particular Construction Site so that the inspection report will reflect that an attempt was made to inspect each such Construction Site in a timely manner.

10.4 Record Keeping

Qualified personnel responsible for the inspection and maintenance of the Sediment Control Devices shall keep records of the following items:

- An uncontrolled release of mud or muddy water or measurable quantities of sediment found off site. The inspector shall include a brief explanation identifying the action taken to prevent future releases as well as any clean up measures taken to re-claim sediment that has left the Construction Site.
- The Sediment Control Devices shall be examined to determine if they are functioning properly or in need of repair. Any deficiencies of structural controls or practices will be corrected promptly, before the next regular inspection. The inspector shall write a brief description of the action taken to correct any problems.

Following each inspection, the inspector shall complete an Inspection Report similar to the one attached to this SWMP as **Appendix A**.

S.G. Interests I, Ltd. shall retain a copy of each completed Inspection Report and a copy of each completed Corrective Action Report at the Construction Site or central field location for a minimum of three years after a Construction Site has been converted to a Completed Construction Site, as such term is defined in Article 2.3 of this SWMP.

10.5 Modification of an Existing Sediment Control Device

If the inspector determines that an existing Sediment Control Device is not working properly and needs to be modified in some way, then the inspector shall note the corrective action that is necessary on a form similar to the Corrective Action Report attached to this SWMP as **Appendix B**.

11.0 CONSTRUCTION SITES – GENERAL CONTROLS

The following controls focus on reducing the contact of storm water with lubrication oils, hydraulic fluids, cutting oils, paints, solvents, coolants, and other supplies commonly used in oil and gas operations. These control measures include material handling and spill prevention measures.

Petroleum products used at the Construction Site are most frequently associated with fueling and maintenance of construction equipment. Potential sources of pollution, such as chemicals and diesel vehicle fuel, should not be stored in large quantities at the Construction Site.

Fuel spills and leaks must be promptly cleaned up to prevent pollution of surface or groundwater. Spill control measures will be implemented in areas where potential spills can occur. The following controls shall be implemented during construction to minimize the potential for storm water to contact hazardous materials or wastes.

- Any salt or chemicals used in the mud system will be contained in the reserve pit.
- A trash container will be used for trash collection and containment. All garbage and non-flammable waste materials will be taken to an authorized county landfill area. All Construction Sites shall be kept litter free. No trash will be placed in the reserve pit.
- Sanitary sewage facilities (portable self-contained chemical toilets) will be located at appropriate work sites and at all drill site locations. Sanitary waste will be collected and disposed of at a licensed sewage disposal facility. No sewage will be buried, dumped or discharged to waters of the State or waters of the U.S.
- Storage areas, protected from storm water runoff, will be used to store minimum quantities of chemicals, paints, solvents, diesel fuel, lubricating oils, and other potentially toxic or hazardous materials. Good housekeeping practices will be used at each Construction Site. Chemical containers will be stored in areas having secondary containment to minimize the possibility of spills or leaks while accessing those materials.
- Any onsite contractor shall initiate additional environmental precautions if it lubricates equipment or fuels vehicles within 100 feet of any stream or wetland area. Chemicals, paints, solvents, fuels, lubricating oils, and other potentially toxic or hazardous materials shall be stored in secondary containment if located or temporarily stored within 100 feet of a stream or wetland area.

- All spills of liquid or dry materials will be promptly and safely removed from the Construction Site. Any spill of a toxic or hazardous material will be immediately reported to the appropriate company employee. A spill of a toxic or hazardous material will also be timely reported to the appropriate governmental agency if so required.
- Construction equipment and vehicles will be periodically inspected for leaks, and all repair work will be quickly handled before placing the equipment back in service. All equipment will be cleaned and inspected for leaks prior to entering a streambed, and no leaking equipment will be allowed within the streambed or within 100 feet of the streambed.
- Gravel areas will be installed, as needed, at access points connecting with a paved road, to minimize the tracking of mud, dirt or sediment onto the paved road.

12.0 FULL STABILIZATION OF A DISTURBED SURFACE AREA

When S.G. Interests I, Ltd. has fully stabilized the surface land disturbed at any Construction Site, it may drop the Construction Site from the list identified in Exhibit “A” of this SWMP by implementing the following action:

- 1) After it has fully stabilized the land, S.G. Interests I, Ltd. shall submit an Inactivation Notice to the CWQCD. The Inactivation Notice shall include the following data: i) the General Permit certification number, ii) the permittee’s name, address, and telephone number, iii) the name, location, and county where the Construction Site is located, and iv) a statement certifying that the surface land at the Construction Site has been fully stabilized, along with a description of the final stabilization methods.
- 2) Unless CWQCD requests additional information regarding the stabilization of the Construction Site, the surface land covered by the Inactivation Notice may be deleted from the list of Construction Sites identified in Exhibit “A” of this SWMP.

CWQCD has identified the following factors that S.G. Interests I, Ltd. may use to determine when it has satisfied CWQCD’s land stabilization requirements: i) uniform vegetation has been established at the Construction Site with a vegetation density of at least 70% of pre-disturbance levels, or, ii) the establishment of a vegetative cover capable of providing erosion control equivalent to pre-existing conditions at the Construction Site (i.e. prior to the time S.G. Interests I, Ltd. made the surface disturbance).

13.0 GENERAL LIMITATIONS ON STORM WATER DISCHARGES MADE UNDER THIS SWMP

The following limitations shall apply to all storm water discharges made under this SWMP:

- 1) Bulk storage structures for petroleum products and other chemicals shall have adequate protection so as to contain all spills and prevent any spilled material from entering waters of the State or waters of the U.S.
- 2) No chemicals shall be added to the water discharges under this SWMP unless CWQCD grants its permission to do so in writing.

- 3) During the construction of any facility used in conjunction with S.G. Interests I, Ltd.'s oil and gas operations under this SWMP, all building materials that are not completely used must be removed from the Construction Site for disposal in a licensed disposal operation. No building materials or supplies shall be buried, dumped or discharged at the Construction Site.
- 4) The off-site vehicle tracking of sediments shall be minimized whenever possible.
- 5) S.G. Interests I, Ltd. agrees to comply with the lawful requirements imposed by municipalities, County, drainage districts, and other local governmental agencies covering the discharge of storm water at each Construction Site, including erosion and sediment control regulations.

14.0 TRANSFER OF THIS SWMP

S.G. Interests I, Ltd. may transfer this SWMP along with a transfer of its Storm Water Discharge Permit issued by CWQCD by completing a required CWQCD transfer form and submitting the signed form to CWQCD for approval.

15.0 REVISIONS TO THIS SWMP

S.G. Interests I, Ltd. may revise this SWMP at any time it deems it necessary to do so. The Water Quality Control Division, in its Stormwater Fact Sheet (attached hereto as Exhibit E) states that the SWMP needs to be revised whenever a Sediment Control Device is not working effectively to minimize or eliminate sediment from being discharged off of the Construction Site. The specific language in question is found at the top of page 5 of Exhibit E and is quoted below:

“Any BMPs not operating in accordance with the SWMP must be fixed immediately. If modifications to the SWMP are deemed necessary, such as replacing an inadequate BMP with an alternate BMP, the SWMP must be revised and the BMPs modified as soon as practicable, but in no case more than 7 calendar days after the inspection”. [Emphasis added.]

Greystone does not believe that the main text of the SWMP needs to be modified if a BMP needs to be changed, added or replaced at a Construction Site. Greystone is therefore recommending that S.G. Interests I, Ltd. adopt the following simple procedure to address a change of a BMP at a specific Construction Site. S.G. Interests I, Ltd. shall implement the following procedure to modify this SWMP in the event a change needs to be made to one or more Sediment Control Devices (aka BMP) being used at a particular Construction Site:

- 1) S.G. Interests I, Ltd. will maintain a separate file folder for each Construction Site that is a part of this SWMP. The file will be identified by the name of the oil and gas well or other facility found at the site in question.
- 2) S.G. Interests I, Ltd. will comply with the periodic inspections that need to be conducted at each Construction Site. An inspection report (see **Appendix A**) shall be completed and signed by the party conducting the inspection. The inspection report shall be placed in the file folder for the specific Construction Site after the inspection is conducted.

- 3) If a Sediment Control Device needs to be changed at a Construction Site, S.G. Interests I, Ltd. will note on the Corrective Action Report (see Appendix B), the type of change that was made, the date it was made and the inspector or other party that made the change. The inspector will also note on a copy of the Exhibit D plat the change or changes that were made to the Sediment Control Devices at that Construction Site. The inspector will also state on the Exhibit D plat for that Construction Site, the specific date the change(s) were made to the Sediment Control Devices so that if the Water Quality Control Division (or its authorized representative) ever inspects the Construction Site, it can track the changes that were made to the Sediment Control Devices and it can verify the changes that were made to the SWMP for that specific Construction Site. The Corrective Action Report will be placed in the file folder for the Construction Site in question.
- 4) If S.G. Interests I, Ltd. follows this recommended procedure, there will be no need to modify the main text of this SWMP if the only change that needs to be made is specific to only one or a few of the Construction Sites subject to this SWMP. At the same time, the actual change made to this SWMP will be reflected in both the Inspection Report and the Corrective Action Report placed in the file folder for the specific Construction Site(s) in question.

16.0 FINAL WINDUP AND TERMINATION OF THIS STORM WATER MANAGEMENT PLAN

If S.G. Interests I, Ltd. reaches a point where there are no more Construction Sites subject to this SWMP, then S.G. Interests I, Ltd. may seek to terminate this SWMP, after first advising CWQCD, or its successor state agency, that S.G. Interests I, Ltd. has implemented full stabilization of the surface land at all Construction Sites and that it therefore intends to terminate this SWMP.

All facility structures and above ground equipment will be removed and the casing of all oil and gas wells shall be plugged and abandoned pursuant to requirements imposed by the Colorado Oil and Gas Conservation Commission (COGCC).

Access roads will be reclaimed in a manner consistent with state regulations imposed by the COGCC. Water bars and physical barricades may be used to facilitate reclamation. All pipelines and any underground utility lines will be abandoned in place.

17.0 VERIFICATION NOTICE AND EFFECTIVE DATE

This Storm Water Management Plan (Plan) was prepared by Greystone Environmental Consultants, Inc. (Greystone) and is signed by Gordon R. Palmer, as Project Manager for Greystone, to verify that the Plan was prepared prior to the date that Greystone submitted an application for a Storm Water Discharge Permit to the CWQCD covering S.G. Interests I, Ltd.'s oil and gas operations in Gunnison and Delta County, Colorado. The effective date of this Plan will be the date listed immediately below.


Gordon R. Palmer

Date: MARCH 6, 2006

EXHIBIT A - CONSTRUCTION SITES

Exhibit A – Construction Sites
Operator: SG Interests I, Ltd

Construction Site #: 24

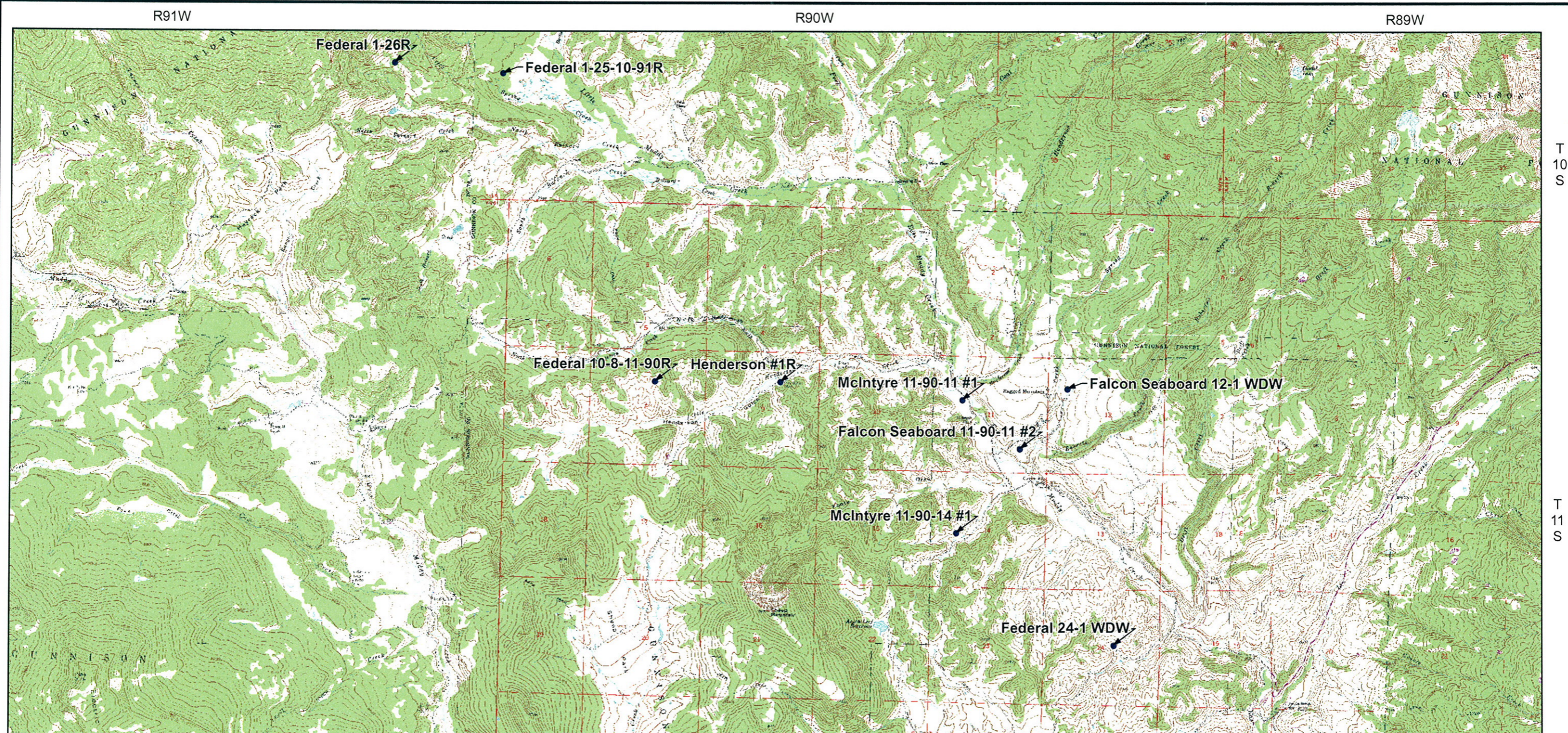
Name of Construction Site #: 24 McIntyre
Flowback Pit #1 and McIntyre Flowback Pit #2

Location of Construction Site #: 24

Township 11 South, Range 90 West 6th P.M.
Pit #1 SWNW Section 24; 2568 FNL, 93.9 FWL
Pit #2 NESE Section 23, 2523 FSL, 11.3 FEL

Gunnison County, Colorado

EXHIBIT B - GENERAL SITE MAP



● Proposed Drill Site Locations

Contour Interval: 20 feet

UTM Zone 13; 1927 North American Datum
USGS 7.5 Minute Quadrangles:
Spruce Mountain, Elk Knob, and Bull Mountain, Colorado



Effective Date: March 1, 2006

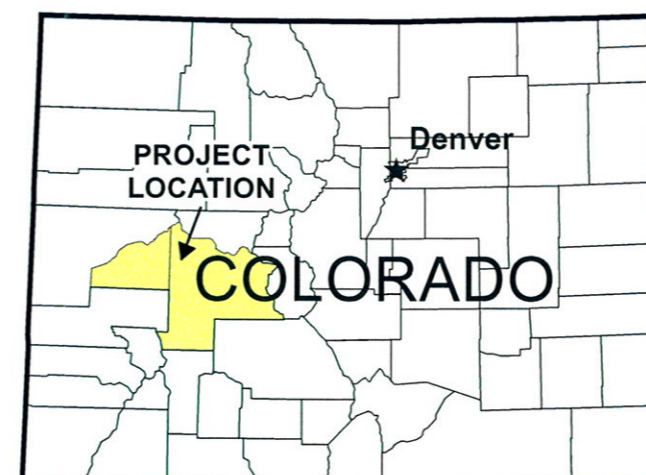


EXHIBIT "B" STORM WATER MANAGEMENT PLAN

GENERAL SITE MAP
OPERATOR: S.G. INTERESTS I, LTD.
COMMON PLAN OF DEVELOPMENT
GUNNISON AND DELTA COUNTIES, COLORADO

Analysis Area: Gunnison and Delta Counties, CO T10-11S, R90-91W

Date Completed: 03/08/06

File: SGInterests_B_11x17.mxd

Map/Data: KW - Review: GP

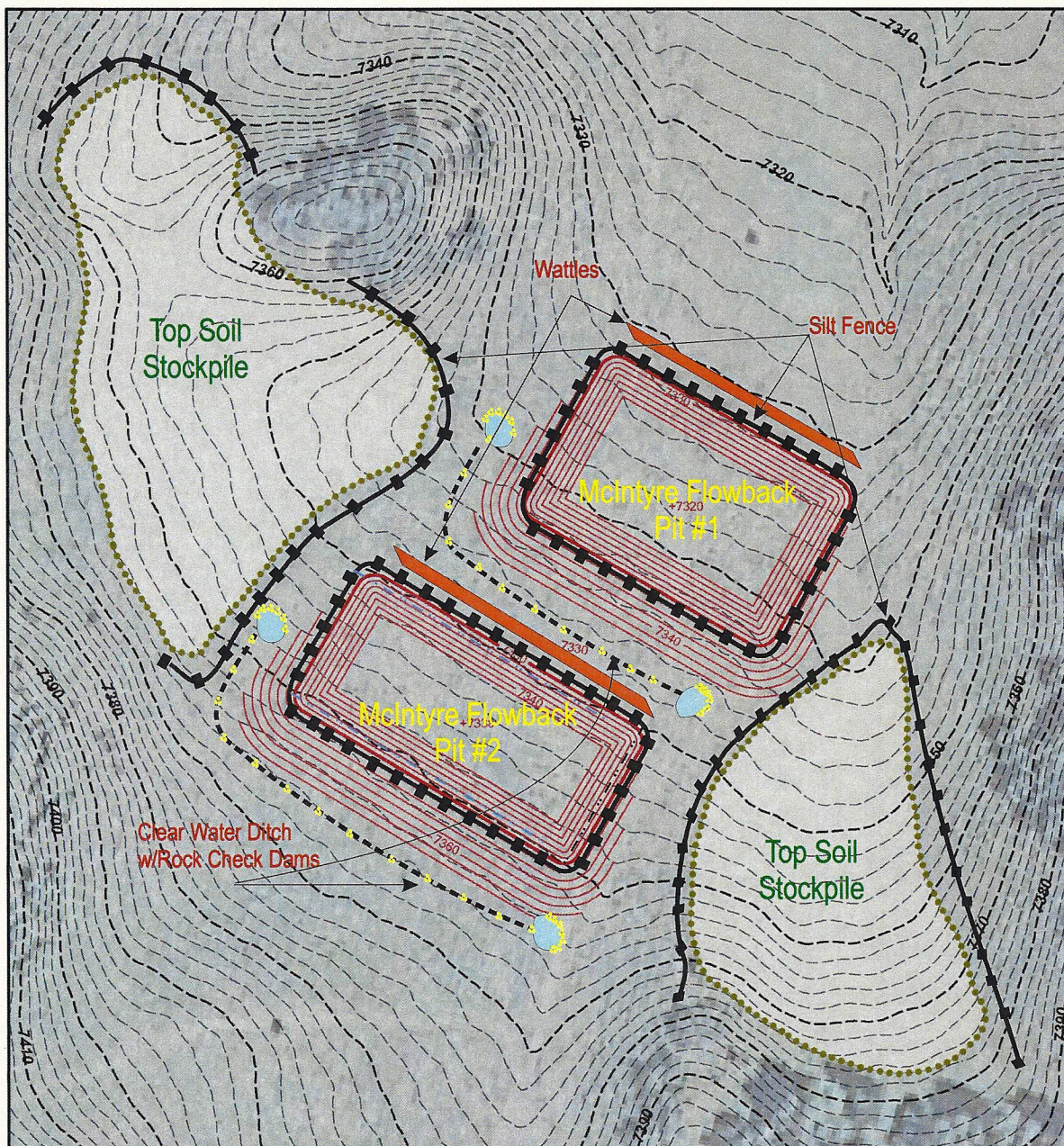
Print: SGInterests_B_11x17.pdf

**EXHIBIT C – SURFACE ACREAGE DISTURBANCE AT EACH
CONSTRUCTION SITE**




**EXHIBIT D – PLAT SHOWING LOCATION OF THE SEDIMENT
CONTROL DEVICES AT THE CONSTRUCTION SITE**

McIntyre Flowback Pits #1 and #2

Proposed Stormwater Management Layout



LEGEND

-  Proposed Contour
-  Existing Contour
-  Proposed Soil Pile

Note:

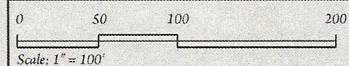
Existing 2-ft surface contours interpolated from LIDAR base data. LIDAR data acquired in November 2008 with 1-meter posting resulting in < 6 in. vertical RMSE (Root Mean Square Error).

Disclaimer:

This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information. The maps are distributed "AS-IS" without warranties of any kind, either expressed or implied, including but not limited to warranties of suitability to a particular purpose or use.

McIntyre Pits

Site Plan with BMPs



Prepared By: ZDP
Prepared For: SG Interests, Ltd.
Contour Interval: 2 ft.

Sedimentation Basin with two - 24" CMP outlets. Daylight to natural channel

Daylight Line Staging Area

24" CMP Culvert @ 10% grade. Install adjustable closure slide gates on CMP at inlet. Riprap discharge outlet area. Flow capacity = 29 cfs each.

Tributary Drainage Area = 10.72 acres
Pit 1 & 2 Surface Area = 1.79 acres
Net Drainage Area = 8.98 Acres

V-shaped borrowditch (typ.) diversion channel 18" deep with 2H:1V side slopes. Flow capacity = 27 cfs.

Edge of Proposed Staging Area

Extend synthetic liner 12" above finished pad grade around perimeter of all pits. (typ.).

Pump

Manifold

Proposed Flowback Pit #1

Proposed Flowback Pit #2

24" CMP Culvert @ 2% minimum grade

10' Buffer Zone

Daylight Line Flowback Pit

Perimeter Fencing

Trapezoid shaped diversion channel 2 ft deep with 3 ft wide bottom and 2H:1V side slopes. Flow capacity = 82 cfs.

Daylight Line Flowback Pit

24" CMP Culvert @ 2% minimum grade

Trapezoid shaped diversion channel 2 ft deep with 2 ft wide bottom and 2H:1V side slopes

Pit 1: 130'x200'x12'
(8,377 cy. / 40,284 bbls.)
Pit 2: 110'x230'x12'
(7,959 cy. / 38,275 bbls.)

Note: No wells located on staging pad. Meter houses are located on the individual well pads.

Estimated Dirt Quantities (cy)

ITEM	CUT		FILL	EXCESS
	SUBSOIL	TOPSOIL		
Pit 1	14,169	1,041		15,210 (C)
Pit 2	13,860	1,057		14,917 (C)
Staging		2,687	28,029	25,342 (F)
TOTAL	28,029	4,785	28,029	4,785 (C)

Notes:

1. Subsoil from pits cuts (28,029 cy.) used to create staging area.
2. Topsoil (4,785 cy.) stored in separate pile from staging area.
3. Topsoil volumes based on 8" soil depth.
4. Total Disturbed Area = +/- 4.0 Ac.

SCALE: 1" = 100'
DATE: 10.22.2010



SG Interests

PO Box 26
Montrose, CO 81402
970-252-0696

Bull Mountain Unit

T. 11 S, R. 90 W, Sections 23 & 24

McIntyre Flowback Pits 1 & 2

CONSTRUCTION LAYOUT

Attachment H

Water Analysis Reports

State of Colorado
Oil and Gas Conservation Commission

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



FOR OGCC USE ONLY

SOURCE OF PRODUCED WATER FOR DISPOSAL

This form must be completed for any new disposal site and for any change in sources of produced water for an existing disposal site.

**Complete the
Attachment Checklist**

OGCC Operator Number: _____	Contact Name and Telephone: _____
Name of Operator: _____	_____
Address: _____	No: _____
City: _____ State: _____ Zip: _____	Fax: _____

OGCC Disposal Facility Number: _____	
Operator's Disposal Facility Name: _____	Operator's Disposal Facility Number: _____
Location (QtrQtr, Sec, Twp, Rng, Meridian): _____	
Address: _____	
City: _____	State: _____ Zip: _____ County: _____

Oper		OGCC
Chemical Analysis of fluid		

If more space is required,
attach additional sheet.

Add Source: OGCC Lease No: _____ API No: _____ Well Name & No: _____
Operator Name: _____ Operator No: _____

Delete Source: Location: QtrQtr: _____ Section: _____ Township: _____ Range: _____ Producing Formation: _____
Analysis Attached? Yes No Transported to disposal site via: Pipeline Truck TDS: _____

Add Source: OGCC Lease No: _____ API No: _____ Well Name & No: _____
Operator Name: _____ Operator No: _____

Delete Source: Location: QtrQtr: _____ Section: _____ Township: _____ Range: _____ Producing Formation: _____
Analysis Attached? Yes No Transported to disposal site via: Pipeline Truck TDS: _____

Add Source: OGCC Lease No: _____ API No: _____ Well Name & No: _____
Operator Name: _____ Operator No: _____

Delete Source: Location: QtrQtr: _____ Section: _____ Township: _____ Range: _____ Producing Formation: _____
Analysis Attached? Yes No Transported to disposal site via: Pipeline Truck TDS: _____

Add Source: OGCC Lease No: _____ API No: _____ Well Name & No: _____
Operator Name: _____ Operator No: _____

Delete Source: Location: QtrQtr: _____ Section: _____ Township: _____ Range: _____ Producing Formation: _____
Analysis Attached? Yes No Transported to disposal site via: Pipeline Truck TDS: _____

Add Source: OGCC Lease No: _____ API No: _____ Well Name & No: _____
Operator Name: _____ Operator No: _____

Delete Source: Location: QtrQtr: _____ Section: _____ Township: _____ Range: _____ Producing Formation: _____
Analysis Attached? Yes No Transported to disposal site via: Pipeline Truck TDS: _____

Add Source: OGCC Lease No: _____ API No: _____ Well Name & No: _____
Operator Name: _____ Operator No: _____

Delete Source: Location: QtrQtr: _____ Section: _____ Township: _____ Range: _____ Producing Formation: _____
Analysis Attached? Yes No Transported to disposal site via: Pipeline Truck TDS: _____

I hereby certify that the statements made in this form are, to the best of my knowledge, true, correct, and complete.

Print Name: _____ Signed: _____

Title: _____ Date: _____

OGCC Approved: _____ Title: _____ Date: _____

CONDITIONS OF APPROVAL, IF ANY:

WELL NAME	SAMPLE ID	API NUMBER	RESERVOIR	LOCATION						TRANSPORT METHOD	TDS (mg/L)
				Q/Q	Sec	Town.		Range.			
Federal 11-90-24 #1	410-002	05-051-06057	CAMEO	NWSE	24	11	S	90	W	Pipe	11,350.0
Jacobs 29-1	Jacobs 29-1	05-051-06042	WILLIAMS FORK-CAMEO	NWNW	29	11	S	89	W	Pipe	4,275.0
Federal 11-90-15 #1	Federal 15-1	05-051-06085	MANCOS	SESW	15	11	S	90	W	Pipe	0.0
Henderson 1-R	Henderson/ Aug0808.00 1-1	05-051-06066	CAMEO	SWNE	9	11	S	90	W	Pipe	21,955.7
Federal C-10-8-11-90R	WA- 36131/Aug0 808.001-5	05-051-06068	WILLIAMS FORK	SWNE	8	11	S	90	W	Pipe	16,410.0
Federal 1-26R	Aug0808.00 1-4/1-26R	05-029-06094	CAMEO	SESE	26	10	S	91	W	TRUCK	21,701.5
Federal 1-25-10-91R	Aug0808.00 1-3/1-25R	05-051-06067	WILLIAMS FORK	SESE	25	10	S	91	W	TRUCK	24,334.0
McIntyre 11-90-14 #1	McIntyre	05-051-06062	CAMEO	NWSW	14	11	S	90	W	PIPE	10,545.0

red values are averages

Green Analytical Laboratories, Inc.
75 Suttle Street
Durango, CO 81303

Federal 11-90-24 #1

API# 05-051-06057

Sagle & Schwab
PO Box 2677
Durango, CO 81302
Attention: Bob Sagle / Marcia Stewart

GAL I.D.: 410-002-01

Date Received: 10/01/04

Date Reported: 11/04/04

QC Batches:

PROJECT NAME:

PROJECT NUMBER:

SAMPLE I.D.: Cameo

Sample Date: 09/30/04

Sample Matrix: Water

Laboratory Report

RESULTS

PARAMETER	METHOD	REPORT		DIL	UNITS
		LIMIT	RESULT		
Alkalinity as CaCO ₃	2320B	10	2840	1	mg/L
Bicarbonate as CaCO ₃	2320B	10	2840	1	mg/L
Carbonate as CaCO ₃	2320B	10	<10	1	mg/L
Hydroxide as CaCO ₃	2320B	10	<10	1	mg/L
Calcium, dissolved	200.7	0.5	76.4	1	mg/L
Chloride	4500Cl	10	5600	1	mg/L
Conductivity	2510B	1.0	23800	1	uS/cm
Iron, total	200.7	0.05	2.62	1	mg/L
Magnesium, dissolved	200.7	0.5	12.9	1	mg/L
pH	150.1	NA	7.78	NA	SU
Potassium, dissolved	200.7	0.5	122	1	mg/L
Resistivity	Calc.	NA	42	1	ohm/cm
Sodium, dissolved	200.7	0.5	3780	1	mg/L
Specific Gravity	Hydrometer	NA	1.009	NA	
Sulfate	4500SO ₄	10	<10	1	mg/L
TDS	2540C	10	12100	1	mg/L
Hardness, as CaCO ₃	Calc.	10	244	1	mg/L
CAB	Calc.	NA	8.52		%

D. Zupelt
For: John Green Laboratory Director

Green Analytical Laboratories, Inc.
75 Suttle Street
Durango, CO 81303

API # 05-051-06057

Sagle & Schwab
PO Box 2677
Durango, CO 81302
Attention: Bob Sagle / Marcia Stewart

GAL I.D.: 410-002-02

Date Received: 10/01/04

Date Reported: 11/04/04

QC Batches:

PROJECT NAME:

PROJECT NUMBER:

SAMPLE I.D.: V-Seam

Sample Date: 09/30/04

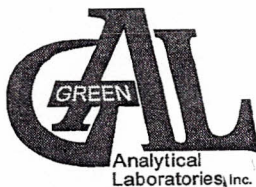
Sample Matrix: Water

Laboratory Report

RESULTS

PARAMETER	METHOD	REPORT			
		LIMIT	RESULT	DIL	UNITS
Alkalinity as CaCO ₃	2320B	10	3780	1	mg/L
Bicarbonate as CaCO ₃	2320B	10	3780	1	mg/L
Carbonate as CaCO ₃	2320B	10	<10	1	mg/L
Hydroxide as CaCO ₃	2320B	10	<10	1	mg/L
Calcium, dissolved	200.7	0.5	47.2	1	mg/L
Chloride	4500Cl	10	3930	1	mg/L
Conductivity	2510B	1.0	20100	1	uS/cm
Iron, total	200.7	0.05	2.16	1	mg/L
Magnesium, dissolved	200.7	0.5	10.0	1	mg/L
pH	150.1	NA	7.72	NA	SU
Potassium, dissolved	200.7	0.5	110	1	mg/L
Resistivity	Calc.	NA	50	1	ohm/cm
Sodium, dissolved	200.7	0.5	3490	1	mg/L
Specific Gravity	Hydrometer	NA	1.009	NA	
Sulfate	4500SO ₄	10	<10	1	mg/L
TDS	2540C	10	10600	1	mg/L
Hardness, as CaCO ₃	Calc.	10	159	1	mg/L
CAB	Calc.	NA	4.49		%

For: D. Zufelt
John Green, Laboratory Director



TIGHT HOLE

CHAIN OF CUSTODY RECORD

Page ____ of ____

Client: SG Interests.
Contact: KRIP SCHWAB
Address: Box 2677
D60, CO 81303
Phone Number: 970/259-2701
FAX Number: 970-385-1598.

NOTES:

- 1) Ensure proper container packaging.
- 2) Ship samples promptly following collection.
- 3) Designate Sample Reject Disposition.

PO# _____

Project Name: _____

Table 1. - Matrix Type

1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) _____

FOR GAL USE ONLY

GAL JOB #

409
410-002

Samplers Signature: _____

Lab Name: Green Analytical Laboratories, Inc. (970) 247-4220 FAX (970) 247-4227										Analyses Required								Comments	
Address: 75 Suttle Street, Durango, CO 81303																			
Sample ID	Collection		Collected by: (Init.)	Miscellaneous			Preservative(s)					APL							
	Date	Time		Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH							Other (Specify)	
01 1. CAMEO	9/30	AM	DD				X						X						Fax when complete
02 2. V-SEAM	9/30	PM	DD				X						X						
3.																			
4.																			
5.																			
6.																			
7.																			
8.																			
9.																			
10.																			
Relinquished by: <u>W. J. Schubert</u>			Date: <u>10/1/04</u>		Time:		Received by: <u>John Green</u>			Date: <u>10/01/04</u>		Time: <u>0900</u>							
Relinquished by:			Date:		Time:		Received by:			Date:		Time:							

* Sample Reject: [] Return [] Dispose [] Store (30 Days)

HALLIBURTON

Water Analysis Report

To: S & G Interests
Submitted by: Halliburton Energy Services
Attention: BOB SAGLE
Well Name: Jacobs 20-1
FX: 070-385-1698

Date: 12/2/2003
Date Rec: 12/1/2003
Report #: FLNR03856
Formation: Produced Water
2.8 hrs Flow

*Sample taken
dry Rig Release*

Specific Gravity	1.006	
pH	7.80	
Resistivity	2.43	@ 70° F
Iron (Fe)	0	Mg / L
Potassium (K)	0	Mg / L
Sodium (Na)	1356	Mg / L
Calcium (Ca)	20	Mg / L
Magnesium (Mg)	10	Mg / L
Chlorides (Cl)	1140	Mg / L
Sulfates (SO ₄)	0	Mg / L
Carbonates (CO ₃)	0.0	Mg / L
Bicarbonates (HCO ₃)	1740	Mg / L
Total Dissolved Solids	4275	Mg / L

Respectfully: Bill Loughridge

Title: Senior Scientist

Location: Farmington, NM

NOTICE: This report is limited to the described sample tested. Any person using or relying on this report agrees that Halliburton shall not be liable for any loss or damage whether due to act or omission resulting from such report or its use.

Schlumberger

Client: SG Interests
 Well: Federal 15-1
 Date: 1/8/2009
 Tested By: Joseph Eslinger

WATER ANALYSIS REPORT

Collection date	1/8/2009			
Temp (°F)	71			
pH	10.0			
Specific Gravity	1.014			
Chlorides (mg/l)	3550			
Iron (mg/l)	8			
Bicarbs (mg/l)	3538			
Carbonates (mg/l)	360			
Hydroxides (mg/l)	0			
Calcium (mg/l)	80			
Magnesium (mg/l)	288			
Sulfates (mg/l)	200			
Sodium (mg/l)	3313			
Potassium (mg/l)				
TDS (mg/l)	0			
Percentage Chloride	0.0			
Resistivity	0.00			

COMMENTS: Bacteria test - RLU = 29

HALLIBURTON

Halliburton Energy Services
The Rockies NWA District Laboratory
Grand Junction, CO 970) 523-3692

Water Analysis Report

Contact Information

Company S G Interests
Reported To astaley
Reported By Deba Shafiee

Date Received September 27, 2007
Date Tested September 27, 2007
Tested By Deba Shafiee

Sample 1 Physical Characteristics

Well Name Henderson Temperature 71 °F
Location 1 R 9/21/07 pH 7.7
Specific Gravity 1.031 Color Slight yellow
Corrected SG 1.033 at 60°F Turbidity moderate
TDS (calculated) 48966 ppm (48910 mg/L) Resistivity 0.42 Ω·m

Sample 1 Chemical Characteristics

Anions
Chloride 28000 mg/L
Sulfate 10 mg/L
Bicarbonate 940 mg/L
Carbonate 0 mg/L
Hydroxide 0 mg/L

Cations
Total Iron 15.0 mg/L
Ferrous Iron 0.3 mg/L
Potassium 8100 mg/L
Calcium 640 mg/L
Magnesium 240 mg/L
Sodium (calculated) 12539 mg/L

Water Analysis Report (cont.)

Sample 2 Physical Characteristics

Well Name	Henderson #1 <u>R</u>	Temperature	70 °F
Location	flowback tank	pH	7.9
Specific Gravity	1.024	Color	slight yellow
Corrected SG	1.026 at 60°F	Turbidity	moderate
TDS (calculated)	31111 ppm (31076 mg/L)	Resistivity	0.72 Ω·m

Sample 2 Chemical Characteristics

Anions	Chloride	16600 mg/L	Cations	Total Iron	2.2 mg/L
	Sulfate	10 mg/L		Ferrous Iron	0.5 mg/L
	Bicarbonate	680 mg/L		Potassium	8200 mg/L
	Carbonate	0 mg/L		Calcium	390 mg/L
	Hydroxide	0 mg/L		Magnesium	210 mg/L
				Sodium (calculated)	5350 mg/L

Sample 3 Physical Characteristics

Well Name	Henderson #1 <u>R</u>	Temperature	70 °F
Location	Reserve Pit	pH	7.5
Specific Gravity	1.03	Color	slight gray
Corrected SG	1.032 at 60°F	Turbidity	moderate
TDS (calculated)	16602 ppm (16602 mg/L)	Resistivity	7.1 Ω·m

Sample 3 Chemical Characteristics

Anions	Chloride	7600 mg/L	Cations	Total Iron	1.8 mg/L
	Sulfate	60 mg/L		Ferrous Iron	0.4 mg/L
	Bicarbonate	280 mg/L		Potassium	8600 mg/L
	Carbonate	0 mg/L		Calcium	170 mg/L
	Hydroxide	0 mg/L		Magnesium	150 mg/L
				Sodium (calculated)	mg/L

Water Analysis Report (cont.)

Sample 4 Physical Characteristics

Well Name	Federal 10-8 R	Temperature	70 °F
Location	Reserve pit	pH	8.2
Specific Gravity	1.019	Color	Pale yellow
Corrected SG	1.021 at 60°F	Turbidity	slight
TDS (calculated)	12210 ppm (12196 mg/L)	Resistivity	4.5 Ω·m

Sample 4 Chemical Characteristics

Anions	Chloride	3400	mg/L
	Sulfate	150	mg/L
	Bicarbonate	180	mg/L
	Carbonate	0	mg/L
	Hydroxide	0	mg/L

Cations	Total Iron	1.3	mg/L
	Ferrous Iron	0.1	mg/L
	Potassium	8400	mg/L
	Calcium	160	mg/L
	Magnesium	80	mg/L
	Sodium (calculated)		mg/L

General Comments

All Samples were filtered with 40 micron filter paper prior to the test for clarity.



Phone 505-334-0447 FAX 505-334-9530

104 Bison Trail, Aztec, NM 87410

WATER ANALYSIS REPORT

SAMPLE

Oil Co. : S&G Interest
Lease : Henderson
Well No.: 1R
Location: Water Holding Tank
Attention: Lynn Garner

Date Sampled : 8-1-08
Date Analyzed: 8-4-08
Lab ID Number: Aug0808.001- 1
Salesperson : Joe MacLaren
Requested By : Joe Oglesby
File Name : Aug0808.001

ANALYSIS

1. Ph 7.800
2. Specific Gravity 60/60 F. 1.015
3. CACO3 Saturation Index @ 80F @140F

Dissolved Gasses

4. Hydrogen Sulfide
5. Carbon Dioxide
6. Dissolved Oxygen

Cations

7. Calcium (Ca++)
8. Magnesium (Mg++)
9. Sodium (Na+) (Calculated)
10. Barium (Ba++)

Anions

11. Hydroxyl (OH-)
12. Carbonate (CO3=)
13. Bicarbonate (HCO3-)
14. Sulfate (SO4=)
15. Chloride (Cl-)
16. Total Dissolved Solids
17. Total Iron (Fe)
18. Manganese (Mn++)
19. Total Hardness as CaCO3
20. Resistivity @ 75 F. (Calculated)

0.819 Moderate
1.659 Severe

MG/L. EQ. WT. *MEQ/L

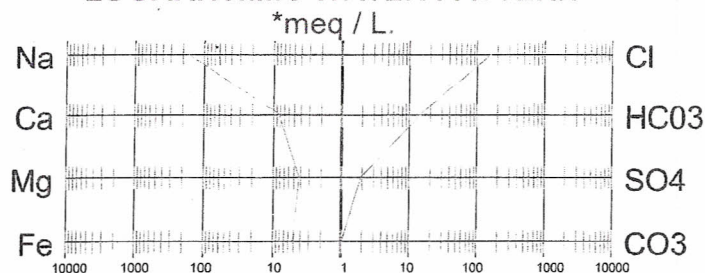
N.A.
N.A.
N.A.

160 / 20.1 = 7.96
49 / 12.2 = 4.02
3,654 / 23.0 = 158.87
0 / 68.7 = 0.00

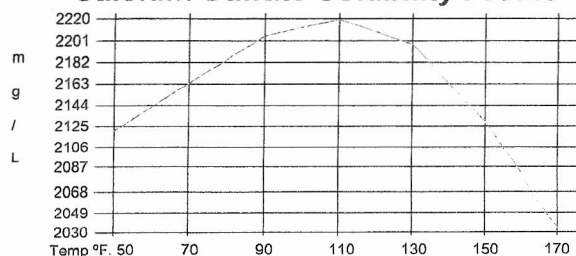
0 / 17.0 = 0.00
0 / 30.0 = 0.00
854 / 61.1 = 13.98
90 / 48.8 = 1.84
5,499 / 35.5 = 154.90
10,306
90.00 / 18.2 = 4.95
3.20 / 27.5 = 0.12
601

0.580 Ohm · meters

LOGARITHMIC WATER PATTERN



Calcium Sulfate Solubility Profile

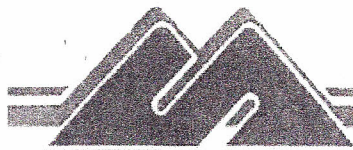


PROBABLE MINERAL COMPOSITION

COMPOUND	*meq/L	X	EQ. WT. =	mg/L.
Ca(HCO3)2	7.96		81.04	645
CaSO4	0.00		68.07	0
CaCl2	0.00		55.50	0
Mg(HCO3)2	4.02		73.17	294
MgSO4	0.00		60.19	0
MgCl2	0.00		47.62	0
NaHCO3	2.00		84.00	168
NaSO4	1.84		71.03	131
NaCl	154.90		58.46	9,056

* milliequivalents per Liter

Jason Hare, Analyst



SIERRA CHEMICALS L.C.

Phone 505-334-0447 FAX 505-334-9530

104 Bison Trail, Aztec, NM 87410

WATER ANALYSIS REPORT

SAMPLE

Oil Co. : S&G Interest
 Lease : Henderson
 Well No.: Water Transfer
 Location: Pump Discharge
 Attention: Lynn Garner

Date Sampled : 8-1-08
 Date Analyzed: 8-4-08
 Lab ID Number: Aug0808.001- 2
 Salesperson : Joe MacLaren
 Requested By : Joe Oglesby
 File Name : Aug0808.001

ANALYSIS

1. Ph 6.100
2. Specific Gravity 60/60 F. 1.019
3. CACO3 Saturation Index @ 80F
@140F

Dissolved Gasses

4. Hydrogen Sulfide
5. Carbon Dioxide
6. Dissolved Oxygen

Cations

7. Calcium (Ca++)
8. Magnesium (Mg++)
9. Sodium (Na+) (Calculated)
10. Barium (Ba++)

Anions

11. Hydroxyl (OH-)
12. Carbonate (CO3=)
13. Bicarbonate (HCO3-)
14. Sulfate (SO4=)
15. Chloride (Cl-)
16. Total Dissolved Solids
17. Total Iron (Fe)
18. Manganese (Mn++)
19. Total Hardness as CaCO3
20. Resistivity @ 75 F. (Calculated)

-1.081 Negligible
 -0.181 Negligible

MG/L. EQ. WT. *MEQ/L

N.A.

N.A.

N.A.

321 / 20.1 = 15.97

340 / 12.2 = 27.87

5,394 / 23.0 = 234.52

0 / 68.7 = 0.00

0 / 17.0 = 0.00

0 / 30.0 = 0.00

513 / 61.1 = 8.40

110 / 48.8 = 2.25

9,498 / 35.5 = 267.55

16,176

60.00 / 18.2 = 3.30

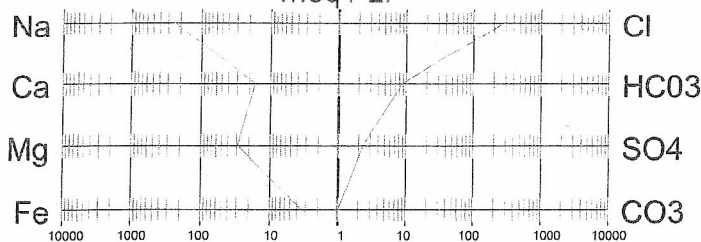
3.20 / 27.5 = 0.12

2,202

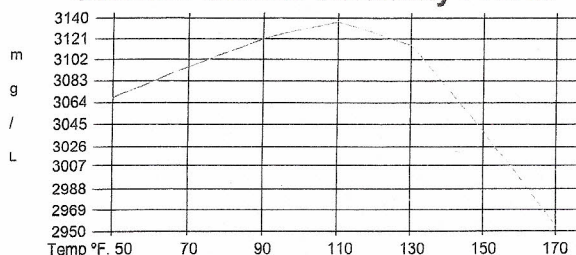
0.335 Ohm · meters

LOGARITHMIC WATER PATTERN

*meq / L.



Calcium Sulfate Solubility Profile



PROBABLE MINERAL COMPOSITION

COMPOUND	*meq/L	X	EQ. WT.	=	mg/L.
Ca(HCO3)2	8.40		81.04		680
CaSO4	2.25		68.07		153
CaCl2	5.32		55.50		295
Mg(HCO3)2	0.00		73.17		0
MgSO4	0.00		60.19		0
MgCl2	27.87		47.62		1,327
NaHCO3	0.00		84.00		0
NaSO4	0.00		71.03		0
NaCl	234.36		58.46		13,701

* milliequivalents per Liter

Jason Hare, Analyst

NOTICE: This report is for information only, and the content is limited to the sample described. Halliburton makes no warranties, expressed or implied, as to the accuracy of the contents or results. Any user of this report agrees Halliburton shall not be liable for any loss or damage, regardless of cause, resulting from the use hereof.

Water Analysis Report (cont.)

Sample 2 Physical Characteristics

Well Name	11-90-12-12-1 & 12-1A	Temperature	68 °F
Location	Falcon Seaboard	pH	7.07
Specific Gravity	1.01	Color	Slight Yellow
Corrected SG	1.012 at 60°F	Turbidity	Cloudy
TDS (calculated)	8775 ppm	Resistivity	0.58 Ω·m

Sample 2 Chemical Characteristics

Anions	Chloride	4800	mg/L	Cations	Total Iron	5.4	mg/L
	Sulfate	4	mg/L		Ferrous Iron	1.0	mg/L
	Bicarbonate	636	mg/L		Potassium	431	mg/L
	Carbonate	0	mg/L		Calcium	260	mg/L
	Hydroxide		mg/L		Magnesium	140	mg/L
					Sodium (calculated)	2531	mg/L

Sample 3 Physical Characteristics

Well Name	1R	Temperature	67 °F
Location	Henderson	pH	5.56
Specific Gravity	1.056	Color	Slight Yellow
Corrected SG	1.057 at 60°F	Turbidity	Cloudy
TDS (calculated)	18445 ppm (18424 mg/L)	Resistivity	0.54 Ω·m

Sample 3 Chemical Characteristics

Anions	Chloride	11600	mg/L	Cations	Total Iron	1.6	mg/L
	Sulfate	4	mg/L		Ferrous Iron	1.0	mg/L
	Bicarbonate	132	mg/L		Potassium	312	mg/L
	Carbonate	0	mg/L		Calcium	736	mg/L
	Hydroxide		mg/L		Magnesium	572	mg/L
					Sodium (calculated)	5462	mg/L

General Comments

McIntyre 11-90-14-1 was reserve pit water. Falcon Seaboard was production water. Henderson 1R was pit water.

HALLIBURTON

Halliburton Energy Services
 The Rockies NWA Regional Laboratory
 Grand Junction, CO 970) 523-3692

Water Analysis Report**Contact Information**

Company SG Interests
 Reported To Ann Staley
 Reported By Joel Snoke

Date Received March 21, 2008
 Date Tested March 21, 2008
 Tested By Ann Ekx, Joel Snoke

Sample Physical Characteristics

Well Name	<u>Fed</u>	Temperature	<u>73</u> °F
Location	<u>10-8R</u>	pH	<u>6.4</u>
Specific Gravity	<u>0.981</u>	Color	<u>Clear</u>
Corrected SG	<u>0.984</u> at 60°F	Turbidity	<u>None</u>
TDS (calculated)	<u>15909</u> ppm (<u>15890 mg/L</u>)	Resistivity	<u>5.85</u> Ω·m

Sample Chemical Characteristics

Anions

Chloride	<u>10400</u>	mg/L
Sulfate	<u>0</u>	mg/L
Bicarbonate	<u>508</u>	mg/L
Carbonate	<u>0</u>	mg/L
Hydroxide		mg/L

Cations

Total Iron	<u>0.4</u>	mg/L
Ferrous Iron	<u>0.0</u>	mg/L
Potassium	<u>40</u>	mg/L
Calcium	<u>2000</u>	mg/L
Magnesium	<u>2200</u>	mg/L
Sodium (calculated)	<u>458</u>	mg/L

General Comments

W051

NOTICE: This report is for information only, and the content is limited to the sample described. Halliburton makes no warranties, expressed or implied, as to the accuracy of the contents or results. Any user of this report agrees Halliburton shall not be liable for any loss or damage, regardless of cause, resulting from the use hereof.

WATER ANALYSIS REPORT

SAMPLE

Oil Co. : S&G Interest
Lease : Federal
Well No.: 10 # 8
Location: Water Holding Tank
Attention: Lynn Garner

Date Sampled : 8-1-08
Date Analyzed: 8-4-08
Lab ID Number: Aug0808.001- 5
Salesperson : Joe MacLaren
Requested By : Joe Oglesby
File Name : Aug0808.001

ANALYSIS

1. Ph 7.300
2. Specific Gravity 60/60 F. 1.022
3. CACO3 Saturation Index @ 80F
@140F

Dissolved Gasses

4. Hydrogen Sulfide
5. Carbon Dioxide
6. Dissolved Oxygen

Cations

7. Calcium (Ca++)
8. Magnesium (Mg++)
9. Sodium (Na+) (Calculated)
10. Barium (Ba++)

Anions

11. Hydroxyl (OH-)
12. Carbonate (CO3=)
13. Bicarbonate (HCO3-)
14. Sulfate (SO4=)
15. Chloride (Cl-)
16. Total Dissolved Solids
17. Total Iron (Fe)
18. Manganese (Mn++)
19. Total Hardness as CaCO3
20. Resistivity @ 75 F. (Calculated)

0.325 Mild
1.115 Moderate

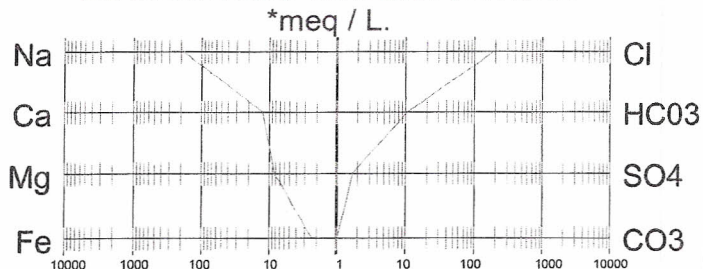
MG/L. EQ. WT. *MEQ/L

N.A.		
N.A.		
N.A.		
240	/ 20.1 =	11.94
97	/ 12.2 =	7.95
4,033	/ 23.0 =	175.35
0	/ 68.7 =	0.00

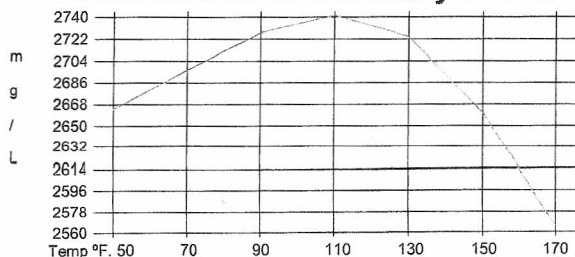
0	/ 17.0 =	0.00
0	/ 30.0 =	0.00
635	/ 61.1 =	10.39
80	/ 48.8 =	1.64
6,499	/ 35.5 =	183.07
11,584		
40.00	/ 18.2 =	2.20
1.40	/ 27.5 =	0.05

1,001
0.383 Ohm · meters

LOGARITHMIC WATER PATTERN



Calcium Sulfate Solubility Profile



PROBABLE MINERAL COMPOSITION

COMPOUND	*meq/L	X	EQ. WT. =	mg/L.
Ca(HCO3)2	10.39		81.04	842
CaSO4	1.55		68.07	105
CaCl2	0.00		55.50	0
Mg(HCO3)2	0.00		73.17	0
MgSO4	0.09		60.19	6
MgCl2	7.86		47.62	374
NaHCO3	0.00		84.00	0
NaSO4	0.00		71.03	0
NaCl	175.21		58.46	10,243

* milliequivalents per Liter

Jason Hare, Analyst

Multi-Chem Group, LLC

Multi-Chem Analytical Laborator

1553 East Highway 40

Vernal, UT 84078



Water Analysis Report

Production Company: **SG INTERESTS**

Sample ID: **WA-36131**

Well Name: **FEDERAL 10-8-11-90R TANK B**

Sample Point: **Prod. Tank**

Sample Date: **1 /15/2010**

Sales Rep: **Ron Gates**

Lab Tech: **John Keel**

Sample Specifics	
Test Date:	1/29/2010
Temperature (°F):	63
Sample Pressure (psig):	0
Specific Gravity (g/cm³):	1.0110
pH:	6.5
Turbidity (NTU):	-
Calculated T.D.S. (mg/L):	20805
Molar Conductivity (µS/cm):	31522
Resitivity (Mohm):	0.3172

Analysis @ Properties in Sample Specifics			
Cations	mg/L	Anions	mg/L
Calcium (Ca):	240.00	Chloride (Cl):	12000.00
Magnesium (Mg):	48.80	Sulfate (SO₄):	87.00
Barium (Ba):	69.00	Dissolved CO₂:	221.76
Strontium (Sr):	-	Bicarbonate (HCO₃):	561.20
Sodium (Na):	7509.00	Carbonate (CO₃):	-
Potassium (K):	-	H₂S:	1.00
Iron (Fe):	62.13	Phosphate (PO₄):	-
Manganese (Mn):	4.94	Silica (SiO₂):	-
Lithium (Li):	-	Fluoride (F):	-
Aluminum (Al):	-	Nitrate (NO₃):	-
Ammonia NH₃:	-	Lead (Pb):	-
		Zinc (Zn):	-
		Bromine (Br):	-
		Boron (B):	-

Test Conditions		Scale Values @ Test Conditions - Potential Amount of Scale in lb/1000bbl										
		Calcium Carbonate CaCO ₃		Gypsum CaSO ₄ · 2H ₂ O		Calcium Sulfate CaSO ₄		Strontium Sulfate SrSO ₄		Barium Sulfate BaSO ₄		Calculated CO ₂
		Sat Index	Scale	Sat Index	Scale	Sat Index	Scale	Sat Index	Scale	Sat Index	Scale	psi
Temp °F	Gauge Press. psi											
63	0	0.15	-0.96	0.01	-2569.70	0.01	-3097.90	-	-	173.43	115.22	3.52
80	0	0.23	-0.77	0.01	-4.49	0.01	-3046.00	-	-	117.43	114.20	1.43
100	0	0.32	-0.59	0.01	-3.23	0.01	-2860.60	-	-	75.92	112.48	1.82
120	0	0.42	-0.45	0.01	-2.38	0.01	-2579.80	-	-	50.18	110.07	2.07
140	0	0.54	-0.33	0.01	-1.78	0.01	-2245.10	-	-	33.83	106.87	2.36
160	0	0.67	-0.22	0.01	-1.37	0.01	-1892.10	-	-	23.23	102.80	2.70
180	0	0.80	-0.13	0.01	-1.07	0.02	-1548.00	-	-	16.21	97.84	3.00
200	0	0.92	-0.05	0.02	-0.86	0.02	-1230.70	-	-	11.47	91.97	3.08
220	2.51	1.03	0.02	0.02	-0.72	0.04	-966.24	-	-	8.06	84.85	3.15
240	10.3	1.14	0.08	0.02	-0.62	0.05	-725.22	-	-	5.83	76.92	3.23
260	20.76	1.22	0.13	0.02	-0.54	0.08	-524.78	-	-	4.26	67.87	3.32
280	34.54	1.29	0.17	0.02	-0.50	0.13	-362.44	-	-	3.14	57.52	3.42
300	52.34	1.34	0.20	0.02	-0.48	0.20	-234.31	-	-	2.33	45.67	3.52

Conclusions:

Calcium Carbonate scale is indicated. See graph for appropriate temperature ranges.

Gypsum Scaling Index is negative from 80°F to 300°F

Calcium Sulfate Scaling Index is negative from 80°F to 300°F

Strontium Sulfate scaling was not evaluated

Barium Sulfate scale is indicated at all temperatures from 80°F to 300°F

Notes:

Multi-Chem Group, LLC

Multi-Chem Analytical Laborator

1553 East Highway 40

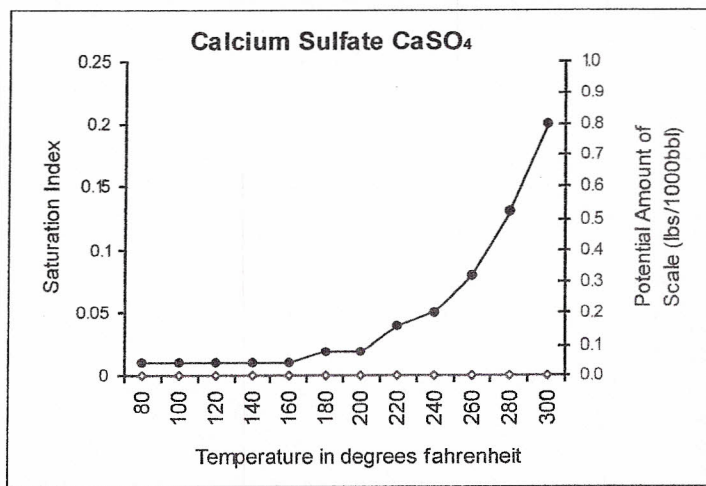
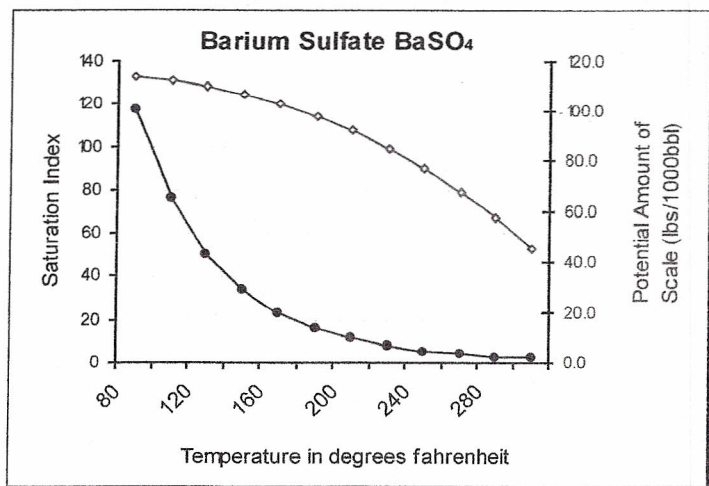
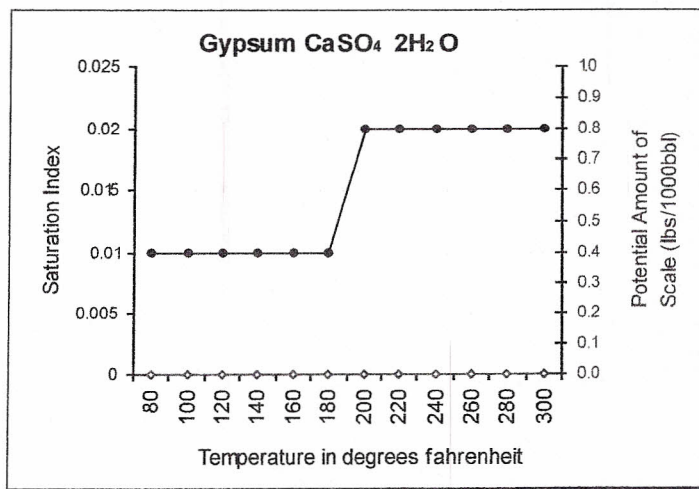
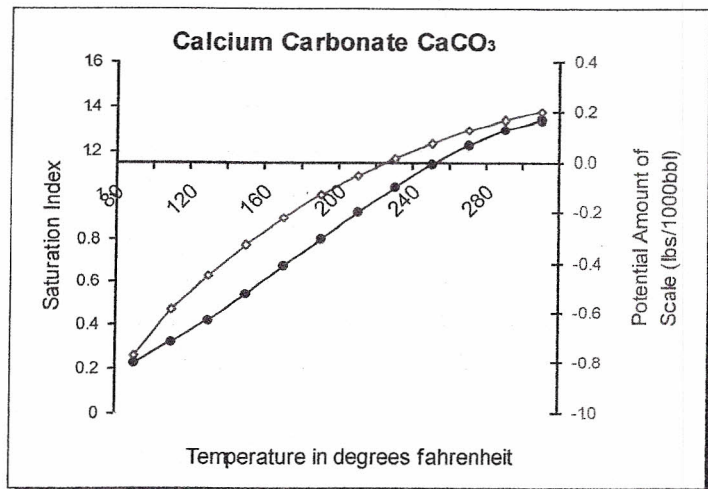
Vernal, UT 84078



Scale Prediction Graphs

Well Name: **FEDERAL 10-8-11-90R TANK B**

Sample ID: **WA-36131**

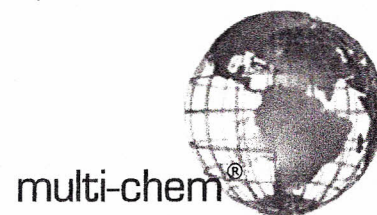


Multi-Chem Group, LLC

Multi-Chem Analytical Laborator

1553 East Highway 40

Vernal, UT 84078

**Water Analysis Report**Production Company: **SG INTERESTS**Sample ID: **WA-36133**Well Name: **FEDERAL 10-8-11-90R TANK A**Sample Point: **prod. Tank**Sample Date: **1/15/2010**Sales Rep: **Ron Gates**Lab Tech: **John Keel****Sample Specifics**

Test Date:	1/29/2010
Temperature (°F):	63
Sample Pressure (psig):	0
Specific Gravity (g/cm³):	1.0090
pH:	6.4
Turbidity (NTU):	-
Calculated T.D.S. (mg/L):	17360
Molar Conductivity (µS/cm):	26303
Resitivity (Mohm):	0.3802

Analysis @ Properties in Sample Specifics

Cations	mg/L	Anions	mg/L
Calcium (Ca):	200.00	Chloride (Cl):	10000.00
Magnesium (Mg):	-	Sulfate (SO ₄):	84.00
Barium (Ba):	24.00	Dissolved CO ₂ :	158.40
Strontium (Sr):	-	Bicarbonate (HCO ₃):	475.80
Sodium (Na):	6383.00	Carbonate (CO ₃):	-
Potassium (K):	-	H ₂ S:	0.50
Iron (Fe):	31.36	Phosphate (PO ₄):	-
Manganese (Mn):	2.72	Silica (SiO ₂):	-
Lithium (Li):	-	Fluoride (F):	-
Aluminum (Al):	-	Nitrate (NO ₃):	-
Ammonia NH ₃ :	-	Lead (Pb):	-
		Zinc (Zn):	-
		Bromine (Br):	-
		Boron (B):	-

Scale Values @ Test Conditions - Potential Amount of Scale in lb/1000bbl

Test Conditions		Calcium Carbonate CaCO ₃		Gypsum CaSO ₄ · 2H ₂ O		Calcium Sulfate CaSO ₄		Strontium Sulfate SrSO ₄		Barium Sulfate BaSO ₄		Calculated CO ₂
Temp °F	Gauge Press. psi	Sat Index	Scale	Sat Index	Scale	Sat Index	Scale	Sat Index	Scale	Sat Index	Scale	psi
63	0	0.08	-1.12	0.01	-2462.70	0.01	-2963.90	-	-	69.08	40.02	3.62
80	0	0.13	-0.94	0.01	-26.84	0.01	-2911.70	-	-	47.05	39.66	1.42
100	0	0.18	-0.77	0.01	-22.78	0.01	-2732.40	-	-	30.64	39.05	1.81
120	0	0.24	-0.63	0.01	-19.62	0.01	-2463.20	-	-	20.41	38.19	2.07
140	0	0.32	-0.52	0.01	-17.13	0.01	-2143.40	-	-	13.86	36.98	2.37
160	0	0.40	-0.42	0.01	-15.13	0.01	-1806.90	-	-	9.58	35.34	2.72
180	0	0.49	-0.34	0.01	-13.52	0.02	-1479.50	-	-	6.73	33.14	3.03
200	0	0.58	-0.27	0.02	-12.21	0.02	-1178.10	-	-	4.79	30.27	3.12
220	2.51	0.66	-0.21	0.02	-11.27	0.03	-926.61	-	-	3.37	26.30	3.21
240	10.3	0.75	-0.15	0.02	-10.39	0.05	-698.30	-	-	2.45	21.51	3.30
260	20.76	0.83	-0.10	0.02	-9.67	0.08	-508.47	-	-	1.79	15.56	3.40
280	34.54	0.90	-0.06	0.02	-9.07	0.12	-354.54	-	-	1.32	8.26	3.51
300	52.34	0.96	-0.02	0.02	-8.58	0.20	-232.56	-	-	0.98	-0.57	3.62

Conclusions:

Calcium Carbonate Scaling Index is negative from 80°F to 300°F

Gypsum Scaling Index is negative from 80°F to 300°F

Calcium Sulfate Scaling Index is negative from 80°F to 300°F

Strontium Sulfate scaling was not evaluated

Barium Sulfate NO CONCLUSION

Notes:

Multi-Chem Group, LLC

Multi-Chem Analytical Laborator

1553 East Highway 40

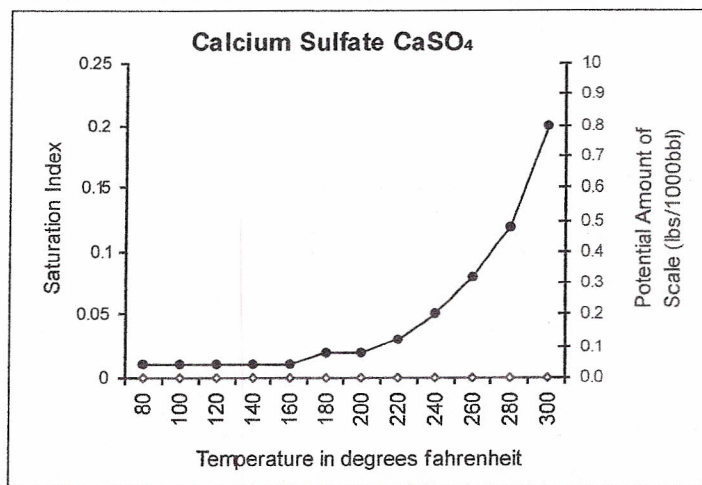
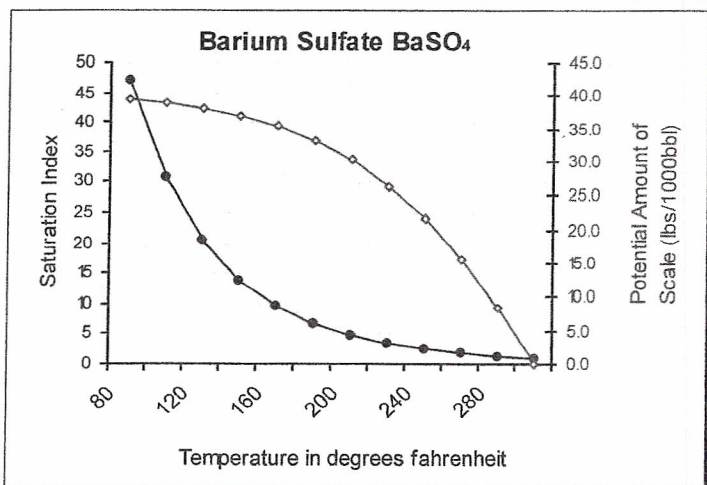
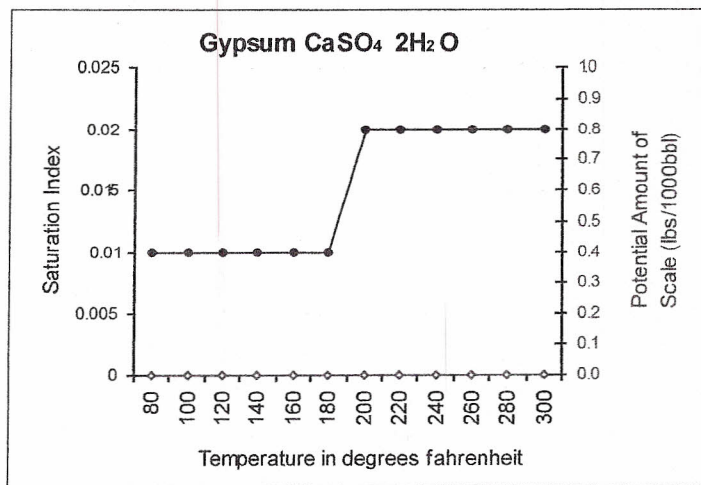
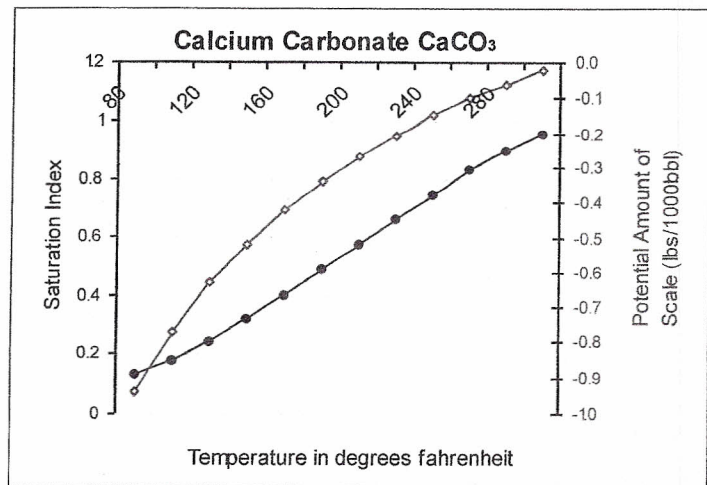
Vernal, UT 84078



Scale Prediction Graphs

Well Name: **FEDERAL 10-8-11-90R TANK A**

Sample ID: **WA-36133**



HALLIBURTON

Halliburton Energy Services
The Rockies NWA Regional Laboratory
Grand Junction, CO 970) 523-3692

Water Analysis Report

Contact Information

Company	SG Interests	Date Received	March 21, 2008
Reported To	Ann Staley	Date Tested	March 21, 2008
Reported By	Joel Snoke	Tested By	Ann Ekx, Joel Snoke

Sample Physical Characteristics

Well Name	Fed	Temperature	72 °F
Location	1-26R	pH	6.2
Specific Gravity	1.009	Color	Yellow
Corrected SG	1.011 at 60°F	Turbidity	None
TDS (calculated)	28857 ppm (28824 mg/L)	Resistivity	1.90 Ω·m

Sample Chemical Characteristics

Anions	Chloride	17400 mg/L	Cations	Total Iron	0.7 mg/L
	Sulfate	0 mg/L		Ferrous Iron	0.1 mg/L
	Bicarbonate	452 mg/L		Potassium	370 mg/L
	Carbonate	0 mg/L		Calcium	2300 mg/L
	Hydroxide	mg/L		Magnesium	0 mg/L
				Sodium (calculated)	8594 mg/L

General Comments

W054

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Phone 505-334-0447 FAX 505-334-9530

104 Bison Trail, Aztec, NM 87410

WATER ANALYSIS REPORT

SAMPLE

Oil Co. : S&G Interest
Lease : Federal
Well No.: 126R
Location: Water Holding Tank
Attention: Lynn Garner

Date Sampled : 8-1-08
Date Analyzed: 8-4-08
Lab ID Number: Aug0808.001- 4
Salesperson : Joe MacLaren
Requested By : Joe Oglesby
File Name : Aug0808.001

ANALYSIS

1. Ph 6.700
2. Specific Gravity 60/60 F. 1.023
3. CACO3 Saturation Index @ 80F @ 140F

Dissolved Gasses

4. Hydrogen Sulfide
5. Carbon Dioxide
6. Dissolved Oxygen

Cations

7. Calcium (Ca++)
8. Magnesium (Mg++)
9. Sodium (Na+) (Calculated)
10. Barium (Ba++)

Anions

11. Hydroxyl (OH-)
12. Carbonate (CO3=)
13. Bicarbonate (HCO3-)
14. Sulfate (SO4=)
15. Chloride (Cl-)
16. Total Dissolved Solids
17. Total Iron (Fe)
18. Manganese (Mn++)
19. Total Hardness as CaCO3
20. Resistivity @ 75 F. (Calculated)

-0.236 Negligible
0.624 Moderate

MG/L. EQ. WT. *MEQ/L

N.A.
N.A.
N.A.

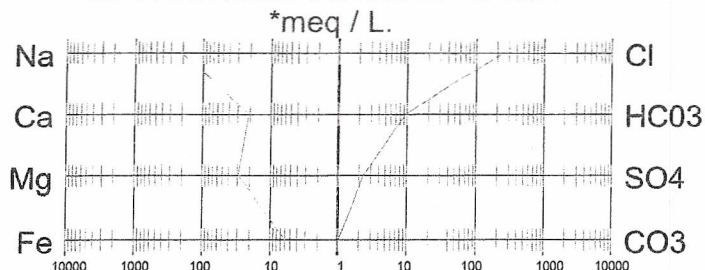
401 / 20.1 = 19.95
340 / 12.2 = 27.87
4,671 / 23.0 = 203.09
0 / 68.7 = 0.00

0 / 17.0 = 0.00
0 / 30.0 = 0.00
561 / 61.1 = 9.18
108 / 48.8 = 2.21
8,498 / 35.5 = 239.38

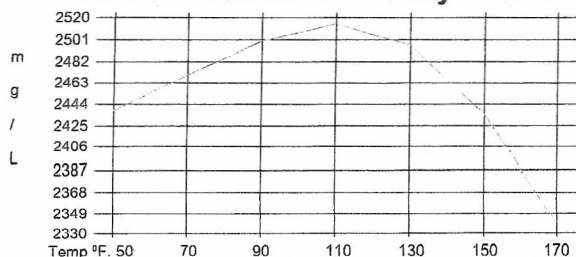
14,579
105.00 / 18.2 = 5.77
4.60 / 27.5 = 0.17

2,402
0.349 Ohm · meters

LOGARITHMIC WATER PATTERN



Calcium Sulfate Solubility Profile

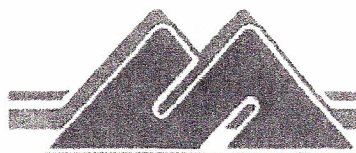


PROBABLE MINERAL COMPOSITION

COMPOUND	*meq/L	X	EQ. WT. =	mg/L.
Ca(HCO3)2	9.18		81.04	744
CaSO4	2.21		68.07	151
CaCl2	8.56		55.50	475
Mg(HCO3)2	0.00		73.17	0
MgSO4	0.00		60.19	0
MgCl2	27.87		47.62	1,327
NaHCO3	0.00		84.00	0
NaSO4	0.00		71.03	0
NaCl	202.96		58.46	11,865

* milliequivalents per Liter

Jason Hare, Analyst



SIERRA CHEMICALS L.C.

Phone 505-334-0447 FAX 505-334-9530

104 Bison Trail, Aztec, NM 87410

WATER ANALYSIS REPORT

SAMPLE

Oil Co. : S&G Interest
Lease : Federal 125-10
Well No.: 91R
Location: Water Holding Tank
Attention: Lynn Garner

Date Sampled : 8-1-08
Date Analyzed: 8-4-08
Lab ID Number: Aug0808.001- 3
Salesperson : Joe MacLaren
Requested By : Joe Oglesby
File Name : Aug0808.001

ANALYSIS

1. Ph 6.700
2. Specific Gravity 60/60 F. 1.021
3. CACO3 Saturation Index @ 80F @ 140F

Dissolved Gasses

4. Hydrogen Sulfide
5. Carbon Dioxide
6. Dissolved Oxygen

Cations

7. Calcium (Ca++)
8. Magnesium (Mg++)
9. Sodium (Na+) (Calculated)
10. Barium (Ba++)

Anions

11. Hydroxyl (OH-)
12. Carbonate (CO3=)
13. Bicarbonate (HCO3-)
14. Sulfate (SO4=)
15. Chloride (Cl-)
16. Total Dissolved Solids
17. Total Iron (Fe)
18. Manganese (Mn++)
19. Total Hardness as CaCO3
20. Resistivity @ 75 F. (Calculated)

-0.182 Negligible
0.718 Moderate

MG/L. EQ. WT. *MEQ/L

N.A.
N.A.
N.A.

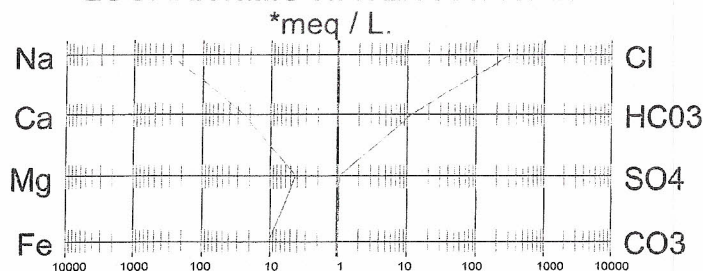
481 / 20.1 = 23.93
49 / 12.2 = 4.02
6,769 / 23.0 = 294.30
0 / 68.7 = 0.00

0 / 17.0 = 0.00
0 / 30.0 = 0.00
683 / 61.1 = 11.18
50 / 48.8 = 1.02
10,998 / 35.5 = 309.80

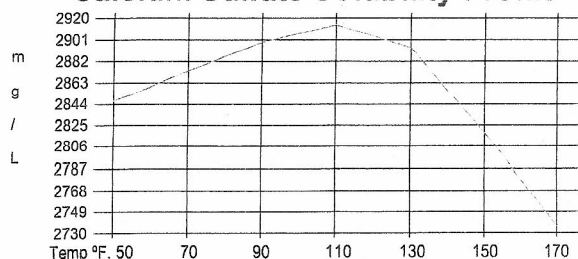
19,030
180.00 / 18.2 = 9.89
2.40 / 27.5 = 0.09
1,401

0.316 Ohm · meters

LOGARITHMIC WATER PATTERN



Calcium Sulfate Solubility Profile



PROBABLE MINERAL COMPOSITION

COMPOUND	*meq/L	X	EQ. WT. =	mg/L.
Ca(HCO3)2	11.18		81.04	906
CaSO4	1.02		68.07	70
CaCl2	11.73		55.50	651
Mg(HCO3)2	0.00		73.17	0
MgSO4	0.00		60.19	0
MgCl2	4.02		47.62	191
NaHCO3	0.00		84.00	0
NaSO4	0.00		71.03	0
NaCl	294.06		58.46	17,191

* milliequivalents per Liter

Jason Hare, Analyst

HALLIBURTON

Halliburton Energy Services
 The Rockies NWA Regional Laboratory
 Grand Junction, CO 970) 523-3692

Water Analysis Report**Contact Information**

Company SG Interests
 Reported To Ann Staley
 Reported By Joel Snoke

Date Received March 21, 2008
 Date Tested March 21, 2008
 Tested By Ann Ekx, Joel Snoke

Sample Physical Characteristics

Well Name	<u>Fed</u>	Temperature	<u>73</u> °F
Location	<u>1-25R</u>	pH	<u>6.3</u>
Specific Gravity	<u>0.994</u>	Color	<u>Yellow</u>
Corrected SG	<u>0.997</u> at 60°F	Turbidity	<u>None</u>
TDS (calculated)	<u>29672</u> ppm <i>(29638 mg/L)</i>	Resistivity	<u>0.32</u> Ω·m

Sample Chemical Characteristics

Anions

Chloride	<u>18200</u>	mg/L
Sulfate	<u>0</u>	mg/L
Bicarbonate	<u>372</u>	mg/L
Carbonate	<u>0</u>	mg/L
Hydroxide	<u></u>	mg/L

Cations

Total Iron	<u>1.6</u>	mg/L
Ferrous Iron	<u>0.1</u>	mg/L
Potassium	<u>20</u>	mg/L
Calcium	<u>10900</u>	mg/L
Magnesium	<u>0</u>	mg/L
Sodium (calculated)	<u>0</u>	mg/L

General Comments

W050

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HALLIBURTON

Halliburton Energy Services
 The Rockies NWA District Laboratory
 Grand Junction, CO 970) 523-3692

Water Analysis Report**Contact Information**

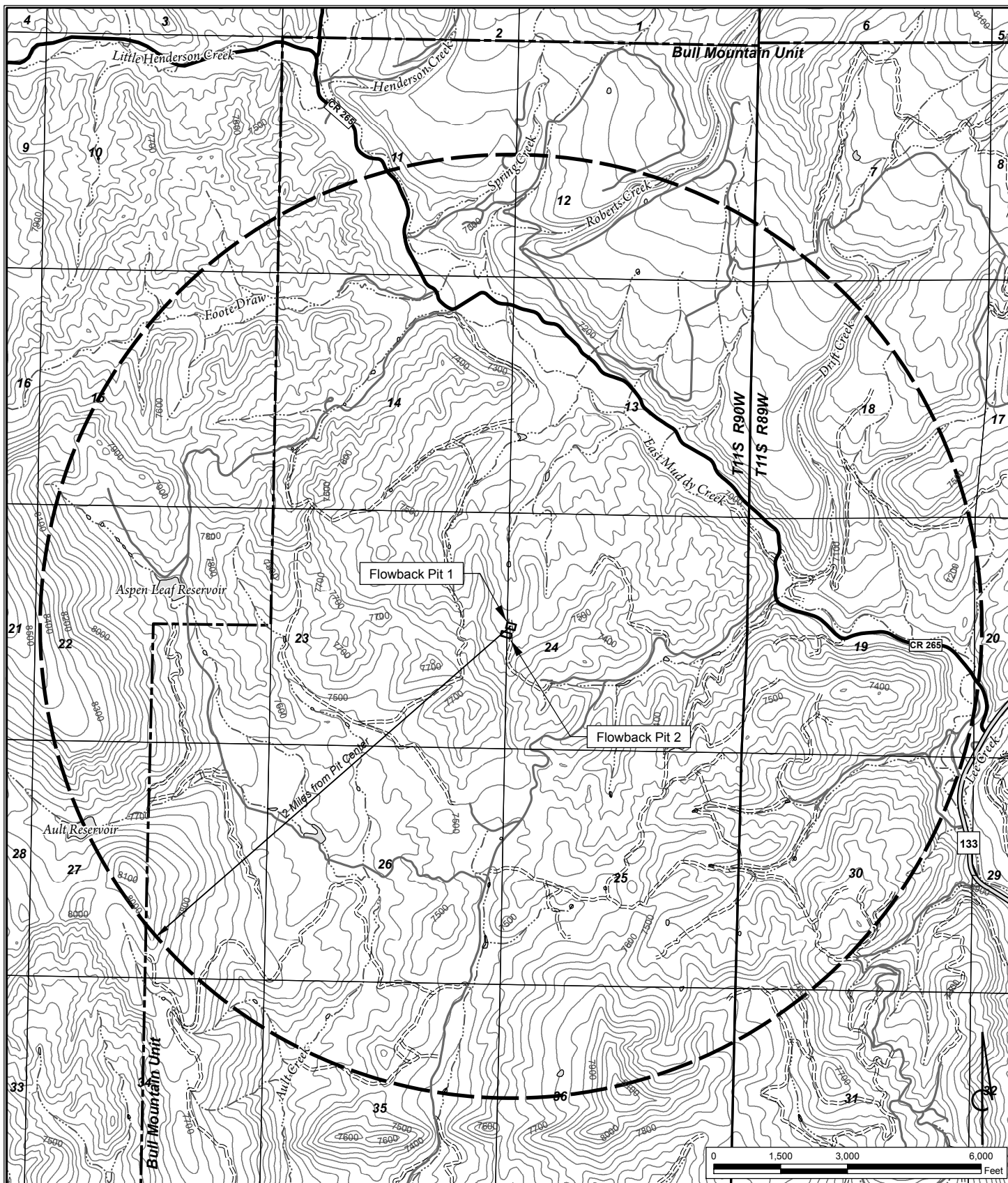
Company	<u>SG Interests</u>	Date Received	<u>September 13, 2007</u>
Reported To	<u>Ann Staley</u>	Date Tested	<u>September 13, 2007</u>
Reported By	<u>Ann Ekx</u>	Tested By	<u>Ann Ekx</u>

Sample 1 Physical Characteristics

Well Name	<u>11-90-14-1</u>	Temperature	<u>67 °F</u>
Location	<u>McIntyre</u>	pH	<u>5.49</u>
Specific Gravity	<u>1.009</u>	Color	<u>Black</u>
Corrected SG	<u>1.010</u> at 60°F	Turbidity	<u>Cloudy</u>
TDS (calculated)	<u>10557</u> ppm (10545 mg/L)	Resistivity	<u>0.47 Ω·m</u>

Sample 1 Chemical Characteristics

Anions	Chloride	<u>6400</u>	mg/L	Cations	Total Iron	<u>0.9</u>	mg/L
	Sulfate	<u>0</u>	mg/L		Ferrous Iron	<u>0.8</u>	mg/L
	Bicarbonate	<u>280</u>	mg/L		Potassium	<u>94</u>	mg/L
	Carbonate	<u>0</u>	mg/L		Calcium	<u>664</u>	mg/L
	Hydroxide		mg/L		Magnesium	<u>252</u>	mg/L
					Sodium (calculated)	<u>2961</u>	mg/L



0 1,500 3,000 6,000 Feet



Bull Mountain Unit



Township

Section



Water Body

Stream



State Highway

County Road

Improved Dirt Road

Two-Track



SG Interests
PO Box 26
Montrose, CO 81402
970-252-0696

Bull Mountain Unit

T. 11 S, R. 90 W, Sections 23 & 24

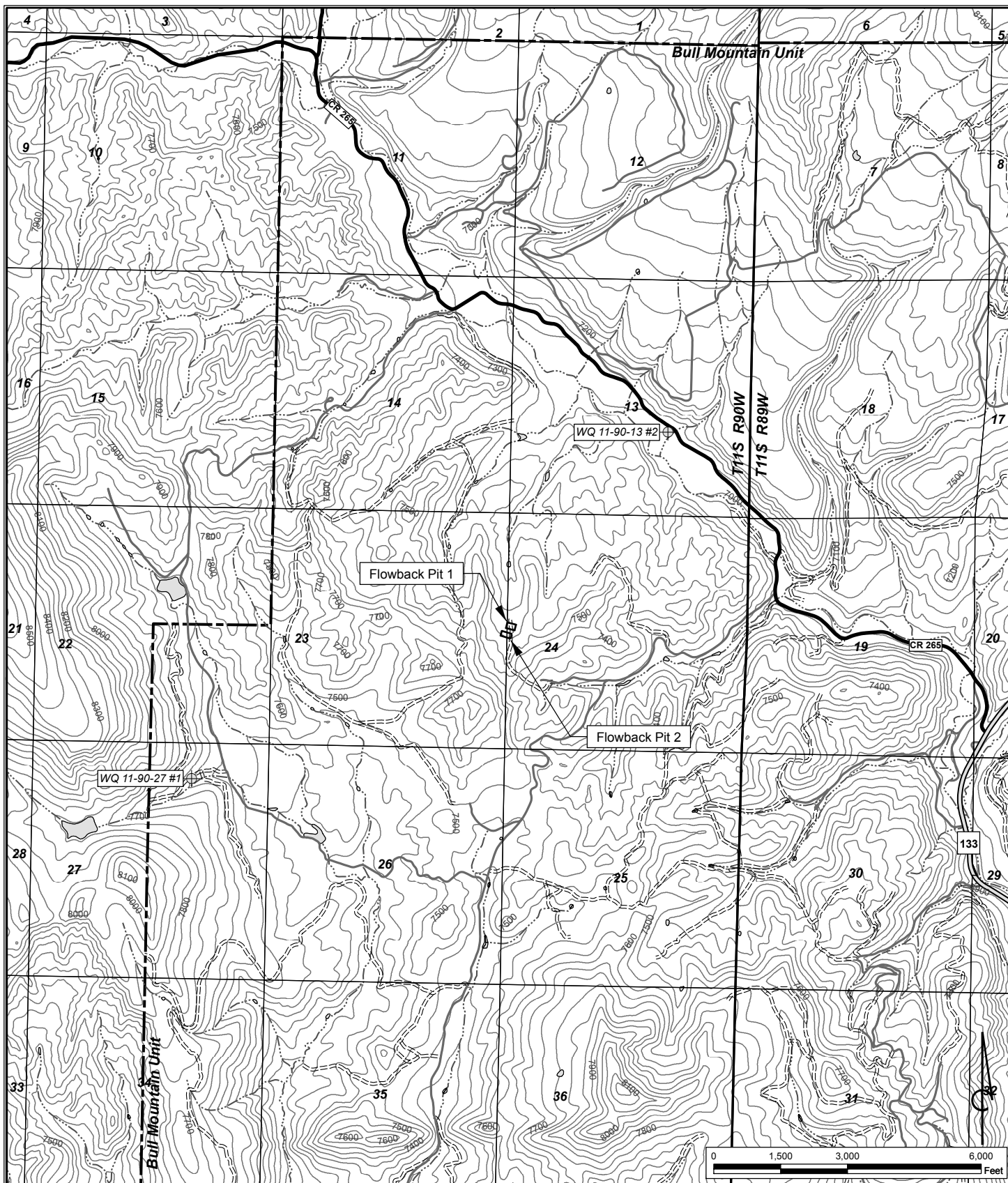
McIntyre Flowback Pit 1
WATER BODIES

CO State Plane Central NAD 83
SCALE: 1" = 3,000'
DATE: 11.11.2010

McIntyre Flowback Pits 1 and 2

Shallow Groundwater Monitoring

SG Interests has two shallow groundwater monitoring sites in the vicinity of McIntyre Flowback Pits 1 and 2; the WQ 11-90-13 #2 and the WQ 11-90-27 #1. Both of these sites are sources of drinking water for area residents. The WQ 11-90-13 #2 is on the east side of the Vannice house. The WQ 11-90-27 #1 site is the outflow from Aspen Leaf Ranch's cistern. This water is used for the residents and guests at the ranch. The water at the Aspen Leaf Ranch cistern is alkaline. No other water quality standard was exceeded at either of these two sites (test results from 2010). These monitoring reports set a baseline for pre pit construction shallow groundwater conditions in the area. The following section contains a map of the monitoring sites, a summary sheet for each of the site's test results, and the laboratory analysis reports.



Bull Mountain Unit
Township
Section



Shallow Groundwater Test Location



Water Body



Stream



State Highway



County Road



Improved Dirt Road



Two-Track



SG Interests

PO Box 26
Montrose, CO 81402
970-252-0696

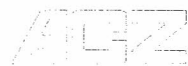
Bull Mountain Unit

T. 11 S, R. 90 W, Sections 23 & 24

McIntyre Flowback Pit 1

SHALLOW GROUNDWATER TEST LOCATIONS

CO State Plane Central NAD 83
SCALE: 1" = 3,000'
DATE: 11.11.2010



Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analysis
Results

SG Interests I, Ltd.

Project ID:

Sample ID: COW SKULL 8

ACZ Sample ID: **L82588-07**

Date Sampled: 06/07/10 00:00

Date Received: 06/09/10

Sample Matrix: Surface Water

Inorganic Prep

Parameter / Method	Result	Unit	MDL	Hold	Date	Analyst
Total Hot Plate Digestion M200.2 ICP					06/16/10 11:36	ear
Total Hot Plate Digestion M200.2 ICP-MS					06/14/10 9:19	cra

Metals Analysis

Parameter / Method	Result	Unit	MDL	Hold	Date	Analyst
Arsenic, total M200.8 ICP-MS		mg/L	0.0005	0.002	06/17/10 7:03	erf
Barium, total M200.7 ICP	0.105	mg/L	0.003	0.02	06/17/10 13:10	ear
Calcium, total M200.7 ICP	38.3	mg/L	0.2	1	06/17/10 13:10	ear
Chromium, total M200.8 ICP-MS		mg/L	0.0005	0.002	06/17/10 7:03	erf
Iron, total M200.7 ICP		mg/L	0.02	0.05	06/17/10 13:10	ear
Magnesium, total M200.7 ICP	5.3	mg/L	0.2	1	06/17/10 13:10	ear
Selenium, total M200.8 ICP-MS		mg/L	0.0001	0.0005	06/17/10 7:03	erf
Sodium, total M200.7 ICP	10.8	mg/L	0.3	2	06/17/10 17:01	ear

Wet Chemistry

Parameter / Method	Result	Unit	MDL	Hold	Date	Analyst
Alkalinity as CaCO3 SM2320B - Titration						
Bicarbonate as CaCO3	143	mg/L	2	20	06/10/10 0:00	jjc
Carbonate as CaCO3		mg/L	2	20	06/10/10 0:00	jjc
Hydroxide as CaCO3		mg/L	2	20	06/10/10 0:00	jjc
Total Alkalinity	143	mg/L	2	20	06/10/10 0:00	jjc
Chloride SM4500Cl-E	1	mg/L	1	5	06/16/10 17:18	aml
Conductivity @25C SM2510B	280	umhos/cm	1	10	06/10/10 4:26	jjc
Fluoride SM4500F-C	0.1	mg/L	0.1	0.5	06/10/10 16:26	jjc
Lab Filtration SM 3030 B					06/09/10 15:11	jlif
pH (lab) SM4500H+ B						
pH	8.3	units	0.1	0.1	06/10/10 0:00	jjc
pH measured at	22.0	C	0.1	0.1	06/10/10 0:00	jjc
Residue, Filterable (TDS) @180C SM2540C	160	mg/L	10	20	06/09/10 16:56	lhb
Sulfate 375.4 - Turbidimetric	4	mg/L	1	5	06/16/10 12:07	aml

Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

SG Interests I, Ltd.

Project ID:

Sample ID: COW SKULL 8

ACZ Sample ID: **L82588-07**

Date Sampled: 06/07/10 0:00

Date Received: 06/09/10

Sample Matrix: Surface Water

Analysis Method: **M8021B/8015D GC/PID/FID**Extract Method: **5030C**

Analyst: kaf

Extract Date: 06/11/10 19:01

Analysis Date: 06/11/10 19:01

Benzene	71-43-2	U	1	*	ug/L	0.2	1
Ethylbenzene	100-41-4	U	1	*	ug/L	0.2	1
m p Xylene	1330-20-7	U	1	*	ug/L	0.4	2
o Xylene	95-47-6	U	1	*	ug/L	0.2	1
Toluene	108-88-3	U	1	*	ug/L	0.2	1
TVH C6 to C10	TVH	U	1	*	mg/L	0.05	0.05
Bromofluorobenzene	460-00-4		1	*	%	70	130
Bromofluorobenzene (TVH)	460-00 4		1	*	%	70	130


Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

SG Interests I, Ltd.

Project ID:

Sample ID: COW SKULL 8

 ACZ Sample ID: **L82588-07**

Date Sampled: 06/07/10 0:00

Date Received: 06/09/10

Sample Matrix: Surface Water

 Analysis Method: **M8270C GC/MS**

 Extract Method: **M3520**

Analyst: djt

Extract Date: 06/10/10 13:39

Analysis Date: 06/16/10 18:26

2-Methylnaphthalene	91-57-6	U	1	*	ug/L	2	10
Acenaphthene	83-32-9	U	1	*	ug/L	2	10
Acenaphthylene	208-96-8	U	1	*	ug/L	2	10
Anthracene	120-12-7	U	1	*	ug/L	2	10
Benzo(a)anthracene	56-55-3	U	1	*	ug/L	2	10
Benzo(a)pyrene	50-32-8	U	1	*	ug/L	2	10
Benzo(b)fluoranthene	205-99-2	U	1	*	ug/L	2	10
Benzo(g,h,i)perylene	191-24-2	U	1	*	ug/L	2	10
Benzo(k)fluoranthene	207-08-9	U	1	*	ug/L	2	10
Chrysene	218-01-9	U	1	*	ug/L	2	10
Dibenzo(a,h)anthracene	53-70-3	U	1	*	ug/L	2	10
Fluoranthene	206-44-0	U	1	*	ug/L	2	10
Fluorene	86-73-7	U	1	*	ug/L	2	10
Indeno(1,2,3-cd)pyrene	193-39-5	U	1	*	ug/L	2	10
Naphthalene	91-20-3	U	1	*	ug/L	2	10
Phenanthrene	85-01-8	U	1	*	ug/L	2	10
Pyrene	129-00-0	U	1	*	ug/L	2	10
2-Fluorobiphenyl	321-60-8						
			63.9				
Nitrobenzene-d5	4165-60-0						
			46.3				
Terphenyl-d14	1718-51-0						
			76.3				
			1	*	%	35	121
			1	*	%	36	117
			1	*	%	10	151

**Laboratories, Inc.**

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Organic Analysis
Final Results Report**SG Interests I, Ltd.**

Project ID:

Sample ID: COW SKULL 8

ACZ Sample ID: **L82588-07**

Date Sampled: 06/07/10 0:00

Date Received: 06/09/10

Sample Matrix: Surface Water

Analysis Method: **M8015D GC/FID**Extract Method: **M3520**

Analyst: abm

Extract Date: 06/10/10 12:14

Analysis Date: 06/14/10 16:37

TPH C10 to C28

U 1 * mg/L 0.1 0.5

OTP

84-15-1

121.9

1 * % 70 130

Laboratories, Inc.

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SG Interests I, Ltd.

Project ID:

Sample ID: PASCO #2

ACZ Sample ID: **L82406-02**

Date Sampled: 05/26/10 00:00

Date Received: 05/28/10

Sample Matrix: Surface Water

Inorganic Prep

Total Hot Plate Digestion	M200.2 ICP	06/03/10 21:45	ear
Total Hot Plate Digestion	M200.2 ICP-MS	06/08/10 15:00	cra

Metals Analysis

Arsenic, total	M200.8 ICP-MS	U	mg/L	0.0005	0.002	06/10/10 10:59	erf	
Barium, total	M200.7 ICP	0.351	mg/L	0.003	0.02	06/04/10 20:47	ear	
Calcium, total	M200.7 ICP	85.5	mg/L	0.2	1	06/04/10 20:47	ear	
Chromium, total	M200.8 ICP-MS	U	mg/L	0.0005	0.002	06/10/10 10:59	erf	
Iron, total	M200.7 ICP	0.08	mg/L	0.02	0.05	06/04/10 20:47	ear	
Magnesium, total	M200.7 ICP	11.0	mg/L	0.2	1	06/04/10 20:47	ear	
Selenium, total	M200.8 ICP-MS	0.0003	B	mg/L	0.0001	0.0005	06/10/10 10:59	erf
Sodium, total	M200.7 ICP	14.2	mg/L	0.3	2	06/07/10 14:20	aeh	

Wet Chemistry

Alkalinity as CaCO ₃	SM2320B - Titration	287	mg/L	2	20	06/03/10 0:00	lhb	
Bicarbonate as CaCO ₃								
Carbonate as CaCO ₃		U	mg/L	2	20	06/03/10 0:00	lhb	
Hydroxide as CaCO ₃		U	mg/L	2	20	06/03/10 0:00	lhb	
Total Alkalinity		287	mg/L	2	20	06/03/10 0:00	lhb	
Chloride	SM4500Cl-E	3	B *	mg/L	1	5	06/08/10 15:05	aml
Conductivity @25C	SM2510B	545	umhos/cm	1	10	06/03/10 4:06	lhb	
Fluoride	SM4500F-C	0.1	B *	mg/L	0.1	0.5	06/04/10 14:23	jjc
Lab Filtration	SM 3030 B		*			05/28/10 14:15	jjc	
pH (lab)	SM4500H+ B							
pH		8.2	H	units	0.1	0.1	06/03/10 0:00	lhb
pH measured at		23.0		C	0.1	0.1	06/03/10 0:00	lhb
Residue, Filterable (TDS) @180C	SM2540C	300	H *	mg/L	10	20	06/04/10 14:10	jlf
Sulfate	375.4 - Turbidimetric	6	*	mg/L	1	5	06/14/10 14:55	aml

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SG Interests I, Ltd.

Project ID:

Sample ID: PASCO #2

ACZ Sample ID: **L82406-02**

Date Sampled: 05/26/10 0:00

Date Received: 05/28/10

Sample Matrix: Surface Water

Analysis Method: **M8021B/8015D GC/PID/FID**

Extract Method: **5030C**

Analyst: kaf

Extract Date: 06/04/10 15:32

Analysis Date: 06/04/10 15:32

Benzene	71-43-2		U	1	*	ug/L	0.2	1
Ethylbenzene	100-41-4		U	1	*	ug/L	0.2	1
m p Xylene	1330-20-7		U	1	*	ug/L	0.4	2
o Xylene	95-47-6		U	1	*	ug/L	0.2	1
Toluene	108-88-3	0.3	J	1	*	ug/L	0.2	1
TVH C6 to C10	TVH		U	1	*	mg/L	0.05	0.05
Bromofluorobenzene	460-00-4	106.3		1	*	%	70	130
Bromofluorobenzene (TVH)	460-00-4	104.7		1	*	%	70	130

SG Interests I, Ltd.

Project ID:

Sample ID: PASCO #2

ACZ Sample ID: **L82406-02**

Date Sampled: 05/26/10 0:00

Date Received: 05/28/10

Sample Matrix: Surface Water

Analysis Method: **M8270C GC/MS**Extract Method: **M3520**

Analyst: djt

Extract Date: 06/01/10 15:13

Analysis Date: 06/08/10 20:10

2-Methylnaphthalene	91-57-6	U	1	ug/L	2	10
Acenaphthene	83-32-9	U	1	ug/L	2	10
Acenaphthylene	208-96-8	U	1	ug/L	2	10
Anthracene	120-12-7	U	1	ug/L	2	10
Benzo(a)anthracene	56-55-3	U	1	ug/L	2	10
Benzo(a)pyrene	50-32-8	U	1	ug/L	2	10
Benzo(b)fluoranthene	205-99-2	U	1	ug/L	2	10
Benzo(g,h,i)perylene	191-24-2	U	1	ug/L	2	10
Benzo(k)fluoranthene	207-08-9	U	1	ug/L	2	10
Chrysene	218-01-9	U	1	ug/L	2	10
Dibenzo(a,h)anthracene	53-70-3	U	1	ug/L	2	10
Fluoranthene	206-44-0	U	1	ug/L	2	10
Fluorene	86-73-7	U	1	ug/L	2	10
Indeno(1,2,3-cd)pyrene	193-39-5	U	1	ug/L	2	10
Naphthalene	91-20-3	U	1	ug/L	2	10
Phenanthrene	85-01-8	U	1	ug/L	2	10
Pyrene	129-00-0	U	1	ug/L	2	10
2-Fluorobiphenyl	321-60-8		1	%	35	121
Nitrobenzene-d5	4165-60-0		1	%	36	117
Terphenyl-d14	1718-51-0		1	%	10	151

SG Interests I, Ltd.

Project ID:

Sample ID: PASCO #2

ACZ Sample ID: **L82406-02**

Date Sampled: 05/26/10 0:00

Date Received: 05/28/10

Sample Matrix: Surface Water

Analysis Method: **M8015D GC/FID**Extract Method: **M3520**

Analyst: abm

Extract Date: 05/28/10 14:37

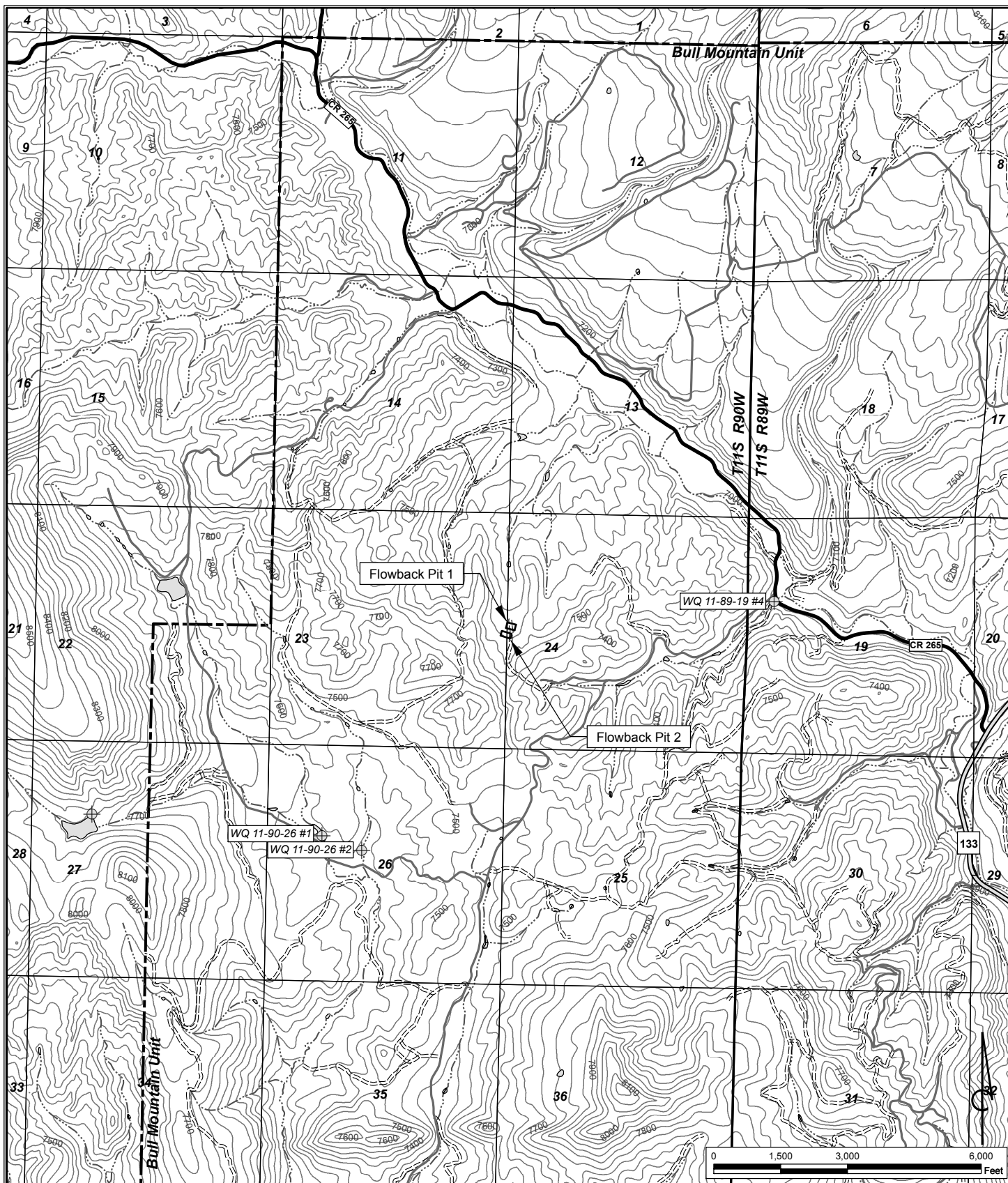
Analysis Date: 06/02/10 19:11

TPH C10 to C28	0.1	J	1	mg/L	0.1	0.5
OTP	84-15-1	72.7	1	%	70	130

McIntyre Flowback Pits 1 and 2

Surface Water Quality Monitoring

SG Interests has three surface water quality monitoring sites in the vicinity of McIntyre Flowback Pits 1 and 2; the WQ 11-90-26 #1, the WQ 11-90-26 #2, and the WQ 11-89-19 #4. The WQ 11-90-26 #1 site is at the edge of a reservoir on Ault Creek. The WQ 11-90-26 #2 is on an unnamed tributary to Ault Creek. The WQ 11-89-19 #4 site is on an unnamed creek. The water at these sites is alkaline, but did not exceed any other water quality standard (test results from 2010). These monitoring reports set a baseline for pre pit construction surface water conditions in the area. The following section contains a map of the monitoring sites, a summary sheet for each of the site's test results, and the laboratory analysis reports.



Bull Mountain Unit

Township

Section



Surface Water Test Location



Water Body



Stream



State Highway



County Road



Improved Dirt Road



Two-Track



SG Interests

PO Box 26
Montrose, CO 81402
970-252-0696

Bull Mountain Unit

T. 11 S, R. 90 W, Sections 23 & 24

McIntyre Flowback Pit 1

SURFACE WATER TEST LOCATIONS

CO State Plane Central NAD 83
SCALE: 1" = 3,000'
DATE: 11.11.2010

ACZ Laboratories, Inc.

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**Inorganic Analytical
Results****SG Interests I, Ltd.**

Project ID:

Sample ID: PASCO #1

ACZ Sample ID: **L82406-01**

Date Sampled: 05/26/10 00:00

Date Received: 05/28/10

Sample Matrix: Surface Water

Inorganic Prep

Parameter	EPA Method	Result	Qual	XO	Units	MDL	POL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP-MS							06/08/10 14:48	cra
Total Hot Plate Digestion	M200.2 ICP							06/03/10 21:32	ear

Metals Analysis

Parameter	EPA Method	Result	Qual	XO	Units	MDL	POL	Date	Analyst
Arsenic, total	M200.8 ICP-MS	0.0007	B		mg/L	0.0005	0.002	06/10/10 10:56	erf
Barium, total	M200.7 ICP	0.350			mg/L	0.003	0.02	06/04/10 20:44	ear
Calcium, total	M200.7 ICP	83.9			mg/L	0.2	1	06/04/10 20:44	ear
Chromium, total	M200.8 ICP-MS		U		mg/L	0.0005	0.002	06/10/10 10:56	erf
Iron, total	M200.7 ICP	0.21			mg/L	0.02	0.05	06/04/10 20:44	ear
Magnesium, total	M200.7 ICP	12.1			mg/L	0.2	1	06/04/10 20:44	ear
Selenium, total	M200.8 ICP-MS	0.0002	B		mg/L	0.0001	0.0005	06/10/10 10:56	erf
Sodium, total	M200.7 ICP	13.7			mg/L	0.3	2	06/07/10 14:17	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XO	Units	MDL	POL	Date	Analyst
Alkalinity as CaCO ₃	SM2320B - Titration								
Bicarbonate as CaCO ₃		252			mg/L	2	20	06/03/10 0:00	lhb
Carbonate as CaCO ₃		23			mg/L	2	20	06/03/10 0:00	lhb
Hydroxide as CaCO ₃			U		mg/L	2	20	06/03/10 0:00	lhb
Total Alkalinity		276			mg/L	2	20	06/03/10 0:00	lhb
Chloride	SM4500Cl-E	5		*	mg/L	1	5	06/08/10 15:05	aml
Conductivity @25C	SM2510B	515			umhos/cm	1	10	06/03/10 3:57	lhb
Fluoride	SM4500F-C	0.2	B	*	mg/L	0.1	0.5	06/04/10 14:17	jjc
Lab Filtration	SM 3030 B			*				05/28/10 14:13	jjc
Lab Filtration & Acidification	SM 3030 B			*				06/02/10 8:05	cra
pH (lab)	SM4500H+ B								
pH		8.6	H		units	0.1	0.1	06/03/10 0:00	lhb
pH measured at		22.0			C	0.1	0.1	06/03/10 0:00	lhb
Residue, Filterable (TDS) @180C	SM2540C	280	H	*	mg/L	10	20	06/04/10 14:09	jlf
Sulfate	375.4 - Turbidimetric	13		*	mg/L	1	5	06/08/10 9:46	aml

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**Inorganic Analytical
Results****SG Interests I, Ltd.**

Project ID:

Sample ID: PASCO #2

ACZ Sample ID: **L82406-02**

Date Sampled: 05/26/10 00:00

Date Received: 05/28/10

Sample Matrix: Surface Water

Inorganic Prep

Parameter	EPA Method	Result	Qual	XC	Units	MDL	POL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							06/03/10 21:45	ear
Total Hot Plate Digestion	M200.2 ICP-MS							06/08/10 15:00	cra

Metals Analysis

Parameter	EPA Method	Result	Qual	XC	Units	MDL	POL	Date	Analyst
Arsenic, total	M200.8 ICP-MS			U	mg/L	0.0005	0.002	06/10/10 10:59	erf
Barium, total	M200.7 ICP	0.351			mg/L	0.003	0.02	06/04/10 20:47	ear
Calcium, total	M200.7 ICP	85.5			mg/L	0.2	1	06/04/10 20:47	ear
Chromium, total	M200.8 ICP-MS			U	mg/L	0.0005	0.002	06/10/10 10:59	erf
Iron, total	M200.7 ICP	0.08			mg/L	0.02	0.05	06/04/10 20:47	ear
Magnesium, total	M200.7 ICP	11.0			mg/L	0.2	1	06/04/10 20:47	ear
Selenium, total	M200.8 ICP-MS	0.0003		B	mg/L	0.0001	0.0005	06/10/10 10:59	erf
Sodium, total	M200.7 ICP	14.2			mg/L	0.3	2	06/07/10 14:20	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XC	Units	MDL	POL	Date	Analyst
Alkalinity as CaCO ₃	SM2320B - Titration								
Bicarbonate as CaCO ₃		287			mg/L	2	20	06/03/10 0:00	lhb
Carbonate as CaCO ₃				U	mg/L	2	20	06/03/10 0:00	lhb
Hydroxide as CaCO ₃				U	mg/L	2	20	06/03/10 0:00	lhb
Total Alkalinity		287			mg/L	2	20	06/03/10 0:00	lhb
Chloride	SM4500Cl-E	3		B *	mg/L	1	5	06/08/10 15:05	aml
Conductivity @25C	SM2510B	545			umhos/cm	1	10	06/03/10 4:06	lhb
Fluoride	SM4500F-C	0.1		B *	mg/L	0.1	0.5	06/04/10 14:23	jic
Lab Filtration	SM 3030 B			*				05/28/10 14:15	jic
pH (lab)	SM4500H+ B								
pH		8.2		H	units	0.1	0.1	06/03/10 0:00	lhb
pH measured at		23.0			C	0.1	0.1	06/03/10 0:00	lhb
Residue, Filterable (TDS) @180C	SM2540C	300		H *	mg/L	10	20	06/04/10 14:10	jlf
Sulfate	375.4 - Turbidimetric	6		*	mg/L	1	5	06/14/10 14:55	aml

ACZ Laboratories, Inc.

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**Organic Analytical
Results****SG Interests I, Ltd.**

Project ID:

Sample ID: PASCO #1

ACZ Sample ID: **L82406-01**

Date Sampled: 05/26/10 0:00

Date Received: 05/28/10

Sample Matrix: Surface Water

BTEX (Toluene, Ethylbenzene, Xylene, and Benzene)

Analysis Method: **M8021B/8015D GC/PID/FID**Extract Method: **5030C**

Analyst: kaf
 Extract Date: 06/04/10 14:23
 Analysis Date: 06/04/10 14:23

Compound	Reference	U	1	*	ug/L	0.2	1
Benzene	71-43-2	U	1	*	ug/L	0.2	1
Ethylbenzene	100-41-4	U	1	*	ug/L	0.2	1
m p Xylene	1330-20-7	U	1	*	ug/L	0.4	2
o Xylene	95-47-6	U	1	*	ug/L	0.2	1
Toluene	108-88-3	U	1	*	ug/L	0.2	1
TVH C6 to C10	TVH	U	1	*	mg/L	0.05	0.05
Bromofluorobenzene	460-00-4		107	1	*	%	70 130
Bromofluorobenzene (TVH)	460-00-4		103.6	1	*	%	70 130

SG Interests I, Ltd.

Project ID:

Sample ID: PASCO #1

ACZ Sample ID: **L82406-01**

Date Sampled: 05/26/10 0:00

Date Received: 05/28/10

Sample Matrix: *Surface Water*

FOR THE RECORD: THE 1990S

Analysis Method: **M8270C GC/MS**

Extract Method: **M3520**

Analyst: djt

Extract Date: 06/01/10 15:10

Analysis Date: 06/08/10 19:44

2-Methylnaphthalene	91-57-6	U	1	ug/L	2	10
Acenaphthene	83-32-9	U	1	ug/L	2	10
Acenaphthylene	208-96-8	U	1	ug/L	2	10
Anthracene	120-12-7	U	1	ug/L	2	10
Benzo(a)anthracene	56-55-3	U	1	ug/L	2	10
Benzo(a)pyrene	50-32-8	U	1	ug/L	2	10
Benzo(b)fluoranthene	205-99-2	U	1	ug/L	2	10
Benzo(g,h,i)perylene	191-24-2	U	1	ug/L	2	10
Benzo(k)fluoranthene	207-08-9	U	1	ug/L	2	10
Chrysene	218-01-9	U	1	ug/L	2	10
Dibenzo(a,h)anthracene	53-70-3	U	1	ug/L	2	10
Fluoranthene	206-44-0	U	1	ug/L	2	10
Fluorene	86-73-7	U	1	ug/L	2	10
Indeno(1,2,3-cd)pyrene	193-39-5	U	1	ug/L	2	10
Naphthalene	91-20-3	U	1	ug/L	2	10
Phenanthrene	85-01-8	U	1	ug/L	2	10
Pyrene	129-00-0	U	1	ug/L	2	10
2-Fluorobiphenyl	321-60-8	58.4	1	%	35	121
Nitrobenzene-d5	4165-60-0	55.8	1	%	36	117
Terphenyl-d14	1718-51-0	71.1	1	%	10	151

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**Organic Analytical
Results**

SG Interests I, Ltd.

Project ID:

Sample ID: PASCO #1

ACZ Sample ID: **L82406-01**

Date Sampled: 05/26/10 0:00

Date Received: 05/28/10

Sample Matrix: Surface Water

Total Petroleum HydrocarbonsAnalysis Method: **M8015D GC/FID**Extract Method: **M3520**

Analyst: abm

Extract Date: 05/28/10 14:36

Analysis Date: 06/02/10 17:53

TPH C10 to C28

U 1 mg/L 0.1 0.5

OTP

84-15-1

77.6

1

%

70

130

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**Inorganic Analytical
Results****SG Interests I, Ltd.**

Project ID:

Sample ID: PASCO #5

ACZ Sample ID: **L82406-05**

Date Sampled: 05/26/10 00:00

Date Received: 05/28/10

Sample Matrix: Surface Water

Inorganic Prep

Parameter	EPA Method	Result	Qual	XO	Units	MDL	POL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							06/04/10 10:14	ear
Total Hot Plate Digestion	M200.2 ICP-MS							06/08/10 12:43	cra

Metals Analysis

Parameter	EPA Method	Result	Qual	XO	Units	MDL	POL	Date	Analyst
Arsenic, total	M200.8 ICP-MS			U	mg/L	0.0005	0.002	06/10/10 15:33	msh
Barium, total	M200.7 ICP	0.349			mg/L	0.003	0.02	06/07/10 11:57	aeh
Calcium, total	M200.7 ICP	83.0			mg/L	0.2	1	06/04/10 17:55	ear
Chromium, total	M200.8 ICP-MS			U	mg/L	0.0005	0.002	06/10/10 15:33	msh
Iron, total	M200.7 ICP	0.72		*	mg/L	0.02	0.05	06/04/10 17:55	ear
Magnesium, total	M200.7 ICP	11.8			mg/L	0.2	1	06/04/10 17:55	ear
Selenium, total	M200.8 ICP-MS	0.0002		B	mg/L	0.0001	0.0005	06/10/10 15:33	msh
Sodium, total	M200.7 ICP	15.4			mg/L	0.3	2	06/04/10 17:55	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XO	Units	MDL	POL	Date	Analyst
Alkalinity as CaCO ₃	SM2320B - Titration								
Bicarbonate as CaCO ₃		239			mg/L	2	20	06/03/10 0:00	lhb
Carbonate as CaCO ₃		32			mg/L	2	20	06/03/10 0:00	lhb
Hydroxide as CaCO ₃				U	mg/L	2	20	06/03/10 0:00	lhb
Total Alkalinity		271			mg/L	2	20	06/03/10 0:00	lhb
Chloride	SM4500Cl-E	5		*	mg/L	1	5	06/08/10 15:05	aml
Conductivity @25C	SM2510B	505			umhos/cm	1	10	06/03/10 4:42	lhb
Fluoride	SM4500F-C	0.2		B	mg/L	0.1	0.5	06/04/10 14:52	jjc
Lab Filtration	SM 3030 B			*				05/28/10 14:24	jjc
pH (lab)	SM4500H+ B								
pH		8.6		H	units	0.1	0.1	06/03/10 0:00	lhb
pH measured at		22.0			C	0.1	0.1	06/03/10 0:00	lhb
Residue, Filterable (TDS) @180C	SM2540C	280		H	mg/L	10	20	06/04/10 14:14	jlf
Sulfate	375.4 - Turbidimetric	2		B	mg/L	1	5	06/10/10 13:42	aml

ACZ Laboratories, Inc.

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**Organic Analytical
Results****SG Interests I, Ltd.**

Project ID:

Sample ID: PASCO #5

ACZ Sample ID: **L82406-05**

Date Sampled: 05/26/10 0:00

Date Received: 05/28/10

Sample Matrix: Surface Water

Analysis Method: **M8021B/8015D GC/PID/FID**Extract Method: **5030C**

Analyst: kaf

Extract Date: 06/04/10 17:49

Analysis Date: 06/04/10 17:49

Benzene	71-43-2	U	1	*	ug/L	0.2	1
Ethylbenzene	100-41-4	U	1	*	ug/L	0.2	1
m p Xylene	1330-20-7	U	1	*	ug/L	0.4	2
o Xylene	95-47-6	U	1	*	ug/L	0.2	1
Toluene	108-88-3	U	1	*	ug/L	0.2	1
TVH C6 to C10	TVH	U	1	*	mg/L	0.05	0.05
Bromofluorobenzene	460-00-4		107.5	1	%	70	130
Bromofluorobenzene (TVH)	460-00 4		105	1	%	70	130

ACZ Laboratories, Inc.

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**Organic Analytical
Results****SG Interests I, Ltd.**

Project ID:

Sample ID: PASCO #5

ACZ Sample ID: **L82406-05**

Date Sampled: 05/26/10 0:00

Date Received: 05/28/10

Sample Matrix: Surface Water

Report generated by ACZ Laboratories, Inc.

Analysis Method: **M8270C GC/MS**Extract Method: **M3520**

Analyst: djt

Extract Date: 06/01/10 15:23

Analysis Date: 06/08/10 21:25

2-Methylnaphthalene	91-57-6	U	1	ug/L	2	10
Acenaphthene	83-32-9	U	1	ug/L	2	10
Acenaphthylene	208-96-8	U	1	ug/L	2	10
Anthracene	120-12-7	U	1	ug/L	2	10
Benzo(a)anthracene	56-55-3	U	1	ug/L	2	10
Benzo(a)pyrene	50-32-8	U	1	ug/L	2	10
Benzo(b)fluoranthene	205-99-2	U	1	ug/L	2	10
Benzo(g,h,i)perylene	191-24-2	U	1	ug/L	2	10
Benzo(k)fluoranthene	207-08-9	U	1	ug/L	2	10
Chrysene	218-01-9	U	1	ug/L	2	10
Dibenzo(a,h)anthracene	53-70-3	U	1	ug/L	2	10
Fluoranthene	206-44-0	U	1	ug/L	2	10
Fluorene	86-73-7	U	1	ug/L	2	10
Indeno(1,2,3-cd)pyrene	193-39-5	U	1	ug/L	2	10
Naphthalene	91-20-3	U	1	ug/L	2	10
Phenanthrene	85-01-8	U	1	ug/L	2	10
Pyrene	129-00-0	U	1	ug/L	2	10
2-Fluorobiphenyl	321-60-8	68.9	1	%	35	121
Nitrobenzene-d5	4165-60-0	52.2	1	%	36	117
Terphenyl-d14	1718-51-0	82	1	%	10	151

ACZ Laboratories, Inc.

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**Organic Analytical
Results****SG Interests I, Ltd.**

Project ID:

Sample ID: PASCO #5

ACZ Sample ID: **L82406-05**

Date Sampled: 05/26/10 0:00

Date Received: 05/28/10

Sample Matrix: Surface Water

Organic Analytical ResultsAnalysis Method: **M8015D GC/FID**Extract Method: **M3520**

Analyst: abm

Extract Date: 05/26/10 14:39

Analysis Date: 06/02/10 20:29

TPH C10 to C28

U 1 mg/L 0.1 0.5

OTP

84-15-1

73.4

1 % 70 130

ACZ Laboratories, Inc.

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**Inorganic Analytical
Results****SG Interests I, Ltd.**

Project ID:

Sample ID: COW SKULL 10

ACZ Sample ID: **L82588-09**

Date Sampled: 06/04/10 00:00

Date Received: 06/09/10

Sample Matrix: Surface Water

Inorganic Prep

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PCL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP-MS							06/14/10 10:08	cra
Total Hot Plate Digestion	M200.2 ICP							06/16/10 12:24	ear

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PCL	Date	Analyst
Arsenic, total	M200.8 ICP-MS		U		mg/L	0.0005	0.002	06/17/10 7:13	erf
Barium, total	M200.7 ICP	0.204			mg/L	0.003	0.02	06/17/10 13:22	ear
Calcium, total	M200.7 ICP	48.3			mg/L	0.2	1	06/17/10 13:22	ear
Chromium, total	M200.8 ICP-MS		U		mg/L	0.0005	0.002	06/17/10 7:13	erf
Iron, total	M200.7 ICP	0.31			mg/L	0.02	0.05	06/17/10 13:22	ear
Magnesium, total	M200.7 ICP	5.7			mg/L	0.2	1	06/17/10 13:22	ear
Selenium, total	M200.8 ICP-MS	0.0003	B		mg/L	0.0001	0.0005	06/17/10 7:13	erf
Sodium, total	M200.7 ICP	33.6			mg/L	0.3	2	06/17/10 17:14	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PCL	Date	Analyst
Alkalinity as CaCO ₃	SM2320B - Titration								
Bicarbonate as CaCO ₃		192			mg/L	2	20	06/10/10 0:00	jjc
Carbonate as CaCO ₃		11	B		mg/L	2	20	06/10/10 0:00	jjc
Hydroxide as CaCO ₃			U		mg/L	2	20	06/10/10 0:00	jjc
Total Alkalinity		204		*	mg/L	2	20	06/10/10 0:00	jjc
Chloride	SM4500Cl-E	7		*	mg/L	1	5	06/16/10 17:19	aml
Conductivity @25C	SM2510B	405		*	umhos/cm	1	10	06/10/10 4:44	jjc
Fluoride	SM4500F-C	0.4	B	*	mg/L	0.1	0.5	06/10/10 16:36	jjc
Lab Filtration	SM 3030 B			*				06/09/10 15:13	jlf
pH (lab)	SM4500H+ B								
pH		8.5	H		units	0.1	0.1	06/10/10 0:00	jjc
pH measured at		22.0			C	0.1	0.1	06/10/10 0:00	jjc
Residue, Filterable (TDS) @180C	SM2540C	230			mg/L	10	20	06/09/10 16:58	lhb
Sulfate	375.4 - Turbidimetric	7		*	mg/L	1	5	06/16/10 12:07	aml

ACZ Laboratories, Inc.

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**Organic Analytical
Results****SG Interests I, Ltd.**

Project ID:

Sample ID: COW SKULL 10

ACZ Sample ID: **L82588-09**

Date Sampled: 06/04/10 0:00

Date Received: 06/09/10

Sample Matrix: Surface Water

BIOTRANSFORMABLE HYDROCARBONSAnalysis Method: **M8021B/8015D GC/PID/FID**Extract Method: **5030C**

Analyst: kaf

Extract Date: 06/11/10 20:05

Analysis Date: 06/11/10 20:05

Benzene	71-43-2	U	1	*	ug/L	0.2	1
Ethylbenzene	100-41-4	U	1	*	ug/L	0.2	1
m p Xylene	1330-20-7	U	1	*	ug/L	0.4	2
o Xylene	95-47-6	U	1	*	ug/L	0.2	1
Toluene	108-88-3	U	1	*	ug/L	0.2	1
TVH C6 to C10	TVH	U	1	*	mg/L	0.05	0.05
Bromofluorobenzene	460-00-4		100.5	1	*	%	70 130
Bromofluorobenzene (TVH)	460-00 4		98.8	1	*	%	70 130

ACZ Laboratories, Inc.

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**Organic Analytical
Results****SG Interests I, Ltd.**

Project ID:

Sample ID: COW SKULL 10

ACZ Sample ID: **L82588-09**

Date Sampled: 06/04/10 0:00

Date Received: 06/09/10

Sample Matrix: Surface Water

Reported by: [Redacted]

Analysis Method: **M8270C GC/MS**Extract Method: **M3520**

Analyst: djt

Extract Date: 06/10/10 13:41

Analysis Date: 06/16/10 19:17

2-Methylnaphthalene	91-57-6	U	1	*	ug/L	2	10
Acenaphthene	83-32-9	U	1	*	ug/L	2	10
Acenaphthylene	208-96-8	U	1	*	ug/L	2	10
Anthracene	120-12-7	U	1	*	ug/L	2	10
Benzo(a)anthracene	56-55-3	U	1	*	ug/L	2	10
Benzo(a)pyrene	50-32-8	U	1	*	ug/L	2	10
Benzo(b)fluoranthene	205-99-2	U	1	*	ug/L	2	10
Benzo(g,h,i)perylene	191-24-2	U	1	*	ug/L	2	10
Benzo(k)fluoranthene	207-08-9	U	1	*	ug/L	2	10
Chrysene	218-01-9	U	1	*	ug/L	2	10
Dibenzo(a,h)anthracene	53-70-3	U	1	*	ug/L	2	10
Fluoranthene	206-44-0	U	1	*	ug/L	2	10
Fluorene	86-73-7	U	1	*	ug/L	2	10
Indeno(1,2,3-cd)pyrene	193-39-5	U	1	*	ug/L	2	10
Naphthalene	91-20-3	U	1	*	ug/L	2	10
Phenanthrene	85-01-8	U	1	*	ug/L	2	10
Pyrene	129-00-0	U	1	*	ug/L	2	10
2-Fluorobiphenyl	321-60-8	60.4	1	*	%	35	121
Nitrobenzene-d5	4165-60-0	52.8	1	*	%	36	117
Terphenyl-d14	1718-51-0	60	1	*	%	10	151

ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

**Organic Analytical
Results**

SG Interests I, Ltd.

Project ID:

Sample ID: COW SKULL 10

ACZ Sample ID: **L82588-09**

Date Sampled: 06/04/10 0:00

Date Received: 06/09/10

Sample Matrix: Surface Water

**Organic Analytical
Results**

Analysis Method: **M8015D GC/FID**

Extract Method: **M3520**

Analyst: abm

Extract Date: 06/10/10 12:16

Analysis Date: 06/14/10 17:28

TPH C10 to C28

U 1 * mg/L 0.1 0.5

OTP

84-15-1

74.3

1 * % 70 130

Attachment I

Financial Assurance

SG Interests I Ltd.

McIntyre Flowback Pits #1 and #2

Financial Assurance

Please see the Preliminary Closure Plan (Attachment J) for a breakdown of reclamation activities and cost estimates. The total cost estimate in the Preliminary Closure Plan will be used to determine the financial security that must be in place prior to final approval by the COGCC.

Attachment J

Closure Plan

McIntyre Flowback Pits #1 and #2 - Preliminary Closure Plan (908.g)

When the pits are no longer needed by SG Interests, the water that is being stored in these pits will be disposed of at either one of SG Interests' permitted water disposal wells within the Bull Mountain Unit or at a commercial water disposal well or facility. The liner system that was used at each pit will be dried, removed, bundled, and disposed of at a solid waste disposal site or recycling facility. The soil beneath each pit will be sampled and tested to verify that there has been no leakage. Table 910-1 will provide the soil test parameters. If a spill is discovered, it will be reported on Form 19. Soil will be remediated as required if any spill is discovered. Next, the pits will be backfilled using the spoil that was stored on site and served as the staging area for each pit. The ground will be returned to near-original contour and topsoil that has been stored on site will be replaced over the land surface. The disturbed area will be seeded with the seed mix recommended by CDOW for use in this project. More detail on the closure of the pits will be included in the Final Closure Plan (Form 27), which will be submitted to the state at least 60 days prior to final pit closure.

Cost to reclaim pits:

Activity: Fence Removal – approximately 4 days to remove and haul off fencing materials

5 people working 12 hours per day = \$6,720

Equipment to remove fence = \$3,500

Activity: Remove temporary and reset permanent BMP's – approximately 2 days

5 people working 12 hours per day = \$3,360

Equipment to seed, trench, mulch, and crimp for 2 days = \$7,200

Activity: Remove and dispose of liner – approximately 2 days

Disposal of materials = \$6,075

Labor for removal of materials = \$6,000

Equipment and trucking = \$6,000

Activity: Earthwork to replace 28,029 yards of subsoil and 4,785 yards of topsoil

Two 627 scrapers working for 8 days to put subsoil back in pits and recontour surface = \$70,072

2 days to put topsoil back over the disturbed area = \$11,962

Activity: Reclaim 2000' of access road

Pick up gravel and haul off, place topsoil over road area, seed = \$32,000

Activity: Sample and test soil beneath pits and sample water monitoring sites

Sample and send out for tests = \$7,200 for soil testing and \$6,000 for water testing

Total cost estimate: \$166,089

Item 1

Sensitive Area Determination

Sensitive Area Determination Checklist

SG Interests I, Ltd.

Person(s) conducting inspection	Catherine Dickert	10/07/2010
Site Information		
Location:	McIntyre Flowback Pits #1 and #2	Time: 11:00 am
Type of Facility:	Flowback pit with pad	
Environmental Conditions	Partly sunny, ground dry	
Temperature	≈55°F	

Has the proposed, new or existing location been designated as a sensitive area?

Yes X

No _____

SURFACE WATER

- 1) Are there any surface water features or SWSAs adjacent to or within ¼ mile of the proposed/new facility?

Yes X

No _____

If yes, list type of surface water feature(s), i.e. rivers, creeks, streams, seeps, springs, wetlands:
There is an unnamed stream to the west and a wetland to the north. Both are within 1,000' of the proposed pit (as detected using LIDAR imagery).

- 2) Could a potential release from the facility reach surface water features?

Yes X

No _____

If yes, describe the pathway a release from the facility would likely follow to determine if the potential to impact surface water is high or low. The elevation of the proposed pit is higher than the elevation of the wetland area to the north. It is possible that a release from the pit could travel downslope to the wetland (see hydrology map).

- 3) Is the potential to impact surface waters from a facility release high or low?

High _____

Low X

GROUNDWATER

- 1) Will the proposed/new or existing facility have any pits that will contain hydrocarbons and chlorides or other E&P wastes?

Yes X

No _____

If yes, list the pit types(s): Lined multi-well frac water and flowback water storage pit.

2) Is the site of the proposed facility underlain by an unconfined aquifer or recharge zone?

Yes X

No _____

3) Is the hydraulic conductivity of the underlying soil or geologic material $\leq 1.0 \times 10^{-7}$ cm/sec?

Yes _____

No X (Fughes loam Ksat value is moderately low or moderately high.)

4) Is the proposed facility located within 1/8 mile of domestic water well or 1/4 mile of a public water supply well which would use the same aquifer?

Yes _____

No X (Nearest domestic water well is 5271' away from Pit #1 and 5,462' from Pit #2.)

5) Is the proposed facility located within a 100-year floodplain?

Yes _____

No X (See floodplain map.)

6) Is the depth to groundwater known?

Yes X (If yes, follow instructions provided in 6(a) of this section.) Geotech shows it at 29'.

No _____ (If no, follow instructions provided in 6(b) of this section.)

(a) If yes, could a potential release from the proposed facility reach groundwater?

Yes X If yes, explain: The potential for a release to contact groundwater exists, but is low because the pit is lined with a double liner laying on geomat. The interstitial space between the liners is separated by geonet. A leak in the upper liner would be detected with the leak detection system and contained by the lower liner. The pit is located entirely in cut soil, so there is very little probability of pit failure.

No _____

(b) If no: (i) Evaluate surrounding soils, topography, and vegetation which may suggest the presence of shallow groundwater. (ii) Gather information from surrounding well data in order to determine a depth to groundwater, i.e. State Engineer's Office.

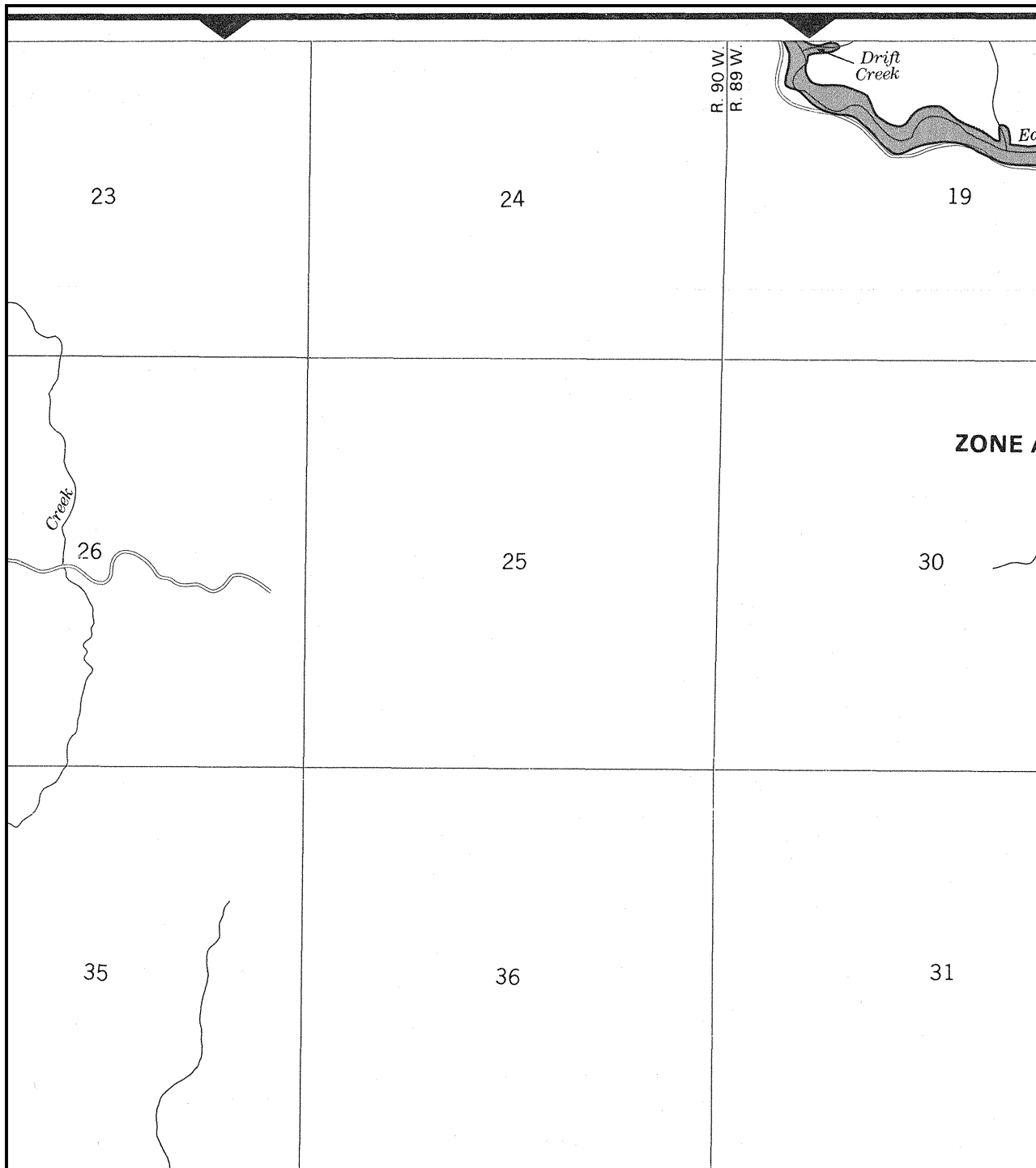
7) Is the potential to impact groundwater from the facility in the event of a release high or low?

High _____

Low X

Additional Comments: Site design, liner design, leak detection system, and secondary containment as described in attached application reduce possibility of ground or surface water contamination as a result of this project.

Signature Catherine Dechert Date 11/24/10



858-8620.



APPROXIMATE SCALE IN FEET

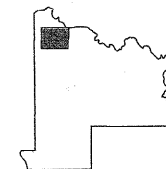
2000 0

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

GUNNISON
COUNTY,
COLORADO
(UNINCORPORATED AREAS)

PANEL 125 OF 975
(SEE MAP INDEX FOR PANELS NOT PRINTED)



PANEL LOCATION

COMMUNITY-PANEL NUMBER

080078 0125 B

EFFECTIVE DATE:
SEPTEMBER 29, 1989



Federal Emergency Management Agency

T. 12 S.
T. 13 S.

4

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Item 12

Drainage Calculations

McIntyre Flowback Pits 1 & 2

NRCS classifies the soils in the project site as Fughes loam located in old alluvium and/or complex landslide deposits derived from sedimentary rock. The soil is described as well drained with no flooding potential. The soil has a hydrologic group rating of C. Group C soils generally having a slow infiltration rate when thoroughly wet. The estimated pre-construction runoff coefficient is expected to range from 0.1 to 0.3. The estimated post-construction runoff coefficient is 0.3.

The National Oceanic and Atmospheric Administration, NOAA Atlas 2 - Volume III, reports the 100-year 24-hour and 25-year 24 hour precipitation events at the frac pit locations to be approximately 3.0 and 2.4 inches respectively. A number of best management practices and diversion structures have been designed to control runoff and runoff resulting from the 100-yr 24-hr and 25-yr 24-hr precipitation events. These structures are shown on the attached drawing (Attachment D).

A runoff capture diversion channel, capable of containing both the 100-yr and 25-yr 24 hour precipitation events, will be constructed above the frac facility on the south and east sides. The drainage area above the channel is approximately 8 – 10 acres and flow will be limited to overland or sheet flow. There is no defined channel flow from the adjacent area. Utilizing the Rational Method for computing peak runoff, the estimated sheet discharge is 3.0 cfs ($0.1 \times 10 \text{ ac.} \times 3''$). Using the Manning-Chezy open channel flow equation and constructing a channel with a 2 ft wide bottom, 2 ft. depth and 2H:1V side slopes, the channel flow capacity is 19 cfs at one ft. of depth and 82 cfs at 2 ft. of depth.

With the runoff diversion channel in place, the total tributary drainage basin area, including the frac pit site, is approximately 10.72 acres. Direct precipitation falling into the pit areas reduces the tributary area to 8.93 acres. Again, using the Rational Method, the estimated peak discharge created by the 100-yr 24-hr event is 8.0 cfs ($0.3 \times 8.93 \text{ ac.} \times 3''$). Borrow ditches constructed along the access roads will convey runoff to the Staging Area located at the north end of the site. The runoff flows will then be diverted into a 24" diameter CMP culvert with the discharge terminating into a large sedimentation basin. This culvert will have a control slide gate to release or retain the runoff. The borrow ditches and the CMP culverts have estimated flow capacities of 27 cfs and 29 cfs, respectively. Additionally, as part of a comprehensive Storm Water Management Plan, erosion and sediment control structures will be installed at the site during construction and post-construction activities.

Pit freeboard will be maintained at a minimum of 2 ft below finished pad grade. An additional pit berm of synthetic liner will extend 12" above finished grade providing sufficient space for a 3-inch 100-yr 24 hr storm event.

To evaluate winter and spring snow melt average precipitation, snow fall and snow fall depths were obtained for the Meredith, Colorado weather station from the Western Regional Data Center. The Meredith station data is attached. Meredith has an elevation of 8210 ft while the McIntyre frac pits are at an elevation of 7350 ft.

Although there will be variability in snowfall, the reported monthly average and peak precipitation events throughout the winter months are significantly less than the drainage system design capacity based on the 100-year event in which 3 inches of precipitation falls in one day. Monthly winter precipitation ranges from 1.03 to 1.25 inches. The record winter period one-day precipitation event occurred in December of 1966 with 1.66 inches of precipitation.

Concerning spring snow melt, the weather data includes average monthly snow depths. The reported average January through April snow depths were 17, 23, 20, and 5 inches, respectively. Peak or maximum snow depths were not reported. Typical water equivalent content for snow ranges from 0.75 to 1.0 inches per one-foot of snow depth. Snow generally melts and sublimates over a period of several weeks as it ripens, however, if 23 inches of snow, for example, melted in one day, the equivalent water content estimate would be 1.91 inches. The drainage system diversion and runoff channels; and culverts have significant additional capacity over and above the 100-yr. 24 hr precipitation event and are appropriate for snow melt conditions. Continued maintenance and inspection of the drainage system is recommended throughout the life of the project.

Item 13

Waste Profile

McIntyre Flowback Pits 1 and 2

Waste Profile (908.b.6)

McIntyre Pits 1 and 2 will hold a maximum of 61,224 bbl of water throughout the operational season for each year they are in use. Pit 1 will hold 31,485 bbl of water and Pit 2 will hold 29,739 bbl of water. The pits will be filled at the start of the operational season at a rate of approximately 3,000 bbls per day. A characteristic waste profile for the produced water that will be used to fill pits 1 and 2 is included in this application (Attachment H). When water is planned for use in frac'ing, the well that will be frac'ed and that will provide flowback water to be stored in pits 1 or 2 will be added to the attached List of Wells (Attachment H). The water stored in the pits will be tested four times per year (analytical testing). This information will be provided to the commission as required on Form 4, Sundry Notice as requested. As described in the operating plan, flowback water will be filtered before being added to the pits. A series of filters will remove hydrocarbons and solids before fluid is added to the pits. Filters will be used to filter dead bacteria matter from the fluid when it is removed from the pits for use. No sheen or hydrocarbons are expected to be in the pit water.