

Appendix 2: A15 Pit –Form 15 (Approved March, 2012)

Operator
Comments:

Certification

I hereby certify all statements made in this form are, to the best of my knowledge, true, correct, and complete.

Signed: _____ Print Name: Heather Mitchell
Title: Regulatory Analyst Email: heather.mitchell@encana.com Date: 01/19/2012

Approval

Signed:  Title: Director of Cogcc Date: 03/12/2012

BMP

<u>Type</u>	<u>Comment</u>
Total: 0 comment(s)	

CONDITIONS OF APPROVAL:

COA 11 - Prior to multi-well pit construction, a Form 27 (Remediation Workplan/Closure Report) must be submitted via a Form 4 Sundry to the COGCC detailing the closure of the original drilling pits (#425199 and #425200) at this well pad location. This form should include the dates of closure, where the fluids were disposed of, and where any impacted soil was disposed of. In addition, analytical results from soil samples collected below the pit prior to the construction of the new multi-well pit, should also be included. (Form 27 Received on March 2, 2012 [REM#6138]).

COA 90 - Notify COGCC Oil and Gas Location Assessment (OGLA) Specialist for Western Colorado (Dave Kubeczko; email dave.kubeczko@state.co.us) and the COGCC Field Inspection Supervisor for Northwest Colorado (Shaun Kellerby; email shaun.kellerby@state.co.us) 48 hours prior to start of construction of the pit.

COA 21 - Surface water samples from West Fork (one upstream and one downstream of the well pad/pit location) shall be collected by the operator prior to pit use and every 12 months during operation to evaluate potential impacts from pit operations. At a minimum, the surface water samples will be analyze for the following parameters: major cations/anions (chloride, fluoride, sulfate, sodium); total dissolved solids (TDS); and BTEX/DRO.

COA 22 - After installation of the uppermost liner and prior to operating the pit, the synthetic liner(s) shall be tested by filling the pit with at least 4 feet of fresh water, measured from the base of the pit (not to exceed the 2-foot freeboard requirement). The operator shall monitor the pit for leaks for a period of 72 hours prior to commencing operations. Operator shall notify the COGCC Oil and Gas Location Assessment (OGLA) Specialist for Western Colorado (Dave Kubeczko; email dave.kubeczko@state.co.us) 48 hours prior to start of the hydrotest. Successful hydrotest results must be maintained by the operator for the life of the pit and provided to COGCC prior to using the pit.

COA 23 - Operator must ensure 110 percent secondary containment for any volume of fluids contained at the water handling facility site during natural gas development activities and operations; including, but not limited to, construction of a berm or diversion dike, diversion/collection trenches within and/or outside of berms/dikes, site grading, or other comparable measures (i.e., best management practices (BMPs) associated with stormwater management) sufficiently protective of nearby surface water. Any berm constructed at the well pad location will be stabilized, inspected at regular intervals (at least every 14 days), and maintained in good condition.

COA 5 - Operator must implement best management practices to contain any unintentional release of fluids, including any fluids conveyed via buried or temporary surface pipelines.

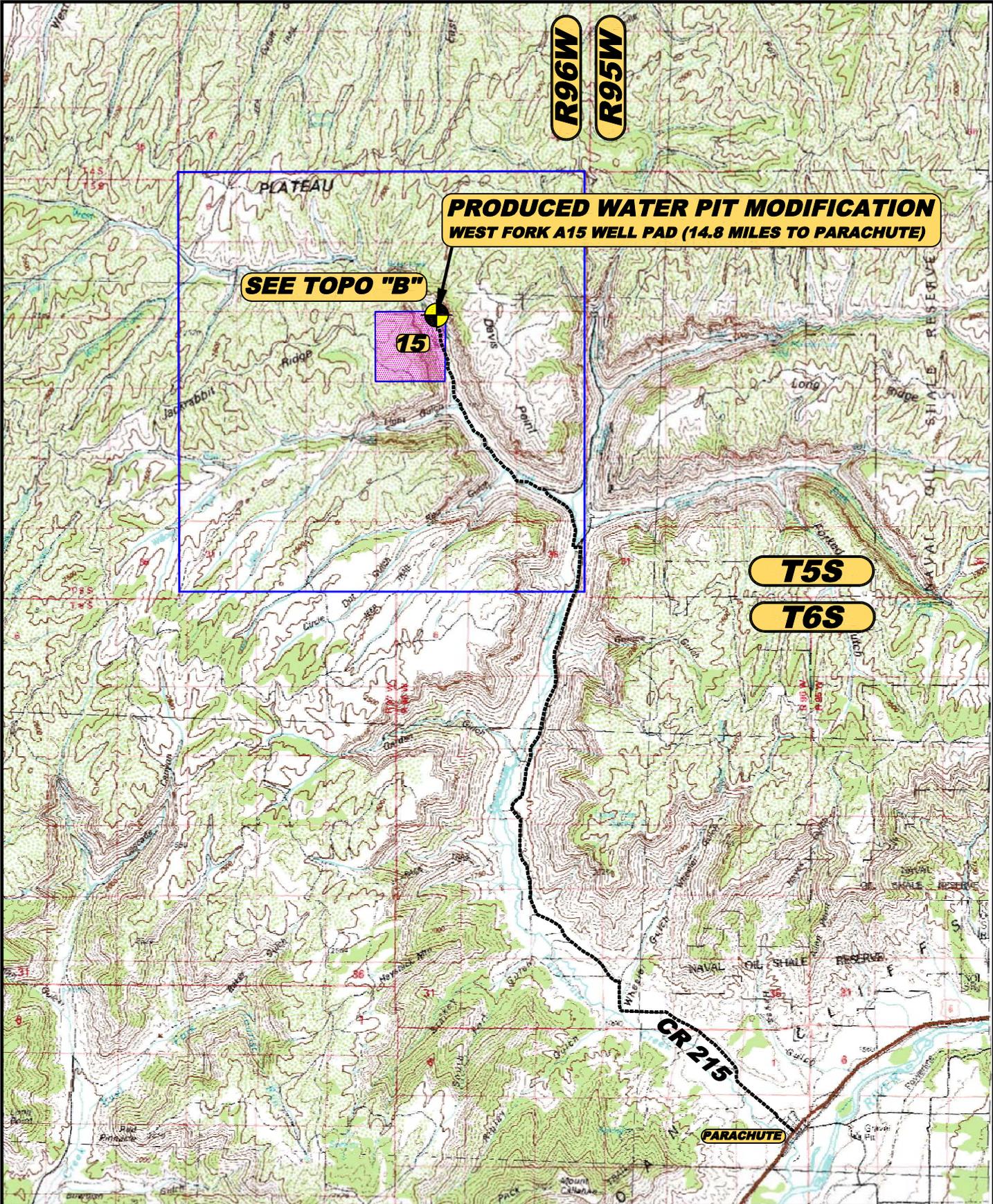
COA 39 - No portion of any pit that will be used to hold liquids shall be constructed on fill material, unless the pit and fill slope are designed and certified by a professional engineer, subject to review and approval by the director prior to construction of the pit. The construction and lining of the pit shall be supervised by a professional engineer or their agent. The entire base of the pit must be in cut.

COA 47 - The production pit must be double-lined. The pit will also require a leak detection system (Rule 904.e).

COA 48 - Operator must submit a professional engineer (PE) approved/stamped as-built drawing (plan view and cross-sections) of the production pit within 14 calendar days of construction. COA 49 - The production pit must be fenced and netted. The operator must maintain the fencing and netting until the pit is closed in accordance with Rule 905. Closure of Pits, and Buried or Partially Buried Produced Water Vessels.

COA 10 - Operator shall pressure test pipelines in accordance with Rule 1101.e.(1) prior to putting into initial service any temporary surface pipelines or configuration of the permanent pipeline network.

COA 27 - Submit additional disposal facilities (wells, pits, landfills, etc.) for pit contents, if different than what was provided on the Form 15 Pit Permit, to COGCC via a Form 4 Sundry prior to disposal.



encanaTM
natural gas

LEGEND:
 **WELL PAD LOCATION**
 30X60 MIN. QUAD:
DOUGLAS PASS, CO.

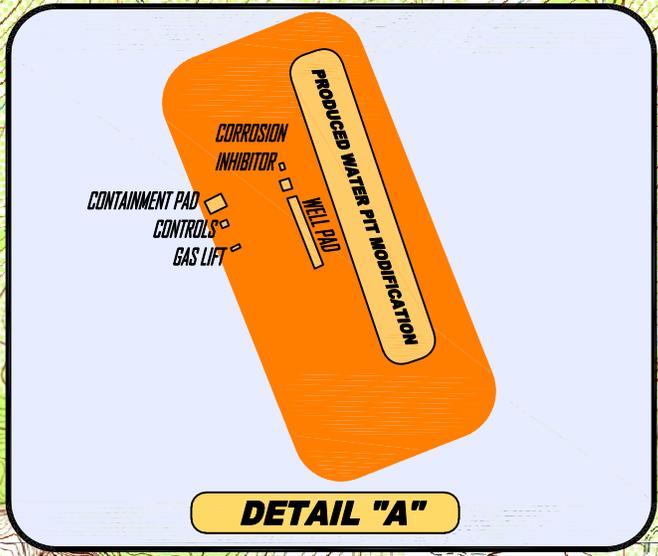


TOPOGRAPHIC MAP "A"
WEST FORK A15 WELL PAD
NE-NE, SEC. 15, T5S, R96W, 6TH P.M.
GARFIELD COUNTY, COLORADO

SCALE: 1"=10000' DRAWN BY: BEC DATE: 08/12/11 REVISED:


Universal Pegasus
 INTERNATIONAL

T5S



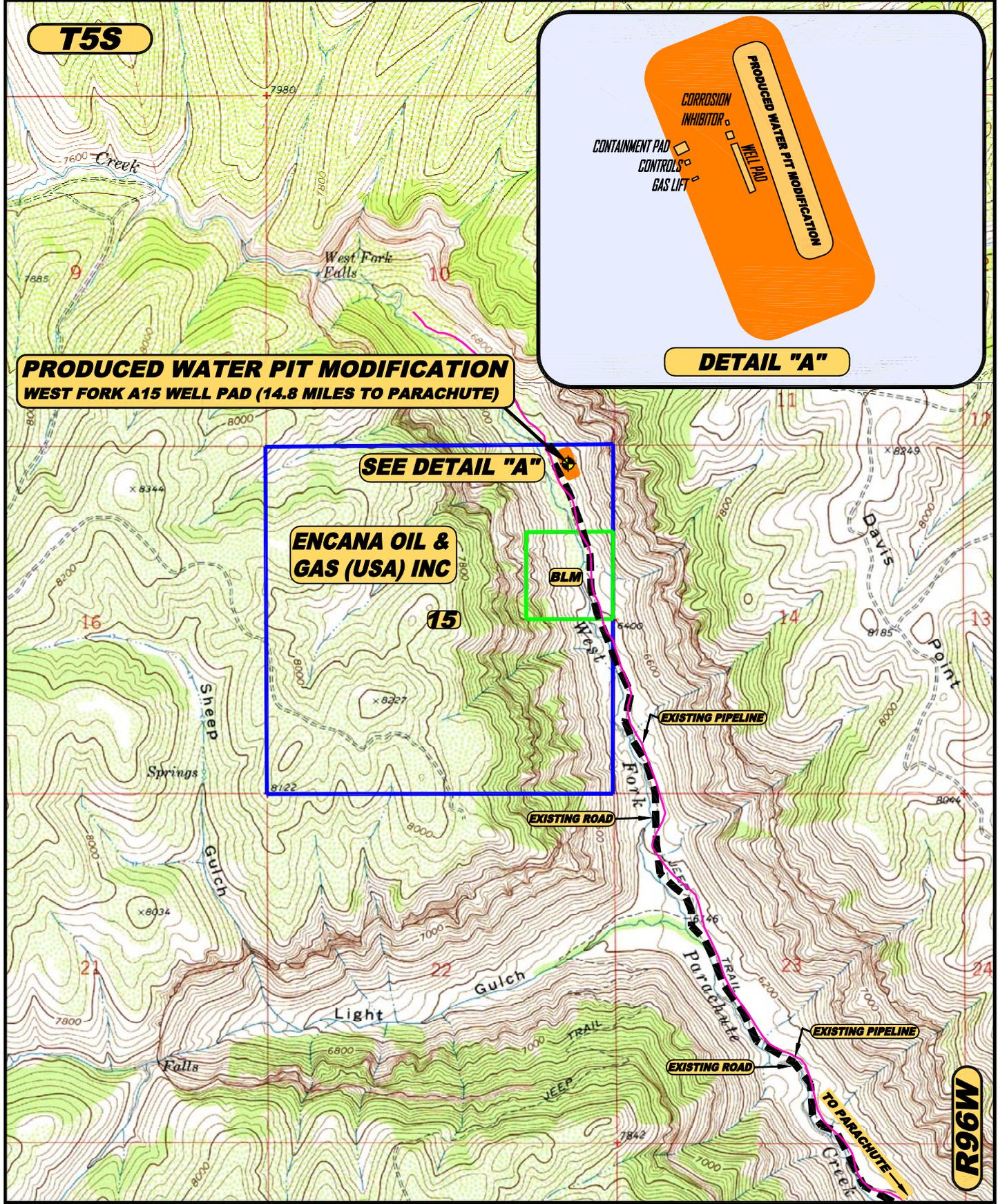
**PRODUCED WATER PIT MODIFICATION
WEST FORK A15 WELL PAD (14.8 MILES TO PARACHUTE)**

SEE DETAIL "A"

**ENCANA OIL &
GAS (USA) INC**

BLM

15



R96W

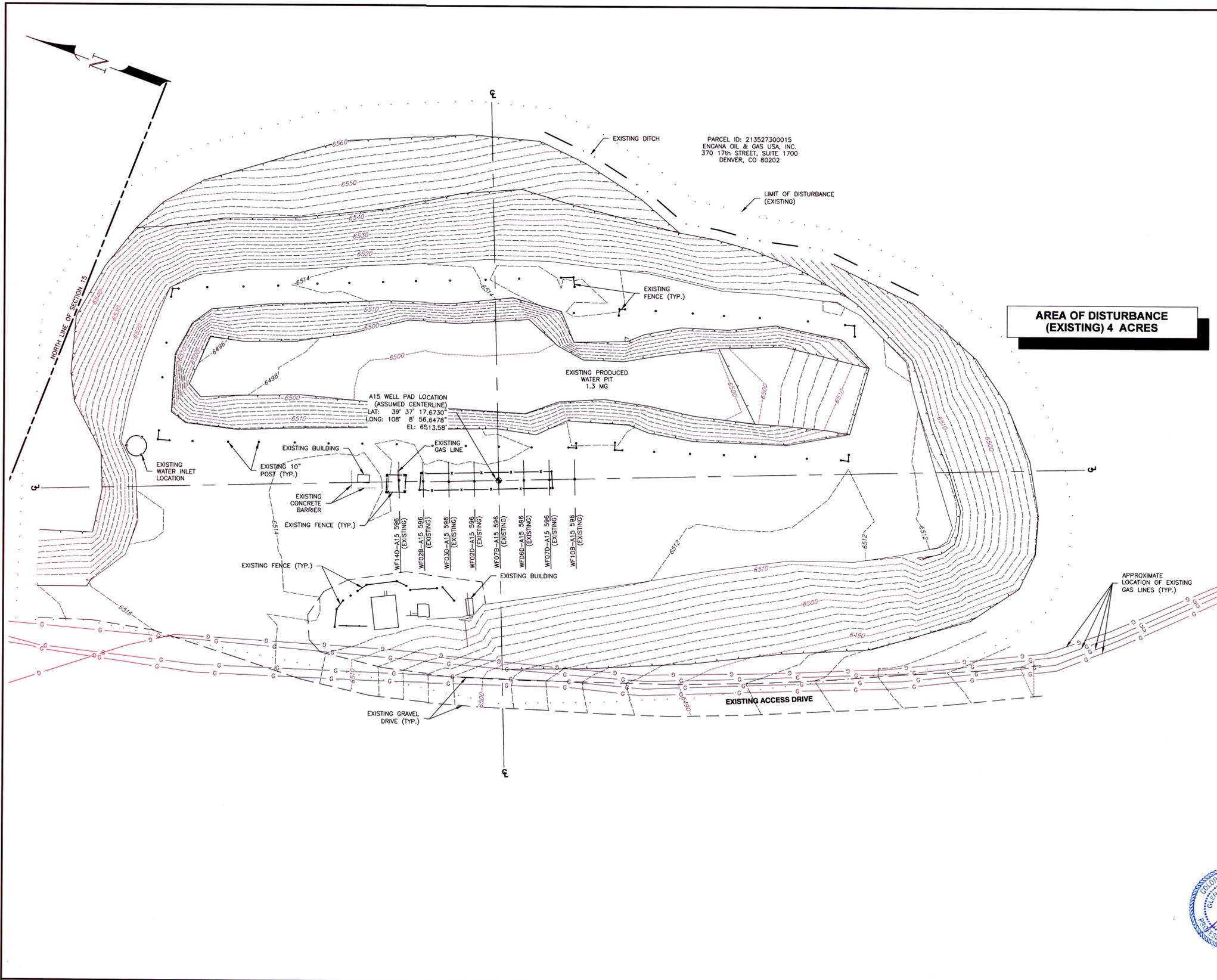


LEGEND:
WELL PAD LOCATION
7.5 MIN. QUAD:
CIRCLE DOT GULCH
CUTOFF GULCH

TOPOGRAPHIC MAP "B"
WEST FORK A15 WELL PAD
NE-NE, SEC. 15, T5S, R96W, 6TH P.M.
GARFIELD COUNTY, COLORADO
 SCALE: 1"=2000' DRAWN BY: BEC DATE: 08/12/11 REVISED:



File Path S:\ActiveProjects\Encana\West Fork A15 Well Pad\20 - CAD\CIVIL\18675-520-SIT-32201.dwg
 Saved by: CHRISTOPHERLASSON on: Jan. 5, 12 - 2:48 PM
 Plotted by: christopher lason on: Jan. 5, 12 - 2:48 PM



PARCEL ID: 213527300015
 ENCANA OIL & GAS USA, INC.
 370 17th STREET, SUITE 1700
 DENVER, CO 80202

**AREA OF DISTURBANCE
 (EXISTING) 4 ACRES**

LEGEND

	EXISTING SECTION LINE
	EXISTING MUNICIPAL BOUNDARY
	EXISTING UNPAVED ROAD
	EXISTING INDEX CONTOUR
	EXISTING INTERMEDIATE CONTOUR
	EXISTING TOP OF SLOPE
	EXISTING BOTTOM OF SLOPE
	EXISTING GAS PIPELINE
	EXISTING GAS WELL
	EXISTING PIPE BOLLARD
	EXISTING FENCE
	EXISTING BUILDING
	EXISTING CENTERLINE OF DITCH
	WELL PAD CENTERLINE LOCATION
	PROPOSED LIMIT OF DISTURBANCE

- NOTES:**
- SITE FEATURES AND TOPOGRAPHY WAS SURVEYED BY UNIVERSALPEGASUS INTERNATIONAL ON 7/21/11.
 - SURVEY BENCHMARK AND SURVEY CONTROL SHOULD BE ESTABLISHED BY THE CONTRACTOR FOR PIT LOCATION, DEPTH AND SLOPE LIMITS, PRIOR TO COMMENCING EXCAVATION ACTIVITIES.
 - PRIOR TO ANY EXCAVATION WORK ON A PAD THAT HAS PIPELINES, THE PIPELINE SHALL BE PREPARED FOR CONSTRUCTION. PIPELINE SHALL BE LOCKED-OUT/TAGGED OUT, PURGED, WATER TESTED AND OPEN TO ATMOSPHERE.
 - ONE-CALL SHALL BE MADE IN ACCORDANCE WITH COLORADO STATE LAW. AFTER ALL PIPES HAVE BEEN HORIZONTAL LOCATED, DEPTH OF PIPES MUST BE DETERMINED WHEN PIPELINES ARE WITHIN TWO FEET OF EXCAVATION. THIS SHALL BE DONE BY DIGGING 6" DOWN ON EITHER SIDE OF THE PIPE AND SLOUGHING OFF THE MATERIAL BY HAND TO LOCATE THE PIPE. WHERE SPACE IS CONFINED, POT-HOLING SHALL BE USED TO LOCATE THE PIPE.
 - PIT VOLUME SHOWN ON PLANS IS MEASURED FROM WATER SURFACE ELEVATION TO BOTTOM OF PIT AND EXCLUDES THE 2' FREEBOARD VOLUME.
 - WELL PAD LOCATION WAS ASSUMED AND DOES NOT COINCIDE WITH EXISTING WELL HEAD LOCATIONS.
 - HORIZONTAL DATUM=NAD 83
 HORIZONTAL PROJECTION=COLORADO CENTRAL ZONE
 VERTICAL DATUM=NAVD88 (GEOID 03)
 U.S. SURVEY FEET (GRID)
 COMBINED SCALE FACTOR=0.99966821
 PDOP=1.28.



ISSUED FOR CONSTRUCTION
 01/05/12



REF. DWG. NO.	REFERENCE TITLE	NO	REVISION	DATE	DRAWN	CHKD	NO

DRAWN SWH	DATE 09/01/11
CHECKED GDB	DATE 11/15/11
APPROVED GDB	DATE 11/18/11
SCALE 1"=30'-0"	SHEET 1 OF 1
JOB NO. 18675	
CLIENT ENCANA NATURAL GAS	
CLIENT JOB NO. -	

CIVIL/STRUCTURAL
**WEST FORK PARACHUTE CREEK - A15 WELL PAD
 PRODUCED WATER PIT
 TOPOGRAPHIC PROPERTY PLAN**

TSS R96W
 GARFIELD COUNTY, COLORADO

encana
 natural gas

DRAWING NO. 18675-520-SIT-32201
REV. 0

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PARCEL ID: 213527300015
 ENCANNA OIL & GAS USA, INC.
 370 17th STREET, SUITE 1700
 DENVER, CO 80202

LOCATION SCHEDULE

FACILITIES	DESCRIPTION	DISTANCE	DIRECTION
BUILDING	EXXONMOBIL BUILDING	15,586FT	NE 45.9'
BUILDING	ENCANA OIL & GAS BUILDING	19,849FT	SE 142.1'
PUBLIC ROAD	UNIMPROVED ROAD	121FT	W
PUBLIC ROAD	UNIMPROVED ROAD (402)	3,235FT	NE 62.5'
MAJOR UTILITY/POWER LINE	ABOVE GROUND POWER LINE	66,327FT	NE 68.4'
RAILROAD	DENVER/RIO GRANDE WESTERN	55,751FT	SE 165.2'
PROPERTY LINE	US BLM	960FT	S
PROPERTY LINE	EXXONMOBIL	488FT	E

NOTE: ALL DISTANCES ARE MEASURED FROM CENTERLINE OF WELL NUMBER WF-07B-A15-596

LEGEND

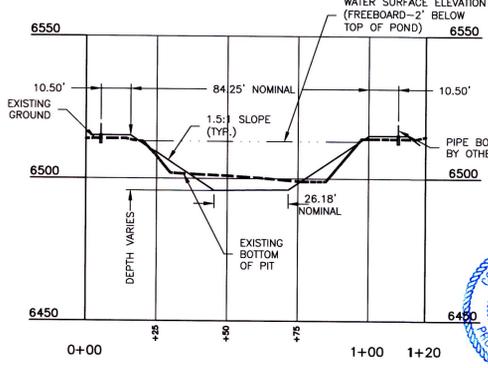
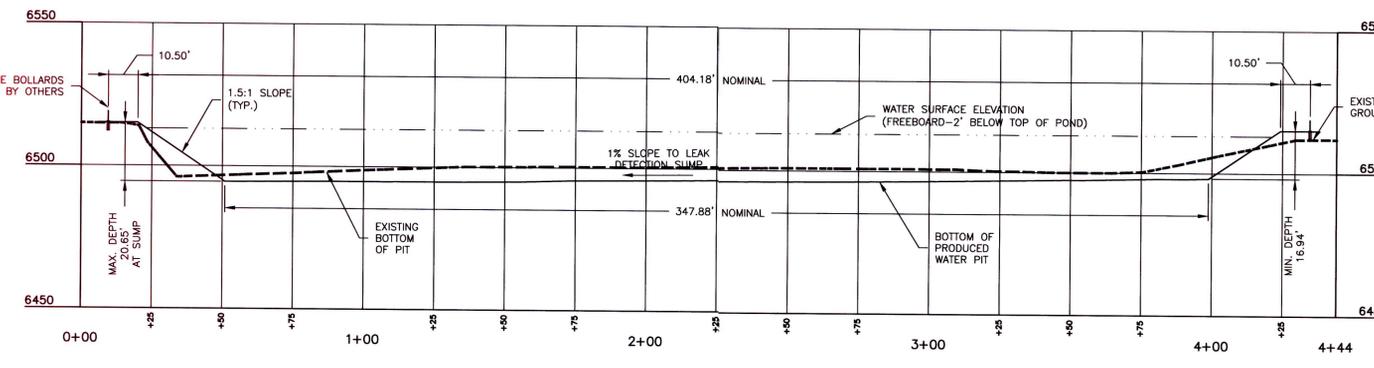
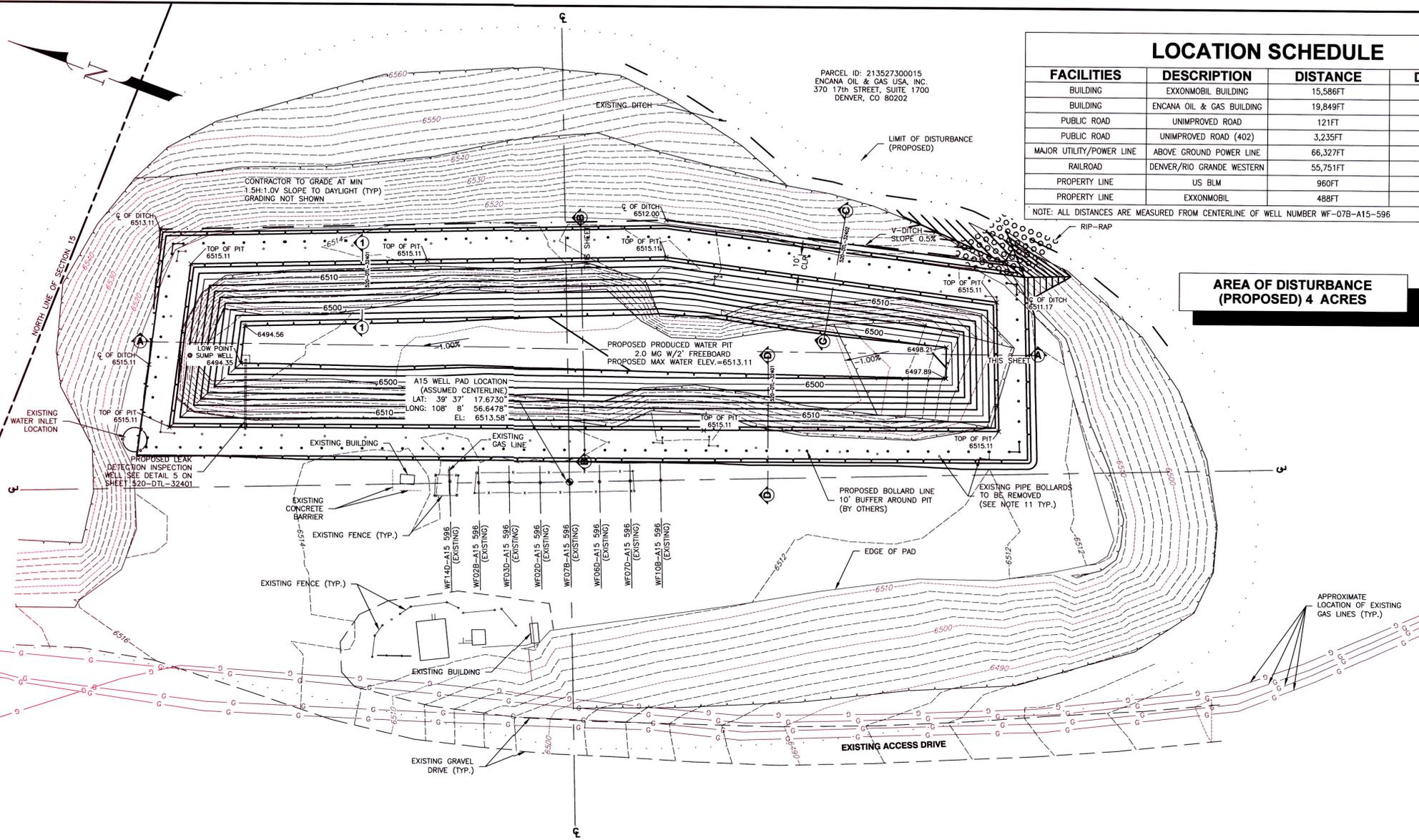
- EXISTING SECTION LINE
- EXISTING MUNICIPAL BOUNDARY
- EXISTING UNPAVED ROAD
- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- EXISTING TOP OF SLOPE
- EXISTING BOTTOM OF SLOPE
- EXISTING GAS PIPELINE
- EXISTING GAS WELL
- EXISTING PIPE BOLLARD
- EXISTING FENCE
- EXISTING BUILDING
- EXISTING CENTERLINE OF DITCH
- WELL PAD CENTERLINE LOCATION
- PROPOSED LIMIT OF DISTURBANCE
- PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- PROPOSED SPOT ELEVATION
- PROPOSED PIPE BOLLARD LINE
- PROPOSED TOP OF SLOPE
- PROPOSED BOTTOM OF SLOPE
- PROPOSED WATER SURFACE
- PROPOSED CENTERLINE OF DITCH
- PROPOSED RIP-RAP

AREA OF DISTURBANCE (PROPOSED) 4 ACRES

NOTES:

- SITE FEATURES AND TOPOGRAPHY WERE SURVEYED BY UNIVERSALPEGASUS INTERNATIONAL ON 7/21/11.
- SURVEY BENCHMARK AND SURVEY CONTROL SHOULD BE ESTABLISHED BY THE CONTRACTOR FOR PIT LOCATION, DEPTH AND SLOPE LIMITS, PRIOR TO COMMENCING EXCAVATION ACTIVITIES.
- WHERE WATERLINE RISER INTERFERES WITH PROPOSED PRODUCED WATER PIT, RISER SHALL BE RELOCATED BY OTHERS, PRIOR TO COMMENCING EXCAVATION ACTIVITIES.
- PRIOR TO ANY EXCAVATION WORK ON A PAD THAT HAS PIPELINES, THE PIPELINE SHALL BE PREPARED FOR CONSTRUCTION. PIPELINE SHALL BE LOCKED-OUT/TAGGED OUT, PURGED, WATER TESTED AND OPEN TO ATMOSPHERE.
- ONE-CALL SHALL BE MADE IN ACCORDANCE WITH COLORADO STATE LAW. AFTER ALL PIPES HAVE BEEN HORIZONTAL LOCATED, DEPTH OF PIPES MUST BE DETERMINED WHEN PIPELINES ARE WITHIN TWO FEET OF EXCAVATION. THIS SHALL BE DONE BY DIGGING 6" DOWN ON EITHER SIDE OF THE PIPE AND SLOUGHING OFF THE MATERIAL BY HAND TO LOCATE THE PIPE. WHERE SPACE IS CONFINED, POT-HOLDING SHALL BE USED TO LOCATE THE PIPE.
- PIPE BOLLARD, FENCING, SWING GATE, EMERGENCY EGRESS PERSONNEL GATES AND BIRD NETTING TO BE DESIGNED AND LOCATED BY OTHERS. PIPE BOLLARDS SHOWN ON PLAN ARE FOR INFORMATION ONLY. ALL PIPE BOLLARD PLACEMENT SHOULD AVOID EXISTING GAS AND WATER LINE INTERFERENCE.
- HORIZONTAL DATUM=HAD 83
HORIZONTAL PROJECTION=COLORADO CENTRAL ZONE
VERTICAL DATUM=NAVD83 (GEOID 03)
U.S. SURVEY FEET (GRID)
COMBINED SCALE FACTOR=0.99966821
PDOP=1.28
- WARNING SIGNS & ENTRY REGULATORY SIGNAGE TO BE PROVIDED & INSTALLED BY OWNER.
- PIT VOLUME SHOWN ON PLANS IS MEASURED FROM WATER SURFACE ELEVATION TO BOTTOM OF BIT AND EXCLUDES THE 2' FREEBOARD VOLUME.
- REMOVE EXISTING LINERS AND FILL IN EXISTING PIT WITH SPOILS FROM NEW PIT EXCAVATION. SPOILS SHOULD BE PLACED AND COMPACTED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
- EXISTING STEEL PIPE BOLLARDS IN CONSTRUCTION AREA SHALL BE REMOVED AND SET ASIDE FOR RE-USE. HOLES SHALL BE FILLED WITH ONSITE FILL MATERIAL AND THOROUGHLY COMPACTED.
- PRODUCED WATER PIT LINER SYSTEM SHALL CONSIST OF A PRIMARY AND SECONDARY LINER, A GEOTEXTILE CUSHION (GCL) LAYER, AND INTERSTITIAL DRAINAGE LAYER WITH LEAK DETECTION WELL. FOR LINER SYSTEM DETAILS SEE DWG. 520-DT1-32401
- THE FOLLOWING PROJECT SPECIFICATIONS SHALL BE INCORPORATED BY REFERENCE:
-18675-520-SPC-001 EARTHWORK AND PIT CONSTRUCTION
-18675-520-SPC-002 GEOSYNTHETIC CLAY LINER
-18675-520-SPC-003 GEOSYNTHETIC DRAINAGE LAYER
-18675-520-SPC-004 GEOMEMBRANE LINER
- CONTRACTOR TO INSTALL RIP-RAP (2" MATERIAL) AT DITCH OUTFALL SHOWN.
- EXISTING DITCHES SHALL BE RETURNED TO FUNCTIONAL CONDITION ONCE WORK IS COMPLETE.
- THE HILLSIDE NORTH AND EAST OF PIT SHALL BE STABILIZED AND SEEDED IMMEDIATELY AFTER COMPLETION OF FINISHED GRADING. CONTRACTOR SHALL INSTALL TEMPORARY EROSION CONTROL MEASURES AS REQUIRED.

PRELIMINARY EARTHWORK CALCULATIONS:
 2944 CYDS CUT
 869 CYDS FILL
 2075 CYDS NET CUT



ISSUED FOR CONSTRUCTION
 01/05/12

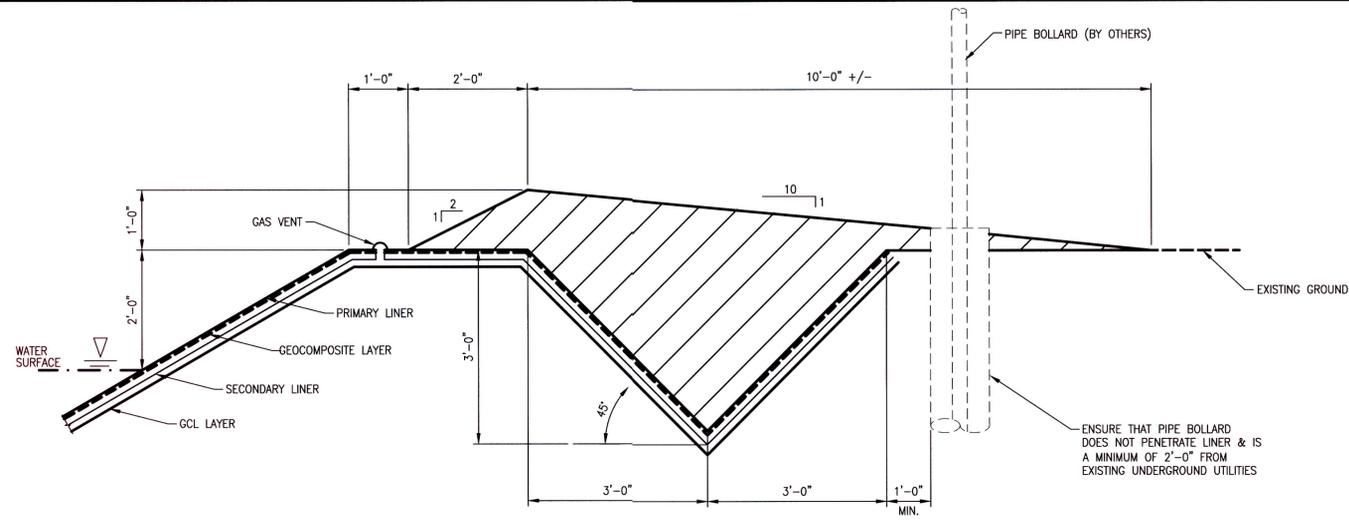
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CHECKED	GDB	DATE	11/15/11
APPROVED	GDB	DATE	11/18/11
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JOB NO.	18675		
CLIENT	ENCANA NATURAL GAS		
CLIENT JOB NO.			

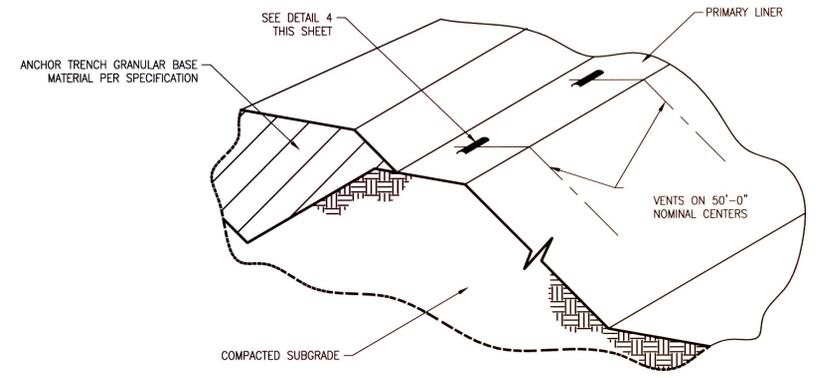
CIVIL/STRUCTURAL
**WEST FORK PARACHUTE CREEK - A15 WELL PAD
 PRODUCED WATER PIT
 LOCATION & GRADING PLAN**
 TSS R96W
 GARFIELD COUNTY, COLORADO

DRAWING NO. **18675-520-SIT-32202** REV. **0**

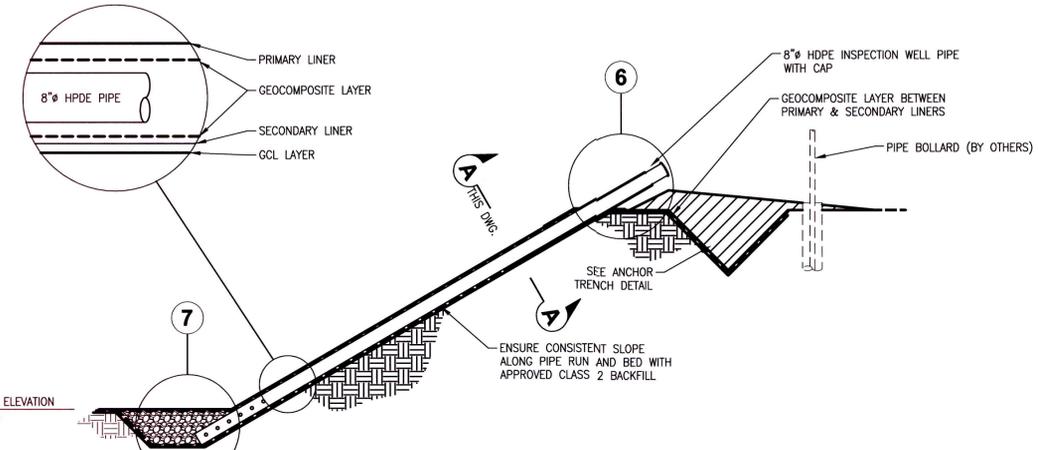
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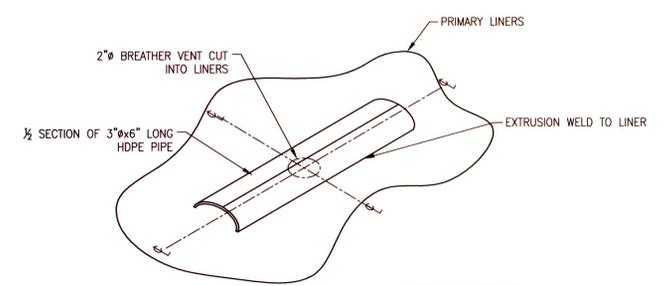
ANCHOR TRENCH DETAIL 1
SCALE : N.T.S. 520-SIT-32202



GAS VENT LOCATION DETAIL 3
SCALE : N.T.S. 520-SIT-32202

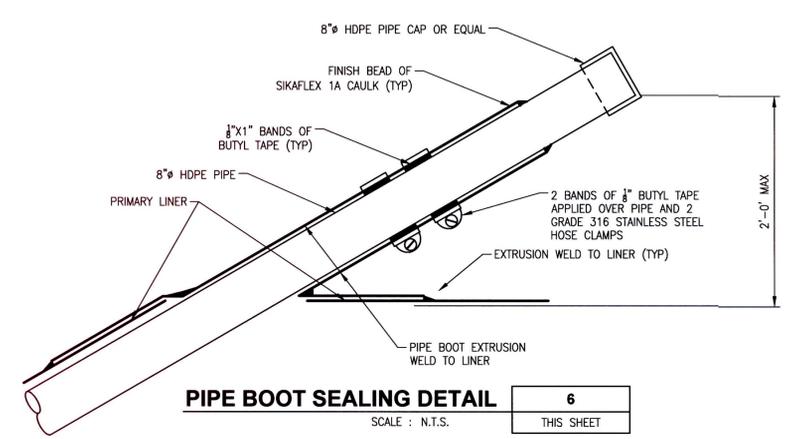


TYPICAL POND LINING SYSTEM DETAIL 2
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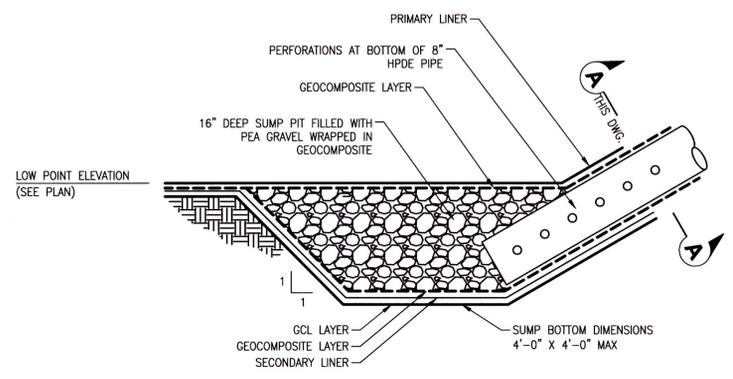


AIR/GAS VENT DETAIL 4
SCALE : N.T.S. THIS SHEET

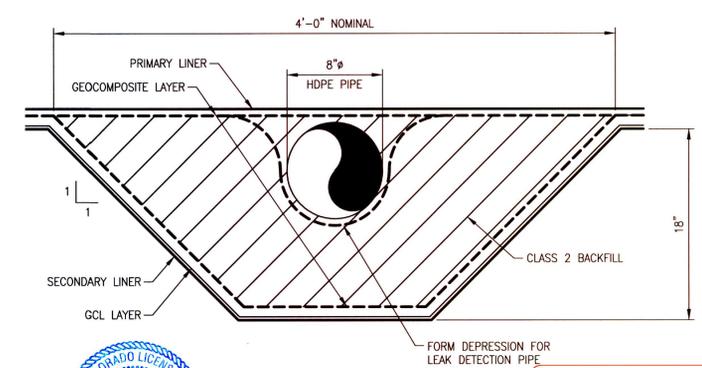
LEAK DETECTION WELL DETAIL W/ PIPE RESTING ON SLOPE GRADE 5
SCALE : N.T.S. 520-SIT-32202



PIPE BOOT SEALING DETAIL 6
SCALE : N.T.S. THIS SHEET



SUMP PIT FILLED WITH GRAVEL 7
SCALE : N.T.S. THIS SHEET



SECTION A-A
SCALE : N.T.S. THIS SHEET



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 01/05/12

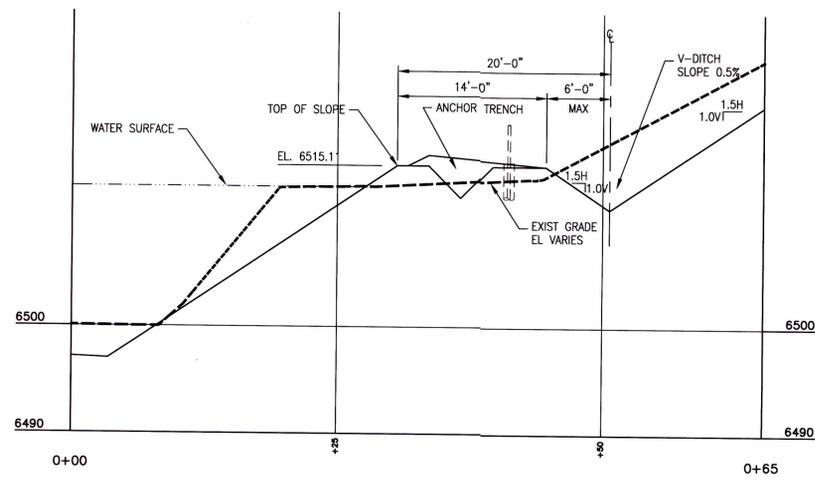
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UniversalPegasus INTERNATIONAL	DRAWN CLL	DATE 11/10/11
	CHECKED GDB	DATE 11/15/11
	APPROVED GDB	DATE 11/18/11
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	JOB NO. 18675	
	CLIENT ENCANA NATURAL GAS	
	CLIENT JOB NO. -	

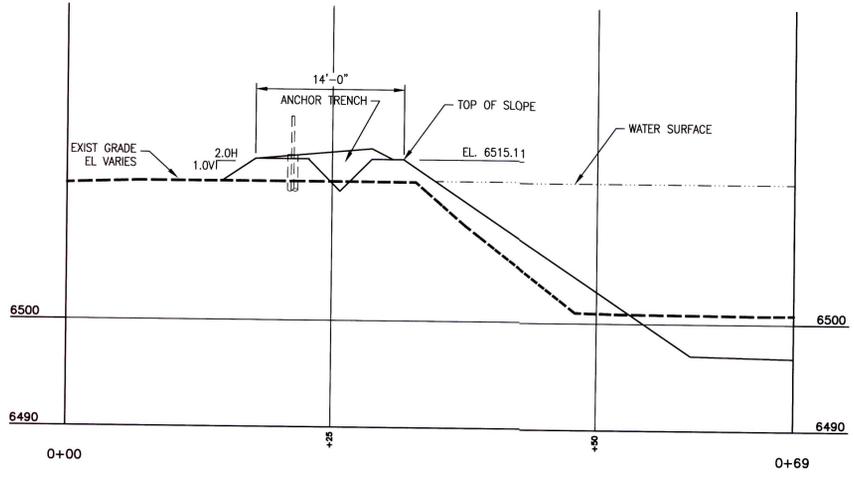
CIVIL/STRUCTURAL
WEST FORK PARACHUTE CREEK - A15 WELL PAD
 PRODUCED WATER PIT
 CIVIL DETAILS
 15S R96W GARFIELD COUNTY, COLORADO

encana
 natural gas
 DRAWING NO. 18675-520-DTL-32401
 REV. 0

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DETAIL C-C
SCALE : 1/8"=1'-0"



DETAIL D-D
SCALE : 1/8"=1'-0"



ISSUED FOR CONSTRUCTION
 01/05/12

REF. DWG. NO.	REFERENCE TITLE	NO	REVISION	DATE	DRAWN	CHKD	NO
			ISSUED FOR CONSTRUCTION	01/05/12	CLL	CDB	0



DRAWN	CLL	DATE	11/10/11
CHECKED	GDB	DATE	11/15/11
APPROVED	GDB	DATE	11/18/11
SCALE	N.T.S. SHEET 1		
JOB NO.	18675		
CLIENT	ENCANA NATURAL GAS		
CLIENT JOB NO.	-		

CIVIL/STRUCTURAL
WEST FORK PARACHUTE CREEK - A15 WELL PAD
PRODUCED WATER PIT
CIVIL DETAILS

TSS R96W GARFIELD COUNTY, COLORADO

DRAWING NO. 18675-520-DTL-32402 REV. 0

FORM
2A

Rev
04/01

State of Colorado
Oil and Gas Conservation Commission

1120 Lincoln Street, Suite 801, Denver, Colorado 80205 Phone: (303) 894-2100 Fax: (303) 894-2109



DE	ET	OE	ES
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Document Number:
400230807

Oil and Gas Location Assessment

New Location Amend Existing Location Location#: 335800

Submit original plus one copy. This form is to be submitted to the COGCC prior to any ground disturbance activity associated with oil and gas development operations. This Assessment may be approved as a standalone application or submitted as an informational report accompanying an Application for Permit-To-Drill, Form 2. Approval of this Assessment will allow for the construction of the below specified location; however, it does not supersede any land use rules applied by the local land use authority. This form may serve as notice to land owners and other interested parties, please see the COGCC web site at <http://colorado.gov/cogcc/> for all accompanying information pertinent to this Oil and Gas Location Assessment.

Location ID:
335800
Expiration Date:

This location assessment is included as part of a permit application.

1. CONSULTATION

- This location is included in a Comprehensive Drilling Plan. CDP # _____
- This location is in a sensitive wildlife habitat area.
- This location is in a wildlife restricted surface occupancy area.
- This location includes a Rule 306.d.(1)A.ii. variance request.

2. Operator

Operator Number: 100185
Name: ENCANA OIL & GAS (USA) INC
Address: 370 17TH ST STE 1700
City: DENVER State: CO Zip: 80202-5632

3. Contact Information

Name: Heather Mitchell
Phone: (720) 876-3070
Fax: (720) 876-4070
email: heather.mitchell@encana.com

4. Location Identification:

Name: N. Parachute Number: WF A15 596
County: GARFIELD
Quarter: NENE Section: 15 Township: 5S Range: 96W Meridian: 6 Ground Elevation: 6512

Define a single point as a location reference for the facility location. This point should be used as the point of measurement in the drawings to be submitted with this application. When the location is to be used as a well site then the point shall be a well location.

Footage at surface: 265 feet FNL, from North or South section line, and 827 feet FEL, from East or West section line.
Latitude: 39.621536 Longitude: -108.149049 PDOP Reading: 1.2 Date of Measurement: 07/21/2011
Instrument Operator's Name: Universal Pegasus

5. Facilities (Indicate the number of each type of oil and gas facility planned on location):

Special Purpose Pits: <input type="checkbox"/>	Drilling Pits: <input type="checkbox"/>	Wells: <input type="text" value="8"/>	Production Pits: <input type="checkbox"/>	Dehydrator Units: <input type="checkbox"/>
Condensate Tanks: <input type="checkbox"/>	Water Tanks: <input type="checkbox"/>	Separators: <input type="text" value="1"/>	Electric Motors: <input type="checkbox"/>	Multi-Well Pits: <input type="text" value="1"/>
Gas or Diesel Motors: <input type="checkbox"/>	Cavity Pumps: <input type="checkbox"/>	LACT Unit: <input type="checkbox"/>	Pump Jacks: <input type="checkbox"/>	Pigging Station: <input type="checkbox"/>
Electric Generators: <input type="checkbox"/>	Gas Pipeline: <input type="text" value="2"/>	Oil Pipeline: <input type="checkbox"/>	Water Pipeline: <input type="text" value="1"/>	Flare: <input type="checkbox"/>
Gas Compressors: <input type="checkbox"/>	VOC Combustor: <input type="checkbox"/>	Oil Tanks: <input type="checkbox"/>	Fuel Tanks: <input type="checkbox"/>	

Other: 1 meter house, 1 chemical tan

6. Construction:

Date planned to commence construction: 04/12/2005 Size of disturbed area during construction in acres: 4.00
Estimated date that interim reclamation will begin: 03/01/2012 Size of location after interim reclamation in acres: 2.50
Estimated post-construction ground elevation: 6512 Will a closed loop system be used for drilling fluids: Yes
Will salt sections be encountered during drilling: Yes No Is H2S anticipated? Yes No
Will salt (>15,000 ppm TDS Cl) or oil based muds be used: Yes No
Mud disposal: Offsite Onsite Method: Land Farming Land Spreading Disposal Facility
Other: Recycle and bury

7. Surface Owner:

Name: Encana Oil & Gas (USA)Inc Phone: 303-623-2300
Address: 370 17th Street Fax: _____
Address: Suite 1700 Email: _____
City: Denver State: CO Zip: 80202 Date of Rule 306 surface owner consultation: _____
Surface Owner: Fee State Federal Indian
Mineral Owner: Fee State Federal Indian
The surface owner is: the mineral owner committed to an oil and gas lease
 is the executer of the oil and gas lease the applicant
The right to construct the location is granted by: oil and gas lease Surface Use Agreement Right of Way
 applicant is owner
Surface damage assurance if no agreement is in place: \$2000 \$5000 Blanket Surety ID _____

8. Reclamation Financial Assurance:

Well Surety ID: 20100017 Gas Facility Surety ID: _____ Waste Mgmt. Surety ID: _____

9. Cultural:

Is the location in a high density area (Rule 603.b.): Yes No
Distance, in feet, to nearest building: 15586, public road: 121, above ground utilit: 66327
, railroad: 55751, property line: 488

10. Current Land Use (Check all that apply):

Crop Land: Irrigated Dry land Improved Pasture Hay Meadow CRP
Non-Crop Land: Rangeland Timber Recreational Other (describe): _____
Subdivided: Industrial Commercial Residential

11. Future Land Use (Check all that apply):

Crop Land: Irrigated Dry land Improved Pasture Hay Meadow CRP
Non-Crop Land: Rangeland Timber Recreational Other (describe): _____
Subdivided: Industrial Commercial Residential

12. Soils:

List all soil map units that occur within the proposed location. Attach the National Resource Conservation Service (NRCS) report showing the "Map Unit Description" report listing the soil typical vertical profile. This data is to used when segregating topsoil.

The required information can be obtained from the NRCS web site at <http://soildatamart.nrcs.usda.gov/> or from the COGCC web site GIS Online map page found at <http://colorado.gov/cogcc>. Instructions are provided within the COGCC web site help section.

NRCS Map Unit Name: NRCS #62 Rock outcrop-Torriorthents complex
NRCS Map Unit Name: _____
NRCS Map Unit Name: _____

13. Plant Community:

Complete this section only if any portion of the disturbed area of the location's current land use is on non-crop land.

Are noxious weeds present: Yes No
Plant species from: NRCS or, field observation Date of observation: 11/30/2011
List individual species: _____

Check all plant communities that exist in the disturbed area.

- Disturbed Grassland (Cactus, Yucca, Cheatgrass, Rye)
- Native Grassland (Bluestem, Grama, Wheatgrass, Buffalograss, Fescue, Oatgrass, Brome)
- Shrub Land (Mahogany, Oak, Sage, Serviceberry, Chokecherry)
- Plains Riparian (Cottonwood, Willow, Aspen, Maple, Poplar, Russian Olive, Tamarisk)
- Mountain Riparian (Cottonwood, Willow, Blue Spruce)
- Forest Land (Spruce, Fir, Ponderosa Pine, Lodgepole Pine, Juniper, Pinyon, Aspen)
- Wetlands Aquatic (Bullrush, Sedge, Cattail, Arrowhead)
- Alpine (above timberline)
- Other (describe): _____

14. Water Resources:

Rule 901.e. may require a sensitive area determination be performed. If this determination is performed the data is to be submitted with the Form 2A.

Is this a sensitive area: No Yes Was a Rule 901.e. Sensitive Areas Determination performed: No Yes
Distance (in feet) to nearest surface water: 177, water well: 1204, depth to ground water: 30
Is the location in a riparian area: No Yes Was an Army Corps of Engineers Section 404 permit filed No Yes
Is the location within a Rule 317B Surface Water Suppl Area buffer zone:
 No 0-300 ft. zone 301-500 ft. zone 501-2640 ft. zone
If the location is within a Rule 317B Surface Water Supply Area buffer have all public water supply systems within 15 miles been notified: No Yes

15. Comments:

This pad will be reclaimed to the vegetation to the south. Encana owns the surface and the minerals. This pad is already built. Encana is not adding any wells, but will be reworking an existing pit on location. Existing pit #s are 425199 and 425200. Pit permit will be filed via email to the location assessment group.

I hereby certify that the statements made in this form are, to the best of my knowledge, true, correct and complete.

Signed: _____ Date: 01/19/2012 Email: heather.mitchell@encana.com
Print Name: Heather Mitchell Title: Regulatory analyst

Based on the information provided herein, this Application for Permit-to-Drill complies with COGCC Rules and applicable orders and is hereby approved.

COGCC Approved: _____ Director of COGCC Date: _____

CONDITIONS OF APPROVAL, IF ANY:

All representations, stipulations and conditions of approval stated in this Form 2A for this location shall constitute representations, stipulations and conditions of approval for any and all subsequent operations on the location unless this Form 2A is modified by Sundry Notice, Form 4 or an Amended Form 2A.

--

Attachment Check List

Att Doc Num	Name
400230807	FORM 2A SUBMITTED
400243042	NRCS MAP UNIT DESC
400243044	ACCESS ROAD MAP
400243047	CONST. LAYOUT DRAWINGS
400243071	LOCATION DRAWING
400243080	MULTI-WELL PLAN
400243081	HYDROLOGY MAP
400243085	REFERENCE AREA PICTURES
400243087	REFERENCE AREA PICTURES
400243089	REFERENCE AREA PICTURES
400243091	REFERENCE AREA PICTURES

Total Attach: 11 Files

General Comments

<u>User Group</u>	<u>Comment</u>	<u>Comment Date</u>

Total: 0 comment(s)

BMP

<u>Type</u>	<u>Comment</u>
Wildlife	<ul style="list-style-type: none">• Prohibit Encana employees and contractors from carrying projectile weapons. Except during company organized events.• Prohibit pets on property.• Strategically apply fugitive dust control measures, including enforcing established speed limits on Encana private roads, to reduce fugitive dust and coating of vegetation and deposition in water sources.
Construction	<ul style="list-style-type: none">• Use solar panels as an alternative energy source for on-location production equipment, where appropriate, economically and technically feasible.• Use multiple gathering lines placed in a single trench to minimize disturbance and construction, where appropriate, economically and technically feasible.• Install trench plugs (sloped to allow wildlife or livestock to exit the trench should they enter) at known wildlife or livestock trails to allow safe crossing on long spans of open trench, where appropriate, economically and technically feasible.• Maintain a minimum of five feet of soil cover between the pipeline and the lowest point of the drainage or water body channel.

Total: 2 comment(s)



Letter Of Transmittal

CLIENT AFE 11153681

Date: 5-Jan-12
To: Mr. Kevin McDowell
Company: Encana Oil & Gas (USA), Inc.
Address: Republic Plaza
370 17th Street, Suite 1700
Denver, CO 80202

Transmittal Number: 18675-100-XMT-002
From: Glen Bancroft
Company: UniversalPegasus
RE: W.F. Parachute Creek - A15 Well Pad
Produced Water Pit Modifications
Issued for Construction (IFC) Package
18675
UPI Project Number: 18675

Phone Number: 720.876.5836

SENDING:

- Via Email
- Via Fax
- Via USPS
- Via FedEx (Tracking No.) _____
- Via Courier _____
- Attached
- Under Separate Cover
- Drawings
- Letter
- Change Order
- Data Sheets
- Specifications
- Material Requisition
- Purchase Order
- Quotes
- Estimate
- Schedule
- Vendor Dwgs
- Vendor Data
- Original
- _____
- _____

ITEM	QTY	DOCUMENT NUMBER	DESCRIPTION
1	1	18675-520-SIT-32201	Drawing - Topographic Property Plan
2	1	18675-520-SIT-32202	Drawing - Location and Grading Plan
3	1	18675-520-DTL-32401	Drawing - Civil Details
4	1	18675-520-DTL-32402	Drawing - Civil Details
5	1	18675-520-SPC-001	Performance Specification for Earthwork and Pit Construction
6	1	18675-520-SPC-002	Performance Specification for Geosynthetic Clay Liner
7	1	18675-520-SPC-003	Performance Specification for Geocomposite Drainage Layer
8	1	18675-520-SPC-004	Performance Specification for Geomembrane Liner
9			
10			
11			
12			

THESE ARE TRANSMITTED AS MARKED BELOW:

- Issue for Review & Comment
- Issue for Approval
- Issue for Bid
- Issue for Construction
- For Your Use or As Requested
- Approved as Submitted
- Approved as Noted
- Return for Revision
- Return for Approval
- Submit for Distribution
- Return by **Xmtl Date** _____
(Date)

REMARKS: Please contact me if you have any questions or comments.

<p>Received</p> <p>SIGNED: _____ DATE: _____</p> <p style="color: red; text-align: center;">Please sign above then promptly scan and return</p>

Sent

SIGNED: Glen Bancroft

TITLE: Project Manager

EMAIL: glen.bancroft@universalpegasus.com

COPY TO: File _____

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		Revision:	0
		Rev. Date:	1/05/12

DOCUMENT No. 18675-520-SPC-001

PERFORMANCE SPECIFICATION FOR EARTHWORK AND PIT CONSTRUCTION

ENCANA OIL & GAS (USA), INC. – SRBU N. PICEANCE

**W.FORK PARACHUTE CREEK – A15 WELL PAD
PRODUCED WATER PIT MODIFICATION PROJECT**

GARFIELD COUNTY, COLORADO

Engineer Stamp:	Approvals:						
		By:	Date:				
	Initiator:	G. Bancroft	11/23/11				
	Mechanical:			Revisions:			
	Civil:	G. Mostofa	11/23/11				
	Electrical:			Rev.:	Date:	By:	Approval:
	Instrument:			0	1/05/12	GDB	GDB
	Project. Mgr.:	G. Bancroft	11/23/11				
	Client:						

THIS DOCUMENT IS SOLELY FOR THE USE OF THE CONTRACTUAL CLIENT AND VENDORS OF UNIVERSALPEGASUS INTERNATIONAL. UNIVERSAL ASSUMES NO LIABILITY TO ANY OTHER PARTY FOR ANY REPRESENTATIONS CONTAINED IN THIS DOCUMENT.

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PERFORMANCE SPECIFICATION FOR EARTHWORK AND PIT CONSTRUCTION

1. GENERAL

1.1. SCOPE

- 1.1.1. This specification covers the technical requirements for earthwork and pit construction for the produced water pit modification project at the A15 Well Pad. The project site is located adjacent to the West Fork of Parachute Creek, in the Piceance Basin, Garfield County, Colorado. All materials shall meet or exceed the requirements of this specification, and all work shall be performed in accordance with the procedures provided in these project specifications.
- 1.1.2. This specification covers the general earthwork and pit construction required for constructing a double synthetic lined pit with leak detection system, in accordance with Paragraph 904.c(3) of the Colorado Oil & Gas Conservation Commission, E&P Waste Management Rules.
- 1.1.3. Related project specifications
 - 18675-520-SPC-002 GEOSYNTHETIC CLAY LINER
 - 18675-520-SPC-003 GEOCOMPOSITE DRAINAGE LAYER
 - 18675-520-SPC-004 GEOMEMBRANE LINER
- 1.1.2. This specification establishes the quality of materials and workmanship for furnishing, delivering, installing and constructing hard material subgrade and standard leak detection wells for double-lined systems.

1.2. REFERENCES

- 1.2.1. 29 CFR – United States Code of Federal Regulations
 - Part 1910 Occupational Safety and Health Standards
 - Part 1926 Safety and Health Regulations for Construction
- 1.2.2. American Society for Testing and Materials (ASTM)
 - ASTM D 422 Standard Method of Test for Particle-Size/Analysis of Soil
 - ASTM D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
 - ASTM D 2487 Standard Test Methods for Classification of Soils for Engineering Purposes
 - ASTM D 2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
 - ASTM D 3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as used in Engineering Design and Construction

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- ASTM D 7382 Standard Test Methods for Determination of Maximum Dry Unit Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibrating Hammer

1.2.3. Colorado Oil & Gas Conservation Commission (COGCC)

- 900 Series Rules, "E&P Waste Management"

1.3. DEFINITIONS

1.3.1. CQA INSPECTOR - Construction Quality Assurance Inspector, independent from CONTRACTOR that is responsible for observing and documenting activities related to quality assurance during the earthwork and pit construction. The CQA INSPECTOR may be the OWNER's Representative or an independent agent hired by the OWNER.

1.3.2. ENGINEER - The individual or firm responsible for the design and preparation of the project's Contract Drawings and Specifications.

1.3.3. CONTRACTOR- Party responsible for earthwork and pit construction, including excavation, stockpiling, filling, compaction, and finish grading.

1.3.4. OWNER - Shall mean Encana Natural Gas.

1.3.5. GEOTECHNICAL ENGINEER – The individual or firm responsible for performing the site geotechnical investigation and preparation of the project soils report.

1.3.6. TESTING LABORATORY – Soil Testing Laboratory, independent from the CONTRACTOR, responsible for conducting laboratory tests on soil samples obtained at the site or during excavation, filling, and compaction, under the direction of the GEOTECHNICAL ENGINEER.

1.4. QUALITY ASSURANCE

1.4.1. The OWNER will engage and pay for the services of a CQA INSPECTOR, GEOTECHNICAL ENGINEER, and TESTING LABORATORY to monitor earthwork and pit construction, and provide required testing.

1.5. QUALIFICATIONS

1.5.1. CONTRACTOR

- CONTRACTOR shall have worked in a similar capacity on at least 5 projects similar in complexity to the project described in the contract documents.
- The CONTRACTOR's Site Supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.

1.6. FIELD QUALITY ASSURANCE

1.6.1. Quality assurance during preparation of hard material subgrade shall be performed by a CQA INSPECTOR on behalf of the ENGINEER. Inspections performed during construction shall be documented and the subgrade shall be approved by the ENGINEER prior to placement of the liner system.

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PERFORMANCE SPECIFICATION FOR EARTHWORK AND PIT CONSTRUCTION

1.6.2. The OWNER shall engage in a third part independent inspection firm for the CQA INSPECTOR.

2. MATERIALS

2.1. BORROW/FILL MATERIAL

- 2.1.1. Material for subgrade shall consist of the naturally occurring clay, silt, sand, and gravel, shaped to the lines and grades on the drawings. The side slopes and bottom of the excavation shall be shaped with aggregate less than 1 inch in diameter in a manner that is smooth and does not allow for protrusion of material greater than ½ inch from the planar surface of the side slopes and bottom of the pit.
- 2.1.2. Drill cuttings mixed with fly ash and wood chips or drill cuttings alone may be used to provide a smooth finish to the subgrade for placement of the geosynthetic clay liner material. Such cuttings must have passed the testing required by Table 910-1 of the COGCC E&P Waste Management Standards.
- 2.1.3. Class 2 Backfill is defined as all soils and rock excavated at the site with a diameter of less than 2 inches. Suitable equipment or approved procedures shall be provided to ensure the maximum dimension is not exceeded.

2.2. LEAK DETECTION WELL

- 2.2.1. The leak detection observation well shall consist of an 8 inch diameter HDPE pipe, perforated at the bottom end as shown on the drawings. The observation well pipe shall be sealed from the primary liner with a pipe boot. A removable cap shall be provided above grade as shown on the drawings.
- 2.2.2. A minimum 4-ft x 4-ft x 16-in deep sump pit filled with 3/8 inch washed pea gravel and wrapped with 6-oz non-woven/non-woven geocomposite (see related specification) shall be placed at the low point of the pond and at the bottom end of the leak detection well.

2.3. SITE CONDITIONS

- 2.3.1. Data on indicated subsurface conditions is made available for the convenience of the earthwork contractor and is not intended as representations or warranties of continuity of such conditions.
- 2.3.2. Protect existing benchmarks, monuments, and other reference points; if disturbed or destroyed, replace as directed by OWNER.
- 2.3.3. Erect and maintain such safeguards as required by construction operations, codes, or existing conditions, for the safety of persons or property, and to protect the same from damage, injury, or loss. Labor safety regulations set forth in OSHA 29-CFR Parts 1910 and 1926 shall apply to all work performed.
- 2.3.4. Provide for diversion of surface drainage during the period of earthwork, keeping excavations free of water during entire process of work, regardless of cause, source or nature of the water.

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3. EXECUTION

3.1. FAMILIARIZATION

3.1.1. Inspection

- Prior to implementing any of the work, the CONTRACTOR shall carefully inspect and verify the existing site conditions that may affect his work.
- If there is conflict between the project drawings and specifications, the more stringent requirement shall apply.
- If the existing site conditions do not match the drawings or specifications, the CONTRACTOR shall notify the ENGINEER.

3.2. EQUIPMENT

3.2.1. Excavating and grading equipment shall be of appropriate size and type for the proposed usage.

3.2.2. See related project specifications for finish surface requirements for preparation for geosynthetics installation.

3.3. SURVEY

3.3.1. The CONTRACTOR shall establish all necessary control points for execution of the work. The CONTRACTOR shall be responsible for all construction surveying to control the work.

3.3.2. Cross-sections of the final as-built condition will be taken as directed.

3.3.3. Prior to installation of any geosynthetics, CONTRACTOR shall verify with grading level that the pit side slopes are at or below maximum slope indicated on the drawings, the bottom of the pit slopes as designed for leak detection system, and the pit depth and general layout is per the drawings.

3.3.4. All survey work will be subject to checking by the OWNER.

3.4. CLEARING AND GRUBBING

3.4.1. Existing pit shall be drained and the existing liner system removed prior to construction. OWNER will identify point of discharge.

3.4.2. Existing fencing, bollards, and netting will be removed prior to the start of work to allow for proper reshaping of the existing pit.

3.4.3. Fluids, solids, and existing liners removed from the existing pit shall be disposed of by the CONTRACTOR, at the waste location(s) identified and approved by OWNER.

3.4.4. Clearing and grubbing shall be performed as required. Clearing will consist of the removal and disposal of all brush, grass, rubbish, and other obstructions resting on the surface of the original ground. Unless otherwise indicated, clearing shall be performed within the limits of and ten feet outside of the construction area. Grubbing shall be performed within all areas of construction. Cleared and

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grubbed materials shall be removed from the jobsite and disposed of by the CONTRACTOR at the waste location(s) identified and approved by the OWNER.

3.5. DUST CONTROL

3.5.1. Apply water or chemical agent for the control of airborne dust originating as a result of earthwork operations in accordance with applicable local ordinances and regulations. Chemicals, if utilized, are to be approved in advance of use by field.

3.6. EXCAVATION

3.6.1. Classification of all excavated materials shall be included in the following:

- Common and Rippable Excavation – for purposes of classification of excavation, Common and Rippable Excavation shall consist of all materials that can be excavated without blasting. Rippable excavation shall consist of all materials that can be effectively loosened or broken down by ripping in a single pass with a late model tractor-mounted hydraulic ripper equipped with one digging point of standard manufacturer’s design adequately sized for use with and propelled by a crawler-type tractor rated equal to or better than a D-9 Caterpillar flywheel horsepower, operating in low gear. Additionally, all boulders or detached pieces of solid rock less than 2 cubic yards in volume will be classified as Common and Rippable Excavation.
- Rock Excavation – For the purpose of classification of excavation, rock is defined as sound and solid masses, layers, or ledges of mineral matter in place and of such hardness and texture that it cannot be effectively loosened or broken down by a hydraulic ripper specified above. Testing to determine compliance with this classification shall be made when requested. All boulders or detached masses of solid rock larger than 2 cubic yards in volume will be classified as rock.

3.6.2. Suitable excavated materials conforming to the requirements of this section shall be utilized in backfills. Unsuitable material within the limits of excavation shall be removed and disposed of as waste. Unsuitable material defined as material that is greater than 2 inches in diameter, organic materials and debris of any kind, or any material that is protruding from the planar surface of the bottom of the pit, side slopes of the pit, and within the anchor trench. Unsuitable or excess excavated material shall be disposed of by the CONTRACTOR at OWNER’s designated waste locations.

3.6.3. The method of excavation shall not weaken surrounding areas or damage structures or parts thereof that are completed or under construction. Existing structures and utilities adjacent to excavations shall be protected and supported to prevent displacement.

3.6.4. Excavations shall conform within the tolerances specified to the lines, grades, sections and elevations shown on the drawings.

3.6.5. Unless otherwise indicated on the drawings, grading tolerances shall be zero to minus four inches for horizontal and sloped planes of excavation in earth and zero to minus six inches for horizontal and sloped planes of excavation in rock.

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- 3.6.6. Over-excavated areas within the pit area shall be restored with properly compacted Class 2 material to the elevations shown on drawings. Compaction equipment shall be suitable for the size and depth of the holes being filled.
- 3.6.7. If any areas outside of the pit area are over-excavated in rock, the over-excavation shall be restored by backfilling spaces under and adjacent to footings, foundations, or other bearing portions of structures with controlled low strength material having a 28-day compressive strength of 150 psi. Restoration of over – excavated areas in rock and soil shall provide uniform bearing values at least equivalent to that previously given by the excavation prior to the over excavation.
- 3.6.8. Areas being excavated and areas to be backfilled shall be maintained in a clean condition free from debris.

3.7. STOCKPILING

- 3.7.1. As part of the earthwork operations, stockpiling of excavated or borrowed material may be required.
- 3.7.2. Approved fill materials and bedding materials shall be stockpiled separately.
- 3.7.3. Soil stockpiles and waste material shall be placed in such a manner to provide natural drainage and a stable embankment as approved by the OWNER.
- 3.7.4. Stockpiles shall be constructed with maximum height not exceeding 40 feet.
- 3.7.5. Location of stockpiles shall be determined by the OWNER.

3.8. BACKFILL AND COMPACTION

- 3.8.1. Approved fill material shall be placed in thin, loose lifts of 8 inches thick or less, moisture conditioned to within 3 percent of optimum moisture content, and compacted to at least 95 percent of maximum standard Proctor dry density as measured by ASTM D698. Placement and compaction of fill shall be observed and tested by a representative of the GEOTECHNICAL ENGINEER.
- 3.8.2. Bottom and side slopes of excavation shall be rolled to ensure that no soft or loose spots remain. Care must be taken to ensure that tracks compact evenly and do not “bridge” between hard points, leaving uncompacted material in between.
- 3.8.3. Existing fill material at the job site may require mixing and/or additional of fine material in order to achieve specified compacted dry density, as directed by the representative of the GEOTECHNICAL ENGINEER.

3.9. ANCHOR TRENCH

- 3.9.1. Liner runout and anchor trench shall be constructed to the dimensions as indicated on the drawings. The subgrade surface of the anchor trench and runout shall be of the same material as the side slope of the pit, and shall be smooth for placement of the liner system. Subgrade shall be inspected by the GEOTECHNICAL ENGINEER prior to placement of liner materials.
- 3.9.2. Class 2 Backfill, as defined herein shall be used to backfill over the liner runout and in the anchor trench.

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PERFORMANCE SPECIFICATION FOR EARTHWORK AND PIT CONSTRUCTION

- 3.9.3. Approved fill material shall be placed in thin, loose lifts of 8 inches thick or less, moisture conditioned to within 3 percent of optimum moisture content, and compacted to at least 95 percent of maximum standard Proctor dry density as measured by ASTM D698. Placement and compaction of fill shall be observed and tested by a representative of the GEOTECHNICAL ENGINEER.
- 3.9.4. Tolerance for final grade over runout and anchor trench shall be minus zero to plus two inches.

3.10. PIPE TRENCH EXCAVATION

- 3.10.1. The pipe location for the leak detection system shall be over excavated.
- 3.10.2. The bottom and sides of the trench shall be finished as required for the pit subgrade and with similar surface treatment.
- 3.10.3. The bottom geocomposite clay liner (GCL) and secondary HDPE liner shall deform into the trench beneath a lapped geocomposite layer.
- 3.10.4. The pipe shall be installed and trench backfilled with Class 2 backfill or approved drill cuttings up to and flush with the pit side walls, so that the pipe rests in bedding material, as indicated on the drawings.
- The pipe shall be onsite and used to test the slope of the trench to ensure a uniform slope to the top.
 - No bends will be allowed in the pipe.
- 3.10.5. A second geocomposite layer shall be installed over the trench backfill material such that the backfill material is completely encapsulated by geocomposite material, as indicated on the drawings. Ensure that the primary liner is not significantly deformed over the pipe or mounded over the trench backfill.

3.11. LEAK DETECTION SUMP WELL

- 3.11.1. The sump well location for the leak detection system shall be over excavated. The leak detection sump shall be excavated so as to provide the cover, bedding depth, and minimum dimensions as shown on the drawings.
- 3.11.2. The bottom and sides of the well shall be finished as required for the pit subgrade and with similar surface treatment.
- 3.11.3. The bottom geocomposite clay liner (GCL) and secondary HDPE liner shall deform into the well beneath a lapped geocomposite layer.
- 3.11.4. The pipe shall be installed and well backfilled with washed 3/8 inch pea gravel up to and flush with the pit bottom, as indicated on the drawings.
- The pipe shall be secured in place so as not to be moved during backfilling operations.
- 3.11.5. A second geocomposite layer shall be installed over the sump gravel bed such that the gravel bed is completely encapsulated by geocomposite material, as indicated on the drawings. Ensure that the primary liner is not significantly mounded over the sump well gravel bed.

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PERFORMANCE SPECIFICATION FOR EARTHWORK AND PIT CONSTRUCTION

3.12. RESHAPING AND GRADING EXISTING IMPROVEMENTS

- 3.12.1. Prior to commencing finish grading, existing improvements shall be checked for their compliance with rough grading requirements shown on the drawings and restored to original lines, grade, and cross section, if required.
- 3.12.2. Clean and reshape previously constructed ditches of sediment and debris to original lines, grade, and cross section.
- 3.12.3. Clean all previously constructed culverts of sediment and debris.

3.13. FINISH GRADING

- 3.13.1. The bottom of the pit shall be graded to drain to the leak detection system sump pit, as indicated on the drawings.
- 3.13.2. Benching of Sloped Surfaces:
 - Pit side slopes shall be no steeper than 1.5 to 1 (horizontal to vertical) as indicated on the drawings.
 - Tolerance for side slopes will be 2 inches in a 4 foot length of straight edge provided the transitions are smooth curves.
- 3.13.3. Surface Preparation:
 - Liner system materials shall not be placed in direct contact with rock under any circumstances.
 - Where rock is exposed at the final finish grades under liner system, the rock shall be overexcavated a minimum of 6 inches and backfilled with clean drill cuttings.
 - Existing rippable hard material on the exposed surface of the pit bottom and side slopes shall be reduced in size to a maximum of 1 inch in diameter.
 - Ensure that there are no rock protrusions more than ½ inch above the planar surface of the pit bottom, side walls, and anchor trench. Reduction of this rock shall be done with the most appropriate means and methods available, such as crushing, tracking, ripping, or the use of compaction equipment. Large or very hard materials which are resistant to crushing with available equipment may require removal or reduction with special equipment.
- 3.13.4. Filling Holes, Depressions and Cavities:
 - Depressions and other cavities shall be filled in with Class 2 material or clean drill cutting to the elevations of the pit bottom and side slopes indicated on the drawings.
 - Crushed rock of less than 1 inch in diameter may also be used to fill in holes, depressions, and cavities. Compaction equipment shall be suitable for the size and depth of the holes being filled.
- 3.13.5. Finish Grading Tolerances:

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- The finish grade tolerance shall be plus zero and minus four inches to the lines and grades as indicated on the drawings.
- Areas not within the allowable tolerances shall be corrected by breaking, scarifying, placing additional material, remixing, and respacing to the specifications herein.

3.14. CLEANUP

3.14.1. Leave work area in a clean and neat condition. Grade all disturbed surfaces to prevent standing surface water.

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DOCUMENT No. 18675-520-SPC-002

**PERFORMANCE SPECIFICATION
FOR
GEOSYNTHETIC CLAY LINER**

ENCANA OIL & GAS (USA), INC. – SRBU N. PICEANCE

**W.FORK PARACHUTE CREEK – A15 WELL PAD
PRODUCED WATER PIT MODIFICATION PROJECT**

GARFIELD COUNTY, COLORADO

Engineer Stamp:	Approvals:						
		By:	Date:				
	Initiator:	G. Bancroft	11/23/11				
	Mechanical:			Revisions:			
	Civil:	G. Mostofa	11/23/11				
	Electrical:			Rev.:	Date:	By:	Approval:
	Instrument:			0	1/05/12	GDB	GDB
	Project. Mgr.:	G. Bancroft	11/23/11				
	Client:						

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PERFORMANCE SPECIFICATION FOR GEOSYNTHETIC CLAY LINER

1. GENERAL

1.1. SCOPE

- 1.1.1. This specification covers the technical requirements for the Manufacturing and Installation of the fabric-encased geosynthetic clay liner (GCL) to be used for the produced water pit modification project at the A15 Well Pad. The project site is located adjacent to the West Fork of Parachute Creek, in the Piceance Basin, Garfield County, Colorado. All materials shall meet or exceed the requirements of this specification, and all work shall be performed in accordance with the procedures provided in these project specifications.
- 1.1.2. The GCL shall be utilized as synthetic matting-type padding beneath a double synthetic liner system, in accordance with Paragraph 904.c(3) of the Colorado Oil & Gas Conservation Commission, E&P Waste Management Rules.
- 1.1.3. Related project specifications
 - 18675-520-SPC-001 EARTHWORK AND PIT CONSTRUCTION
 - 18675-520-SPC-003 GEOCOMPOSITE DRAINAGE LAYER
 - 18675-520-SPC-004 GEOMEMBRANE LINER

1.2. REFERENCES

- 1.2.1. American Society for Testing and Materials (ASTM)
 - ASTM D 4632, "Standard Test Method for Grab Breaking Load and Elongation of Geotextiles"
 - ASTM D 4643, "Determination of Water (Moisture) Content of Soil by the Microwave Oven Method"
 - ASTM D 5084, "Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter"
 - ASTM D 5261, "Standard Test Method for Measuring Mass Per Unit Area of Geotextiles"
 - ASTM D 5321, "Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method"
 - ASTM D 5887, "Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter"
 - ASTM D 5888, "Standard Guide for Storage and Handling of Geosynthetic Clay Liners"
 - ASTM D 5889, "Standard Practice for Quality Control of Geosynthetic Clay Liners"
 - ASTM D 5890, "Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners"

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- ASTM D 5891, "Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners"
 - ASTM D 5993, "Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners"
 - ASTM D 6102, "Standard Guide for Installation of Geosynthetic Clay Liners"
 - ASTM D 6243, "Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method"
 - ASTM D 6496, "Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners"
 - ASTM D 6768, "Standard Test Method for Tensile Strength of Geosynthetic Clay Liners"
 - ASTM E 96, "Standard Test Methods for Water Vapor Transmission of Materials"
- 1.2.2. Colorado Oil & Gas Conservation Commission (COGCC)
- 900 Series Rules, "E&P Waste Management"

1.3. DEFINITIONS

- 1.3.1. CQA INSPECTOR - Construction Quality Assurance Inspector, independent from MANUFACTURER and INSTALLER that is responsible for observing and documenting activities related to quality assurance during the lining system construction. The CQA INSPECTOR may be the OWNER's Representative or an independent agent hired by the OWNER.
- 1.3.2. ENGINEER - The individual or firm responsible for the design and preparation of the project's Contract Drawings and Specifications.
- 1.3.3. INSTALLER- Party responsible for field handling, transporting, storing, deploying, and seaming the geosynthetic clay liner.
- 1.3.4. MANUFACTURER - The party responsible for manufacturing the geosynthetic clay liner rolls.
- 1.3.5. OWNER - Shall mean Encana Natural Gas.
- 1.3.6. TESTING LABORATORY - Geosynthetic Quality Assurance Laboratory, independent from the MANUFACTURER and INSTALLER, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the OWNER.
- 1.3.7. Geosynthetic Clay Liner (GCL) - A factory manufactured hydraulic barrier consisting of granular sodium bentonite clay, sandwiched between, supported and encapsulated by two geotextiles, held together by needlepunching.

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- 1.3.8. Geotextile - A semi-permeable woven or nonwoven fabric used to contain the bentonite used in a GCL.
- 1.3.9. Sodium Bentonite - The high swelling clay component of GCLs consisting primarily of the mineral Montmorillonite.
- 1.3.10. Needlepunching - A GCL manufacturing process whereby boards of barbed needles incorporate the staple fibers from a nonwoven geotextile, through a sodium bentonite clay layer, into the matrix of a second geotextile layer.
- 1.3.11. Thermal Fusing - A needlepunching enhancement process utilizing heat to bond the needlepunched fibers and more permanently lock them into the second geotextile to increase the internal shear strength characteristics.
- 1.3.12. Minimum Average Roll Value (MARV) - The minimum average value of the material in a particular lot calculated as the mean of the tested values minus two standard deviations providing a 95% confidence level.

1.4. SUBMITTALS

1.4.1. Pre-Award

- Manufacturer's Quality Control Manual
- Manufacturer's Product Datasheet for proposed material
- Project Reference List for GCL consisting of at least ten projects totaling 10 million square feet in size.
- A representative sample, approximately 3" x 5" of proposed GCL

1.4.2. Post-Award

- Prior to shipping material to site
 - Certification of quality control tests from manufacturer of GCL product
 - Certification of quality control tests from manufacturer of Bentonite
- Prior to installing GCL
 - Certification signed by the Contractor and CQA INSPECTOR of subgrade acceptance
- Upon completion of GCL installation
 - Certification by Installer that the GCL was installed per project specifications
 - Material and Installation Warranties
 - As-built drawings showing actual GCL placement

1.5. CONSTRUCTION QUALITY ASSURANCE (CQA)

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- 1.5.1. The OWNER will engage and pay for the services of a third party CQA INSPECTOR and lab for monitoring the quality and installation of the GCL.
- 1.5.2. The specific CQA INSPECTOR designated by the OWNER shall be responsible for all aspects of the QA program, including the documentation and monitoring of the manufacturing and installation processes.

1.6. QUALIFICATIONS

1.6.1. Manufacturer

- GCL shall be manufactured by one of the following:
 - GSE Lining Technology, Inc.
 - CETCO Lining Technologies, Inc.
 - Engineer approved equal
- MANUFACTURER shall have manufactured a minimum of 10 million square feet of GCL during the last year.

1.6.2. Installer

- Installation shall be performed by one of the following installation companies:
 - MANUFACTURER Approved Installer
 - Engineer approved equal
- Installer shall have experience installing GCLs on at least 5 projects and have installed a minimum of 2 million square feet of GCL materials.

1.7. DELIVERY, STORAGE & HANDLING

1.7.1. General: Conform to the MANUFACTURER'S requirements and ASTM D5888 unless otherwise specified.

1.7.2. Delivery:

- Deliver material to the site only after the CQA INSPECTOR accepts required submittals.
- Material shall be covered with a waterproof plastic covering resistant to ultraviolet degradation.
- Ship less than two weeks prior to scheduled installation unless otherwise approved by engineer.
- Each roll shall be marked with the manufacturer's name, product identification, and roll number.

1.7.3. Handling:

- The CQA INSPECTOR shall verify that proper handling equipment exists which does not pose any danger to installation personnel or risk of

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damage or deformation to the liner material itself. Suitable handling equipment is described below:

- Spreader Bar Assembly - A spreader bar assembly shall include both a core pipe or bar and a spreader bar beam. The core pipe shall be used to uniformly support the roll when inserted through the GCL core while the spreader bar beam will prevent chains or straps from chafing the roll edges.
- Stinger - A stinger is a rigid pipe or rod with one end directly connected to a forklift or other handling equipment. If a stinger is used, it should be fully inserted to its full length into the roll to prevent excessive bending of the roll when lifted.
- Roller Cradles - Roller cradles consist of two large diameter rollers spaced approximately 3 inches apart, which both support the GCL roll and allows it to freely unroll. The use of roller cradles shall be permitted if the rollers support the entire width of the GCL roll.
- Straps – A properly structured and supported pole or “carpet puller” can be used to unload GCL rolls onsite. As an alternative, straps that are appropriately rated can be used as an approved lifting method to unload GCL rolls.

1.7.4. Storage:

- Store rolls in space allocated by OWNER. Space should be at high ground level or elevated above ground surface.
- Stack no more than 3 rolls high.
- Protect rolls from UV, precipitation, other sources of moisture, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.
- An additional tarpaulin or plastic sheet shall be used over the stacked rolls to provide extra protection for GCL material stored outdoors.
- Preserve integrity and readability of roll labels.
- Bagged bentonite material shall be stored and tarped next to GCL rolls unless other more protective measures are available. Bags shall be stored on pallets or other suitably dry surface which will prevent undue prehydration.

1.7.5. GCL Inspection upon Delivery:

- Each roll shall be visually inspected when unloaded to determine if any packaging or material has been damaged during transit.
- Repairs to damaged GCL shall be performed in accordance with Section 3.7 of this specification.
 - Rolls exhibiting damage shall be marked and set aside for closer examination during deployment.

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- Minor rips or tears in the plastic packaging shall be repaired with moisture resistant tape prior to being placed in storage to prevent moisture damage.
- GCL rolls delivered to the project site shall be only those indicated on GCL manufacturing quality control certificates.
- For needlepunched GCLs, the presence of free-flowing water within the packaging shall require that roll to be set aside for further examination to ascertain the extent of damage, if any. Free-flowing water within the packaging of unreinforced GCLs shall be cause for rejection of that roll.

1.8. WARRANTY

- 1.8.1. Material shall be warranted, on a pro-rata basis against Manufacturer’s defects for a period of 5 years from the date of geomembrane installation.
- 1.8.2. Installation shall be warranted against defects in workmanship for a period of 1 year from the date of geomembrane completion.

2. PRODUCT

2.1. QUALIFICATIONS

- 2.1.1. The GCL product supplied to the project shall be in full accordance with the requirements of this section.
- 2.1.2. The GCL shall be manufactured by mechanically bonding the geotextiles using a needlepunching process as described in Section 1.3 to enhance frictional and internal shear strength characteristics.
- 2.1.3. The needlepunched GCL shall thermally heat set the nonwoven fibers where they protrude from the second geotextile (woven or nonwoven depending upon product) to more permanently secure the reinforcement in place. Other means may be used to lock the fibers in place if the process demonstrates similar performance to the thermal heat set process.
- 2.1.4. In order to maintain these characteristics, no glues, adhesives or other non-mechanical bonding processes shall be used in lieu of the needlepunch process. Their use to enhance the physical properties of the GCL is permitted.

2.2. MATERIALS

- 2.2.1. Acceptable Products
 - GSE BentoLiner NWL
 - CETCO Bentomat DN
 - Engineer approved alternative
- 2.2.2. Alternative Materials

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- Prior to considering an alternative GCL material, the Contractor shall submit certified test results and statements of quality from the proposed GCL supplier to the engineer, indicating without exception that the proposed GCL meets the requirements of this specification. Submittals shall be delivered to the engineer a minimum of five business days in advance of the bid.

2.3. GCL PHYSICAL PROPERTIES

- 2.3.1. The GCL material shall be in accordance with the test methods, test frequencies and material physical properties as listed in Table 2.3.
- 2.3.2. Dimensions - The minimum acceptable dimensions for the GCL panels shall be 15 feet wide and 125 feet long. Short rolls (rolls less than 125 feet long) may be supplied, but at a rate not to exceed 5% of the total square footage produced for this project.
- 2.3.3. Overlap_Markings - A minimum overlap guide-line and a construction match-line delineating the overlap zone shall be imprinted with non-toxic ink on both edges of the GCL panel to ensure the accuracy of the seam. These lines shall be used during CQA to ensure the minimum overlap is achieved. The minimum overlap guideline shall indicate where the edge of the panel must be placed in order to achieve the correct overlap for each panel.
- 2.3.4. The GCL will have seam overlaps a minimum of 6 inches for all woven/nonwoven GCLs. GCL's comprised of a nonwoven/nonwoven geotextiles will have a minimum seam overlap of 6 inches for scrim reinforced and 12 inches minimum for all non-scrim reinforced nonwoven GCLs. End of panel or butt end seams shall be a minimum of 12 inches for all woven/nonwoven GCLs, 12 inches for all scrim-reinforced double nonwoven GCLs, and 24 inches for non-scrim reinforced double nonwoven GCLs.
- 2.3.5. Accessory Bentonite - Any accessory bentonite used for sealing seams, penetrations, or repairs, shall be the same granular bentonite as used in the production of the GCL itself.

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Table 2.3: Geosynthetic Clay Liner

TESTED PROPERTY	TEST METHOD	FREQUENCY	VALUE (ENGLISH)	VALUE (SI)
GEOTEXTILE PROPERTY				
Cap Nonwoven, Mass/Unit Area	ASTM D 5261	1/200,000 ft ² (1/20,000 m ²)	6.0 oz/yd ² MARV ¹	200 g/m ² MARV ¹
Carrier Scrim Nonwoven, Mass/Unit Area	ASTM D 5261	1/200,000 ft ² (1/20,000 m ²)	6.0 oz/yd ² MARV	200 g/m ² MARV
BENTONITE PROPERTY				
Swell Index	ASTM D 5890	1/100,000 lb (50,000 kg)	24 ml/2 g min	24 ml/2 g min
Moisture Content	ASTM D 4643	1/100,000 lb (50,000 kg)	12% max	12% max
Fluid Loss	ASTM D 5891	1/100,000 lb (50,000 kg)	18 ml max	18 ml max
FINISHED GCL PROPERTY				
Bentonite, Mass/Unit Area ²	ASTM D 5993	1/40,000 ft ² (1/4,000 m ²)	0.75 lb/ft ² MARV	3.66 kg/m ² MARV
Tensile Strength ³	ASTM D 6768	1/40,000 ft ² (1/4,000 m ²)	45 lb/in MARV	7.8 kN/m MARV
Peel Strength	ASTM D 6496 ASTM D 4632 ⁴	1/40,000 ft ² (1/4,000 m ²)	3.5 lb/in MARV 21 lb MARV	610 N/m MARV 93 N MARV
Hydraulic Conductivity ⁵	ASTM D 5887	1/Week	5 x 10 ⁻¹¹ m/sec max	5 x 10 ⁻¹¹ m/sec max
Index Flux ⁵	ASTM D 5887	1/Week	1 x 10 ⁻⁸ m ³ /m ² /sec max	1 x 10 ⁻⁸ m ³ /m ² /sec max
Internal Shear Strength ⁶	ASTM D 6243	Periodically	500 psf Typical	24 kPa Typical
ROLL DIMENSIONS				
Width x Length ⁷	Typical	Every Roll	15.5 ft x 150 ft	4.7 m x 45.7 m
Area per Roll	Typical	Every Roll	2,325 ft ²	216 m ²
Packaged Weight	Typical	Every Roll	2,600 lb	1,179 kg

NOTES:

- ¹Minimum Average Roll Value.
- ²Oven-dried measurement. Equates to 0.84 lb/ft(4.1 kg/m) when indexed to a 12% moisture content.
- ³Tested in machine direction.
- ⁴Modified ASTM D 4632 to use a 4 in (100 mm) wide grip. The maximum peak of five specimens averaged in machine direction.
- ⁵Deaired, deionized water @ 5 psi (34.5 kPa) maximum effective confining stress and 2 psi (13.8 kPa) head pressure.
- ⁶Typical peak value for specimen hydrated for 24 hours and sheared under a 200 psf (9.6 kPa) normal stress.
- ⁷Roll widths and lengths have a tolerance of ±1%.

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3. INSTALLATION

3.1. GENERAL

3.1.1. The following installation procedures are as specific as possible while recognizing that the specific requirements of the project may necessitate minor modifications. Significant deviations from these procedures shall be pre-approved by the project engineer or other designated party.

3.2. SUBGRADE PREPARATION

3.2.1. The subgrade upon which the GCL is to be installed shall be suitable for the placement of GCL material, subject to the following requirements:

- Earthen Subgrade - The surface upon which the GCL material will be installed shall be constructed, inspected, and tested in accordance with the Earthwork and Pit Construction Specification. The earthwork contractor shall provide written certification that the subgrade has been prepared in accordance with the project specifications.
- The surface upon which the GCL is installed shall be smooth and free of wheel ruts, debris, roots, sticks, and rocks larger than 1.0 in (25 mm). Site specific compaction requirements shall be followed in accordance with the project plans and specifications. At a minimum, the site shall be smooth rolled at the level of compaction such that installation equipment and other construction vehicle traffic do not cause rutting greater than 1.0 in (25 mm) deep. Furthermore, all protrusions extending more than 0.5 in (12 mm) from the subgrade shall be removed, crushed, or pushed into the subgrade.
- Immediately prior to deployment of the GCL, the subgrade shall be final compacted to fill in any remaining voids or desiccation cracks and to ensure that no sharp irregularities or abrupt elevation changes exist greater than 1.0 in (25 mm). The surfaces to be lined shall be maintained in this condition and free of standing water. GCL can be deployed on a frozen subgrade, if the subgrade would meet all the conditions as previously outlined if unfrozen. GCL cannot be deployed on snow or ice.
- The subgrade surface and preparation should be inspected and certified by the CQA INSPECTOR prior to GCL placement. Upon approval by the CQA INSPECTOR, it is the INSTALLER's responsibility to communicate to the CQA INSPECTOR any changes in the condition of the subgrade that might render it out of compliance with any of the requirements of the project specification or ASTM Standard D 6102.D.

3.3. ANCHOR TRENCH

3.3.1. An anchor trench shall be excavated by the INSTALLER to the lines and grades shown on the project drawings at the top of slopes.

- The anchor trench shall be constructed free of sharp edges or corners and maintained in a dry condition. No loose soil shall be permitted beneath the GCL within the trench.

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- The anchor trench shall be inspected and approved by the CQA INSPECTOR prior to GCL placement, back-filling and compaction of the anchor key material.
- All GCL material installed on slopes shall be anchored in accordance with the project drawings to prevent potential GCL panel movement.

3.4. GCL PLACEMENT

3.4.1. GCL Material shall be placed in general accordance with the procedures specified below, or modified to account for site specific conditions.

- GCL Orientation - GCL panels are typically placed with the nonwoven side up (heat burnished side down) to maximize the shear strength characteristics. However, the heat burnished side up if it maximizes the shear strength characteristics of a site specific interface. In base or flat areas, the GCL does not require any particular orientation.
- GCL Panel Position - Where possible, all slope panels should be installed parallel to the maximum slope while panels installed in flat areas require no particular orientation.
- Panel Deployment - GCL materials shall be installed in general accordance with the procedures set forth in this section, subject to site-specific conditions which would necessitate modifications.
 - Deployment should proceed from the highest elevation to the lowest to facilitate drainage in the event of precipitation.
 - The GCL may be deployed on slopes by pulling the material from a suspended roll, or securing a roll end into an anchor trench and unrolling each panel as the handling equipment slowly moves backwards.
 - Deployment on flat areas shall be conducted in the same manner as that for the slopes, however, care should be taken to minimize “dragging” the GCL. Slip-sheet may be used to facilitate positioning of the liner while ensuring the GCL is not damaged from underlying sources.
 - The GCL will have seam overlaps a minimum of 6 inches for all woven/nonwoven GCLs. GCL’s comprised of a nonwoven/nonwoven geotextile will have a minimum seam overlap of 6 inches for scrim reinforced and 12 inches minimum for all non-scrim reinforced nonwoven GCLs. End of panel or butt end seams shall be a minimum of 12 inches for all woven/nonwoven GCLs, 12 inches for all scrim-reinforced double nonwoven GCLs, 24 inches for non-scrim reinforced double nonwoven GCLs, and be free of wrinkles, folds or “fish-mouths”.
 - The contractor shall only install as much GCL that can be covered at the end of the day. No GCL shall be left exposed overnight. The exposed edge of the GCL shall be covered by a

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temporary tarpaulin or other such water resistant sheeting until the next working day.

3.5. SEAMING

3.5.1. Overlap Line

- Woven/Nonwoven and Scrim Reinforced Nonwoven GCLs
 - A 6-inch lap line and a 9-inch match line for scrim reinforced GCLs shall be imprinted on both edges of the upper geotextile component of the GCL to assist in installation overlap quality control. Lines shall be printed as continuous dashes in easily observable non-toxic ink.
- Non-Scrim Reinforced Nonwoven GCLs
 - A 12-inch lap line and 15-inch match line for non-scrim reinforced GCLs shall be imprinted on both edges of the upper geotextile component of the GCL to assist in installation overlap quality control. Lines shall be printed as continuous dashes in easily observable non-toxic ink.

3.5.2. Seams

- Woven/Nonwoven and Scrim Reinforced Nonwoven GCLs
 - Overlap seams shall be a minimum of six inches on panel edges and one foot on panel ends.
- Non-Scrim Reinforced Nonwoven GCLs
 - Overlap seams shall be a minimum of 12 inches on panel edges and 2 foot on panel ends.
- Loose granular bentonite shall be placed between panel overlaps at a rate of 0.25 pound per lineal foot.

3.6. DETAILING

3.6.1. Detail work, defined as the sealing of the liner to pipe penetrations, foundation walls, drainage structures, spillways, and other appurtenances, shall be performed as recommended by the GCL Manufacturer.

3.7. DAMAGE REPAIR

3.7.1. Prior to cover material placement, damage to the GCL shall be identified and repaired by the installer. Damage is defined as any rips or tears in the geotextiles, delamination of geotextiles, or a displaced panel.

3.7.2. Rip and Tear Repair (Flat Surfaces) - Rips or tears may be repaired by completely exposing the affected area, removing all foreign objects or soil, and by then placing a patch cut from unused GCL over the damage (damaged material may be left in place), with a minimum overlap of 12 inches on all edges. Accessory bentonite should be placed between the patch edges and the repaired

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material at a rate of a quarter pound per lineal foot of edge spread in a continuous six inch fillet.

3.7.3. Rip and Tear Repair (Slopes) - Damaged GCL material on slopes shall be repaired by the same procedures above, however, the edges of the patch should also be adhered to the repaired liner with an adhesive to keep the patch in position during backfill or cover operations.

3.8. DISPLACED PANELS

3.8.1. Displaced panels shall be adjusted to the correct position and orientation. The adjusted panel shall then be inspected for any geotextile damage or bentonite loss. Damage shall be repaired by the above procedure.

3.9. PREMATURE HYDRATION

3.9.1. If the GCL is prematurely hydrated greater than 30% moisture, installer shall notify the CQA INSPECTOR and project engineer for a site specific determination as to whether the material is acceptable or if alternative measures must be taken to ensure the quality of the design.

3.10. COVER MATERIAL

3.10.1. The cover materials shall be compatible as well as suitable for use over the GCL, and placed in a manner appropriate to the particular subgrade. Regardless of the cover material, the uncovered edge of GCL panels shall be protected at the end of the working day with a waterproof sheet which is secured adequately with ballast.

3.10.2. Geosynthetic Cover - Precautions shall be taken to prevent damage to the GCL by restricting the use of heavy equipment over the liner system.

- Equipment - Installation of the overlying geosynthetic component can be accomplished through the use of lightweight, rubber-tired equipment such as a 4-wheel all-terrain vehicle (ATV). This vehicle can be driven directly on the GCL, provided the ATV makes no sudden stops, starts, or turns.
- Placement - Smooth HDPE may be dragged across the GCL surface with equipment or by hand labor during positioning. Similarly, the HDPE may be unrolled with the use of low ground pressure equipment.
- Use of Textured Liners - If a textured geomembrane is placed over the GCL, a slip sheet (such as 20-mil smooth HDPE) may first be placed over the GCL in order to allow the geomembrane to slide into its proper position. Once the overlying geomembrane is properly positioned, the slip-sheet shall be carefully removed paying close attention to avoiding any movement to the geomembrane.

3.11. ACTIVATION

3.11.1. If the GCL will be utilized for the control of non-aqueous phase liquids, prehydration may be necessary. The GCL manufacturer shall be contacted for these cases for site specific recommendations.

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4. MEASUREMENT AND PAYMENT

- 4.1. Payment for GCL installation will be as per contract unit price per square foot, as measured parallel to liner surface, including designed anchor trench material and is based upon net lined area.
- 4.2. Net lined area is defined to be the true area of all surfaces to be lined plus designed burial in all anchor trenches, rubsheets, and sacrificial layers.
- 4.3. Prices shall include full compensation for furnishing all labor, material, tools, equipment, and incidentals.
- 4.4. Prices shall include all work involved in performing GCL installation completely as shown on the drawing, as specified herein, and as directed by the ENGINEER.

END OF SECTION

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DOCUMENT No. 18675-520-SPC-003

PERFORMANCE SPECIFICATION FOR GEOCOMPOSITE DRAINAGE LAYER

ENCANA OIL & GAS (USA), INC. – SRBU N. PICEANCE

**W.FORK PARACHUTE CREEK – A15 WELL PAD
PRODUCED WATER PIT MODIFICATION PROJECT**

GARFIELD COUNTY, COLORADO

Engineer Stamp:	Approvals:						
		By:	Date:				
	Initiator:	G. Bancroft	11/23/11				
	Mechanical:			Revisions:			
	Civil:	G. Mostofa	11/23/11				
	Electrical:			Rev.:	Date:	By:	Approval:
	Instrument:			0	1/05/12	GDB	GDB
	Project. Mgr.:	G. Bancroft	11/23/11				
	Client:						

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1. GENERAL

1.1. SCOPE

- 1.1.1. This specification covers the technical requirements for the Manufacturing and Installation of the fabric-encased geocomposite drainage layer to be used for the produced water pit modification project at the A15 Well Pad. The project site is located adjacent to the West Fork of Parachute Creek, in the Piceance Basin, Garfield County, Colorado. All materials shall meet or exceed the requirements of this specification, and all work shall be performed in accordance with the procedures provided in these project specifications.
- 1.1.2. The geocomposite shall be utilized as a drainage underlayment for leak detection between primary and secondary geomembrane liners for a double synthetic liner system, in accordance with Paragraph 904.c(3) of the Colorado Oil & Gas Conservation Commission, E&P Waste Management Rules.
- 1.1.3. Related project specifications
- 18675-520-SPC-001 EARTHWORK AND PIT CONSTRUCTION
 - 18675-520-SPC-002 GEOSYNTHETIC CLAY LINER
 - 18675-520-SPC-004 GEOMEMBRANE LINER

1.2. REFERENCES

- 1.2.1. American Society for Testing and Materials (ASTM)
- ASTM D 1505-98 Standard Test Method for Density of Plastics by the Density-Gradient Technique
 - ASTM D 1603-94 Standard Test Method for Carbon Black in Olefin Plastics
 - ASTM D 4355-02 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
 - ASTM D 4491-99 Standard Test Method for Water Permeability of Geotextiles by Permittivity
 - ASTM D 4716-00 Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
 - ASTM D 4751-99 Standard Test Method for Determining Apparent Opening Size of a Geotextile
 - ASTM D 4833-88 (1996) Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
 - ASTM D 5035-95 Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
 - ASTM D 5199-99 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

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- ASTM D 5261-92 (1996) Standard Test Method for Measuring the Mass Per Unit Area of Geotextiles
- ASTM D7005-03 Determining The Bond Strength (Ply-Adhesion) of Geocomposites

1.2.2. Colorado Oil & Gas Conservation Commission (COGCC)

- 900 Series Rules, “E&P Waste Management”

1.2.3. Relevant publications from the Environmental Protection Agency (EPA):

- Daniel, D.E. and R.M. Koerner, (1993), Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities, EPA/600/R-93/182.

1.3. DEFINITIONS

- 1.3.1. CQA INSPECTOR - Construction Quality Assurance Inspector, independent from MANUFACTURER and INSTALLER that is responsible for observing and documenting activities related to quality assurance during the lining system construction. The CQA INSPECTOR may be the OWNER’s Representative or an independent agent hired by the OWNER.
- 1.3.2. ENGINEER - The individual or firm responsible for the design and preparation of the project’s Contract Drawings and Specifications.
- 1.3.3. INSTALLER- Party responsible for field handling, transporting, storing and deploying the geocomposite.
- 1.3.4. MANUFACTURER - The party responsible for manufacturing the geosynthetic clay liner rolls.
- 1.3.5. OWNER - Shall mean Encana Natural Gas.
- 1.3.6. TESTING LABORATORY - Geosynthetic Quality Assurance Laboratory, independent from the MANUFACTURER and INSTALLER, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the OWNER.
- 1.3.7. Lot- A quantity of resin (usually the capacity of one rail car) used to manufacture polyethylene geocomposite rolls. The finished rolls will be identified by a roll number traceable to the resin lot.

1.4. QUALIFICATIONS

1.4.1. MANUFACTURER

- Geocomposite shall be manufactured by the following:
 - GSE Lining Technology, Inc.
 - approved equal
- MANUFACTURER shall have manufactured a minimum of 10,000,000 square feet of polyethylene geocomposite material during the last year.

1.4.2. INSTALLER

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- Installation shall be performed by one of the following installation companies (or approved equal):
 - GSE Lining Technology, Inc.
 - GSE Approved Dealer/ Installer
- INSTALLER shall have installed a minimum of 2,000,000 square feet of geocomposite in the last year.
- INSTALLER shall have worked in a similar capacity on at least 5 projects similar in complexity to the project described in the contract documents, and with in at least 50,000 square feet of geonet installation on each project.
- The Installation Supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.

1.5. LABELING, DELIVERY, STORAGE AND HANDLING

- 1.5.1. Labeling - Each roll delivered to the site shall be wrapped and labeled by the MANUFACTURER. The label will identify manufacturer's name, product identification, length, width, and roll number.
- 1.5.2. Delivery - Rolls will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.
- 1.5.3. Storage - The on-site storage location provided by the CONTRACTOR to protect the geonet from abrasions, excessive dirt and moisture shall be level (no wooden pallets), smooth, dry, protected from theft and vandalism, and be located adjacent to the area being lined.
- 1.5.4. Handling - The INSTALLER shall handle all rolls in such a manner to ensure they are not damaged in any way and shall take any necessary precautions to prevent damage to underlying layers during placement of the drainage material.

1.6. WARRANTY

- 1.6.1. Material shall be warranted, on a pro-rata basis against defects for a period of 5-years from the date of the geocomposite installation.
- 1.6.2. Installation shall be warranted against defects in workmanship for a period of 1-year from the date of geocomposite completion.

2. PRODUCTS

2.1. MATERIALS

- 2.1.1. Acceptable Products
 - GSE FabriNet – double-sided, nonwoven/nonwoven, 6 oz/yd²
 - Engineer approved alternative
- 2.1.2. Alternative Materials

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- Prior to considering an alternative geocomposite material, the Contractor shall submit certified test results and statements of quality from the proposed geocomposite supplier to the engineer, indicating without exception that the proposed geocomposite meets the requirements of this specification. Submittals shall be delivered to the ENGINEER a minimum of five business days in advance of the bid.

2.2. GEOCOMPOSITE PROPERTIES

- 2.2.1. A geocomposite shall be manufactured by extruding two crossing strands to form a bi-planar drainage net structure with a non-woven geotextile bonded to both sides.
- 2.2.2. The geocomposite specified shall have properties that meet or exceed the values listed in Table 2.2A.

Table 2.2A: Geocomposite

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE ¹		
			6 oz/yd ²	8 oz/yd ²	10 oz/yd ²
Geocomposite					
Transmissivity ² , gal/min/ft (m ² /sec) Double-Sided Composite	ASTM D 4716	1/540,000 ft ²	0.48 (1 x 10 ⁻⁴)	0.48 (1 x 10 ⁻⁴)	0.43 (9 x 10 ⁻⁵)
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft ²	1.0 (178)	1.0 (178)	1.0 (178)
Geonet Core³					
Transmissivity ² , gal/min/ft (m ² /sec)	ASTM D 4716		9.66 (2 x 10 ⁻³)	9.66 (2 x 10 ⁻³)	9.66 (2 x 10 ⁻³)
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	45 (7.9)	45 (7.9)	45 (7.9)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	2.0	2.0	2.0
Geotextile^{3,4}					
Mass per Unit Area, oz/yd ² (g/m ²)	ASTM D 5261	1/90,000 ft ²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft ²	160 (710)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft ²	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft ²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec ⁻²)	ASTM D 4491	1/540,000 ft ²	1.5	1.3	1.0
Flow Rate, gpm/ft ² (lpm/m ²)	ASTM D 4491	1/540,000 ft ²	110 (4,480)	95 (3,865)	75 (3,050)

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UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	200 (5)	200 (5)	200 (5)
Roll Width ⁵ , ft (m)			14.5 (4.4)	14.5 (4.4)	14.5 (4.4)
Roll Length ⁵ , ft (m)	Double-Sided Composite		270 (82.3)	260 (79.2)	230 (70.1)
Roll Area, ft ² (m ²)	Double-Sided Composite		3,915 (364)	3,770 (350)	3,335 (310)

NOTES:

- ¹AOS in mm is a maximum value.
- ²Gradient of 0.1, normal load of 10,000 psf, water at 70 F between steel plates for 15 minutes. Contact manufacturer for performance transmissivity value for use in design.
- ³Component properties prior to lamination.
- ⁴Refer to geotextile product data sheet for additional specifications.
- ⁵Roll widths and lengths have a tolerance of ±1%.
- *Modified.

2.2.3. Resin

- Resin shall be new first quality, compounded polyethylene resin
- Natural resin (without carbon black) shall meet the requirements of Table 2.2B.

Table 2.2B: Raw Material Properties

Property	Test Method	Value
Density (g/cm ³)	ASTM D 1505	>0.94
Melt Flow Index (g/10 min)	ASTM D 1238	≤ 1.0

2.3. MANUFACTURING QUALITY CONTROL

- 2.3.1. The geocomposite shall be manufactured in accordance with the Manufacturer's Quality Control Plan submitted to and approved by the ENGINEER.
- 2.3.2. The geocomposite shall be tested according to the test methods and frequencies listed in Table 2.3.

Table 2.3: Manufacturing Quality Control Test Frequencies

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Characteristics	Test Method	Units	Frequency
			Bi-Planar
Resin			
Polymer Density	ASTM D 1505	g/cm ³	Once Per Lot
Melt Flow Index	ASTM D 1238	g/10 min	Once Per Lot
Geonet Test			
Carbon Black	ASTM D 1603	%	1/50,000 ft ²
Tensile Strength, MD	ASTM D 5035	lb/ ft	1/50,000 ft ²
Density	ASTM D 1505	g/cm ³	1/50,000 ft ²
Geotextile Test			
Mass per Unit Area	ASTM D 5261	oz/yd ²	1/90,000 ft ²
Grab Tensile	ASTM D 4632	lb	1/90,000 ft ²
Puncture	ASTM D 4833	lb	1/90,000 ft ²
AOS, US Sieve	ASTM D 4751	mm	1/540,000 ft ²
Water Flow Rate	ASTM D 4491	gpm/ft ²	1/540,000 ft ²
UV Resistance	ASTM D 4355, (after 500 hours)	% retained	Once per resin formulation
Geocomposite Test			
Ply Adhesion	ASTM D7005	lb/in	1/50,000 ft ²
Transmissivity	ASTM D 4716	m ² /sec	1/540,000 ft ²

3. EXECUTION

3.1. FAMILIARIZATION

3.1.1. Inspection

- Prior to implementing any of the work in the Section to be lined, the INSTALLER shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of the Section may properly commence without adverse impact.
- If the INSTALLER has any concerns regarding the installed work of other Sections, he shall notify the ENGINEER.

3.2. MATERIAL PLACEMENT

3.2.1. The geocomposite roll should be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the ENGINEER.

3.2.2. If the project contains long, steep slopes, special care should be taken so that only full length rolls are used at the top of the slope.

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- 3.2.3. In the presence of wind, all geocomposites shall be weighted down with sandbags or the equivalent. Such sandbags shall be used during placement and remain until replaced with cover material.
- 3.2.4. If the project includes an anchor trench at the top of the slopes, the geocomposite shall be properly anchored to resist sliding. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.
- 3.2.5. In applying fill material, no equipment can drive directly across the geocomposite. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.
- 3.2.6. The cover soil shall be placed on the geocomposite in a manner that prevents damage to the geocomposite. Placement of the cover soil shall proceed immediately following the placement and inspection of the geocomposite.

3.3. SEAMS AND OVERLAPS

- 3.3.1. Each component of the geocomposite will be secured or seamed to the like component at overlaps.
- 3.3.2. Geonet Components
 - Adjacent edges of the geonet along the length of the geocomposite roll shall be placed with the edges of each geonet butted against each other.
 - The overlaps shall be joined by tying the geonet structure with cable ties. These ties shall be spaced every 5 feet along the roll length.
 - Adjoining geocomposite rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite a minimum of 12 inches across the roll width.
 - The geonet portion should be tied every 6 inches in the anchor trench or as specified by the ENGINEER.

3.4. REPAIR

- 3.4.1. Prior to covering the deployed geocomposite, each roll shall be inspected for damage resulting from construction.
- 3.4.2. Any rips, tears or damaged areas on the deployed geocomposite shall be removed and patched. The patch shall be secured to the original geonet by tying every 6 inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be cut out and the two portions of the geonet shall be joined in accordance with Subsection 3.3.

4. MEASUREMENT AND PAYMENT

- 4.1. Payment for geocomposite installation will be as per contract unit price per square foot, as measured parallel to liner surface, including designed anchor trench material and is based upon net lined area.

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- 4.2. Net lined area is defined to be the true area of all surfaces to be lined plus designed burial in all anchor trenches, rubsheets, and sacrificial layers.
- 4.3. Prices shall include full compensation for furnishing all labor, material, tools, equipment, and incidentals.
- 4.4. Prices shall include all work involved in performing geocomposite installation completely as shown on the drawing, as specified herein, and as directed by the ENGINEER.

END OF SECTION