M/047/0103
cc: Leslie
Task: 5336

REDleaf
RESOURCES, INC.

March 5, 2013

RECEIVED
MAR 06 2013
DIV. OF OIL, GAS & MINING

Rob Herbert, P.G.
Manger, Ground Water Protection Section
Utah Division of Water Quality
Utah Department of Environmental Quality
195 North 1950 West
P.O. Box 144870
Salt Lake City, UT 84114-4870

Subject: Red Leaf Resources, Inc., Ground Water Discharge Permit Application – Supplemental Submission

Dear Mr. Herbert:

Enclosed herewith is a supplemental submission of the Ground Water Discharge Permit Application for Red Leaf Resources, Inc.'s, Seep Ridge site in Uintah County for your review.

The application was prepared for Red Leaf Resources, Inc. by JBR Environmental Consultants, Inc. under the direction of Robert Bayer, P.G.

The enclosed document supplements and supersedes previous application information. Please note that certain drawings submitted along with this submission contain information and/or data determined to be proprietary and/or business confidential by Red Leaf Resources, Inc., and are submitted to UDWQ with the understanding that they shall be managed as proprietary and/or business confidential by UDWQ. Drawings, information, and/or data considered to have confidential information have been stamped with the words "confidential business information" in accordance with R317-8-3.3.

Should you have any questions or comments about this application or if additional information is required, please contact Jay Vance at 801-878-8100.

Sincerely,

Lance Lehnhof
General Counsel

Enclosures

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

10808 South River Front Parkway · Suite 200 · South Jordan, UT 84095-5956
801-878-8100 · 801-878-8101 (fax) · www.redleafinc.com

M1047/0103
cc: Leslie
Task 5336

Utah Ground Water Discharge Permit Application
for
Red Leaf Resources, Inc.
Southwest #1 Project

March 5, 2013

Prepared for:

Red Leaf Resources, Inc.
10808 River Front Parkway, Suite 200
South Jordan, Utah 84095-5956

Prepared by:

JBR Environmental Consultants, Inc.
8160 South Highland Drive
Sandy, Utah 84093

JBR

creating solutions for today's environment

Utah Ground Water Discharge Permit Application
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Prepared by:

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8160 South Highland Drive
Sandy, Utah 84093

Utah Ground Water Discharge Permit Information
for
Red Leaf Resources, Inc.
Southwest #1 Project

1. Administrative Information

Applicant Name, Mailing Address, Telephone Number, Contact Information, Designated Agent

Red Leaf Resources, Inc.
10808 South River Front Parkway
Suite 200
South Jordan, UT 84095-5956
(801) 878-8100
Fax: (801) 878-8101
Company Representative: Jay Vance, P.E.
Designated Agent: Lance Lehnhof

Facility Legal Location

Portions of Sections 19, 20, 29 and 30, Township 13 South, Range 23 East; portions of Sections 25 and 36 of Township 13 South, Range 22 East. All sections are located in Uintah County, Utah. The Universal Transverse Mercator Geographic Coordinate System (UTM) coordinates for the facility are: Zone 12 Northing 4390671.43, Easting 638650.23. Latitude and longitude: 39° 39' 23" north latitude, 109° 23' 04" west longitude.

Owner and Operator Information

The owner and operator information is the same as the applicant information: Red Leaf Resources, Inc., is the owner and operator for this facility. Further information may be found at the following website: http://www.redleafinc.com/

Facility and Contact Information

Southwest #1 Mine Project
Red Leaf Resources, Inc.
55 miles south of Vernal, UT
EPS Site Manager: Steve Barrett
Office Phone: 801- 878-8100; Site Phone: 801-994-1830
Mr. Barrett supervises the daily operations and maintenance of the Southwest #1 Mine Project Site.

2. Introduction

Red Leaf Resources, Inc. (RLR), a privately held corporation, has developed the EcoShale™ In-Capsule Technology to extract petroleum from oil shale. RLR is proving the new technology at a location in eastern Utah. The EcoShale™ In-Capsule Technology uses heat to extract kerogen from oil shale as gases and liquids.

This operation, Southwest #1 Project, is located approximately 55 miles south of Vernal, in Uintah County, Utah (Figure 1, Location Map).

Following oil extraction, the shale will be encapsulated in place for final disposition, with no identified impact to surface or ground water resources.

3. Background Information

Since October 2008 when RLR initiated construction of a test facility, RLR has been in continuous operation with activities including site construction, testing and scale-up of the EcoShale™ In-Capsule Technology test unit, operations and maintenance. The operation consists of simultaneously mining the oil shale and creating the heating capsules for extracting oil.

The facility is currently operating under the authority of a Small Mine Operation (SMO) Permit. RLR intends to expand activities at Southwest #1 small mine site by converting to a Large Mining Operation (LMO). Mining will initiate in SE1/4 of Section 30, T13S, R23E with its first capsule. Upon successful completion of the first capsule and a corporate decision to proceed, construction of subsequent capsules will progress east to west and south to north.

4. Facility Classification and Type

4.1. Facility Classification

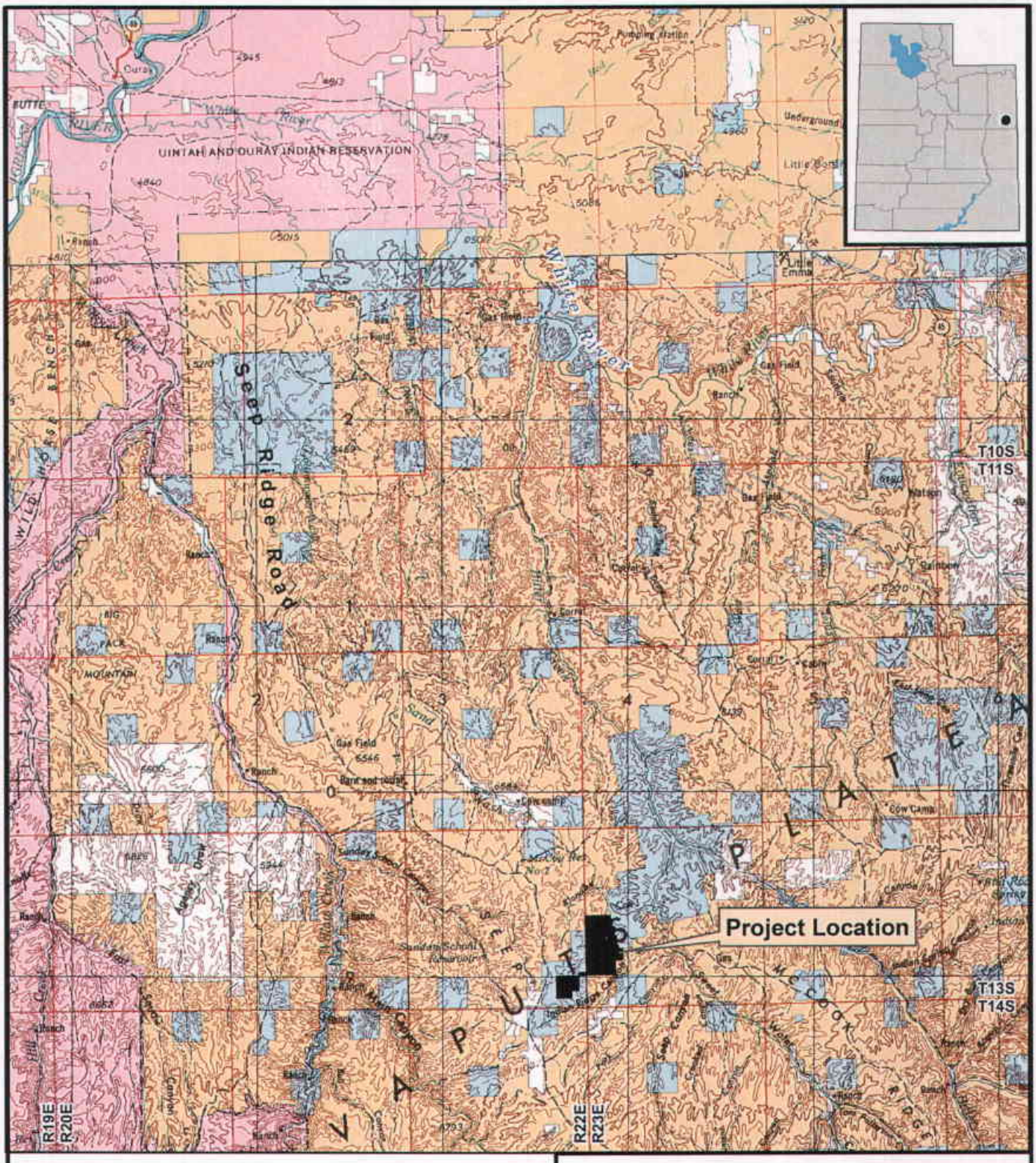
The Southwest #1 Mine will be a large mine operation.

4.2. Type of Facility

The new facility will be an oil shale production operation to extract kerogen from mined oil shale ore. It includes equipment maintenance, laboratory support facilities, and ancillary facilities, as necessary.

4.3. SIC/NAICS Codes

The Standard Industrial Classification (SIC) and North American Industry Classification System (NAICS) codes that describe the proposed facility are 1311 (SIC) and 211111 (NAICS) for petroleum extraction, production, and oil shale mining and beneficiating.



RED LEAF RESOURCES, INC.
Southwest #1 Project

FIGURE 1
LOCATION MAP

JBR

DRAWN BY	DATE DRAWN
CP	06/01/2011

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drawings\Red...Figures\Figure 1 Location Map 060111 WR OilGas GaugeStation.mxd

4.4. Project Facility Life

The initial life of mining operation is 30 years. As the operation progresses additional reserves maybe discovered which could extend the life of the facility.

5. Red Leaf Resources Oil Shale Mine and Operation Description

5.1. Staged Development

The development of the full-scale mining and oil-production operation will begin with a single capsule, which is termed the early production system or EPS capsule. It will be approximately 75 percent of the size of the full commercial scale capsules and unlike them, will not be constructed sequentially with other capsules. Following the description below of the entire EcoShale™ In-Capsule technology, a description of the EPS design and operation is provided in section 5.3.

5.2. Overall Operation Description

The EcoShale™ In-Capsule Technology uses heat to extract kerogen from oil shale deposits to produce crude oil. The operation is designed to maximize resource recovery and accommodate construction of "capsules" designed for low temperature heating of the shale to extract the hydrocarbons as gases and liquids. The operation consists of the simultaneous mining of the oil shale and the construction of the heating capsules. All materials mined are utilized completely and play a role in the RLR technology for capsule construction, hydrocarbon extraction and reclamation. The general mining sequence will consist of the following unit operations:

- Land clearing (where required)
- Soil removal and stockpiling
- Pre-stripping of unconsolidated overburden (when required)
- Drilling, blasting overburden
- Overburden removal
- Overburden loading, hauling, and screening
- Drilling, blasting of ore and interburden
- Ore and interburden loading, hauling, and screening
- Selective use of screened materials in construction of capsules
- Heating and kerogen recovery
- Final grading
- Soil placement and revegetation

Mining will begin in the SE¼ of Section 30, T13S R23E, progressing east to west and south to north with production ending in Section 19, T13S, R23E. (After mining is completed in Sections 19 and 30, the lease that comprises one half of Section 36, T13S, R22E will be mined (See NOI Figure 2, Life of Mine Ore Plan Layout in Appendix A).The mine plan includes clearing and grubbing operations, installation of stormwater control, salvaging of soil, followed by mining of the soil overburden, interburden, and oil shale. Topsoil is salvaged and carefully stockpiled to be used during the reclamation phase. NOI Figure 12, Capsule Construction Progression Plan (Appendix A) is a diagrammatic, conceptual representation of the capsule construction and operation advance in a typical pit.

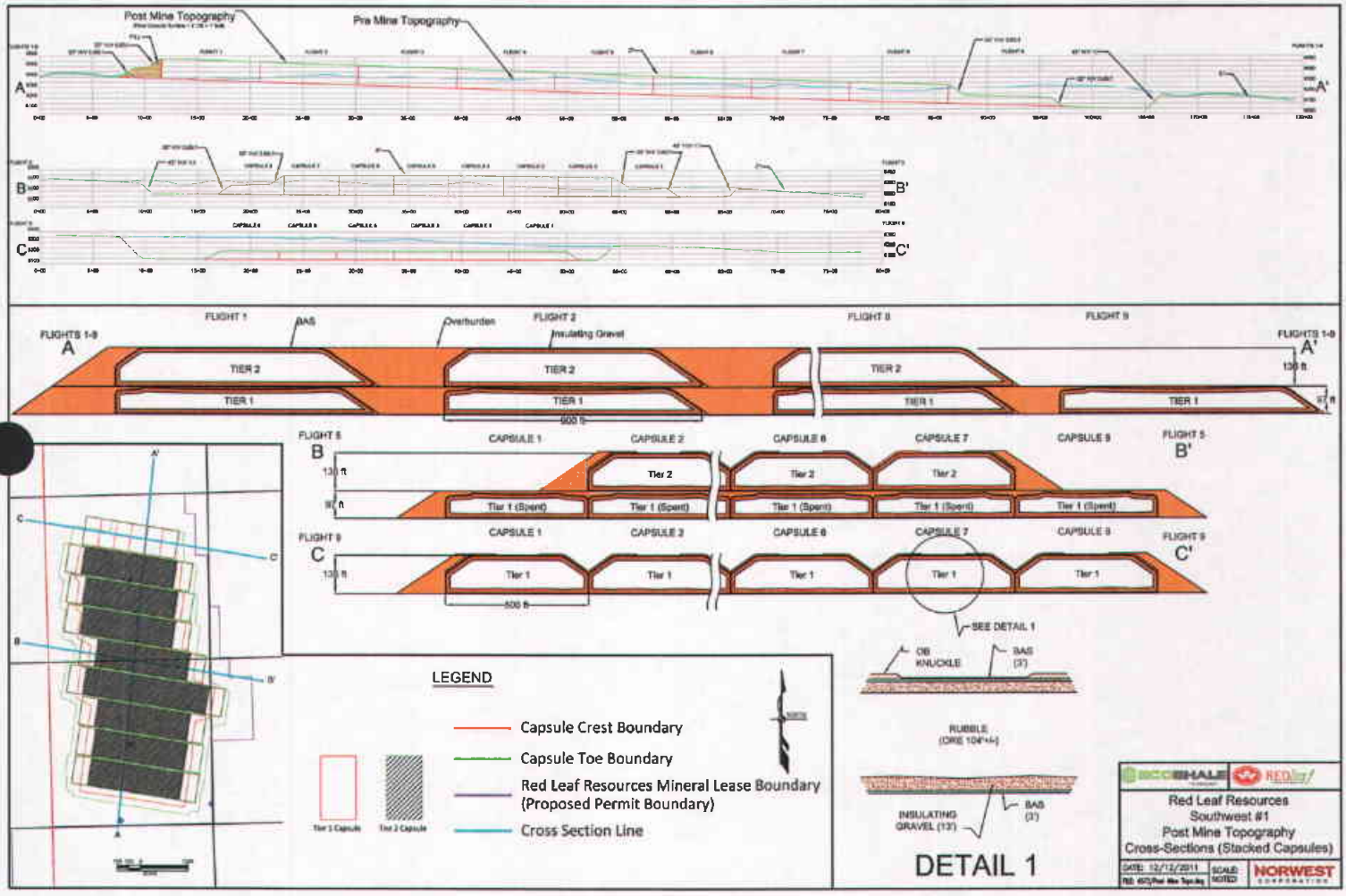

Post Mine Topography
Pre Mine Topography
A
A'
B
B'
C
C'
FLIGHTS 1-8
FLIGHT 1
BAS
Overburden
FLIGHT 2
Insulating Gravel
FLIGHT 8
FLIGHT 9
TIER 2
TIER 1
500 ft
FLIGHT 5
CAPSULE 1
CAPSULE 2
CAPSULE 6
CAPSULE 7
CAPSULE 8
Tier 2
Tier 1 (Spent)
FLIGHT 9
CAPSULE 3
Tier 1
SEE DETAIL 1
OB KNUCKLE
BAS (3')
RUBBLE (ORE 104'+/-)
INSULATING GRAVEL (13')
DETAIL 1
LEGEND
Capsule Crest Boundary
Capsule Toe Boundary
Red Leaf Resources Mineral Lease Boundary (Proposed Permit Boundary)
Cross Section Line
Tier 1 Capsule
Tier 2 Capsule
Red Leaf Resources
Southwest #1
Post Mine Topography
Cross-Sections (Stacked Capsules)
NORWEST

Figure 2 shows capsule construction sequence, major construction components, construction details, and pre-mining and post-reclamation topography.

Once enough overburden is removed from the pit area to create a capsule, an impermeable liner of bentonite-amended shale (BAS) is placed on the bottom of the capsule to prevent impacts to groundwater and the surrounding ecosystem. Manufacture of the capsule-sealing BAS involves using a special size fraction of materials mixed with bentonite and appropriate quantities of water in a pug mill (or similar equipment) to produce a bentonite sealing material for placement in the capsules. The BAS will be mixed, placed at optimal moisture content and compacted as necessary. Alternative methods for BAS placement may be used. The saturated hydraulic conductivity of the BAS layer will be 1.0×10^{-07} cm/sec or less. A three-foot layer of BAS will surround each capsule, top, bottom, sides, and ends (RLR 2011).

Inside the BAS layer is a 13-foot thick rind of coarse-sized material or gravel which serves as insulation inside the BAS barrier to conserve heat and protect the BAS from thermal breakdown. A steel liquids-collection pan will be installed within the insulating layer at the bottom of each capsule to direct the liberated petroleum liquids to a collection system and to prevent loss of oil to the underlying liner or the environment. The pans are sloped to direct liquids to collection troughs, which in turn direct liquids to sumps over grated vertical delivery pipes at an engineered bulkhead system.

Above the bottom insulation layer, approximately 100 feet of ore will be placed within the cell in lifts at the same time the side walls, end walls and insulation layers are built. The mined material is placed in layers with corrugated steel heating pipes throughout the capsule. The ore and heating pipes will be incrementally stacked on top of one another in the capsules. Initially, each capsule would be heated to approximately the boiling point of water and held at that temperature until steam production diminishes. This step is completed prior to increasing the heat to pyrolysis temperatures. The heating pipes heat the ore to a maximum temperature of approximately 725 °F and, through pyrolysis, liberate liquid and gaseous components of kerogen. Separate collection channels and pipes conduct the liquids and gases to the north end of each capsule. Capsules may be stacked in two levels or tiers. Extraction components (i.e., collection tanks, compressors) are mobile and are located adjacent to each capsule. The sequence and rate of capsule construction is designed to produce and sustain a target production rate of approximately 9,500 barrels per day of oil at full commercial scale.

The aerial dimensions are approximately 500 by 900 feet for all capsules. The capsules may have a height up to approximately 136 feet prior to heating. The capsules are designed with a pitched cover surface that will distribute stress across the upper BAS layer and accommodate settling at the edge to protect the constructed BAS wall which, with the covering BAS, seals the capsule. Capsule construction is further discussed below in Section 10, Capsule Design Report.

Initial overburden materials and ore from a portion of the flight of capsules will have to be temporarily stockpiled outside of the pit. Once sufficient pit area is opened, the oil shale and other materials can then be sequentially handled prior to placement on the pit floor where capsule construction occurs.

Most overburden, interburden, and all ore may be sized through mobile, skid-mounted, crushing, screening and stacking conveyor systems, or similar equipment. The mobile systems can move with the pit advance, and, consequently, haul distances are expected to remain relatively constant throughout the life of the commercial phase of the project. Geotechnical data on the materials that will be used in capsule construction are found in Appendix B - Stacked Capsule Backing Wall Stability Analysis.

The side slopes of the capsules will consist of backfilled overburden constructed and compacted in shallow lifts to provide support to the BAS layer on the capsule sidewalls. Backfilled side slopes of the capsules are anticipated to be approximately 1.5H:1V, with a small terrace, used as a ramp during capsule construction, remaining between the bottom tier and top tier of capsules (Figure 2).

A series of clean-water diversions and sumps will be constructed to manage upland runoff from offsite tributaries at the western perimeter of the project site to prevent impacts to water resources and minimize erosion potential. (See the Drainage Design Plan [Norwest 2011], attached as Appendix C). Due to the site topography, the diversions cannot convey all the runoff that might flow towards the mining pits. Areas that cannot be diverted require the use of ponds or sumps to contain runoff. The operational sumps are sized according the area of contributing watersheds and the 10-year 24-hour storm event. The sump locations and contributing watersheds are shown on Figures 1 and 2 of the Drainage Design Plan, Appendix C. Most of the sumps would be on-channel structures and would resemble a typical stock reservoir. RLR plans to use water collected in the sumps for its operations to supplement well water and water removed from the ore during production (Norwest 2011).

5.3. Early Production System (EPS) Capsule

The EPS capsule will be a stand-alone capsule approximately three-fourths the size of a full scale commercial capsule. It will be constructed in the southeast portion of Section 30, T13S, R23E. Its location relative to the commercial scale capsules flights is discussed in Section 10.2. The capsule will have BAS floor dimensions of approximately 385 feet wide by 695 feet long by 80 feet high at the capsule edge (and approximately 176 feet high at the top of each capsule crown). The capsule walls will be buttressed on all four sides by engineered fill.

The EPS capsule will function in the manner described above for the commercial scale capsule. However, key capsule components are designed to standards believed necessary to confirm proofs of concept for the key design components. These standards are intended to enable observation, measurement, and assessment of the key design concepts and components during the EPS. What is learned during EPS will be applied to the final design of the commercial scale capsules. The key concepts and components include the bedding materials for piping, pipe sizing and spacing, insulation effectiveness, design effects on fluid and gas recovery, bulkhead design, including BAS penetrations for heating and product recovery piping, heat delivery and product recovery manifold effectiveness, BAS thickness, construction procedures, capsule dimensions, and capsule containment effectiveness, especially roof performance during capsule settling. Changes to these capsule and system features may be made prior to EPS construction as more information becomes available. Further information on EPS is provided in the Capsule Design Report in Section 10.2.

5.4. Reclamation

Reclamation is integrated as part of the RLR technology, with overburden placed on top of the capsule prior to heating. Once the kerogen liquid and gas components are extracted from the ore and the capsule temperature has been sufficiently reduced on the second (or top) tier of capsules, final grading and reseeding will occur. The capsule reclamation and mining activities will occur simultaneously throughout the site. Pit endwalls and the final highwall will be regraded and stabilized by sloping back the walls or backfilling material against them to achieve a slope angle of 45 degrees in compliance with Utah Division of Oil Gas and Mining (DOGM) rules and minimize potential safety hazards.

With the exception of pit endwalls and the final highwall in each of the two lease parcels, the final configuration of the capsules represents the topographic surface that will require grading. After the heaters have been removed from each capsule, a cooling period will be allowed. After cooling and settlement is completed, the capsules will be ready for regrading and final reclamation. Final grading to achieve acceptable surface contours for positive drainage will be completed, where necessary, using overburden material not used in capsule construction and is expected to include both shot rock and unconsolidated material. The latter may also be used as supplemental plant growth material if its chemical characteristics are suitable. Salvaged soil will then be used for establishing vegetative cover for the final graded capsule.

The final top surface of the capsules will be regraded in some areas to reduce runoff on to the sideslopes and minimize erosion potential. Small areas will be left with a concave surface to collect precipitation; encourage establishment of more mesic vegetation communities; and reduce run-off. Given the limited precipitation and high evapo-transporation rates for the Uinta Basin, puddling of moisture is not anticipated to last for extended periods of time. With a cover design that promotes evapotranspiration and with a total thickness of cover material of approximately 20-24 feet, including 3 feet of BAS, puddled water will not enter the hydrocarbon recovery zone of the capsules. By managing the relatively flat top surfaces of the capsules in this manner, run-off from the top surface to the sideslopes will be limited, as will resultant erosion.

All disturbed areas will be left in a stable configuration and planted with varying seed mixes suited for the different slopes, aspects and topographic positions established in the regrading plan.

The residual hydrocarbon in the capsules following retorting is coke (RLR 2010), which is a gray, hard, porous, insoluble solid that consists of fused mineral matter and fixed carbon (Bates and Jackson 1984). Due to capsule design and system operation, a minimal amount of the product generated during pyrolysis may not be recoverable and may remain within the capsules after extraction.

6. Issued and Pending Permits

6.1. Permit History

Permitted activities include an Exploration Permit (EXP 047/0062) issued in October 2008, operation, testing and scale-up of the EcoShale™ In-Capsule Technology, and site management, operations, maintenance and testing through its Small Mining Operation (SMO) # S/047/0102.

6.2. Pending Permits

A Notice of Intention to Commence Large Mining Operations (NOI) was filed with the DOGM on August 4, 2011. On March 9, 2012, DOGM issued final approval of the NOI conditioned upon filing with DOGM, 30 days prior to disturbance, "either a ground water discharge permit (including a permit by rule) from Utah Division of Water Quality (DWQ) , or a letter saying a permit is not required.".

The project area is located in Indian Country and most federal permits are therefore under the jurisdiction of the U.S. EPA.

Nationwide permits for Storm Water discharge under the federal National Pollutant Discharge Elimination System (NPDES) will be obtained from EPA Region 8 for both construction of the facility and facility operations. Storm Water Pollution Prevention Plans (SWPPPs) have been prepared and will be kept current. Plans will be available on site prior to commencement of construction or mining activities.

RLR has filed a notice and application for a Nationwide General permit under section 404 of the federal Clean Water Act for the dredging and filling necessary to construct a sediment basin within Waters of the U.S. with the U.S. Army Corps of Engineers. Review of the notice is in progress by the Corps staff in Bountiful, Utah.

RLR operates as a minor source emitter in continuous operations beginning with the start-up of its initial small capsule operation under the DOGM SMO referenced above and has registered as such in accordance with newly promulgated EPA air regulations for operation in Indian Country. Prior to registration, the facilities have not been subject to implementation of a minor source permitting program.

The Southwest No. 1 project may have a Non-Transient Non-Community Water System (NTNWS). The engineering plans and specifications for an NTNWS must be approved prior to construction by the Executive Secretary of the Utah Division of Drinking Water.

Sanitary waste water is and will, upon commencement of the proposed operations, be collected and removed from the site by a licensed contractor. Solid waste will be collected and taken to a municipal or commercial landfill.

7. Water Information

7.1. Well and Spring Identification

The United States Geological Survey (USGS) National Hydrography Dataset was used to identify any mapped springs in the general vicinity; no springs in or near the mine area were identified (USGS 2010, JBR 2011).The records of the Utah Division of Water Rights were used to identify wells and springs in the area. A single spring has been recorded as having a water right with the Utah Division of Water Rights, as shown on Figure 3. No drinking water wells within a one-mile radius have been identified.

In addition to the water sources identified from public sources, a seep and spring inventory for the project area and vicinity was carried out. The Inventory area and locations of springs, seeps, and possible seeps identified during the inventory are discussed below in Section 9.5.1, as are the water sources identified in public records and referenced above. One of the seeps identified in the survey has an associated water right; the others do not. The hydrogeology report, below, further discusses these features.

7.2. Surface Water Body Identification

No bodies of surface water have been identified within a one-mile radius of the mine operation.

7.3. Drainage Identification

The Southwest #1 Mine Project Area is dissected by numerous ephemeral drainages typical of high-desert landscapes, and does not contain any perennial surface water sources. Nearly all land surrounding the RLR project slopes down to the east to drain to Sweetwater Canyon Creek via Indian Ridge Canyon and its tributaries. A small portion at the north end of the area drains to Klondike Canyon, which is another tributary of Sweetwater Canyon. Sweetwater Canyon Creek is an eventual tributary of the White River. The confluence of Sweetwater Canyon Creek and Bitter Creek is approximately 3 miles northeast of the RLR site.

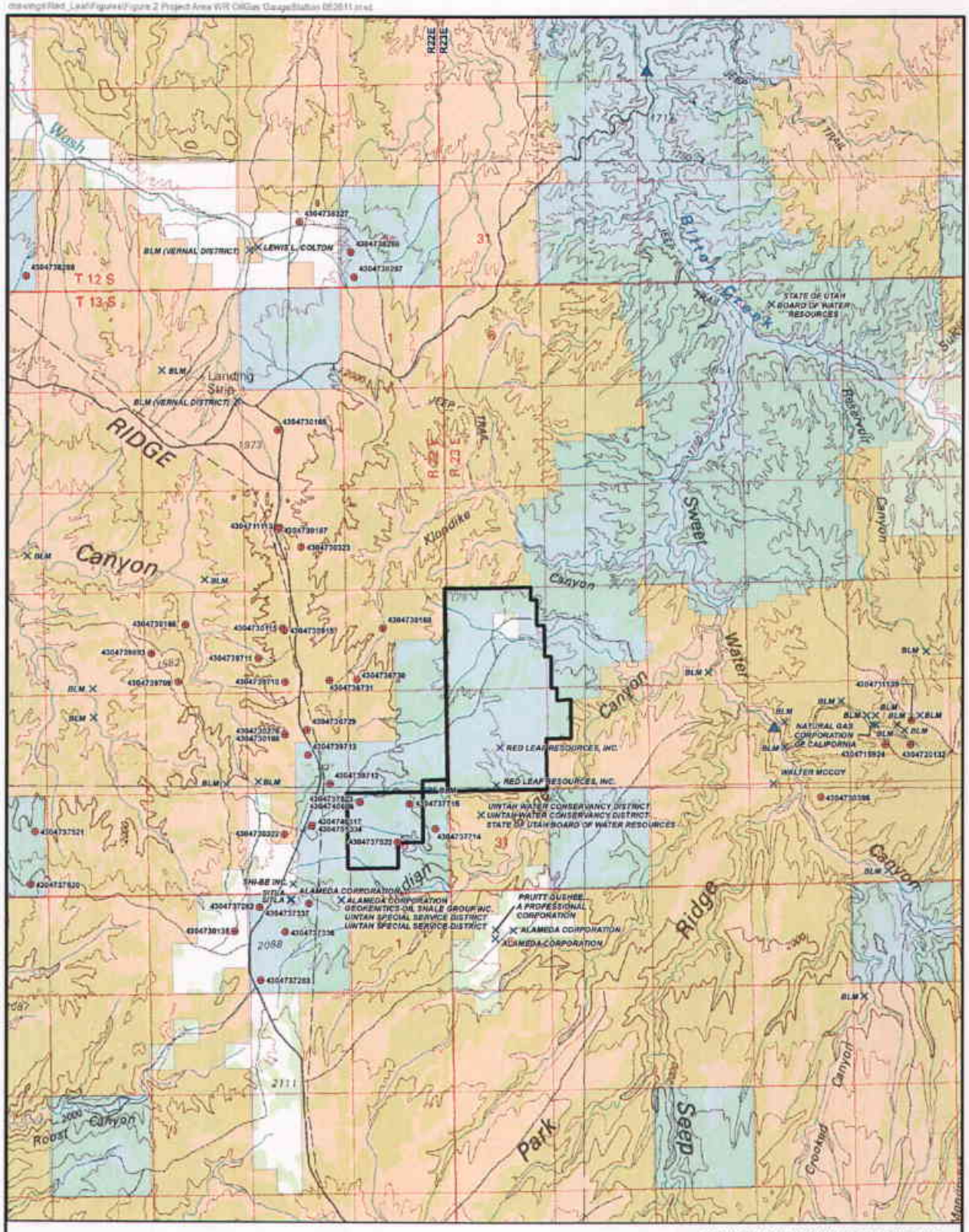
No drainages that allow surface water to discharge from the site have been identified within a one-mile radius of the mine operation.

7.4. Well-head Protection Area Identification

No well-head protection areas have been identified within a one-mile radius of the mine operation.

7.5. Drinking Water Source Identification

No drinking water sources within a one-mile radius of the mine operation have been identified in the area of Figure 3, Project Area. No drinking water sources subject to the protection of Utah Administrative Code (UAC) 309-600 have been identified within a one-mile radius of the mine operation. The RLR water well is used as a drinking water source; however, it does not meet the definition of a Public Water System per UAC 309-110 and is therefore not regulated under UAC 309-600.



BASE MAP: USGS 1:100,00-SCALE METRIC TOPOGRAPHIC MAP

Legend

- Lease Boundary
- USFS Gaging Station
- Water Right Point of Diversion (Owner)
- Oil / Gas Well (API #)

Land Ownership

- Federal
- State
- Private

N

5,000 0 5,000 Feet

RED LEAF RESOURCES, INC.
Southwest #1 Project

FIGURE 3
PROJECT AREA

JBR

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7.6. Well Logs

Wells in the area are owned by the Bureau of Land Management (BLM), one private owner, and Red Leaf Resources. Well logs and area hydrogeology are discussed in the hydrogeology report, below.

8. General Discharge Identification

8.1. Discharge Point Identification

This mine operation is designed to be a zero-discharge operation. There are no point discharges from the operation. The facility is conservatively designed. Containment of all product liquids and gases is insured through secondary containment of all tanks and clay seals three feet thick surrounding each capsule.

8.2. Planned Discharges

This mine operation is designed to be a no-discharge operation. There is no planned discharge water or other liquid for the operation. Due to capsule design, storm water will not contact waste materials and will be managed on site and may be used as part of the project's water supply. Any storm water discharges will be in compliance with the facility's Nationwide NPDES Storm Water Discharge Permit for storm water management.

8.3. Potential Discharges

This mine operation is designed to be a no-discharge operation. There is no potential for discharge of non-storm-water-induced water or other liquids from the operations.

8.4. Means of Discharge

The capsules are designed to prevent both infiltration of precipitation-derived water into them and discharge of fluids from them. The capsules are conservatively designed as discussed further below in this document. The cover material is engineered as an impermeable cap that will be covered with a pre-determined thickness of earthen borrow, graded, covered with salvaged topsoil, and revegetated, negating the necessity of post-closure care after revegetative cover has been established.

Stockpiles of mined ore are not potential sources of contamination due to contact with precipitation and subsequent discharge. During the initial capsule construction, mined ore will be stockpiled prior to capsule loading. Storm water coming in contact will be contained on site and/or managed in accordance with the facility's Nationwide NPDES Storm Water Discharge Permit and Storm Water Pollution Prevention Plan. Following the commencement of capsule construction, ore will be mined and placed in open capsules, all of which will be contained in the open pit, thereby preventing discharge of any contact water.

8.5. Flows, Sources of Pollution, and Treatment Technology

All production flows will be contained in both primary and secondary containment. There are no discharges from the facility. No treatment of waste water or waste solid is required as there is no generation of associated waste streams. Solid materials are fully encapsulated in the capsules. Storm water will be collected for beneficial use and discharges will only occur during excessive storm events as allowed under the Nationwide NPDES Storm Water Discharge Permit.

8.6. Discharge Effluent Characteristics

This mine operation is designed to be a no-discharge operation. There is no planned discharge water or other liquid from the operation.

9. Hydrogeology Report

9.1. Regional Geology and Landform

The RLR Project Area is located in the Uinta Basin section of the Colorado Plateau physiographic province (Stokes 1986). This physiographic province is also known as the Colorado Plateau's Level III Ecoregion (Woods et al 2001).

The Uinta Basin is a structural depression with Eocene fluvial and lacustrine sedimentary rocks exposed at the surface. The Project Area is located in the southern part of the basin and is underlain by north-dipping middle Eocene strata. The region is characterized by a dissected plateau with strong relief (Stokes 1986). Elevations in the Basin range from under 5000 feet in the Basin center near the Green and White Rivers and above 8000 feet at the southern Basin margins. Incised tributaries of the two rivers flow northward as ephemeral, intermittent and locally permanent streams providing the framework for rapid runoff throughout the southern Uinta Basin.

9.2. Southern Uinta Basin Geology

The southern Uinta Basin is underlain almost entirely by the Green River Formation, which is comprised of two members: the upper Parachute Creek Member and the underling Douglas Creek Member. The Parachute Creek Member is characterized by the presence of oil shale throughout its thickness. The Mahogany Zone is a 100-foot-plus interval in the upper third of the unit that represents the horizon with the highest concentration of kerogen and is the zone to be mined by RLR at Seep Ridge.

Table 1, below, shows summaries from the logs of two oil wells drilled to the west and southwest of the Project Area (Hot Rod Oil Government Chorney B-NCT-1 and Texaco Seep Ridge Unit #2, respectively). These two wells, the nearest to the Project Area, were used by Sprinkel (2009) to develop the "Interim Geologic Map of the Seep Ridge 30'x60' Quadrangle." Only the upper portions of the logs, from the surface through the regional Mesa Verde aquifer to the Dakota Sandstone, are shown. They place the Douglas Creek Member of the Green River Formation 780 to 1100 feet bgs and show the relative location of the Mahogany Zone within the Green River Formation. The Douglas Creek Member potentially contains the uppermost aquifer in the Green River Formation in the eastern Uinta Basin.

Table 1 Selected Oil and Gas Well Logs Near the Project Area

Well ID & Location	Formations	Unit Symbol	Top (feet bgs)	Thickness (feet)
Texaco Seep Ridge Unit #2				
SE1/4NE1/4 Sec 3, T14S, R22E API: 4304730135 Surface: 6834' AMSL	Parachute Creek Member, Green River Formation	Tgp	0	780
	Mahogany oil-shale zone, Green River Formation		731	
	Douglas Cr Member, Green River Form.	Tgd	780	691
	Green River-Wasatch transition zone	Tg-Tw	1471	451
	Wasatch Formation	Tw	1922	1511
	Upper Mesaverde Group	Kmv	3433	1487
	Sego Sandstone of Mesaverde Group	Kmv	4920	566
	Buck Tongue of Mancos Shale	Kmv	5486	54
	Castlegate Sandstone of Mesaverde Group	Kmv	5540	280
	Mancos Shale	Kms	5820	3400
	Frontier Formation	Kfd	9220	320
	Mowry Shale	Kfd	9540	30
	Dakota Sandstone	Kfd	9570	31
Hot Rod Oil Government Chorney B-NCT-1				
SE1/4SW1/4 Sec23, T13S, R22E API: 4304730115 Surface: 6624' AMSL	Parachute Creek Member, Green River Formation	Tgp	0	1120
	Mahogany oil-shale zone, Green River Formation		415	
	Douglas Cr Member, Green River Form.	Tgd	1120	995
	Green River-Wasatch Formations transition zone	Tg-Tw	2115	185
	Wasatch Formation	Tw	2300	1765
	Upper Mesaverde Group	Kmv	4065	1390
	Sego Sandstone of Mesaverde Group	Kmv	5455	515
	Buck Tongue of Mancos Shale	Kmv	5970	100
	Castlegate Sandstone of Mesaverde Group	Kmv	6070	280
	Mancos Shale	Kms	6350	3505
	Frontier Formation	Kfd	9855	335
	Mowry Shale	Kfd	10190	30

Well ID & Location	Formations	Unit Symbol	Top (feet bgs)	Thickness (feet)
	Dakota Sandstone	Kfd	10220	40

Source: Sprinkel 2009

Each well shown in Table 1 penetrated substantial thicknesses of the Parachute Creek Member. The Hot Rod well penetrated 1120 feet of the Parachute Creek Member and is likely to have collared near the top of the unit since Vanden Berg (2008) describes the nominal thickness of the Parachute Creek Member in the Uinta Basin as just over 1100 feet.

A key stratigraphic marker, the Mahogany Marker, is located within the Mahogany Zone. The Mahogany Marker is an ash-fall tuff that is recognized throughout the southern Uinta Basin. Two other, but less well recognizable, are the A Groove and the B Grove. Their relationship to the Mahogany Zone can be seen in the typical Stratigraphic Column, Figure 5.The Mahogany Marker is located over 700 feet above the base of the Parachute Creek Member. Throughout Its thickness, the Parachute Creek member is kerogen-rich and is commonly described as oil shale (Vanden Berg, 2008).

Keighlin (1977) and Pipiringos (1978) prepared preliminary geologic maps of the Bates Knolls and Cooper Canyon 7.5 minute quadrangles, respectively, that depict the surficial geology in the vicinity of the project area. The Douglas Creek Member is mapped in Sweetwater Canyon several miles to the east of the project area, in Indian Ridge Canyon about 2 miles to the south, and Sunday School Canyon several miles to the west. Only the Parachute Creek Member is mapped in most of Klondike Canyon located a mile or less north of the project areas. Keighlin (1977) and Pipiringos (1978) describe the Douglas Creek Member as being comprised of (in decreasing order of abundance) sandstone, mudstone, siltstone, algal limestones, and chalky limestones or dolomitic limestones. The descriptions are apparently derived from oil well data. These authors describe the thickness of the Douglas Creek Member as having a range of from 1480 to 1800 feet in the Bates Knoll quadrangle (Keighlin, 1977) and 1187 feet in the Cooper Canyon quadrangle (Pipiringos, 1978). The thickness of the Parachute Creek Member as described above would place the top of the Douglas Creek Member from 600 to 900 feet below ground surface beneath the project area.

The mapped occurrence of the Douglas Creek Member in some of the canyons in the vicinity of the Project Area, most notably Indian Ridge Canyon, does not reflect the thickness of the Parachute Creek Member as described by Keigllin (1977) and Pipiringos (1978). The presence of mapped Douglas Creek in Indian Ridge Canyon within ½ mile of outcrop of the Mahogany Marker at the project area would place the upper contact at an elevation up to 500 feet higher than the well data would indicate. The explanation for this difference is not provided in either of the referenced preliminary geologic maps. However, according to Michael Vanden Berg of the UGS (personal communication, 2013), the lower contact of the Parachute Creek Member was often picked as the top of the uppermost sandstone below the Mahogany Bed by geologists doing field mapping in the 1970s and early 1980s. The basal contact of

the Parachute Creek Member derived from oil well logs seems likely to have been picked at the lowest observed occurrence of oil shale.

The Parachute Creek Member is known to be carbonate-rich and more kerogen rich in the center of the Basin where deeper water levels persisted throughout the period over which the sediments now forming Parachute Creek Member were deposited. In the center of the basin, oil shale is present in significant quantities (measured in gallons per ton) throughout the 1100-foot thickness of the member. To the east and south, toward the Douglas Creek Arch and Uncompahgre Uplift, respectively, deposition of terrigenous clastic sediments increased, forming silty and sandy marlstones and locally siltstone and sandstone horizons. Deposition of carbonate rocks and organic matter occurred when water levels in the lake in which the Green River Formation was deposited (termed Lake Uinta) were high and deep-water, anoxic conditions prevailed. Fluctuations in lake depth over time nearer the basin margins resulted in greater quantities of clastic sediments when lake levels dropped and more carbonate and organic matter deposition occurred with higher lake levels and deeper water conditions. It is likely to be a clastic horizon in the Parachute Creek Member that was mapped by Keiglin (1977) and Pipiringos (1978) as the top of the Douglas Creek Member in the project area vicinity.

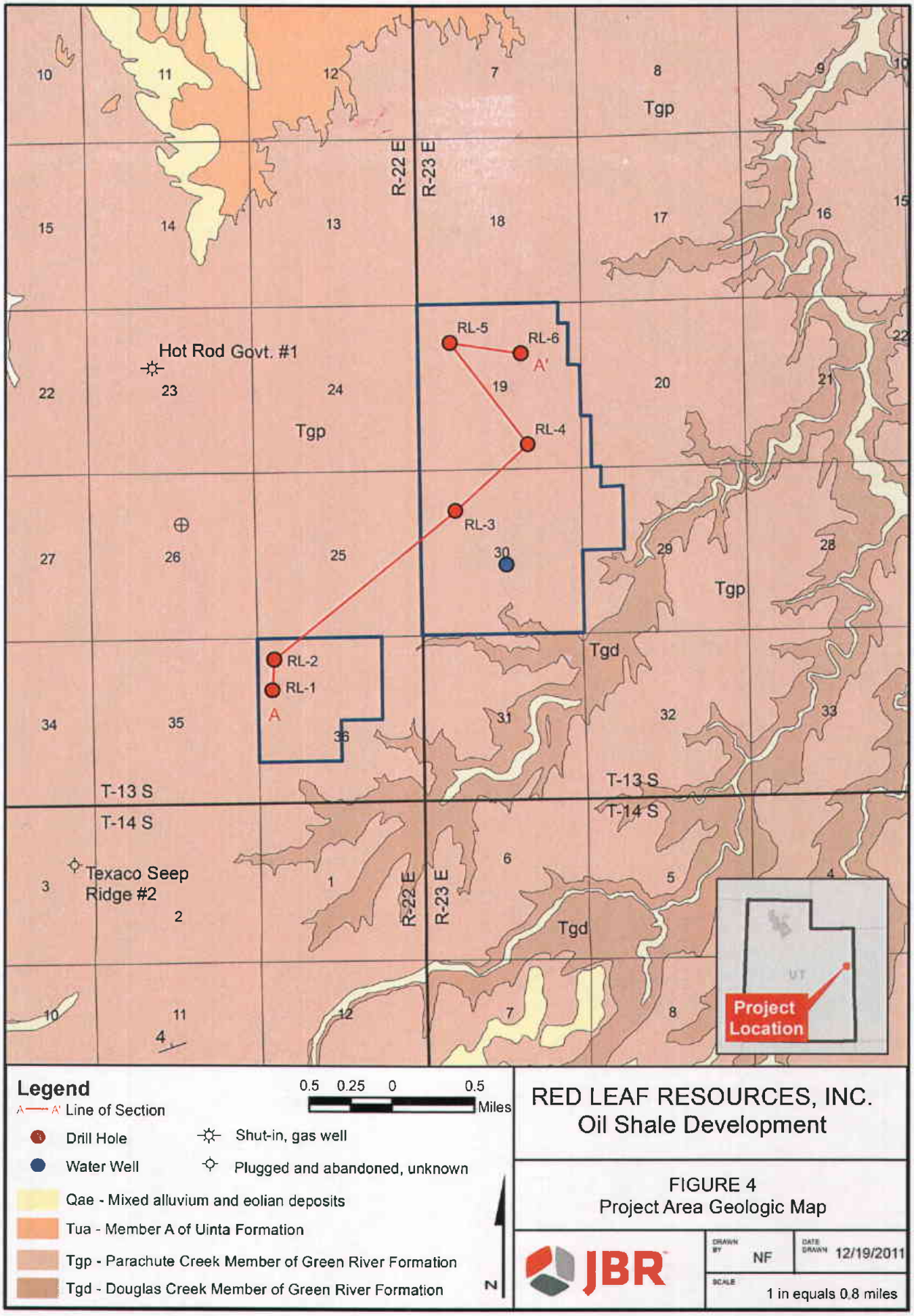
Regardless of the "pick" for the top of the Douglas Creek Member in the southern part of the Basin, there is no question that the boundary between it and the overlying Parachute Creek Member is gradational. The transition from an interlayered sequence of carbonate and siliclastic rock to the south and a carbonate-dominant sequence in the basin center is not conducive to lateral flow in the Parachute Creek Member in a down gradient direction. The oil shale horizons at depth beneath the Mahogany Zone would act as aquitards, inhibiting downward migration and recharge of ground water.

9.2.1. Project Area and Local Geology

Bedrock at the RLR project area is the middle Eocene (Tertiary), oil shale-bearing Parachute Creek Member of the Green River Formation. Figure 4 is a geologic map of the project area and vicinity. Geologic information derived from monitor well geology is presented in Section 9.5.2.

The Parachute Creek Member consists mainly of oil shale, which is a dolomitic marlstone (a clayey and/or silty carbonate rock) that contains a solid hydrocarbon material known as kerogen. The oil shale interbeds with minor amounts of siltstone, sandstone, and altered volcanic tuff beds. The Mahogany Oil Shale Zone within the Parachute Creek Member will be the oil shale source for the proposed operation. Depth to the top of the Mahogany Marker, which identifies the top of the kerogen-rich Mahogany Zone, is between the surface and 160 feet below ground surface (bgs) in the Project Area. Figure 5 is a typical stratigraphic column for the section penetrated by the core drilling at the RLR project site It was prepared by Norwest.

The typical stratigraphic column depicts rock types encountered and the locations of key stratigraphic zones or markers in the oil shale horizon including the Mahogany Marker, the Mahogany Bed, a stratigraphic interval located above the Mahogany Marker known as the A Groove; and another interval beneath the ore zone, which is called the B Groove. These two horizons get their names from their



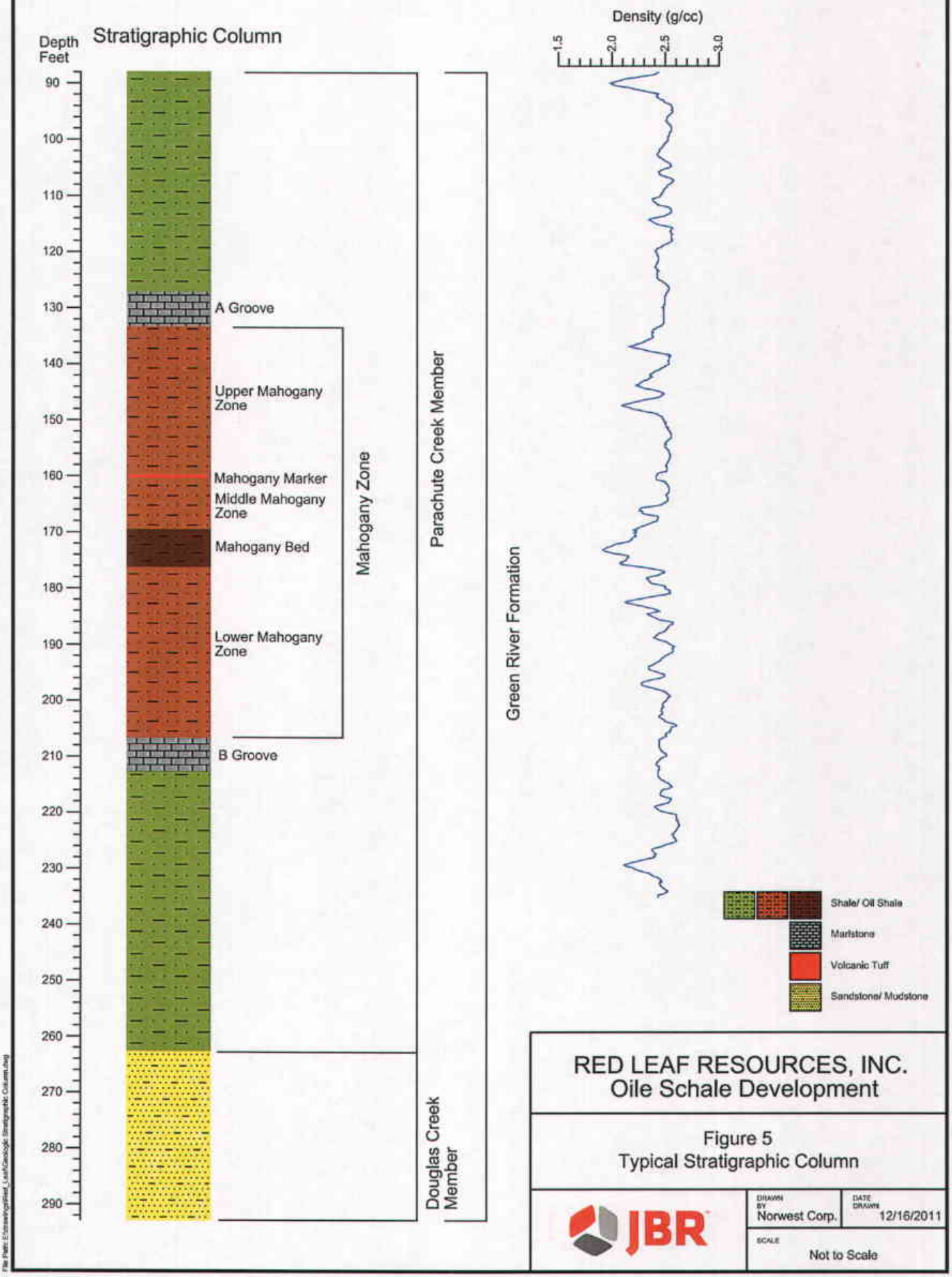
RED LEAF RESOURCES, INC.
Oil Shale Development

FIGURE 4
Project Area Geologic Map

JBR

DRAWN BY	DATE DRAWN
NF	12/19/2011

SCALE: 1 in equals 0.8 miles



RED LEAF RESOURCES, INC.
Oile Schale Development

Figure 5
Typical Stratigraphic Column

JBR

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Norwest Corp.	12/16/2011
SCALE	
Not to Scale	

appearance in outcrop where, unlike the cliff-forming Mahogany zone, they are slope formers. The B-Groove is easily identified in outcrop; however, its appearance in the subsurface is difficult to distinguish visibly. As a result, it is typically identified in the subsurface by geophysical logs or fisher assay data (Cashion, 1992).

Core hole geologic cross sections are shown on Figure **6**. Key stratigraphic horizons, the A Groove, Mahogany Marker, B Groove, along with the Mahogany Bed are shown on the sections. Each hole on the cross section is represented by a bulk density log showing the "picks" for the stratigraphic markers and beds as well as the ore zone to be mined. These markers and beds are correlated on the cross sections. The datum for the cross section is mean sea level. The cross sections show the apparent dip of the beds in the plane of each section. Cross section DG-4 to DG-5 is parallel to the structural strike of the beds and indicates that the dip is just a few degrees east of due north at this location. The rock types present in all of the holes are consistent, and the dominant rock type is oil shale, as Figure 6 shows. The other rock types are mudstones which occur in the A-Groove and B-Groove horizons and elsewhere, and thin silicified tuff horizons, most notably the Mahogany Marker. A sandstone bed is located in all holes in the zone to be mined. The sandstone is cemented by calcium carbonate and is not porous (Norwest, 2011, personal communication).

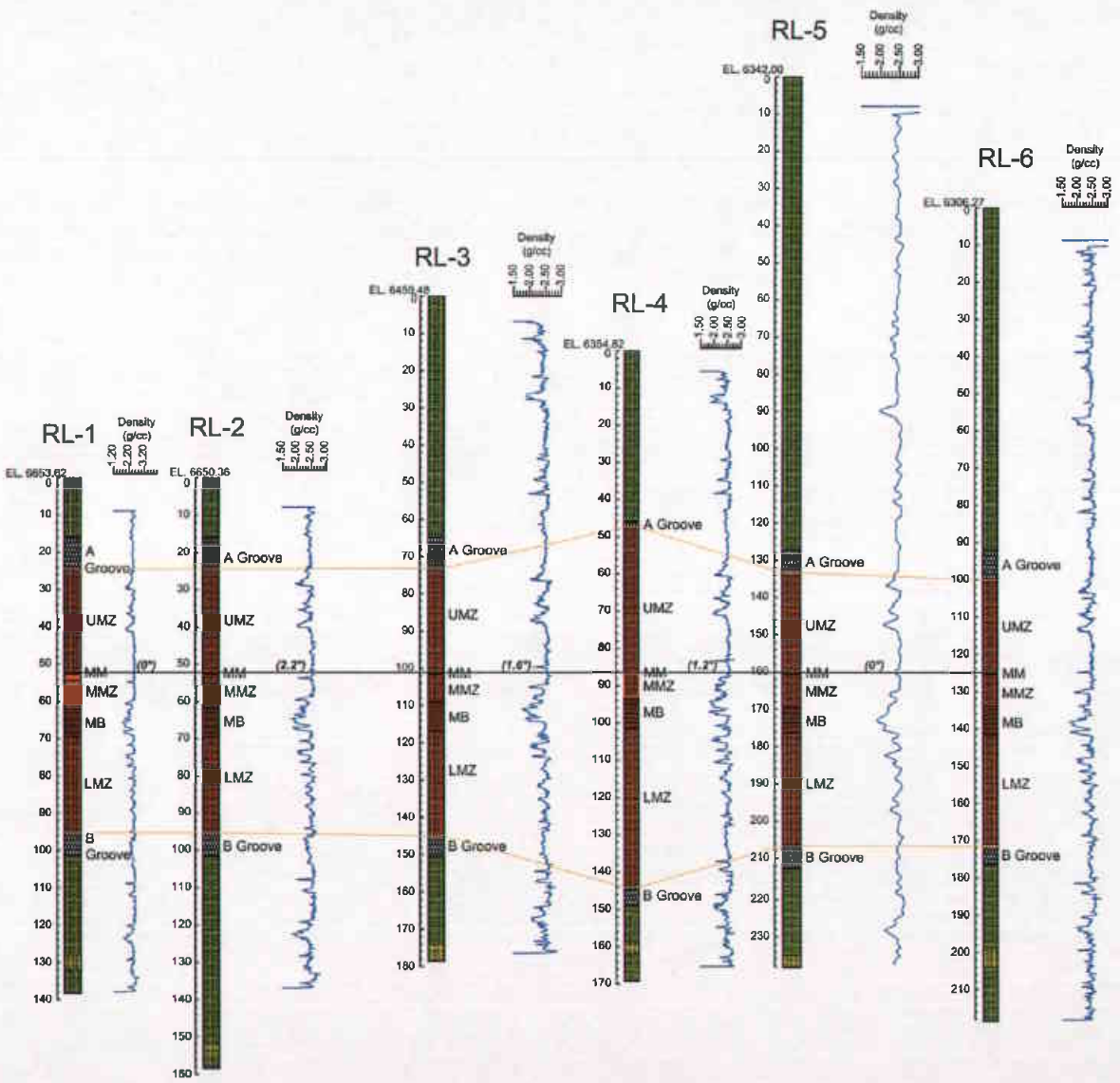
9.3. Area Surface Water

Nearly all of the Project Area drains to Sweetwater Canyon Creek via Indian Ridge Canyon and its tributaries. A small portion at the north end of the Project Area drains to Klondike Canyon, which is another tributary of Sweetwater Canyon. Sweetwater Canyon Creek is tributary to Bitter Creek, which is a tributary of the White River. The confluence of Sweetwater Canyon Creek and Bitter Creek is approximately 3.3 miles northeast of the northeast corner of the RLR site. The confluence of Bitter Creek and the White River is approximately 20 miles north of the RLR site.

Annual rainfall is generally low for this region, averaging 10 inches per year. The 10-year 24-hour storm event for the Project Area is 1.68 inches. (WRCC 2010)

The USGS briefly maintained a gaging station on Sweetwater Canyon Creek approximately 2 miles east of the Red Leaf site and upstream of Indian Ridge Canyon in T13S, R23E, Section 27 (Sweetwater Canyon Creek near Watson, Utah) (Figure 3, Project Area). Drainage area for the station was 124 square miles. The gaging station was operated for four years between October 1974 and October 1978. During that period the average daily discharge was 0.089 cubic feet per second (cfs). It had zero average daily discharge for 82 percent of the period of record. Discharge periods were during spring runoff and following summer/fall storm events. The maximum discharge during these four years was 59 cfs on July 25, 1976; the average discharge for that day was 9.4 cfs, demonstrating the "flashy" nature of the stream. (USGS 2011)

The USGS maintained a gaging station on Bitter Creek approximately eight miles downstream of the RLR site (Bitter Creek near Bonanza, Utah) for water years 1971 through 1989. During that period the annual



Legend

- Shale/ Oil Shale
- Marlstone
- Volcanic Tuff
- Sandstone/ Mudstone

(2.2°) Apparent dip of Mahogany Marker between drill hole.

Cross Section developed by Norwest Corp

RED LEAF RESOURCES, INC.
Oil Schale Development

Figure 6
Geologic Cross Section
(Datum is Mahogany Marker)

JBR

DRAWN BY	DATE DRAWN
CP	12/21/2011
SCALE	Horizontal - NTS Vertical - as shown

average discharge ranged from 0.28 cfs in 1972 to 18.5 cfs in 1987, with the overall annual average for the period being 6.06 cfs. The maximum daily average recorded for the period was 150 cfs on September 5, 1982. Periods of no flow were common, and followed the same general hydrograph as Sweetwater Canyon Creek. (USGS 2011)

The Project Area slopes down to the east and Indian Ridge Canyon. It is dissected by numerous ephemeral drainages, and does not contain any perennial surface water sources. The USGS National Hydrography Dataset shows no springs in or near the Project Area (USGS 2010, JBR 2011). The ephemeral drainages that cross the area are typical of those found in this high-desert environment. Channels are incised in some reaches and essentially undefined in others, riparian vegetation is lacking, and bed/bank sediment movement is evident. The runoff regime of these channels is controlled primarily by local summer thunderstorms that generate infrequent and short-lived, but often intense, flash floods.

9.4. Area Groundwater

9.4.1. Southern Uinta Basin Ground Water Setting

The State of Utah defines an aquifer as "a geologic formation, group of geologic formations or part of a geologic formation that contains sufficiently saturated permeable material to yield usable quantities of water to wells and springs" (UAC R317-6-1). The Utah State Water Plan (UDWR 1999) refers to the Mesa Verde Formation as the regional aquifer closest to the surface in the Project Area.

Groundwater underlies the lease area at depth (Freethy and Cordy 1991). Mesozoic-age rock underlies much of the upper Colorado River basin, including the Uinta Basin. Several aquifers of regional extent are found within these rocks (Freethey and Cordy 1991). Groundwater associated with the Mesa Verde Group is the uppermost of these larger aquifers. Within the Uinta Basin, the saturated thickness associated with this aquifer often well exceeds 2,000 feet, but is buried quite deep (Freethey and Cordy 1991). Based on Utah Division of Oil, Gas and Mining (DOGM) records of oil and gas wells near the Red Leaf project site, the top of the Mesa Verde Formation is between 3,000 and 4,000 feet below ground surface (as indicated for APIs 43-047-30135, 43-047-30115, 43-047-37336, 43-047-37283, 43-047-33488, 43-047-37523, 43-047-37522 and others (DOGM 2011). The locations of wells in the project vicinity are shown on Figure 3. Summary logs of two of the aforementioned wells are provided in Table 1 and their locations are shown on Figure 4, Geologic Map.

Regionally, the direction of groundwater movement in this part of the Uinta Basin is toward the north and the White River. Water quality in the Mesa Verde and other regional aquifers ranges from relatively good to briny, with a range between 1,000 mg/L and 3,000 mg/L total dissolved solids expected in the aquifer underlying the Red Leaf project (Price and Miller 1975).

State and federal publications (Price and Miller 1975; Sprinkel 2009) describe the Green River, Wasatch, and Mesa Verde formations as intermixed strata of sandstone, shale, siltstone, and mudstone, with permeabilities ranging from very low to high. The Green River Formation is generally considered an

aquiclude in the southern part of the Basin, with low spring and well yields (Price and Miller 1975). In the central and northern parts of the Basin, the Birds Nest Aquifer is located in the upper part of the Parachute Creek Member and is recharged from the area of Evacuation Creek to the east where the Birds Nest zone is exposed in part (BLM 2008).

The UGS has compiled information on surface and ground water quality in the southeastern Uinta Basin in an Open-File Report (Wallace, 2012). That report describes water quality and gross geology in selected wells, springs, and drill holes in the Basin. In addition, 24 water quality samples from surface water bodies, springs and wells were collected as part of the study; however, none were in the vicinity of the project area. Supplemental data for the study were provided by oil and gas companies, and published sources.

Notable in the compiled data are data reported in a U.S. Geological Survey (USGS) Water-Resources Investigations report (Holmes, 1980). This report describes the results of ground water test holes drilled by the USGS in the Southeastern Uinta Basin from 1976 to 1978. The objective of the study was to evaluate the 2 recognized aquifers in the Green River Formation: the Birds Nest aquifer in the Parachute Creek Member and the Douglas Creek aquifer. A total of six wells were drilled; all reportedly penetrated some thickness of the Douglas Creek Member. Two of the six wells were completed in the south-central part of the Basin. Test hole 2 was drilled approximately five miles east of the project area on a small tributary of Bitter Creek and Test Hole 3 was drilled approximately seven miles to the northwest on Willow Creek. Each well encountered the Douglas Creek Member relatively near the ground surface.

After collaring in the Parachute Creek Member, Test hole 2 was drilled to a depth of 1,290 feet and penetrated what Holmes (1980) described as intertonguing beds of the Douglas Creek and Wasatch Formation beginning at a depth of 50 feet. Small quantities of water were encountered near the surface and at a depth of 400 feet. Significant water was encountered at a depth of 740 feet in what was described as the Douglas Creek Member. Discharge rates of up to 200 gpm were encountered as the hole was deepened. The water is inferred, based on geophysical logging, to be derived from sandstones. The well was cased to total depth and was uncemented. Static water level was measured at 383 feet depth after completion of the well and prior to aquifer testing. The static water level observed indicates that the Douglas Creek aquifer at this location is confined.

Test hole 3 was drilled to a depth of 1,092 feet and penetrated alluvium to a depth of 190 feet where it entered the Douglas Creek Member. After drilling through a 60-foot-thick tongue of the Wasatch Formation, it bottomed in the Douglas Creek. The upper 250 feet of the hole was cased to eliminate caving. Measured discharge rate was variable and reached a maximum flow rate of 190 gpm at 550 feet. Again, based on geophysical logging, sandstone was believed to be the dominant lithology in the well. The well was not cased and is open from 250 feet to 1,092 feet. No aquifer tests were conducted. Static water level was 11 feet below ground surface after completion, again indicating that the Douglas Creek aquifer is confined in this area.

Regional ground water conditions and their relationship to the Southwest #1 project area are discussed further below.

9.4.2. Project Area Hydrogeology

The Green River and Wasatch Formations overlie the Mesa Verde Group in the project area (see Table 1), with the Parachute Creek Member of the Green River Formation being the surface bedrock formation found throughout the majority of the RLR parcels (Figure 4). The Parachute Creek Member contains the Mahogany Oil Shale zone, from which RLR would extract its ore. The Douglas Creek Member underlies the Parachute Creek Member and is not exposed on the leases. Ground water from the Douglas Creek aquifer discharges to stream channels in the southern Uinta Basin and to wells in the northern part of the Basin.

According to records on file with the Utah Division of Water Rights (2011), groundwater in the vicinity of the Red Leaf project has been encountered at depths shallower than those reported by Price and Miller (1975) or Freethey and Cordy (1991) for the Mesa Verde. Records of nearby water wells on file with the Utah DWR (2011) show the following:

1. A 455-foot well in T14S, R23E, NE¼ Section 6 was drilled and abandoned during year 2004 due to a lack of water;
2. A 1,312-foot-deep well drilled in 1978 had a static water level of 475 feet and produced at a rate of 9 gallons per minute (GPM) during a pump test; this well is in T14S, R22E, Section 2 (southwest of the RLR parcels) and first encountered water at 890 feet;
3. A 900-foot well drilled in T13S, R23E, SE¼ Section 30 in 2010 (by RLR), hit water at 603 feet with a production rate of 1 GPM. A second formation at 830 feet yielded 15 GPM.

These ground water occurrences likely reflect localized, perched aquifers associated with lenses of permeable bedrock in the Douglas Creek Member of the Green River Formation. Alluvial deposits are minimal in the RLR parcels and are insufficient to meet the state definition of an aquifer. The Douglas Creek Member of the Green River Formation crops out in some of the deeper canyons in and near the Project Area (Sprinkel 2009).

The oil-shale-rich Parachute Creek Member behaves as an aquiclude inhibiting recharge of underlying horizons by infiltrating precipitation on the Red Leaf leases. Recharge to the underlying Douglas Creek Member from the surface on the leases themselves is therefore de minimis. The recharge area for the Douglas Creek Member is the expansive outcrop area in the southern-most part of the Uinta Basin. From the recharge area, ground water flows to the north where it recharges the aquifer in the central part of the basin and discharges in the many stream channels that dissect the entire area (Holmes and Kimball, 1987). The B-Groove horizon is known to be a water-bearing horizon in the Piceance Creek Basin in northwestern Colorado where its lithology is comprised of sandstone, siltstone, some marlstone and lean oil shale (BLM, 2006). These lithologies along with fracturing result in sufficient transmissivity to enable the B Groove to behave as an aquifer, at least locally in the Piceance Creek Basin. At the White River mine in eastern Uintah County, the B-Groove is not mentioned as an aquifer in the Environmental Assessment (EA) performed for by the BLM for the Oil Shale Exploration Company's Research

Development and Design (RD&D) lease (BLM Environmental Assessment Ut T-080-06-280-EA). Presumably the dewatering activity necessary for reopening the mine would impact recharge to a B Groove aquifer and the impact would have been analyzed in the EA. It is reasonable to presume that the B Groove is not an aquifer at the White River Mine.

In contrast to the B Groove lithology in the Piceance Basin, the B-Groove horizon at the Red Leaf project area is described consistently in all nine drill holes as being comprised of mudstone, brown- or blue-gray in color lean (oil shale-poor), and weakly to strongly laminated. Only occasional short, vertical, closed fractures are noted in the core logs. A laminated mudstone would have no primary porosity or permeability and would tend not to preferentially develop secondary permeability through fracturing, as the rare occurrences of closed fractures indicate.

The oil and gas well logs used by Sprinkel (2009) that are nearest to the RLR site are shown in Table 1 from the surface through the regional Mesa Verde aquifer and the Dakota sandstone. They are consistent with the three water wells described above in placing the Douglas Creek Member of the Green River Formation 780 to 1100 feet bgs.

9.4.3. Area Surface and Ground Water Quality

Table 2 shows selected water quality data from the USGS Sweetwater Canyon Creek gaging station during its four years of record, and Table 3 shows selected water quality data from the USGS Bitter Creek gaging station during its 18 years of record. They show dissolved solids concentrations increasing in the downstream direction.

Table 2 Selected Water Quality Data for the USGS Sweetwater Canyon Creek near Mouth near Watson, Utah Gaging Station, Water Years 1974-1977.

Parameter	# of Samples	Average	Minimum	Maximum
pH (SU)	9	8.2	8.0	8.5
Total Dissolved Solids (mg/L)	11	1,930	1,350	2,200
Total Dissolved Solids (tons/day)	8	2.7	0.52	10.6
Suspended Sediment (mg/L)	11	3,784	202	8,660
Specific Conductance (microsiemens/cm)	10	2,299	1,800	5,250

Table 3 Selected Water Quality Data for the USGS Bitter Creek near Bonanza, Utah Gaging Station, Water Years 1971-1989.

Parameter	# of Samples	Average	Minimum	Maximum
pH (SU)	41	8.1	7.4	8.6
Total Dissolved Solids (mg/L)	40	6,236.5	2,700	9,460
Total Dissolved Solids (tons/day)	33	24.3	0.22	103
Suspended Sediment (mg/L)	27	240.7	7	1,080
Specific Conductance (microsiemens/cm)	110	5,114[1]	1,540	>8,000

[1] Average does not include the nine instances recorded as >8,000 µS/cm

State-designated beneficial uses for the White River and its tributaries are 2B (secondary contact recreation), 3B (warm water fish and aquatic life), and 4 (agriculture). The latest 305(b) report to Congress (DWQ 2006) finds that the White River fully supports its designated 3B and 4 beneficial uses (2B was not assessed), and thus its water quality is not considered to be impaired.

Ground water quality for the southern part of the Douglas Creek member of the Green River Formation is described in Holmes and Kimball (1987) as follows:

> Water in the southern part of the aquifer most closely resembles the water from springs that discharge in canyon bottoms. This water is dominated by sulfate, bicarbonate, sodium, magnesium, or calcium as a result of reactions that take place in the recharge area. As the water moves downgradient in the aquifer, further reactions cause additional changes in the chemical quality. The dissolved-solids concentration increases from south to north in the aquifer. This change is in the direction of the flow path.

Table 4 is a summary of chemical quality of water in the Douglas Creek aquifer taken from Holmes and Kimball (1987).

Table 4 Summary of chemical quality of water in the Douglas Creek Aquifer

Variable	Southern part of the aquifer				Central aquifer mean value
	# of samples	Mean	Minimum	Maximum	
Water Temperature (°C)	4	19.1	16.5	22	25.5
Specific conductance (µS/cm)	4	1,070	940	1,300	1,670
pH (standard units)	3	8.2[1]	7.2	8.8	8.7[1]
		Milligrams per liter			
Alkalinity (as $CaCO_3$)	4	222	160	300	530
Hardness (as $CaCO_3$)	4	710	100	2,300	8.5
Calcium (as CA)	4	22	4.5	54	2.6
Magnesium (as Mg)	4	20	1.8	44	0.4
Sodium (as Na)	4	225	180	340	390
Potassium (as K)	4	0.8	0.6	1.0	0.9
Chloride (as Cl)	4	9.2	7.4	12	25
Sulfate (as SO_4)	4	365	270	470	300
Fluoride (as F)	4	0.3	0.2	0.5	2.4
Silica (as SiO_2)	4	11	8.1	17	14
Dissolved solids (calculated)	4	785	640	950	1,060
Nitrogen, ammonia (as N)	2	0.06	0.01	0.12	1.0
Nitrogen, nitrate (as N)	2	0.20	0.01	0.38	<0.01
		Micrograms per liter			
Boron (as B)	4	250	70	630	550
Iron (as Fe)	4	1,010	40	2,100	20
Manganese (as Mn)	4	28	10	60	10

[1] Geometric mean

Source: Holmes and Kimball 1987

9.5. Project Area Ground Water Investigation

In addition to publically available ground water data in the project vicinity described above, a site-specific ground water assessment was also carried out. The ground water assessment had two components: a seep and spring inventory and a monitor well installation and analysis program.

9.5.1. Seep and Spring Inventory

The seep and spring inventory area was determined based on distance from the lease boundaries (at least ½ mile and in most cases 1 mile) and locations of surface drainage divides. Appendix D contains the entire seep and spring report. Observations and conclusions from the survey are summarized below. The figure in Appendix D shows the boundary of the area over which the seep and spring inventory was conducted and the spring, seeps, and potential seeps identified and mapped.

Field work was carried out in Fall 2012. Partial drought conditions in the area and seasonal effects were recognized as potential limiting factors in identification of seeps and springs. The work was carried out by two-person field crews traveling on foot or by off-road vehicle.

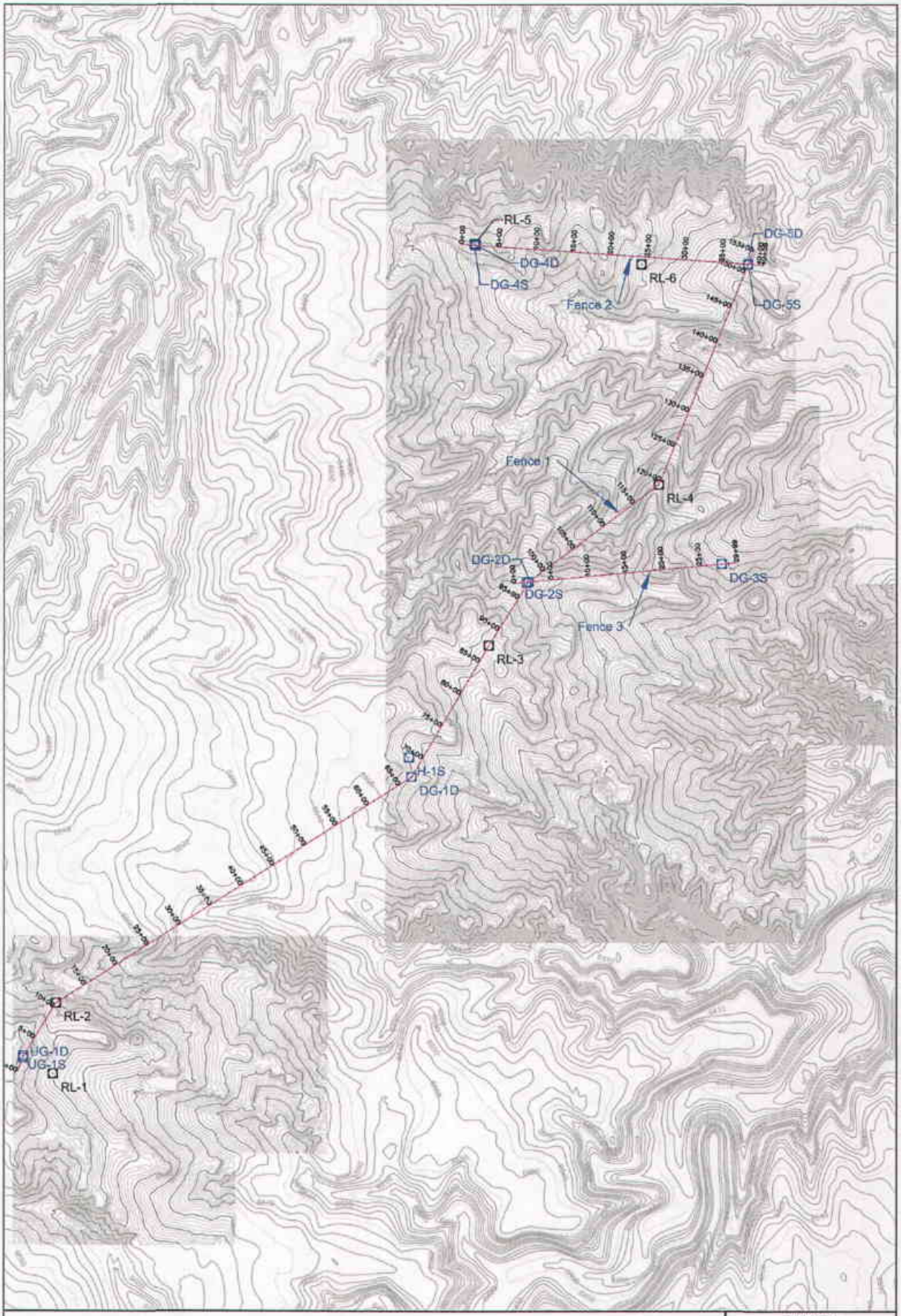
Key field observations and data collection included visual indications of seep or spring flow, evidence of seep flow (erosion features) as distinguished from stream flow, hydrophytic vegetation potentially associated with seeps (vegetation type and extent), geologic origins of any flows (i.e., alluvium or bedrock [e.g., bedding plane or fracture]), topographic and landscape features, site photographs, evidence of wildlife or livestock usage, evidence of spring development, and field parameters where measurable (pH, electrical conductivity, water temperature, and flow rate).

Few seeps or springs were identified within the inventory area (Appendix D), with none observed in the northwestern "highland area" of upper Klondike Canyon or the majority of the main Indian Ridge Canyon. One seep was identified in a canyon tributary to Indian Ridge Canyon in the southwest region of the study area. One spring, a seep, and a seep complex were identified in the lower portion of Klondike Canyon and two nearby tributary canyons in the northeast corner of the survey area. These seeps and springs are described in greater detail in Appendix D. The only ground water source identified by the water rights research was found during the inventory. In addition, based primarily on localized concentrations of potentially hydrophytic vegetation, "potential seeps" were also observed and mapped.

The single spring identified, Klondike Canyon Spring-01, had a measurable flow rate (0.28 gpm), a pH of 8.1, and electrical conductivity of 3.0 mS (millisiemens). No other measurable flows were encountered at the seeps identified. The observed geological occurrence of the single spring and most seeps was discharging or potentially discharging stream bed material, which was comprised of alluvium, residuum, or both. A seep in a tributary of Klondike Canyon to the northeast of the northern lease block was an immeasurable discharge from a bedding parting in oil shale. This seep is the only confirmed discharge from bedrock encountered during the survey.

9.5.2. Monitor Wells

Monitor wells were located to assess upgradient and downgradient subsurface water conditions in the RLR lease blocks. Monitor well locations are shown on Figure 7 and geologic sections through the wells are shown on Figure 8. Well locations were selected to characterize subsurface water across the area to be mined. If necessary, the wells can be used in the future as monitoring wells during the life of the



LEGEND

- UG-1S 2010 Core Hole Location
- RL-1 2012 Well Location
- Cross-section Location

FIGURE 7

Red Leaf Resources
Lease Area with
Cross-section Locations

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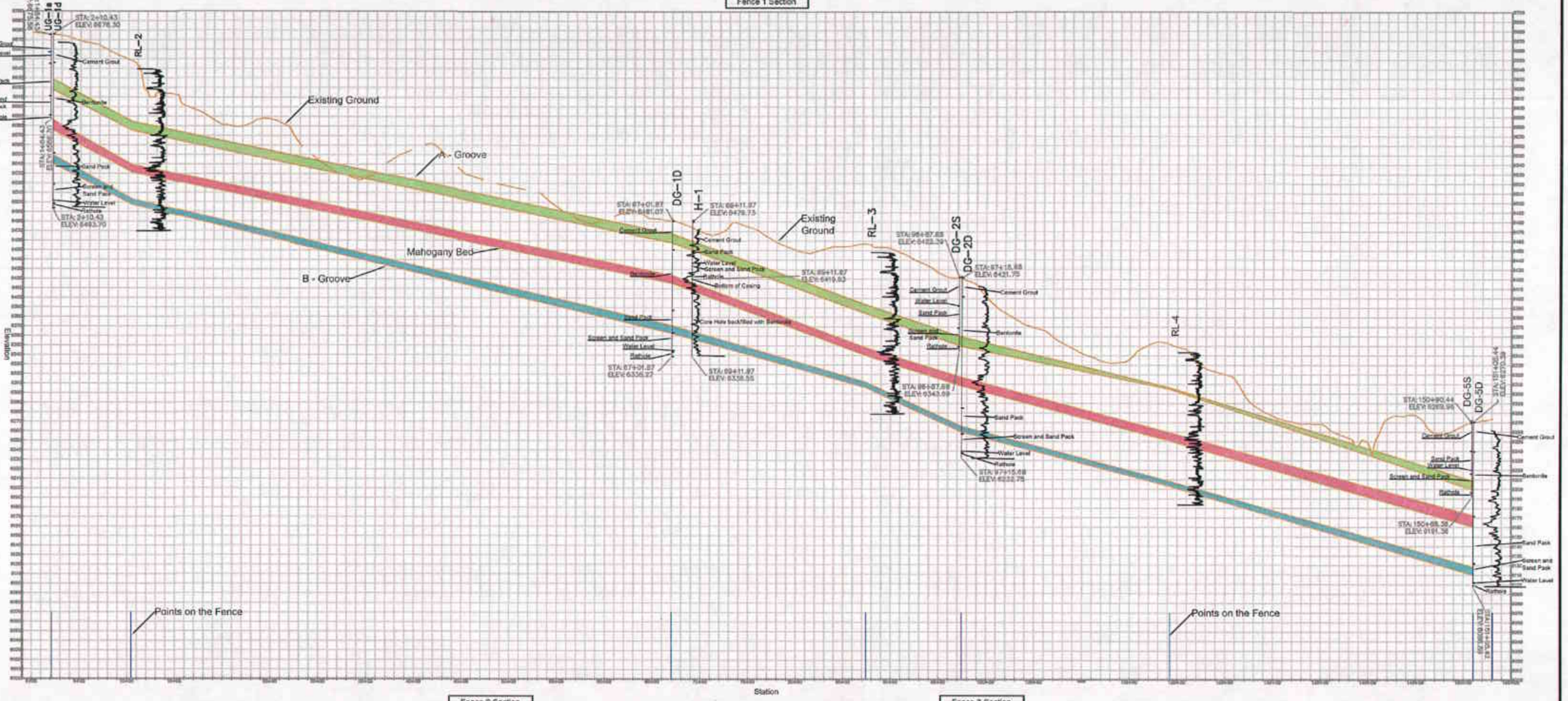
FILE: 187150SPB-1

Fence 1 Section



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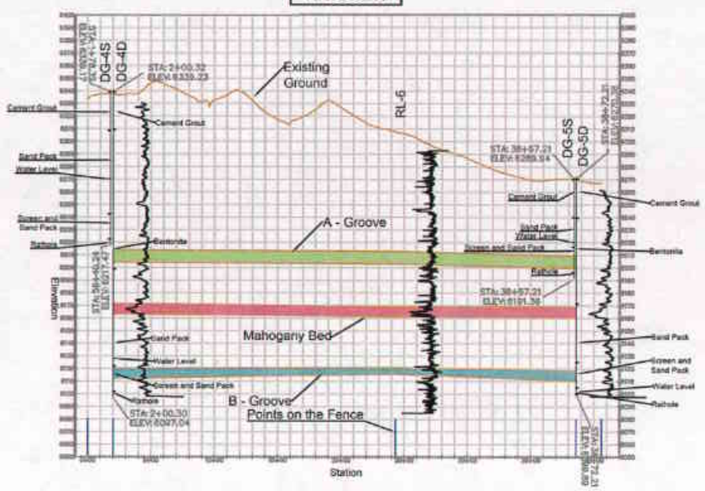
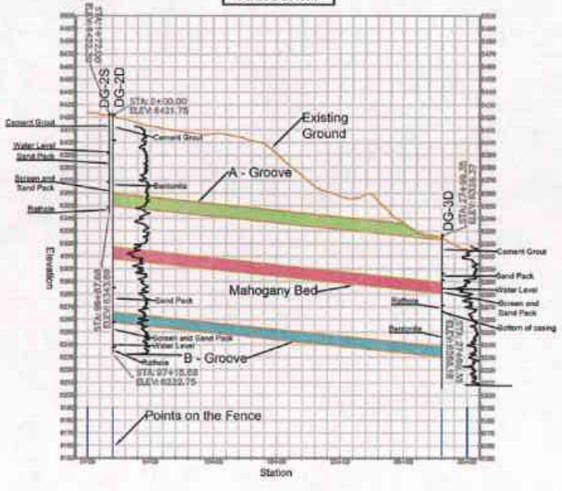


Fence 3 Section



LEGEND

0 300 600 900 1200
FEET

FIGURE 8

Red Leaf Resources
Lease Area
Fence Diagrams

DATE: 02/01/2013 | SCALE: 1"=600'
FILE: 1871503FIG-2 | NORWEST CORPORATION

commercial operation. In the interim baseline conditions including potentiometric surface and water quality data will be collected

Six rotary holes designed for completion as monitor wells were drilled in the fall of 2012. The holes are designated UG-1 and DG-1 through 5. UG-1 is an up-gradient boring located on the western edge of Section 36, the isolated lease block on the southwest part of the Seep Ridge leases. The other borings are intended to provide monitor points down gradient from the proposed northward-advancing mining operations. Each boring was drilled to the unnamed sandstone unit that occurs beneath the B Groove. This unit was selected because it is present beneath the entire project area based on previous core drilling and because it is easily recognized in drill cuttings. Monitor well drilling was overseen by a senior ground water hydrologist with Norwest. A Norwest geologist familiar with the lithologies in the area was also present during drilling to prepare a geologic log of the rotary cuttings. A tricone bit on a rotary drill was used to drill each hole. Samples of drill cuttings were collected at 5-foot intervals and described lithologically. In addition, a geophysical log was run on each well and drill hole. Bulk density logs for each well and core hole are plotted on the cross sections shown on Figure 8.

After installing a surface casing, monitor wells were advanced with an 8-inch tricone bit with an air rotary rig. Minimal water was added during drilling, and circulation was primarily maintained with compressed air. During drilling, water returns were observed and, when possible, flow rates estimated. All but one (DG-3) of the wells encountered water or moist cuttings during drilling. No effort was made during drilling to apply more compressed air than necessary to maintain circulation so as to avoid excessive removal of encountered water. Water returns were black with a strong petroliferous odor as the wells penetrated the oil shale horizons, which comprise most of the stratigraphic interval penetrated by each well.

Of the six monitor wells drilled, five displayed evidence of water encounters in the upper and lower parts of the bore hole. In order to ensure that horizons with possible water occurrences assessed for water-bearing horizons, a shallower boring was drilled adjacent to each of the five deeper wells, resulting in a total of 11 monitor wells designated: UG-1D, UG-1S, DG-1D, H-1, DG-2D, DG-2S, DG-3, DG-4D, DG-4S, DG-5D, and DG-5S. H-1 was a core hole drilled adjacent to DG-1 that was reamed, backfilled and completed as a shallow twin to DG-1.

Each well was completed in the following general manner: the zone for completion was selected; granular bentonite backfill was placed in cases where the lower parts of a boring were not selected for completion (H-1 and DG-3); a 20-foot well screen over a 5-foot "rathole" (length of closed-end solid casing) was installed in the base of the completion zone; the completion zone was filled with 70-mesh sand to the top of the zone of interest; granular bentonite fill was placed to within 20 to 30 feet of the top of the hole and then neat cement grout was poured to seal the top of the well. Following well completion, locking caps were then placed on each wellhead to secure the well.

After completion, the drill rig was used to air lift water from each well in an effort to remove water introduced during drilling. Wells were then monitored weekly until the water level in each well stabilized. Water level stabilization in each well required a number of weeks.

After the water level in each well stabilized, aquifer tests were conducted on those wells with stabilized water levels within the screened interval. The wells tested included UG-1s, H-1, DG-2s, DG-3, DG-4s, DG-5s, all of which were termed shallow completions, completed in the upper parts of the section within or above the A Groove. Of the five deep completions (UG-1D, DG-1D, H-1, DG-2D, DG-4D, and DG-5D) only DG-4D contained a water column extending into the screened interval following well completion.

Aquifer tests were conducted under the direction of a Norwest ground water hydrologist. The method of testing was a recovery test following rapid pumping and evacuation of each well. The wells were pumped using a portable submersible pump until the well bores were evacuated, which occurred over intervals of from 2 to 23 minutes. Recovery was monitored with pressure transducers suspended in the screened zone of each well and wired to an electronic data recorder secured at the well head. Data was recovered regularly on a portable computer. A description of the aquifer testing procedure is provided in Appendix E.

The recovery of the wells to stable waters level required from 7 to 13 days. Only partial water level recovery took place in 5 of the 7 wells tested (UG-1s, H-1, DG-2s, DG-3, DG-4s). Water level recovery in well DG-5s was nearly 100 percent. No recovery occurred in DG-4D and Norwest believes that the water encountered had leaked from the upper, wetter horizon prior to full hydration and sealing of the granular bentonite installed in the well annulus to isolate the lower section of the boring.

The hydraulic conductivities calculated using the results of hydraulic testing are summarized as follows:

Well DG-2s	4.57×10^{-7} ft/min, or 6.58×10^{-4} ft/day, or 2.32×10^{-7} cm/sec.
Well DG-3	2.80×10^{-7} ft/min, or 4.03×10^{-4} ft/day, or 1.42×10^{-7} cm/sec .
Well DG-4s	9.83×10^{-7} ft/min, or 1.42×10^{-3} ft/day or 4.99×10^{-7} cm/sec.
Well DG-5s	1.90×10^{-6} ft/min, or 2.74×10^{-3} ft/day or 9.52×10^{-7} cm/sec.
Well H-1	9.83×10^{-7} ft/min, or 1.42×10^{-3} ft/day or 4.99×10^{-7} cm/sec .
Well UG-1s	9.49×10^{-7} ft/min, or 1.37×10^{-3} ft/day or 9.49×10^{-7} cm/sec.

9.5.3. Water Quality

During evacuation of the wells during the aquifer test pumping, water samples were collected by Norwest. Samples were also collected from the other wells containing water that were not tested. Samples were collected and appropriately preserved for bulk parameters, major cations and ions, metals, and selected organic constituents. Samples were maintained under chain of custody delivery to

Chemtech-Ford Laboratories for analysis. The laboratory analytical reports are provided in Appendix F. In addition, samples from wells H-1, DG-4s and DG-5s along with a recent snow melt sample were collected for analysis of stable isotopes of hydrogen (H and $\delta\ ^{2}H$ [deuterium]) and oxygen ($\delta\ ^{16}O$ and $\delta\ ^{18}O$). The purpose of the sampling and analysis effort was to assess the relative age of the water encountered in the wells. The results of these analyses, the theory of their application, and interpretation of the results are provided in Appendix G. Samples were analyzed for the aforementioned parameters by Isotech Labs and interpreted by Norwest (Appendix G). The conclusion reached by Norwest is as follows:

> The main conclusion to be drawn from the results is that the modern snow, which is partly evaporated in melting of the LMWL (the local meteoric water line), is much lighter than the three formation waters. This, and the possibility the formation waters belong to a different MWL, from warmer times, suggest the formation waters are not recently infiltrated water. Likely the waters are much older and possibly belong to a time sequence that had a markedly different climate and elevation.

The water quality data yielded one common and surprising result: total dissolved solids (TDS) concentrations that ranged from 9,020 mg/l to 58,600 mg/l. These concentrations exceed many samples of saline ground water in the Birds Nest Aquifer in the central part of the Uintah Basin and exceed the TDS concentrations reported in all but 1 of 43 samples from the Green River Formation in the broad vicinity of the project area reported in UGS Open-File Report 595 (Wallace, 2012).The probable age of the shallow subsurface water in the Parachute Creek Member on site along with extremely low hydraulic conductivity demonstrate that recharge through the bedrock near surface at the project area is likely to be nil. The very high TDS concentrations likely result from the extended residence time of the old water within the oil shale and/or are representative of the water that was trapped in the minimal storage capacity of these rocks. The shallow subsurface water is likely to have been present in the oil shale-bearing strata for millennia without significant recharge into or through the beds. Similar conditions are likely present in the oil shale beds beneath the portion of the Parachute Creek penetrated by the core and rotary drill holes on the site. This observation is consistent with the assessment that the Parachute Creek Member is a confining unit to the underlying Douglas Creek Aquifer in the southeastern part of the basin (Glover, Natz and Martin, 1998).

10.Capsule Design Report

The design for the commercial-scale EcoShale Capsules is described in Section 10.1. The unique added design features of the EPS capsule are described in Section 10.2 and the related appendix. The EPS capsule design includes components that will enable RLR engineers to evaluate performance of the capsule and enable them to make efficiency and cost improvements as well as verify the "environmental integrity" of the capsule design.

10.1. Capsule Construction Plan

The overall operation description is described above in Section 6.0. This section is intended to describe only individual capsule construction.

10.1.1. Methods and Equipment

Capsule construction consists of several different elements. Each of the elements is listed below with a description of how each will be built. The current plan is to build two capsules every 120 days providing one capsule for extraction every 60 days.

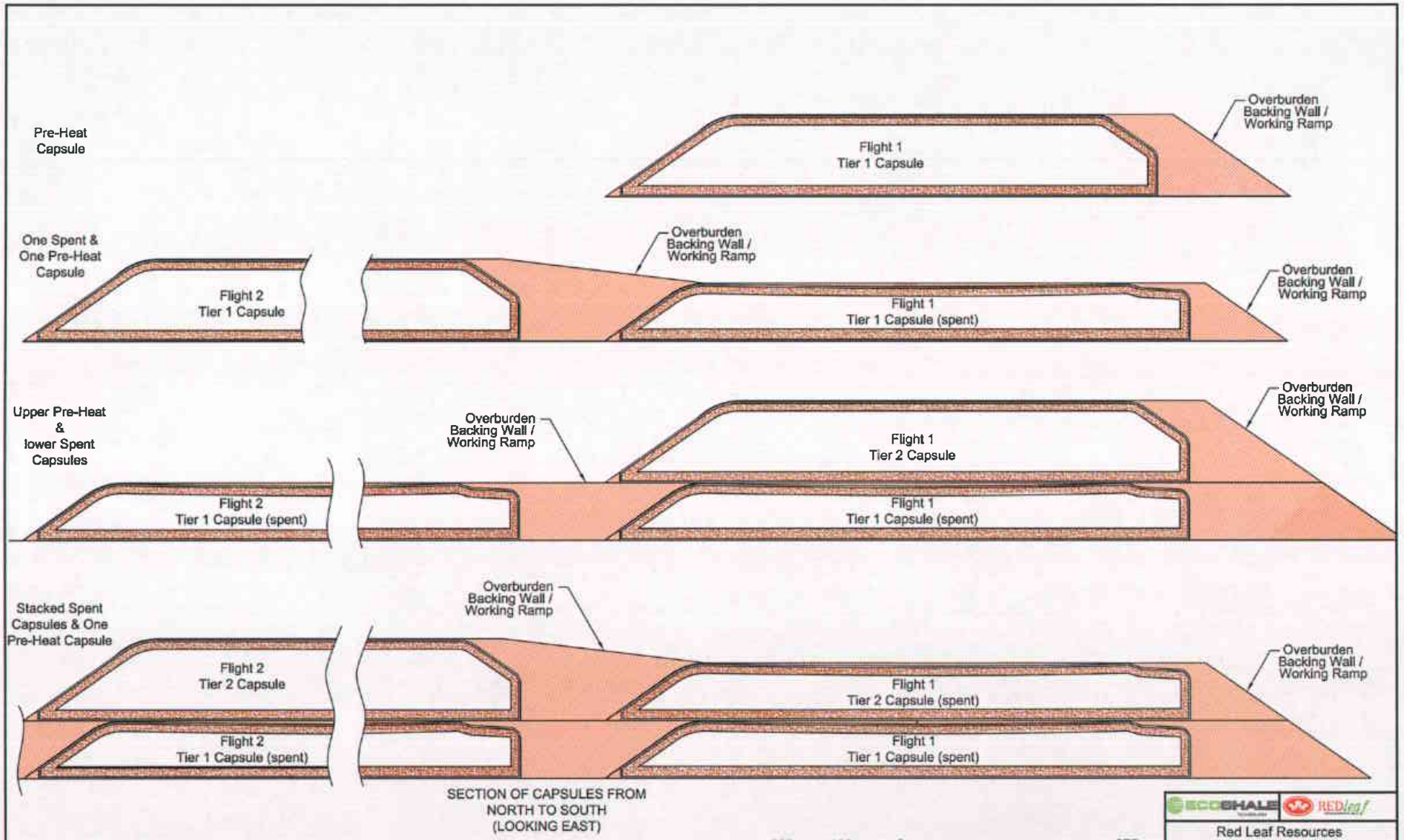
10.1.2. Capsule Stacking (with input from Hatch)

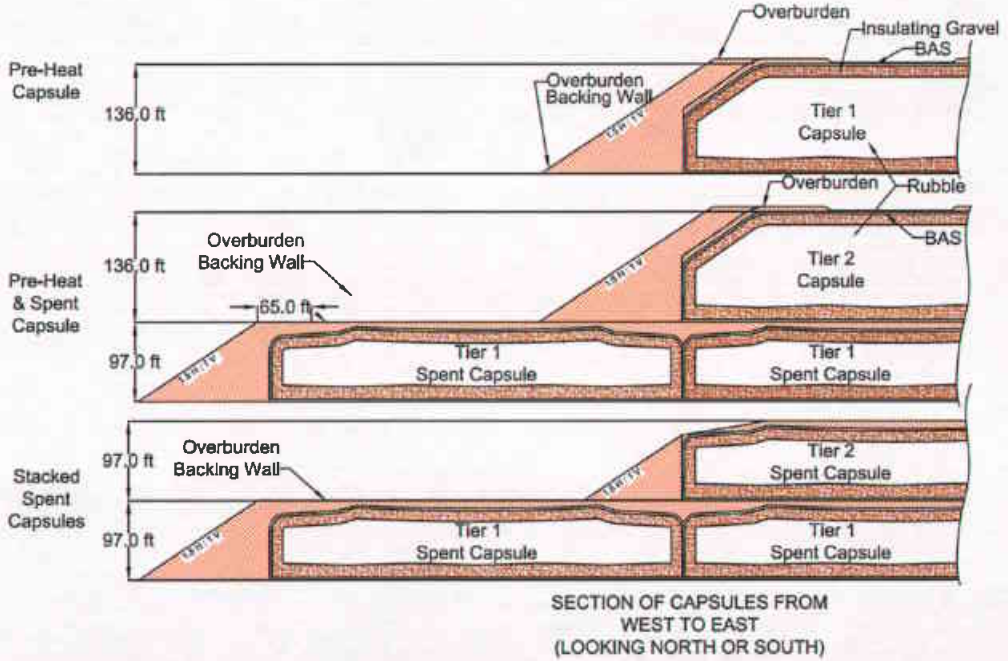
Selected steps in capsule construction and extraction are illustrated on Figure 2 and on Figure 9 (2 sheets). The steps are further described below.

10.1.3. Capsule Floor and Walls

The capsule floor will be constructed with 3ft of compacted BAS covered by 13ft of gravel (2" x 3/8" crushed shale) with an oil collection pan embedded within the gravel. The floor of the mining horizon dips to the north at three degrees (2) and serves not only as the floor of the mining horizon, but also as the base upon which the production capsules will be constructed.

Constructing the floor of the capsule starts by creating the required drainage profile using dozers to contour the pit floor assuring that the natural grade is maintained and the required east-west drainage profile is achievable along the capsule floor and within the gravel. Next the BAS layer will be placed with trucks delivering the BAS and road graders or dozers spreading this material across the entire capsule floor. Traditional roller or sheep foot compactors will run over the BAS compacting the capsule. The basal BAS layer for each capsule will be constructed using BAS manufactured on site with screened shale meeting the target design gradation, blended with an appropriate bentonite clay formulation provided by a commercial producer of bentonite. The blended mixture will be moisture conditioned to a water content between optimum and +4 percent and will be placed in lifts of loose material no greater than 18 inches in thickness at 95 percent compaction. The BAS Quality Control Plan presented below in Section 11 describes the procedure to be used to develop installation and compaction practices based on performance evaluation of BAS test fills. Among other things, the lift thicknesses of loose BAS placed for compaction will be reduced if the results of this test fill work will so dictate.


Pre-Heat Capsule
Flight 1 Tier 1 Capsule
Overburden Backing Wall / Working Ramp
One Spent & One Pre-Heat Capsule
Flight 2 Tier 1 Capsule
Overburden Backing Wall / Working Ramp
Flight 1 Tier 1 Capsule (spent)
Overburden Backing Wall / Working Ramp
Upper Pre-Heat & lower Spent Capsules
Overburden Backing Wall / Working Ramp
Flight 1 Tier 2 Capsule
Flight 2 Tier 1 Capsule (spent)
Flight 1 Tier 1 Capsule (spent)
Overburden Backing Wall / Working Ramp
Stacked Spent Capsules & One Pre-Heat Capsule
Overburden Backing Wall / Working Ramp
Flight 2 Tier 2 Capsule
Flight 1 Tier 2 Capsule (spent)
Overburden Backing Wall / Working Ramp
Flight 2 Tier 1 Capsule (spent)
Flight 1 Tier 1 Capsule (spent)
SECTION OF CAPSULES FROM NORTH TO SOUTH (LOOKING EAST)
NOTE:
CAPSULE STACKING IS FOR REPRESENTATION ONLY. THE ACTUAL STACKING METHOD CAN BE FOUND ON OTHER DRAWINGS.
200 100 0 375
SCALE
ECOSHALE
REDleaf
Red Leaf Resources
Capsule Life Cycle
Sections for South to North
Sheet 1 of 2
DATE: 12/12/2011
SCALE: NOTED
NORWEST CORPORATION



SECTION OF CAPSULES FROM WEST TO EAST (LOOKING NORTH OR SOUTH)

NOTE:
CAPSULE STACKING IS FOR REPRESENTATION ONLY. THE ACTUAL STACKING METHOD CAN BE FOUND ON OTHER DRAWINGS.

200 100 0 375

SCALE

ECOSHALE | REDleaf

Red Leaf Resources
Capsule Life Cycle
Sections for West to East
Sheet 2 of 2

DATE: 12/12/2011 | SCALE: NOTED | NORWEST CORPORATION

Following placement of the BAS, the first layer of gravel will be placed on the surface of the BAS with trucks and graders. The first gravel layer will be placed to create the final East-West grade required for the oil drainage path through and out of the capsule.

The oil collection pan is the next component of the floor to be built. The oil collection pan will be constructed from steel sheets. Steel specifications are provided in Appendix H. The panels of the oil collection pan will be laid across the floor of the capsule with lapping joints over the corrugations to develop an integrated surface for the oil to flow across. The oil collection panels will be placed like roof shingles with the upstream lap higher than the downstream sheet. The finished oil collection pan will be arranged to direct the oil flow into two channels that run south to north on either side of the center of the capsule and down the pit floor. Figure 10 illustrates the dual slope of the oil collection pan and the collection channels. The equipment used to place the pans will require use of forklifts and mine personnel handling the non-galvanized carbon steel gauge steel sheets directly to insure proper lapping. The pans will direct oil into a channel or formed pan, which will connect to a pipe and, through a sealed conduit, conduct petroleum liquids to the product collection manifold at the north end of each capsule.

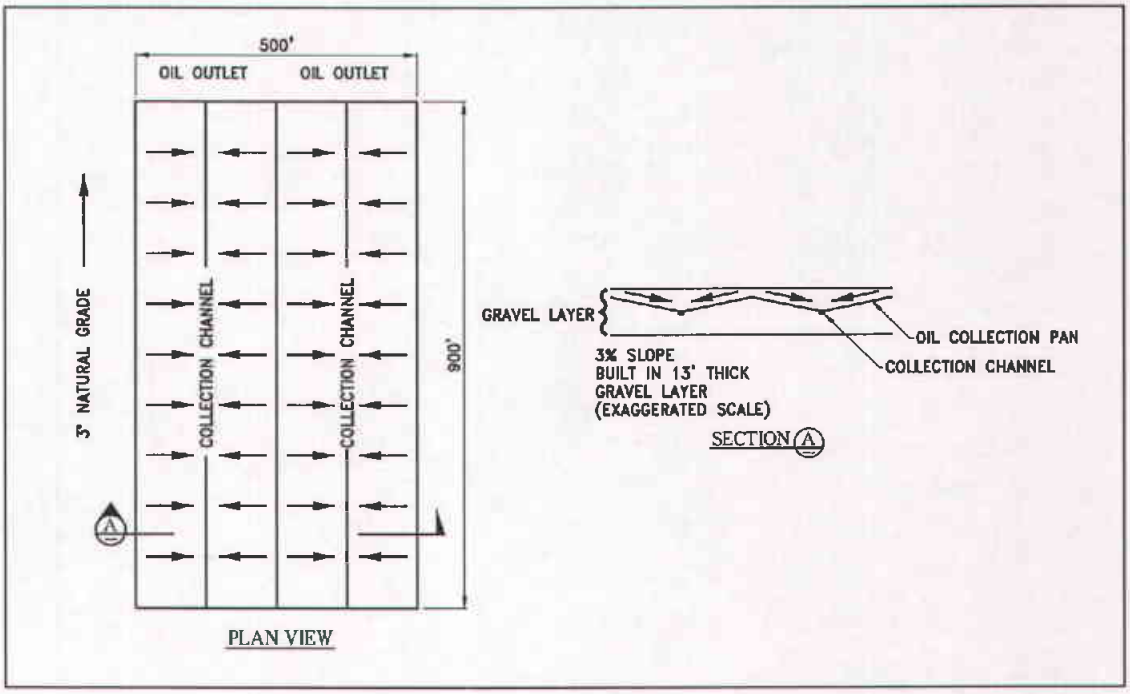


Figure 10 Capsule Floor Arrangement

After a row of pans and collection channels are placed, a second gravel layer will be placed on top of the oil collection pan to protect the pan by distributing the load from continued equipment traffic. The beginning of the BAS side walls develops as the gravel floor advances. The BAS perimeter wall will connect directly to the BAS floor to complete the encapsulation needed for oil extraction. The BAS wall will be 3ft thick and will be placed using mobile equipment and BAS walls will be advanced as discussed below in Section 10.1.4.

As the BAS wall progresses above the gravel floor, the gravel wall will begin to develop. Gravel will also encapsulate the ore. Gravel will insulate the BAS from the heat used to retort the oil shale. To minimize degradation scrapers will not routinely drive on the rubble material..

Construction of vertical walls requires the placement of backing material. In areas where no future capsule is required the backing material needs to be placed with bottom up construction or with layered stacking. Layered stacking is required for the perimeter backing wall to provide sufficient safety factor for construction and to establish compaction to support the vertical walls. In areas where future capsules are planned, backing material must be placed or layered ahead of the capsule progression. Layer stacking of the backing material allows the placement of pipes in the next capsule. Placement of backing materials in the next capsule is illustrated in Figure 11. Rubble, gravel, BAS and backing walls needed to support the BAS/gravel walls must progress upwards at similar rates. To maximize the number of capsules that can be placed on the site, it will be necessary to build the adjoining area of the next capsule. The material placed in the next capsule will provide a resisting force, keeping the wall in position. The material placed in the adjoining capsule will need to be placed by layer stacking rather than allowing the material to cascade into place from above as in the last capsule in a flight of capsules. Layer stacking allow pipes to be placed in the adjoining capsule. In outlining capsules the backing wall can be built with cascade fill.

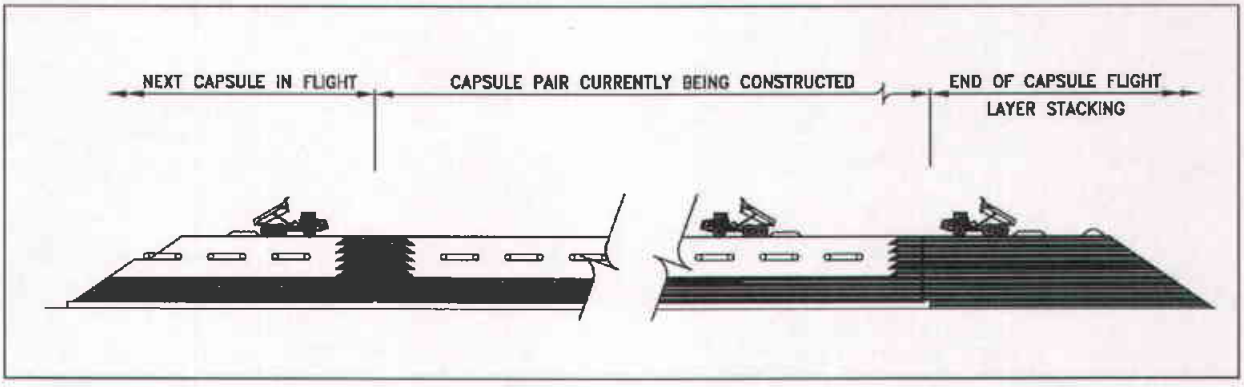


Figure 11 Layer Stacking

10.1.4. Placing Ore, Progressing the Walls and Laying Heating Pipes

Rubble (ore) will be placed with standard AHT and dozers. BAS will be placed using portable forms as depicted in Figure 12. The forms enable the placement of BAS as a discrete wall without possible effects from the adjacent gravel during placement. After a course of BAS has been placed and gravel has been placed against the forms. The forms will be removed and used again for the ongoing wall construction, leaving a smooth outer BAS wall in contact with the porous gravel.

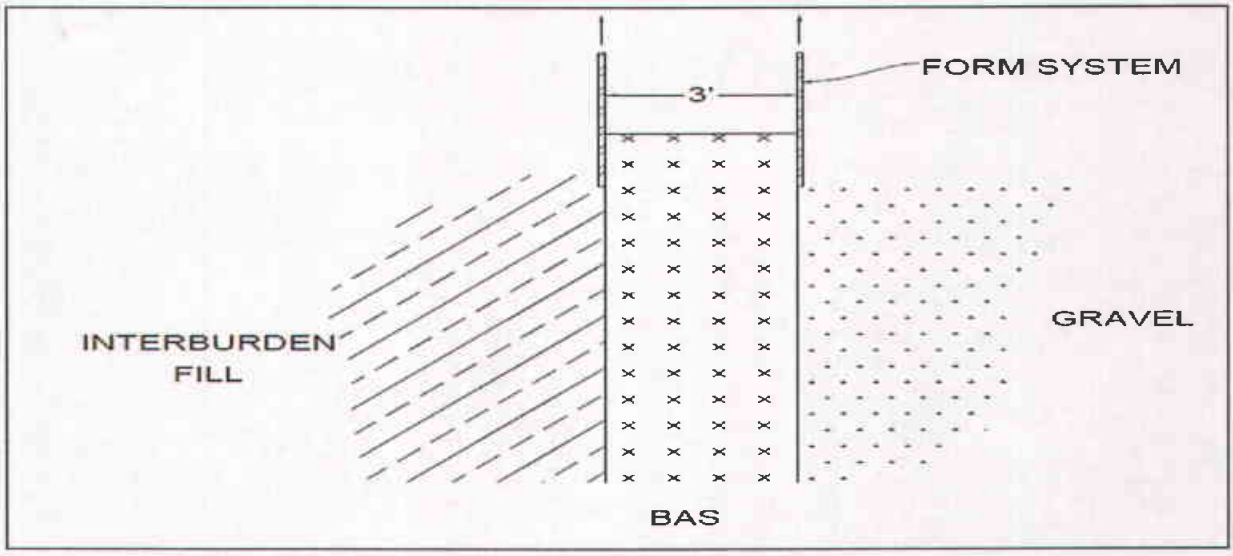


Figure 12 BAS Wall Progression with Forms

The wall between capsules will be created from BAS and gravel. Three of the four walls, the south end and both sides, are internally vertical and the fourth is built at the angle of repose. The wall constructed at the angle of repose is the north wall, and is where all the system equipment will tie into the capsule. Six layers of pipes will be placed as the ore placement continues until the level of ore in the capsule has reached the required thickness. Pipes will be milled on the capsule while being placed in continuous runs from a mobile pipe rolling mill (MPRM) or using alternative vendors, supply chains, and/or pipe manufacturing. Pipes will be corrugated. Typical specification for the steel to be used in pipe milling is provided in Appendix H. Placement of rubble will continue while the pipes are placed. Layering of ore, bedding, and placement of pipes and instrumentation will continue until the capsule is full. At the north end of each capsule a bulkhead and manifold system will contain the piping to distribute heated air to the capsule and recover liquid and gas products from the in-capsule collection pipes for storage and processing

10.1.5. Capsule Pipe Wall or Floor Penetrations

The heating pipes will be connected to the blowers and heaters just beyond the boundaries of the capsule's northern wall. To keep the BAS seal functioning, the BAS needs to be protected from heat that is introduced into the capsules from the heating pipes. Proprietary fabrications have been designed and will be installed to enable BAS protection from heating. The penetrations will be through the floor for the EPS capsule, as discussed below in section 10.2.

10.1.6. Access Ramp

A pad and access ramp will be constructed along the south end of capsule flight. The pad and the access ramp will be constructed using traditional methods for earth structures that utilize haul trucks, graders, and compactors. After the first flight of capsules is complete, the ramps to the second and subsequent flights will be built on the northern toe of the previous capsule flight. Building on the previous capsule's northern wall minimizes construction space and materials needed to build the ramp.

10.1.7. Capsule Roof Finishing

The east and west margins of each capsule surface will be sloped (Figures 2 and 9). The purpose of the slope is part of the capsule design that enables the upper BAS layer to remain intact and keep the capsules sealed when they settle following heating. Finishing the capsule margins with slopes at the angle of repose will reduce the amount of backing material needed for the top part of the capsules.

Ore will be placed to the required depth after which 13 feet of gravel will be placed gravel over the rubble. Roads will be cut into the gravel to provide a road for the BAS trucks and compaction equipment.

After the BAS is placed, additional haul trucks and graders will cover the BAS with run of mine interburden/overburden material to a depth of from 4 to 15 feet, followed by placement of growth media (topsoil/topsoil substitute) in thicknesses of 6 to 12 inches.

10.1.8. Progression

For the commercial phase, before the current capsule pair is completed, construction of the floor of the next capsule pair will start for the capsule construction sequence to continue. A layout of capsule construction progression is depicted in cross sections (Figure 2) and diagrammatically in NOI Figure 12 (Appendix A).

10.1.9. Material Handling Equipment

The materials handling equipment will be used to size and sort the materials for capsule construction. The equipment will consist of a designed system of screens, conveyors and crushers that will size the mined material. Separate equipment streams will be used to handle ore and overburden/interburden. Off-spec ore and overburden/interburden will be sized and sorted as necessary to produce construction fill, insulating gravel, and the sized gravel for the BAS.

10.1.10 Capsule Stacking

Capsules may be stacked to provide sufficient retorting capacity for the ore to be mined. Capsule stacking is depicted in Figures 2 and 9. Figure 2 shows the relationship of the stacked capsules in a series of 3 cross sections. The sections are provided in 2 formats. The upper version shows the capsule rows and flights to scale with both pre and post-mining topography depicted. These sections include labeled slope angles for mine highwall, fill-slope, and capsule surface angles following reclamation. Also shown are the locations of all flights and capsules to scale, relative to the local topography. The lower part of the figure shows cross sections of the capsules in their configurations after the lower tier of

capsules has collapsed. Note that capsule stacking takes place in the first 8 flights, but not the 9th flight. Note also the detail showing the BAS, gravel blanket, ore, upper gravel blanket and capping BAS with the overburden knuckle. Figure 7 shows the capsules and related earthwork construction more diagrammatically. Each of the 2 sheets depicts the progression of capsule construction beginning with a completed first tier capsule, then to the post-heating, consolidated tier 1 capsule containing only spent shale and then to tier 2 capsule placement and finally consolidation. Each drawing calls out selected capsule-related components, notably backing walls and working ramps. The second sheet contains labeled sloped and height dimensions.

10.1.11. Capsule Consolidation

After capsule heating and oil recovery, the oil shale is expected to lose its strength, resulting in significant capsule settlement (consolidation). Capsules will be constructed to a height of up to 136 feet; however, following consolidation the capsules will be reduced to a height as low as 97 feet. More recent information has lead RLR's engineers to believe that consolidation is likely to be less than the 40 feet estimated during earlier design work. Some of the consolidation will occur during capsule construction as the ore thickness increases but will not affect the yet-uninstalled covering BAS. Information used to analyze capsule deformation includes material properties of gravel insulation, shale and BAS. Material properties were developed from laboratory testing which included laboratory reactor retorting of oil shale samples, reactor heat/compression testing of the shale, BAS permeability testing, and evaluating the conditions found during the pilot run, 2012 site constructability testing, and geotechnical work done by outside laboratories. This data was compared to published and unpublished information on behavior of consolidating spent oil shale based on work done in Colorado in the late 1970s.From this comparative work on capsule design, it is known that a sufficient thickness of earthen cover above the covering BAS layer is needed to maintain the BAS in compression. The thickness required to do so will be evaluated in the design, construction and operation of the EPS.

10.1.12. BAS Integrity on Consolidation: Knuckle

One of purposes of the sloped upper edges of the capsule is to prevent excessive shear of the BAS as consolidation occurs. With excessive shear, vertical BAS walls joining the horizontal upper BAS layer would not remain intact. However, the BAS in the sloped capsule roof must remain under compression as capsule consolidation occurs. The side slopes are therefore finished with the addition of earthen fill to create a knuckle. This knuckle design can be used for various capsule heights, with the depth of the knuckle related to the level of expected subsidence. Figure 2 depicts the knuckle construction. The extra fill placed over both the sloped wall and the adjoining roof surface completes the knuckle that maintains compressive stress on the BAS and gravel layers as settlement of the heated capsule occurs and the adjacent unheated capsule remains at its constructed height.

Consolidation in the EPS capsule will be monitored carefully and assessed post-cooling to determine if the BAS has maintained its plasticity and remained intact. If the integrity of the liner has been affected, it will be repaired and design modifications to overcome the observed effects will be made.

10.2. Early Production System Capsule Design

The EPS capsule will be approximately three quarters the size of a full-scale commercial capsule. The location of the EPS capsule and related facilities is shown on Figure 13. The relationship of the EPS capsule to the remaining capsules in the first flight of commercial-scale capsules is shown in Figure 14. Figures C-1 and C-2 in Appendix I provide information on design details of the EPS capsule. The information in these drawings and the narrative that accompanies them in Appendix I is proprietary and clearly marked **confidential business information**. Accordingly, RLR requests that Appendix I in its entirety be maintained as confidential applicant material in accordance with the Division's rules and policies. This appendix is bound separately from the body of this application and the other appendices.

11. Construction Quality Control Plan

(This section was prepared for RLR by Intermountain Geotechnical and Environmental Services (IGES)

11.1 Bentonite Amended Shale (BAS) Quality Control

11.1.1 General

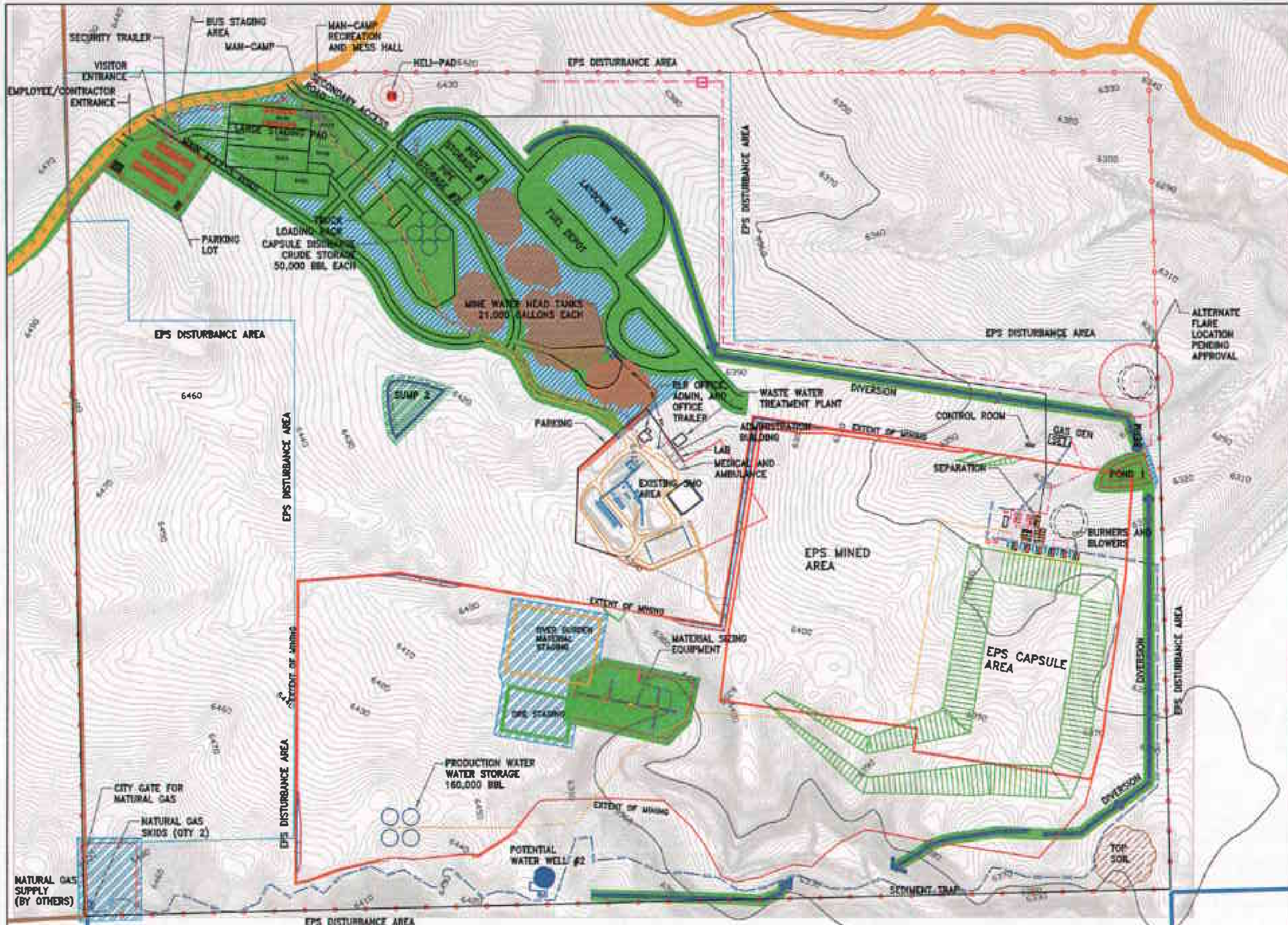
Quality of BAS placement, compaction and projected performance will be determined using field moisture density monitoring correlating to a suite of data developed on more rigorously evaluated test fill performance. The following discussions present approach for test fill preparation, performance monitoring and correlation development as the basis for this quality control approach for the EPS.

11.1.2 Test Fill Development

A minimum of two test fills will be constructed using the same size and type of equipment proposed for capsule bottom liner and cap and BAS sidewalls. Each test fill will be constructed using BAS manufactured on site with processed screened shale meeting the target design gradation, blended with 10%, Sure Seal 80 (80% passing #200 mesh sieve) bentonite clay product to be provided by Western Clay, or alternative product and/or vendor. The blended mixture will be moisture conditioned to a water content between optimum and +2 to 4 percent and transported to the test fill site via truck. The size of each test fill will be approximately 20 ft. by 40 ft.

11.2 Bottom Liner Fill

BAS fill will then be placed on a prepared cleared surface of exposed shale and bladed to a maximum loose lift thickness of 18 inches as proposed for liner construction and compacted with successive passes of a compactor of equal size and type as proposed for actual cell construction. A minimum of 4 passes will be applied uniformly over the fill. At the end of the 4^{th} pass, a series of nuclear density measurements at various depths will be performed and recorded. Two additional passes of the compactor will then be performed and an additional nuclear density tests will be performed if required to achieve compaction. A subsequent 2 passes and additional density tests series will be performed as required to permit evaluation of the appropriate number of passes required to achieve the minimum 95% compaction for the 18 inch lift thickness.



LEGEND:
- OVERBURDEN STAGING
- ORE STAGING
- INSULATION MATERIAL STAGING
- RAS STAGING
- TOPOGRAPHY CONTOUR
- DISTURBANCE BOUNDARY
- EXISTING RD
- PROPOSED RD
- MINE WATER
- POTABLE WATER
- FIREWATER SYSTEM
- POWER LINE (POTENTIAL)
- NATURAL GAS SUPPLY
- FENCE LINE
- SEWER
- CAPSULE DISCHARGE WATER
- CRUDE OIL LINE
- CLEAR AND GRUB
- STRIP AREAS
- STOCKPILES (TOPSOIL)

	AREA (sqft)	VOLUME (cuft)
CLEAR & GRUB	3413773	
STRIP	3015400	3015400
STOCKPILE	372186	

STATION : UPPER SAND WASH UTAH
LATITUDE : 39° 42' 48" N
LONGITUDE : 109° 20' 46" W
ELEVATION : 6300 FT.
ELEMENT : MEAN WIND SPEED

m/s: 1.3 - 1.8; 1.8 - 3.6; 3.6 - 5.85; 5.85 - 8.55; 8.55 - 11.25; 11.25 - 14.40; 14.40 - 17.55; 17.55 - 21.10; 21.10+

START DATE : JUNE 1 1995
END DATE : JUNE 30, 2010
OF DAYS : 5509 OF 5509
OBS/POSS : 130249 OF 132216
WESTERN REGIONAL CLIMATE CENTER

SUB-INTERVAL WINDOWS

	START	END
DATE:	JAN. 01	DEC. 31
HOUR:	00	23

UPPER SAND WASH REFERENCE WIND ROSE

NORTH

500 250 0 250 500 1000

DRAWING IS IN STATE PLANES NAD83 (FT)

FIGURE 13

ECOSHALE TECHNOLOGY — RED leaf — NORWEST CORPORATION

TITLE

EPS
SITE PLAN

SCALE	DATE	CLIENT NO.	PROJECT NO.	DISP.	DWG.	REV.
1" = 250'	8/10/12	0187	EPS	A	2001	E

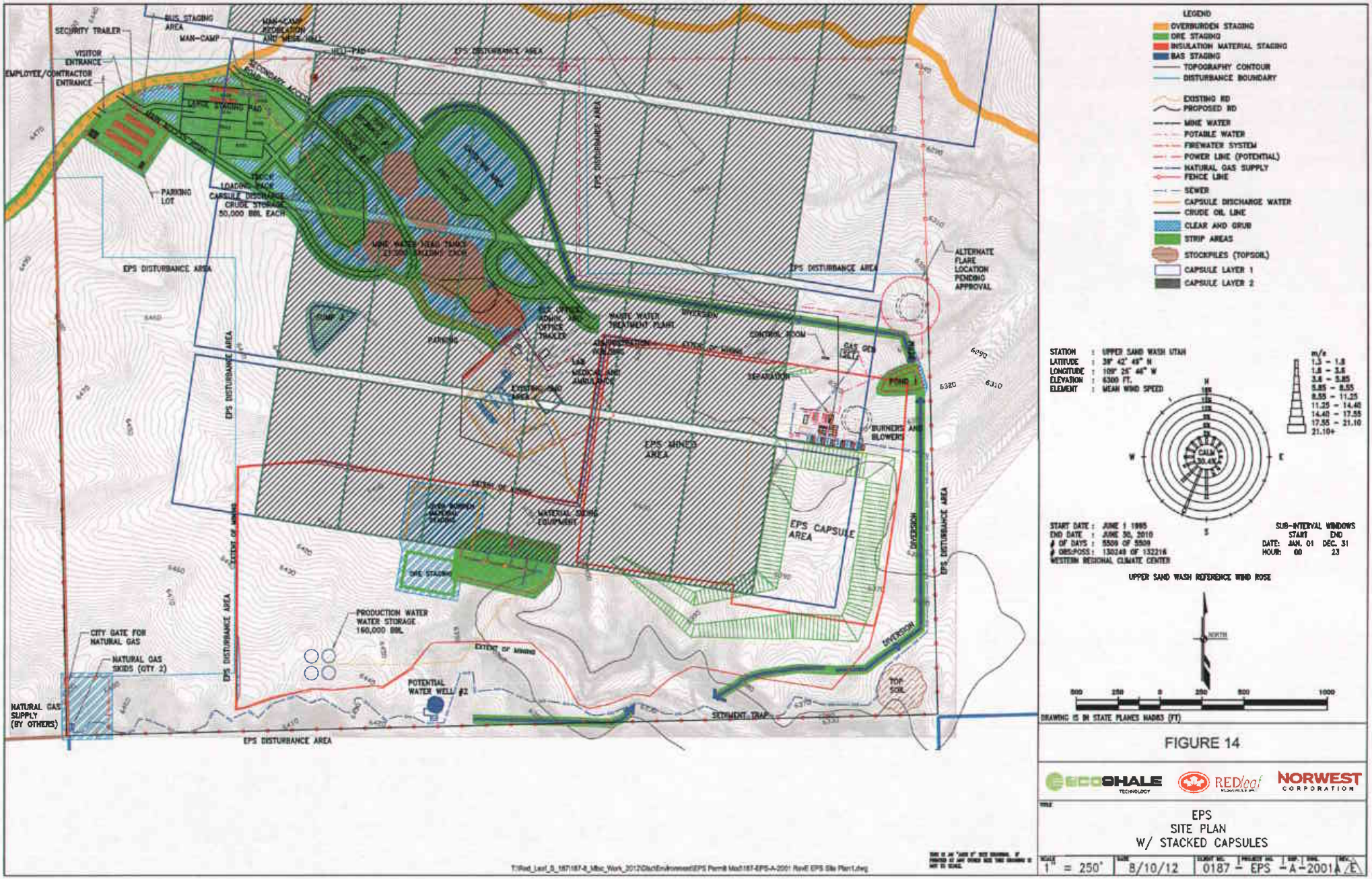


FIGURE 14

ECOSHALE TECHNOLOGY | REDleaf RESOURCES | NORWEST CORPORATION

TITLE:

EPS
SITE PLAN
W/ STACKED CAPSULES

SCALE	DATE	DRAWING NO.	PROJECT NO.	SUP.	SHEET	REV.
1" = 250'	8/10/12	0187 - EPS	-A-	2001	A	/E

T:\Red_Leaf_S_187\187-8_Misc_Work_2012\Dist\Environment\EPS Permit Mod\187-EPS-A-2001 RevE EPS Site Plan1.dwg

Compacted materials within the fill will be ripped and recompacted if it is determined that less than the maximum number of passes is required to achieve required compaction. If the full maximum number of passes used during compaction evaluation is required, the fill will not be ripped, but protected with a temporary 6 inch lift of BAS or heavy plastic cover until infiltration testing equipment is ready to be installed. Any delay in installation of SDRI testing equipment will require that the test fill be appropriately protected from moisture loss or surface disturbance.

11.3 Side Liner Fill

BAS fill will be placed on a prepared cleared surface of exposed shale and bladed to a maximum loose lift thickness of 12 inches as proposed for side liner construction and compacted with successive passes of a compactor of equal size and type as proposed for actual cell construction. A minimum of 3 to 4 passes will be applied uniformly over the fill. At the end of the 4th pass, a series of nuclear density measurements will be performed and recorded. Two additional passes of the compactor will then be performed if required and an additional nuclear density tests performed. A series of subsequent passes and density tests will be performed to permit evaluation of the appropriate number of passes required to achieve the required 95% compaction for the 12 inch lift thickness if required.

Compacted materials within the fill will be ripped and recompacted if it is determined that less than maximum number of passes used in test fill construction is required to achieve required compaction. If the maximum number of passes is required no ripping will be performed. The fill in either case will be protected from moisture loss with either a temporary 6 inch lift of BAS or heavy plastic tarp or cover until infiltration testing equipment is ready to be installed.

11.4 Test Fill Evaluation

Hydraulic conductivity of each test fill will be evaluated in situ using a sealed double ring infiltrometer (SDRI). Testing will be performed in general accordance with ASTM D5093-02 (2008)[1] methods. Additionally, at the conclusion of the test relatively undisturbed 3-inch-minimum diameter tube samples of the test fill will be obtained for laboratory determination of hydraulic conductivity as a means of comparison of the test fill performance and projected future performance as a result of compression that will occur from ultimate cell construction and loading with up to 100 feet of oil shale. Laboratory testing will be performed in accordance with ASTM D-5084-10[2]. A minimum of four test specimens will be obtained from the fill within the innermost ring. A complete compliment of index tests including Atterberg limits, grain-size and moisture and density will be performed on the tube specimens subjected to laboratory hydraulic conductivity evaluations.

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[1] ASTM D5093 - 02(2008) Standard Test Method for Field Measurement of Infiltration Rate Using Double-Ring Infiltrometer with Sealed-Inner Ring[2] Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

[2] Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

Field density measurements will also be obtained from within the inner ring area to assess any potential density loss that may have occurred as a result of swelling.

The results of the testing program protocols outlined above will form the basis for quality control testing during actual liner construction and side wall construction.

11.5 Proposed Liner Testing Frequency

During actual liner construction, the following frequency and types of test are proposed to confirm acceptance of the means and methods.

11.5.2 Bottom and Top

Field Moisture and Density measurement (ASTM D-6938 – 10) – one test/400 cy of liner or approximately every 10,000 sq. ft./lift.

11.5.3 Side Walls

Field Moisture and Density measurement (ASTM D-6938 – 10) – one test/50 cy of liner or approximately every 270 ft. of wall/lift.

12. Ground Water Discharge Control Plan

The zero-discharge design of the capsules is described in detail in Section 10.0 and the plan for ensuring the design specifications for the BAS installation is described in Section 11.0 At the request of UDWQ staff, samples of spent shale were analyzed for leachable constituents, as described below.

12.1. Spent Shale Leachate Evaluation

Although the capsules are designed to prevent contact of meteoric water with spent shale within the capsules, leachability testing using the U.S. EPA's Synthetic Precipitate Leach Procedure (SPLP) was conducted on samples of spent shale. Samples were collected from spent shale derived from bench-scale testing. Spent shale from the bench testing was stored in sealed containers at RLR's contract testing laboratory. Samples were collected from the sealed containers in appropriate laboratory-supplied sample containers and in accordance with appropriate collecting methods by a staff member of the engineering firm IGES, a contractor to RLR. Samples were transported chilled and under chain of custody to American West Analytical Laboratories (AWAL) for SPLP testing.

The SPLP test is an EPA SW-846 analytical method (Method 1312) that can be used to determine the concentration of contaminants that will leach from soil and similar materials due to contact with, and subsequent leaching by, precipitation (USEPA, 1998).[3] Method 1312 specifies 3 distinct extraction fluids depending on the relative location of the sample area in the United States (east or west of the Mississippi River) and the compounds to be analyzed in the leachate. Extraction Fluid #1 is deionized

[3] USEPA (1998). Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd ed., draft IVA, U.S. Environmental Protection Agency, Office of Solid Waste: Washington, DC.

Compacted materials within the fill will be ripped and recompacted if it is determined that less than the maximum number of passes is required to achieve required compaction. If the full maximum number of passes used during compaction evaluation is required, the fill will not be ripped, but protected with a temporary 6 inch lift of BAS or heavy plastic cover until infiltration testing equipment is ready to be installed. Any delay in installation of SDRI testing equipment will require that the test fill be appropriately protected from moisture loss or surface disturbance.

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[1] ASTM D5093 - 02(2008) Standard Test Method for Field Measurement of Infiltration Rate Using Double-Ring Infiltrometer with Sealed-Inner Ring[2] Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

[2] Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

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The SPLP test is an EPA SW-846 analytical method (Method 1312) that can be used to determine the concentration of contaminants that will leach from soil and similar materials due to contact with, and subsequent leaching by, precipitation (USEPA, 1998).[3] Method 1312 specifies 3 distinct extraction fluids depending on the relative location of the sample area in the United States (east or west of the Mississippi River) and the compounds to be analyzed in the leachate. Extraction Fluid #1 is deionized

[3] USEPA (1998). Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd ed., draft IVA, U.S. Environmental Protection Agency, Office of Solid Waste: Washington, DC.

water very weakly acidified to a pH of 4.2 and is used for samples collected east of the Mississippi. Extraction Fluid #2, for samples from West of the Mississippi is acidified to a pH of 5.0. Extraction Fluid #3 is filtered deionized water and it is use for extraction of volatile organic compounds (VOCs) regardless of sample location. For the RLR spent shale samples, leachate derived from leaching with Reagent #2 was analyzed for all parameters except VOCs, for which Reagent #3 was used.

Three samples of the spent shale, designated R11-122 210#1, #2, and #3, were collected for analysis. The samples are duplicates and were collected to insure representativeness in the event that the stored samples were inhomogeneous. Samples were leached with appropriate leaching solution and the leachates were analyzed for the following parameters:

- General chemistry: pH, total dissolved solids (TDS), major ions (Ca, Cl^-, F^-, K, Mg, Na, SO_4), alkalinity, nitrate/nitrite (as N), oil and grease, Sr, and total organic carbon (TOC);
- Organic compounds: volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs);
- Trace metals and metalloids: Ag, As, B, Ba, Be, Cd, Cr, Fe, Hg, Li, Pb, Mn, Mo, Ni, Sb, Se, Sn, Tl, V, and Zn.

Both the VOC and SVOC leachates were analyzed for an extensive list of compounds determined by the laboratory, based on its experience.

The entire laboratory report provided by AWAL is attached as Appendix J. The results for the general chemistry analyses are summarized in the following table;

Table 5 General Chemistry

Sample Number	Lab	R11-122 210			Ground Water Quality Standard (note: N/S means no standard has been set)	Water Quality Standard for Bitter Creek and Tributaries 4-Day Average 1-hour Average
Parameter	Reporting Limit	#1	#2	#3		
pH (pH units)	1.00	9.92	9.99	10.2	6.5 – 8.5	6.5 – 9.0
TDS (mg/l)	20.0	172	220	220	≥500 mg/l	≥500 mg/l
Calcium (mg/l)	1.0	3.44	3.64	3.48	N/S	N/S

Fluoride (mg/l)	0.100	1.56	1.64	1.84	4.0	N/S
Potassium (mg/l)	1.00	4.23	<1.00	4.28	N/S	N/S
Magnesium (mg/l)	1.00	1.14	1.25	<1.00	N/S	N/S
Sodium (mg/l)	1.00	36.9	33.5	37.4	N/S	N/S
Sulfate (mg/l)	5.00	17.4	18.5	19.8	N/S	N/S
Alkalinity (mg/l)	40.0	68.9	82.0	78.7	N/S	N/S
nitrate/nitrite (as N) (mg/l)	0.0100	0.0106	0.0251	0.0142	10.0	N/S
oil and grease (mg/l)	1.00	9.92	<3.0	<3.00	N/S	N/S

The results of the metals analyses are shown in the table below. Note that only those metals with detectable quantities are shown in the table. Again, complete analytical results are shown in the attached lab report.

Table 6 Metals Detected by Lab Analysis

Sample Number	Lab	R11-122 210			Ground Water Quality Standard (note: N/S means no standard has been set)	Water Quality Standard for Bitter Creek and Tributaries
Parameter	Reporting Limit	#1	#2	#3		4-Day Average 1-hour Average
Antimony (mg/l)	0.00500	**0.00923**	**0.00761**	**0.00929**	0.006	N/S
Arsenic (mg/l)	0.00300	0.0367	0.0371	0.0391	0.05	0.150 0.340

Barium (mg/l)	0.00200	0.0483	0.0479	0.0410	2.0	N/S
Boron (mg/l)	0.500	0.840	0.832	0.878	N/S	N/S
Molybdenum (mg/l)	0.0200	0.129	<0.0200	0.159	N/S	N/S
Selenium (mg/l)	0.00400	0.00786	0.00753	0.00725	0.05	0.0046 0.0184
Strontium (mg/l)	0.0040	0.0686	0.0707	0.0640	N/S	N/S
Vanadium (mg/l)	0.0500	0.0638	0.0640	0.0666	N/S	N/S

As with the metals, only detectable quantities of VOCs and SVOCs are shown in the following two tables.

Table 7 VOCs Detected by Lab Analysis

Sample Number	Lab	R11-122 210			Ground Water Quality Standard
Parameter	Reporting Limit	#1	#2	#3	(note: N/S means no standard has been set)
Acetone	0.0100	0.0195	0.0178	0.0152	N/S
Acrylonitrile	0.00500	0.0171	0.0134	0.0118	N/S

Table 8 SVOCs Detected by Lab Analysis

Sample Number	Lab	R11-122 210			Ground Water Quality Standard
Parameter	Reporting Limit	#1	#2	#3	(note: N/S means no standard has been set)
Benzoic acid	0.0200	0.0326	0.0354	0.0259	N/S

The preceding tables compare the detectable concentrations of ions and compounds identified in the spent shale by the previously described laboratory analysis to both Utah Ground Water Quality Standards and established Water Quality Standards for the Bitter Creek watershed, which would be the receiving water of any release to surface waters. The following excerpt from UAC R317-2.6, Standards of Quality for Waters of the State, Use Designations, indicates the applicable uses designated for Bitter Creek and its tributaries:

> Class 2B -- Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing.
>
> Class 3A -- Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.
>
> Class 4 -- Protected for agricultural uses including irrigation of crops and stock watering.

Water quality standards shown in the tables are those for Class 3A waters, which are the most stringent of the 3 use designations.

The analytical results for the three samples are consistent for almost all parameters analyzed, indicating that the spent shale is quite homogenous and that the samples analyzed are representative of the spent shale from the bench tests. The results of the analyses found only two parameters that exceeded ground water quality standards: pH and antimony. Two parameters, pH and selenium, exceed the water quality standards established for Class 3A-designated streams. The antimony and selenium results are less than twice the laboratory reporting limit, which makes the accuracy of the results questionable.

The volatile organic compounds, acetone and acrylonitrile, are not constituents of oil shale, shale oil, or spent shale. Their identification in the AWAL report is due to either laboratory contamination, or a false positive from the detector. False positives occur when the mass detector detects an ion designated as 'characteristic' of a compound. The problem occurs because a given ion may not be exclusive to that compound, hence, a case of misidentification occurs. Standardized tests have not advanced to a point where these cases of misidentification are detected. Individual research is required to determine which of the two is required. Water quality standards have not been established for either compound.

The single SVOC detected, benzoic acid, has no established water quality standard. Both acetone and benzoic acid were detected at levels less than twice the lab reporting limit, which suggests that the reported concentrations are questionable.

The exceedingly low concentrations of the few detected ions and compounds would, even if unconfined by the clay-enclosed capsules, not reach either ground water or surface water in concentrations that would be detectable.

13. Reclamation and Closure Evaluation

The post reclamation configuration of the backfilled mine and capsules was evaluated to assess both erosion of the surface and infiltration of precipitation derived water through reclamation cover including the BAS.

13.1. Infiltration Modeling

Potential for infiltration of precipitation was analyzed using the Hydrologic Evaluation of Landfill Performance (HELP), which was developed by the EPA for evaluation of landfill designs. Appendix K contains the report prepared by Norwest describing the model setup, inputs, and results.

The modeling results demonstrated that the designed capsule cap and ET cover provides adequate control on infiltration into the capsules for the vegetated cover case using the design parameters. Even for 30 years of bare cover or very wet years the HELP model predicts minimal infiltration into the capsule for these extreme conditions.

The results are especially conservative given the absorptive capacity of the spent shale. Raw (un-retorted) shale and spent shale were tested under ASTM protocol ASTM C 127, Specific Gravity and Absorption, Coarse Aggregate. Raw shale had an absorptive capacity (by weight) of 2.7%, while spent shale had an absorptive capacity of 11.3 %, a 4-fold increase.

HELP modeling conservatively predicted annual infiltration through the upper BAS layer of 0.16 inches per year. The HELP model did not consider the fate of infiltrating precipitation that penetrated the upper BAS layer. However, this absorptive capacity will have a significant impact upon the potential for migration of fluids through the spent shale to the bottom of the capsule and the three-foot BAS under-liner. A one-foot thickness of spent shale would have the capacity to absorb the volume of fluids that are predicted to infiltrate through the BAS over of approximately 6 years. The collective absorptive capacity of the entire spent shale thickness and retention capacity of the pore space in the spent shale would provide further assurance that a release of fluids from the capsules to surface or ground water will not occur.

14. Compliance Monitoring Plan

Monitoring of capsule performance and reclamation and closure performance will commence during construction of the capsules. Survey control and other methods developed during design, operation, and post-production evaluation of the EPS capsule will be used to monitor all aspects of capsule construction beginning with grade control on the pit floor and extending through reclamation.

For the EPS capsule, operational monitoring and post-operational monitoring through the cooling period and beyond will be employed to evaluate capsule performance. From a perspective of water quality and protection, the capsules are protective of ground water. The cover, capsule, and liner system (including a vegetative cover, layers of fill above the BAS liner, the BAS liner itself, the gravel layer that serves as a capillary barrier, the capsule's significant central volume made up of spent shale,

an additional gravel layer, an underlying collection pan that can practically serve as a collection lysimter following the production phase, underlying layers of road base, and the final BAS liner) all serve to prevent discharge and protect ground water.

Due to settling of the cover during production, the BAS will be evaluated following settlement. Remediation will be performed if necessary. (Note: What is learned from overall capsule performance during EPS will be applied to modifications in design, construction and operation of the capsules during the full operational stage of production.)

Details of the compliance plan for assessment of engineered systems and controls will be provided with the design drawings to support DWQ's approval of the facility construction.

As described herein, the Seep Ridge site does not include a hydrogeological setting that facilitates detection of discharges from the EPS capsule via upgradient and downgradient monitor wells due to the extremely low hydraulic conductivity of the oil shale beds.

The design of and reclamation plan for RLR's EcoShale™ capsules promote high evapotranspiration (ET) while ensuring that remaining water reports primarily as runoff with minimal infiltration. Nevertheless, baseline water quality and quantity data will be collected in the event that monitoring may be appropriate in the future .

The proposed compliance monitoring plan for RLR is designed to detect an occurrence of pollutant discharge most near the source. The proposed monitoring points are

1. Sampling from the EcoShale™ capsules' product collection pan, and
2. Sampling from trenches underlying the EcoShale™ capsules

The focus of monitoring will be on discharges from the EcoShale™ capsule. Capsules are designed with, among other design features, an underlying collection pan to collect oil during the capsule's production phase. The EcoShale™ capsules' product collection pan is constructed within the lower portion of the capsule, beneath the heating/retort zone. During the production phase, the EcoShale™ capsule product collection plan is used to collect oil and water.

Following the production phase, the collection pan remains and acts as a large collection lysimeter beneath the entire capsule. This pan collection system will be monitored for the presence of groundwater. Monitoring and sampling the capsule collection pan will provide an early indication of any water percolation through the capsule. This pan and monitoring system also provides a system of removal of water and its chemical constituents. This approach to monitoring is expected to provide the best indication of groundwater discharge from the capsules.

As mentioned above, an additional sample collection point will be at the surface of the bedrock downslope from the capsule. Trenches constructed for product and heating pipe conveyance beneath the EPS capsule will be sampling and monitoring points. Analysis of water samples collected from trenches will also provide an indication of possible discharge of chemical constituents from the capsule.

Due to the design of the capsule, which minimizes and prevents percolation through the capsule layers and into the capsule, significant volumes of water percolation through the capsule are not expected. However, monitoring and sampling will be conducted to detect the presence of water in and beneath the capsule and constituents in the water.

Monitoring will occur semi-annually. Due to the possibility of limitation on volumes of groundwater collected, the following priority will be used for analysis of available sample volumes:

- Metals (As, Ba, Cd, Cr, Cu, Pb, Se, Ag, Zn)
- Organics (TPH, TOC)

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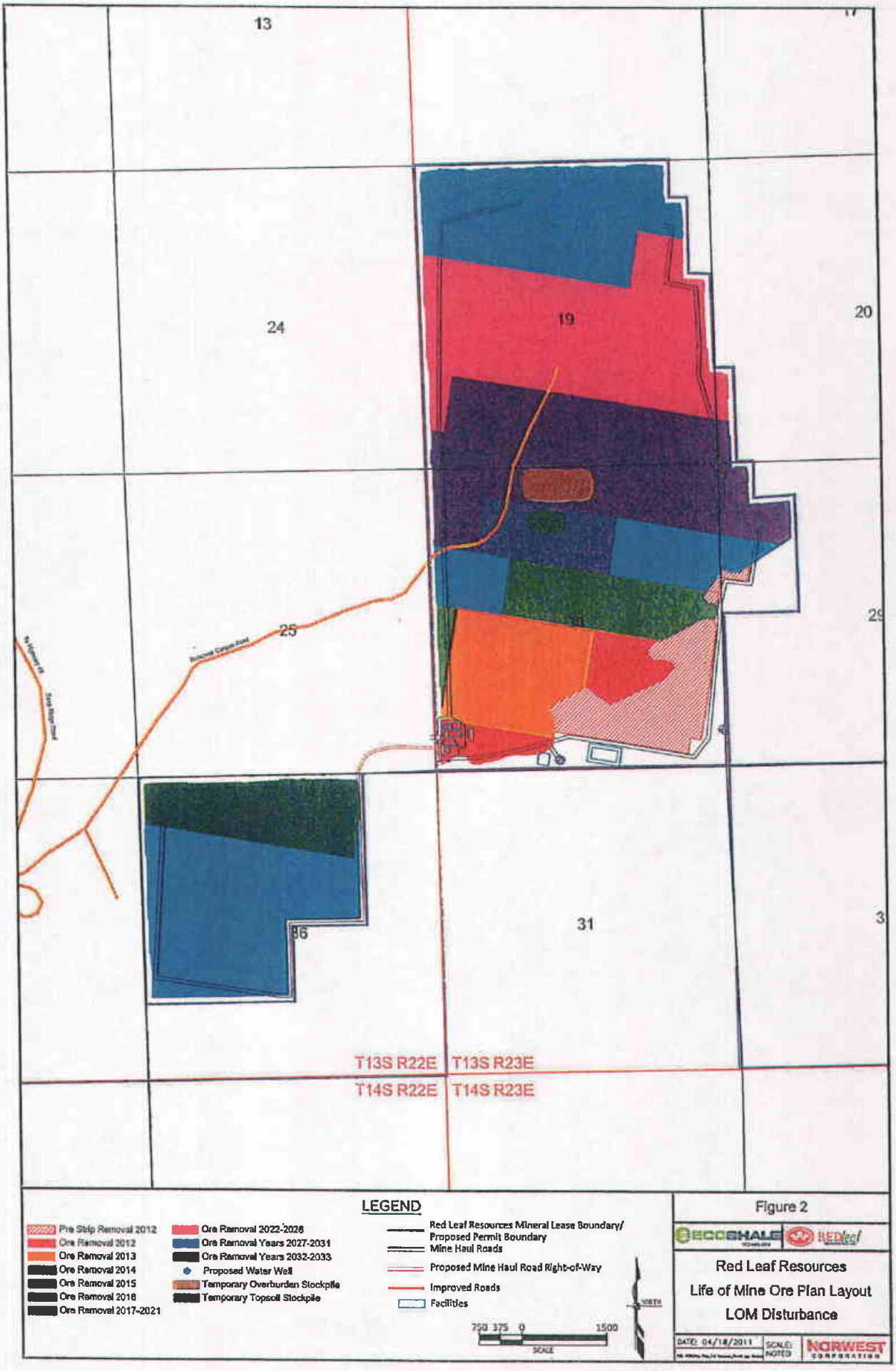
Appendix A

Selected Figures
from the
Utah Division of Oil, Gas and Mining
Notice of Intent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LEGEND
Pre Strip Removal 2012
Ore Removal 2012
Ore Removal 2013
Ore Removal 2014
Ore Removal 2015
Ore Removal 2016
Ore Removal 2017-2021
Ore Removal 2022-2026
Ore Removal Years 2027-2031
Ore Removal Years 2032-2033
Proposed Water Well
Temporary Overburden Stockpile
Temporary Topsoil Stockpile
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ECOSHALE
REDleaf
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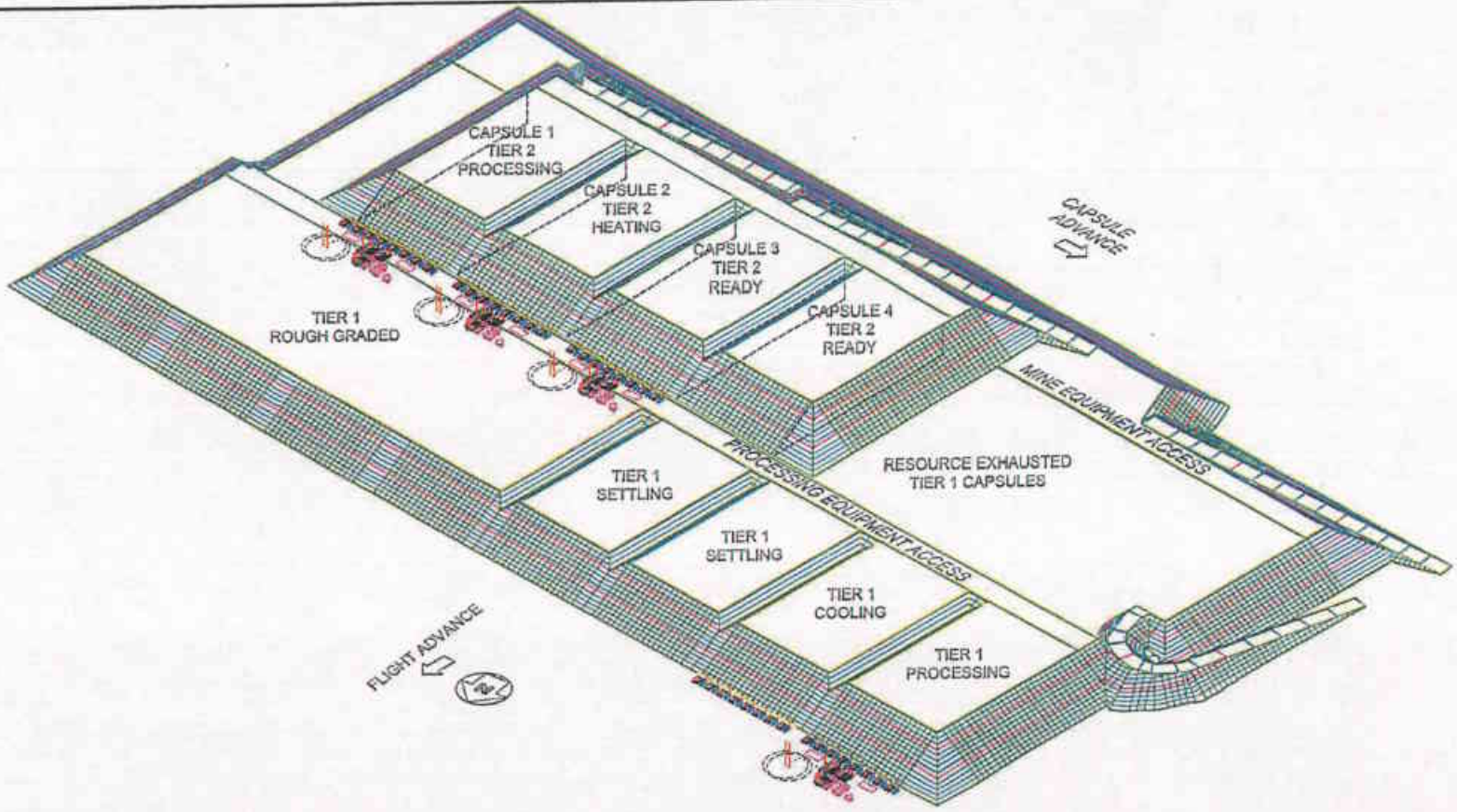
DATE: 04/18/2011
SCALE: NOTED
NORWEST CORPORATION



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SCALE

Figure 12

Conceptual Oil Shale Processing
Capsule Construction Progression Plan

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NORWEST CORPORATION

Appendix B

Stacked Capsule Backing Wall
Stability Analysis

Norwest Corporation
April 21, 2011

NORWEST
CORPORATION

April 21, 2011

File #: 09-4573

Red Leaf Resources
200 W. Civic Center Dr.,
Suite 190
Sandy, UT 84070
USA

Attn: Mr. Shawn Packard

Dear Shawn;

Re: Stacked Capsule Backing Wall Stability Analysis

1 INTRODUCTION

This letter report presents the results of a preliminary analysis and provides recommendations to support the geotechnical design of the cell containment slopes for the capsules that will be constructed in the mined out area of Red Leaf's ECOSHALE Project in Uintah County, Utah.

2 SCOPE OF WORK

Norwest was asked to provide a geotechnical evaluation of the backing walls that will support the vertical walls of the BAS (bentonite amended soil) liner and provide containment of retorted oil shale material and associated by-products inside the capsules. It is understood that the backing walls will be constructed with surface overburden material and run-of-mine low grade shale that will be excavated by a combination of blasting and mechanical excavation during the development of the pit. In addition, the backing walls will need to satisfy long-term stability criteria related to reclamation since the capsules will be left in place following the retorting process to form permanent landforms.

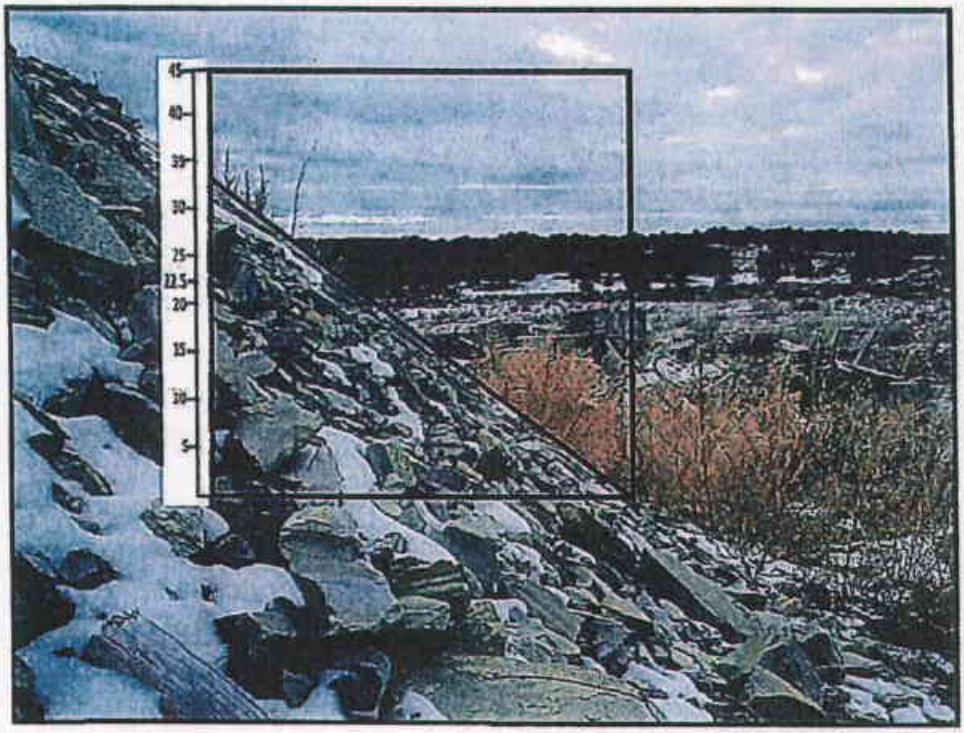
The scope of work involved a geotechnical analysis that was based on a stacked capsule configuration design presented to Norwest consisting of two 96 foot high capsules stacked on top of each other for a total backing wall height of 192 feet. The backing walls incorporate ramp designs to accommodate capsule construction equipment. A typical cross-section of the stacked capsule configuration can be seen in the stability output files presented in Appendix B.

3 MATERIAL PARAMETERS

The material parameters used in the stability analysis were selected based on site reconnaissance photos, data provided by Intermountain GeoEnvironmental Services Inc. (IGES), and Norwest's experience with compacted rockfill materials. Photos of loose, end-dumped shale materials representative of the typical

material that will be used to construct the backfill walls indicate an average angle of repose of about 35° (see Photo 1). The friction angle and cohesion used to model the surface material in the Red Leaf Cell Highwall Design by IGES were 36° and 50psf respectively. An additional strength assessment provided by IGES recommended strength parameters for the backing wall material over a range of normal stresses based on a literature review. The IGES assessment (see Appendix A) provided recommendations for compacted shale rockfill strength parameters for a range of loading conditions.

PHOTO 1
ANGLE OF REPOSE



The following material parameters were used to model the compacted backfill, oil shale, and bedrock units in the stability analysis of the capsule backing walls. Note that the BAS and insulating gravel units were not included in the preliminary backing wall stability analysis.

TABLE 1
STABILITY ANALYSIS MATERIAL PARAMETERS

Material Type	Unit Weight (pcf)	Friction Angle (°)	Cohesion (psf)
Compacted Backfill	130	40	0
Oil Shale	130	40	0
Pit Floor	Impenetrable Bedrock		

4 STABILITY ANALYSIS CRITERIA

The stability analysis criteria used to evaluate the stability of the backing walls is based on discussions with the state regulatory agency and the generally accepted standard of practice followed in the design of rockfill slopes. The minimum design safety factors used to evaluate the static and pseudo-static stability anslyses were 1.25 and 1.10 respectively. The horizontal seismic coefficients used in the pseudo-static analyses were selected based on regional data for Uintah County provided by the United States Geological Survey website. The pseudo-static stability analysis was evaluated for a 1 in 500 year event for operations and a 1 in 2,500 year event for long-term closure. A summary of the stability analysis minimum factor of safety criteria is presented in Table 2.

TABLE 2
SUMMARY OF STABILITY ANALYSIS CRITERIA

Analysis Type	Minimum Safety Factor
Static	1.25
Pseudo-static (1 in 500 year, k_h=0.04g)	1.10
Pseudo-static (1 in 2,500 year, k_h=0.12g)	1.10

5 STABILITY ANALYSIS

The stacked capsule backing wall stability analysis was performed on a model with two 1.5H:1V slopes and a total height of 192 feet (see sections in Appendix B). The piezometric surface was assumed to be the pit floor (i.e. the compacted backfill and oil shale materials are unsaturated). The results of the stacked capsule stability analysis satisfy the safety factor criteria and are summarized in Table 4. The stability analysis output files are presented in Appendix B. The values presented in the table represent the minimum safety factors associated with a failure surface that affects the entire height of the backing wall and the BAS liner system in the capsule.

TABLE 4
STABILITY ANALYSIS RESULTS

Analysis Type	Safety Factor
Static	2.00
Pseudo-static (1 in 500 year)	1.83
Pseudo-static (1 in 2,500 year)	1.56

6 CONCLUSIONS AND RECOMMENDATIONS

The results of the stability analysis show that the stacked capsule backing walls designed and constructed according the design configuration presented to Norwest will satisfy static and pseudo-static safety factor criteria. The following recommendations should be considered in the detailed design of the capsule backing walls:

- Backing wall material should be placed and compacted in lifts such that a minimum of 95% Standard Proctor Density is achieved.
- Backing wall slopes can be constructed at angle of repose but will require re-sloping to a 1.5H:1V slope angle in order to satisfy long-term safety factor criteria.
- Surface water that collects on the top of the capsules should be controlled and directed away from the crests of the backing walls to minimize erosion on the backing wall slopes.
- Ditches should be constructed at the toe of the backing wall slopes to ensure that the piezometric surface is maintained at the pit floor elevation.
- Further investigation work and lab testing should be carried out to determine the intact strength of the bedrock foundation and risk of planar bedding failures through potential weak layers affecting the stability of the backing walls and impacting the integrity of the BAS liner.
- The heat effects and pressure generated within the capsules during the retorting process should be evaluated to determine if they will adversely affect the stability of the backing walls and the integrity of the BAS liner.

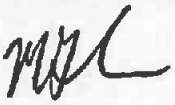
7 CLOSURE

All geotechnical information and results contained herein have been reviewed and interpreted by Michael Graham, PEng.

As mutual protection to Red Leaf Resources, the public and ourselves, this report and drawings are submitted for exclusive use of Red Leaf Resources. We specifically disclaim any responsibility for losses or damages incurred through the use of our work for a purpose other than as described in the report. Our reports and analysis should not be reproduced in whole or in part without our express written permission, other than as required in relation to this report.

Yours sincerely,

NORWEST CORPORATION



Michael Graham, PEng
Senior Geotechnical Engineer

Enclosures/Attachments

Appendix A	Summary Report: Data Review and Development of Rockfill Strength Parameters
Appendix B	Stability Analysis Output Files

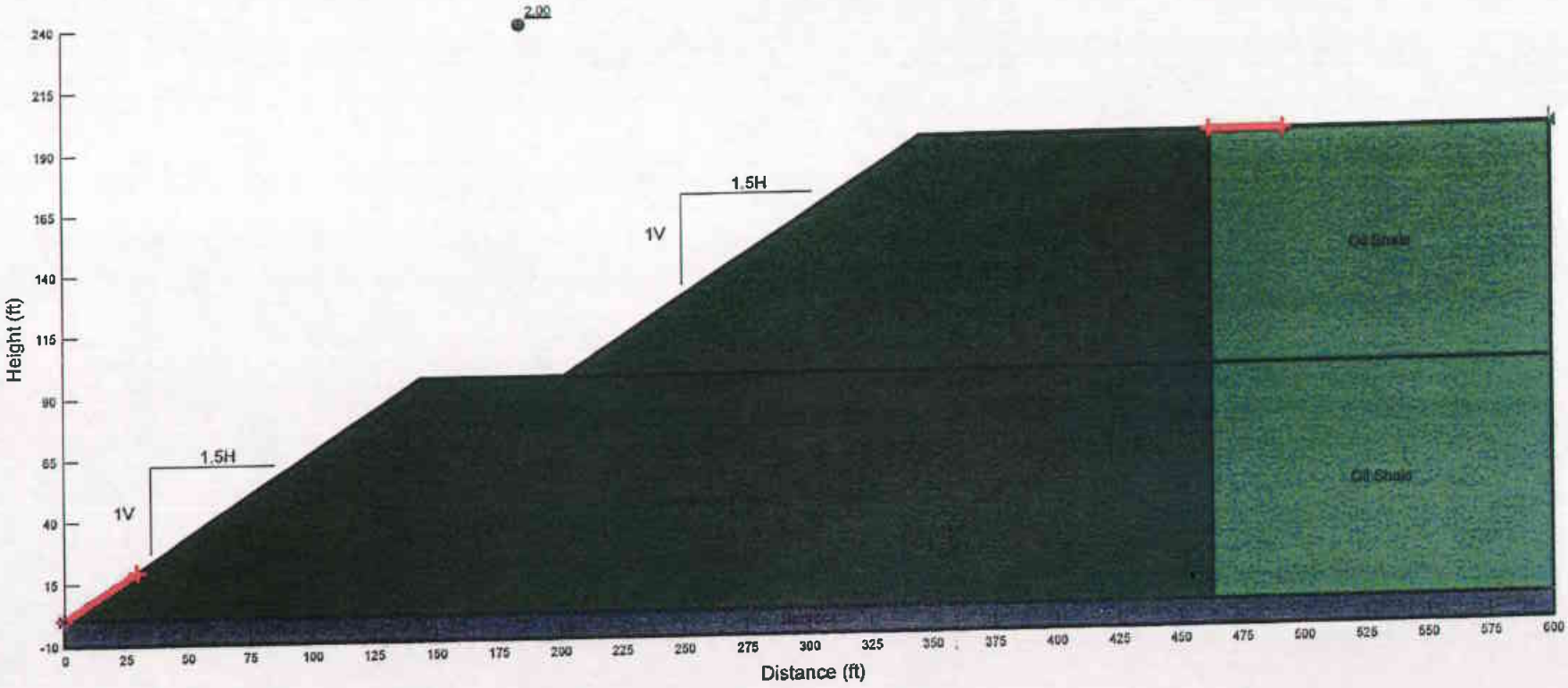
APPENDIX B

Stability Analysis Output Files

Red Leaf Ecoshale
Stacked.gsz
Static
I:\DATA\Salt Lake City Jobs\09-4573 Red Leaf\Engineering\SlopeW
21/04/2011

Spencer
Horz Seismic Load: 0

Name: Compacted Backfill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Oil Shale Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1

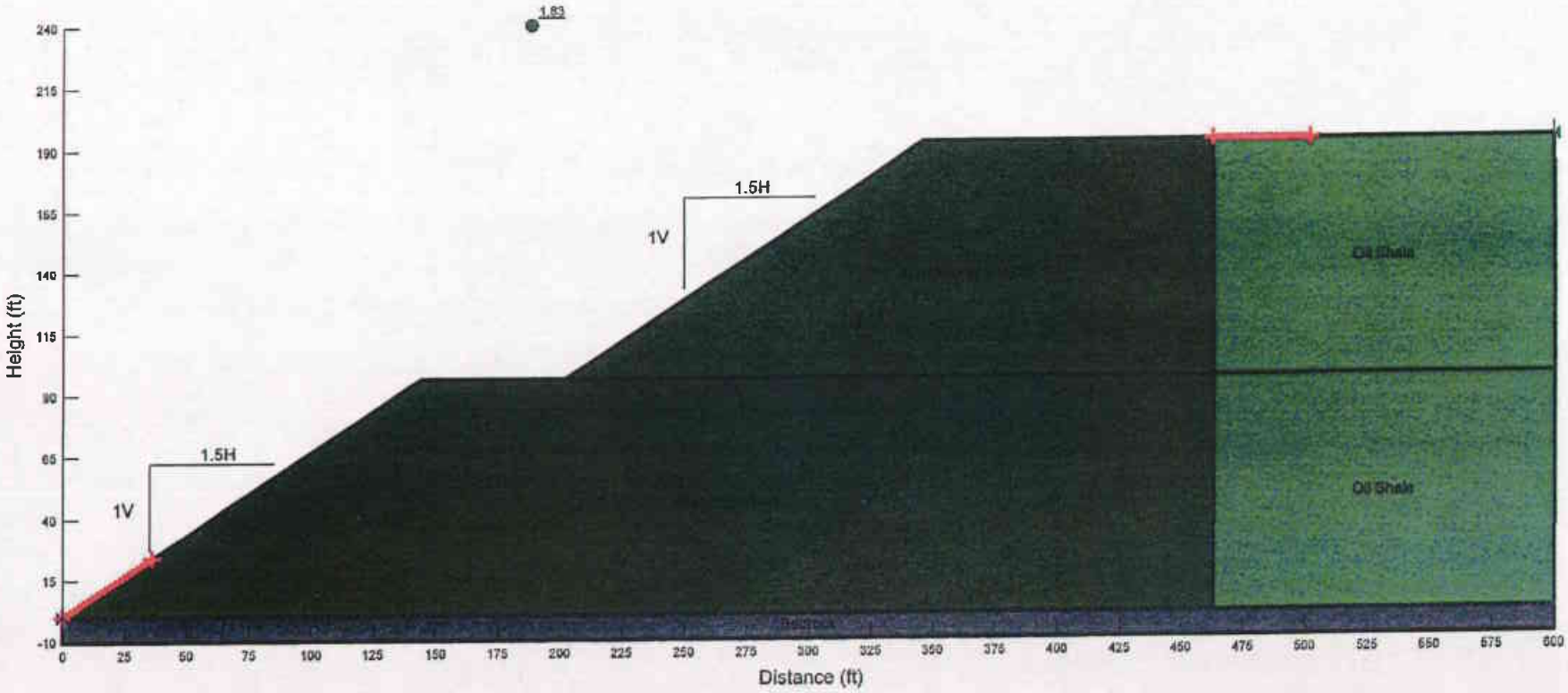


NORWEST

Red Leaf Ecoshale
Stacked.gsz
Pseudo-static_1/500
I:\DATA\Salt Lake City Jobs\09-4573 Red Leaf\Engineering\SlopeW
21/04/2011

Spencer
Horz Seismic Load: 0.04

Name: Compacted Backfill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Oil Shale Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1

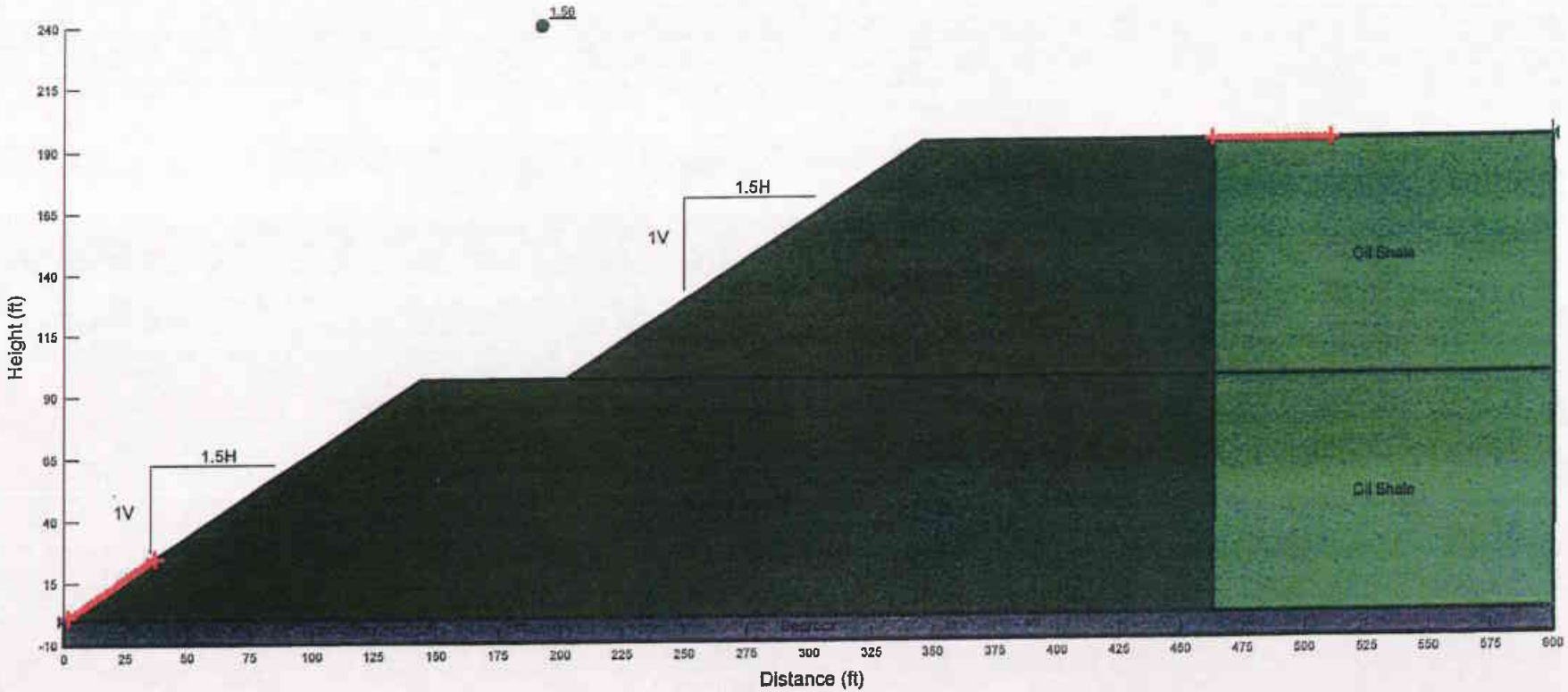


NORWEST

Red Leaf Ecoshale
Stacked.gsz
Pseudo-static_1/2500
I:\DATA\Salt Lake City Jobs\09-4573 Red Leaf\Engineering\SlopeW
21/04/2011

Spencer
Horz Seismic Load: 0.12

Name: Compacted Backfill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Oil Shale Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1



NORWEST

Appendix C

Operations and Reclamation Drainage Design Plan for Red Leaf Resources

Norwest Corporation
April 21, 2011

OPERATIONS AND RECLAMATION DRAINAGE DESIGN PLAN

RED LEAF RESOURCES

Submitted to:
RED LEAF RESOURCES

April 21, 2011

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950 So. Cherry St., Suite 800
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CORPORATION

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CORPORATION

OPERATIONS AND RECLAMATION DRAINAGE PLAN
RED LEAF RESOURCES

Background

The Red Leaf Resources Eco Shale Mining Project uses heat to extract kerogen deposits from sedimentary shale deposits. The mining process consists of the simultaneous mining of the oil shale and the creation of the heating capsules. Upland clean water diversions and/or sumps and perimeter stormwater control will be installed initially, and then topsoil is salvaged and carefully stockpiled to be used during the reclamation phase. Once enough overburden is removed from the mine to create a capsule, a bentonite amended soil (BAS) liner is installed, followed by a metal liner above it to collect fluids and prevent seepage. The BAS is designed to stay intact throughout the heating and reclamation phase as described in greater detail in the NOI. This containment strategy prevents impacts to groundwater and the surrounding ecosystem. Collection pipes are placed along the bottom of the capsule. The mined material is placed above the collected pipes followed by a series of heating pipes to heat the material to extract the kerogen. The mined material and heating pipes will be incrementally stacked on top of each other in the heating capsules. The heating rods heat the material to volatize the kerogen deposits into gas and melt the kerogen into liquid which flows through the collection pipes to a central location to eventually undergo further processing.

A second layer of capsules will be constructed above the first layer, once cooling has occurred. Capsules are 500' wide by 900' long. The capsules will be reclaimed immediately once the kerogen liquid and gas deposits are extracted from the second layer. Reclamation will occur after 3.5 years of the beginning of operations, but drop to 2 years following the establishment of flights to the north that will accommodate access. The capsule reclamation and mining activities will occur simultaneously throughout the site. The water management plan includes a stormwater plan for initial reclamation, as well as one for final reclamation.

Soils and Vegetation

The soils on the site are generally classified as 55% Walknolls Mikim associated soils, which are well-drained silty loams and silty sands with a rated permeability of 2-6 in/hr (NRCS, 2003). This combination of soil type and permeability results in a B hydrologic soil type. Based on the vegetation surveys previously performed at the site, there is typically 80% vegetation cover consisting of pinyon and juniper or greasewood, sagebrush, and grass vegetation (JBR, 2010). This vegetation type and density results in a curve number of 75 for pinyon-juniper pre-mine watersheds and 86 for barren lands where topsoil salvage has occurred or reclaimed areas.

Design Storm Events

An estimated 10-year 24-hour storm event of 1.68 inches was used in the SEDCAD peak flow modeling for the pond and sump sizing. The 100-year 24-hour event is 2.54 inches (Bonnin, 2006), which was used in the calculations for the clean water diversions and the spillway design for ponds and sumps. The 100-year 60-day event of 6.17" was used to predict a worst case volume of storage for the two end-pit ponds (NOAA, 2011)..

Groundwater

A previous study by JBR Environmental Consultants has indicated a lack of groundwater that could affect inflow through the project area. Boreholes in the project area are typically dry to a depth greater than 900'; therefore, groundwater inflow was not factored into the calculations and design.

Operations Drainage Plan

A series of clean water diversions and sumps will be constructed to manage upland runoff from offsite tributaries at the western perimeter of the project site to prevent impacts to water resources and minimize erosion potential. Excavation is planned to first occur at the southwest corner of Section 30, T13S R23E and move north and east (Figures 2 and 3 of the NOI). Subsequent pits will be developed from east to west per the pit layout and ore removal timing map. Mining will continue north through Sections 30 and 19, and then operations will proceed from the south side of the lease in Section 36, T13S R22E **(see Figure 1).** The diversions and sumps necessary to protect each mining block will be constructed prior to any disturbance of that mining block. The diversions and sumps will be built in the order of the proposed mining sequence. **Table 1** lists the phasing of the diversion construction and the corresponding areas of protection.

The clean water diversions were modeled using the 100-year, 24-hour storm event of 2.54". The clean water diversion locations are shown on **Figure 1,** and design details for the worst case scenarios (largest contributing watersheds and steepest topography) are summarized in **Table 1.** The contributing watershed used in the analysis is shown on **Figure 1.** The design details for the diversions are shown on **Figure 4** and **Figure 5.** The diversions are typically triangular in shape with 4.5H:1V side slopes and 2-foot channel depths. The channel depth includes 0.5 feet of freeboard above peak flow. Some diversions on steep terrain (greater than 3%) are trapezoidal in shape with a 10-foot bottom width and 3H:1V side slopes. The different channel geometry is necessary to keep flow velocities below the limiting velocity of 5.5 feet per second. Select areas where the channel slope is greater than 5% may require armoring with angular rock, or pre-stabilization of a proposed vegetative channel with an erosion control product. As-built designs consisting of surveyed ditch profiles, representative cross-sections and hydraulics calculations will be submitted following construction. These will verify that design flows can be handled.

Due to the site topography, the diversions cannot convey all the runoff that would flow towards the mining pits. Areas that cannot be diverted require the use of ponds or sumps to contain runoff. The operational sumps are sized according the area of contributing watersheds and the 10-year 24-hour storm event. The sump locations and contributing watersheds are shown on **Figures 1** and **2**, and design details are listed in **Table 2**. The sumps are typically on-channel structures and will resemble a typical stock reservoir. The maximum height of a sump embankment will not exceed 10 feet in height and the maximum capacity will not exceed 20 acre-feet. An emergency spillway that is capable of safely conveying the peak flow during the 100-year, 24-hour storm with at least 1-foot of freeboard has been included in the design. The minimum spillway depth is 3 feet. The sumps have been designed to fully contain the runoff from the 10-year, 24-hour storm when the sump is empty. Therefore, water contained in the sump must be pumped or trucked to another location to provide the necessary operational containment. Norwest will submit as-built surveys to UDOGM within three months of the completion of construction.

Red Leaf plans to use the McCoy Reservoir #2 as highwall containment for Period 13. A 2011 survey found that the reservoir had 16.96 acre feet of capacity to the emergency spillway. The 10-year 24-hour runoff from the watershed contributing to this site is 8.03 acre feet. Red Leaf will utilize the reservoir for storage of operations water. The entire volume will be available for storage prior to its use as a sump to protect mining in Period 13.

The ponds (**Table 3**) were designed to handle the 10-year 24-hour storm event at a minimum and may be used for supplemental storage of operational ground water. Pond 1 has a capacity of 11.81 acre feet and is designed to retain 1.25 acre feet of water from the 10-year 24-hour storm. Pond 2 has a capacity of 2.17 acre feet and is designed to contain 0.35 acre feet for the 10-year 24-hour storm. Pond 3 has a capacity of 21.83 acre feet and

will contain 4.91acre feet of runoff for the 10-year 24-hour event. Operational staff will develop a strategy to identify the maximum storage level to ensure containment of the 10-year 24-hour storm. All three ponds have less than 20 acre feet of storage above grade, and Pond 3 utilizes excavated storage to achieve this objective. Red Leaf will submit as-built surveys to UDOGM within three months of the completion of construction.

During the reclamation phase, ponds and perimeter ditches will be constructed on site within the lease boundaries to control and contain runoff from the site after mining operations cease. The post-mine reclamation drainage plan is shown on **Figure 3**. The design details for the ponds are listed in **Table 3** and illustrated in **Figure 6**. Earthen ditches will collect runoff from the reclaimed areas and route it to down drains that are armored with angular rock. Four down drains on the west side of the larger mine area have been designed to collect water from existing drainages that will be mined-out. These ditches will be operational during mining operations and following the completion of mining. Sumps have been included at the bottom of each down drain for use during mining operations to prevent water from flowing into the open pit. In some cases, water will be conveyed through culverts to the sumps and designs are shown in **Table 4**. Reclamation will occur simultaneously to mining activities, which means that the operational drainage plan will be a combination of the designs included in **Figures 1** and **2**. For example, while Period 12 is being mined, CD-8 (**Figure 1**) will divert water from the west side of the pit to the north and away from the pit. Water from the reclaimed areas will be diverted through collection ditch CD-20s to Sump 20 (**Figure 2**).

Following the completion of mining, these sumps will be reclaimed and five reclamation ponds will be used to contain runoff waters and to provide water for stock and wildlife. The ponds will be inspected to ensure their storage and long-term stability prior to closure. Maintenance will be performed if necessary. The reclamation ditches and down drains will remain (**Figure 3**). Two in-pit ponds (Ponds 4 and 5) have been included at the northeast corner of the two mining areas, because these will be left as excavated areas

and water will naturally collect there. The adjacent highwall will be protected by a toe berm constructed with materials excavated for the ponds. The crest of the berm will be 5 feet above the modeled 100-year 60-day storm event of 6.17". The berm will have a 3H:1V outslope (**Figure 3**). The toe berm will be constructed in 6-inch horizontal lifts and compacted to 90% dry density. The berm adjacent to Pond 4 is 18 feet tall, and the berm adjacent to Pond 5 is 15 feet tall. The emergency spillway of the ponds outside the pit will be sized to safely pass the 100-year 24-hour storm event. Ponds will be constructed with 3:1 side slopes.

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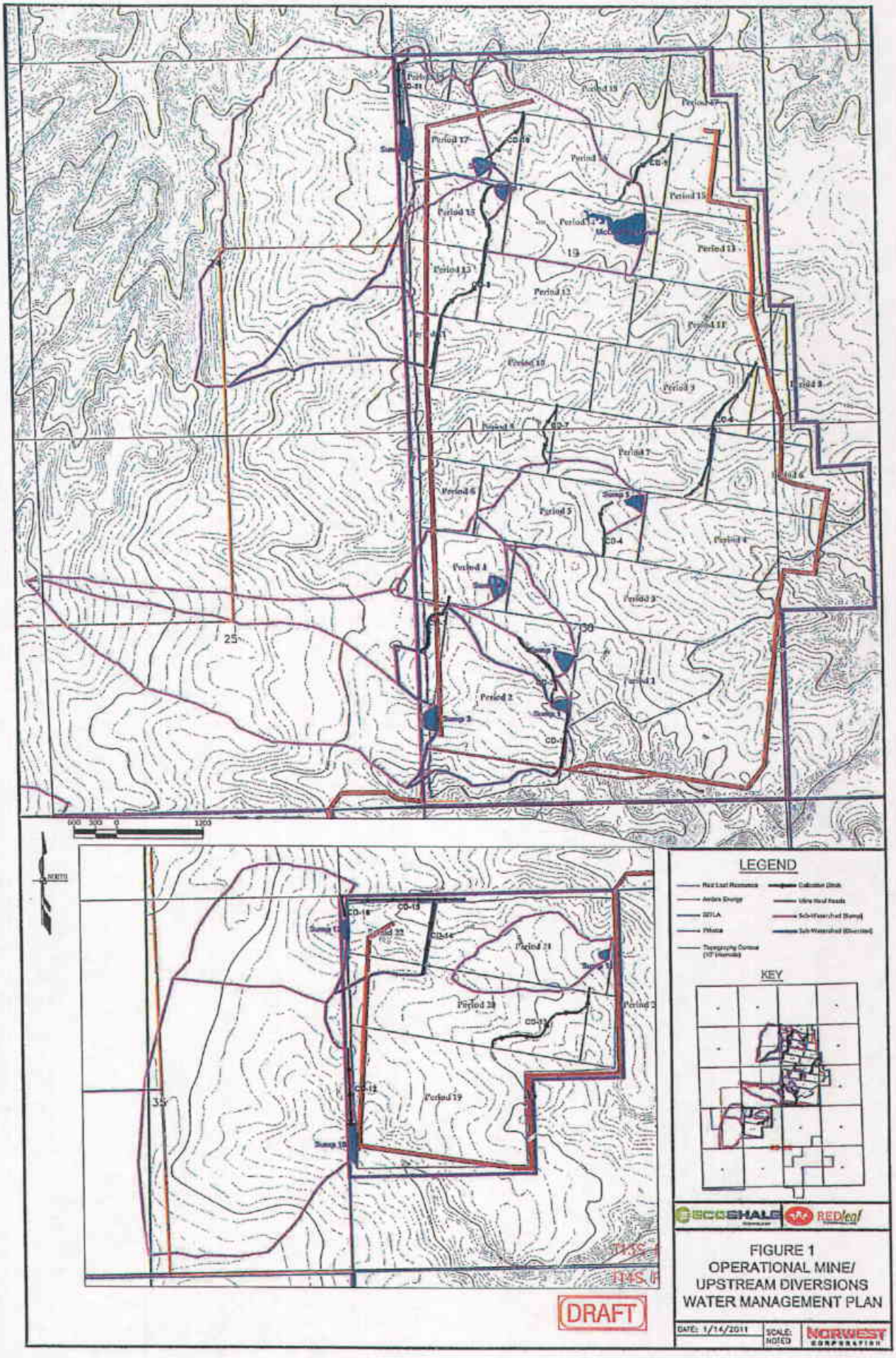

LEGEND
KEY
DRAFT
FIGURE 1
OPERATIONAL MINE/
UPSTREAM DIVERSIONS
WATER MANAGEMENT PLAN
DATE: 1/14/2011
SCALE: NOTED
NORWEST CORPORATION

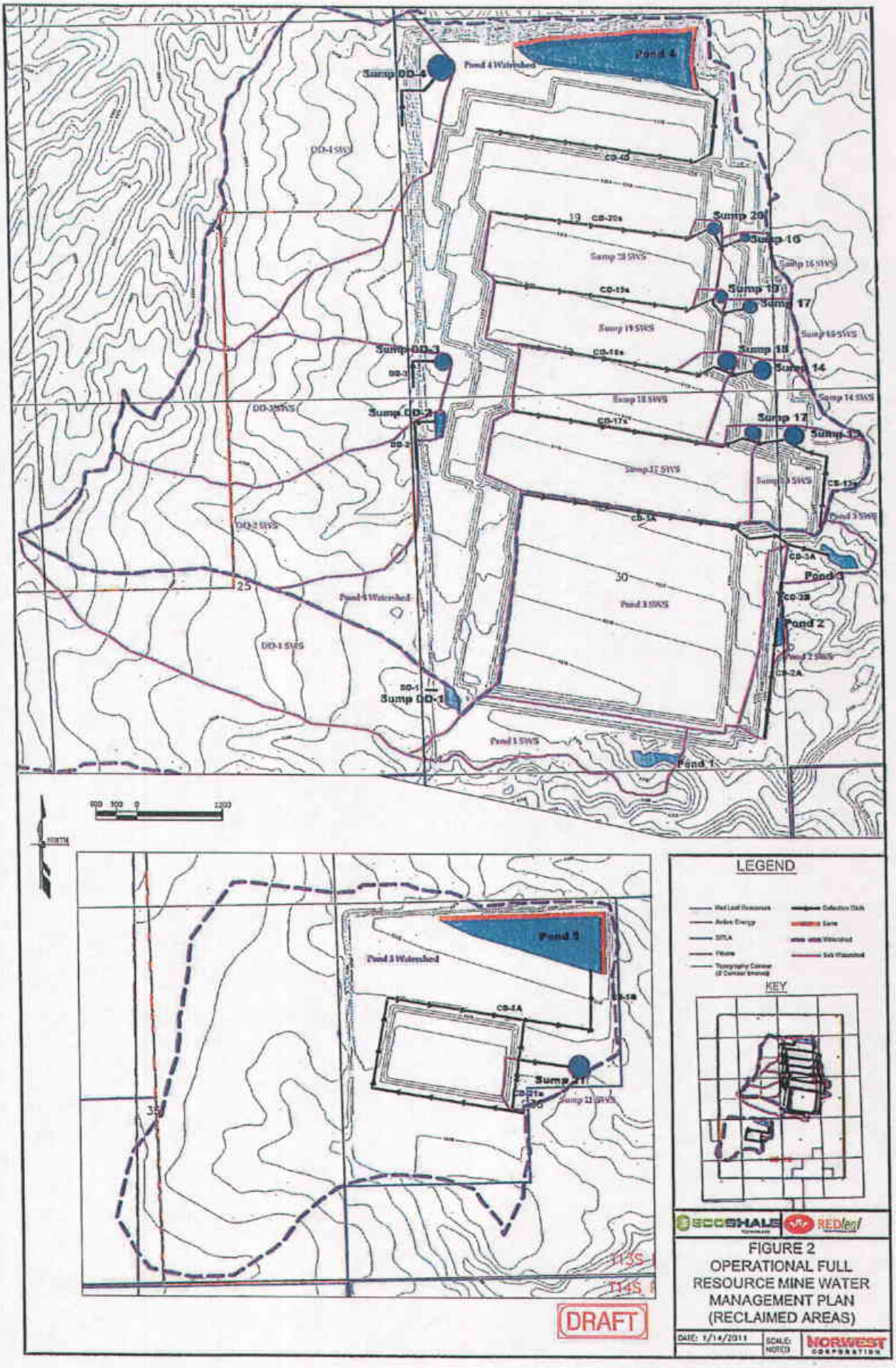
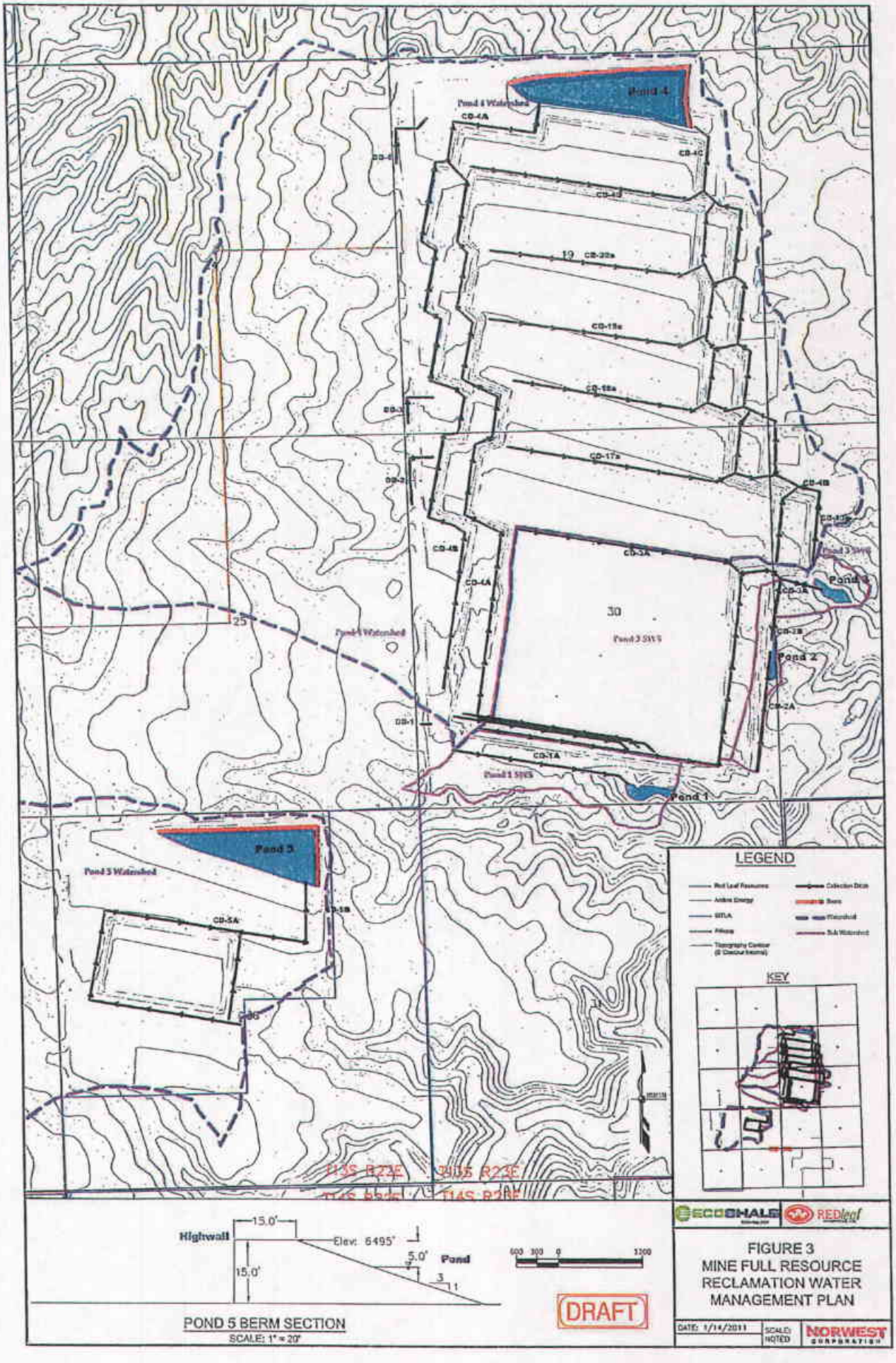
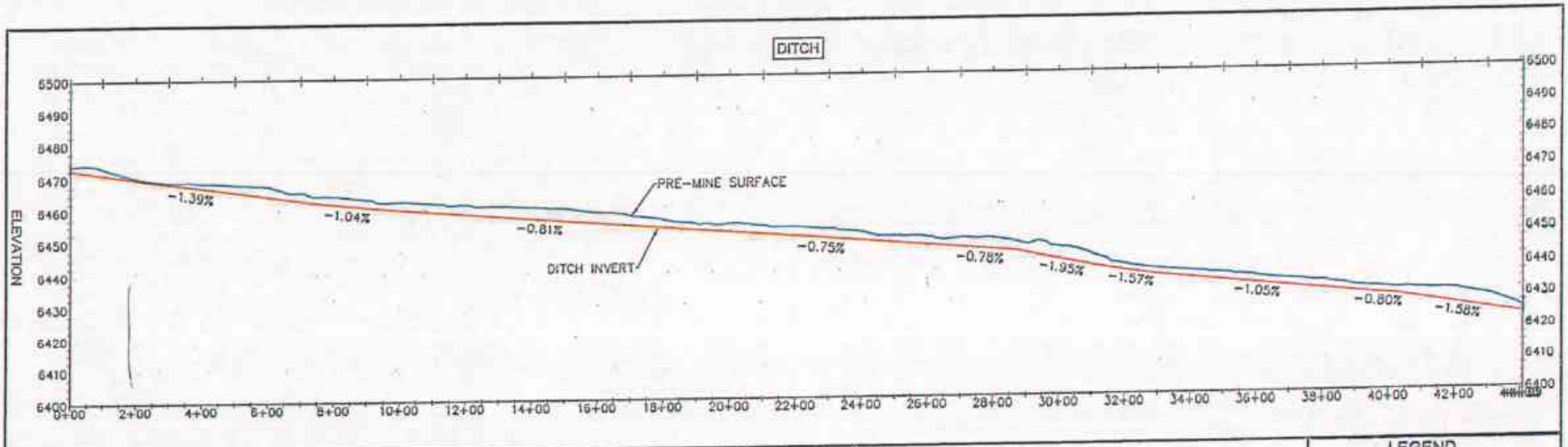
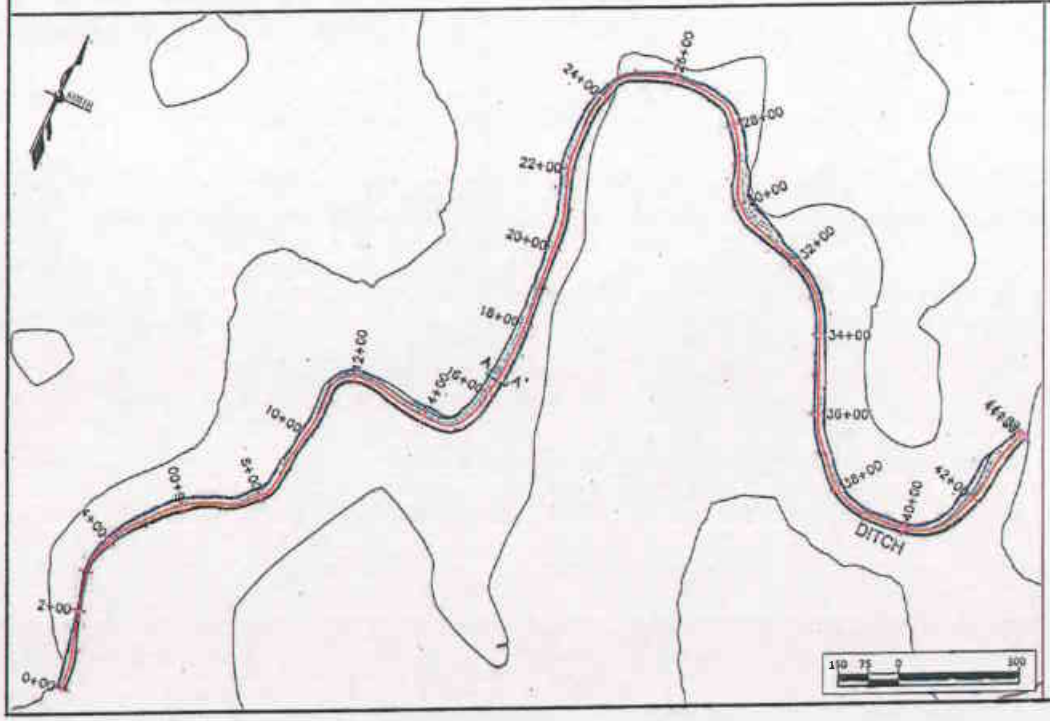


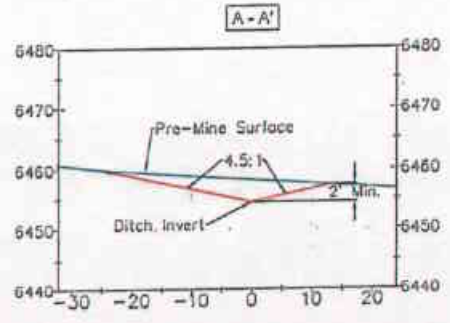
FIGURE 2
OPERATIONAL FULL RESOURCE MINE WATER MANAGEMENT PLAN (RECLAIMED AREAS)

DATE: 1/14/2011 | SCALE: NORES | NORWEST CORPORATION


Pond 4
Pond 4 Watershed
CD-4A
CD-4C
CD-4B
CD-3A
CD-4A
CD-3B
CD-2B
CD-2A
Pond 2
Pond 1
Pond 3
Pond 3 Watershed
CD-5A
CD-5B
CD-5
Pond 3 Sump
Pond 2 Sump
Pond 1 Sump
25
30
31
T13S R23E
T14S R23E
LEGEND
KEY
Highwall
15.0'
Elev. 6495'
5.0'
Pond
15.0'
3
1
POND 5 BERM SECTION
SCALE: 1" = 20'
600 300 0 1200
DRAFT
ECOSHALE
REDleaf
FIGURE 3
MINE FULL RESOURCE
RECLAMATION WATER
MANAGEMENT PLAN
DATE: 1/14/2011
SCALE: NOTED
NORWEST







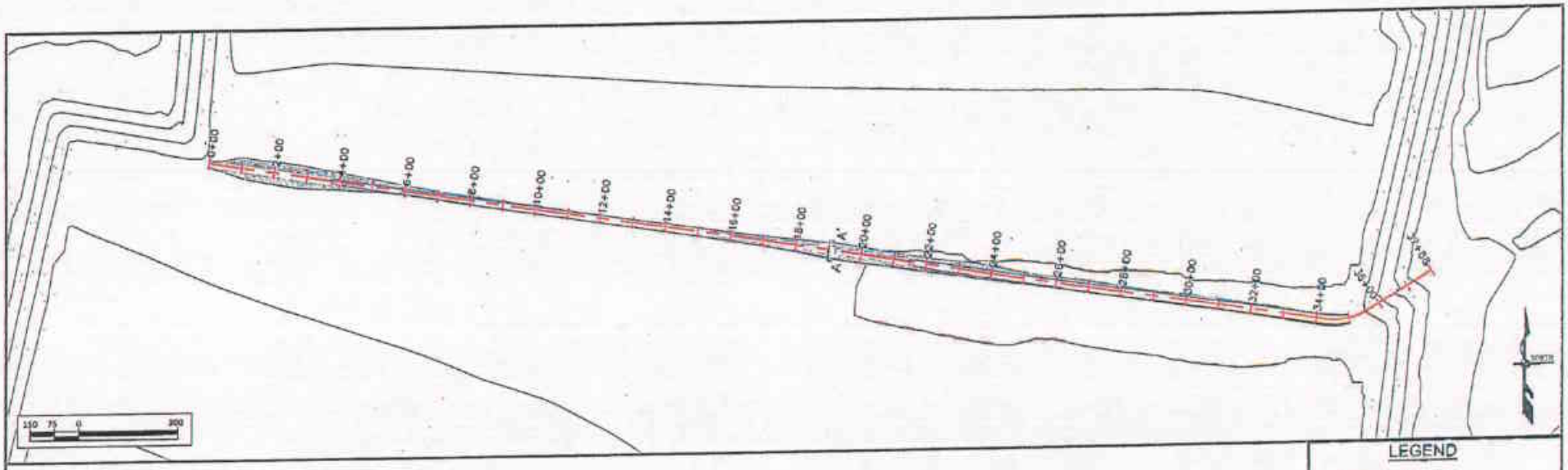
NOTES:
- CHANNEL SEGMENTS STEEPER THAN 5% MAY NEED TO BE ARMORED WITH RIP RAP.
- COLLECTION DITCHES AND ANY ASSOCIATED SUMPS ARE TO BE BUILT PRIOR TO ANY DISTURBANCE OF THE MINE BLOCK.
- DITCHES DISCHARGE TO SUMPS, PONDS, OR EXISTING DRAINAGES.

DRAFT

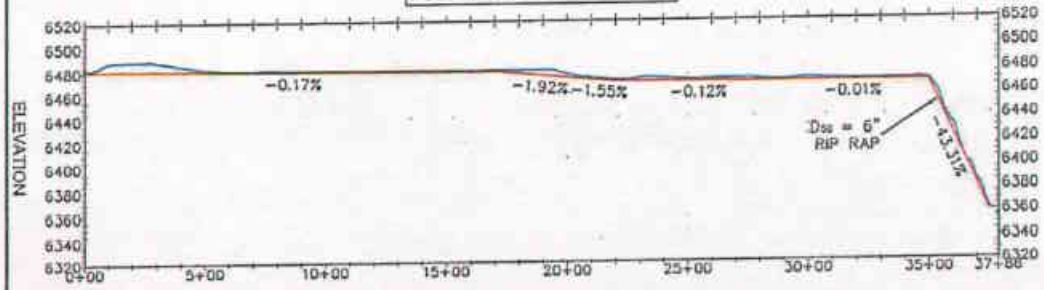
LEGEND

FIGURE 4
TYPICAL COLLECTION DITCH DESIGN

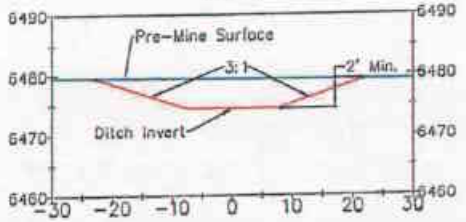
DATE: 10/29/2010 SCALE: NOTED NORWEST CORPORATION



POST MINE COLLECTION DITCH



A - A'



NOTES:
- CHANNEL SEGMENTS STEEPER THAN 5% MAY NEED TO BE ARMORED WITH RIP RAP.
- COLLECTION DITCHES AND ANY ASSOCIATED SUMPS ARE TO BE BUILT PRIOR TO ANY DISTURBANCE OF THE MINE BLOCK.
- DITCHES DISCHARGE TO SUMPS, PONDS, OR COLLECTION DITCHES.

DRAFT

LEGEND

FIGURE 5
TYPICAL RECLAMATION DITCH DESIGN

DATE: 10/29/2010 SCALE: NOTED

NORWEST CORPORATION

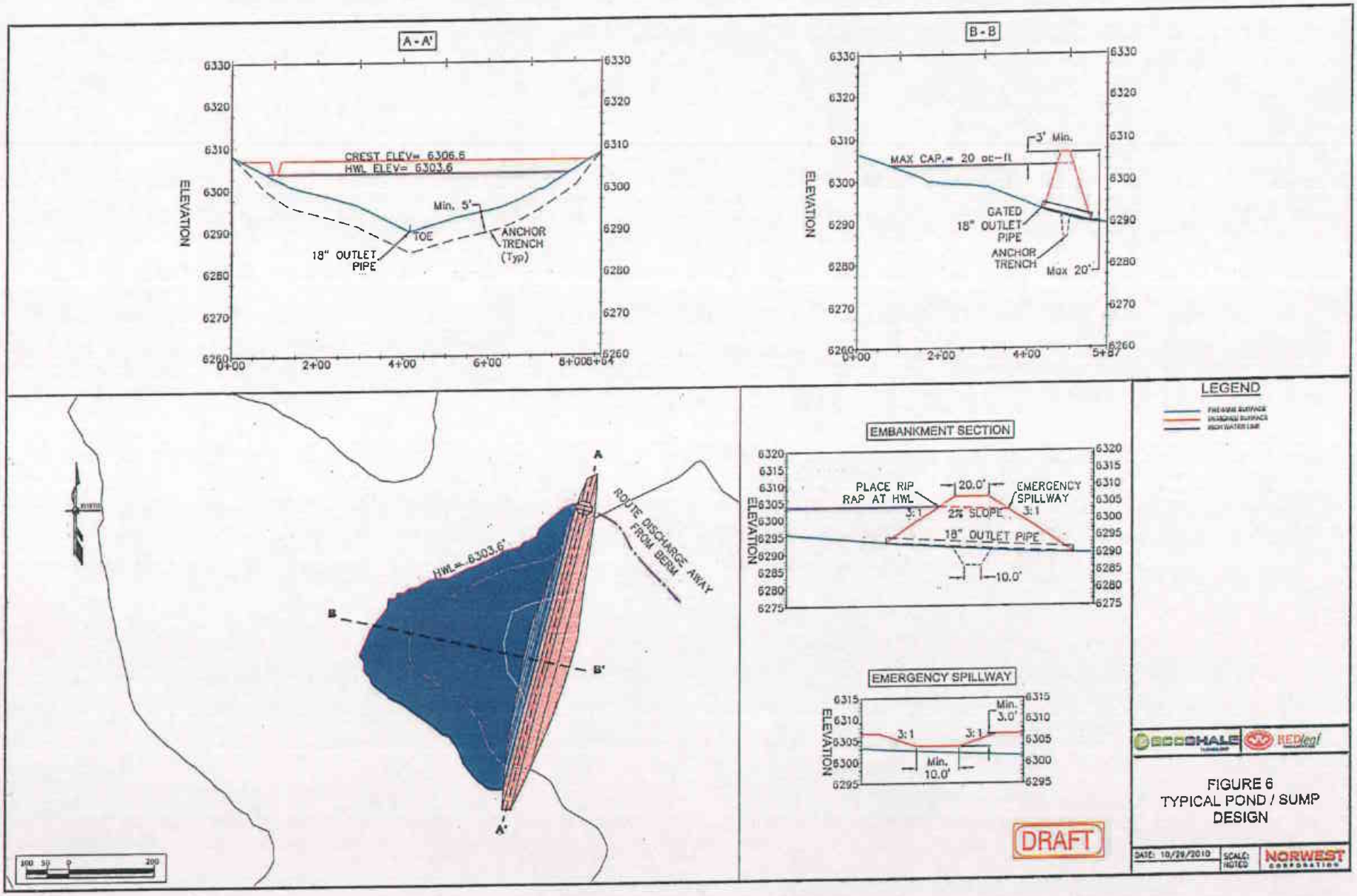


FIGURE 6
TYPICAL POND / SUMP DESIGN

DATE: 10/29/2010 SCALE: NOTED NORWEST CORPORATION

Table 1: Collection Ditches (Mining Phase)

Ditch	Protected Area	Length	Top Elev.	Bottom Elev.	Elevation Change	Slope %
CD-1	Period 1	908	6450	6390	60	6.61
CD-2	Period 1	1149	6425	6390	35	3.05
CD-3	Period 2	1196	6480	6475	5	0.42
CD-4	Period 4	1237	6390	6370	20	1.62
CD-5	REMOVED					
CD-6	Period 6, 8	2638	6360	6280	80	3.03
CD-7	Period 7	923	6415	6385	30	3.25
CD-8	Periods 10, 12, 14	2365	6380	6310	70	2.96
CD-9	Period 15	1476	6300	6290	10	0.68
CD-10	Period 16	996	6360	6320	40	4.02
CD-11	Period 17	1177	6420	6360	60	5.10
CD-12	Period 19	1298	6685	6620	65	5.01
CD-13	Period 19	2277	6600	6580	20	0.88
CD-14	Period 21	1306	6660	6585	75	5.74
CD-15	Period 21	2005	6635	6570	65	3.24
CD-16	Period 22	415	6640	6630	10	2.41

Worst Case Design Scenario: 100-year 24-hour storm event (2.54")

Ditch CD-8 Largest Contributing Watershed

Name	Mine Periods in Use	SWS Area (ac)	Peak Flow (cfs)	Shape	Bottom Width	Side Slopes	Flow Depth	Freeboard	Channel Depth	Velocity (fps)
Ditch CD-8	10,12,14	95.05	27	Trapezoidal	10	3H:1V	0.49	0.5	0.99	4.75

Ditch CD-1 Slope: 6.6%

Name	Mine Periods in Use	SWS Area (ac)	Peak Flow (cfs)	Shape	Bottom Width	Side Slopes	Flow Depth	Freeboard	Channel Depth	Velocity (fps)
Ditch CD-1	1	1.35	1.07	Tri	-	4.5H:1V	0.27	0.5	0.77	3.29
	Assumed CD-3 and Sump 3 were in place									
Ditch CD-14	21	69.89	16.59	Trapezoidal	10	3H:1V	0.3	0.5	0.8	5.05

Table 2: Operational Sumps (Mining Phase)

Name	SWS Area (ac)	Runoff (ac ft)	Slopes	Height (ft)	HWL Area (ac)	Capacity (ac ft)	Toe Elev (ft.)	HWL Elev (ft.)	Crest Elev (ft.)	Freeboard (ft.)	Spillway	Mine Period Protected
Sump 1	90.90	1.74	3H:1V	10	0.36	3.38	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 1
Sump 2	23.88	0.46	3H:1V	10	1.11	6.34	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 1
Sump 3	155.67	2.98	3H:1V	10	1.04	5.88	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 2
Sump 4	32.18	0.62	3H:1V	10	1.23	7.13	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Periods 2 and 3
Sump 5	50.13	0.96	3H:1V	10	0.62	4.46	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 4
McCoy Reservoir	419.06	8.03	3H:1V	10	4.33	16.96	0	2	4	2	Trapezoidal, 10' wide, 3:1 sideslopes	Period 13
Sump 7	31.33	0.60	3H:1V	10	0.73	4.01	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 14
Sump 8	268.07	5.14	3H:1V	10	0.98	5.51	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Periods 14 and 15
Sump 9	223.76	4.29	3H:1V	10	1.47	8.40	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 17
Sump 10	226.19	4.34	3H:1V	10	1.17	5.40	0	12	15	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 19
Sump 11	37.75	0.72	3H:1V	10	0.31	1.47	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 20
Sump 12	79.53	1.52	3H:1V	10	0.13	2.02	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 22
Sump 13	140.49	2.69	3H:1V	10	1.20	7.09	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 14	94.20	1.81	3H:1V	10	1.22	7.23	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 15	74.22	1.42	3H:1V	10	0.59	3.23	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine

Table 2: Operational Sumps (Mining Phase)

Name	SWS Area (ac)	Runoff (ac ft)	Slopes	Height (ft)	HWL Area (ac)	Capacity (ac ft)	Toe Elev (ft.)	HWL Elev (ft.)	Crest Elev (ft.)	Freeboard (ft.)	Spillway	Mine Period Protected
Sump 16	89.65	1.72	3H:1V	10	0.24	1.97	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 17	98.15	1.84	3H:1V	10	0.65	3.77	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 18	66.09	1.27	3H:1V	10	1.06	6.18	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 19	65.14	1.25	3H:1V	10	0.48	2.56	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 20	74.78	1.43	3H:1V	10	0.48	2.54	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 21	13.78	0.26	3H:1V	10	1.59	9.60	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-1	173.23	3.32	3H:1V	10	0.80	4.33	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-2	176.31	3.38	3H:1V	10	0.74	3.79	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-3	159.83	3.06	3H:1V	10	0.49	4.88	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-4	245.66	4.71	3H:1V	10	1.43	13.77	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine

Table 3: Ponds (Reclamation)

Name	SWS Area (ac.)	10-Yr 24-Hr Runoff (ac-ft.)	100-Yr 24-Hr Runoff (ac-ft.)	100-Yr 60-Day Runoff (ac-ft)	Slopes	Height (ft.)	Toe Elev (ft.)	HWL Elev (ft.)	Crest Elev (ft.)	Freeboard (ft.)	Bottom Area (sq. ft.)	HWL Area (sq. ft.)	Bottom Area (ac.)	HWL Area (ac.)	Capacity (ac-ft.)	Spillway
Pond 1	64.99102	1.245661	3.41	24.21	3H:1V	12	0	10	12	2	54698	98246	1.26	2.26	11.81	Trapezoidal, 10' wide, 3:1 sideslopes
Pond 2	18.42	0.353065	0.97	6.86	3H:1V	10	0	7	10	3	5574	23437	0.13	0.54	2.17	Trapezoidal, 10' wide, 3:1 sideslopes
Pond 3	256.13	4.909112	13.45	95.41	3H:1V	20	0	18	20	2	24166.67	88158	0.55	2.02	21.83	Trapezoidal, 10' wide, 3:1 sideslopes
Pond 4	1543.10	29.57615	81.01	506.74	3H:1V	25	0	25	25	Below Grade Excavation	823049	1244739	18.89	28.58	589.22	None
Pond 5	613.86	11.76571	32.23	197.25	3H:1V	10	0	10	10	Below Grade Excavation	832645.87	990698	19.11	22.74	209.03	None

Table 4: Downdrain Sumps, Culvert and Downdrain Designs (Reclamation Phase)

Name	SWS Area (ac)	Runoff (ac-ft)	Slopes	Height (ft)	HWL Area (ac)	Capacity (ac-ft)	Toe Elev (ft.)	HWL Elev (ft.)	Crest Elev (ft.)	Freeboard (ft.)	Spillway	Mine Period Protected
Sump DD-1	173.23	3.32	3H:1V	10	0.80	4.33	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-2	177.46	3.40	3H:1V	10	0.73	3.79	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-3	160.49	3.08	3H:1V	10	0.49	5.22	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-4	247.01	4.73	3H:1V	10	2.22	13.75	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine

		Road Culvert				Downdrain Pipe				
Name	SWS Area (ac)	Min. Diameter (in.)	Length (ft)	Pipe Slope	Peak Discharge (cfs)	Min. Diameter (in.)	Length (ft)	Pipe Slope	Peak Discharge (cfs)	Mine Period Protected
DD-1	173.23	30	65	1%	24.24	30	134	26%	24	Post-Mine
DD-2	177.46	42	65	1%	47.97	42	103	78%	47.45	Post-Mine
DD-3	160.49	42	65	2%	44.73	42	136	65.7	43.88	Post-Mine
DD-4	247.01	NA	NA	NA	NA	75.8	230	87	75.8	Post-Mine

Red Leaf Resources

Southwest #1 Project Area
Seep and Spring Inventory
Fall 2012

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ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
BLM	Bureau of Land Management
cfs	cubic feet per second
GIS	Geographic Information Systems
gpm	gallons per minute
GPS	Geographic Positioning System
JBR	JBR Environmental Consultants, Inc.
LMO	Large Mining Operations
NOI	Notice of Intent
NRCS	National Resources Conservation Service
NWIS	National Water Information System
OHWM	Ordinary High Water Mark
RLR	Red Leaf Resources, Inc.
SAR	Sodium Absorption
SITLA	State Institutional Trust Land Association
SMO	Small Mining Operations
UDOGM	Utah Division of Oil, Gas, and Mining
UDWG	Utah Division of Water Quality
UDWR	Utah Division of Water Rights
USEPA	United States Environmental Protection Agency
USGS	United States Geological Service
WoUS	Waters of the United States
WRCC	Western Regional Climate Center

1.0 INTRODUCTION

The Red Leaf Resources, Inc., (RLR) Southwest #1 Project Area is located on School and Institutional Trust Land Administration (SITLA) properties in eastern Utah, approximately 55 miles south of Vernal, Utah. RLR controls two SITLA mineral leases within this Project Area, which are the subject of this seep and spring inventory. Lease ML 43374 is located in Section 36, T13S, R22E. Parts of ML 50150 included in this survey are located in Sections 19 and 30, T13S, R23E, SLBM. The combined area of the two leases totals approximately 1,604 acres.

In February 2007, RLR filed the first technology patents for the EcoShale™ In-Capsule Technology for mining oil shale. The original filing was modified in February 2008 and three U.S. patents have been published while others are still in process.

In October 2008, RLR initiated construction of a test facility under its Exploration Permit. RLR has been in continuous permitted operation since 2008 with activities including site construction, testing and scale-up of the EcoShale™ In-Capsule Technology test unit, operations and maintenance. The EcoShale™ In-Capsule Technology is used to extract kerogen deposits from sedimentary shale deposits. The operation consists of simultaneous mining of the oil shale and creating the heating capsules for processing the mined ore.

The facility is currently operating under the authority of a Small Mine Operation (SMO) Permit. RLR intends to expand activities at Southwest #1 small mine site by converting to a Large Mining Operation (LMO). Mining will initiate in SE1/4 of Section 30, T13S, R23E, and progress east to west and south to north. RLR submitted a Notice of Intent (NOI) to Commence Large Mining Operations to the Utah Division of Oil, Gas, and Mining (UDOGM) on September 1, 2011 (RLR 2011).

This seep and spring inventory is part of baseline activities for a revised Ground Water Discharge Permit application associated with the LMO.

2.0 ENVIRONMENTAL SETTING

The topography of the Southwest #1 Project Area is relatively flat with rolling hills. The vegetative cover on the site is predominantly grass/sagebrush community with interspersed stands of pinion and juniper. Several small, dry draws extend into the Project Area. McCoy Reservoir # 2 is located within the northern third of the Southwest #1 Project Area. Although the dam is in working condition, the reservoir was dry on June 22, 2010.

Geology and Landform

The Southwest #1 Project Area is located in the Uinta Basin section of the Colorado Plateau physiographic province (Stokes 1986). This physiographic province is also known as the Colorado Plateaus Level III Ecoregion (Woods et al 2001).

The Uinta Basin is a structural depression. The Southwest #1 Project Area is located in the southern part of the basin and is underlain by northwesterly dipping Tertiary strata. The region is characterized by a dissected plateau with strong relief (Stokes 1986). Approximate elevation in the Southwest #1 Project Area ranges from 6,200 feet in the northwest corner of Section 19, T13S, R23E to 6,600 feet in the southwest corner of Section 36, T13S, R22E.

Bedrock at the RLR Project Area is the Tertiary, oil shale-bearing Parachute Creek Member of the Green River Formation. The Parachute Creek Member consists mainly of oil shale, which is a marlstone that contains a solid hydrocarbon material known as kerogen. The oil shale interbeds with minor amounts of siltstone, sandstone, and altered volcanic tuff beds. The Mahogany Oil Shale Zone within the Parachute Creek Member will be the oil shale source for the proposed operation. Depth to the top of the Mahogany Marker, which identifies the top of the kerogen-rich Mahogany Zone, is between the surface and 160 feet below ground surface (bgs) in the Project Area.

Soils

Four main soil map units were identified within the Project Area, as per the Order 2 soil survey titled Uinta Area, Utah - Parts of Daggett, Grand, and Uintah Counties Soil Survey (NRCS 2003). The Gompers soils (map units 81 and 82) are not very extensive. The Walknolls-Mikim association (map unit 263) soils are prevalent across most of the northern parcel of the Project Area in sagebrush-grass and greasewood-sagebrush dominated areas. The Whitesage-Cedarknoll complex (map unit 270) is found mostly under pinyon-juniper forest, which is found on the west side of both parcels in the Project Area, and extends from the southwest to northwest edges of the properties. This map unit is at a slightly higher elevation than the Walknolls-Mikim association. **Table 1** summarizes the acreage, depth, and general characteristics of each soil map unit within the Project Area.

Table 1 Characteristics of Soils in the Project Area

Soil Series	Ecological Site[1]	Acres in Lease Area	Soil Depth	Shrink-swell Potential	pH	$CaCO_3$ %	Gyp-sum %	SAR	Drainage Class
81	Gompers very channery silt loam, 4 to 25 percent slopes	191.8	0"-22"	About 1.5 percent (low)	7.9 to 9.0	To 30%	0	0	Well drained
82	Gompers very channery silt loam, 25 to 50 percent slopes	23.6	0"-22"	About 1.5 percent (low)	7.9 to 9.0	To 40%	0	0	Well drained
263	Walknolls-Mikim association, 2 to 50 percent slopes	330.4	0"-22" 0"-60"	About 1.5 percent (low) to about 4.5 percent (moderate)	7.9 to 90	To 30%	0	0 - 2.0	Well drained
270	Whitesage-Cedarknoll complex, 3 to 8 percent slopes	1059.0	0"-60" 19"-22"	About 1.5 percent (low)	7.9 to 9.0	To 40%	0	0 - 2.0	Moderately drained

[1] http://www.ut.nrcs.usda.gov/technical/technology/range/mlra34b.html

Vegetation

The Southwest #1 Project Area is located in an area of patchy pinyon-juniper forest (*Pinus edulis/Juniperus osteosperma*) on white/tan, gently-to-steeply-sloping shale hills. These hills interfinger with sandier, loamy swales. The swales support shrub-dominated grasslands that grade into greasewood-dominated shrublands on shallower soils and where moisture collects. Common species in the shrub-grasslands are big sagebrush (*Artemisia tridentata*), black sage (*A. nova*), winterfat (*Krascheninnikovia lanata*), greasewood (*Sarcobatus vermiculatus*), four-winged saltbush (*Atriplex canescens*), snakeweed (*Gutierrezia sarothrae*), galleta grass (*Hilaria jamesii*), and western wheatgrass (*Pascopyrum smithii*). Barren areas are interspersed within the pinyon-juniper communities, and are mostly located on south-facing slopes or the bases of the white shale outcrops.

The vegetation in the Southwest #1 Project Area is dominated by native plants common to the location, elevation, and underlying geology of the area. Non-native vegetation included cheatgrass (*Bromus tectorum*) which was found in scattered patches throughout the Project Area, and two small patches of scotch thistle (*Onopordum acanthium)* and whitetop (*Cardaria draba*) were noted within the area and along access roads.

The Southwest #1 Project Area contains four main ecological communities and two disturbed areas that were mapped. These include Pinyon-juniper forest, Greasewood-sagebrush shrubland, Sagebrush-grassland, Barren outcrop, Impound area (an annual

forb community found at McCoy Reservoir #2), and Disturbed land (roads, oil and gas pads, Red Leaf test facility area).

The area of McCoy Reservoir #2 supports a cover of annual plants typically found in seasonally wet areas. Disturbed areas include access roads, an oil/gas drilling/production pad, and the current Red Leaf small mine site. Essentially no vegetation is found on disturbed areas.

Surface Water

Nearly all of the Southwest #1 Project Area drains to Sweetwater Canyon Creek via Indian Ridge Canyon and its tributaries. A small portion at the north end of the Project Area drains to Klondike Canyon, which is another tributary of Sweetwater Canyon. Sweetwater Canyon Creek is tributary to Bitter Creek, which is a tributary of the White River. The confluence of Sweetwater Canyon Creek and Bitter Creek is approximately 3.3 miles northeast of the northeast corner of the Project Area. The confluence of Bitter Creek and the White River is approximately 20 miles north of the Project Area.

Annual rainfall is generally low for this region averaging 10 inches per year. The 10-year 24-hour storm event for the Project Area is 1.68 inches. (WRCC 2010)

The USGS briefly maintained a gaging station on Sweetwater Canyon Creek approximately two miles east of the Project Area and upstream of Indian Ridge Canyon in T13S, R23E, Section 27 (Sweetwater Canyon Creek near mouth near Watson, Utah). Drainage area for the station was 124 square miles. The gaging station was operated for four years between October 1974 and October 1978. During that period, the average daily discharge was 0.089 cubic feet per second (cfs). It had zero average daily discharge for 82 percent of the period of record. Discharge periods were during spring runoff and following summer/fall storm events. The maximum discharge during these four years was 59 cfs on July 25, 1976; the average discharge for that day was 9.4 cfs, demonstrating the "flashy" nature of the stream. (USGS 2011)

The USGS maintained a gaging station on Bitter Creek approximately eight miles downstream of the Project Area (Bitter Creek near Bonanza, Utah) for water years 1971 through 1989. During that period the annual average discharge ranged from 0.28 cfs in 1972 to 18.5 cfs in 1987, with the overall annual average for the period being 6.06 cfs. The maximum daily average recorded for the period was 150 cfs on September 5, 1982. Periods of no flow were common and followed the same general hydrograph of Sweetwater Canyon Creek. (USGS 2011).

The Project Area slopes down to the east and toward Indian Ridge Canyon. It is dissected by numerous ephemeral drainages and does not contain any perennial surface water sources. The USGS National Hydrography Dataset shows no springs in or near the Project Area (USGS 2010, JBR 2011). The ephemeral drainages that cross the area are typical of those found in this high desert environment. Channels are incised in some reaches and essentially undefined in others; riparian vegetation is lacking, and bed/bank sediment movement is evident. The runoff regime of these channels is

controlled primarily by local summer thunderstorms that generate infrequent and short-lived, but often intense, flash floods.

Groundwater

The State of Utah defines an aquifer as "a geologic formation, group of geologic formations or part of a geologic formation that contains sufficiently saturated permeable material to yield usable quantities of water to wells and springs" (R317-6-1). The Utah State Water Plan (Utah Division of Water Resources 1999) refers to Mesa Verde as the regional aquifer closest to the surface in the Southwest #1 Project Area.

Regionally, the direction of groundwater movement in this part of the Uinta Basin is toward the north and the White River. Water quality in the Mesa Verde and other regional aquifers ranges from relatively good to briny, with a range between 1,000 mg/L and 3,000 mg/L total dissolved solids expected in the aquifer underlying the Red Leaf project (Price and Miller 1975). The Mesa Verde is approximately 3500 to 4000 feet bgs at the Red Leaf site.

The Green River and Wasatch Formations overlie the Mesa Verde Group in the Project Area, with the Parachute Creek Member of the Green River Formation being the surface bedrock formation found throughout the majority of the Red Leaf parcels (Sprinkel 2009). The Parachute Creek Member contains the Mahogany Oil Shale zone, from which RLR would extract its ore.

According to records on file with the Utah Division of Water Rights (2011), groundwater in the vicinity of the Project Area is generally found at depths shallower than those reported by Price and Miller (1975) or Freethey and Cordy (1991) for the Mesa Verde. The shallower depths likely reflect localized, perched aquifers associated with lenses of permeable bedrock in the Douglas Creek Member of the Green River Formation. Alluvial deposits are minimal in the lease parcels and are insufficient to meet the state definition of an aquifer. The Douglas Creek Member of the Green River Formation crops out in some of the deeper canyons in and near the Project Area (Sprinkel 2009).

Surface and Ground Water Quality

Table 2 shows selected water quality data from the USGS Sweetwater Canyon Creek gaging station during its four years of record, and **Table 3** shows selected water quality data from the USGS Bitter Creek gaging station during its 18 years of record. They show dissolved solids concentrations increasing in the downstream direction.

Table 2 Selected Water Quality Data for the USGS Sweetwater Canyon Creek Near Mouth Near Watson, Utah Gaging Station, Water Years 1974-1977

Parameter	No. of Samples	Average	Minimum	Maximum
pH (SU)	9	8.2	8.0	8.5
Total Dissolved Solids (mg/L)	11	1,930	1,350	2,200
Total Dissolved Solids (tons/day)	8	2.7	0.52	10.6
Suspended Sediment (mg/L)	11	3,784	202	8,660
Specific Conductance (microSiemens/cm)	10	2,299	1,800	5,250

Table 3 Selected Water Quality Data for the USGS Bitter Creek Near Bonanza, Utah Gaging Station, Water Years 1971-1989

Parameter	No. of Samples	Average	Minimum	Maximum
pH (SU)	41	8.1	7.4	8.6
Total Dissolved Solids (mg/L)	40	6,236.5	2,700	9,460
Total Dissolved Solids (tons/day)	33	24.3	0.22	103
Suspended Sediment (mg/L)	27	240.7	7	1,080
Specific Conductance (microSiemens/cm)	110	5,114[1]	1,540	>8,000

[1] Average does not include the nine instances recorded as >8,000 µS/cm

State-designated beneficial uses for the White River and its tributaries are 2B (secondary contact recreation), 3B (warm water fish and aquatic life), and 4 (agriculture). The latest 305(b) report to Congress (UDWQ 2006) finds that the White River fully supports its designated 3B and 4 beneficial uses (2B was not assessed), and thus its water quality is not considered to be impaired.

Water quality in the RLR well was tested December 10, 2010 with the following results:

- The pH was 8.27 s.u.,
- Total dissolved solids was 724 mg/L,
- Chloride was 8.36 mg/L,
- Sodium was 159 mg/L, and
- Calcium was 26.1 mg/L.

This is consistent with water quality for the southern part of the Douglas Creek Member of the Green River Formation, as described in Holmes and Kimball (1987):

Water in the southern part of the aquifer most closely resembles the water from springs that discharge in canyon bottoms. This water is dominated by sulfate, bicarbonate, sodium, magnesium, or calcium as a result of reactions that take place in the recharge area. As the water moves downgradient in the aquifer, further reactions cause additional

changes in the chemical quality. The dissolved-solids concentration increases from south to north in the aquifer. This change is in the direction of the flow path.

Table 4 is a summary of chemical quality of water in the Douglas Creek aquifer taken from Holmes and Kimball (1987).

Table 4 Summary of Chemical Quality of Water in the Douglas Creek Aquifer

Variable	Southern Part of the Aquifer				Central Aquifer Mean Value
	No. of Samples	Mean	Minimum	Maximum	
Water Temperature (°C)	4	19.1	16.5	22	25.5
Specific conductance (µS/cm)	4	1,070	940	1,300	1,670
pH (standard units)	3	8.2[1]	7.2	8.8	8.7[1]
		Milligrams per liter			
Alkalinity (as $CaCO_3$)	4	222	160	300	530
Hardness (as $CaCO_3$)	4	710	100	2,300	8.5
Calcium (as CA)	4	22	4.5	54	2.6
Magnesium (as Mg)	4	20	1.8	44	0.4
Sodium (as Na)	4	225	180	340	390
Potassium (as K)	4	0.8	0.6	1.0	0.9
Chloride (as Cl)	4	9.2	7.4	12	25
Sulfate (as SO_4)	4	365	270	470	300
Fluoride (as F)	4	0.3	0.2	0.5	2.4
Silica (as SiO_2)	4	11	8.1	17	14
Dissolved solids (calculated)	4	785	640	950	1,060
Nitrogen, ammonia (as N)	2	0.06	0.01	0.12	1.0
Nitrogen, nitrate (as N)	2	0.20	0.01	0.38	<0.01
		Micrograms per liter			
Boron (as B)	4	250	70	630	550
Iron (as Fe)	4	1,010	40	2,100	20
Manganese (as Mn)	4	28	10	60	10

[1] Geometric mean

Source: Holmes and Kimball 1987

3.0 INVENTORY BOUNDARY

Figure 1 illustrates the seep and spring inventory boundary. The inventory boundary area encompasses 8,562 acres and the following canyons or drainages, all tributaries to Sweet Water Canyon:

- Klondike Canyon
- Reservoir Canyon
- Indian Ridge Canyon

4.0 INVENTORY METHODS

The seep and spring inventory itself involves several stages. These stages are pre-field data gathering, field data-gathering, and report preparation.

Pre-field data gathering

Pre-field data gathering included the following:

- Water rights research
- Agency records review (i.e., UDOGM, USGS)
- Aerial photographs, topographic maps, and GIS review
- Literature research
- Discussions with field personnel who have worked on the site

From this effort, field personnel could locate the most likely locations for seeps and springs, based on prior records, vegetation, and other indicators.

Field data gathering

The goal of the seep and spring data gathering was to understand the habit of occurrence of seeps and springs and to locate any previously unreported water sources in the inventory area. Key field observations and data collection included:

- Hydrophytic vegetation associated with seeps (vegetation type and extent)
- Evidence of seep flow (erosion features) as distinguished from stream flow
- Geologic origins of any flows (i.e., alluvium or bedrock [e.g., bedding plane or fracture])
- Topographic and landscape features
- Photographs of the sites, including possible seeps and of areas with no spring/seep potential except for a dry draw

- Site name or assigned a site number
- Location (using GPS where sky coverage allowed, verified by map reading, or map reading alone where a GPS reading was not possible)
- Type of development if the site had been developed as part of a water right;
- Usage (wildlife or livestock sign)
- Field parameters included pH, conductivity, water temperature, and flow rate
- Note: Where flow rate could not be measured, it was estimated and noted as such.

The northern portion of the inventory area was covered primarily on foot, specifically drainage bottoms, including headwater areas, which are the most likely locations for spring occurrences that may be of a localized nature. The upper portions of the canyon drainages were also examined from the plateau. In this type of terrain, safety can be an issue and may limit the ability to access some features. For inaccessible areas or cliff faces, binocular scoping was used to scan the terrain. The southern portions of the inventory area that did not contain dissected terrain were examined from a vehicle.

Two inventory teams were on site for two field days, beginning October 22, 2012. Each inventory team carried a topographic map, geographic positioning system (GPS) unit, binoculars, camera, flagging, high visibility vests, field equipment (to measure pH, conductivity, temperature, and flow), and field notebook. Where no springs or seeps were identified within a given area of coverage, field notes reflected their absence. Due to drought conditions as well as the time of year when the inventory occurred, sites were recorded where, based upon vegetative indicators, a seasonal spring may be present, even if it was dry at the time of the survey. Where seep or spring sites were identified, they were photographed, and the above field parameters were recorded.

JBR were allowed access field crews on either lease. Reasonable access was available to all portions of the defined seep and spring inventory area.

JBR requested that, since hunting was allowed and ongoing in the inventory area, and in the general vicinity, that JBR be provided with contact information ahead of time, for any parties who may be leading, directing, or responsible for such activity. If at any time the field crews felt their safety was in question, field work would have ceased until the appropriate contacts were made and safe working conditions resumed.

Report Preparation

Following data compiling and analysis, JBR prepared a report documenting its findings, and which is suitable for submittal to UDOGM.

5.0 INVENTORY RESULTS

Few seeps or springs were identified within the inventory area (**Figure 1, Table 5**), with none observed in the northwestern "highland area" of upper Klondike Canyon or the majority of the main Indian Ridge Canyon. One seep was identified in a canyon tributary to Indian Ridge Canyon (in the southwest region of the study area). One spring, a seep, and a seep complex were identified in the lower portion of Klondike Canyon and two nearby tributary canyons. These seeps and springs are described in greater detail below and in the sections that follow, with photos provided in Appendix A. The only spring identified by the water rights research was found during the inventory

In addition, several potential seeps were identified throughout the inventory area. This includes one in a tributary canyon to Indian Ridge Canyon, four in Reservoir Canyon (also tributary to Indian Ridge Canyon), and one in a tributary canyon to Klondike Canyon. These potential seeps are not described in detail below but are listed and described briefly in **Table 5**. There may be additional seeps or springs issuing from the channel bottom in both the Klondike and Indian Ridge Canyon drainages that are dependent upon local, annual recharge (i.e., ephemeral or intermittent), and that were not identified due to the late fall survey window. As a result, the spring repeat survey may be able to identify additional seeps and/or springs.

Klondike Canyon - Parachute Creek Member of the Green River Formation
The Parachute Creek Formation is stratigraphically the highest geologic stratum in the inventory area with spring occurrences and has the greatest areal extent. It is moderately resistant, light-to-medium-gray, light-to-medium-brown, yellow, organic-rich marlstone, siltstone, sandstone, and oolitic limestone; it contains pods of the mineral nahcolite. The spring occurrences found within the Klondike Canyon system was in the Parachute Creek Member. The spring is identified as Klondike Canyon Spring 01.

Klondike Canyon Spring 01
The sole spring found within the Klondike Canyon system was the largest water source identified during the fall 2012 survey. It was in the bottom of the main tributary channel draining from the west to the east into Sweet Water Canyon and surfaced within the stream channel at the base of a small cliff/ridge. The cliff and ridge material was formed predominantly by in situ Parachute Creek Member shale with minor interbedded sandy siltstones.

At sample time (10:00 am), water was flowing at approximately 0.28 gpm, measured using the bucket method. There was continuous flow for approximately 50 feet, where flow then went subsurface. Flow resurfaced and went subsurface again several times within approximately 300 feet before going subsurface for the last time. The flow did not increase downstream or progress for a sufficient distance to support perennial stream flows in the downstream channel. There were a few tamarisk and small areas of sedges within the 300 feet; however, water was confined to the stream bottom and in most areas there was only a substrate of bedrock and gravel. Temperature was 8.0°C, pH was 8.11, and conductivity was 3.0 mS. The expectation is that this spring is dependent upon local, annual recharge and may significantly diminish as the water year progresses. See photos 1 – 7 in **Appendix A**.

The seep occurrences found within the Klondike Canyon system were in the Parachute Creek Member. They are identified Klondike Canyon Seep 02 & 03. The seeps were both located in the bottom of stream channels, at the base of five-to-ten-foot drop-offs. Flows were not measurable, most likely due to being surveyed so late in the fall. Typically, these springs surfaced at the base of rock outcrops where fracturing was evident. The flows did not continue downstream, thus did not support perennial stream flows in the downstream channels. The expectation is that these springs are dependent upon local, annual recharge and may significantly diminish as the water year progresses.

Klondike Canyon Seep 02
This is a small seep that appears to issue from a bedding plane within the Parachute Member shale directly below a small cliff of said Parachute shale in the middle of the drainage. Water originated from the bedding plane at a drop in the stream channel. There was no surface water flow at the time it was observed. Rather, there was a very shallow pocket of water at a ledge in the rock, with water streaks on the rock below. There was no development, and there is no water right on file with the State Engineer's Office. There was some evidence of wildlife usage but no vegetation due to its location

(bedrock). Temperature was 12.1°C, pH was 9.0, and conductivity was 2.1 mS. See photos 8 – 9 in **Appendix A**.

Klondike Canyon Seep 03

This site was a series of several small non-flowing seeps that appeared to issue from the channel bottom from fractures and bedding planes from within the Parachute Member. These seeps were all near in situ Parachute shale cliffs/ridges within the middle of the drainages.

Flow could not be measured at these seeps, and due to the lack of standing water parameters (temperature, pH, and conductivity) could not be measured. These seeps were not developed and appear to flow only seasonally. There is no water right record on file with the State Engineer's Office that appears to be associated with this location. There was some evidence of wildlife use but only minimal vegetation (tamarisk and sedges at some locations). Cliff habitat was present in the surrounding area. See photos 10 – 16 in **Appendix A**.

Indian Ridge - Parachute Creek Member of the Green River Formation

The Parachute Creek Formation is stratigraphically the highest geologic stratum in the inventory area with spring occurrences and has the greatest areal extent. It is moderately resistant, light- to medium-gray, light- to medium-brown, yellow, organic-rich marlstone, siltstone, sandstone, and oolitic limestone; and contains pods of the mineral nahcolite. The only seep found in the Indian Ridge Canyon system is in the Parachute Creek Member (Indian Ridge Canyon Seep 01), located in a tributary near the Project Area. Flow was not measured at this seep as an only damp and/or saturated condition was present. The expectation is that this seep is dependent upon local, annual recharge and may significantly diminish as the water year progresses.

Indian Ridge Canyon Seep 01

This seep discharged from a shale bedrock outcrop at a small drop in the stream channel. There was in situ bedding of the Parachute Member located immediately in the channel and on the surrounding drainage walls. There was no surface water flow. Just upstream of the seep in the channel bottom was an old pipe that may have been associated with some previous development. There is a water right record on file for this seep/spring with the State Enginee'rs Office. There was no riparian or wetland vegetation associated with the site, as water was confined to an area of the streambed with bedrock. See photo 18 in **Appendix A**.

The water right associated with this seep is number 49-586 has an 1861 priority date for a flow of 0.015 cfs. Geokinetics Spring is listed as the source. The designated beneficial use for this water is for stockwatering and "other" and the status of this water right is pending adjudication claim.

Indian Ridge – Alluvium/Residuum of the Parachute Creek Member

Four other potential seeps were found in this formation, one just up canyon from the seep described above, with the other three in the channel bottom downstream of McCoy

Reservoir. Flows were not measured at any of these seeps/springs as only damp and/or saturated conditions were present. The expectation is that these springs are dependent upon local, annual recharge and may significantly diminish as the water year progresses. Four additional potential seeps were found along the tributary labeled IR2 on **Figure 1** that should be revisited during the spring survey for further investigation.

The three seeps/springs found in the Indian Ridge Canyon system are located in the bottom of the northern most tributary channel draining from the northwest to the southeast into Indian Ridge Canyon (Reservoir Canyon).

Indian Ridge Canyon Seep 02

This seep occurred appeared from the bottom of the channel within the mixed alluvium/residuum of Parachute Creek. The wet spot was surrounded by a ring of precipitated mineral salts that was not identified at any of the other seep/springs. Formational outcropping was not identified at this site. Flow was not measured at this seep/spring as only damp and/or saturated conditions were present. The expectation is that this spring is dependent upon local, annual recharge and may significantly diminish as the water year progresses. There is no water right record on file with the State Engineer's Office that appears to be associated with this seep/spring. There was evidence of wildlife use; however there was no riparian development. See photo 19 in **Appendix A**.

Indian Ridge Canyon Seep 03

This is a series of seeps that discharge from the bottom of the channel between the mixed alluvium/residuum of the Parachute Creek and the Parachute Creek Member on the east side of the channel. Minor Parachute Creek shale units were observed above the saturated zone; however, most of these beds were not in situ. Flow was not measured at these seeps as only damp and/or saturated conditions were present. The expectation is that these seeps are dependent upon local, annual recharge and may significantly diminish as the water year progresses. There is no water right record on file with the State Engineer's Office that appears to be associated with this seep. There was no evidence of wildlife use, and no riparian development was present. See photos 20 – 21 in **Appendix A**.

Indian Ridge Canyon Seep 04

This is a non-flowing seep that discharged from the mixed alluvium/residuum of the Parachute Creek on the bottom, west side of the channel. The residuum consisted of weathered Parachute Creek shale. There was no evidence of in situ formation or bedding in the immediate vicinity of the site. Flow was not measured at this seep/spring as only damp and/or saturated conditions were present. The expectation is that this spring is dependent upon local, annual recharge and may significantly diminish as the water year progresses. There is no water right record on file with the State Engineer's Office that appears to be associated with this seep/spring. There was no evidence of wildlife use and no riparian development. See photo 22 in **Appendix A**.

Indian Ridge Canyon Seep 05

This occurrence issued from the west side of the channel within the mixed alluvium/residuum of the Parachute Creek and the Parachute Creek Member. In situ bedding of shale and siltstone was present within, above, and below the damp/saturated zone. Flow was not measured at this seep/spring as only damp and/or saturated conditions were present. The expectation is that this spring is dependent upon local, annual recharge and may significantly diminish as the water year progresses. There is no water right record on file with the State Engineer's Office that appears to be associated with this seep/spring. There was no evidence of wildlife use and no riparian development. See photos 23 – 24 in **Appendix A**.

Table 5 Seep and Springs Identified During the Fall 2012 Survey

Seep/Spring	Location	Photos	Description
Klondike Canyon Area			
Klondike Canyon Spring 01	39° 40' 57.60"' N 109° 21' 49.30" W	1 – 7	See description in text.
Klondike Canyon Seep 02	39° 41' 12.70" N 109° 21' 55.60" W	8 – 9	See description in text.
Klondike Canyon Seep 03A	39° 41' 31.20"' N 109° 21' 39.80" W	10 – 16	See description in text.
Klondike Canyon Seep 03B	39° 41' 33.09" N 109° 21' 45.73" W		
Klondike Canyon Seep 03C	39° 41' 31.65" N 109° 21' 40.76" W		
Klondike Canyon Seep 03D	39° 41' 30.45" N 109° 21' 36.07" W		
Klondike Canyon Seep 03E	39° 41' 29.02" N 109° 21' 32.75" W		
Klondike Canyon Seep 03F	39° 41' 30.50" N 109° 21' 33.70" W		
Potential Seep 01	39° 41' 32.50" N 109° 21' 47.00" W	17	An area of dry sedges up-canyon from the seeps described as Klondike Canyon Seep – 03. Area could be a seep that is dependent upon local, annual recharge and may significantly diminish as the water year progresses. There is no water right record on file with the State Engineer's Office that appears to be associated with this seep. There was no evidence of wildlife use. This area should be checked during the spring survey.
Indian Ridge Canyon Area			
Indian Ridge Canyon Seep 01	39° 39' 3.00" N 109° 23' 55.20" W	18	See description in text.
Potential Seep 02	39° 40' 19.02" N 109° 22' 08.53" W	19	These occurrences issued from the bottom of the channel between the mixed alluvium/colluvium and the Parachute Creek Formation on the east side of the channel. Only damp and/or saturated conditions were present. Areas could be seeps and/or springs that are dependent upon local, annual recharge and may significantly diminish as the water year progresses. There is no water right record on file with the State Engineer's Office associated with these seep/springs. There was no evidence of wildlife use. These areas should be checked during the spring survey.
Potential Seep 03A	39° 40' 07.06" N 109° 21' 43.32" W	20	
Potential Seep 03B	39° 40' 04.55" N 109° 21' 43.78" W	21	
Potential Seep 04	39° 39' 57.66" N 109° 21' 43.68" W	22	
Potential Seep 05	39° 39' 6.00" N 109° 24' 7.20" W	23 – 24	Dirt on side slope was wet, with a very muddy area at the base in the stream bottom – possible from precipitation – but was wet enough and had evidence of significant wildlife usage. There is no water right record on file with the State Engineers Office associated with this seep. This area should be checked during the spring survey.

6.0 SUMMARY

JBR conducted a seep and spring survey for RLR in late fall in the vicinity of the Southwest #1 Project Area. The intent of the survey was to obtain initial baseline water resources data. Seep and spring resources were sparse in the inventory area, with one spring, two individual seeps, and one large seep complex noted. In addition, five potential seeps were identified. **Table 6** provides a summary of the data collected. There may be additional springs issuing from the channel bottom of the Klondike and Indian Ridge Canyon drainages and their tributaries that were not identified due to the late fall survey date. All identified sites should be revisited during a spring 2013 survey, and main channel reaches should also be reexamined.

Table 6 Seep and Springs Summary Table

Seep/Spring	Geologic Formation/Elevation (feet)	Flow (gpm)	pH (standard units)	Conductivity (mS)	Temperature (°C)
Klondike Canyon Spring 01	Parachute Creek/5,950	0.28	8.11	3.0	8.0
Klondike Canyon Seep 02	Parachute Creek/6,040	NA	9.0	2.1	12.1
Klondike Canyon Seep 03	Parachute Creek/6,000	NA	NA	NA	NA
Indian Ridge Canyon Seep 01	Parachute Creek/6,510	NA	NA	NA	NA
Potential Seep 01	Alluvium/Residuum of Parachute Creek /6,000	NA	NA	NA	NA
Potential Seep 02	Alluvium/Residuum of Parachute Creek /6,200	NA	NA	NA	NA
Potential Seep 03	Alluvium/Residuum of Parachute Creek /6,160	NA	NA	NA	NA
Potential Seep 04	Alluvium/Residuum of Parachute Creek /6,120	NA	NA	NA	NA
Potential Seep 05	Parachute Creek and Alluvium/Residuum of Parachute Creek /6,510	NA	NA	NA	NA

7.0 REFERENCES

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APPENDIX A

Photographs

Photo 1 Klondike Canyon Spring – 01 looking down canyon

Photo 2 Klondike Canyon Spring – 01 looking up canyon

Photo 3 **Klondike Canyon Spring – 01 downstream extent of initial flow**

Photo 4 **Klondike Canyon Spring – 01 area of surface water flow downstream of the initial spring run**

Photo 5 Klondike Canyon Spring – 01 frozen pool downstream of spring

Photo 6 Klondike Canyon Spring – 01 area of frozen flow downstream of pool

Photo 7 Klondike Canyon Spring – 01 wet area at downstream end of flow

Photo 8 Klondike Canyon Seep – 02

Photo 9 Klondike Canyon Seep – 02

Photo 10 Klondike Canyon Seep – 03

Photo 11 Klondike Canyon Seep – 03

Photo 12 Klondike Canyon Seep – 03

Photo 13 Klondike Canyon Seep – 03

Photo 14 Klondike Canyon Seep – 03

Photo 15 Klondike Canyon Seep – 03

Photo 16 Klondike Canyon Seep – 03

Photo 17 Potential Seep – 01

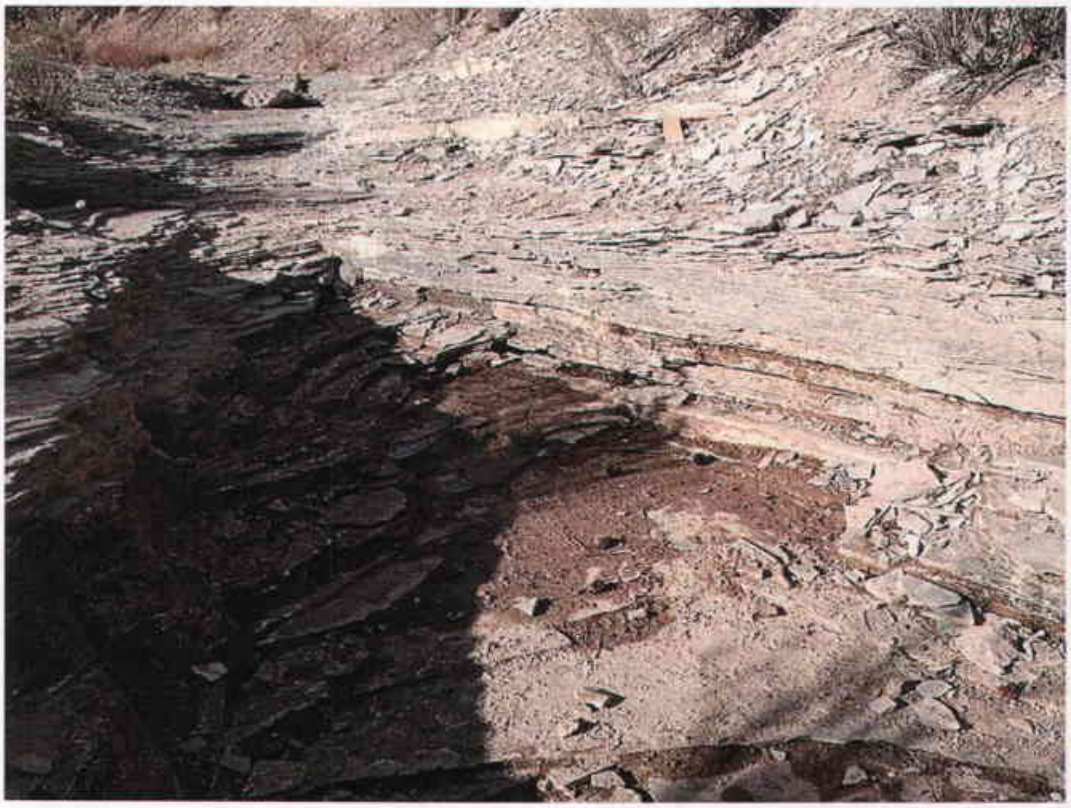

Photo 18 Indian Ridge Canyon Seep – 01

Photo 19 Potential Seep – 02

Photo 20 Potential Seep – 03A

Photo 21 Potential Seep – 03B

Photo 22 Potential Seep – 04

Photo 23 Potential Seep – 05

Photo 24 Potential Seep – 05

INTERIM SUMMARY OF AQUIFER TEST RESULTS
FINAL IN PROCESS BY NORWEST

1 WELL TEST ANALYSIS

Hydraulic tests were performed at the Red Leaf Seep Ridge site (the Site) to measure hydraulic properties, of the intervals screened, by 7 monitoring wells installed at the Site. Observations recorded during monitoring well development and sampling indicated that the screened intervals were relatively tight and yielded little water. In all cases it was not possible to maintain a reasonable, consistent pumping rate or the wells easily pumped dry.

Table 1 compares the pumped volume with a calculated well bore volume prior to the test start, including water in the void space of the sand pack for each well. A conservative porosity value of 0.3 was used to calculate the volume of water in the sand pack in the well annulus. In all pumping cases, the pumped volumes were limited. For three of the monitoring wells (DG-3, DG-4s and DG-5s) the pumped volume was less than the volume of water present in the well bore. For those wells where the pumped volume exceeded the volume in the well bore (DG-2s, UG-1s and H-1), the short duration of pumping and the relative volume of water withdrawn from the well are unlikely adequately stress the interval screened by each well. Therefore these pumping data are unlikely to be useful for measuring hydraulic properties for the screened intervals. However, the water level recovery data for each test represented the inflow of water from the formation into the well. Based on those observations, it was determined that an appropriate test of the hydraulic properties was to analyze the water level recovery after rapidly pumping the wells dry as the recovery portion of a slug test After pumping the 7 monitoring wells dry, recovery data from six of the monitoring wells yielded data adequate for analysis of groundwater zone properties.

All analyses were performed with AQTESOLV 4.5 software. Although several analytical methods were applied to the data, the Hvorslev (1951) method was used in all cases.

1.1 WELL DG-2S

The DG-2s well was pumped on 1/3/2013 for 8 minutes yielding 73 gallons and allowed to recover for approximately 13 days. The well did not fully recover from the test in that time, recovering to approximately 60% of the pre-pumping water level. The volume of pumping from this well indicates that there was some contribution of water from the interval screened by this monitoring well. Recovery data are very good and yield an excellent fit. Hydraulic conductivity was estimated as 4.57×10^{-7} ft/min, or 6.58×10^{-4} ft/day.

1.2 WELL DG-3

The DG-3 well was pumped on 1/17/2013 for 2 minutes yielding 28 gallons and allowed to recover for approximately 7 days. The well did not fully recover from the test in that time, recovering to approximately 50% of the pre-pumping water level. Recovery data are very good and yield an excellent fit. Hydraulic conductivity was estimated as 2.80×10^{-7} ft/min, or 4.03×10^{-4} ft/day.

1.3 WELL DG-4S

The DG-4s well was pumped on 12/17/2012 for 23 minutes yielding 79 gallons and allowed to recover for approximately 17 days. DG-4s well did not fully recover from the test in that time, recovering to approximately 85% of the pre-pumping water level. Recovery data are good and yield a good fit. Hydraulic conductivity was estimated as 9.83×10^{-7} ft/min, or 1.42×10^{-3} ft/day.

1.4 WELL DG-5S

The DG-5s well was pumped on 12/17/2012 for 9 minutes yielding 44 gallons and allowed to recover for approximately 15 days. The well reached near full recovery after 13 days with water level in the well recovering to within 0.1 feet of pre-pumping conditions. Recovery data indicate a delayed response to drawdown of the well, shown by the increase in the rate of recovery starting approximately 8 days into the recovery period. Water level recovery in the well at that point was 90% of pre-test levels. Hydraulic conductivity estimation was based on recovery prior to the point of delayed response and was estimated as 1.90×10^{-6} ft/min, or 2.74×10^{-3} ft/day.

1.5 WELL H-1

The H-1 well was pumped on 1/17/2013 for 3 minutes yielding 28 gallons and allowed to recover for just less than 8 days. H-1 well did not fully recover from the test in that time, recovering to approximately 20% of the pre-pumping water level. Recovery data are good and yield a good fit. Hydraulic conductivity was estimated as 7.64×10^{-8} ft/min, or 1.04×10^{-4} ft/day.

1.6 WELL UG-1S

The UG-1s well was pumped on 1/17/2013 for 9.5 minutes yielding 109 gallons and allowed to recover for approximately 7 days. The well did not fully recover from the test in that time, recovering to approximately 57% of the pre-pumping conditions in the well. The volume of pumping from this well indicates that there was some contribution of water from the interval screened by the well. Recovery data indicate a reduction of recovery of the water level in the well, as indicated by the decrease in the rate of recovery after approximately 3.2 days. Such a decrease in the rate of recovery can be indicative of either a low permeability boundary condition or limited storage in the interval screened by the well. Hydraulic conductivity was estimated as 9.49×10^{-7} ft/min, or 1.37×10^{-3} ft/day.

TABLE 1
WELL BORE STORAGE VS. TOTAL VOLUME PUMPED

	DG-2s	DG-3	DG-4s	DG-5s	H-1	UG-1s
Total WBS, gal	57.7	28.7	94.1	61.3	23.1	50.1
Pumped vol, total gal	73.0	28.5	78.9	43.6	28.3	108.8

Appendix F

Monitor Well
Laboratory Analytical Reports

CHEMTECH-FORD
LABORATORIES

1/10/2013

Work Order: 1211744

Norwest Corporation

Attn: Tom Suchoski

136 East South Temple, 12th Floor

Salt Lake City, UT 84111

Client Service Contact: Linda Daniels 801.262.7299

The analyses presented on this report were performed in accordance with the National Environmental Laboratory Accreditation Program (NELAP) unless noted in the comments, flags or case narrative. If the report is to be used for regulatory compliance, it should be presented in its entirety, and not be altered.

NELAP ACCREDITED TNI LABORATORY

Approved By:

Dave Gayer, Laboratory Director

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211744-01

Name:	Norwest Corporation	***Sample Date:***	12/17/2012 12:30 PM
Sample Site:	Red Leaf	***Receipt Date:***	12/18/2012 2:43 PM
Comments:	DG-5s	***Sampler:***	Client
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	916	6.6	mg/L	12/28/2012 13:57	PNM	SM 2340B		
Inorganic								
Acidity	ND	250	mg/L	1/3/2013 16:00	RMC	SM 2310 B		APH
Alkalinity - Bicarbonate (HCO3)	5850	10.0	mg/L	1/3/2013 9:00	RMC	SM 2320 B	71-52-3	APH
Alkalinity - Carbonate (CO3)	4100	10.0	mg/L	1/3/2013 9:00	RMC	SM 2320 B	3812-32-6	APH
Alkalinity - CO2	7810	10.0	mg/L	1/3/2013 9:00	RMC	SM 2320 B	124-38-9	APH
Alkalinity - Hydroxide (OH)	ND	10.0	mg/L	1/3/2013 9:00	RMC	SM 2320 B	14280-30-9	APH
Alkalinity - Total (as CaCO3)	11600	10.0	mg/L	1/3/2013 9:00	RMC	SM 2320 B	CTFID10279	APH
Chloride	1500	100	mg/L	12/19/2012 10:00	TSM	EPA 300.0	16887-00-6	
Dissolved Organic Carbon	3000	500	mg/L	1/3/2013 12:00	PNM	SM 5310 C	CTFID10073	
Nitrate + Nitrite, Total	ND	0.1	mg/L	12/19/2012 9:30	KSL	SM 4500 NO3-F	CTFID10163	
Oil & Grease (HEM)	ND	5	mg/L	12/20/2012 9:00	KSL	EPA 1664A	CTFID10169	
Phosphorus, Total as P	7.9	0.50	mg/L	12/21/2012 8:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	78	5	mg/L	12/20/2012 8:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	20600	20	mg/L	12/24/2012 0:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	3110	500	mg/L	1/3/2013 12:00	PNM	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	45	4	mg/L	12/20/2012 15:30	RMC	SM 2540 D	CTFID10267	
Metals								
Aluminum, Dissolved	ND	0.2	mg/L	12/27/2012 18:52	PNM	EPA 200.7	7429-90-5	
Aluminum, Total	50.9	0.2	mg/L	12/28/2012 13:57	PNM	EPA 200.7	7429-90-5	
Antimony, Total	0.0760	0.0050	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	1.27	0.0050	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7440-38-2	
Barium, Total	2.11	0.025	mg/L	12/28/2012 13:57	PNM	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0050	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7440-41-7	
Calcium, Total	224	1.0	mg/L	12/28/2012 13:57	PNM	EPA 200.7	7440-43-9	
Cadmium, Total	0.0135	0.0020	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	0.0836	0.0050	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.310	0.0050	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7440-47-3	
Copper, Total	0.377	0.0100	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	0.11	0.10	mg/L	12/27/2012 18:52	PNM	EPA 200.7	7439-89-6	
Iron, Total	46.0	0.10	mg/L	12/28/2012 13:57	PNM	EPA 200.7	7439-89-6	
Lead, Total	0.155	0.0050	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7439-92-1	
Mercury, Total	ND	0.0002	mg/L	12/28/2012 14:40	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	86.9	1.0	mg/L	12/28/2012 13:57	PNM	EPA 200.7	7439-95-4	
Manganese, Dissolved	0.0640	0.0050	mg/L	12/28/2012 17:16	MJB	EPA 200.8	7439-96-5	
Manganese, Total	2.48	0.0050	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7439-96-5	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211744-01

Name:	**Norwest Corporation**	***Sample Date:***	12/17/2012 12:30 PM
Sample Site:	Red Leaf	***Receipt Date:***	12/18/2012 2:43 PM
Comments:	DG-5s	***Sampler:***	Client
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Nickel, Total	0.302	0.0050	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7440-02-0	
Potassium, Total	181	2.5	mg/L	12/28/2012 13:57	PNM	EPA 200.7	7440-09-7	
Selenium, Total	0.606	0.0050	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7782-49-2	
Silver, Total	0.013	0.005	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7440-22-4	
Sodium, Total	6190	50.0	mg/L	1/2/2013 17:59	PNM	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0020	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	0.335	0.0050	mg/L	12/21/2012 15:42	MJB	EPA 200.8	7440-62-2	
Zinc, Total	0.21	0.05	mg/L	12/28/2012 13:57	PNM	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	12/20/2012 17:26	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	ND	5.0	mg/L	12/24/2012 7:40	RB	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	0.009	0.002	mg/L	12/20/2012 17:26	PE	EPA 8260B	71-43-2	
Ethylbenzene	ND	0.005	mg/L	12/20/2012 17:26	PE	EPA 8260B	100-41-4	
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	12/20/2012 17:26	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	12/20/2012 17:26	PE	EPA 8260B	91-20-3	
Toluene	0.006	0.005	mg/L	12/20/2012 17:26	PE	EPA 8260B	108-88-3	
Xylenes, total	ND	0.005	mg/L	12/20/2012 17:26	PE	EPA 8260B	1330-20-7	

6100 South Stratler
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Certificate of Analysis

Lab Sample No.: 1211744-02

Name:	**Norwest Corporation**	***Sample Date:***	12/17/2012 3:30 PM
Sample Site:	Red Leaf	***Receipt Date:***	12/18/2012 2:43 PM
Comments:	DG-4s	***Sampler:***	Client
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	90.1	1.3	mg/L	12/28/2012 14:01	PNM	SM 2340B		
Inorganic								
Acidity	ND	250	mg/L	1/3/2013 16:00	RMC	SM 2310 B		APH
Alkalinity - Bicarbonate (HCO3)	11900	10.0	mg/L	1/3/2013 9:00	RMC	SM 2320 B	71-52-3	APH
Alkalinity - Carbonate (CO3)	10400	10.0	mg/L	1/3/2013 9:00	RMC	SM 2320 B	3812-32-6	APH
Alkalinity - CO2	16900	10.0	mg/L	1/3/2013 9:00	RMC	SM 2320 B	124-38-9	APH
Alkalinity - Hydroxide (OH)	ND	10.0	mg/L	1/3/2013 9:00	RMC	SM 2320 B	14280-30-9	APH
Alkalinity - Total (as CaCO3)	27100	10.0	mg/L	1/3/2013 9:00	RMC	SM 2320 B	CTFID10279	APH
Chloride	8300	100	mg/L	12/19/2012 10:00	TSM	EPA 300.0	16887-00-6	
Dissolved Organic Carbon	2000	500	mg/L	1/3/2013 12:00	PNM	SM 5310 C	CTFID10073	
Nitrate + Nitrite, Total	0.8	0.1	mg/L	12/19/2012 9:30	KSL	SM 4500 NO3-F	CTFID10163	
Oil & Grease (HEM)	ND	5	mg/L	12/20/2012 9:00	KSL	EPA 1664A	CTFID10169	
Phosphorus, Total as P	6.7	0.50	mg/L	12/21/2012 8:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	660	20	mg/L	12/20/2012 8:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	58600	20	mg/L	12/24/2012 0:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	2340	500	mg/L	1/3/2013 12:00	PNM	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	672	20	mg/L	12/20/2012 15:30	RMC	SM 2540 D	CTFID10267	
Metals								
Aluminum, Dissolved	ND	0.2	mg/L	12/27/2012 18:55	PNM	EPA 200.7	7429-90-5	
Aluminum, Total	0.9	0.05	mg/L	12/28/2012 14:01	PNM	EPA 200.7	7429-90-5	
Antimony, Total	0.0006	0.0005	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	0.0310	0.0005	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7440-38-2	
Barium, Total	0.335	0.005	mg/L	12/28/2012 14:01	PNM	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0005	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7440-41-7	
Calcium, Total	19.6	0.2	mg/L	12/28/2012 14:01	PNM	EPA 200.7	7440-43-9	
Cadmium, Total	ND	0.0002	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	ND	0.0005	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.0138	0.0005	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7440-47-3	
Copper, Total	0.0295	0.0010	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	0.19	0.10	mg/L	12/27/2012 18:55	PNM	EPA 200.7	7439-89-6	
Iron, Total	1.62	0.02	mg/L	12/28/2012 14:01	PNM	EPA 200.7	7439-89-6	
Lead, Total	0.0008	0.0005	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7439-92-1	
Mercury, Total	ND	0.0002	mg/L	12/28/2012 14:40	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	10.0	0.2	mg/L	12/28/2012 14:01	PNM	EPA 200.7	7439-95-4	
Manganese, Dissolved	0.0148	0.0050	mg/L	12/31/2012 13:01	MJB	EPA 200.8	7439-96-5	
Manganese, Total	0.0060	0.0005	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7439-96-5	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211744-02

Name:	**Norwest Corporation**	***Sample Date:***	12/17/2012 3:30 PM
Sample Site:	Red Leaf	***Receipt Date:***	12/18/2012 2:43 PM
Comments:	DG-4s	***Sampler:***	Client
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Nickel, Total	0.0031	0.0005	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7440-02-0	
Potassium, Total	118	0.5	mg/L	12/28/2012 14:01	PNM	EPA 200.7	7440-09-7	
Selenium, Total	0.0515	0.0005	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7782-49-2	
Silver, Total	ND	0.0005	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7440-22-4	
Sodium, Total	19000	50.0	mg/L	1/2/2013 18:03	PNM	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0002	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	0.0055	0.0005	mg/L	12/21/2012 15:45	MJB	EPA 200.8	7440-62-2	
Zinc, Total	0.06	0.01	mg/L	12/28/2012 14:01	PNM	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	12/20/2012 17:54	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	ND	5.0	mg/L	12/24/2012 8:07	RB	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	0.011	0.002	mg/L	12/20/2012 17:54	PE	EPA 8260B	71-43-2	
Ethylbenzene	0.003	0.005	mg/L	12/20/2012 17:54	PE	EPA 8260B	100-41-4	J
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	12/20/2012 17:54	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	12/20/2012 17:54	PE	EPA 8260B	91-20-3	
Toluene	0.009	0.005	mg/L	12/20/2012 17:54	PE	EPA 8260B	108-88-3	
Xylenes, total	0.007	0.005	mg/L	12/20/2012 17:54	PE	EPA 8260B	1330-20-7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

J = Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).

APH = The analysis was performed past the EPA recommended holding time.

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CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF CUSTODY

COMPANY: NORWEST
ADDRESS: 136 E So Temple
CITY/STATE/ZIP: SLC UT 8411
PHONE #: 801-539-0044 FAX:
CONTACT: Tom Suchoski PROJECT: Redleaf
EMAIL: TSuchoski@Norwestcorp.com

BILLING ADDRESS:
BILLING CITY/STATE/ZIP:
PURCHASE ORDER #:

TURNAROUND REQUIRED: *
* Expedited turnaround subject to additional charge

CHEMTECH-FORD LABORATORIES

___ Mark 'X' here if you want a copy sent to DEQ Division of Drinking Water

MATRIX: DW = Drinking Water; WW = Wastewater; W = Water; S = Soil; SO = Solid; SL = Sludge; O = Other

ANALYTICAL TESTS REQUESTED: VOC; DRO; TPH; BTEX; Oil & Grease; Total Metals; Dissolved Metals; See attached list; FIELD: Residual Chlorine; Total Coliform + E. coli (Present/Absent); Total Coliform + E. coli (Enumerated); HPC (Plate Count); E. coli only

Bacteriological: R = Routine; I = Investigative; TG = Trigger Source; CO = Confirmation

REPEAT: OR = Original Location; UP = Upstream; DN = Downstream

Lab ID #	SAMPLE CENTIFICATION	SAMPLE DATE	SAMPLE TIME	Drinking Water FACILITY ID	Repeat (Fail #)	SYSTEM #
11744 -01	1 DG-5S	12-17-12	12:30			
-02	2 DG-4S	12-17-12	15:30			
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					

Sampled by: [print] Sampled by: [signature]

ON ICE NOT ON ICE

Special instructions: * Diss. metals run on lab-filtered sample - not field filtered sampl
Per Tom S. ad 12/19/12

Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time
	12/18/12 14:43		12/18/12 1443
Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time
Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time

CHEMTECH-FORD 6100 South Stratler Street (380 West) Murray, UT 84107 Phone: 801-262-7299 FAX: 801-262-7378 www.chemtechford.com

TABLE 1

Preliminary Water Quality Laboratory Analytes

Analytes

Acidity	Hardness	Total Suspended Solids
Alkalinity	Nitrate + Nitrite	Total Dissolved Solids
Chloride	Sulfate	

Total and Dissolved Metals

Aluminum	Iron	Silver
Dissolved Aluminum	Dissolved Iron	Sodium
Antimony	Lead	Thallium
Arsenic	Magnesium	Vanadium
Barium	Manganese	Zinc
Beryllium	Dissolved Manganese	
Cadmium	Mercury	
Calcium	Nickel	
Chromium	Potassium	
Cobalt	Phosphorous	
Copper	Selenium	

Age
H_2 and O_2 Ratios

Organics
Total Organic Carbon (TOC)
Dissolved Organic Carbon (DOC)
Oil and Grease
Total Petroleum Hydrocarbons (TPH)
Benzene, Toluene, Ethylbenzene, and Xylene Aromatic compounds (BTEX)

Additional compounds that could be sampled for, if required:

Oil Range Organics (ORO)

CHEMTECH-FORD LABORATORIES

Sample Receipt Checklist

Lab ID #: 11744

Delivery Method: (circle one)

UPS FedEX USPS

(Walk-In) Courier Chemtech

Sample(s) sealed: Yes / (No)

Appropriate container/preserve: (Yes) / No

Temperature 3 C°

Comments:

G = 250 mL amber.

	Lab ID #	Bottle Type	Lot # (preservative)	No. of Subsample(s)	Preserved by client / third party	Preserved in Receiving/Laboratory	Vials submitted with headspace	Sample submitted past hold time	Filtered by client in field
1	01-02	AG							
2		O	903						
3		N	931						
4		M	922						
5		M	922						X
6		G							
7		W1-3	921						
8		T1-3	890						
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

Bottle Type

Plastic		Glass	
A-	Plastic Unpreserved	D-	625 ($Na_2S_2O_3$)
B-	Miscellaneous Plastic	G-	Glass Unpreserved
C-	Cyanide Qt (NaOH)	H-	HAAs (NH_4Cl)
F-	Sulfide Qt (NaOH/Zn Acetate)	J-	508/515/525 (Na_2SO_3)
M-	Metals Pint (HNO_3)	O-	Oil & Grease (1:1 HCl)
N-	Nutrient Pint (H_2SO_4)	P-	Phenols (H_2SO_4)
R-	Radiological Gallon (HNO_3)	T-	TOC/TOX (H_3PO_4)
S-	Sludge Cups/Tubs	U-	531 (MCAA, $Na_2S_2O_3$)
Q-	Plastic Bags	V-	524/THMs (Ascorbic Acid)
E-	Coliform/Ecoli	W-	8260 (1:1 HCl)
Additional Volumes		X-	Vial Unpreserved
Q- quart	1/2pt- half pint	Y-	624/504 ($Na_2S_2O_3$)
P- pint	1/2- half gallon	Z-	Miscellaneous Glass

CHEMTECH-FORD
LABORATORIES

1/21/2013

Work Order: 1300094

Norwest Corporation

Attn: Tom Suchoski

136 East South Temple, 12th Floor

Salt Lake City, UT 84111

Client Service Contact: Linda Daniels 801.262.7299

The analyses presented on this report were performed in accordance with the National Environmental Laboratory Accreditation Program (NELAP) unless noted in the comments, flags or case narrative. If the report is to be used for regulatory compliance, it should be presented in its entirety, and not be altered.

NELAP ACCREDITED TNI LABORATORY

Approved By: Dave Gayer, Laboratory Director

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300094-01

Name: Norwest Corporation
Sample Site: Red Leaf
Comments: DG-4D
Sample Matrix: Water

Sample Date: 1/3/2013 1:00 PM
Receipt Date: 1/4/2013 9:30 AM
Sampler: Tom Suchoski
Project: Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	36.1	13.2	mg/L	1/14/2013 20:38	PNM	SM 2340B		
Inorganic								
Acidity	ND	5.0	mg/L	1/14/2013 10:00	RMC	SM 2310 B		
Alkalinity - Bicarbonate (HCO3)	21100	1.0	mg/L	1/10/2013 14:00	RMC	SM 2320 B	71-52-3	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/10/2013 14:00	RMC	SM 2320 B	3812-32-6	
Alkalinity - CO2	11100	1.0	mg/L	1/10/2013 14:00	RMC	SM 2320 B	124-38-9	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/10/2013 14:00	RMC	SM 2320 B	14280-30-9	
Alkalinity - Total (as CaCO3)	17300	1.0	mg/L	1/10/2013 14:00	RMC	SM 2320 B	CTFID10279	
Chloride	4900	100	mg/L	1/4/2013 16:00	TSM	EPA 300.0	16887-00-6	
Conductivity	10900	3	umho/cm	1/16/2013 15:30	BCA	EPA 120.1	CTFID10052	
Dissolved Organic Carbon	4000	500	mg/L	1/16/2013 11:00	BCA	SM 5310 C	CTFID10073	
Nitrate + Nitrite, Total	ND	0.1	mg/L	1/11/2013 14:00	KSL	SM 4500 NO3-F	CTFID10163	
Oil & Grease (HEM)	33	5	mg/L	1/7/2013 9:30	KSL	EPA 1664A	CTFID10169	
pH	9.9	0.1	pH Units	1/4/2013 12:00	RMC	SM 4500 H-B	CTFID10187	SPH
Phosphorus, Total as P	11	0.50	mg/L	1/10/2013 14:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	200	100	mg/L	1/8/2013 9:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	36100	100	mg/L	1/7/2013 9:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	4300	500	mg/L	1/16/2013 11:00	BCA	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	102	10	mg/L	1/8/2013 9:00	RMC	SM 2540 D	CTFID10267	
Metals								
Aluminum, Dissolved	ND	0.5	mg/L	1/14/2013 16:53	PNM	EPA 200.7	7429-90-5	
Aluminum, Total	ND	0.5	mg/L	1/14/2013 20:38	PNM	EPA 200.7	7429-90-5	
Antimony, Total	ND	0.0050	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	0.0172	0.0050	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7440-38-2	
Barium, Total	0.380	0.050	mg/L	1/14/2013 20:38	PNM	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0050	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7440-41-7	
Calcium, Total	4.3	2.0	mg/L	1/14/2013 20:38	PNM	EPA 200.7	7440-43-9	
Cadmium, Total	ND	0.0020	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	ND	0.0050	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.0115	0.0050	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7440-47-3	
Copper, Total	ND	0.0100	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	ND	0.20	mg/L	1/14/2013 16:53	PNM	EPA 200.7	7439-89-6	
Iron, Total	0.53	0.20	mg/L	1/14/2013 20:38	PNM	EPA 200.7	7439-89-6	
Lead, Total	ND	0.0050	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7439-92-1	
Mercury, Total	ND	0.0002	mg/L	1/9/2013 10:00	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	6.1	2.0	mg/L	1/14/2013 20:38	PNM	EPA 200.7	7439-95-4	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300094-01

Name:	**Norwest Corporation**	***Sample Date:***	1/3/2013 1:00 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/4/2013 9:30 AM
Comments:	DG-4D	***Sampler:***	Tom Suchoski
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Manganese, Dissolved	0.144	0.0050	mg/L	1/11/2013 15:24	MJB	EPA 200.8	7439-96-5	
Manganese, Total	0.0186	0.0050	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7439-96-5	
Nickel, Total	ND	0.0050	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7440-02-0	
Potassium, Total	28.1	5.0	mg/L	1/14/2013 20:38	PNM	EPA 200.7	7440-09-7	
Selenium, Total	0.0354	0.0050	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7782-49-2	
Silver, Total	ND	0.005	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7440-22-4	
Sodium, Total	10100	5.0	mg/L	1/14/2013 20:38	PNM	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0020	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	ND	0.0050	mg/L	1/11/2013 12:55	MJB	EPA 200.8	7440-62-2	
Zinc, Total	ND	0.10	mg/L	1/14/2013 20:38	PNM	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	1/8/2013 23:54	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	ND	5.0	mg/L	1/7/2013 10:34	MAH	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	0.008	0.002	mg/L	1/8/2013 23:54	PE	EPA 8260B	71-43-2	
Ethylbenzene	0.002	0.005	mg/L	1/8/2013 23:54	PE	EPA 8260B	100-41-4	J
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	1/8/2013 23:54	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	1/8/2013 23:54	PE	EPA 8260B	91-20-3	
Toluene	0.031	0.005	mg/L	1/8/2013 23:54	PE	EPA 8260B	108-88-3	
Xylenes, total	0.014	0.005	mg/L	1/8/2013 23:54	PE	EPA 8260B	1330-20-7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300094-02

Name:	**Norwest Corporation**	***Sample Date:***	1/3/2013 3:30 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/4/2013 9:30 AM
Comments:	DG-2S	***Sampler:***	Tom Suchoski
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	88.7	13.2	mg/L	1/14/2013 20:42	PNM	SM 2340B		
Inorganic								
Acidity	ND	5.0	mg/L	1/14/2013 10:00	RMC	SM 2310 B		
Alkalinity - Bicarbonate (HCO3)	41900	1.0	mg/L	1/10/2013 14:00	RMC	SM 2320 B	71-52-3	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/10/2013 14:00	RMC	SM 2320 B	3812-32-6	
Alkalinity - CO2	20700	1.0	mg/L	1/10/2013 14:00	RMC	SM 2320 B	124-38-9	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/10/2013 14:00	RMC	SM 2320 B	14280-30-9	
Alkalinity - Total (as CaCO3)	34300	1.0	mg/L	1/10/2013 14:00	RMC	SM 2320 B	CTFID10279	
Chloride	3000	100	mg/L	1/4/2013 16:00	TSM	EPA 300.0	16887-00-6	
Conductivity	8900	6	umho/cm	1/16/2013 15:30	BCA	EPA 120.1	CTFID10052	
Dissolved Organic Carbon	2700	500	mg/L	1/16/2013 11:00	BCA	SM 5310 C	CTFID10073	
Nitrate + Nitrite, Total	ND	0.1	mg/L	1/11/2013 14:00	KSL	SM 4500 NO3-F	CTFID10163	
Oil & Grease (HEM)	6	5	mg/L	1/7/2013 9:30	KSL	EPA 1664A	CTFID10169	
pH	9.9	0.1	pH Units	1/4/2013 12:00	RMC	SM 4500 H-B	CTFID10187	SPH
Phosphorus, Total as P	20	0.50	mg/L	1/10/2013 14:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	ND	100	mg/L	1/8/2013 9:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	47000	100	mg/L	1/7/2013 9:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	3000	500	mg/L	1/16/2013 11:00	BCA	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	240	10	mg/L	1/8/2013 9:00	RMC	SM 2540 D	CTFID10267	
Metals								
Aluminum, Total	1.2	0.5	mg/L	1/14/2013 20:42	PNM	EPA 200.7	7429-90-5	
Antimony, Total	ND	0.0050	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	0.0322	0.0050	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7440-38-2	
Barium, Total	0.380	0.050	mg/L	1/14/2013 20:42	PNM	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0050	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7440-41-7	
Calcium, Total	17.0	2.0	mg/L	1/14/2013 20:42	PNM	EPA 200.7	7440-43-9	
Cadmium, Total	ND	0.0020	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	ND	0.0050	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.0111	0.0050	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7440-47-3	
Copper, Total	ND	0.0100	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	1.14	0.20	mg/L	1/14/2013 16:58	PNM	EPA 200.7	7439-89-6	
Iron, Total	2.86	0.20	mg/L	1/14/2013 20:42	PNM	EPA 200.7	7439-89-6	
Lead, Total	ND	0.0050	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7439-92-1	
Mercury, Total	0.0006	0.0002	mg/L	1/9/2013 10:00	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	11.3	2.0	mg/L	1/14/2013 20:42	PNM	EPA 200.7	7439-95-4	
Manganese, Dissolved	0.0380	0.0050	mg/L	1/11/2013 15:27	MJB	EPA 200.8	7439-96-5	

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Certificate of Analysis

Lab Sample No.: 1300094-02

Name:	**Norwest Corporation**	***Sample Date:***	1/3/2013 3:30 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/4/2013 9:30 AM
Comments:	DG-2S	***Sampler:***	Tom Suchoski
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Manganese, Total	0.0121	0.0050	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7439-96-5	
Nickel, Total	0.0068	0.0050	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7440-02-0	
Potassium, Total	60.5	5.0	mg/L	1/14/2013 20:42	PNM	EPA 200.7	7440-09-7	
Selenium, Total	0.0174	0.0050	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7782-49-2	
Silver, Total	ND	0.005	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7440-22-4	
Sodium, Total	17200	500	mg/L	1/15/2013 16:18	PNM	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0020	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	0.0058	0.0050	mg/L	1/11/2013 12:58	MJB	EPA 200.8	7440-62-2	
Zinc, Total	ND	0.10	mg/L	1/14/2013 20:42	PNM	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	1/9/2013 0:51	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	ND	5.0	mg/L	1/7/2013 11:01	MAH	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	0.007	0.002	mg/L	1/9/2013 0:51	PE	EPA 8260B	71-43-2	
Ethylbenzene	ND	0.005	mg/L	1/9/2013 0:51	PE	EPA 8260B	100-41-4	
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	1/9/2013 0:51	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	1/9/2013 0:51	PE	EPA 8260B	91-20-3	
Toluene	0.023	0.005	mg/L	1/9/2013 0:51	PE	EPA 8260B	108-88-3	
Xylenes, total	0.003	0.005	mg/L	1/9/2013 0:51	PE	EPA 8260B	1330-20-7	J

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801-262-7299 Office

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Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SPH = Sample submitted past method specified holding time.

J = Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).

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CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF CUSTODY

CHEMTECH-FORD LABORATORIES

COMPANY: NORWEST
ADDRESS: 136 E SOUTH TEMPLE
CITY/STATE/ZIP: SLC UT 84101
PHONE #: 801-539-8044 FAX:
CONTACT: TOM SUCHOSKI PROJECT:
EMAIL: TSUCHOSKI@NORWEST CORP.COM

BILLING ADDRESS: SAME
BILLING CITY/STATE/ZIP:
PURCHASE ORDER #: RED LEAF 187-15

TURNAROUND REQUIRED:*
* Expedited turnaround subject to additional charge

___ Mark "X" here if you want a copy sent to DEQ Division of Drinking Water.

MATRIX: DW = Drinking Water; WW = Wastewater; W = Water; S = Soil; SO = Solid; SL = Sludge; O = Other

ANALYTICAL TESTS REQUESTED: 14 COND - SP COND; SEE NORWEST LIST - ENTERED 10 1 12; FIELD: Residual Chlorine; Total Coliform + E. coli (Present/Absent); Total Coliform + E. coli (Enumerated); HPC (Plate Count); E. coli only

Bacteriological: R = Routine; I = Investigative; TG = Trigger Source; CO = Confirmation

REPEAT: OR = Original Location; UP = Upstream; DN = Downstream

Lab ID #		SAMPLE IDENTIFICATION	SAMPLE DATE	SAMPLE TIME	Drinking Water FACILITY ID	Repeat (Fail #)	SYSTEM #
00094 -01	1	DG-4D	1/3/13	13:00			
-02	2	DG-2S	1/3/13	15:30			
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						

Sampled by: [print] TJS Sampled by: [signature]

ON ICE NOT ON ICE

Special Instructions:

Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time
	1/4/13 9:30		1/4/13 9:30
Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time
Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time

Payment Terms are net 30 days OAC. 1.5% interest charge per month (18% per annum). Client agrees to pay collection costs and attorney's fees.

TABLE 1

Preliminary Water Quality Laboratory Analytes

Analytes

Acidity	Hardness	Total Suspended Solids
Alkalinity	Nitrate + Nitrite	Total Dissolved Solids
Chloride	Sulfate	

Total and Dissolved Metals

Aluminum	Iron	Silver
Dissolved Aluminum	Dissolved Iron	Sodium
Antimony	Lead	Thallium
Arsenic	Magnesium	Vanadium
Barium	Manganese	Zinc
Beryllium	Dissolved Manganese	
Cadmium	Mercury	
Calcium	Nickel	
Chromium	Potassium	
Cobalt	Phosphorous	
Copper	Selenium	

Age
H_2 and O_2 Ratios

Organics
Total Organic Carbon (TOC)
Dissolved Organic Carbon (DOC)
Oil and Grease
Total Petroleum Hydrocarbons (TPH)
Benzene, Toluene, Ethylbenzene, and Xylene Aromatic compounds (BTEX)

Additional compounds that could be sampled for, if required:

Oil Range Organics (ORO)

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Sample Receipt Checklist

Lab ID #: 000914

Delivery Method: (circle one)

UPS FedEX USPS

(Walk-In) Courier Chemtech

Sample(s) sealed: Yes / No

Appropriate container/preserve: Yes / No

Temperature 1 C°

	Lab ID #	Bottle Type	Lot # (preservative)	No. of Subsample(s)	Preserved by client / third party	Preserved in Receiving/Laboratory	Vials submitted with headspace	Sample submitted past hold time	Filtered by client in field
1	01-02	AQ		2					
2		O	903						
3		G							
4		W1-3	921						
5		T1-3	933						
6		N	931						
7		M	937						
8		M	937						X
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

Comments:

Bottle Type	
Plastic	**Glass**
A- Plastic Unpreserved	D- 625 ($Na_2S_2O_3$)
B- Miscellaneous Plastic	G- Glass Unpreserved
C- Cyanide Qt (NaOH)	H- HAAs (NH_4Cl)
F- Sulfide Qt (NaOH/Zn Acetate)	J- 508/515/525 (Na_2SO_3)
M- Metals Pint (HNO_3)	O- Oil & Grease (1:1 HCl)
N- Nutrient Pint (H_2SO_4)	P- Phenols (H_2SO_4)
R- Radiological Gallon (HNO_3)	T- TOC/TOX (H_3PO_4)
S- Sludge Cups/Tubs	U- 531 (MCAA, $Na_2S_2O_3$)
Q- Plastic Bags	V- 524/THMs (Ascorbic Acid)
E- Coliform/Ecoli	W- 8260 (1:1 HCl)
Additional Volumes	X- Vial Unpreserved
Q- quart 1/2pt- half pint	Y- 624/504 ($Na_2S_2O_3$)
P- pint 1/2- half gallon	Z- Miscellaneous Glass

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2/6/2013

Work Order: 1300514

Norwest Corporation

Attn: Tom Suchoski

136 East South Temple, 12th Floor

Salt Lake City, UT 84111

Client Service Contact: Linda Daniels 801.262.7299

The analyses presented on this report were performed in accordance with the National Environmental Laboratory Accreditation Program (NELAP) unless noted in the comments, flags or case narrative. If the report is to be used for regulatory compliance, it should be presented in its entirety, and not be altered.

NELAP ACCREDITED TNI LABORATORY

Approved By:

Dave Gayer, Laboratory Director

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300514-01

Name: Norwest Corporation
Sample Site: Red Leaf
Comments: H1
Sample Matrix: Water

Sample Date: 1/16/2013 2:50 PM
Receipt Date: 1/18/2013 1:57 PM
Sampler: Norwest
Project: Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	24.0	13.2	mg/L	1/22/2013 20:41	MJB	SM 2340B		
Inorganic								
Acidity	ND	50.0	mg/L	1/29/2013 13:30	RMC	SM 2310 B		
Alkalinity - Bicarbonate (HCO3)	6430	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	71-52-3	
Alkalinity - Carbonate (CO3)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	3812-32-6	
Alkalinity - CO2	2970	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	124-38-9	
Alkalinity - Hydroxide (OH)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	14280-30-9	
Alkalinity - Total (as CaCO3)	5280	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	CTFID10279	
Chloride	800	100	mg/L	1/19/2013 11:00	TSM	EPA 300.0	16887-00-6	
Conductivity	10600	1	umho/cm	2/1/2013 17:20	IJH	EPA 120.1	CTFID10052	
Dissolved Organic Carbon	941	500	mg/L	2/1/2013 12:00	BCA	SM 5310 C	CTFID10073	
Nitrate + Nitrite, Total	ND	1.0	mg/L	2/1/2013 11:00	KSL	SM 4500 NO3-F	CTFID10163	A-01
Oil & Grease (HEM)	ND	5	mg/L	1/22/2013 9:00	SPH	EPA 1664A	CTFID10169	
pH	10.4	0.1	pH Units	1/18/2013 17:00	SPH	SM 4500 H-B	CTFID10187	SPH
Phosphorus, Total as P	2.1	0.50	mg/L	1/23/2013 20:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	200	100	mg/L	1/19/2013 11:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	9020	100	mg/L	1/23/2013 8:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	1090	500	mg/L	2/5/2013 13:20	BTK	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	46	4	mg/L	1/21/2013 13:12	IJH	SM 2540 D	CTFID10267	
Metals								
Aluminum, Dissolved	1.2	0.5	mg/L	1/29/2013 19:39	PNM	EPA 200.7	7429-90-5	
Aluminum, Total	1.7	0.5	mg/L	1/22/2013 20:41	MJB	EPA 200.7	7429-90-5	
Antimony, Total	0.0066	0.0050	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	0.121	0.0050	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7440-38-2	
Barium, Total	0.059	0.050	mg/L	1/22/2013 20:41	MJB	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0050	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7440-41-7	
Calcium, Total	4.7	2.0	mg/L	1/22/2013 20:41	MJB	EPA 200.7	7440-43-9	
Cadmium, Total	ND	0.0020	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	ND	0.0050	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.0456	0.0050	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7440-47-3	
Copper, Total	0.0517	0.0100	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	ND	0.20	mg/L	1/29/2013 19:39	PNM	EPA 200.7	7439-89-6	
Iron, Total	0.84	0.20	mg/L	1/22/2013 20:41	MJB	EPA 200.7	7439-89-6	
Lead, Total	0.0063	0.0050	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7439-92-1	
Mercury, Total	0.0014	0.0002	mg/L	1/23/2013 12:00	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	3.0	2.0	mg/L	1/22/2013 20:41	MJB	EPA 200.7	7439-95-4	

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Certificate of Analysis

Lab Sample No.: 1300514-01

Name:	**Norwest Corporation**	***Sample Date:***	1/16/2013 2:50 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/18/2013 1:57 PM
Comments:	H1	***Sampler:***	Norwest
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Manganese, Dissolved	0.0074	0.0050	mg/L	1/28/2013 14:34	MJB	EPA 200.8	7439-96-5	
Manganese, Total	0.0286	0.0050	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7439-96-5	
Nickel, Total	0.0085	0.0050	mg/L	1/23/2013 13:16	MJB	EPA 200.8	7440-02-0	
Potassium, Total	16.5	5.0	mg/L	1/22/2013 20:41	MJB	EPA 200.7	7440-09-7	
Selenium, Total	0.0297	0.0050	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7782-49-2	
Silver, Total	ND	0.005	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7440-22-4	
Sodium, Total	3310	5.0	mg/L	1/22/2013 20:41	MJB	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0020	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	0.0494	0.0050	mg/L	1/22/2013 19:20	MJB	EPA 200.8	7440-62-2	
Zinc, Total	ND	0.10	mg/L	1/22/2013 20:41	MJB	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	1/22/2013 15:22	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	ND	5.0	mg/L	1/23/2013 12:15	MAH	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	ND	0.002	mg/L	1/22/2013 15:22	PE	EPA 8260B	71-43-2	
Ethylbenzene	ND	0.005	mg/L	1/22/2013 15:22	PE	EPA 8260B	100-41-4	
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	1/22/2013 15:22	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	1/22/2013 15:22	PE	EPA 8260B	91-20-3	
Toluene	0.011	0.005	mg/L	1/22/2013 15:22	PE	EPA 8260B	108-88-3	
Xylenes, total	ND	0.005	mg/L	1/22/2013 15:22	PE	EPA 8260B	1330-20-7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300514-02

Name:	**Norwest Corporation**	***Sample Date:***	1/17/2013 11:30 AM
Sample Site:	Red Leaf	***Receipt Date:***	1/18/2013 1:57 PM
Comments:	DG-3S	***Sampler:***	Norwest
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	30.2	13.2	mg/L	1/22/2013 20:57	MJB	SM 2340B		
Inorganic								
Acidity	ND	50.0	mg/L	1/29/2013 13:30	RMC	SM 2310 B		
Alkalinity - Bicarbonate (HCO3)	15000	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	71-52-3	
Alkalinity - Carbonate (CO3)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	3812-32-6	
Alkalinity - CO2	9590	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	124-38-9	
Alkalinity - Hydroxide (OH)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	14280-30-9	
Alkalinity - Total (as CaCO3)	12300	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	CTFID10279	
Chloride	4300	100	mg/L	1/19/2013 11:00	TSM	EPA 300.0	16887-00-6	
Conductivity	27000	1	umho/cm	2/1/2013 17:20	IJH	EPA 120.1	CTFID10052	
Dissolved Organic Carbon	1140	500	mg/L	2/1/2013 12:00	BCA	SM 5310 C	CTFID10073	
Nitrate + Nitrite, Total	ND	1.0	mg/L	2/1/2013 11:00	KSL	SM 4500 NO3-F	CTFID10163	A-01
Oil & Grease (HEM)	7	5	mg/L	1/22/2013 9:00	SPH	EPA 1664A	CTFID10169	
pH	9.1	0.1	pH Units	1/18/2013 17:00	SPH	SM 4500 H-B	CTFID10187	SPH
Phosphorus, Total as P	4.0	0.50	mg/L	1/23/2013 20:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	200	100	mg/L	1/19/2013 11:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	23400	100	mg/L	1/23/2013 8:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	1250	500	mg/L	2/5/2013 13:20	BTK	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	40	7	mg/L	1/22/2013 16:00	IJH	SM 2540 D	CTFID10267	
Metals								
Aluminum, Dissolved	ND	0.5	mg/L	1/29/2013 19:43	PNM	EPA 200.7	7429-90-5	
Aluminum, Total	ND	0.5	mg/L	1/22/2013 20:57	MJB	EPA 200.7	7429-90-5	
Antimony, Total	0.0053	0.0050	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	0.131	0.0050	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7440-38-2	
Barium, Total	0.273	0.050	mg/L	1/22/2013 20:57	MJB	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0050	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7440-41-7	
Calcium, Total	2.5	2.0	mg/L	1/22/2013 20:57	MJB	EPA 200.7	7440-43-9	
Cadmium, Total	0.0060	0.0020	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	0.0139	0.0050	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.0428	0.0050	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7440-47-3	
Copper, Total	0.0896	0.0100	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	0.56	0.20	mg/L	1/29/2013 19:43	PNM	EPA 200.7	7439-89-6	
Iron, Total	0.63	0.20	mg/L	1/22/2013 20:57	MJB	EPA 200.7	7439-89-6	
Lead, Total	0.0076	0.0050	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7439-92-1	
Mercury, Total	ND	0.0002	mg/L	1/23/2013 12:00	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	5.8	2.0	mg/L	1/22/2013 20:57	MJB	EPA 200.7	7439-95-4	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300514-02

Name:	**Norwest Corporation**	***Sample Date:***	1/17/2013 11:30 AM
Sample Site:	Red Leaf	***Receipt Date:***	1/18/2013 1:57 PM
Comments:	DG-3S	***Sampler:***	Norwest
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Manganese, Dissolved	0.167	0.0050	mg/L	1/28/2013 14:38	MJB	EPA 200.8	7439-96-5	
Manganese, Total	0.200	0.0050	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7439-96-5	
Nickel, Total	0.0532	0.0050	mg/L	1/23/2013 13:18	MJB	EPA 200.8	7440-02-0	
Potassium, Total	31.2	5.0	mg/L	1/22/2013 20:57	MJB	EPA 200.7	7440-09-7	
Selenium, Total	0.142	0.0050	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7782-49-2	
Silver, Total	0.016	0.005	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7440-22-4	
Sodium, Total	8200	5.0	mg/L	1/22/2013 20:57	MJB	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0020	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	0.0424	0.0050	mg/L	1/22/2013 19:24	MJB	EPA 200.8	7440-62-2	
Zinc, Total	ND	0.10	mg/L	1/22/2013 20:57	MJB	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	1/22/2013 15:50	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	ND	5.0	mg/L	1/23/2013 12:42	MAH	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	0.004	0.002	mg/L	1/22/2013 15:50	PE	EPA 8260B	71-43-2	
Ethylbenzene	ND	0.005	mg/L	1/22/2013 15:50	PE	EPA 8260B	100-41-4	
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	1/22/2013 15:50	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	1/22/2013 15:50	PE	EPA 8260B	91-20-3	
Toluene	0.005	0.005	mg/L	1/22/2013 15:50	PE	EPA 8260B	108-88-3	
Xylenes, total	0.002	0.005	mg/L	1/22/2013 15:50	PE	EPA 8260B	1330-20-7	J

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300514-03

Name:	**Norwest Corporation**	***Sample Date:***	1/17/2013 1:15 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/18/2013 1:57 PM
Comments:	UG-1S	***Sampler:***	Norwest
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	31.4	13.2	mg/L	1/22/2013 21:02	MJB	SM 2340B		
Inorganic								
Acidity	ND	50.0	mg/L	1/29/2013 13:30	RMC	SM 2310 B		
Alkalinity - Bicarbonate (HCO3)	31100	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	71-52-3	
Alkalinity - Carbonate (CO3)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	3812-32-6	
Alkalinity - CO2	15000	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	124-38-9	
Alkalinity - Hydroxide (OH)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	14280-30-9	
Alkalinity - Total (as CaCO3)	25500	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	CTFID10279	
Chloride	1500	100	mg/L	1/19/2013 11:00	TSM	EPA 300.0	16887-00-6	
Conductivity	32700	1	umho/cm	2/1/2013 17:20	IJH	EPA 120.1	CTFID10052	
Dissolved Organic Carbon	1940	500	mg/L	2/1/2013 12:00	BCA	SM 5310 C	CTFID10073	
Nitrate + Nitrite, Total	ND	1.0	mg/L	2/1/2013 11:00	KSL	SM 4500 NO3-F	CTFID10163	A-01
Oil & Grease (HEM)	ND	5	mg/L	1/24/2013 10:00	SPH	EPA 1664A	CTFID10169	
pH	9.9	0.1	pH Units	1/18/2013 17:00	SPH	SM 4500 H-B	CTFID10187	SPH
Phosphorus, Total as P	15	0.50	mg/L	1/23/2013 20:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	ND	100	mg/L	1/19/2013 11:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	33400	100	mg/L	1/23/2013 8:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	2100	500	mg/L	2/5/2013 13:20	BTK	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	349	10	mg/L	1/22/2013 16:00	IJH	SM 2540 D	CTFID10267	
Metals								
Aluminum, Dissolved	ND	0.5	mg/L	1/29/2013 19:47	PNM	EPA 200.7	7429-90-5	
Aluminum, Total	ND	0.5	mg/L	1/22/2013 21:02	MJB	EPA 200.7	7429-90-5	
Antimony, Total	0.0059	0.0050	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	0.178	0.0050	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7440-38-2	
Barium, Total	0.335	0.050	mg/L	1/22/2013 21:02	MJB	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0050	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7440-41-7	
Calcium, Total	4.6	2.0	mg/L	1/22/2013 21:02	MJB	EPA 200.7	7440-43-9	
Cadmium, Total	ND	0.0020	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	0.0058	0.0050	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.0100	0.0050	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7440-47-3	
Copper, Total	0.0610	0.0100	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	0.44	0.20	mg/L	1/29/2013 19:47	PNM	EPA 200.7	7439-89-6	
Iron, Total	0.70	0.20	mg/L	1/22/2013 21:02	MJB	EPA 200.7	7439-89-6	
Lead, Total	ND	0.0050	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7439-92-1	
Mercury, Total	0.0003	0.0002	mg/L	1/23/2013 12:00	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	4.9	2.0	mg/L	1/22/2013 21:02	MJB	EPA 200.7	7439-95-4	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300514-03

Name:	**Norwest Corporation**	***Sample Date:***	1/17/2013 1:15 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/18/2013 1:57 PM
Comments:	UG-1S	***Sampler:***	Norwest
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Manganese, Dissolved	0.165	0.0050	mg/L	1/28/2013 14:41	MJB	EPA 200.8	7439-96-5	
Manganese, Total	0.181	0.0050	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7439-96-5	
Nickel, Total	0.0296	0.0050	mg/L	1/23/2013 13:20	MJB	EPA 200.8	7440-02-0	
Potassium, Total	38.7	5.0	mg/L	1/22/2013 21:02	MJB	EPA 200.7	7440-09-7	
Selenium, Total	0.0340	0.0050	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7782-49-2	
Silver, Total	ND	0.005	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7440-22-4	
Sodium, Total	13700	5.0	mg/L	1/22/2013 21:02	MJB	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0020	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	0.0373	0.0050	mg/L	1/22/2013 19:27	MJB	EPA 200.8	7440-62-2	
Zinc, Total	ND	0.10	mg/L	1/22/2013 21:02	MJB	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	1/22/2013 16:47	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	ND	5.0	mg/L	1/23/2013 13:09	MAH	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	0.006	0.002	mg/L	1/22/2013 16:47	PE	EPA 8260B	71-43-2	
Ethylbenzene	ND	0.005	mg/L	1/22/2013 16:47	PE	EPA 8260B	100-41-4	
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	1/22/2013 16:47	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	1/22/2013 16:47	PE	EPA 8260B	91-20-3	
Toluene	0.003	0.005	mg/L	1/22/2013 16:47	PE	EPA 8260B	108-88-3	J
Xylenes, total	ND	0.005	mg/L	1/22/2013 16:47	PE	EPA 8260B	1330-20-7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300514-04

Name:	**Norwest Corporation**	***Sample Date:***	1/17/2013 3:00 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/18/2013 1:57 PM
Comments:	DG-2D	***Sampler:***	Norwest
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	335	13.2	mg/L	1/22/2013 21:08	MJB	SM 2340B		
Inorganic								
Acidity	ND	50.0	mg/L	1/29/2013 13:30	RMC	SM 2310 B		
Alkalinity - Bicarbonate (HCO3)	27800	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	71-52-3	
Alkalinity - Carbonate (CO3)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	3812-32-6	
Alkalinity - CO2	13600	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	124-38-9	
Alkalinity - Hydroxide (OH)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	14280-30-9	
Alkalinity - Total (as CaCO3)	22800	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	CTFID10279	
Chloride	3900	100	mg/L	1/19/2013 11:00	TSM	EPA 300.0	16887-00-6	
Conductivity	35900	1	umho/cm	2/1/2013 17:20	IJH	EPA 120.1	CTFID10052	
Dissolved Organic Carbon	4160	500	mg/L	2/1/2013 12:00	BCA	SM 5310 C	CTFID10073	
Nitrate + Nitrite, Total	ND	1.0	mg/L	2/1/2013 11:00	KSL	SM 4500 NO3-F	CTFID10163	A-01
Oil & Grease (HEM)	8	5	mg/L	1/24/2013 10:00	SPH	EPA 1664A	CTFID10169	
pH	9.8	0.1	pH Units	1/18/2013 17:00	SPH	SM 4500 H-B	CTFID10187	SPH
Phosphorus, Total as P	12	0.50	mg/L	1/23/2013 20:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	300	100	mg/L	1/19/2013 11:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	39200	100	mg/L	1/23/2013 8:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	4240	500	mg/L	2/5/2013 13:20	BTK	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	2030	20	mg/L	1/22/2013 16:00	IJH	SM 2540 D	CTFID10267	
Metals								
Aluminum, Dissolved	ND	0.5	mg/L	1/29/2013 19:51	PNM	EPA 200.7	7429-90-5	
Aluminum, Total	19.1	0.5	mg/L	1/22/2013 21:08	MJB	EPA 200.7	7429-90-5	
Antimony, Total	0.0064	0.0050	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	0.183	0.0050	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7440-38-2	
Barium, Total	1.31	0.050	mg/L	1/22/2013 21:08	MJB	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0050	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7440-41-7	
Calcium, Total	75.4	2.0	mg/L	1/22/2013 21:08	MJB	EPA 200.7	7440-43-9	
Cadmium, Total	0.0034	0.0020	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	0.0120	0.0050	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.0392	0.0050	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7440-47-3	
Copper, Total	0.137	0.0100	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	0.57	0.20	mg/L	1/29/2013 19:51	PNM	EPA 200.7	7439-89-6	
Iron, Total	16.7	0.20	mg/L	1/22/2013 21:08	MJB	EPA 200.7	7439-89-6	
Lead, Total	0.0227	0.0050	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7439-92-1	
Mercury, Total	ND	0.0002	mg/L	1/23/2013 12:00	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	35.6	2.0	mg/L	1/22/2013 21:08	MJB	EPA 200.7	7439-95-4	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300514-04

Name:	**Norwest Corporation**	***Sample Date:***	1/17/2013 3:00 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/18/2013 1:57 PM
Comments:	DG-2D	***Sampler:***	Norwest
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Manganese, Dissolved	0.0264	0.0050	mg/L	1/28/2013 14:45	MJB	EPA 200.8	7439-96-5	
Manganese, Total	0.416	0.0050	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7439-96-5	
Nickel, Total	0.0459	0.0050	mg/L	1/23/2013 13:22	MJB	EPA 200.8	7440-02-0	
Potassium, Total	54.1	5.0	mg/L	1/22/2013 21:08	MJB	EPA 200.7	7440-09-7	
Selenium, Total	0.0607	0.0050	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7782-49-2	
Silver, Total	ND	0.005	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7440-22-4	
Sodium, Total	14000	500	mg/L	1/25/2013 15:48	MJB	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0020	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	0.0526	0.0050	mg/L	1/22/2013 19:31	MJB	EPA 200.8	7440-62-2	
Zinc, Total	0.10	0.10	mg/L	1/22/2013 21:08	MJB	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	1/22/2013 17:15	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	ND	5.0	mg/L	1/23/2013 13:35	MAH	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	0.002	0.002	mg/L	1/22/2013 17:15	PE	EPA 8260B	71-43-2	
Ethylbenzene	ND	0.005	mg/L	1/22/2013 17:15	PE	EPA 8260B	100-41-4	
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	1/22/2013 17:15	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	1/22/2013 17:15	PE	EPA 8260B	91-20-3	
Toluene	0.003	0.005	mg/L	1/22/2013 17:15	PE	EPA 8260B	108-88-3	J
Xylenes, total	0.002	0.005	mg/L	1/22/2013 17:15	PE	EPA 8260B	1330-20-7	J

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Certificate of Analysis

Lab Sample No.: 1300514-05

Name:	**Norwest Corporation**	***Sample Date:***	1/17/2013 4:20 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/18/2013 1:57 PM
Comments:	DG-5D	***Sampler:***	Norwest
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	393	13.2	mg/L	1/22/2013 21:12	MJB	SM 2340B		
Inorganic								
Acidity	ND	50.0	mg/L	1/29/2013 13:30	RMC	SM 2310 B		
Alkalinity - Bicarbonate (HCO3)	35400	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	71-52-3	
Alkalinity - Carbonate (CO3)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	3812-32-6	
Alkalinity - CO2	19200	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	124-38-9	
Alkalinity - Hydroxide (OH)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	14280-30-9	
Alkalinity - Total (as CaCO3)	29100	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	CTFID10279	
Chloride	3100	100	mg/L	1/19/2013 11:00	TSM	EPA 300.0	16887-00-6	
Conductivity	38900	1	umho/cm	2/1/2013 17:20	IJH	EPA 120.1	CTFID10052	
Dissolved Organic Carbon	3660	500	mg/L	2/1/2013 12:00	BCA	SM 5310 C	CTFID10073	A-01a
Nitrate + Nitrite, Total	ND	1.0	mg/L	2/1/2013 11:00	KSL	SM 4500 NO3-F	CTFID10163	A-01
Oil & Grease (HEM)	14	5	mg/L	1/24/2013 10:00	SPH	EPA 1664A	CTFID10169	
pH	9.6	0.1	pH Units	1/18/2013 17:00	SPH	SM 4500 H-B	CTFID10187	SPH
Phosphorus, Total as P	14	0.50	mg/L	1/23/2013 20:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	200	100	mg/L	1/19/2013 11:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	43500	100	mg/L	1/23/2013 8:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	3600	500	mg/L	2/5/2013 13:20	BTK	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	1150	20	mg/L	1/22/2013 16:00	IJH	SM 2540 D	CTFID10267	
Metals								
Aluminum, Dissolved	ND	0.5	mg/L	1/29/2013 19:55	PNM	EPA 200.7	7429-90-5	
Aluminum, Total	13.1	0.5	mg/L	1/22/2013 21:12	MJB	EPA 200.7	7429-90-5	
Antimony, Total	0.0081	0.0050	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	0.153	0.0050	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7440-38-2	
Barium, Total	0.868	0.050	mg/L	1/22/2013 21:12	MJB	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0050	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7440-41-7	
Calcium, Total	67.4	2.0	mg/L	1/22/2013 21:12	MJB	EPA 200.7	7440-43-9	
Cadmium, Total	0.0048	0.0020	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	0.0092	0.0050	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.0293	0.0050	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7440-47-3	
Copper, Total	0.155	0.0100	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	1.02	0.20	mg/L	1/29/2013 19:55	PNM	EPA 200.7	7439-89-6	
Iron, Total	15.0	0.20	mg/L	1/22/2013 21:12	MJB	EPA 200.7	7439-89-6	
Lead, Total	0.0140	0.0050	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7439-92-1	
Mercury, Total	0.0003	0.0002	mg/L	1/23/2013 12:00	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	54.4	2.0	mg/L	1/22/2013 21:12	MJB	EPA 200.7	7439-95-4	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300514-05

Name:	**Norwest Corporation**	***Sample Date:***	1/17/2013 4:20 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/18/2013 1:57 PM
Comments:	DG-5D	***Sampler:***	Norwest
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Manganese, Dissolved	0.0883	0.0050	mg/L	1/28/2013 14:48	MJB	EPA 200.8	7439-96-5	
Manganese, Total	0.382	0.0050	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7439-96-5	
Nickel, Total	0.0406	0.0050	mg/L	1/23/2013 13:24	MJB	EPA 200.8	7440-02-0	
Potassium, Total	73.2	5.0	mg/L	1/22/2013 21:12	MJB	EPA 200.7	7440-09-7	
Selenium, Total	0.0621	0.0050	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7782-49-2	
Silver, Total	0.007	0.005	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7440-22-4	
Sodium, Total	16200	500	mg/L	1/25/2013 15:52	MJB	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0020	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	0.0517	0.0050	mg/L	1/22/2013 19:34	MJB	EPA 200.8	7440-62-2	
Zinc, Total	0.12	0.10	mg/L	1/22/2013 21:12	MJB	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	1/22/2013 18:11	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	7.8	5.0	mg/L	1/23/2013 14:02	MAH	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	ND	0.002	mg/L	1/22/2013 18:11	PE	EPA 8260B	71-43-2	
Ethylbenzene	ND	0.005	mg/L	1/22/2013 18:11	PE	EPA 8260B	100-41-4	
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	1/22/2013 18:11	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	1/22/2013 18:11	PE	EPA 8260B	91-20-3	
Toluene	ND	0.005	mg/L	1/22/2013 18:11	PE	EPA 8260B	108-88-3	
Xylenes, total	ND	0.005	mg/L	1/22/2013 18:11	PE	EPA 8260B	1330-20-7	

6100 South Stratler
Murray, UT 84107
801-262-7299 Office

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SPH = Sample submitted past method specified holding time.

J = Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).

A-01a = The DOC is higher than the TOC in this sample. Reanalysis of the sample verified the results.

A-01 = All 5 samples in this set were first run with no dilution and all results were ND. The matrix spike did not recover due to matrix interference. The samples and spike were rerun at a 10X dilution to account for matrix issues.

HD

CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF CUSTODY

COMPANY: NORWEST
ADDRESS: 136E South Temple
CITY/STATE/ZIP: SLC UT 84101
PHONE #: 801 539-8044 FAX:
CONTACT: Tom Suchoski PROJECT:
EMAIL: TSuchoski@NorwestCorp.com

BILLING ADDRESS: SAME
BILLING CITY/STATE/ZIP:
PURCHASE ORDER #: RED LEAF 187.15

TURNAROUND REQUIRED:*
* Expedited turnaround subject to additional charge

CHEMTECH-FORD LABORATORIES

___ Mark 'X' here if you want a copy sent to DEQ Division of Drinking Water.

MATRIX: DW = Drinking Water; WW = Wastewater; W = Water; S = Soil; SO = Solid; SL = Sludge; O = Other

ANALYTICAL TESTS REQUESTED — Bacteriological: R = Routine; I = Investigative; TG = Trigger Source; CO = Confirmation

REPEAT: OR = Original Location; UP = Upstream; DN = Downstream

Lab ID #	SAMPLE IDENTIFICATION	SAMPLE DATE	SAMPLE TIME	Drinking Water FACILITY ID	PH	Cond - SP. cond	SEE NORWEST LIST - EMAILED TO LI2	FIELD: Residual Chlorine	Total Coliform + E. coli (Present/Absent)	Total Coliform + E. coli (Enumerated)	HPC (Plate Count)	E. coli only	Repeat (Fail #)	SYSTEM #
00514														
01	1. H1	1-16-13	1450											
	2. (ALL BOTTLES FILTERED)													
02	3. DG-3S	1-17-13	1130											
	4. (ALL BOTTLES FILTERED)													
03	5. UG-1S	1-17-13	1315											
	6. (ALL BOTTLES FILTRED													
04	7. DG-2d	1-17-13	1500											
	8. (NOT FILTERED, HNO_3 WASHED OUT OF BOTTLES FOR METALS TEST)													
05	9. DG-5d	1-17-13	1620											
	10. (NOT FILTERED, HNO_3 WASHED OUT OF BOTLES FOR METALS TEST													

Sampled by: [print] | Sampled by: [signature] | ON ICE | NOT ON ICE

Special instructions:

Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time
	1-18-13 1400		1/18/13 13:57
Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time
Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time

Payment Terms are net 30 days OAC. 1.5% interest charge per month (18% per annum). Client agrees to pay collection costs and attorney's fees.

TABLE 1

Preliminary Water Quality Laboratory Analytes

Analytes

Acidity	Hardness	Total Suspended Solids
Alkalinity	Nitrate + Nitrite	Total Dissolved Solids
Chloride	Sulfate	

Total and Dissolved Metals

Aluminum	Iron	Silver
Dissolved Aluminum	Dissolved Iron	Sodium
Antimony	Lead	Thallium
Arsenic	Magnesium	Vanadium
Barium	Manganese	Zinc
Beryllium	Dissolved Manganese	
Cadmium	Mercury	
Calcium	Nickel	
Chromium	Potassium	
Cobalt	Phosphorous	
Copper	Selenium	

Age
H_2 and O_2 Ratios

Organics
Total Organic Carbon (TOC)
Dissolved Organic Carbon (DOC)
Oil and Grease
Total Petroleum Hydrocarbons (TPH)
Benzene, Toluene, Ethylbenzene, and Xylene Aromatic compounds (BTEX)

Additional compounds that could be sampled for, if required:

Oil Range Organics (ORO)

CHEMTECH-FORD LABORATORIES

Sample Receipt Checklist

Lab ID #: 00514

Delivery Method: (circle one)

UPS FedEX USPS

(Walk-In) Courier Chemtech

Sample(s) sealed: Yes / No

Appropriate container/preserve: Yes / No

Temperature 4 C°

	Lab ID #	Bottle Type	Lot # (preservative)	No. of Subsample(s)	Preserved by client / third party	Preserved in Receiving/Laboratory	Vials submitted with headspace	Sample submitted past hold time	Filtered by client in field
1	01-03	AG	—						X
2		O	942						X
3		N	951						X
4		M1	937						X
5		M2	↓						X
6		G	—						X
7		W1-3	921						X
8		T1-3	941						X
9	04	AG	—						
10		O	942						
11		N	939 931						
12		M1	—						
13		M2	—						
14		G	—						
15		W1-3	921						
16		T1-3	933						
17	05	AG							
18		O	942						
19		N	939						
20		M1	—						
21		M2	—						
22		G							
23		W1-3	921						
24		T1-3	933						
25									

Comments:

G: 250 mL amber glass

04-05 M1+2 - bottles rinsed in field by client.

→ 250 mL amber glass

Bottle Type	
Plastic	**Glass**
A- Plastic Unpreserved	D- 625 ($Na_2S_2O_3$)
B- Miscellaneous Plastic	G- Glass Unpreserved
C- Cyanide Qt (NaOH)	H- HAAs (NH_4Cl)
F- Sulfide Qt (NaOH/Zn Acetate)	J- 508/515/525 (Na_2SO_3)
M- Metals Pint (HNO_3)	O- Oil & Grease (1:1 HCl)
N- Nutrient Pint (H_2SO_4)	P- Phenols (H_2SO_4)
R- Radiological Gallon (HNO_3)	T- TOC/TOX (H_3PO_4)
S- Sludge Cups/Tubs	U- 531 (MCAA, $Na_2S_2O_3$)
Q- Plastic Bags	V- 524/THMs (Ascorbic Acid)
E- Coliform/Ecoli	W- 8260 (1:1 HCl)
Additional Volumes	X- Vial Unpreserved
Q- quart 1/2pt- half pint	Y- 624/504 ($Na_2S_2O_3$)
P- pint 1/2- half gallon	Z- Miscellaneous Glass

CHEMTECH-FORD
LABORATORIES

2/6/2013

Work Order: 1300674

Norwest Corporation

Attn: Tom Suchoski

136 East South Temple, 12th Floor

Salt Lake City, UT 84111

Client Service Contact: Linda Daniels 801.262.7299

The analyses presented on this report were performed in accordance with the National Environmental Laboratory Accreditation Program (NELAP) unless noted in the comments, flags or case narrative. If the report is to be used for regulatory compliance, it should be presented in its entirety, and not be altered.

NELAP ACCREDITED TNI LABORATORY

Approved By: Dave Gayer, Laboratory Director

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300674-01

Name:	**Norwest Corporation**	***Sample Date:***	1/24/2013 12:15 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/25/2013 12:00 PM
Comments:	UG-1d	***Sampler:***	Client
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	169	26.5	mg/L	2/1/2013 11:18	PNM	SM 2340B		
Inorganic								
Acidity	ND	50.0	mg/L	1/29/2013 13:30	RMC	SM 2310 B		
Alkalinity - Bicarbonate (HCO3)	33700	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	71-52-3	
Alkalinity - Carbonate (CO3)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	3812-32-6	
Alkalinity - CO2	19500	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	124-38-9	
Alkalinity - Hydroxide (OH)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	14280-30-9	
Alkalinity - Total (as CaCO3)	27700	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	CTFID10279	
Chloride	10600	200	mg/L	1/27/2013 7:00	TSM	EPA 300.0	16887-00-6	
Conductivity	52200	1	umho/cm	2/1/2013 17:20	IJH	EPA 120.1	CTFID10052	
Dissolved Organic Carbon	2560	500	mg/L	2/1/2013 12:00	BTK	SM 5310 C	CTFID10073	
Nitrate + Nitrite, Total	ND	1.0	mg/L	2/1/2013 11:00	KSL	SM 4500 NO3-F	CTFID10163	A-01
Oil & Grease (HEM)	ND	5	mg/L	1/30/2013 10:00	SPH	EPA 1664A	CTFID10169	
pH	9.3	0.1	pH Units	1/25/2013 14:00	SPH	SM 4500 H-B	CTFID10187	SPH
Phosphorus, Total as P	12	0.50	mg/L	1/27/2013 13:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	200	100	mg/L	1/26/2013 9:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	52800	100	mg/L	1/28/2013 13:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	2560	500	mg/L	2/5/2013 13:20	BTK	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	182	20	mg/L	1/29/2013 0:00	IJH	SM 2540 D	CTFID10267	
Metals								
Aluminum, Dissolved	ND	1.0	mg/L	1/30/2013 16:56	PNM	EPA 200.7	7429-90-5	
Aluminum, Total	ND	1.0	mg/L	2/1/2013 11:18	PNM	EPA 200.7	7429-90-5	
Antimony, Total	ND	0.0050	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	0.224	0.0050	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7440-38-2	
Barium, Total	2.21	0.100	mg/L	2/1/2013 11:18	PNM	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0050	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7440-41-7	
Calcium, Total	5.2	4.0	mg/L	2/1/2013 11:18	PNM	EPA 200.7	7440-43-9	
Cadmium, Total	0.0281	0.0020	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	ND	0.0050	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.0105	0.0050	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7440-47-3	
Copper, Total	0.0593	0.0100	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	1.04	0.40	mg/L	1/30/2013 16:56	PNM	EPA 200.7	7439-89-6	
Iron, Total	1.15	0.40	mg/L	2/1/2013 11:18	PNM	EPA 200.7	7439-89-6	
Lead, Total	ND	0.0050	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7439-92-1	
Mercury, Total	ND	0.0002	mg/L	1/28/2013 12:45	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	37.9	4.0	mg/L	2/1/2013 11:18	PNM	EPA 200.7	7439-95-4	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300674-01

Name:	**Norwest Corporation**	***Sample Date:***	1/24/2013 12:15 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/25/2013 12:00 PM
Comments:	UG-1d	***Sampler:***	Client
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Manganese, Dissolved	0.169	0.0050	mg/L	2/1/2013 13:00	MJB	EPA 200.8	7439-96-5	
Manganese, Total	0.177	0.0050	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7439-96-5	
Nickel, Total	0.0286	0.0050	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7440-02-0	
Potassium, Total	43.8	10.0	mg/L	2/1/2013 11:18	PNM	EPA 200.7	7440-09-7	
Selenium, Total	0.360	0.0050	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7782-49-2	
Silver, Total	0.093	0.005	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7440-22-4	
Sodium, Total	20000	10.0	mg/L	2/1/2013 11:18	PNM	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0020	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	0.0386	0.0050	mg/L	2/1/2013 11:10	MJB	EPA 200.8	7440-62-2	
Zinc, Total	ND	0.20	mg/L	2/1/2013 11:18	PNM	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	1/29/2013 13:36	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	ND	5.0	mg/L	1/31/2013 10:11	RB	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	0.003	0.002	mg/L	1/29/2013 13:36	PE	EPA 8260B	71-43-2	
Ethylbenzene	ND	0.005	mg/L	1/29/2013 13:36	PE	EPA 8260B	100-41-4	
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	1/29/2013 13:36	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	1/29/2013 13:36	PE	EPA 8260B	91-20-3	
Toluene	0.017	0.005	mg/L	1/29/2013 13:36	PE	EPA 8260B	108-88-3	
Xylenes, total	0.002	0.005	mg/L	1/29/2013 13:36	PE	EPA 8260B	1330-20-7	J

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300674-02

Name:	**Norwest Corporation**	***Sample Date:***	1/24/2013 12:15 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/25/2013 12:00 PM
Comments:	UG-1d DUP	***Sampler:***	Client
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	169	26.5	mg/L	2/1/2013 11:22	PNM	SM 2340B		
Inorganic								
Acidity	ND	50.0	mg/L	1/29/2013 13:30	RMC	SM 2310 B		
Alkalinity - Bicarbonate (HCO3)	33700	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	71-52-3	
Alkalinity - Carbonate (CO3)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	3812-32-6	
Alkalinity - CO2	19400	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	124-38-9	
Alkalinity - Hydroxide (OH)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	14280-30-9	
Alkalinity - Total (as CaCO3)	27600	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	CTFID10279	
Chloride	10700	200	mg/L	1/27/2013 7:00	TSM	EPA 300.0	16887-00-6	
Conductivity	52400	1	umho/cm	2/1/2013 17:20	IJH	EPA 120.1	CTFID10052	
Dissolved Organic Carbon	2520	500	mg/L	2/1/2013 12:00	BTK	SM 5310 C	CTFID10073	
Nitrate + Nitrite, Total	ND	1.0	mg/L	2/1/2013 11:00	KSL	SM 4500 NO3-F	CTFID10163	A-01
Oil & Grease (HEM)	ND	5	mg/L	1/30/2013 10:00	SPH	EPA 1664A	CTFID10169	
pH	9.3	0.1	pH Units	1/25/2013 14:00	SPH	SM 4500 H-B	CTFID10187	SPH
Phosphorus, Total as P	12	0.50	mg/L	1/27/2013 13:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	200	100	mg/L	1/26/2013 9:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	53700	100	mg/L	1/28/2013 13:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	2540	500	mg/L	2/5/2013 13:20	BTK	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	216	20	mg/L	1/29/2013 0:00	IJH	SM 2540 D	CTFID10267	
Metals								
Aluminum, Dissolved	ND	1.0	mg/L	1/30/2013 17:00	PNM	EPA 200.7	7429-90-5	
Aluminum, Total	ND	1.0	mg/L	2/1/2013 11:22	PNM	EPA 200.7	7429-90-5	
Antimony, Total	ND	0.0050	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	0.229	0.0050	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7440-38-2	
Barium, Total	2.19	0.100	mg/L	2/1/2013 11:22	PNM	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0050	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7440-41-7	
Calcium, Total	5.1	4.0	mg/L	2/1/2013 11:22	PNM	EPA 200.7	7440-43-9	
Cadmium, Total	0.0317	0.0020	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	ND	0.0050	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.0113	0.0050	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7440-47-3	
Copper, Total	0.0941	0.0100	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	1.08	0.40	mg/L	1/30/2013 17:00	PNM	EPA 200.7	7439-89-6	
Iron, Total	1.16	0.40	mg/L	2/1/2013 11:22	PNM	EPA 200.7	7439-89-6	
Lead, Total	ND	0.0050	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7439-92-1	
Mercury, Total	ND	0.0002	mg/L	1/28/2013 12:45	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	38.0	4.0	mg/L	2/1/2013 11:22	PNM	EPA 200.7	7439-95-4	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300674-02

Name:	**Norwest Corporation**	***Sample Date:***	1/24/2013 12:15 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/25/2013 12:00 PM
Comments:	UG-1d DUP	***Sampler:***	Client
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Manganese, Dissolved	0.0768	0.0050	mg/L	2/1/2013 13:00	MJB	EPA 200.8	7439-96-5	
Manganese, Total	0.180	0.0050	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7439-96-5	
Nickel, Total	0.0292	0.0050	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7440-02-0	
Potassium, Total	43.9	10.0	mg/L	2/1/2013 11:22	PNM	EPA 200.7	7440-09-7	
Selenium, Total	0.363	0.0050	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7782-49-2	
Silver, Total	0.099	0.005	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7440-22-4	
Sodium, Total	19900	10.0	mg/L	2/1/2013 11:22	PNM	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0020	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	0.0396	0.0050	mg/L	2/1/2013 11:13	MJB	EPA 200.8	7440-62-2	
Zinc, Total	ND	0.20	mg/L	2/1/2013 11:22	PNM	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	1/29/2013 14:05	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	ND	5.0	mg/L	1/31/2013 10:38	RB	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	0.003	0.002	mg/L	1/29/2013 14:05	PE	EPA 8260B	71-43-2	
Ethylbenzene	ND	0.005	mg/L	1/29/2013 14:05	PE	EPA 8260B	100-41-4	
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	1/29/2013 14:05	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	1/29/2013 14:05	PE	EPA 8260B	91-20-3	
Toluene	0.016	0.005	mg/L	1/29/2013 14:05	PE	EPA 8260B	108-88-3	
Xylenes, total	ND	0.005	mg/L	1/29/2013 14:05	PE	EPA 8260B	1330-20-7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300674-03

Name:	Norwest Corporation	**Sample Date:**	1/24/2013 2:20 PM
Sample Site:	Red Leaf	**Receipt Date:**	1/25/2013 12:00 PM
Comments:	DG-1d	**Sampler:**	Client
Sample Matrix:	Water	**Project:**	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Calculations								
Hardness as CaCO3	162	26.5	mg/L	2/1/2013 11:26	PNM	SM 2340B		
Inorganic								
Acidity	ND	50.0	mg/L	1/29/2013 13:30	RMC	SM 2310 B		
Alkalinity - Bicarbonate (HCO3)	14100	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	71-52-3	
Alkalinity - Carbonate (CO3)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	3812-32-6	
Alkalinity - CO2	9180	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	124-38-9	
Alkalinity - Hydroxide (OH)	ND	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	14280-30-9	
Alkalinity - Total (as CaCO3)	11600	10.0	mg/L	1/29/2013 10:30	RMC	SM 2320 B	CTFID10279	
Chloride	6500	100	mg/L	1/26/2013 9:00	TSM	EPA 300.0	16887-00-6	
Conductivity	32300	1	umho/cm	2/1/2013 17:20	IJH	EPA 120.1	CTFID10052	
Dissolved Organic Carbon	3080	500	mg/L	2/1/2013 12:00	BTK	SM 5310 C	CTFID10073	
Nitrate + Nitrite, Total	ND	0.1	mg/L	2/1/2013 11:00	KSL	SM 4500 NO3-F	CTFID10163	A-01
Oil & Grease (HEM)	7	5	mg/L	1/30/2013 10.00	SPH	EPA 1664A	CTFID10169	
pH	9.0	0.1	pH Units	1/25/2013 14:00	SPH	SM 4500 H-B	CTFID10187	SPH
Phosphorus, Total as P	4.4	0.50	mg/L	1/27/2013 13:00	TSM	SM 4500 PB5E	7723-14-0	
Sulfate	500	100	mg/L	1/26/2013 9:00	TSM	EPA 300.0	14808-79-8	
Total Dissolved Solids (TDS)	30300	100	mg/L	1/28/2013 13:00	SPH	SM 2540 C	CTFID10226	
Total Organic Carbon	3090	500	mg/L	2/5/2013 13:20	BTK	SM 5310 C	CTFID10236	
Total Suspended Solids (TSS)	212	20	mg/L	1/29/2013 0:00	IJH	SM 2540 D	CTFID10267	
Metals								
Aluminum, Dissolved	ND	1.0	mg/L	1/30/2013 17:24	PNM	EPA 200.7	7429-90-5	
Aluminum, Total	ND	1.0	mg/L	2/1/2013 11:26	PNM	EPA 200.7	7429-90-5	
Antimony, Total	ND	0.0050	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7440-36-0	
Arsenic, Total	0.178	0.0050	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7440-38-2	
Barium, Total	1.10	0.100	mg/L	2/1/2013 11:26	PNM	EPA 200.7	7440-39-3	
Beryllium, Total	ND	0.0050	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7440-41-7	
Calcium, Total	4.4	4.0	mg/L	2/1/2013 11:26	PNM	EPA 200.7	7440-43-9	
Cadmium, Total	0.0053	0.0020	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7440-43-9	
Cobalt, Total	ND	0.0050	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7440-48-4	
Chromium, Total	0.0109	0.0050	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7440-47-3	
Copper, Total	0.0499	0.0100	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7440-50-8	
Iron, Dissolved	ND	0.40	mg/L	1/30/2013 17:24	PNM	EPA 200.7	7439-89-6	
Iron, Total	ND	0.40	mg/L	2/1/2013 11:26	PNM	EPA 200.7	7439-89-6	
Lead, Total	ND	0.0050	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7439-92-1	
Mercury, Total	0.0002	0.0002	mg/L	1/28/2013 12:45	AKL	EPA 245.1	7439-97-6	
Magnesium, Total	36.7	4.0	mg/L	2/1/2013 11:26	PNM	EPA 200.7	7439-95-4	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1300674-03

Name:	**Norwest Corporation**	***Sample Date:***	1/24/2013 2:20 PM
Sample Site:	Red Leaf	***Receipt Date:***	1/25/2013 12:00 PM
Comments:	DG-1d	***Sampler:***	Client
Sample Matrix:	Water	***Project:***	Water

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	CAS No.	Flag
Metals								
Manganese, Dissolved	ND	0.0050	mg/L	2/1/2013 13:00	MJB	EPA 200.8	7439-96-5	
Manganese, Total	0.0769	0.0050	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7439-96-5	
Nickel, Total	0.0127	0.0050	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7440-02-0	
Potassium, Total	29.3	10.0	mg/L	2/1/2013 11:26	PNM	EPA 200.7	7440-09-7	
Selenium, Total	0.136	0.0050	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7782-49-2	
Silver, Total	0.015	0.005	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7440-22-4	
Sodium, Total	9870	10.0	mg/L	2/1/2013 11:26	PNM	EPA 200.7	7440-23-5	
Thallium, Total	ND	0.0020	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7440-28-0	
Vanadium, Total	0.0866	0.0050	mg/L	2/1/2013 11:17	MJB	EPA 200.8	7440-62-2	
Zinc, Total	ND	0.20	mg/L	2/1/2013 11:26	PNM	EPA 200.7	7440-66-6	
Gasoline Range								
Gasoline Range Organics	ND	0.24	mg/L	1/29/2013 14:33	PE	EPA 8260B	CTFID10117	
Diesel Range								
Diesel Range Organics	6.7	5.0	mg/L	1/31/2013 11:05	RB	EPA 8015B	CTFID10069	
BETX Compounds								
Benzene	0.002	0.002	mg/L	1/29/2013 14:33	PE	EPA 8260B	71-43-2	
Ethylbenzene	ND	0.005	mg/L	1/29/2013 14:33	PE	EPA 8260B	100-41-4	
Methyl-tert-butyl ether (MTBE)	ND	0.005	mg/L	1/29/2013 14:33	PE	EPA 8260B	1634-04-4	
Naphthalene	ND	0.005	mg/L	1/29/2013 14:33	PE	EPA 8260B	91-20-3	
Toluene	0.036	0.005	mg/L	1/29/2013 14:33	PE	EPA 8260B	108-88-3	
Xylenes, total	ND	0.005	mg/L	1/29/2013 14:33	PE	EPA 8260B	1330-20-7	

6100 South Stratler
Murray, UT 84107
801-262-7299 Office

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SPH = Sample submitted past method specified holding time.

J = Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).

A-01 = All 5 samples in this set were first run with no dilution and all results were ND. The matrix spike did not recover due to matrix interference. The samples and spike were rerun at a 10X dilution to account for matrix issues.

6100 South Stratler
Murray, UT 84107
801-262-7299 Office

HD

CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF CUSTODY

COMPANY: NORWEST
ADDRESS: 136 E SOUTH TEMPLE
CITY/STATE/ZIP: SLC UT 84101
PHONE #: (801) 539-0044 FAX:
CONTACT: TOM SUCHOSKI PROJECT:
EMAIL: TSCHOSKI@NORWESTCORP.COM

BILLING ADDRESS: SAME
BILLING CITY/STATE/ZIP:
PURCHASE ORDER #: READ LEAF 182-16

TURNAROUND REQUIRED:*
* Expedited turnaround subject to additional charge

CHEMTECH-FORD LABORATORIES

___ Mark "X" here if you want a copy sent to DEQ Division of Drinking Water.

MATRIX: DW = Drinking Water; WW = Wastewater; W = Water; S = Soil; SO = Solid; SL = Sludge; O = Other

ANALYTICAL TESTS REQUESTED

Bacteriological: R = Routine; I = Investigative; TG = Trigger Source; CO = Confirmation

REPEAT: OR = Original Location; UP = Upstream; DN = Downstream

Lab ID #		SAMPLE IDENTIFICATION	SAMPLE DATE	SAMPLE TIME	Drinking Water FACILITY ID	pH	Cond - SP COND	SEE NORWEST UST - EMAIL TO LIZ	FIELD: Residual Chlorine	Total Coliform + E. coli (Present/Absent)	Total Coliform + E. coli (Enumerated)	HPC (Plate Count)	E. coli only	Repeat (Fail #)	SYSTEM #
00614	1	UG-1d	1-24-13	1215											
-01	2														
	3	UG-1d DUP	1-24-13	1215											
	4														
-03	5	DG-1d	1-24-13	1420											
	6														
	7														
	8														
	9														
	10														

Sampled by: [print]
Sampled by: [signature]
ON ICE / NOT ON ICE

Special Instructions:

Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time
	1-25-13 12:00		1/25/2013 12:00
Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time
Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time

CHEMTECH-FORD 6100 South Stratler Street (350 West) Murray, UT 84107 Phone: 801-262-7299 FAX: 801-262-7378 www.chemtechford.com

TABLE 1

Preliminary Water Quality Laboratory Analytes

Analytes

Acidity	Hardness	Total Suspended Solids
Alkalinity	Nitrate + Nitrite	Total Dissolved Solids
Chloride	Sulfate	

Total and Dissolved Metals

Aluminum	Iron	Silver
Dissolved Aluminum	Dissolved Iron	Sodium
Antimony	Lead	Thallium
Arsenic	Magnesium	Vanadium
Barium	Manganese	Zinc
Beryllium	Dissolved Manganese	
Cadmium	Mercury	
Calcium	Nickel	
Chromium	Potassium	
Cobalt	Phosphorous	
Copper	Selenium	

Age
H_2 and O_2 Ratios

Organics
Total Organic Carbon (TOC)
Dissolved Organic Carbon (DOC)
Oil and Grease
Total Petroleum Hydrocarbons (TPH)
Benzene, Toluene, Ethylbenzene, and Xylene Aromatic compounds (BTEX)

Additional compounds that could be sampled for, if required:

Oil Range Organics (ORO)

CHEMTECH-FORD LABORATORIES

Sample Receipt Checklist

Lab ID #: 00674

Delivery Method: (circle one)

UPS FedEX USPS

(Walk-In) Courier Chemtech

Sample(s) sealed: Yes / (No)

Appropriate container/preserve: (Yes) / No

Temperature 5 C°

	Lab ID #	Bottle Type	Lot # (preservative)	No. of Subsample(s)	Preserved by client / third party	Preserved in Receiving/Laboratory	Vials submitted with headspace	Sample submitted past hold time	Filtered by client in field
1	01	AG		2					
2		D	942						
3		M	952						
4		M	952						
5		N	951						
6		G							
7		TI-3	941						
8		WI-3	921						
9	02	AG		2					
10		D	942						
11		M	952						
12		M	422						
13		N	939						
14		G							
15		TI-3	941						
16		WI-3	921						
17	03	AG		2					
18		D	942						
19		M	952						
20		M	952						
21		N	939						
22		G							
23		TI-3	941						
24		WI-3	921						
25									

Comments:

G = 250 mL amber

Bottle Type	
Plastic	**Glass**
A- Plastic Unpreserved	D- 625 ($Na_2S_2O_3$)
B- Miscellaneous Plastic	G- Glass Unpreserved
C- Cyanide Qt (NaOH)	H- HAAs (NH_4Cl)
F- Sulfide Qt (NaOH/Zn Acetate)	J- 508/515/525 (Na_2SO_3)
M- Metals Pint (HNO_3)	O- Oil & Grease (1:1 HCl)
N- Nutrient Pint (H_2SO_4)	P- Phenols (H_2SO_4)
R- Radiological Gallon (HNO_3)	T- TOC/TOX (H_3PO_4)
S- Sludge Cups/Tubs	U- 531 (MCAA, $Na_2S_2O_3$)
Q- Plastic Bags	V- 524/THMs (Ascorbic Acid)
E- Coliform/Ecoli	W- 8260 (1:1 HCl)
Additional Volumes	X- Vial Unpreserved
Q- quart 1/2pt- half pint	Y- 624/504 ($Na_2S_2O_3$)
P- pint 1/2- half gallon	Z- Miscellaneous Glass

Appendix G

Water Sample
Stable Isotope Analyses

NORWEST
CORPORATION

REDleaf
RESOURCES, INC.

136 EAST SOUTH TEMPLE, 12TH FLOOR
SALT LAKE CITY, UTAH 84111 USA
TEL: (801) 539-0044 FAX: (801) 539-0055

MEMORANDUM

To	Bob Bayer (JBR) and Jay Vance (Red Leaf)	**Project #**	187-29
From	Tom Suchoski	**Doc #**	
CC:	John Imse, Shawn Packard	**Date**	2/22/13
Subject	Water Age – Preliminary Evaluation		

Samples of formation water from piezometers and a recent snow melt sample were submitted for stable water isotope analysis. The analyses suggest the formation water originated in warmer times than the snow sample, and that the former is therefore quite old, which is consistent with stagnant and discontinuous pockets of formation water rather than groundwater flow in an aquifer.

Three formation waters from a portion of the Parachute Member of the Green River Formation were sampled in Dec 2012 and Jan 2013 by pump and submitted to Isotech Labs for analysis of various water quality parameters in Attachment A and stable water isotopes. Figure 1 shows the locations of the sample points. Details of the piezometers are presented in the Drilling Report prepared by Norwest (2013). A fresh snow sample was collected at a location beside the road at the SW corner of Section 36, T 13S R22E, on January 31, 2013, at an elevation of about 6600 ft amsl. Table 1 gives pertinent sample information.

Table 1

Sample Points and Data

Sample ID	Collection Method	Location	TDS (mg/l)	$\delta^{18}O$	$\delta^{2}H$
H-1	Pump	Piezometer H-1 - above the A-groove	9,020	-13.87	-110.9
DG-4s	Pump	Piezometer DG-4s – above the A-groove	58,600	-14.87	-116.2
DG-5s	Pump	Piezometer DG-4s – above the A-groove	20,600	-13.36	-108.2
SM-1	Snow Melt	SW/4 Sec 36, T13S, R22E	~200*	-18.04	-145.7

*Estimated from EC Value

Craig (1961) discovered that the ratios of minor stable isotopes of hydrogen and oxygen in water express global patterns due to evaporation and condensation, which has been widely used since to assess paths in the hydrological cycle. The isotopic composition of seawater, the ratios of the stable isotopes of hydrogen (H and ^{2}H or deuterium) and oxygen (^{16}O and ^{18}O), is approximately uniform around the globe at present, though the ratios have varied in geological time. Evaporation off the ocean or source water body surface creates water vapor, as a result of kinetic and equilibrium processes, the stable isotope ratios found in the water vapor within the atmosphere are isotopically the same as the seawater. The process of differential evaporation or condensation of isotope ratios is called "fractionation". As the airmass moves away from the ocean or source water body, when vapor in a cloud condenses the liquid is enriched in the heavier isotopes and the remaining vapor becomes isotopically "lighter". Progressive "rain-out" makes the rain or snow fall from a cloud as it moves inland and up in elevation "lighter". Temperatures in the evaporative and condensing environments (the latitude of origin and the elevation of the cloud) affect the vapor pressure differences and the amount of fractionation these processes cause. Craig (1961) discovered a global meteoric water line (GMWL) generalizing water isotopic composition for the world; local meteoric water lines (LMWL) have been developed by numerous workers specific to regions with particular weather patterns.

Once water enters the subsurface the processes of evaporation and condensation cease and water isotopic signature is generally considered "locked". This means that isotopic ratios or signatures of waters remain the same and can be used to determine if two water samples come from the same source or that waters can often be traced along flow paths from points of infiltration. Also, water samples can be evaluated to indicate whether two water samples occurred from similar climatic regimes.

Figure 2 shows the water isotopic analyses for the four Seep Ridge samples. The values on the axes express the ratio of the heavier isotope to the lighter, and relative to a standard ("VSMO") which approximates modern seawater. The GMWL and a local line from the region are plotted, and show the characteristic slope of approximately 8, due to ^{2}H fractionating eight times as much as ^{18}O on average in the precipitation cycle. The composition of water in an airmass is pushed left along this line from its starting point near zero (with some shift at the origin due to evaporation taking place off the sea at varying air humidity) by progressive "rain-out" making the remaining vapor isotopically "lighter".

No LMWL has been determined for the Uinta Basin, but the Bear River Range ("BRR") line shown on the figure as a surrogate from northern Utah and southeast Idaho (USGS, 2004) is similar to the GMWL. The Uinta Basin weather pattern is not dissimilar to the Bear River Range and northern Utah.

All of the four samples are below the BRR and GMWL, indicating the waters either did not follow the local MWL or they were partially evaporated. The partial evaporation reverses the trend down the LMWL as lighter water is lost to vapor, but the slope of the reversal is less than that of the GMWL because of kinetic effects of diffusion. The composition of the remaining water therefore follows a (temperature and humidity dependent) path something like the blue arrow in Figure 2 (suggesting sample DG-4s migrated off the modern LMWL by evaporation). In fact, the three formation waters would appear to all show the same trend and define a different MWL than the modern one. This is shown by the line labeled SR MWL on the figure.

The main conclusion to be drawn from the results is that the modern snow, which is partly evaporated in melting off the LMWL, is much lighter than the three formation waters. This, and the possibility the formation waters belong to a different MWL from warmer times, suggest the formation waters are not recently infiltrated water. Likely the waters are much older and possibly belong to a time sequence that had a markedly different climate and elevation.

REFERENCES:

Craig, H., 1961 Isotopic variations in meteoric waters: Science, v. 133, p. 1,702–1,703.

USGS, 2004. Development of a Local Meteoric Water Line for Southeastern Idaho, Western Wyoming, and South-Central Montana. U.S. Geological Survey, Scientific Investigations Report 2004-5126, Prepared in cooperation with the U.S. Department Of Energy, Idaho Falls, Idaho, October 2004

ATTACHMENT A

SAMPLE PARAMETERS

NORWEST CORPORATION

REDleaf RESOURCES, INC.

Preliminary Water Quality Laboratory Analytes

Analytes

Acidity	Hardness	Total Suspended Solids
Alkalinity	Nitrate + Nitrite	Total Dissolved Solids
Chloride	Sulfate	

Total and Dissolved Metals

Aluminum	Cobalt	Nickel
Dissolved Aluminum	Copper	Potassium
Antimony	Iron	Phosphorous
Arsenic	Dissolved Iron	Selenium
Barium	Lead	Silver
Beryllium	Magnesium	Sodium
Cadmium	Manganese	Thallium
Calcium	Dissolved Manganese	Vanadium
Chromium	Mercury	Zinc

Age
H and O Isotope Ratios

Organics
Total Organic Carbon (TOC)
Dissolved Organic Carbon (DOC)
Diesel Range Organics (DRO)
Gasoline Range Organics (GRO)
Total Petroleum Hydrocarbons (TPH)
Benzene, Toluene, Ethylbenzene, and Xylene Aromatic compounds (BTEX)

NORWEST CORPORATION

REDleaf RESOURCES, INC.

Appendix H

Steel Specifications

Collection Pan
and
Capsule Piping

ACR Steel Sales, LLC
PO Box 150, Valley Park, MO, 63088 • (636) 517-1420

Specifications for material supplied to Red Leaf Resources.
Delivered to Tinhorns Are Us, Tuttle, OK 11/03/2011

Hot Roll Black Steel
.058 x 27.250" x coil
Weight: 9,360 lbs (2 coils)
CS Type B
Pickled Dry
Temper Rolled
Heat Number: 41125790
Chemical Properties

C	Mn	P	S	Al	Si	Cu	Ni	Cr	Mo	V	Cb	Ti	N
.06	.32	.01	.005	.026	.030	.090	---	.060	---	.001	---	---	---

ACR Steel Sales, LLC
PO Box 150, Valley Park, MO, 63088 • (636) 517-1420

HOT ROLL BLACK STEEL

Grade

Commercial Quality: Steel of this quality is produced for uses that involve simple bending or moderate forming. The steel can be bent flat on itself in any direction at room temperature. Designation CS Type B

Chemical Composition

C	Mn	P	S	Al	Si	Cu	Ni	Cr	Mo	V	Cb	Ti	N
.02 - .15	.60 max	.030 max	.035 max	---	---	.20 max	.20 max	.15 max	.06 max	.008 max	.008 max	.025 max	---

Mechanical Property Requirements

Yield Strength min. ksi: 30 to 50
Tensile Strength min. ksi: none
Elongation in 2in.: 25% and over

Recommended Processes

1. Pickled dry: removes surface scale
2. Temper roll: reduced the tendency of the steel to coil break.

Appendix I

EPS Information

Confidential Business Information
(Included under separate cover)

Appendix J

SPLP Leachate Analysis
American West Analytical
Laboratories

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

John Wallace
IGES
4153 South Commerce Drive
Salt Lake City, UT 84107
TEL: (801) 270-9400

RE: Red Leaf ECOSHALE / 01109-013

Dear John Wallace: Lab Set ID: 1110545

American West Analytical Laboratories received 3 sample(s) on 10/27/2011 for the analyses presented in the following report.

All analyses were performed in accordance to The NELAC Institute protocols unless noted otherwise. American West Analytical Laboratories is certified by The NELAC Institute in Utah and Texas; and is state certified in Colorado, Idaho, and Missouri. Certification document is available upon request. If you have any questions or concerns regarding this report please feel free to call.

The abbreviation "Surr" found in organic reports indicates a surrogate compound that is intentionally added by the laboratory to determine sample injection, extraction, and/or purging efficiency. The "Reporting Limit" found on the report is equivalent to the practical quantitation limit (PQL). This is the minimum concentration that can be reported by the method referenced and the sample matrix. The reporting limit must not be confused with any regulatory limit. Analytical results are reported to three significant figures for quality control and calculation purposes.

11/7/2011: This is a revision to a report originally issued 11/2/2011. Pages 1, 8-34, 46, and 51-79 have been revised.

11/9/2011: Pages 1 and 7 have been revised for cosmetic corrections.

Thank You,

Approved by: Kyle F. Gross Digitally signed by Kyle F. Gross DN: cn=Kyle F. Gross, o=AWAL, ou=AWAL, email=kyle@awal-labs.com, c=US Date: 2011.11.09 10:15:32 -07'00'

Laboratory Director or designee

INORGANIC ANALYTICAL REPORT

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-001
Client Sample ID: R11-122 #1
Collection Date: 10/27/2011 0930h
Received Date: 10/27/2011 1346h

Analytical Results SPLP METALS Method 1312

SPLP Prep Date: 10/27/2011 1800h

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00500	**0.00923**	
Arsenic	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00300	**0.0367**	
Barium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00200	**0.0483**	
Beryllium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00300	< 0.00300	*
Boron	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	0.500	**0.840**	
Cadmium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.000900	< 0.000900	*
Calcium	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	1.00	**3.44**	
Chromium	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00400	< 0.00400	*
Iron	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	0.100	< 0.100	
Lead	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00200	< 0.00200	*
Lithium	mg/L	10/28/2011 1422h	11/1/2011 1932h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	1.00	**1.14**	
Manganese	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00600	< 0.00600	*
Mercury	mg/L	10/28/2011 1400h	10/31/2011 1010h	SW7470A	0.00100	< 0.00100	
Molybdenum	mg/L	10/28/2011 1422h	10/31/2011 1640h	SW6010C	0.0200	**0.129**	
Nickel	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00400	< 0.00400	*
Potassium	mg/L	10/28/2011 1422h	10/31/2011 1640h	SW6010C	1.00	**4.23**	
Selenium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00400	**0.00786**	
Silver	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00200	< 0.00200	*
Sodium	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	1.00	**36.9**	
Strontium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00400	**0.0686**	
Thallium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00200	< 0.00200	*
Tin	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	0.0500	**0.0638**	
Zinc	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.0250	< 0.0250	*

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-002
Client Sample ID: R11-122 #2
Collection Date: 10/27/2011 0935h
Received Date: 10/27/2011 1346h

Analytical Results SPLP METALS Method 1312

SPLP Prep Date: 10/27/2011 1800h

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00500	**0.00761**	
Arsenic	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00300	**0.0371**	
Barium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00200	**0.0479**	
Beryllium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00300	< 0.00300	*
Boron	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	0.500	**0.832**	
Cadmium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.000900	< 0.000900	*
Calcium	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	1.00	**3.64**	
Chromium	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00400	< 0.00400	*
Iron	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	0.100	< 0.100	
Lead	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00200	< 0.00200	*
Lithium	mg/L	10/28/2011 1422h	11/1/2011 1935h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	1.00	**1.25**	
Manganese	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00600	< 0.00600	*
Mercury	mg/L	10/28/2011 1400h	10/31/2011 1021h	SW7470A	0.00100	< 0.00100	
Molybdenum	mg/L	10/28/2011 1422h	10/31/2011 1705h	SW6010C	0.0200	< 0.0200	
Nickel	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00400	< 0.00400	*
Potassium	mg/L	10/28/2011 1422h	10/31/2011 1705h	SW6010C	1.00	< 1.00	
Selenium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00400	**0.00753**	
Silver	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00200	< 0.00200	*
Sodium	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	1.00	**33.5**	
Strontium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00400	**0.0707**	
Thallium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00200	< 0.00200	*
Tin	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	0.0500	**0.0640**	
Zinc	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.0250	< 0.0250	*

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-003
Client Sample ID: R11-122 #3
Collection Date: 10/27/2011 0940h
Received Date: 10/27/2011 1346h

Analytical Results SPLP METALS Method 1312

SPLP Prep Date: 10/27/2011 1800h

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00500	0.00929	
Arsenic	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00300	0.0391	
Barium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00200	0.0410	
Beryllium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00300	< 0.00300	*
Boron	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	0.500	0.878	
Cadmium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.000900	< 0.000900	*
Calcium	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	1.00	3.48	
Chromium	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00400	< 0.00400	*
Iron	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	0.100	< 0.100	
Lead	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00200	< 0.00200	*
Lithium	mg/L	10/28/2011 1422h	11/1/2011 1937h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	1.00	< 1.00	
Manganese	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00600	< 0.00600	*
Mercury	mg/L	10/28/2011 1400h	10/31/2011 1023h	SW7470A	0.00100	< 0.00100	
Molybdenum	mg/L	10/28/2011 1422h	10/31/2011 1709h	SW6010C	0.0200	0.159	
Nickel	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00400	< 0.00400	*
Potassium	mg/L	10/28/2011 1422h	10/31/2011 1709h	SW6010C	1.00	4.28	
Selenium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00400	0.00725	
Silver	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00200	< 0.00200	*
Sodium	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	1.00	37.4	
Strontium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00400	0.0640	
Thallium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00200	< 0.00200	*
Tin	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	0.0500	0.0666	
Zinc	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.0250	< 0.0250	*

** - The reporting limits were raised due to sample matrix interferences.*
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INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-001
Client Sample ID: R11-122 #1
Collection Date: 10/27/2011 0930h
Received Date: 10/27/2011 1346h

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		10/31/2011 0730h	SM2320B	40.0	68.9	
Chloride	mg/L		11/1/2011 1321h	SM4500-Cl-E	5.00	< 5.00	[1]@
Fluoride	mg/L		10/31/2011 0840h	SM4500-F-C	0.100	1.56	
Nitrate/Nitrite (as N)	mg/L		10/31/2011 1148h	E353.2	0.0100	0.0106	B
Oil & Grease	mg/L		10/28/2011 1250h	E1664A	3.00	< 3.00	
pH @ 25° C	pH Units		10/28/2011 1715h	SM4500-H+B	1.00	9.92	
Sulfate	mg/L		10/29/2011 0940h	SM4500-SO4-E	5.00	17.4	
Total Dissolved Solids	mg/L		10/28/2011 1300h	SM2540C	20.0	172	

Analysis performed on an SPLP extract.
@ - High RPD due to suspected sample non-homogeneity or matrix interference.
[1] - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.
B - This analyte was also detected in the SPLP blank at 0.0189 mg/L.

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INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-002
Client Sample ID: R11-122 #2
Collection Date: 10/27/2011 0935h
Received Date: 10/27/2011 1346h

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		10/31/2011 0730h	SM2320B	40.0	**82.0**	
Chloride	mg/L		11/1/2011 1324h	SM4500-Cl-B	5.00	< 5.00	
Fluoride	mg/L		10/31/2011 0840h	SM4500-F-C	0.100	**1.64**	
Nitrate/Nitrite (as N)	mg/L		10/31/2011 1152h	E353.2	0.0100	**0.0251**	B
Oil & Grease	mg/L		10/28/2011 1250h	E1664A	3.00	< 3.00	
pH @ 25° C	pH Units		10/28/2011 1715h	SM4500-H+B	1.00	**9.99**	
Sulfate	mg/L		10/29/2011 0940h	SM4500-SO4-E	5.00	**18.5**	
Total Dissolved Solids	mg/L		10/28/2011 1300h	SM2540C	20.0	**220**	

Analysis performed on an SPLP extract.
B - This analyte was also detected in the SPLP blank at 0.0189 mg/L.

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-003
Client Sample ID: R11-122 #3
Collection Date: 10/27/2011 0940h
Received Date: 10/27/2011 1346h

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		10/31/2011 0730h	SM2320B	40.0	78.7	
Chloride	mg/L		11/1/2011 1325h	SM4500-Cl-E	5.00	< 5.00	
Fluoride	mg/L		10/31/2011 0840h	SM4500-F-C	0.100	1.84	
Nitrate/Nitrite (as N)	mg/L		10/31/2011 1153h	E353.2	0.0100	0.0142	B
Oil & Grease	mg/L		10/28/2011 1250h	E1664A	3.00	< 3.00	
pH @ 25° C	pH Units		10/28/2011 1715h	SM4500-H+B	1.00	10.2	
Sulfate	mg/L		10/29/2011 1045h	SM4500-SO4-E	5.00	19.8	
Total Dissolved Solids	mg/L		10/28/2011 1300h	SM2540C	20.0	220	

Analysis performed on an SPLP extract.
B - This analyte was also detected in the SPLP blank at 0.0189 mg/L.

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1
Collection Date: 10/27/2011 0930h
Received Date: 10/27/2011 1346h **Method:** SW8270D

Analytical Results SVOA SPLP by GC/MS Method 8270D/1312/3510C

Analyzed: 11/4/2011 1759h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1'-Biphenyl	92-52-4	0.0100	< 0.0100	
1,2,4,5-Tetrachlorobenzene	95-94-3	0.0100	< 0.0100	
1,2,4-Trichlorobenzene	120-82-1	0.0100	< 0.0100	
1,2-Dichlorobenzene	95-50-1	0.0100	< 0.0100	
1,3,5-Trinitrobenzene	99-35-4	0.0100	< 0.0100	
1,4-Naphthoquinone	130-15-4	0.0100	< 0.0100	
1,3-Dichlorobenzene	541-73-1	0.0100	< 0.0100	
1,3-Dinitrobenzene	99-65-0	0.0100	< 0.0100	
1,4-Dichlorobenzene	106-46-7	0.0100	< 0.0100	
1,4-Phenylenediamine	106-50-3	0.0100	< 0.0100	
1-Chloronaphthalene	90-13-1	0.0100	< 0.0100	
1-Methylnaphthalene	90-12-0	0.0100	< 0.0100	
1-Naphthylamine	134-32-7	0.0100	< 0.0100	
2,3,4,6-Tetrachlorophenol	58-90-2	0.0100	< 0.0100	
2,4,5-Trichlorophenol	95-95-4	0.0100	< 0.0100	
2,4,6-Trichlorophenol	88-06-2	0.0100	< 0.0100	
2,4-Dichlorophenol	120-83-2	0.0100	< 0.0100	
2,4-Dimethylphenol	105-67-9	0.0100	< 0.0100	
2,4-Dinitrophenol	51-28-5	0.0200	< 0.0200	
2,4-Dinitrotoluene	121-14-2	0.0100	< 0.0100	
2,6-Dichlorophenol	87-65-0	0.0100	< 0.0100	
2,6-Dinitrotoluene	606-20-2	0.0100	< 0.0100	
2-Acetylaminofluorene	53-96-3	0.0100	< 0.0100	
2-Chloronaphthalene	91-58-7	0.0100	< 0.0100	
2-Chlorophenol	95-57-8	0.0100	< 0.0100	
2-Methylnaphthalene	91-57-6	0.0100	< 0.0100	
2-Methylphenol	95-48-7	0.0100	< 0.0100	
2-Naphthylamine	91-59-8	0.0100	< 0.0100	
2-Nitroaniline	88-74-4	0.0100	< 0.0100	
2-Nitrophenol	88-75-5	0.0100	< 0.0100	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/4/2011 1759h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
2-Picoline	109-06-8	0.0100	< 0.0100	
3&4-Methylphenol		0.0100	< 0.0100	
3,3'-Dichlorobenzidine	91-94-1	0.0100	< 0.0100	
3,3'-Dimethylbenzidine	119-93-7	0.0100	< 0.0100	
3-Methylcholanthrene	56-49-5	0.0100	< 0.0100	
3-Nitroaniline	99-09-2	0.0100	< 0.0100	
4,6-Dinitro-2-methylphenol	534-52-1	0.0100	< 0.0100	
4-Aminobiphenyl	92-67-1	0.0100	< 0.0100	
4-Bromophenyl phenyl ether	101-55-3	0.0100	< 0.0100	
4-Chloro-3-methylphenol	59-50-7	0.0100	< 0.0100	
4-Chloroaniline	106-47-8	0.0100	< 0.0100	
4-Chlorophenyl phenyl ether	7005-72-3	0.0100	< 0.0100	
4-Nitroaniline	100-01-6	0.0100	< 0.0100	
4-Nitrophenol	100-02-7	0.0100	< 0.0100	
5-Nitro-o-toluidine	99-55-8	0.0100	< 0.0100	
7,12-Dimethylbenz(a)anthracene	57-97-6	0.0100	< 0.0100	
a,a-Dimethylphenethylamine	122-09-8	0.0100	< 0.0100	
Acenaphthene	83-32-9	0.0100	< 0.0100	
Acenaphthylene	208-96-8	0.0100	< 0.0100	
Acetophenone	98-86-2	0.0100	< 0.0100	
alpha-Terpineol	98-55-5	0.0100	< 0.0100	
Aniline	62-53-3	0.0100	< 0.0100	
Anthracene	120-12-7	0.0100	< 0.0100	
Aramite	140-57-8	0.0100	< 0.0100	
Azobenzene	103-33-3	0.0100	< 0.0100	
Benz(a)anthracene	56-55-3	0.0100	< 0.0100	
Benzidine	92-87-5	0.0100	< 0.0100	
Benzo(a)pyrene	50-32-8	0.0100	< 0.0100	
Benzo(b)fluoranthene	205-99-2	0.0100	< 0.0100	
Benzo(g,h,i)perylene	191-24-2	0.0100	< 0.0100	
Benzo(k)fluoranthene	207-08-9	0.0100	< 0.0100	
Benzoic acid	65-85-0	0.0200	**0.0326**	
Benzyl alcohol	100-51-6	0.0100	< 0.0100	
Bis(2-chloroethoxy)methane	111-91-1	0.0100	< 0.0100	
Bis(2-chloroethyl) ether	111-44-4	0.0100	< 0.0100	
Bis(2-chloroisopropyl) ether	108-60-1	0.0100	< 0.0100	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/4/2011 1759h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Bis(2-ethylhexyl) phthalate	117-81-7	0.0100	< 0.0100	
bis(2-ethylhexyl)adipate	103-23-1	0.0100	< 0.0100	
Butyl benzyl phthalate	85-68-7	0.0100	< 0.0100	
Carbazole	86-74-8	0.0100	< 0.0100	
Chlorobenzilate	510-15-6	0.0100	< 0.0100	
Chrysene	218-01-9	0.0100	< 0.0100	
Di-n-butyl phthalate	84-74-2	0.0100	< 0.0100	
Di-n-octyl phthalate	117-84-0	0.0100	< 0.0100	
Diallate (cis or trans)	2303-16-4	0.0100	< 0.0100	
Dibenz(a,h)anthracene	53-70-3	0.0100	< 0.0100	
Dibenzofuran	132-64-9	0.0100	< 0.0100	
Diethyl phthalate	84-66-2	0.0100	< 0.0100	
Dimethoate	60-51-5	0.0100	< 0.0100	
Dimethyl phthalate	131-11-3	0.0100	< 0.0100	
Dimethylaminoazobenzene	60-11-7	0.0100	< 0.0100	
Dinoseb	88-85-7	0.0100	< 0.0100	
Diphenylamine	122-39-4	0.0100	< 0.0100	
Disulfoton	298-04-4	0.0100	< 0.0100	
Ethyl methanesulfonate	62-50-0	0.0100	< 0.0100	
Famphur	52-85-7	0.0100	< 0.0100	
Fluoranthene	206-44-0	0.0100	< 0.0100	
Fluorene	86-73-7	0.0100	< 0.0100	
Hexachlorobenzene	118-74-1	0.0100	< 0.0100	
Hexachlorobutadiene	87-68-3	0.0100	< 0.0100	
Hexachlorocyclopentadiene	77-47-4	0.0100	< 0.0100	
Hexachloroethane	67-72-1	0.0100	< 0.0100	
Hexachlorophene	70-30-4	0.0100	< 0.0100	
Hexachloropropene	1888-71-7	0.0100	< 0.0100	
Indene	95-13-6	0.0100	< 0.0100	
Indeno(1,2,3-cd)pyrene	193-39-5	0.0100	< 0.0100	
Isodrin	465-73-6	0.0100	< 0.0100	
Isophorone	78-59-1	0.0100	< 0.0100	
Isosafrole	120-58-1	0.0100	< 0.0100	
Kepone	143-50-0	0.0100	< 0.0100	
Methapyrilene	91-80-5	0.0100	< 0.0100	
Methyl methanesulfonate	66-27-3	0.0100	< 0.0100	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/4/2011 1759h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
n-Decane	124-18-5	0.0100	< 0.0100	
N-Nitrosodi-n-butylamine	924-16-3	0.0100	< 0.0100	
N-Nitrosodiethylamine	55-18-5	0.0100	< 0.0100	
N-Nitrosodimethylamine	62-75-9	0.0100	< 0.0100	
N-Nitrosodiphenylamine	86-30-6	0.0100	< 0.0100	
N-Nitrosodi-n-propylamine	621-64-7	0.0100	< 0.0100	
N-Nitrosomethylethylamine	10595-95-6	0.0100	< 0.0100	
N-Nitrosomorpholine	59-89-2	0.0100	< 0.0100	
N-Nitrosopiperidine	100-75-4	0.0100	< 0.0100	
N-Nitrosopyrrolidine	930-55-2	0.0100	< 0.0100	
n-Octadecane	593-45-3	0.0100	< 0.0100	
Naphthalene	91-20-3	0.0100	< 0.0100	
Nitrobenzene	98-95-3	0.0100	< 0.0100	
Nitroquinoline-1-oxide	56-57-5	0.0100	< 0.0100	
O,O,O-Triethyl phosphorothioate	126-68-1	0.0100	< 0.0100	
o-Toluidine	95-53-4	0.0100	< 0.0100	
Parathion	56-38-2	0.0100	< 0.0100	
Methyl parathion	298-00-0	0.0100	< 0.0100	
Pentachlorobenzene	608-93-5	0.0100	< 0.0100	
Pentachloronitrobenzene	82-68-8	0.0100	< 0.0100	
Pentachlorophenol	87-86-5	0.0100	< 0.0100	
Phenacetin	62-44-2	0.0100	< 0.0100	
Phenanthrene	85-01-8	0.0100	< 0.0100	
Phenol	108-95-2	0.0100	< 0.0100	
Phorate	298-02-2	0.0100	< 0.0100	
Pronamide	23950-58-5	0.0100	< 0.0100	
Pyrene	129-00-0	0.0100	< 0.0100	
Pyridine	110-86-1	0.0100	< 0.0100	
Quinoline	91-22-5	0.0100	< 0.0100	
Safrole	94-59-7	0.0100	< 0.0100	
Tetraethyl dithiopyrophosphate	3689-24-5	0.0100	< 0.0100	
Thionazin	297-97-2	0.0100	< 0.0100	
Surr: 2,4,6-Tribromophenol	118-79-6	10-159	65.6	
Surr: 2-Fluorobiphenyl	321-60-8	10-124	46.9	
Surr: 2-Fluorophenol	367-12-4	14-106	31.8	
Surr: Nitrobenzene-d5	4165-60-0	10-180	43.6	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/4/2011 1759h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: Phenol-d6	13127-88-3	10-122	24.8	
Surr: Terphenyl-d14	1718-51-0	10-199	114	

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ORGANIC ANALYTICAL REPORT

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2
Collection Date: 10/27/2011 0935h
Received Date: 10/27/2011 1346h **Method:** SW8270D

Analytical Results SVOA SPLP by GC/MS Method 8270D/1312/3510C

Analyzed: 11/4/2011 1825h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1´-Biphenyl	92-52-4	0.0100	< 0.0100	
1,2,4,5-Tetrachlorobenzene	95-94-3	0.0100	< 0.0100	
1,2,4-Trichlorobenzene	120-82-1	0.0100	< 0.0100	
1,2-Dichlorobenzene	95-50-1	0.0100	< 0.0100	
1,3,5-Trinitrobenzene	99-35-4	0.0100	< 0.0100	
1,4-Naphthoquinone	130-15-4	0.0100	< 0.0100	
1,3-Dichlorobenzene	541-73-1	0.0100	< 0.0100	
1,3-Dinitrobenzene	99-65-0	0.0100	< 0.0100	
1,4-Dichlorobenzene	106-46-7	0.0100	< 0.0100	
1,4-Phenylenediamine	106-50-3	0.0100	< 0.0100	
1-Chloronaphthalene	90-13-1	0.0100	< 0.0100	
1-Methylnaphthalene	90-12-0	0.0100	< 0.0100	
1-Naphthylamine	134-32-7	0.0100	< 0.0100	
2,3,4,6-Tetrachlorophenol	58-90-2	0.0100	< 0.0100	
2,4,5-Trichlorophenol	95-95-4	0.0100	< 0.0100	
2,4,6-Trichlorophenol	88-06-2	0.0100	< 0.0100	
2,4-Dichlorophenol	120-83-2	0.0100	< 0.0100	
2,4-Dimethylphenol	105-67-9	0.0100	< 0.0100	
2,4-Dinitrophenol	51-28-5	0.0200	< 0.0200	
2,4-Dinitrotoluene	121-14-2	0.0100	< 0.0100	
2,6-Dichlorophenol	87-65-0	0.0100	< 0.0100	
2,6-Dinitrotoluene	606-20-2	0.0100	< 0.0100	
2-Acetylaminofluorene	53-96-3	0.0100	< 0.0100	
2-Chloronaphthalene	91-58-7	0.0100	< 0.0100	
2-Chlorophenol	95-57-8	0.0100	< 0.0100	
2-Methylnaphthalene	91-57-6	0.0100	< 0.0100	
2-Methylphenol	95-48-7	0.0100	< 0.0100	
2-Naphthylamine	91-59-8	0.0100	< 0.0100	
2-Nitroaniline	88-74-4	0.0100	< 0.0100	
2-Nitrophenol	88-75-5	0.0100	< 0.0100	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/4/2011 1825h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
2-Picoline	109-06-8	0.0100	< 0.0100	
3&4-Methylphenol		0.0100	< 0.0100	
3,3´-Dichlorobenzidine	91-94-1	0.0100	< 0.0100	
3,3´-Dimethylbenzidine	119-93-7	0.0100	< 0.0100	
3-Methylcholanthrene	56-49-5	0.0100	< 0.0100	
3-Nitroaniline	99-09-2	0.0100	< 0.0100	
4,6-Dinitro-2-methylphenol	534-52-1	0.0100	< 0.0100	
4-Aminobiphenyl	92-67-1	0.0100	< 0.0100	
4-Bromophenyl phenyl ether	101-55-3	0.0100	< 0.0100	
4-Chloro-3-methylphenol	59-50-7	0.0100	< 0.0100	
4-Chloroaniline	106-47-8	0.0100	< 0.0100	
4-Chlorophenyl phenyl ether	7005-72-3	0.0100	< 0.0100	
4-Nitroaniline	100-01-6	0.0100	< 0.0100	
4-Nitrophenol	100-02-7	0.0100	< 0.0100	
5-Nitro-o-toluidine	99-55-8	0.0100	< 0.0100	
7,12-Dimethylbenz(a)anthracene	57-97-6	0.0100	< 0.0100	
a,a-Dimethylphenethylamine	122-09-8	0.0100	< 0.0100	
Acenaphthene	83-32-9	0.0100	< 0.0100	
Acenaphthylene	208-96-8	0.0100	< 0.0100	
Acetophenone	98-86-2	0.0100	< 0.0100	
alpha-Terpineol	98-55-5	0.0100	< 0.0100	
Aniline	62-53-3	0.0100	< 0.0100	
Anthracene	120-12-7	0.0100	< 0.0100	
Aramite	140-57-8	0.0100	< 0.0100	
Azobenzene	103-33-3	0.0100	< 0.0100	
Benz(a)anthracene	56-55-3	0.0100	< 0.0100	
Benzidine	92-87-5	0.0100	< 0.0100	
Benzo(a)pyrene	50-32-8	0.0100	< 0.0100	
Benzo(b)fluoranthene	205-99-2	0.0100	< 0.0100	
Benzo(g,h,i)perylene	191-24-2	0.0100	< 0.0100	
Benzo(k)fluoranthene	207-08-9	0.0100	< 0.0100	
Benzoic acid	65-85-0	0.0200	0.0354	
Benzyl alcohol	100-51-6	0.0100	< 0.0100	
Bis(2-chloroethoxy)methane	111-91-1	0.0100	< 0.0100	
Bis(2-chloroethyl) ether	111-44-4	0.0100	< 0.0100	
Bis(2-chloroisopropyl) ether	108-60-1	0.0100	< 0.0100	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/4/2011 1825h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Bis(2-ethylhexyl) phthalate	117-81-7	0.0100	< 0.0100	
bis(2-ethylhexyl)adipate	103-23-1	0.0100	< 0.0100	
Butyl benzyl phthalate	85-68-7	0.0100	< 0.0100	
Carbazole	86-74-8	0.0100	< 0.0100	
Chlorobenzilate	510-15-6	0.0100	< 0.0100	
Chrysene	218-01-9	0.0100	< 0.0100	
Di-n-butyl phthalate	84-74-2	0.0100	< 0.0100	
Di-n-octyl phthalate	117-84-0	0.0100	< 0.0100	
Diallate (cis or trans)	2303-16-4	0.0100	< 0.0100	
Dibenz(a,h)anthracene	53-70-3	0.0100	< 0.0100	
Dibenzofuran	132-64-9	0.0100	< 0.0100	
Diethyl phthalate	84-66-2	0.0100	< 0.0100	
Dimethoate	60-51-5	0.0100	< 0.0100	
Dimethyl phthalate	131-11-3	0.0100	< 0.0100	
Dimethylaminoazobenzene	60-11-7	0.0100	< 0.0100	
Dinoseb	88-85-7	0.0100	< 0.0100	
Diphenylamine	122-39-4	0.0100	< 0.0100	
Disulfoton	298-04-4	0.0100	< 0.0100	
Ethyl methanesulfonate	62-50-0	0.0100	< 0.0100	
Famphur	52-85-7	0.0100	< 0.0100	
Fluoranthene	206-44-0	0.0100	< 0.0100	
Fluorene	86-73-7	0.0100	< 0.0100	
Hexachlorobenzene	118-74-1	0.0100	< 0.0100	
Hexachlorobutadiene	87-68-3	0.0100	< 0.0100	
Hexachlorocyclopentadiene	77-47-4	0.0100	< 0.0100	
Hexachloroethane	67-72-1	0.0100	< 0.0100	
Hexachlorophene	70-30-4	0.0100	< 0.0100	
Hexachloropropene	1888-71-7	0.0100	< 0.0100	
Indene	95-13-6	0.0100	< 0.0100	
Indeno(1,2,3-cd)pyrene	193-39-5	0.0100	< 0.0100	
Isodrin	465-73-6	0.0100	< 0.0100	
Isophorone	78-59-1	0.0100	< 0.0100	
Isosafrole	120-58-1	0.0100	< 0.0100	
Kepone	143-50-0	0.0100	< 0.0100	
Methapyrilene	91-80-5	0.0100	< 0.0100	
Methyl methanesulfonate	66-27-3	0.0100	< 0.0100	

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Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/4/2011 1825h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
n-Decane	124-18-5	0.0100	< 0.0100	
N-Nitrosodi-n-butylamine	924-16-3	0.0100	< 0.0100	
N-Nitrosodiethylamine	55-18-5	0.0100	< 0.0100	
N-Nitrosodimethylamine	62-75-9	0.0100	< 0.0100	
N-Nitrosodiphenylamine	86-30-6	0.0100	< 0.0100	
N-Nitrosodi-n-propylamine	621-64-7	0.0100	< 0.0100	
N-Nitrosomethylethylamine	10595-95-6	0.0100	< 0.0100	
N-Nitrosomorpholine	59-89-2	0.0100	< 0.0100	
N-Nitrosopiperidine	100-75-4	0.0100	< 0.0100	
N-Nitrosopyrrolidine	930-55-2	0.0100	< 0.0100	
n-Octadecane	593-45-3	0.0100	< 0.0100	
Naphthalene	91-20-3	0.0100	< 0.0100	
Nitrobenzene	98-95-3	0.0100	< 0.0100	
Nitroquinoline-1-oxide	56-57-5	0.0100	< 0.0100	
O,O,O-Triethyl phosphorothioate	126-68-1	0.0100	< 0.0100	
o-Toluidine	95-53-4	0.0100	< 0.0100	
Parathion	56-38-2	0.0100	< 0.0100	
Methyl parathion	298-00-0	0.0100	< 0.0100	
Pentachlorobenzene	608-93-5	0.0100	< 0.0100	
Pentachloronitrobenzene	82-68-8	0.0100	< 0.0100	
Pentachlorophenol	87-86-5	0.0100	< 0.0100	
Phenacetin	62-44-2	0.0100	< 0.0100	
Phenanthrene	85-01-8	0.0100	< 0.0100	
Phenol	108-95-2	0.0100	< 0.0100	
Phorate	298-02-2	0.0100	< 0.0100	
Pronamide	23950-58-5	0.0100	< 0.0100	
Pyrene	129-00-0	0.0100	< 0.0100	
Pyridine	110-86-1	0.0100	< 0.0100	
Quinoline	91-22-5	0.0100	< 0.0100	
Safrole	94-59-7	0.0100	< 0.0100	
Tetraethyl dithiopyrophosphate	3689-24-5	0.0100	< 0.0100	
Thionazin	297-97-2	0.0100	< 0.0100	
Surr: 2,4,6-Tribromophenol	118-79-6	10-159	**85.9**	
Surr: 2-Fluorobiphenyl	321-60-8	10-124	**42.7**	
Surr: 2-Fluorophenol	367-12-4	14-106	**31.6**	
Surr: Nitrobenzene-d5	4165-60-0	10-180	**65.6**	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/4/2011 1825h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: Phenol-d6	13127-88-3	10-122	**22.3**	
Surr: Terphenyl-d14	1718-51-0	10-199	**106**	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3
Collection Date: 10/27/2011 0940h
Received Date: 10/27/2011 1346h **Method:** SW8270D

Analytical Results SVOA SPLP by GC/MS Method 8270D/1312/3510C

Analyzed: 11/4/2011 1851h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1´-Biphenyl	92-52-4	0.0100	< 0.0100	
1,2,4,5-Tetrachlorobenzene	95-94-3	0.0100	< 0.0100	
1,2,4-Trichlorobenzene	120-82-1	0.0100	< 0.0100	
1,2-Dichlorobenzene	95-50-1	0.0100	< 0.0100	
1,3,5-Trinitrobenzene	99-35-4	0.0100	< 0.0100	
1,4-Naphthoquinone	130-15-4	0.0100	< 0.0100	
1,3-Dichlorobenzene	541-73-1	0.0100	< 0.0100	
1,3-Dinitrobenzene	99-65-0	0.0100	< 0.0100	
1,4-Dichlorobenzene	106-46-7	0.0100	< 0.0100	
1,4-Phenylenediamine	106-50-3	0.0100	< 0.0100	
1-Chloronaphthalene	90-13-1	0.0100	< 0.0100	
1-Methylnaphthalene	90-12-0	0.0100	< 0.0100	
1-Naphthylamine	134-32-7	0.0100	< 0.0100	
2,3,4,6-Tetrachlorophenol	58-90-2	0.0100	< 0.0100	
2,4,5-Trichlorophenol	95-95-4	0.0100	< 0.0100	
2,4,6-Trichlorophenol	88-06-2	0.0100	< 0.0100	
2,4-Dichlorophenol	120-83-2	0.0100	< 0.0100	
2,4-Dimethylphenol	105-67-9	0.0100	< 0.0100	
2,4-Dinitrophenol	51-28-5	0.0200	< 0.0200	
2,4-Dinitrotoluene	121-14-2	0.0100	< 0.0100	
2,6-Dichlorophenol	87-65-0	0.0100	< 0.0100	
2,6-Dinitrotoluene	606-20-2	0.0100	< 0.0100	
2-Acetylaminofluorene	53-96-3	0.0100	< 0.0100	
2-Chloronaphthalene	91-58-7	0.0100	< 0.0100	
2-Chlorophenol	95-57-8	0.0100	< 0.0100	
2-Methylnaphthalene	91-57-6	0.0100	< 0.0100	
2-Methylphenol	95-48-7	0.0100	< 0.0100	
2-Naphthylamine	91-59-8	0.0100	< 0.0100	
2-Nitroaniline	88-74-4	0.0100	< 0.0100	
2-Nitrophenol	88-75-5	0.0100	< 0.0100	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/4/2011 1851h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
2-Picoline	109-06-8	0.0100	< 0.0100	
3&4-Methylphenol		0.0100	< 0.0100	
3,3´-Dichlorobenzidine	91-94-1	0.0100	< 0.0100	
3,3´-Dimethylbenzidine	119-93-7	0.0100	< 0.0100	
3-Methylcholanthrene	56-49-5	0.0100	< 0.0100	
3-Nitroaniline	99-09-2	0.0100	< 0.0100	
4,6-Dinitro-2-methylphenol	534-52-1	0.0100	< 0.0100	
4-Aminobiphenyl	92-67-1	0.0100	< 0.0100	
4-Bromophenyl phenyl ether	101-55-3	0.0100	< 0.0100	
4-Chloro-3-methylphenol	59-50-7	0.0100	< 0.0100	
4-Chloroaniline	106-47-8	0.0100	< 0.0100	
4-Chlorophenyl phenyl ether	7005-72-3	0.0100	< 0.0100	
4-Nitroaniline	100-01-6	0.0100	< 0.0100	
4-Nitrophenol	100-02-7	0.0100	< 0.0100	
5-Nitro-o-toluidine	99-55-8	0.0100	< 0.0100	
7,12-Dimethylbenz(a)anthracene	57-97-6	0.0100	< 0.0100	
a,a-Dimethylphenethylamine	122-09-8	0.0100	< 0.0100	
Acenaphthene	83-32-9	0.0100	< 0.0100	
Acenaphthylene	208-96-8	0.0100	< 0.0100	
Acetophenone	98-86-2	0.0100	< 0.0100	
alpha-Terpineol	98-55-5	0.0100	< 0.0100	
Aniline	62-53-3	0.0100	< 0.0100	
Anthracene	120-12-7	0.0100	< 0.0100	
Aramite	140-57-8	0.0100	< 0.0100	
Azobenzene	103-33-3	0.0100	< 0.0100	
Benz(a)anthracene	56-55-3	0.0100	< 0.0100	
Benzidine	92-87-5	0.0100	< 0.0100	
Benzo(a)pyrene	50-32-8	0.0100	< 0.0100	
Benzo(b)fluoranthene	205-99-2	0.0100	< 0.0100	
Benzo(g,h,i)perylene	191-24-2	0.0100	< 0.0100	
Benzo(k)fluoranthene	207-08-9	0.0100	< 0.0100	
Benzoic acid	65-85-0	0.0200	**0.0259**	
Benzyl alcohol	100-51-6	0.0100	< 0.0100	
Bis(2-chloroethoxy)methane	111-91-1	0.0100	< 0.0100	
Bis(2-chloroethyl) ether	111-44-4	0.0100	< 0.0100	
Bis(2-chloroisopropyl) ether	108-60-1	0.0100	< 0.0100	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/4/2011 1851h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Bis(2-ethylhexyl) phthalate	117-81-7	0.0100	< 0.0100	
bis(2-ethylhexyl)adipate	103-23-1	0.0100	< 0.0100	
Butyl benzyl phthalate	85-68-7	0.0100	< 0.0100	
Carbazole	86-74-8	0.0100	< 0.0100	
Chlorobenzilate	510-15-6	0.0100	< 0.0100	
Chrysene	218-01-9	0.0100	< 0.0100	
Di-n-butyl phthalate	84-74-2	0.0100	< 0.0100	
Di-n-octyl phthalate	117-84-0	0.0100	< 0.0100	
Diallate (cis or trans)	2303-16-4	0.0100	< 0.0100	
Dibenz(a,h)anthracene	53-70-3	0.0100	< 0.0100	
Dibenzofuran	132-64-9	0.0100	< 0.0100	
Diethyl phthalate	84-66-2	0.0100	< 0.0100	
Dimethoate	60-51-5	0.0100	< 0.0100	
Dimethyl phthalate	131-11-3	0.0100	< 0.0100	
Dimethylaminoazobenzene	60-11-7	0.0100	< 0.0100	
Dinoseb	88-85-7	0.0100	< 0.0100	
Diphenylamine	122-39-4	0.0100	< 0.0100	
Disulfoton	298-04-4	0.0100	< 0.0100	
Ethyl methanesulfonate	62-50-0	0.0100	< 0.0100	
Famphur	52-85-7	0.0100	< 0.0100	
Fluoranthene	206-44-0	0.0100	< 0.0100	
Fluorene	86-73-7	0.0100	< 0.0100	
Hexachlorobenzene	118-74-1	0.0100	< 0.0100	
Hexachlorobutadiene	87-68-3	0.0100	< 0.0100	
Hexachlorocyclopentadiene	77-47-4	0.0100	< 0.0100	
Hexachloroethane	67-72-1	0.0100	< 0.0100	
Hexachlorophene	70-30-4	0.0100	< 0.0100	
Hexachloropropene	1888-71-7	0.0100	< 0.0100	
Indene	95-13-6	0.0100	< 0.0100	
Indeno(1,2,3-cd)pyrene	193-39-5	0.0100	< 0.0100	
Isodrin	465-73-6	0.0100	< 0.0100	
Isophorone	78-59-1	0.0100	< 0.0100	
Isosafrole	120-58-1	0.0100	< 0.0100	
Kepone	143-50-0	0.0100	< 0.0100	
Methapyrilene	91-80-5	0.0100	< 0.0100	
Methyl methanesulfonate	66-27-3	0.0100	< 0.0100	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/4/2011 1851h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
n-Decane	124-18-5	0.0100	< 0.0100	
N-Nitrosodi-n-butylamine	924-16-3	0.0100	< 0.0100	
N-Nitrosodiethylamine	55-18-5	0.0100	< 0.0100	
N-Nitrosodimethylamine	62-75-9	0.0100	< 0.0100	
N-Nitrosodiphenylamine	86-30-6	0.0100	< 0.0100	
N-Nitrosodi-n-propylamine	621-64-7	0.0100	< 0.0100	
N-Nitrosomethylethylamine	10595-95-6	0.0100	< 0.0100	
N-Nitrosomorpholine	59-89-2	0.0100	< 0.0100	
N-Nitrosopiperidine	100-75-4	0.0100	< 0.0100	
N-Nitrosopyrrolidine	930-55-2	0.0100	< 0.0100	
n-Octadecane	593-45-3	0.0100	< 0.0100	
Naphthalene	91-20-3	0.0100	< 0.0100	
Nitrobenzene	98-95-3	0.0100	< 0.0100	
Nitroquinoline-1-oxide	56-57-5	0.0100	< 0.0100	
O,O,O-Triethyl phosphorothioate	126-68-1	0.0100	< 0.0100	
o-Toluidine	95-53-4	0.0100	< 0.0100	
Parathion	56-38-2	0.0100	< 0.0100	
Methyl parathion	298-00-0	0.0100	< 0.0100	
Pentachlorobenzene	608-93-5	0.0100	< 0.0100	
Pentachloronitrobenzene	82-68-8	0.0100	< 0.0100	
Pentachlorophenol	87-86-5	0.0100	< 0.0100	
Phenacetin	62-44-2	0.0100	< 0.0100	
Phenanthrene	85-01-8	0.0100	< 0.0100	
Phenol	108-95-2	0.0100	< 0.0100	
Phorate	298-02-2	0.0100	< 0.0100	
Pronamide	23950-58-5	0.0100	< 0.0100	
Pyrene	129-00-0	0.0100	< 0.0100	
Pyridine	110-86-1	0.0100	< 0.0100	
Quinoline	91-22-5	0.0100	< 0.0100	
Safrole	94-59-7	0.0100	< 0.0100	
Tetraethyl dithiopyrophosphate	3689-24-5	0.0100	< 0.0100	
Thionazin	297-97-2	0.0100	< 0.0100	
Surr: 2,4,6-Tribromophenol	118-79-6	10-159	90.4	
Surr: 2-Fluorobiphenyl	321-60-8	10-124	40.5	
Surr: 2-Fluorophenol	367-12-4	14-106	32.3	
Surr: Nitrobenzene-d5	4165-60-0	10-180	45.2	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/4/2011 1851h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: Phenol-d6	13127-88-3	10-122	25.2	
Surr: Terphenyl-d14	1718-51-0	10-199	110	

[1] - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.
Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

ORGANIC ANALYTICAL REPORT

Client: IGES
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1
Collection Date: 10/27/2011 0930h
Received Date: 10/27/2011 1346h

Contact: John Wallace
Method: SW8260C

Analytical Results — VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 11/3/2011 0435h
SPLP Prep Date: 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	< 0.00200	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	< 0.00200	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	< 0.0100	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	

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Jose Rocha
QA Officer

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/3/2011 0435h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	**0.0195**	
Acetonitrile	75-05-8	0.00500	**0.0171**	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	< 0.00200	
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	

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Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/3/2011 0435h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Isobutyl alcohol	78-83-1	0.100	< 0.100	
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	< 0.00200	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	< 0.00200	
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	< 0.00200	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	< 0.00200	
o-Xylene	95-47-6	0.00200	< 0.00200	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	< 0.00200	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	

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Kyle F. Gross
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Jose Rocha
QA Officer

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/3/2011 0435h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: 1,2-Dichloroethane-d4	17060-07-0	77-144	**109**	
Surr: 4-Bromofluorobenzene	460-00-4	80-123	**97.7**	
Surr: Dibromofluoromethane	1868-53-7	80-124	**98.7**	
Surr: Toluene-d8	2037-26-5	80-125	**102**	

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Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2
Collection Date: 10/27/2011 0935h
Received Date: 10/27/2011 1346h **Method:** SW8260C

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 11/3/2011 0457h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	< 0.00200	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	< 0.00200	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	< 0.0100	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/3/2011 0457h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	**0.0178**	
Acetonitrile	75-05-8	0.00500	**0.0134**	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	< 0.00200	
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/3/2011 0457h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Isobutyl alcohol	78-83-1	0.100	< 0.100	
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	< 0.00200	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	< 0.00200	
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	< 0.00200	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	< 0.00200	
o-Xylene	95-47-6	0.00200	< 0.00200	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	< 0.00200	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/3/2011 0457h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: 1,2-Dichloroethane-d4	17060-07-0	77-144	**111**	
Surr: 4-Bromofluorobenzene	460-00-4	80-123	**98.0**	
Surr: Dibromofluoromethane	1868-53-7	80-124	**99.2**	
Surr: Toluene-d8	2037-26-5	80-125	**101**	

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

ORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3
Collection Date: 10/27/2011 0940h
Received Date: 10/27/2011 1346h **Method:** SW8260C

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 11/3/2011 0519h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	< 0.00200	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	< 0.00200	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	< 0.0100	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	

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Jose Rocha
QA Officer

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/3/2011 0519h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	0.0152	
Acetonitrile	75-05-8	0.00500	0.0118	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	< 0.00200	
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/3/2011 0519h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Isobutyl alcohol	78-83-1	0.100	< 0.100	
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	< 0.00200	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	< 0.00200	
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	< 0.00200	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	< 0.00200	
o-Xylene	95-47-6	0.00200	< 0.00200	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	< 0.00200	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/3/2011 0519h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: 1,2-Dichloroethane-d4	17060-07-0	77-144	112	
Surr: 4-Bromofluorobenzene	460-00-4	80-123	99.1	
Surr: Dibromofluoromethane	1868-53-7	80-124	99.2	
Surr: Toluene-d8	2037-26-5	80-125	99.4	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-15285	Boron	mg/L	SW6010C	2.03	2.000	0	102	80-120				10/31/2011 1201h
LCS-15285	Calcium	mg/L	SW6010C	20.1	20.00	0	101	80-120				10/31/2011 1201h
LCS-15285	Chromium	mg/L	SW6010C	0.391	0.4000	0	97.8	80-120				10/31/2011 1201h
LCS-15285	Iron	mg/L	SW6010C	2.01	2.000	0	101	80-120				10/31/2011 1201h
LCS-15285	Magnesium	mg/L	SW6010C	19.8	20.00	0	99.0	80-120				10/31/2011 1201h
LCS-15285	Molybdenum	mg/L	SW6010C	0.410	0.4000	0	103	80-120				10/31/2011 1632h
LCS-15285	Potassium	mg/L	SW6010C	19.2	20.00	0	95.9	80-120				10/31/2011 1632h
LCS-15285	Sodium	mg/L	SW6010C	20.2	20.00	0	101	80-120				10/31/2011 1201h
LCS-15285	Tin	mg/L	SW6010C	1.83	2.000	0	91.5	80-120				10/31/2011 1201h
LCS-15285	Vanadium	mg/L	SW6010C	0.403	0.4000	0	101	80-120				10/31/2011 1201h
LCS-15285	Antimony	mg/L	SW6020A	0.403	0.4000	0	101	85-115				10/29/2011 0023h
LCS-15285	Arsenic	mg/L	SW6020A	0.400	0.4000	0	100	85-115				10/29/2011 0023h
LCS-15285	Barium	mg/L	SW6020A	0.402	0.4000	0	100	85-115				10/29/2011 0023h
LCS-15285	Beryllium	mg/L	SW6020A	0.399	0.4000	0	99.7	85-115				10/29/2011 0023h
LCS-15285	Cadmium	mg/L	SW6020A	0.401	0.4000	0	100	85-115				10/29/2011 0023h
LCS-15285	Copper	mg/L	SW6020A	0.398	0.4000	0	99.6	85-115				10/29/2011 0023h
LCS-15285	Lead	mg/L	SW6020A	0.402	0.4000	0	100	85-115				10/29/2011 0023h
LCS-15285	Manganese	mg/L	SW6020A	0.398	0.4000	0	99.6	85-115				10/29/2011 0023h
LCS-15285	Nickel	mg/L	SW6020A	0.399	0.4000	0	99.7	85-115				10/29/2011 0023h
LCS-15285	Selenium	mg/L	SW6020A	0.400	0.4000	0	99.9	85-115				10/29/2011 0023h
LCS-15285	Silver	mg/L	SW6020A	0.400	0.4000	0	100	85-115				10/29/2011 0023h
LCS-15285	Strontium	mg/L	SW6020A	0.396	0.4000	0	98.9	85-115				10/29/2011 0023h
LCS-15285	Thallium	mg/L	SW6020A	0.398	0.4000	0	99.6	85-115				10/29/2011 0023h

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-15285	Zinc	mg/L	SW6020A	2.05	2.000	0	102	85-115				10/29/2011 0023h
LCS-15289	Mercury	mg/L	SW7470A	0.00339	0.003330	0	102	80-120				10/31/2011 1006h

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15285	Boron	mg/L	SW6010C	< 0.500				-				10/31/2011 1157h
MB-15285	Calcium	mg/L	SW6010C	< 1.00				-				10/31/2011 1157h
MB-15285	Chromium	mg/L	SW6010C	< 0.0100				-				10/31/2011 1157h
MB-15285	Iron	mg/L	SW6010C	< 0.100				-				10/31/2011 1157h
MB-15285	Lithium	mg/L	SW6010C	< 0.100				-				11/1/2011 1926h
MB-15285	Magnesium	mg/L	SW6010C	< 1.00				-				10/31/2011 1157h
MB-15285	Molybdenum	mg/L	SW6010C	< 0.0200				-				10/31/2011 1628h
MB-15285	Potassium	mg/L	SW6010C	< 1.00				-				10/31/2011 1628h
MB-15285	Sodium	mg/L	SW6010C	< 1.00				-				10/31/2011 1157h
MB-15285	Tin	mg/L	SW6010C	< 0.500				-				10/31/2011 1157h
MB-15285	Vanadium	mg/L	SW6010C	< 0.0500				-				10/31/2011 1157h
MB-SPLP-15271	Boron	mg/L	SW6010C	< 0.500				-				10/31/2011 1205h
MB-SPLP-15271	Calcium	mg/L	SW6010C	< 1.00				-				10/31/2011 1205h
MB-SPLP-15271	Chromium	mg/L	SW6010C	< 0.0100				-				10/31/2011 1205h
MB-SPLP-15271	Iron	mg/L	SW6010C	< 0.100				-				10/31/2011 1205h
MB-SPLP-15271	Lithium	mg/L	SW6010C	< 0.100				-				11/1/2011 1929h
MB-SPLP-15271	Magnesium	mg/L	SW6010C	< 1.00				-				10/31/2011 1205h
MB-SPLP-15271	Molybdenum	mg/L	SW6010C	< 0.0200				-				10/31/2011 1636h
MB-SPLP-15271	Potassium	mg/L	SW6010C	< 1.00				-				10/31/2011 1636h
MB-SPLP-15271	Sodium	mg/L	SW6010C	< 1.00				-				10/31/2011 1205h
MB-SPLP-15271	Tin	mg/L	SW6010C	< 0.500				-				10/31/2011 1205h
MB-SPLP-15271	Vanadium	mg/L	SW6010C	< 0.0500				-				10/31/2011 1205h
MB-15285	Antimony	mg/L	SW6020A	< 0.00500				-				10/29/2011 0018h

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Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15285	Arsenic	mg/L	SW6020A	< 0.00300				-				10/29/2011 0018h
MB-15285	Barium	mg/L	SW6020A	< 0.00200				-				10/29/2011 0018h
MB-15285	Beryllium	mg/L	SW6020A	< 0.00300				-				10/29/2011 0018h
MB-15285	Cadmium	mg/L	SW6020A	< 0.000900				-				10/29/2011 0018h
MB-15285	Copper	mg/L	SW6020A	< 0.00400				-				10/29/2011 0018h
MB-15285	Lead	mg/L	SW6020A	< 0.00200				-				10/29/2011 0018h
MB-15285	Manganese	mg/L	SW6020A	< 0.00600				-				10/29/2011 0018h
MB-15285	Nickel	mg/L	SW6020A	< 0.00400				-				10/29/2011 0018h
MB-15285	Selenium	mg/L	SW6020A	< 0.00400				-				10/29/2011 0018h
MB-15285	Silver	mg/L	SW6020A	< 0.00200				-				10/29/2011 0018h
MB-15285	Strontium	mg/L	SW6020A	< 0.00400				-				10/29/2011 0018h
MB-15285	Thallium	mg/L	SW6020A	< 0.00200				-				10/29/2011 0018h
MB-15285	Zinc	mg/L	SW6020A	< 0.0250				-				10/29/2011 0018h
MB-SPLP-15271	Antimony	mg/L	SW6020A	< 0.00500				-				10/29/2011 0012h
MB-SPLP-15271	Arsenic	mg/L	SW6020A	< 0.00300				-				10/29/2011 0012h
MB-SPLP-15271	Barium	mg/L	SW6020A	< 0.00200				-				10/29/2011 0012h
MB-SPLP-15271	Beryllium	mg/L	SW6020A	< 0.00300				-				10/29/2011 0012h
MB-SPLP-15271	Cadmium	mg/L	SW6020A	< 0.000900				-				10/29/2011 0012h
MB-SPLP-15271	Copper	mg/L	SW6020A	< 0.00400				-				10/29/2011 0012h
MB-SPLP-15271	Lead	mg/L	SW6020A	< 0.00200				-				10/29/2011 0012h
MB-SPLP-15271	Manganese	mg/L	SW6020A	< 0.00600				-				10/29/2011 0012h
MB-SPLP-15271	Nickel	mg/L	SW6020A	< 0.00400				-				10/29/2011 0012h
MB-SPLP-15271	Selenium	mg/L	SW6020A	< 0.00400				-				10/29/2011 0012h

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Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15271	Silver	mg/L	SW6020A	< 0.00200				-				10/29/2011 0012h
MB-SPLP-15271	Strontium	mg/L	SW6020A	< 0.00400				-				10/29/2011 0012h
MB-SPLP-15271	Thallium	mg/L	SW6020A	< 0.00200				-				10/29/2011 0012h
MB-SPLP-15271	Zinc	mg/L	SW6020A	< 0.0250				-				10/29/2011 0012h
MB-15289	Mercury	mg/L	SW7470A	< 0.00100				-				10/31/2011 1005h
MB-SPLP-15271	Mercury	mg/L	SW7470A	< 0.00100				-				10/31/2011 1025h

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-001AMS	Boron	mg/L	SW6010C	2.80	2.000	0.8400	98.0	75-125				10/31/2011 1222h
1110545-001AMS	Calcium	mg/L	SW6010C	23.1	20.00	3.440	98.3	75-125				10/31/2011 1222h
1110545-001AMS	Chromium	mg/L	SW6010C	0.373	0.4000	0	93.2	75-125				10/31/2011 1222h
1110545-001AMS	Iron	mg/L	SW6010C	2.02	2.000	0	101	75-125				10/31/2011 1222h
1110545-001AMS	Magnesium	mg/L	SW6010C	20.9	20.00	1.140	98.8	75-125				10/31/2011 1222h
1110545-001AMS	Molybdenum	mg/L	SW6010C	0.527	0.4000	0.1290	99.6	75-125				10/31/2011 1644h
1110545-001AMS	Potassium	mg/L	SW6010C	23.0	20.00	4.226	93.8	75-125				10/31/2011 1644h
1110545-001AMS	Sodium	mg/L	SW6010C	55.3	20.00	36.90	92.0	75-125				10/31/2011 1222h
1110545-001AMS	Tin	mg/L	SW6010C	1.81	2.000	0	90.5	75-125				10/31/2011 1222h
1110545-001AMS	Vanadium	mg/L	SW6010C	0.447	0.4000	0.06380	95.8	75-125				10/31/2011 1222h
1110545-001AMS	Antimony	mg/L	SW6020A	0.403	0.4000	0.009231	98.5	75-125				10/29/2011 0046h
1110545-001AMS	Arsenic	mg/L	SW6020A	0.436	0.4000	0.03671	99.7	75-125				10/29/2011 0046h
1110545-001AMS	Barium	mg/L	SW6020A	0.443	0.4000	0.04833	98.7	75-125				10/29/2011 0046h
1110545-001AMS	Beryllium	mg/L	SW6020A	0.402	0.4000	0	101	75-125				10/29/2011 0046h
1110545-001AMS	Cadmium	mg/L	SW6020A	0.399	0.4000	0	99.7	75-125				10/29/2011 0046h
1110545-001AMS	Copper	mg/L	SW6020A	0.400	0.4000	0	100	75-125				10/29/2011 0046h
1110545-001AMS	Lead	mg/L	SW6020A	0.401	0.4000	0	100	75-125				10/29/2011 0046h
1110545-001AMS	Manganese	mg/L	SW6020A	0.393	0.4000	0	98.4	75-125				10/29/2011 0046h
1110545-001AMS	Nickel	mg/L	SW6020A	0.395	0.4000	0	98.9	75-125				10/29/2011 0046h
1110545-001AMS	Selenium	mg/L	SW6020A	0.407	0.4000	0.007856	99.7	75-125				10/29/2011 0046h
1110545-001AMS	Silver	mg/L	SW6020A	0.400	0.4000	0	99.9	75-125				10/29/2011 0046h
1110545-001AMS	Strontium	mg/L	SW6020A	0.459	0.4000	0.06864	97.6	75-125				10/29/2011 0046h
1110545-001AMS	Thallium	mg/L	SW6020A	0.398	0.4000	0.0001900	99.5	75-125				10/29/2011 0046h

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-001AMS	Zinc	mg/L	SW6020A	2.07	2.000	0.01842	102	75-125				10/29/2011 0046h
1110545-001AMS	Mercury	mg/L	SW7470A	0.00313	0.003330	0	94.1	80-120				10/31/2011 1014h

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Jose Rocha
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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-001AMSD	Boron	mg/L	SW6010C	2.88	2.000	0.8400	102	75-125	2.82	20		10/31/2011 1226h
1110545-001AMSD	Calcium	mg/L	SW6010C	22.8	20.00	3.440	96.8	75-125	1.31	20		10/31/2011 1226h
1110545-001AMSD	Chromium	mg/L	SW6010C	0.383	0.4000	0	95.8	75-125	2.65	20		10/31/2011 1226h
1110545-001AMSD	Iron	mg/L	SW6010C	1.99	2.000	0	99.5	75-125	1.5	20		10/31/2011 1226h
1110545-001AMSD	Magnesium	mg/L	SW6010C	20.5	20.00	1.140	96.8	75-125	1.93	20		10/31/2011 1226h
1110545-001AMSD	Molybdenum	mg/L	SW6010C	0.533	0.4000	0.1290	101	75-125	1.05	20		10/31/2011 1701h
1110545-001AMSD	Potassium	mg/L	SW6010C	22.8	20.00	4.226	92.6	75-125	0.997	20		10/31/2011 1701h
1110545-001AMSD	Sodium	mg/L	SW6010C	53.7	20.00	36.90	84.0	75-125	2.94	20		10/31/2011 1226h
1110545-001AMSD	Tin	mg/L	SW6010C	1.82	2.000	0	91.0	75-125	0.551	20		10/31/2011 1226h
1110545-001AMSD	Vanadium	mg/L	SW6010C	0.457	0.4000	0.06380	98.3	75-125	2.21	20		10/31/2011 1226h
1110545-001AMSD	Antimony	mg/L	SW6020A	0.406	0.4000	0.009231	99.2	75-125	0.685	20		10/29/2011 0052h
1110545-001AMSD	Arsenic	mg/L	SW6020A	0.436	0.4000	0.03671	99.7	75-125	0.0181	20		10/29/2011 0052h
1110545-001AMSD	Barium	mg/L	SW6020A	0.445	0.4000	0.04833	99.2	75-125	0.456	20		10/29/2011 0052h
1110545-001AMSD	Beryllium	mg/L	SW6020A	0.405	0.4000	0	101	75-125	0.763	20		10/29/2011 0052h
1110545-001AMSD	Cadmium	mg/L	SW6020A	0.401	0.4000	0	100	75-125	0.476	20		10/29/2011 0052h
1110545-001AMSD	Copper	mg/L	SW6020A	0.402	0.4000	0	100	75-125	0.406	20		10/29/2011 0052h
1110545-001AMSD	Lead	mg/L	SW6020A	0.401	0.4000	0	100	75-125	0.156	20		10/29/2011 0052h
1110545-001AMSD	Manganese	mg/L	SW6020A	0.398	0.4000	0	99.4	75-125	1.08	20		10/29/2011 0052h
1110545-001AMSD	Nickel	mg/L	SW6020A	0.396	0.4000	0	99.0	75-125	0.149	20		10/29/2011 0052h
1110545-001AMSD	Selenium	mg/L	SW6020A	0.406	0.4000	0.007856	99.7	75-125	0.016	20		10/29/2011 0052h
1110545-001AMSD	Silver	mg/L	SW6020A	0.401	0.4000	0	100	75-125	0.29	20		10/29/2011 0052h
1110545-001AMSD	Strontium	mg/L	SW6020A	0.461	0.4000	0.06864	98.2	75-125	0.445	20		10/29/2011 0052h
1110545-001AMSD	Thallium	mg/L	SW6020A	0.400	0.4000	0.0001900	100	75-125	0.48	20		10/29/2011 0052h

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-001AMSD	Zinc	mg/L	SW6020A	2.07	2.000	0.01842	102	75-125	0.0715	20		10/29/2011 0052h
1110545-001AMSD	Mercury	mg/L	SW7470A	0.00325	0.003330	0	97.5	80-120	3.57	20		10/31/2011 1015h

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: DUP

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110572-001EDUP	pH @ 25° C	pH Units	SM4500-H+B	6.83		6.820		-	0.147	5		10/28/2011 1715h
1110504-003FDUP	Total Dissolved Solids	mg/L	SM2540C	9,900		9,500		-	4.12	5		10/28/2011 1300h
1110506-002ADUP	Total Dissolved Solids	mg/L	SM2540C	440		436.0		-	0.913	5		10/28/2011 1300h
1110526-015BDUP	Total Dissolved Solids	mg/L	SM2540C	8,780		8,440		-	3.95	5		10/28/2011 1300h
1110544-002DDUP	Total Dissolved Solids	mg/L	SM2540C	4,700		4,400		-	6.59	5	@	10/28/2011 1300h

@ - High RPD due to suspected sample non-homogeneity or matrix interference.

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-R33139	Alkalinity (as CaCO3)	mg/L	SM2320B	48,400	50,000	0	96.8	90-110				10/31/2011 0730h
LCS-R33224	Chloride	mg/L	SM4500-Cl-E	26.2	25.00	0	105	90-110				11/1/2011 1318h
LCS-R33153	Fluoride	mg/L	SM4500-F-C	0.995	1.000	0	99.5	90-110				10/31/2011 0840h
LCS-R33166	Nitrate/Nitrite (as N)	mg/L	E353.2	1.05	1.000	0	105	90-110				10/31/2011 1145h
LCS-R33114	Oil & Grease	mg/L	E1664A	38.3	40.00	0	95.8	78-114				10/28/2011 1250h
LCS-R33097	pH @ 25° C	pH Units	SM4500-H+B	9.03	9.000	0	100	98-102				10/28/2011 1715h
LCS-R33116	Sulfate	mg/L	SM4500-SO4-E	1,020	1,000	0	102	90-110				10/29/2011 0940h
LCS-R33118	Sulfate	mg/L	SM4500-SO4-E	957	1,000	0	95.7	90-110				10/29/2011 1045h
LCS-R33228	Total Dissolved Solids	mg/L	SM2540C	204	205.0	0	99.5	80-120				10/28/2011 1300h
LCS-R33231	Total Dissolved Solids	mg/L	SM2540C	200	205.0	0	97.6	80-120				10/28/2011 1300h

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-R33139	Alkalinity (as CaCO3)	mg/L	SM2320B	< 10.0				-				10/31/2011 0730h
MB-SPLP-15271	Alkalinity (as CaCO3)	mg/L	SM2320B	< 40.0				-				10/31/2011 0730h
MB-R33224	Chloride	mg/L	SM4500-Cl-E	< 5.00				-				11/1/2011 1317h
MB-SPLP-15271	Chloride	mg/L	SM4500-Cl-E	< 5.00				-				11/1/2011 1319h
MB-R33153	Fluoride	mg/L	SM4500-F-C	< 0.100				-				10/31/2011 0840h
MB-SPLP-15271	Fluoride	mg/L	SM4500-F-C	< 0.100				-				10/31/2011 0840h
MB-R33166	Nitrate/Nitrite (as N)	mg/L	E353.2	< 0.0100				-				10/31/2011 1143h
MB-SPLP-15271	Nitrate/Nitrite (as N)	mg/L	E353.2	0.0189				-			B^	10/31/2011 1146h
MB-R33114	Oil & Grease	mg/L	E1664A	< 3.00				-				10/28/2011 1250h
MB-SPLP-15271	Oil & Grease	mg/L	E1664A	< 3.00				-				10/28/2011 1250h
MB-R33116	Sulfate	mg/L	SM4500-SO4-E	< 5.00				-				10/29/2011 0940h
MB-R33118	Sulfate	mg/L	SM4500-SO4-E	< 5.00				-				10/29/2011 1045h
MB-SPLP-15271	Sulfate	mg/L	SM4500-SO4-E	< 5.00				-				10/29/2011 1045h
MB-R33228	Total Dissolved Solids	mg/L	SM2540C	< 10.0				-				10/28/2011 1300h
MB-R33231	Total Dissolved Solids	mg/L	SM2540C	< 10.0				-				10/28/2011 1300h

B - This analyte was detected in the method blank above the PQL as expected because of the nitric acid used in the SPLP fluid.
^ - Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

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Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110567-002AMS	Alkalinity (as CaCO3)	mg/L	SM2320B	479	200.0	291.9	93.5	80-120				10/31/2011 0730h
1110545-001AMS	Chloride	mg/L	SM4500-Cl-E	14.8	10.00	3.091	117	90-110			'	11/1/2011 1322h
1110545-003AMS	Fluoride	mg/L	SM4500-F-C	2.88	1.000	1.840	104	80-120				10/31/2011 0840h
1110545-001AMS	Nitrate/Nitrite (as N)	mg/L	E353.2	1.02	1.000	0.01060	101	90-110				10/31/2011 1149h
1110504-003DMS	Sulfate	mg/L	SM4500-SO4-E	143	100.0	50.75	92.1	80-120				10/29/2011 1045h
1110545-001AMS	Sulfate	mg/L	SM4500-SO4-E	36.9	20.00	17.45	97.2	80-120				10/29/2011 0940h

' - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110567-002AMSD	Alkalinity (as CaCO3)	mg/L	SM2320B	479	200.0	291.9	93.5	80-120	0	10		10/31/2011 0730h
1110545-001AMSD	Chloride	mg/L	SM4500-Cl-E	12.4	10.00	3.091	92.7	90-110	18	10	@	11/1/2011 1323h
1110545-003AMSD	Fluoride	mg/L	SM4500-F-C	2.80	1.000	1.840	96.0	80-120	2.82	10		10/31/2011 0840h
1110545-001AMSD	Nitrate/Nitrite (as N)	mg/L	E353.2	1.00	1.000	0.01060	99.0	90-110	2.1	10		10/31/2011 1150h
1110504-003DMSD	Sulfate	mg/L	SM4500-SO4-E	138	100.0	50.75	87.3	80-120	3.45	10		10/29/2011 1045h
1110545-001AMSD	Sulfate	mg/L	SM4500-SO4-E	37.9	20.00	17.45	102	80-120	2.73	10		10/29/2011 0940h

@ - High RPD due to suspected sample non-homogeneity or matrix interference.

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: QCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
QCS-R33114	Oil & Grease	mg/L	E1664A	40.3	40.00	2.200	95.3	78-114				10/28/2011 1250h

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: QCSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
QCSD-R33114	Oil & Grease	mg/L	E1664A	41.5	40.00	2.200	98.2	78-114	2.93	18		10/28/2011 1250h

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-15421	1,2,4-Trichlorobenzene	mg/L	SW8270D	0.0270	0.08000	0	33.7	10-104				11/4/2011 1733h
LCS-15421	1,4-Dichlorobenzene	mg/L	SW8270D	0.0156	0.08000	0	19.5	10-118				11/4/2011 1733h
LCS-15421	2,4,6-Trichlorophenol	mg/L	SW8270D	0.0668	0.08000	0	83.5	17-119				11/4/2011 1733h
LCS-15421	2,4-Dimethylphenol	mg/L	SW8270D	0.0687	0.08000	0	85.9	10-131				11/4/2011 1733h
LCS-15421	2,4-Dinitrotoluene	mg/L	SW8270D	0.0901	0.08000	0	113	42-219				11/4/2011 1733h
LCS-15421	2-Chloronaphthalene	mg/L	SW8270D	0.0398	0.08000	0	49.8	23-126				11/4/2011 1733h
LCS-15421	2-Chlorophenol	mg/L	SW8270D	0.0463	0.08000	0	57.9	15-128				11/4/2011 1733h
LCS-15421	4,6-Dinitro-2-methylphenol	mg/L	SW8270D	0.103	0.08000	0	128	30-198				11/4/2011 1733h
LCS-15421	4-Chloro-3-methylphenol	mg/L	SW8270D	0.0694	0.08000	0	86.8	29-148				11/4/2011 1733h
LCS-15421	4-Nitrophenol	mg/L	SW8270D	0.0428	0.08000	0	53.5	10-157				11/4/2011 1733h
LCS-15421	Acenaphthene	mg/L	SW8270D	0.0476	0.08000	0	59.6	20-116				11/4/2011 1733h
LCS-15421	Benzo(a)pyrene	mg/L	SW8270D	0.0923	0.08000	0	115	10-221				11/4/2011 1733h
LCS-15421	N-Nitrosodi-n-propylamine	mg/L	SW8270D	0.0408	0.08000	0	51.0	20-148				11/4/2011 1733h
LCS-15421	Pentachlorophenol	mg/L	SW8270D	0.0985	0.08000	0	123	21-153				11/4/2011 1733h
LCS-15421	Phenol	mg/L	SW8270D	0.0208	0.08000	0	26.0	10-131				11/4/2011 1733h
LCS-15421	Pyrene	mg/L	SW8270D	0.0870	0.08000	0	109	37-150				11/4/2011 1733h
LCS-15421	Surr: 2,4,6-Tribromophenol	%REC	SW8270D	0.0885	0.08000		111	10-165				11/4/2011 1733h
LCS-15421	Surr: 2-Fluorobiphenyl	%REC	SW8270D	0.0197	0.04000		49.2	32-128				11/4/2011 1733h
LCS-15421	Surr: 2-Fluorophenol	%REC	SW8270D	0.0268	0.08000		33.5	10-121				11/4/2011 1733h
LCS-15421	Surr: Nitrobenzene-d5	%REC	SW8270D	0.0227	0.04000		56.7	10-127				11/4/2011 1733h
LCS-15421	Surr: Phenol-d6	%REC	SW8270D	0.0216	0.08000		26.9	10-124				11/4/2011 1733h
LCS-15421	Surr: Terphenyl-d14	%REC	SW8270D	0.0444	0.04000		111	51-221				11/4/2011 1733h

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Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	1,1'-Biphenyl	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,2,4,5-Tetrachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,2,4-Trichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,2-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,3,5-Trinitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,3-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,3-Dinitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,4-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,4-Naphthoquinone	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,4-Phenylenediamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1-Chloronaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1-Methylnaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1-Naphthylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,3,4,6-Tetrachlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,4,5-Trichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,4,6-Trichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,4-Dichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,4-Dimethylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,4-Dinitrophenol	mg/L	SW8270D	< 0.0200				-				11/4/2011 1708h
MB-15421	2,4-Dinitrotoluene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,6-Dichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,6-Dinitrotoluene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Acetylaminofluorene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h

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Contact: John Wallace
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QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	2-Chloronaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Chlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Methylnaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Naphthylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Nitrophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Picoline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	3&4-Methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	3,3'-Dichlorobenzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	3,3'-Dimethylbenzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	3-Methylcholanthrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	3-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4,6-Dinitro-2-methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Aminobiphenyl	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Bromophenyl phenyl ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Chloro-3-methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Chloroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Chlorophenyl phenyl ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Nitrophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	5-Nitro-o-toluidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	7,12-Dimethylbenz(a)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h

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Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	a,a-Dimethylphenethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Acenaphthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Acenaphthylene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Acetophenone	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	alpha-Terpineol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Aniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Aramite	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Azobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benz(a)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzo(a)pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzo(b)fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzo(g,h,i)perylene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzo(k)fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzoic acid	mg/L	SW8270D	< 0.0200				-				11/4/2011 1708h
MB-15421	Benzyl alcohol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Bis(2-chloroethoxy)methane	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Bis(2-chloroethyl) ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Bis(2-chloroisopropyl) ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Bis(2-ethylhexyl) phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	bis(2-ethylhexyl)adipate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Butyl benzyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h

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QC SUMMARY REPORT

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Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	Carbazole	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Chlorobenzilate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Chrysene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Diallate (cis or trans)	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dibenz(a,h)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dibenzofuran	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Diethyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dimethoate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dimethyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dimethylaminoazobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Di-n-butyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Di-n-octyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dinoseb	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Diphenylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Disulfoton	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Ethyl methanesulfonate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Famphur	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Fluorene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Hexachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Hexachlorobutadiene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Hexachlorocyclopentadiene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Hexachloroethane	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	Hexachlorophene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Hexachloropropene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Indene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Indeno(1,2,3-cd)pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Isodrin	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Isophorone	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Isosafrole	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Kepone	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Methapyrilene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Methyl methanesulfonate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Naphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	n-Decane	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Nitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Nitroquinoline-1-oxide	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosodiethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosodimethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosodi-n-butylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosodiphenylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosodi-n-propylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosomethylethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosomorpholine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosopiperidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosopyrrolidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h

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MB-15421	n-Octadecane	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	O,O,O-Triethyl phosphorothioate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	o-Toluidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Parathion	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Methyl parathion	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pentachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pentachloronitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pentachlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Phenacetin	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Phenanthrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Phenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Phorate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pronamide	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pyridine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Quinoline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Safrole	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Tetraethyl dithiopyrophosphate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Thionazin	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Surr: 2,4,6-Tribromophenol	%REC	SW8270D	0.0657	0.08000		82.1	10-165				11/4/2011 1708h
MB-15421	Surr: 2-Fluorobiphenyl	%REC	SW8270D	0.0187	0.04000		46.7	18-108				11/4/2011 1708h
MB-15421	Surr: 2-Fluorophenol	%REC	SW8270D	0.0236	0.08000		29.5	10-121				11/4/2011 1708h
MB-15421	Surr: Nitrobenzene-d5	%REC	SW8270D	0.0217	0.04000		54.2	10-127				11/4/2011 1708h

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Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	Surr: Phenol-d6	%REC	SW8270D	0.0203	0.08000		25.4	10-124				11/4/2011 1708h
MB-15421	Surr: Terphenyl-d14	%REC	SW8270D	0.0403	0.04000		101	10-133				11/4/2011 1708h
MB-SPLP-15423	1,1'-Biphenyl	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,2,4,5-Tetrachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,2,4-Trichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,2-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,3,5-Trinitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,3-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,3-Dinitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,4-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,4-Naphthoquinone	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,4-Phenylenediamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1-Chloronaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1-Methylnaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1-Naphthylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,3,4,6-Tetrachlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,4,5-Trichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,4,6-Trichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,4-Dichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,4-Dimethylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,4-Dinitrophenol	mg/L	SW8270D	< 0.0200				-				11/4/2011 2008h
MB-SPLP-15423	2,4-Dinitrotoluene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,6-Dichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h

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Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15423	2,6-Dinitrotoluene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Acetylaminofluorene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Chloronaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Chlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Methylnaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Naphthylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Nitrophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Picoline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	3&4-Methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	3,3'-Dichlorobenzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	3,3'-Dimethylbenzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	3-Methylcholanthrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	3-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4,6-Dinitro-2-methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Aminobiphenyl	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Bromophenyl phenyl ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Chloro-3-methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Chloroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Chlorophenyl phenyl ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Nitrophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h

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Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15423	5-Nitro-o-toluidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	7,12-Dimethylbenz(a)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	a,a-Dimethylphenethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Acenaphthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Acenaphthylene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Acetophenone	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	alpha-Terpineol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Aniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Aramite	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Azobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benz(a)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzo(a)pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzo(b)fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzo(g,h,i)perylene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzo(k)fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzoic acid	mg/L	SW8270D	< 0.0200				-				11/4/2011 2008h
MB-SPLP-15423	Benzyl alcohol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Bis(2-chloroethoxy)methane	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Bis(2-chloroethyl) ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Bis(2-chloroisopropyl) ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Bis(2-ethylhexyl) phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h

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MB-SPLP-15423	bis(2-ethylhexyl)adipate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Butyl benzyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Carbazole	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Chlorobenzilate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Chrysene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Diallate (cis or trans)	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dibenz(a,h)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dibenzofuran	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Diethyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dimethoate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dimethyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dimethylaminoazobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Di-n-butyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Di-n-octyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dinoseb	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Diphenylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Disulfoton	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Ethyl methanesulfonate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Famphur	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Fluorene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Hexachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Hexachlorobutadiene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h

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MB-SPLP-15423	Hexachlorocyclopentadiene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Hexachloroethane	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Hexachlorophene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Hexachloropropene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Indene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Indeno(1,2,3-cd)pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Isodrin	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Isophorone	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Isosafrole	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Kepone	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Methapyrilene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Methyl methanesulfonate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Naphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	n-Decane	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Nitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Nitroquinoline-1-oxide	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosodiethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosodimethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosodi-n-butylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosodiphenylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosodi-n-propylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosomethylethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosomorpholine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15423	N-Nitrosopiperidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosopyrrolidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	n-Octadecane	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	O,O,O-Triethyl phosphorothioate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	o-Toluidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Parathion	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Methyl parathion	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pentachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pentachloronitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pentachlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Phenacetin	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Phenanthrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Phenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Phorate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pronamide	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pyridine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Quinoline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Safrole	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Tetraethyl dithiopyrophosphate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Thionazin	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Surr: 2,4,6-Tribromophenol	%REC	SW8270D	0.0601	0.08000		75.1	10-165				11/4/2011 2008h
MB-SPLP-15423	Surr: 2-Fluorobiphenyl	%REC	SW8270D	0.0137	0.04000		34.3	18-108				11/4/2011 2008h

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15423	Surr: 2-Fluorophenol	%REC	SW8270D	0.0204	0.08000		25.5	10-121				11/4/2011 2008h
MB-SPLP-15423	Surr: Nitrobenzene-d5	%REC	SW8270D	0.0146	0.04000		36.5	10-127				11/4/2011 2008h
MB-SPLP-15423	Surr: Phenol-d6	%REC	SW8270D	0.0169	0.08000		21.2	10-124				11/4/2011 2008h
MB-SPLP-15423	Surr: Terphenyl-d14	%REC	SW8270D	0.0430	0.04000		107	10-133				11/4/2011 2008h

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Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-003AMS	1,2,4-Trichlorobenzene	mg/L	SW8270D	0.0342	0.1600	0	21.4	20-107				11/4/2011 1917h
1110545-003AMS	1,4-Dichlorobenzene	mg/L	SW8270D	0.0195	0.1600	0	12.2	11-90				11/4/2011 1917h
1110545-003AMS	2,4,6-Trichlorophenol	mg/L	SW8270D	0.178	0.1600	0	111	17-128				11/4/2011 1917h
1110545-003AMS	2,4-Dimethylphenol	mg/L	SW8270D	0.120	0.1600	0	75.1	10-176				11/4/2011 1917h
1110545-003AMS	2,4-Dinitrotoluene	mg/L	SW8270D	0.189	0.1600	0	118	21-191				11/4/2011 1917h
1110545-003AMS	2-Chloronaphthalene	mg/L	SW8270D	0.0793	0.1600	0	49.6	12-132				11/4/2011 1917h
1110545-003AMS	2-Chlorophenol	mg/L	SW8270D	0.0922	0.1600	0	57.6	20-107				11/4/2011 1917h
1110545-003AMS	4,6-Dinitro-2-methylphenol	mg/L	SW8270D	0.216	0.1600	0	135	20-250				11/4/2011 1917h
1110545-003AMS	4-Chloro-3-methylphenol	mg/L	SW8270D	0.145	0.1600	0	90.6	10-136				11/4/2011 1917h
1110545-003AMS	4-Nitrophenol	mg/L	SW8270D	0.0839	0.1600	0	52.5	10-135				11/4/2011 1917h
1110545-003AMS	Acenaphthene	mg/L	SW8270D	0.104	0.1600	0	65.3	21-113				11/4/2011 1917h
1110545-003AMS	Benzo(a)pyrene	mg/L	SW8270D	0.186	0.1600	0	116	15-169				11/4/2011 1917h
1110545-003AMS	N-Nitrosodi-n-propylamine	mg/L	SW8270D	0.0914	0.1600	0	57.1	10-133				11/4/2011 1917h
1110545-003AMS	Pentachlorophenol	mg/L	SW8270D	0.191	0.1600	0	119	10-131				11/4/2011 1917h
1110545-003AMS	Phenol	mg/L	SW8270D	0.0455	0.1600	0	28.5	10-71				11/4/2011 1917h
1110545-003AMS	Pyrene	mg/L	SW8270D	0.175	0.1600	0	110	23-150				11/4/2011 1917h
1110545-003AMS	Surr: 2,4,6-Tribromophenol	%REC	SW8270D	0.183	0.1600		114	14-159				11/4/2011 1917h
1110545-003AMS	Surr: 2-Fluorobiphenyl	%REC	SW8270D	0.0501	0.08000		62.6	10-124				11/4/2011 1917h
1110545-003AMS	Surr: 2-Fluorophenol	%REC	SW8270D	0.0504	0.1600		31.5	10-106				11/4/2011 1917h
1110545-003AMS	Surr: Nitrobenzene-d5	%REC	SW8270D	0.0412	0.08000		51.4	10-180				11/4/2011 1917h
1110545-003AMS	Surr: Phenol-d6	%REC	SW8270D	0.0445	0.1600		27.8	10-122				11/4/2011 1917h
1110545-003AMS	Surr: Terphenyl-d14	%REC	SW8270D	0.0871	0.08000		109	10-199				11/4/2011 1917h

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-003AMSD	1,2,4-Trichlorobenzene	mg/L	SW8270D	0.0301	0.1600	0	18.8	20-107	12.7	25	1	11/4/2011 1943h
1110545-003AMSD	1,4-Dichlorobenzene	mg/L	SW8270D	0.0181	0.1600	0	11.3	11-90	7.02	25		11/4/2011 1943h
1110545-003AMSD	2,4,6-Trichlorophenol	mg/L	SW8270D	0.173	0.1600	0	108	17-128	2.92	25		11/4/2011 1943h
1110545-003AMSD	2,4-Dimethylphenol	mg/L	SW8270D	0.114	0.1600	0	71.1	10-176	5.47	25		11/4/2011 1943h
1110545-003AMSD	2,4-Dinitrotoluene	mg/L	SW8270D	0.196	0.1600	0	122	21-191	3.44	25		11/4/2011 1943h
1110545-003AMSD	2-Chloronaphthalene	mg/L	SW8270D	0.0702	0.1600	0	43.9	12-132	12.1	25		11/4/2011 1943h
1110545-003AMSD	2-Chlorophenol	mg/L	SW8270D	0.0817	0.1600	0	51.1	20-107	12	25		11/4/2011 1943h
1110545-003AMSD	4,6-Dinitro-2-methylphenol	mg/L	SW8270D	0.226	0.1600	0	141	20-250	4.34	25		11/4/2011 1943h
1110545-003AMSD	4-Chloro-3-methylphenol	mg/L	SW8270D	0.140	0.1600	0	87.4	10-136	3.64	25		11/4/2011 1943h
1110545-003AMSD	4-Nitrophenol	mg/L	SW8270D	0.0800	0.1600	0	50.0	10-135	4.76	25		11/4/2011 1943h
1110545-003AMSD	Acenaphthene	mg/L	SW8270D	0.0960	0.1600	0	60.0	21-113	8.42	25		11/4/2011 1943h
1110545-003AMSD	Benzo(a)pyrene	mg/L	SW8270D	0.190	0.1600	0	118	15-169	1.72	25		11/4/2011 1943h
1110545-003AMSD	N-Nitrosodi-n-propylamine	mg/L	SW8270D	0.0885	0.1600	0	55.3	10-133	3.25	25		11/4/2011 1943h
1110545-003AMSD	Pentachlorophenol	mg/L	SW8270D	0.192	0.1600	0	120	10-131	0.481	25		11/4/2011 1943h
1110545-003AMSD	Phenol	mg/L	SW8270D	0.0392	0.1600	0	24.5	10-71	14.9	25		11/4/2011 1943h
1110545-003AMSD	Pyrene	mg/L	SW8270D	0.180	0.1600	0	113	23-150	2.69	25		11/4/2011 1943h
1110545-003AMSD	Surr: 2,4,6-Tribromophenol	%REC	SW8270D	0.180	0.1600		112	14-159				11/4/2011 1943h
1110545-003AMSD	Surr: 2-Fluorobiphenyl	%REC	SW8270D	0.0460	0.08000		57.4	10-124				11/4/2011 1943h
1110545-003AMSD	Surr: 2-Fluorophenol	%REC	SW8270D	0.0464	0.1600		29.0	10-106				11/4/2011 1943h
1110545-003AMSD	Surr: Nitrobenzene-d5	%REC	SW8270D	0.0379	0.08000		47.4	10-180				11/4/2011 1943h
1110545-003AMSD	Surr: Phenol-d6	%REC	SW8270D	0.0403	0.1600		25.2	10-122				11/4/2011 1943h
1110545-003AMSD	Surr: Terphenyl-d14	%REC	SW8270D	0.0896	0.08000		112	10-199				11/4/2011 1943h

[1] - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.
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Laboratory Director

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QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS VOC 110211B	1,1,1-Trichloroethane	mg/L	SW8260C	0.0188	0.02000	0	94.0	49.9-140				11/2/2011 2219h
LCS VOC 110211B	1,1-Dichloroethene	mg/L	SW8260C	0.0166	0.02000	0	82.8	46-171				11/2/2011 2219h
LCS VOC 110211B	1,2-Dichlorobenzene	mg/L	SW8260C	0.0183	0.02000	0	91.4	67-135				11/2/2011 2219h
LCS VOC 110211B	1,2-Dichloroethane	mg/L	SW8260C	0.0174	0.02000	0	86.9	60-137				11/2/2011 2219h
LCS VOC 110211B	1,2-Dichloropropane	mg/L	SW8260C	0.0178	0.02000	0	88.8	59-135				11/2/2011 2219h
LCS VOC 110211B	Benzene	mg/L	SW8260C	0.0186	0.02000	0	93.1	62-127				11/2/2011 2219h
LCS VOC 110211B	Chlorobenzene	mg/L	SW8260C	0.0189	0.02000	0	94.5	63-140				11/2/2011 2219h
LCS VOC 110211B	Chloroform	mg/L	SW8260C	0.0175	0.02000	0	87.4	67-132				11/2/2011 2219h
LCS VOC 110211B	Ethylbenzene	mg/L	SW8260C	0.0190	0.02000	0	94.8	55-133				11/2/2011 2219h
LCS VOC 110211B	Isopropylbenzene	mg/L	SW8260C	0.0199	0.02000	0	99.5	60-147				11/2/2011 2219h
LCS VOC 110211B	Methyl tert-butyl ether	mg/L	SW8260C	0.0179	0.02000	0	89.4	37-189				11/2/2011 2219h
LCS VOC 110211B	Methylene chloride	mg/L	SW8260C	0.0181	0.02000	0	90.4	57-162				11/2/2011 2219h
LCS VOC 110211B	Naphthalene	mg/L	SW8260C	0.0154	0.02000	0	77.0	28-136				11/2/2011 2219h
LCS VOC 110211B	Tetrahydrofuran	mg/L	SW8260C	0.0164	0.02000	0	81.9	43-146				11/2/2011 2219h
LCS VOC 110211B	Toluene	mg/L	SW8260C	0.0190	0.02000	0	95.1	67-128				11/2/2011 2219h
LCS VOC 110211B	Trichloroethene	mg/L	SW8260C	0.0183	0.02000	0	91.6	54-152				11/2/2011 2219h
LCS VOC 110211B	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0476	0.05000		95.2	69-132				11/2/2011 2219h
LCS VOC 110211B	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0484	0.05000		96.7	85-118				11/2/2011 2219h
LCS VOC 110211B	Surr: Dibromofluoromethane	%REC	SW8260C	0.0465	0.05000		93.0	80-120				11/2/2011 2219h
LCS VOC 110211B	Surr: Toluene-d8	%REC	SW8260C	0.0516	0.05000		103	81-120				11/2/2011 2219h

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 110211B	1,1,1,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1,1-Trichloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1,2,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1,2-Trichloro-1,2,2-trifluoroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1,2-Trichloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1-Dichloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2,3-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2,3-Trichloropropane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2,3-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2,4-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2,4-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2-Dibromo-3-chloropropane	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	1,2-Dibromoethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2-Dichloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,3,5-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,3-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,3-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,4-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h

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Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 110211B	1,4-Dioxane	mg/L	SW8260C	< 0.0500				-				11/2/2011 2304h
MB VOC 110211B	2,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	2-Butanone	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	2-Chloroethyl vinyl ether	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	2-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	2-Hexanone	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	2-Nitropropane	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	4-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	4-Isopropyltoluene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	4-Methyl-2-pentanone	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Acetone	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	Acetonitrile	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Acrolein	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Acrylonitrile	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	Allyl chloride	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Benzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Benzyl chloride	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Bis(2-chloroisopropyl) ether	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Bromobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Bromochloromethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Bromodichloromethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Bromoform	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Bromomethane	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 110211B	Butyl acetate	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Carbon disulfide	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Carbon tetrachloride	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Chlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Chloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Chloroform	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Chloromethane	mg/L	SW8260C	< 0.00300				-				11/2/2011 2304h
MB VOC 110211B	Chloroprene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	cis-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	cis-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Cyclohexane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Cyclohexanone	mg/L	SW8260C	< 0.0500				-				11/2/2011 2304h
MB VOC 110211B	Dibromochloromethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Dibromomethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Dichlorodifluoromethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Ethyl acetate	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	Ethyl ether	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	Ethyl methacrylate	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Ethylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Hexachlorobutadiene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Iodomethane	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Isobutyl alcohol	mg/L	SW8260C	< 0.100				-				11/2/2011 2304h
MB VOC 110211B	Isopropyl acetate	mg/L	SW8260C	< 0.0200				-				11/2/2011 2304h

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Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 110211B	Isopropyl alcohol	mg/L	SW8260C	< 0.0250				-				11/2/2011 2304h
MB VOC 110211B	Isopropylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	m,p-Xylene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Methacrylonitrile	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Methyl Acetate	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Methyl methacrylate	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Methyl tert-butyl ether	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Methylcyclohexane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Methylene chloride	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	n-Amyl acetate	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Naphthalene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	n-Butyl alcohol	mg/L	SW8260C	< 0.0500				-				11/2/2011 2304h
MB VOC 110211B	n-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	n-Hexane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	n-Octane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	n-Propylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	o-Xylene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Pentachloroethane	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Propionitrile	mg/L	SW8260C	< 0.0250				-				11/2/2011 2304h
MB VOC 110211B	Propyl acetate	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	sec-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Styrene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	tert-Butyl alcohol	mg/L	SW8260C	< 0.0200				-				11/2/2011 2304h

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 110211B	tert-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Tetrachloroethene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Tetrahydrofuran	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Toluene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	trans-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	trans-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	trans-1,4-Dichloro-2-butene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Trichloroethene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Trichlorofluoromethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Vinyl acetate	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	Vinyl chloride	mg/L	SW8260C	< 0.00100				-				11/2/2011 2304h
MB VOC 110211B	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0493	0.05000		98.7	69-132				11/2/2011 2304h
MB VOC 110211B	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0499	0.05000		99.8	85-118				11/2/2011 2304h
MB VOC 110211B	Surr: Dibromofluoromethane	%REC	SW8260C	0.0485	0.05000		97.0	80-120				11/2/2011 2304h
MB VOC 110211B	Surr: Toluene-d8	%REC	SW8260C	0.0520	0.05000		104	81-120				11/2/2011 2304h
MB-SPLP-15304	1,1,1,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1,1-Trichloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1,2,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1,2-Trichloro-1,2,2-trifluoroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1,2-Trichloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1-Dichloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h

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QC SUMMARY REPORT

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Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15304	1,1-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2,3-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2,3-Trichloropropane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2,3-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2,4-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2,4-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2-Dibromo-3-chloropropane	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	1,2-Dibromoethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2-Dichloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,3,5-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,3-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,3-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,4-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,4-Dioxane	mg/L	SW8260C	< 0.0500				-				11/3/2011 0413h
MB-SPLP-15304	2,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	2-Butanone	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	2-Chloroethyl vinyl ether	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	2-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	2-Hexanone	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	2-Nitropropane	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	4-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15304	4-Isopropyltoluene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	4-Methyl-2-pentanone	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Acetone	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	Acetonitrile	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Acrolein	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Acrylonitrile	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	Allyl chloride	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Benzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Benzyl chloride	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Bis(2-chloroisopropyl) ether	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Bromobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Bromochloromethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Bromodichloromethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Bromoform	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Bromomethane	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Butyl acetate	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Carbon disulfide	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Carbon tetrachloride	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Chlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Chloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Chloroform	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Chloromethane	mg/L	SW8260C	< 0.00300				-				11/3/2011 0413h
MB-SPLP-15304	Chloroprene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h

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Contact: John Wallace
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QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15304	cis-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	cis-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Cyclohexane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Cyclohexanone	mg/L	SW8260C	< 0.0500				-				11/3/2011 0413h
MB-SPLP-15304	Dibromochloromethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Dibromomethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Dichlorodifluoromethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Ethyl acetate	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	Ethyl ether	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	Ethyl methacrylate	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Ethylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Hexachlorobutadiene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Iodomethane	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Isobutyl alcohol	mg/L	SW8260C	< 0.100				-				11/3/2011 0413h
MB-SPLP-15304	Isopropyl acetate	mg/L	SW8260C	< 0.0200				-				11/3/2011 0413h
MB-SPLP-15304	Isopropyl alcohol	mg/L	SW8260C	< 0.0250				-				11/3/2011 0413h
MB-SPLP-15304	Isopropylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	m,p-Xylene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Methacrylonitrile	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Methyl Acetate	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Methyl methacrylate	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Methyl tert-butyl ether	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Methylcyclohexane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15304	Methylene chloride	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	n-Amyl acetate	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Naphthalene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	n-Butyl alcohol	mg/L	SW8260C	< 0.0500				-				11/3/2011 0413h
MB-SPLP-15304	n-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	n-Hexane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	n-Octane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	n-Propylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	o-Xylene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Pentachloroethane	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Propionitrile	mg/L	SW8260C	< 0.0250				-				11/3/2011 0413h
MB-SPLP-15304	Propyl acetate	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	sec-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Styrene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	tert-Butyl alcohol	mg/L	SW8260C	< 0.0200				-				11/3/2011 0413h
MB-SPLP-15304	tert-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Tetrachloroethene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Tetrahydrofuran	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Toluene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	trans-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	trans-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	trans-1,4-Dichloro-2-butene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Trichloroethene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15304	Trichlorofluoromethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Vinyl acetate	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	Vinyl chloride	mg/L	SW8260C	< 0.00100				-				11/3/2011 0413h
MB-SPLP-15304	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0552	0.05000		110	69-132				11/3/2011 0413h
MB-SPLP-15304	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0487	0.05000		97.5	85-118				11/3/2011 0413h
MB-SPLP-15304	Surr: Dibromofluoromethane	%REC	SW8260C	0.0495	0.05000		99.0	80-120				11/3/2011 0413h
MB-SPLP-15304	Surr: Toluene-d8	%REC	SW8260C	0.0504	0.05000		101	81-120				11/3/2011 0413h

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1111038-005AMS	1,1,1-Trichloroethane	mg/L	SW8260C	0.0209	0.02000	0	104	67-147				11/3/2011 0307h
1111038-005AMS	1,1-Dichloroethene	mg/L	SW8260C	0.0159	0.02000	0	79.3	51-152				11/3/2011 0307h
1111038-005AMS	1,2-Dichlorobenzene	mg/L	SW8260C	0.0185	0.02000	0	92.6	70-130				11/3/2011 0307h
1111038-005AMS	1,2-Dichloroethane	mg/L	SW8260C	0.0203	0.02000	0	101	39-162				11/3/2011 0307h
1111038-005AMS	1,2-Dichloropropane	mg/L	SW8260C	0.0195	0.02000	0	97.5	59-135				11/3/2011 0307h
1111038-005AMS	Benzene	mg/L	SW8260C	0.0197	0.02000	0	98.6	66-145				11/3/2011 0307h
1111038-005AMS	Chlorobenzene	mg/L	SW8260C	0.0183	0.02000	0	91.7	63-140				11/3/2011 0307h
1111038-005AMS	Chloroform	mg/L	SW8260C	0.0183	0.02000	0	91.6	50-146				11/3/2011 0307h
1111038-005AMS	Ethylbenzene	mg/L	SW8260C	0.0183	0.02000	0	91.4	69-133				11/3/2011 0307h
1111038-005AMS	Isopropylbenzene	mg/L	SW8260C	0.0194	0.02000	0	97.1	60-147				11/3/2011 0307h
1111038-005AMS	Methyl tert-butyl ether	mg/L	SW8260C	0.0184	0.02000	0	91.9	37-189				11/3/2011 0307h
1111038-005AMS	Methylene chloride	mg/L	SW8260C	0.0196	0.02000	0	98.2	55-176				11/3/2011 0307h
1111038-005AMS	Naphthalene	mg/L	SW8260C	0.0147	0.02000	0	73.6	41-131				11/3/2011 0307h
1111038-005AMS	Tetrahydrofuran	mg/L	SW8260C	0.0213	0.02000	0	107	43-146				11/3/2011 0307h
1111038-005AMS	Toluene	mg/L	SW8260C	0.0182	0.02000	0	91.0	18-192				11/3/2011 0307h
1111038-005AMS	Trichloroethene	mg/L	SW8260C	0.0182	0.02000	0	91.0	61-153				11/3/2011 0307h
1111038-005AMS	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0549	0.05000		110	77-144				11/3/2011 0307h
1111038-005AMS	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0463	0.05000		92.6	80-123				11/3/2011 0307h
1111038-005AMS	Surr: Dibromofluoromethane	%REC	SW8260C	0.0482	0.05000		96.3	80-124				11/3/2011 0307h
1111038-005AMS	Surr: Toluene-d8	%REC	SW8260C	0.0485	0.05000		97.1	80-125				11/3/2011 0307h

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Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1111038-005AMSD	1,1,1-Trichloroethane	mg/L	SW8260C	0.0212	0.02000	0	106	67-147	1.38	25		11/3/2011 0329h
1111038-005AMSD	1,1-Dichloroethene	mg/L	SW8260C	0.0174	0.02000	0	87.2	51-152	9.55	25		11/3/2011 0329h
1111038-005AMSD	1,2-Dichlorobenzene	mg/L	SW8260C	0.0186	0.02000	0	93.0	70-130	0.485	25		11/3/2011 0329h
1111038-005AMSD	1,2-Dichloroethane	mg/L	SW8260C	0.0203	0.02000	0	102	39-162	0.0985	25		11/3/2011 0329h
1111038-005AMSD	1,2-Dichloropropane	mg/L	SW8260C	0.0200	0.02000	0	99.8	59-135	2.33	25		11/3/2011 0329h
1111038-005AMSD	Benzene	mg/L	SW8260C	0.0203	0.02000	0	102	66-145	2.85	25		11/3/2011 0329h
1111038-005AMSD	Chlorobenzene	mg/L	SW8260C	0.0188	0.02000	0	94.0	63-140	2.42	25		11/3/2011 0329h
1111038-005AMSD	Chloroform	mg/L	SW8260C	0.0188	0.02000	0	93.9	50-146	2.53	25		11/3/2011 0329h
1111038-005AMSD	Ethylbenzene	mg/L	SW8260C	0.0190	0.02000	0	94.8	69-133	3.65	25		11/3/2011 0329h
1111038-005AMSD	Isopropylbenzene	mg/L	SW8260C	0.0198	0.02000	0	99.1	60-147	2.04	25		11/3/2011 0329h
1111038-005AMSD	Methyl tert-butyl ether	mg/L	SW8260C	0.0187	0.02000	0	93.7	37-189	1.94	25		11/3/2011 0329h
1111038-005AMSD	Methylene chloride	mg/L	SW8260C	0.0214	0.02000	0	107	55-176	8.81	25		11/3/2011 0329h
1111038-005AMSD	Naphthalene	mg/L	SW8260C	0.0149	0.02000	0	74.5	41-131	1.28	25		11/3/2011 0329h
1111038-005AMSD	Tetrahydrofuran	mg/L	SW8260C	0.0215	0.02000	0	108	43-146	0.841	25		11/3/2011 0329h
1111038-005AMSD	Toluene	mg/L	SW8260C	0.0188	0.02000	0	94.2	18-192	3.51	25		11/3/2011 0329h
1111038-005AMSD	Trichloroethene	mg/L	SW8260C	0.0185	0.02000	0	92.3	61-153	1.47	25		11/3/2011 0329h
1111038-005AMSD	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0550	0.05000		110	77-144				11/3/2011 0329h
1111038-005AMSD	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0474	0.05000		94.9	80-123				11/3/2011 0329h
1111038-005AMSD	Surr: Dibromofluoromethane	%REC	SW8260C	0.0492	0.05000		98.3	80-124				11/3/2011 0329h
1111038-005AMSD	Surr: Toluene-d8	%REC	SW8260C	0.0491	0.05000		98.2	80-125				11/3/2011 0329h

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REVISED 11/31/11 TOC's sent out

WORK ORDER Summary

Work Order: **1110545**
Page 1 of 3 10/31/2011

Client: IGES
Client ID: IGE100 **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013 **QC Level:** LEVEL I **WO Type:** Standard
Comments: 3 Day Rush - see instructions of where report is to be sent. DO NOT send report to IGES, invoice only. All work is to be done on the SPLP leachate. / 10-31-11 TOC's sent out, instrument problems.;

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-001A	R11-122 #1	10/27/2011 0930h	10/27/2011 1346h	11/1/2011	Solid	1312LM-PR	☐	TCLPFridge	1
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	
						3510-SVOA-TCLP-PR	☐	TCLPFridge	
						6010C-SPLP	☑	TCLPFridge	
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	
						HG-SPLP-7470A	☐	TCLPFridge	
						HG-SPLP-PR	☐	TCLPFridge	
						NO2/NO3-W-353.2	☐	TCLPFridge	
						OGB-W-1664A	☐	TCLPFridge	
						OUTSIDE LAB	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	
1110545-002A	R11-122 #2	10/27/2011 0935h				1312LM-PR	☐	TCLPFridge	
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	

WORK ORDER Summary

Client: IGES

Work Order: 1110545

10/31/2011

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-002A	R11-122 #2	10/27/2011 0935h	10/27/2011 1346h	11/1/2011	Solid	3510-SVOA-TCLP-PR	☐	TCLPFridge	1
						6010C-SPLP	☑	TCLPFridge	
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	
						HG-SPLP-7470A	☐	TCLPFridge	
						HG-SPLP-PR	☐	TCLPFridge	
						NO2/NO3-W-353.2	☐	TCLPFridge	
						OGB-W-1664A	☐	TCLPFridge	
						OUTSIDE LAB	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	
1110545-003A	R11-122 #3	10/27/2011 0940h				1312LM-PR	☐	TCLPFridge	
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	
						3510-SVOA-TCLP-PR	☐	TCLPFridge	
						6010C-SPLP	☑	TCLPFridge	
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	

WORK ORDER Summary

Work Order: **1110545**

Client: IGES

 10/31/2011

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-003A	R11-122 #3	10/27/2011 0940h	10/27/2011 1346h	11/1/2011	Solid	HG-SPLP-7470A	☐	TCLPFridge	1
						HG-SPLP-PR	☐	TCLPFridge	
						NO2/NO3-W-353.2	☐	TCLPFridge	
						OGB-W-1664A	☐	TCLPFridge	
						OUTSIDE LAB	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	

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RUSH

WORK ORDER Summary

Work Order: 1110545
Page 1 of 3 10/28/2011

Client: IGES
Client ID: IGE100 Contact: John Wallace
Project: Red Leaf ECOSHALE / 01109-013 QC Level: LEVEL I H+SPO WO Type: Standard
Comments: 3 Day Rush - see instructions of where report is to be sent. DO NOT send report to IGES, invoice only. All work is to be done on the SPLP leachate.;

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-001A	R11-122 #1	10/27/2011 0930h	10/27/2011 1346h	11/1/2011	Solid	1312LM-PR	☐	TCLPFridge	1
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	
						3510-SVOA-TCLP-PR	☐	TCLPFridge	
						6010C-SPLP	☑	TCLPFridge	
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	
						HG-SPLP-7470A	☐	TCLPFridge	
						HG-SPLP-PR	☐	TCLPFridge	
						NO2/NO3-W-353.2	☐	TCLPFridge	
						OGB-W-1664A	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	
						TOC-W-5310B	☐	TCLPFridge	
1110545-002A	R11-122 #2	10/27/2011 0935h				1312LM-PR	☐	TCLPFridge	
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	
						3510-SVOA-TCLP-PR	☐	TCLPFridge	

WORK ORDER Summary

Work Order: 1110545

Client: IGES

 10/28/2011

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-002A	R11-122 #2	10/27/2011 0935h	10/27/2011 1346h	11/1/2011	Solid	6010C-SPLP	☑	TCLPFridge	1
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	
						HG-SPLP-7470A	☐	TCLPFridge	
						HG-SPLP-PR	☐	TCLPFridge	
						NO2/NO3-W-353.2	☐	TCLPFridge	
						OGB-W-1664A	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	
						TOC-W-5310B	☐	TCLPFridge	
1110545-003A	R11-122 #3	10/27/2011 0940h				1312LM-PR	☐	TCLPFridge	
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	
						3510-SVOA-TCLP-PR	☐	TCLPFridge	
						6010C-SPLP	☑	TCLPFridge	
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	
						HG-SPLP-7470A	☐	TCLPFridge	
						HG-SPLP-PR	☐	TCLPFridge	

WORK ORDER Summary

Work Order: 1110545

Client: IGES

 10/28/2011

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-003A	R11-122 #3	10/27/2011 0940h	10/27/2011 1346h	11/1/2011	Solid	NO2/NO3-W-353.2	☐	TCLPFridge	1
						OGB-W-1664A	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	
						TOC-W-5310B	☐	TCLPFridge	

Client IGES, Inc

Address 4153 Commerce Dr

SLC (City) UT (State) 84107 (Zip)

Phone 801-270-9406 Fax 801-270-9401

Contact John Wallace

E-mail johnw@igesinc.com

Project Name Red Leaf Ecoshale

Project Number/P.O.# 01109-013

Sampler Name J. Wallace

AMERICAN WEST ANALYTICAL LABORATORIES
463 West 3600 South
Salt Lake City, Utah 84115
(801) 263-8686
(888) 263-8686
Fax (801) 263-8687
Email:awal@awal-labs.com

CHAIN OF CUSTODY

Lab Sample Set # 1110545

Page _____ of _____

Turn Around Time (Circle One)

1 day 2 day (3 day) 4 day 5 day Standard

Sample ID	Date/Time Collected	Matrix	Number of Containers (Total)	TESTS REQUIRED	QC LEVEL	COMMENTS
R11-122 #1	10/27/11 0930		1	SEE ATTACHED MEMO	1 2 2+ 3 3+ 4	
R11-122 #2	10/27/11 0935		1			
R11-122 #3	10/27/11 0940		1			
				EMAIL RESULTS TO Jim Hatch CAMP PER MEMO		

LABORATORY USE ONLY

SAMPLES WERE:

1 Shipped or hand delivered (Y) N
Notes:

2 Ambient or (Chilled)
Notes: on ice

3 Temperature 10°

4 Received Broken/Leaking (Improperly Sealed)
Y (N)
Notes:

5 Properly Preserved
(Y) N
Checked at Bench
Y N
Notes:

6 Received Within Holding Times
(Y) N
Notes:

COC Tape Was:

1 Present on Outer Package
Y N NA

2 Unbroken on Outer Package
Y N NA

3 Present on Sample
Y N NA

4 Unbroken on Sample
Y N NA

Discrepancies Between Sample Labels and COC Record?
Y (N)
Notes:

Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME John F. Wallace	Time 1246	PRINT NAME Elma Hafiane	Time 1346
Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME	Time	PRINT NAME	Time
Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME	Time	PRINT NAME	Time
Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME	Time	PRINT NAME	Time

Special Instructions:

Memo

IGES®

4153 South 300 West
Salt Lake City, UT 84107
(801) 270-9400 Telephone
(801) 270-9401 FAX

Attention:	Info:	File: 01109-013 Redleaf SPLP Testing
Pat Noteboom - AWAL		

From: John F. Wallace, P.E.
Date: October 27, 2011
Subject: SPLP Testing Requirements

Pat,

Please find accompanying this request, 3 samples identified as R11-122 210 day run #1, 2 & 3. Please perform the following tests on each of the samples in accordance with all applicable EPA methods. Samples were taken the morning of 10/27/11 between 9:30 and 10:00 am as indicated on the accompanying COC.

SPLP analyses as follows-
Three discrete samples will be developed for Synthetic Precipitation Leaching Procedure analysis (SPLP, EPA Method 1312). As requested by the State WQD, leachate developed from each of the three samples tested will be analyzed for the following suite of constituents:

- General Chemistry: pH, total dissolved solids (TDS), major ions including Ca, Cl, K, Mg, Na, SO_4 and alkalinity;
- Organics: total organic carbon, oil and grease, volatile organic compounds (Complete VOC List) and semi-volatile organic compounds (Complete SVOC List);
- Metals: Ag, As, B, Ba, Be, Cd, Cr, Cu, Fe, Hg, Li, Pb, Mn, Mo, Ni, Sb, Se, Sn, Tl(Thalium), V, Zn; and
- Miscellaneous: Nitrate + nitrite, ~~fluorine~~ Fluoride and strontium

Results will be directed to Mr. James Holtcamp, Esq. in order to maintain attorney client privilege for the data at the following:

Holland & Hart, LLP
60 East South Temple, Suite 2000
Salt Lake City, UT 84111 Ph – 801-799-5847 Email – jholtcamp@hollandhart.com

Please rush testing so that results will be available by next Wednesday 11/2/11. As always, call with any questions.
Regards,

Li not on lists —

Appendix K

Reclamation Cover
Performance Modeling
(Help)

RECLAMATION COVER PERFORMANCE MODELING

RED LEAF RESOURCES

Submitted to:
RED LEAF RESOURCES

November 7, 2011

Norwest Corporation
950 So. Cherry St., Suite 800
Denver, Colorado 80246
Tel: (303) 782-0164
Fax: (303) 782-2560

www.norwestcorp.com

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RECLAMATION COVER PERFORMANCE MONITORING
RED LEAF RESOURCES

Background

The Red Leaf Resources Eco Shale Mining Project uses heat to extract kerogen deposits from sedimentary shale deposits. The mining process consists of the simultaneous mining of the oil shale and the creation of the heating capsules. Once enough overburden is removed from the mine to create a capsule, an impermeable liner is placed on the bottom of the capsule to prevent impacts to groundwater and the surrounding ecosystem. Collection pipes are placed along the bottom of the capsule. The mined material is placed above the collected pipes, followed by a series of heating pipes to heat the material to extract the kerogen. The mined material and heating pipes will be incrementally stacked on top of each other in the heating capsules. The heating rods heat the material to volatize the kerogen deposits into gas and melt the kerogen into liquid which flows through the collection pipes to a central location to eventually undergo further processing.

A second layer of capsules will be constructed on top of the first layer, once cooling has occurred. Capsules are 500' wide by 900' long. The capsules will be reclaimed immediately once the kerogen liquid and gas deposits are extracted from the second layer, and the capsules have cooled and settled. The capsule reclamation and mining activities will occur simultaneously throughout the site. The final cover on the capsules consists of a low permeability bentonite amended soil (BAS) cap overlain by a layer of overburden and a vegetated soil layer. This is a common form of a closure cap designed to minimize the potential for infiltration into the capsules with precipitation running off of the cap or being removed by evapotranspiration (ET) from the vegetated cover.

The performance of the designed cap was evaluated using the Hydrologic Evaluation of Landfill Performance (HELP) model V 3.07[1] (Schroeder et al., 1994). The HELP model is widely used in evaluating landfill cap and liner performance. The cap was modeled as designed, with the cap design being described more fully in the application. This text summarizes the pertinent features of the capsule design, the parameters needed for the HELP model, the basis for the parameters used, and the model results.

Closed Capsule Size and Description

The closed capsules are 500' wide and 900' long with a surface area of approximately 10.3 acres. The capsules are independently closed so the modeling evaluation was for a representative single capsule. Each capsule has 8 layers with the upper three being the BAS cap, overburden layer, and growth layer. The 8 layers are shown on Table 1.

Table 1. Model Layers

Model Layer	Represents	Thickness (feet)	Notes
1	topsoil	1	Top 12 inches of stripped material. Scarified to alleviate compaction
2	overburden layer	2	Stripped material from 12 to 36 inches below topsoil in areas where vegetation is dominated by grasses and shrubs
3	BAS cap	3	Low permeability cap
4	gravel insulation layer	13	High permeability
5	spent ore layer	61	Spent oil shale
6	gravel insulation layer	13	High permeability
7	Steel Plate	0.01	Oil collection system
8	BAS liner	3	Low permeability liner

The capsules have a cap, sides, and liner consisting of BAS with an in situ permeability of $1x10^{-7}$ cm/sec or less. Model layers 3 and 8 are of this material. The gravel insulation layers will be higher conductivity material. The spent oil shale is represented with a

[1] Available at http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=landfill

moderate conductivity material. The BAS cap will be covered and protected with at least a 2 ft thick layer of overburden material from the site which is model layer 2. The overburden will be overlain by a 1 ft thick layer of soil which is model layer 1.

The overburden and soil will be gathered during the stripping portion of site preparation with the soil being the top 12 inches and primarily a silty loam. The overburden will be a lift of up to 2 feet of suitable cover (subsoil and overburden) below the soil where the vegetation is dominated by grasses and shrubs. The cover will be compacted from equipment during the spreading operation. Compaction in the soil will be alleviated by scarification using ripper shanks on a grader.

Site Weather Data

The water budget for the capsule cap is strongly influenced by the weather regime and growing season at the site. Four types of weather data are required:

a. Evapotranspiration
b. Precipitation
c. Temperature
d. Solar Radiation

There are a number of cities with weather data available in the HELP model. The nearest cities to the site are Grand Junction, CO, Salt Lake City UT, Pocatello ID, and Lander, WY. The HELP model can generate from 1 to 100 years of data stochastically for selected locations using a synthetic weather generator. The program can improve the statistical characteristics of the resulting daily values by using site specific mean monthly values. There is a 15 year history of weather data for the Upper Sand Wash RAWS meteorological station located approximately 5.2 miles NW (at N 39° 42' 49" West 109° 26' 46" with and elevation of 6,300 ft) from the site with a similar altitude and topography as the Red Leaf site (Hatch, 2010). This 15-year history was used with the synthetic weather generator to generate the input weather data from the HELP model.

The data analysis period of reference data from this site is 15 years from June 1, 1995, to June 30, 2010. Site specific data for precipitation, elevation, temperature, relative humidity, and latitude were used in the generation of the synthetic data sets. Site specific parameters and default parameters for the four cities are shown in Tables 2 through 4.

Table 2. General Parameters

Parameter	Red Leaf Site	Pocatello, Idaho	Salt Lake City, Utah	Grand Junction, CO	Lander, WY
Latitude	39.66	42.55	40.76	39.07	42.8
Growing season start day	124	132	117	109	136
Growing season end day	243	275	289	293	272
Growing season length (days)	119	143	172	184	136
Average wind speed (mph)	4.9	10.2	8.8	8.1	6.9
First quarter relative humidity	59.8%	70.0%	67.0%	60.0%	60.0%
Second quarter relative humidity	37.6%	52.0%	48.0%	36.0%	50.0%
Third quarter relative humidity	37.2%	43.0%	39.0%	36.0%	41.0%
Fourth quarter relative humidity	55.2%	65.0%	65.0%	57.0%	59.0%
Elevation (not from HELP)	6,414	4,462	4,327	4,593	5,358
Maximum Leaf Area Index (LAI)	1.6	1.6	1.6	1.6	1.6

Table 3. Mean Monthly Precipitation (inches)

Month	Red Leaf Site	Pocatello, Idaho	Salt Lake City, Utah	Grand Junction, CO
January	0.3	1.13	1.35	0.64
February	0.4	0.86	1.33	0.54
March	0.6	0.94	1.72	0.75
April	0.9	1.16	2.21	0.71
May	0.6	1.2	1.47	0.76
June	0.8	1.06	0.97	0.44
July	0.7	0.47	0.72	0.47
August	1.3	0.6	0.92	0.91
September	1.6	0.65	0.89	0.7
October	1.1	0.92	1.14	0.87
November	0.4	0.91	1.22	0.63

Month	Red Leaf Site	Pocatello, Idaho	Salt Lake City, Utah	Grand Junction, CO
December	0.3	0.96	1.37	0.58
Total	9.0	10.86	15.31	8.00

1. Lander, WY monthly precipitation data not available in HELP model
2. Red Leaf site data from Upper Sand Wash station

Table 4. Mean Monthly Temperature (Fahrenheit)

Month	Red Leaf Site	Pocatello, Idaho	Salt Lake City, Utah	Grand Junction, CO	Lander, WY
January	25.2	23.8	28.6	25.5	19.6
February	29.0	29.5	34.1	33.5	25.7
March	38.2	35.5	40.7	41.9	32.1
April	45.9	44.6	49.2	51.7	42.3
May	56.4	54.0	58.8	62.1	52.6
June	65.9	62.5	68.3	72.3	62.3
July	73.9	71.2	77.5	78.9	70.8
August	70.0	68.9	74.9	75.9	68.6
September	60.4	59.2	65.0	67.1	58.3
October	47.9	48.1	53.0	54.9	46.8
November	35.5	35.2	39.7	39.6	30.8
December	24.6	26.6	30.3	28.3	23.2
Mean Annual	47.7	46.6	51.7	52.6	44.4

1. Red Leaf site data from Upper Sand Wash station

Evapotranspiration

Site specific values for evapotranspiration shown in Table 2 were used. The growing season for the Vernal area is listed as 119 days by the USBR Central Utah Project – Vernal Unit and Vernal Chamber of Commerce. The HELP documentation states the start of the growing season for grasses in the Julian date is when the normal mean daily temperature rises above 50 to 55 degrees Fahrenheit and ends when it falls below this range with cooler climates having a start and end at lower temperatures. Based on the site average monthly temperatures, higher late summer precipitation, and constrained by the 119 days the start of the growing season was set to June 1 (152) and ended September

28 (271). The evaporative zone depth was set to 36 inches for the reclaimed case with vegetation and 18 inches for the bare soil case, based on the silty loam nature of the topsoil. The maximum leaf area index was set to zero for the bare soil case and 1.6 for the reclaimed case. The 1.6 represents a mixture of poor and fair grass stands and is suggested by the HELP model based on the shorter growing season.

Precipitation

The site has approximately 9 inches of precipitation yearly with the largest amounts of precipitation occurring in August through October. The closest match for the precipitation volumes and pattern of lower winter precipitation and higher precipitation in late summer is Grand Junction, Colorado as shown in Table 3. Grand Junction also provides the closest match for relative humidity for the four quarters with an average difference of 0.2% and a maximum difference of -1.8% for the fourth quarter.

Site specific values of mean monthly precipitation were used with the Grand Junction, CO coefficients to generate 30 years of daily precipitation. Table 5 compares the synthetic mean monthly precipitation to the site data.

Table 5. Mean Monthly Precipitation – Site and Model

Month	Red Leaf Site	HELP
January	0.3	0.27
February	0.4	0.37
March	0.6	0.57
April	0.9	0.99
May	0.6	0.57
June	0.8	0.75
July	0.7	0.65
August	1.3	1.31
September	1.6	1.35
October	1.1	1.29
November	0.4	0.53
December	0.3	0.26
Total	9.0	8.91

Temperature

The nearest match for temperature is Pocatello, ID with cold winters and maximum mean monthly temperatures in the low 70s during the summer as shown in Table 4. Site specific values of mean monthly temperature were used with the Pocatello, ID coefficients to generate 30 years of daily temperatures.

Solar Radiation

The site specific latitude was used with the Pocatello, ID coefficient to generate 30 years of daily solar radiation values.

Capsule Layers and Parameters

The capsule cap has three elements as previously described. This section describes the layers in more detail, the associated HELP model parameters, and basis for the parameters used. Default HELP model parameters for the various soil characteristics were used when possible. This is summarized in Table 6.

The soil and overburden are silty loam from the site and the soil from 1 to 3 feet below the ground surface as noted in the capsule description section. For modeling purposes these were represented as silty sands with the overburden layer being less permeable than the soil. The BAS layers were represented as barrier soils with low hydraulic conductivity. The gravel insulation layers were represented as permeable gravels. The spent ore layer was represented as a moderate permeability, finer material and the steel plate as an essentially impermeable membrane liner.

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Table 6. Model Parameters

Model Layer	Represents	Thickness (feet)	Soil Texture		Total Porosity (vol/vol)	Field Capacity (vol/vol)	Wilting Point (vol/vol)	Initial Soil Water Content (vol/vol)	Saturated Hydraulic Conductivity (cm/sec)
			Number	Description					
1	topsoil	1	5	silty sand	0.457	0.131	0.058	0.109	1.0×10^{-3}
2	overburden layer	2	6	silty sand	0.453	0.190	0.085	0.092	7.2×10^{-4}
3	BAS cap	3	16	barrier soil	0.427	0.418	0.367	0.427	1.0×10^{-7}
4	gravel insulation layer	13	21	gravel	0.397	0.032	0.013	0.032	3.0×10^{-1}
5	spent ore layer	61	10	clayey silt	0.398	0.244	0.136	0.136	1.2×10^{-4}
6	gravel insulation layer	13	21	gravel	0.397	0.032	0.013	0.032	3.0×10^{-1}
7	steel plate	0.01	35	simulated as a membrane liner	0.000	0.000	0.000	0.000	1.0×10^{-13}
8	BAS liner	3	16	barrier soil	0.427	0.418	0.367	0.427	1.0×10^{-7}

Model Execution

The HELP model was run for 30 years for a variety of climatic, soil, and design data to examine the potential cap performance for a range of potential conditions. The base model simulation was for a vegetated landfill cap as designed. This model was run using synthetic data sets described previously.

Sensitivity model runs were then conducted for:

1. Bare landfill (non-vegetated)
2. Increased precipitation to 150% of historical.
3. Lower Leaf Area Index (LAI)

Model Results

The model output is summarized in Table 7. The HELP model was run to evaluate the potential for moisture penetration through the BAS layer into the capsule where it could have the potential to infiltrate the spent shale. The HELP model assumes that any soil barrier such as the BAS layer is at full saturation. Leakage is modeled as saturated Darcian flow and is assumed to occur only as long as there is head on the surface of the liner.

Table 7. Model Results

	Average Annual Totals (inches) for Years 1 through 30				
Scenario	Precip	Runoff	ET	Percolation through Layer 3	Average Head on Layer 3
Base Reclaimed Case	8.90	0.000	8.860	0.006	0.001
Non-vegetated Case	8.90	0.071	8.468	0.263	0.293
Increased Precipitation (150%)	13.37	0.016	13.128	0.158	0.242
Lower LAI (1.2)	8.90	0.000	8.861	0.007	0.001

1. Model input and output files available on request

The average annual totals for percolation through the BAS liner and average head on the liner are shown in Table 7 for the modeled scenarios. This shows minimal head on the top of Layer 3 and percolation through layer 3 of less than 0.01 inches per year for the base vegetated case. The bare cover allowed 0.34 inches of infiltration per year with the unrealistic assumption that the vegetation was not established at the site for 30 years. A 50% increase in mean monthly precipitation for the vegetated cover predicted infiltration of 0.16 inches per year. The infiltration is a function of the precipitation and average head on layer 3. These vary over time with over half of the years having an average head of 0.000 inches on layer 3. This simulation shows the ability of the cover to handle much wetter years than average. The vegetated cover with a lower LAI showed very similar performance to the base case.

Based on these model results, the designed capsule cap and ET cover provides adequate control on infiltration into the capsules for the vegetated cover case using the design parameters. Even for 30 years of bare cover or very wet years the HELP model predicts minimal infiltration into the capsule for these extreme conditions.

References

Hatch, (2010). Site Climatic Conditions for Utah Oil Shale Commercial Demonstration Project.

Schroeder, P.R., Azia N.M., Lloyd, C.M., and Zappi, P.A. (1994). "The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3," EPA/600/R-94/168b, September 1994, U.S. Environmental Protection Agency Office of Research and Development, Washington, DC. Available at http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=landfill