

Interim Monitoring Report – September 2014 Monitoring Results

Union Pacific Railroad Great Salt Lake Causeway Culvert Closure and Bridge Construction Project

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Prepared for
Union Pacific Railroad
Omaha, NE 68179

Prepared by
HDR, Inc.
3949 South 700 East, Suite 500
Salt Lake City, UT 84107

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Acronyms

°C	degrees Celsius
°F	degrees Fahrenheit
µm	micrometers
cm	centimeters
EPA	U.S. Environmental Protection Agency
g/L	grams per liter
g/mL	grams per milliliter
GIS	geographic information systems
IMP	Interim Monitoring Plan
km	kilometers
m	meters
mg/L	milligrams per liter
NELAP	National Environmental Laboratory Accreditation Program
NGVD 29	National Geodetic Vertical Datum of 1929
NWP	Nationwide Permit
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
SM	Standard Methods for the Examination of Water and Wastewater
SOP	standard operating procedure
TDS	total dissolved solids
UDWQ	Utah Division of Water Quality
UGS	Utah Geological Survey
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

1.0 Interim Monitoring Goals and Objectives

1.1 Background

In September 2014, Union Pacific Railroad (UPRR) conducted its third round of interim monitoring in the Great Salt Lake pursuant to the requirements of the U.S. Army Corps of Engineers (USACE) Nationwide Permit (NWP) 14 verification issued December 6, 2013, and the Utah Division of Water Quality (UDWQ) 401 Water Quality Certification for temporary closure of the east culvert of the UPRR causeway that extends across the Great Salt Lake (USACE 2013, 2014; UDWQ 2013).

The USACE- and UDWQ-approved interim monitoring plan (IMP), resubmitted in March 2014, consisted of four elements: (1) compiling surface water elevation data for the concurrent monitoring period, (2) collecting in-situ water profiles for temperature and other parameters, (3) collecting water quality samples for metals and other parameters for analyses at an off-site laboratory, and (4) collecting brine shrimp samples for metals analyses at an off-site laboratory and counts and taxonomic identification (Table 1; UPRR 2014).

Interim monitoring is focused on characterizing the open waters of Gilbert Bay and Gunnison Bay near the project site (Figure 1 below). The activities of compiling surface water elevation and collecting salinity gradient data meet the USACE NWP 14 interim monitoring requirements (USACE 2013). All other data collection met the UDWQ certification requirements (UDWQ 2013).

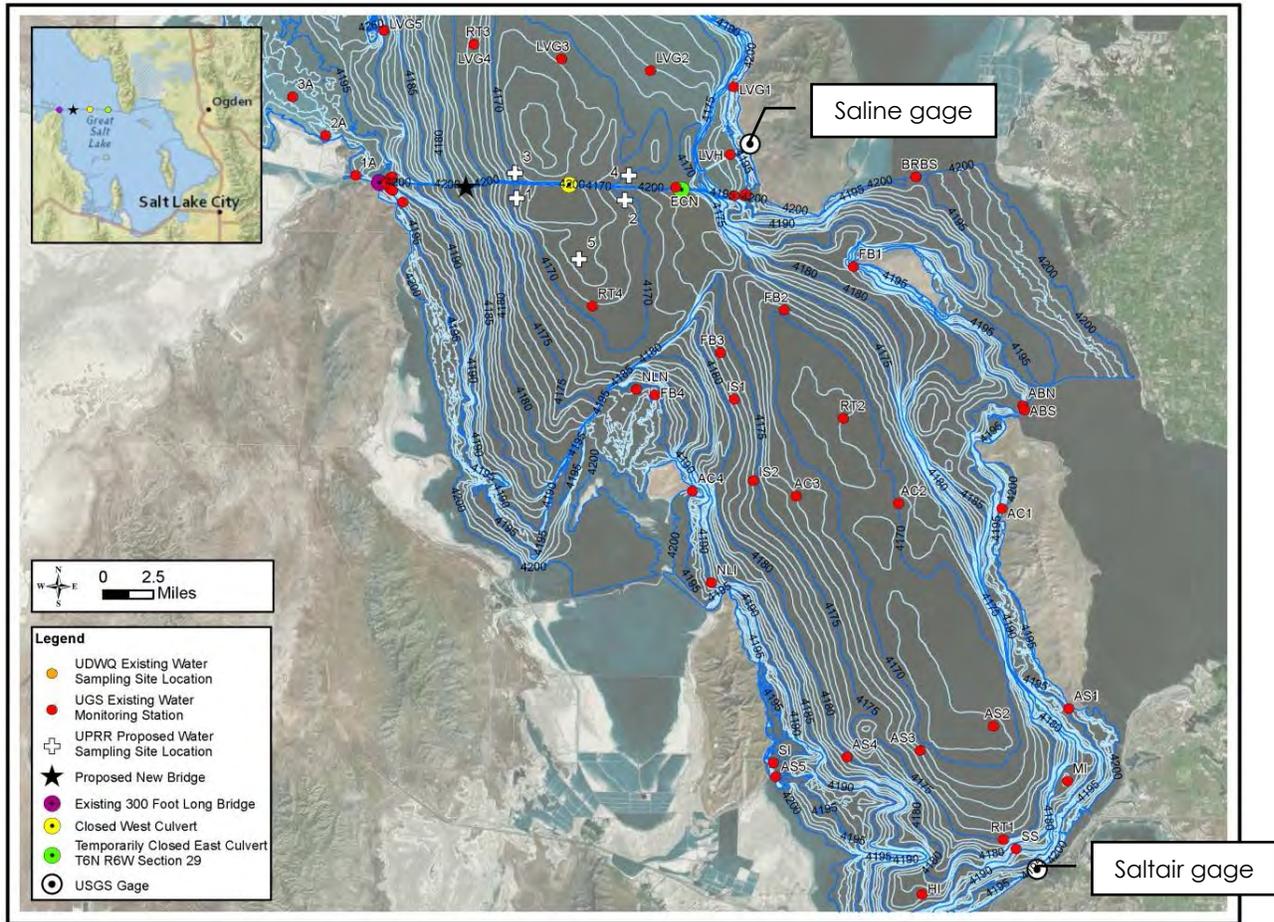
Table 1. Interim Monitoring Goals and Objectives

Element	Goals	Objectives
Surface water elevations	Capture temporary hydrologic impacts resulting from closure of the east culvert.	Obtain surface water elevations for the North Arm and South Arm of the Great Salt Lake from USGS reporting stations located at Saline and Saltair.
Surface water profiles and conventional water quality	Collect Great Salt Lake total water depth, depth to the deep brine layer ^a (if present), ambient Secchi depth, pH, temperature, and salinity profiles.	Collect salinity data consistent with UDWQ and USGS methods and reporting limits.
Surface and bottom water metals, sulfate sampling and dissolved oxygen	Collect Great Salt Lake ambient metals, sulfate, hardness, and dissolved oxygen data set in surface water.	Collect metals, sulfate, and dissolved oxygen water samples at specified locations consistent with UDWQ reporting limits.
Brine shrimp counts and tissue sampling	Collect Great Salt Lake ambient brine shrimp population data and tissue metals and percent moisture data set at co-located South Arm water quality stations.	Collect brine shrimp for taxonomic identification, counts, and tissue analysis at specified locations in accordance with UDWQ-approved reporting limits.

UDWQ = Utah Division of Water Quality; USGS = U.S. Geological Survey

^a Deep brine layer depth refers to the vertical zone in a water column in which salinity changes rapidly with depth. For the purpose of this interim monitoring report, deep brine layer depth, halocline, and chemocline are synonymous.

Figure 1. Interim Monitoring Sampling Site Locations



Source: UPRR 2011

1.2 September 2014 Monitoring Event

HDR, Inc., conducted the September 2014 monitoring on behalf of UPRR. The South Arm sampling was conducted on September 23, and the North Arm sampling was conducted on September 10. This was the third monitoring event conducted in 2014.

This data report is provided to document the collection and laboratory analyses of samples collected from the open water of the Great Salt Lake in accordance with permit conditions and the IMP. Only minimal interpretation of the data is provided in this report; additional interpretation will be provided in the annual interim monitoring report in accordance with the IMP (UPRR 2014).

2.0 Methods

Sample site locations are shown in Figure 1 above and are listed in Table 2. In accordance with the UDWQ- and USACE-approved IMP, monitoring occurred at three locations in Gilbert Bay and two locations in Gunnison Bay. Sample locations were to the south and north of the UPRR Great Salt Lake causeway in the vicinity of the east and west culverts and a location in Gilbert Bay between the causeway and the rest of Gilbert Bay. These sampling sites were located in the open waters of Gunnison and Gilbert Bays at locations specified in the Utah 401 Water Quality Certification and in USACE NWP 14. Photographs were collected during the monitoring event at each site and are presented in Appendix B, Site Photographs, of this report.

Table 2. Interim Monitoring Sampling Site Coordinates and Descriptions

Site Name	Latitude	Longitude	Description
Gilbert Bay			
Sampling site 1	41° 12' 49.65" N	112° 43' 4.82" W	Halfway between the proposed bridge and the west culvert; 1 km south of the UPRR causeway
Sampling site 2	41° 12' 47.86" N	112° 36' 52.62" W	Halfway between the west and east culverts; 1 km south of the UPRR causeway
Sampling site 5	41° 10' 9.65" N	112° 39' 25.81" W	6 km south of the west culvert
Gunnison Bay			
Sampling site 3	41° 13' 54.62" N	112° 43' 11.77" W	Halfway between the proposed bridge and the west culvert; 1 km north of the UPRR causeway
Sampling site 4	41° 13' 34.84" N	112° 36' 40.64" W	Halfway between the west and east culverts; 0.5 km north of the UPRR causeway

N = north; W = west; km = kilometers, UPRR = Union Pacific Railroad

Table 3 below lists the samples collected and parameters measured at each site as well as the frequency of collection.

2.1 Surface Water Elevation

The U.S. Geological Survey (USGS) records surface water elevations at Saltair (USGS Station 10010000) and Saline, Utah (USGS Station 10010100) (see Figure 1 above). Elevations are in the National Geodetic Vertical Datum of 1929 (NGVD 29). Data were downloaded from ut.water.usgs.gov/greatsaltlake/elevations for the week of each sample collection.

Table 3. Interim Monitoring Parameters, Locations and Frequency

Parameter	Number and Sample Depth	Frequency	Field Duplicate ^a	Field Blank ^a	Equipment Blank ^a	Sampling Site				
						1	2	3	4	5
Total water depth	One measurement taken from water surface to bottom of lake.	Four times per year	NA	NA	NA	X	X	X	X	X
Depth from water surface to deep brine layer	One location inferred from conductivity profile	Four times per year	NA	NA	NA	X	X	X	X	X
Secchi depth	Measurements taken from water surface and averaged.	Four times per year	NA	NA	NA	X	X	X	X	X
Conductivity, temperature, pH	Vertical profile; measurements taken in situ every 0.5 m. The field conductivity measurements will establish whether there is a deep brine layer present.	Four times per year	NA	NA	NA	X	X	X	X	X
Total dissolved solids, density	Vertical profile; grab samples taken every 1.5 m in upper brine layer; samples taken every 0.5 m in the deep brine layer.	Four times per year	10% of samples	10% of samples	10% of samples	X	X	X	X	X
Total metals (As, Cu, Pb, Se, Hg, Zn), SO ₄ , hardness, and DO	Grab samples taken 0.2 m from the water surface and 0.5 m from the bottom.	Four times per year	10% of samples	10% of samples	10% of samples	X	X	X	X	X
Brine shrimp count	One sample from one vertical tow.	Tri-annually (May, July, and September)	1 per event	NA	NA	X	X	NA	NA	X
Brine shrimp tissue, percent moisture, total metals (As, Cu, Pb, Se, Hg, Zn)	Composite sample from three vertical tows.	Tri-annually (May, July, and September)	1 per event	NA	NA	X	X	NA	NA	X

m = meters

As = arsenic

Hg = mercury

SO₄ = sulfate

NA = not applicable

Cu = copper

Pb = lead

Zn = zinc

X = parameter measured at this site

DO = dissolved oxygen

Se = selenium

^a See Section 2.4, Brine Shrimp, and Appendix F, Data Quality Assurance Documentation. Field duplicate, field blank, and equipment blank samples were collected as part of the field quality assurance program.

2.2 In-situ Measurements

Field data sheets are provided in Appendix G, Field and Analytical Laboratory Data Reports. UPRR noted relevant conditions (air temperature and a description of the location) on the field data sheet during each sampling event. Shared sampling equipment was thoroughly cleaned between sampling sites.

In-situ water quality measurements included total water depth, depth to the deep brine layer (if present), Secchi depth, and vertical profiles of water temperature, conductivity, dissolved oxygen, and pH. Secchi depth was measured first. Then, water temperature, conductivity, dissolved oxygen, and pH were measured every 0.5 meter (m) with a multiprobe water quality meter. These water quality measurements were used to determine the depth to the deep brine layer (if present).

A Troll 9500, rented from In-Situ, Inc., was used for data collection. Calibration of each probe was performed by In-Situ, Inc., prior to deployment (Appendix F, Data Quality Assurance Documentation). Calibration was also verified in the field using the manufacturer’s recommended calibration methods.

The depth to the deep brine layer was used to determine the frequency of the grab samples for total dissolved solids (TDS) and density¹ samples according to the following rules:

- If a deep brine layer is present:
 - Collect samples above the deep brine layer every 1.5 m.
 - Collect samples below the deep brine layer every 0.5 m.
- If a deep brine layer is not present:
 - Collect samples every 1.5 m.

In addition to the density samples being sent off site to the laboratory (see Section 2.3, Surface Water Sample Analyses), specific gravity² was determined via hydrometer (see Appendix H, Standard Operating Procedure for Specific Gravity Determinations Using a Hydrometer). The two Fisherbrand hydrometers used were calibrated for 60 degrees Fahrenheit (°F), one for specific gravities of 1.100–1.220 and one for specific gravities of 1.200–1.420.

2.3 Surface Water Sample Analyses

As described in the USACE- and UDWQ-approved IMP, each analytical sample was collected into laboratory-supplied clean containers. Water samples were collected at depth with a Kemmerer sampler, which was thoroughly cleaned between sites.

Water samples to be analyzed for metals were collected using “clean hands” methods consistent with the U.S. Environmental Protection Agency’s (EPA) Method 1669 (EPA 1996) and the UDWQ standard operating procedure (SOP) for “Trace Metals Sample Collection (Clean Hands/Dirty Hands), Decontamination, and Multiprobe In-situ Monitoring Procedures.”

The samples were preserved (as appropriate), stored, and delivered to a National Environmental Laboratory Accreditation Program (NELAP)–certified laboratory for analyzing the laboratory parameters listed in the IMP (Table 4 below; UPRR 2014). September 2014 metals samples were analyzed by Brooks Rand

¹ In the metric system, specific gravity (dimensionless) and density (g/mL) are numerically equal for a given temperature.

² See footnote 1.

Laboratory in Seattle, Washington. Density,³ dissolved oxygen, hardness, sulfate, and TDS analyses were performed by ChemTech Ford in Salt Lake City, Utah. A chain-of-custody record was maintained with the samples at all times.

Table 4. Water Quality Parameters and Constituents To Be Measured and Methods, with Detection Limits, Reporting Limits, and Laboratory Hold Time

Parameter		Method ^a	Method Detection Limit	Method Reporting Limit	Hold Time
Field Measurements – Surface Water					
Lake elevation ^b	—	USGS automated gage	—	—	—
Total water depth	—	Troll 9500 field measurement	—	0.1 m	Field
Depth to deep brine layer ^c	—	Troll 9500 field measurement	—	0.1 m	Field
Secchi depth	—	—	—	0.1 m	Field
pH	—	SM 4500-H	0.1 su	0.1 su	Field profile
Specific conductivity	—	SM 2510A	0.001 µmhos	0.001 µmhos	Field profile
Temperature	—	SM 2520	0.1 °C	0.1 °C	Field profile
Specific gravity	--	ASTM 1429 ^d	0.001	0.001 (unitless)	—
Laboratory Analyses – Surface Water ^{e,f}					
Density	—	SM 2710F	—	0.001 g/mL	7 days
Dissolved oxygen	DO	SM 4500-OC	—	0.1 mg/L	8 hours
Hardness	—	SM 2340 C	—	1 mg/L as CaCO ₃	14 days
Sulfate (total)	SO ₄ ²⁻	EPA 300.0	—	1 mg/L	28 days
Total dissolved solids	Salinity	SM 2540C	—	5 mg/L	7 days
Arsenic (total)	As	EPA 1640	0.05 µg/L	0.15 µg/L	180 days
Copper (total)	Cu	EPA 1640	0.04 µg/L	0.12 µg/L	180 days
Lead (total)	Pb	EPA 1640	0.003 µg/L	0.013 µg/L	180 days
Mercury (total)	Hg	EPA 1631E	0.15 ng/L	0.40 ng/L	28 days
Selenium (total)	Se	EPA 1640	0.070 µg/L	0.210 µg/L	180 days
Zinc (total)	Zn	EPA 1640	0.26 µg/L	0.75 µg/L	180 days

³ See footnote 1 on page 7.

Table 4. Water Quality Parameters and Constituents To Be Measured and Methods, with Detection Limits, Reporting Limits, and Laboratory Hold Time

Parameter		Method ^a	Method Detection Limit	Method Reporting Limit	Hold Time
Laboratory Analyses – Gilbert Bay Brine Shrimp ^f					
Percent moisture	—	SM 2540G	—	1.0%	—
Arsenic (total)	As	EPA 1638	0.014 mg/kg	0.040 mg/kg	180 days
Copper (total)	Cu	EPA 1638	0.03 mg/kg	0.16 mg/kg	180 days
Lead (total)	Pb	EPA 1638	0.004 mg/kg	0.040 mg/kg	180 days
Mercury (total)	Hg	EPA 1631	0.12 ng/g	0.4 ng/g	28 days
Selenium (total)	Se	EPA 1638	0.06 mg/kg	0.15 mg/kg	180 days
Zinc (total)	Zn	EPA 1638	0.20 mg/kg	1.00 mg/kg	180 days
Laboratory Counts – Gilbert Bay Brine Shrimp					
Brine shrimp (<i>Artemia franciscana</i>)		Dissection microscope	Not applicable	Not applicable	Not applicable

°C = degrees Celsius

CaCO₃ = calcium carbonate

EPA = sampling method from EPA

µmhos = micromhos

m = meters

SM = Standard Methods for the Examination of Water and Wastewater

g/mL = grams per milliliter

mg/L = milligrams per liter

µg/L = micrograms per liter

ng/L = nanograms per liter

mg/kg = milligrams per kilogram

ng/g = nanograms per gram

su = standard units

^a Laboratory analytical method or field equipment.^b See Section 2.1, Surface Water Elevation.^c Deep brine layer depth refers to the vertical zone in a water column in which salinity changes rapidly with depth. The location of the deep brine layer is determined from abrupt changes in conductivity, temperature, and dissolved oxygen.^d Standard operating procedure is provided in Appendix H, Standard Operating Procedure for Specific Gravity Determinations Using a Hydrometer.^e Estimated by ChemTech Ford Laboratories and Brooks Rand Laboratories (metals). Due to the nature of Great Salt Lake water, reporting limits might be elevated for some analyses.^f Estimated by Brooks Rand Laboratories. Due to the nature of brine shrimp tissue, reporting limits might be elevated for some analyses.

2.4 Brine Shrimp

Brine shrimp samples were collected for both metals analyses and taxonomic identification. Brine shrimp were collected via vertical tow within Gilbert Bay at stations 1, 2, and 5. One plankton tow was performed at these stations for brine shrimp taxonomic life stage identification and counts.

Each tow was from the bottom of the water column to the water surface using a 165-micrometer (μm) net with a 50-centimeter (cm)-diameter opening and a screened sample bucket attached at the bottom. The net was lowered to the desired depth and raised at an approximate rate of 0.5 m per second to collect brine shrimp from the water column.

The analytical sample was concentrated into the sample bucket and transferred to a labeled and NELAP-certified laboratory-supplied sample jar. The procedure was repeated in order to collect a sample for brine shrimp taxonomic analysis by EcoAnalysts, Inc., of Moscow, Idaho, a laboratory certified by the Society for Freshwater Sciences. The samples were stored and recorded on separate chain-of-custody forms (one for the analytical laboratory and one for the taxonomic laboratory).

2.5 Quality Assurance

All data were collected in accordance with the IMP's Quality Assurance Project Plan (QAPP) (UPRR 2014). After each event, UPRR subjected all data to quality assurance/quality control (QA/QC) procedures including but not limited to spot checks of transcription, review of electronic data submissions for completeness, comparison of geographic information systems (GIS) maps with field notes on locations, and identification of any inconsistent data. Documentation of this process is provided in Appendix F, Data Quality Assurance Documentation.

In addition, UPRR evaluated the resulting data for their consistency with the data quality objectives in the QAPP. As a result of this process, UPRR determined that the laboratory's mercury concentrations were estimated and qualified these data (V).

Quality assurance documentation is provided in Appendix F, Data Quality Assurance Documentation.

2.6 Study Variances and Corrective Action

The September 2014 monitoring event was conducted in conformance with the IMP, with the following six variances:

1. Brine shrimp sample collection for metals analysis was limited to one vertical plankton tow per site instead of three tows as specified in the IMP. It was determined in the field that one tow would provide an adequate quantity of sample because of the abundance of shrimp adults and cysts observed on the first tow at each site. Data quality was not reduced due to this variance. No corrective action is required.
2. Equipment rinsate results in May, July, and September 2014 had elevated mercury levels, which suggests that field sample handling might have introduced trace quantities of mercury into the deep brine samples. Hence, all deep brine mercury results have been qualified as estimated (indicated as V in Table 6 on page 18). Additional discussion is provided in Appendix F, Data Quality Assurance Documentation.
3. Duplicate agreement for arsenic and lead in surface water was greater than 20% in the duplicate collected from Gunnison Bay's surface sample. All arsenic and lead results are considered estimated (V). Additional discussion is provided in Appendix F, Data Quality Assurance Documentation.
4. Duplicate agreement in brine shrimp was greater than 10% for arsenic, copper, lead, and zinc, and the arsenic and lead relative percent differences (RPD) in the field duplicates were greater than 20%. These differences are likely related to the heterogeneous matrix and the large variability in the adult-to-cyst ratio. Nevertheless, all arsenic and lead brine shrimp results are considered estimated (V). Additional discussion is provided in Appendix F, Data Quality Assurance Documentation.
5. The IMP requires the monitoring team to collect density and TDS samples "every 1.5 meters" above the deep brine layer and "every 0.5 meter" within the deep brine layer, if present. One of the density and TDS samples near the surface was not collected at site 2. However, sample depths above and below the missing sample depth had similar results. No corrective action is required.
6. In September, laboratory measurements of density had better precision than the July and May sampling rounds and are considered valid results. However, to be consistent with the July monitoring event, hydrometer data were used for salinity calculations. As described in the May 2014 report, UPRR consulted with the Utah Geological Survey (UGS) (Rupke 2014) to identify the approach to determine density. In addition to laboratory measurements, specific gravity⁴ measurements of the samples were made with a hydrometer and are also presented in this report. The hydrometer SOP is provided in Appendix H, Standard Operating Procedure for Specific Gravity Determinations Using a Hydrometer. Hydrometer data were used for salinity calculations.

⁴ See footnote 1 on page 7.

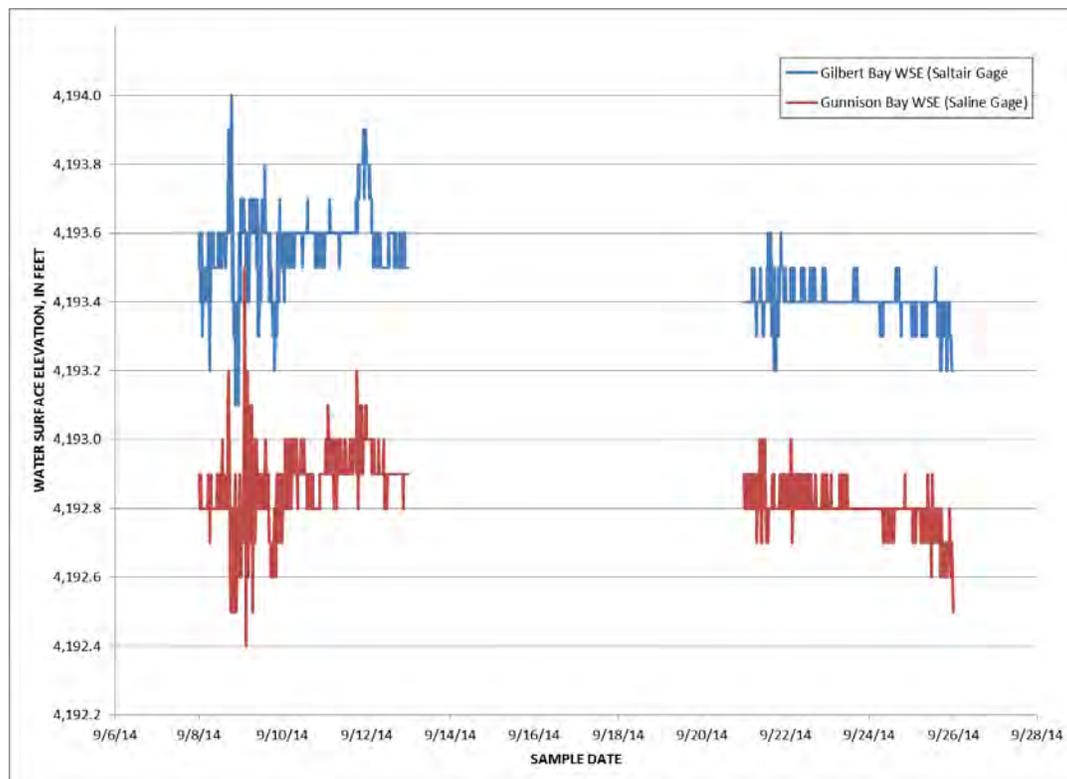
3.0 Results

The September 2014 monitoring event occurred on September 10 in Gunnison Bay (sites 3 and 4). The Gilbert Bay sites (sites 1, 2, and 5) were sampled on September 23. After September 10, monitoring activities were not conducted until September 23 because low water levels made it difficult to launch the boat from the Antelope Island boat harbor. The boat was eventually launched from the Promontory Point harbor. On each sampling day, the weather was clear with a light wind and variable surface conditions (see the photos in Appendix B, Site Photographs).

3.1 Surface Water Elevation

UPRR acquired surface water elevation data in 15-minute increments for Gunnison and Gilbert Bays from the USGS website (USGS 2014; see Appendix A, Surface Water Elevation Data). During the September 23 South Arm sample collection event, the average surface water elevation recorded at the South Arm (Gilbert Bay) Saltair gage was 4,193.4 feet, and the average at the North Arm (Gunnison Bay) Saline gage was 4,192.8 feet. During the September 10 North Arm sample collection event, the average surface water elevation recorded at the South Arm (Gilbert Bay) Saltair gage was 4,193.6 feet, and the average at the North Arm (Gunnison Bay) Saline gage was 4,192.9 feet (Figure 2). The USGS data presented in this report are reported by USGS as preliminary and will be updated when available.

Figure 2. South and North Arm Surface Water Elevations (USGS Stations 10010000 and 10010100) during the September 2014 Monitoring Period



Elevations are in the NGVD 29 datum. Provisional data subject to revision.

3.2 In-situ Measurements

Synoptic in-situ methods are listed in Table 4 above (see Section 2.3, Surface Water Sample Analyses). Temperature, pH, and dissolved oxygen profiles are provided below in Figure 3, Figure 4, and Figure 5, respectively, and depths are summarized in Table 5.⁵ The total water depths of sampling sites ranged from 5.90 meters at site 3 to 8.57 meters at site 5 (Table 5). Sites 1, 2, and 5 had a deep brine layer. Secchi depths were greater at the Gilbert Bay sites (sites 1, 2, and 5) than at the Gunnison Bay sites (sites 3 and 4).

Table 5. Water Level, Total Depth, Secchi Depth, and Brine Layer Depth – September 2014

Parameter	Units	Gilbert Bay			Gunnison Bay	
		Site 1	Site 2	Site 5	Site 3	Site 4
Average water surface elevation of South Arm sampling day, September 23	feet NGVD 29	4193.4			4192.8	
Average water surface elevation of South Arm sampling day, September 10	feet NGVD 29	4193.6			4192.9	
Secchi depth	meters	1.8	2.1	2.0	0.8	0.8
Total water depth	meters	7.95	7.75	8.57	5.90	6.45
Depth from water surface to deep brine layer	meters	7.25	7.5	7.35	Not found	Not found
Deep brine layer thickness	meters	0.70	0.25	1.22	Not found	Not found

NGVD 29 = National Geodetic Vertical Datum of 1929

Water temperature profiles in Gilbert Bay (sites 1, 2, and 5) were similar, with temperatures decreasing with depth (Figure 3 below). Water temperature profiles in Gunnison Bay (sites 3 and 4) were also similar and slightly warmer than the sites in Gilbert Bay. Gilbert Bay (sites 1, 2, and 5) had similar pH profiles, with reduced pH in the deep brine layer (Figure 4 below). The pH profiles of the Gunnison Bay sites (sites 3 and 4) were similar to each other and about 0.5 pH units higher than the pH of Gilbert Bay's deep brine layer.

In the upper water column of Gilbert Bay (sites 1, 2, and 5), dissolved oxygen concentrations ranged between about 3.6 milligrams per liter (mg/L) and 6.7 mg/L (Figure 5 below), while in the deep brine layer below depths of 4,170 feet, dissolved oxygen conditions were less than 3.5 mg/L. The vertical profiles of dissolved oxygen concentrations at sites 3 and 4 in Gunnison Bay were of similar shape although differing in concentration. In Gunnison Bay, dissolved oxygen at site 3 ranged between 4.3 and 6 mg/L, while at site 4, dissolved oxygen ranged between 3.7 and 4.5 mg/L.

⁵ Specific conductance (conductivity) was also collected using the sonde and was used in the field to help identify the deep brine layer. Specific conductance data were recorded on the field data sheet and are provided in Appendix G, Field and Analytical Laboratory Data Reports.

Figure 3. Temperature Profiles – September 2014

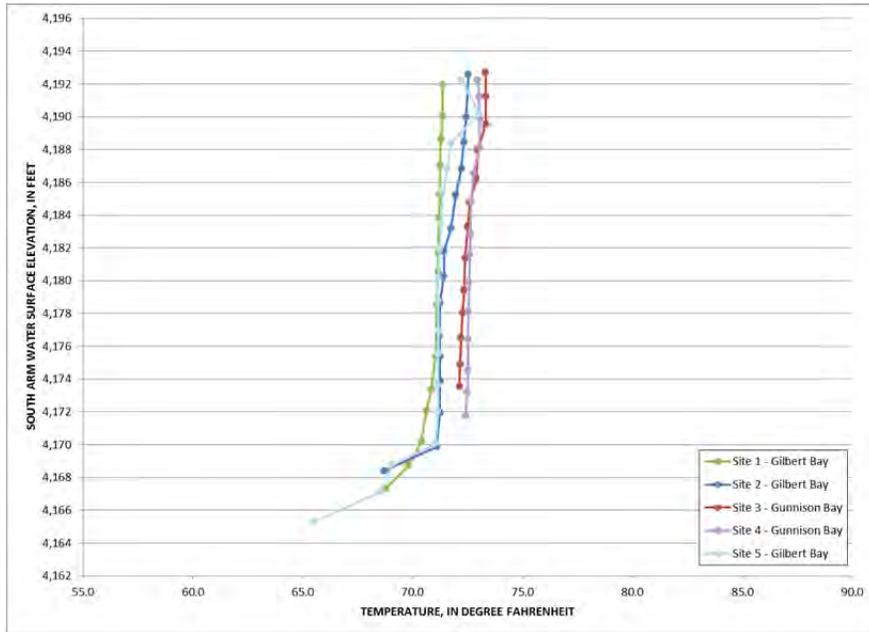


Figure 4. pH Profiles – September 2014

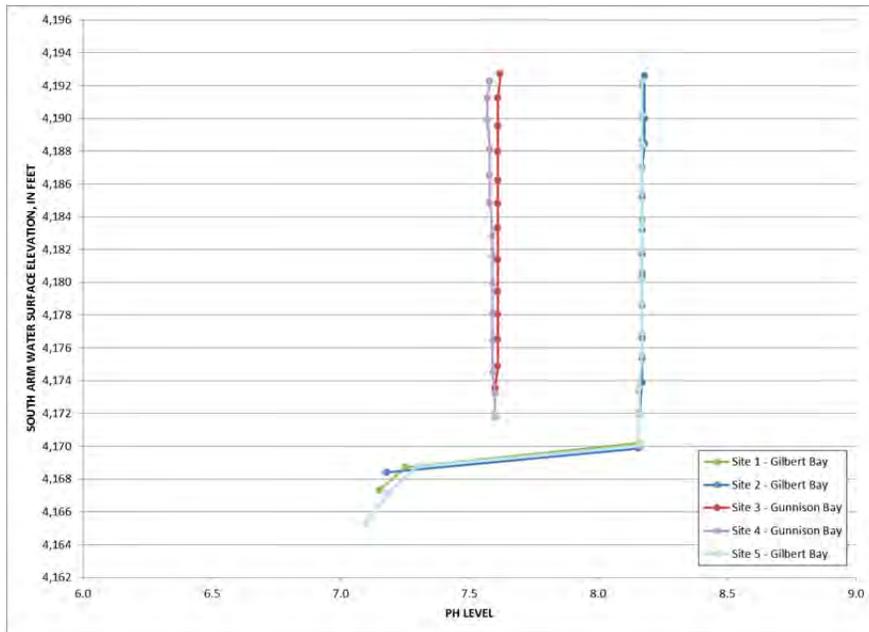
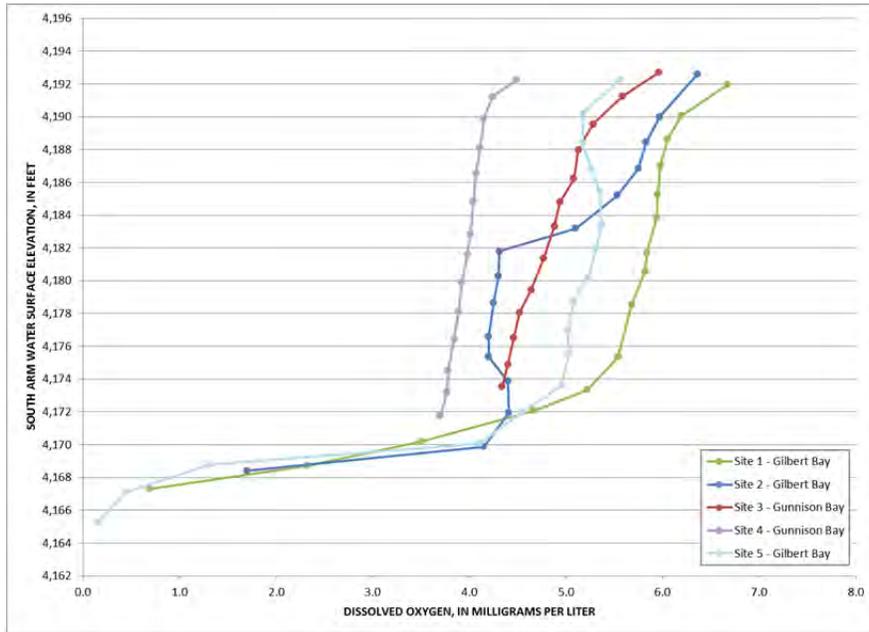


Figure 5. Dissolved Oxygen Profiles – September 2014



3.3 Surface Water Samples

Results of surface water hardness, sulfate, and metals analyses are provided in Table 6 on page 18 with greater detail available in Appendix C, Surface Water Analytical Results (data tables), and Appendix G, Field and Analytical Laboratory Data Reports (field data sheets and laboratory data packages). The complete density dataset is provided in Appendix C (data table) and Appendix G (bench data) as well.

TDS and salinity profiles are provided below in Figure 6 and Figure 7, respectively. TDS concentrations in Gilbert Bay (sites 1, 2, and 5) ranged between 153 and 176 grams per liter (g/L) in the upper water column (Figure 6). TDS concentrations indicate that a deep brine layer was present at site 5, since the deeper water column TDS concentration value was considerably elevated relative to the upper water column TDS concentrations. TDS concentrations at sites 1 and 2 did not show the increase in TDS that was expected based on the in-situ conductivity⁶ measurements. Profiles of TDS concentrations in Gunnison Bay ranged from 325 to 349 g/L at site 3 and from 315 to 343 g/L at site 4.

Specific gravities measured via hydrometer were used to determine sample densities (Equation 1). Data are provided in Appendix C, Surface Water Analytical Results; the SOP is provided in Appendix H, Standard Operating Procedure for Specific Gravity Determinations using a Hydrometer. Percent salinity was estimated from the measured TDS concentrations and density per the relationship shown in Equation 2 below.

Equation 1	$\text{Density}_{\text{brine}} \text{ (g/mL)} = \text{SG}_{\text{brine}} \times \text{Density of fresh water (g/mL)}$ <p><i>where</i></p> $\text{SG}_{\text{brine}} = \text{hydrometer-measured specific gravity (dimensionless)}$ $\text{Density of fresh water} = 1.000 \text{ g/mL (temperature dependent)}$
Equation 2	$\text{Salinity (\%)} = \text{TDS}_{\text{brine}} / \text{Density}_{\text{brine}} \times 100$ <p><i>where</i></p> $\text{TDS}_{\text{brine}} = \text{laboratory-measured TDS}_{\text{brine}} \text{ (g/mL)}$ $\text{Density}_{\text{brine}} = \text{Density}_{\text{brine}} \text{ from Equation 1 (g/mL)}$

⁶ See footnote 5 on page 13.

Figure 6. TDS Profiles – September 2014

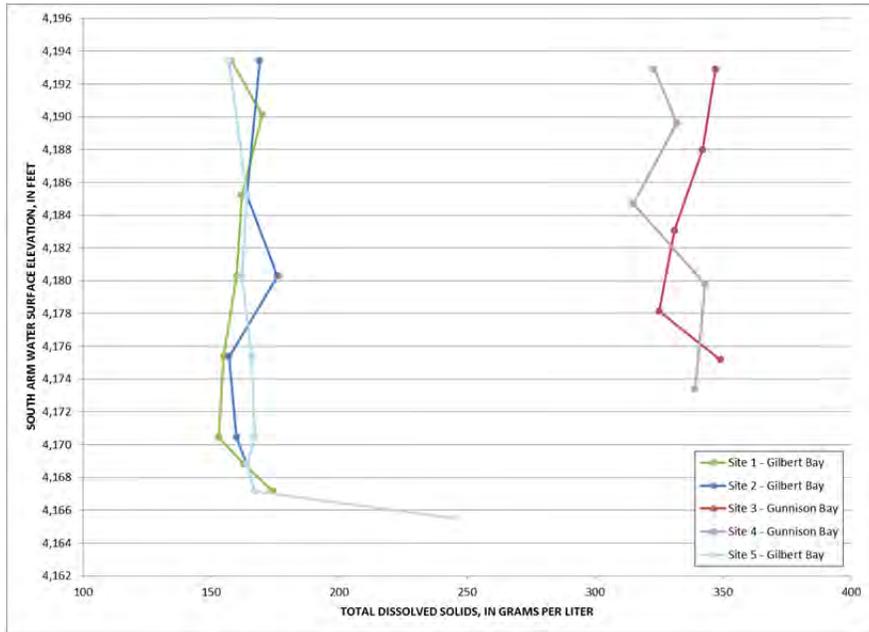


Figure 7. Salinity Profiles Based on Laboratory TDS and Hydrometer Measurements of Specific Gravity – September 2014

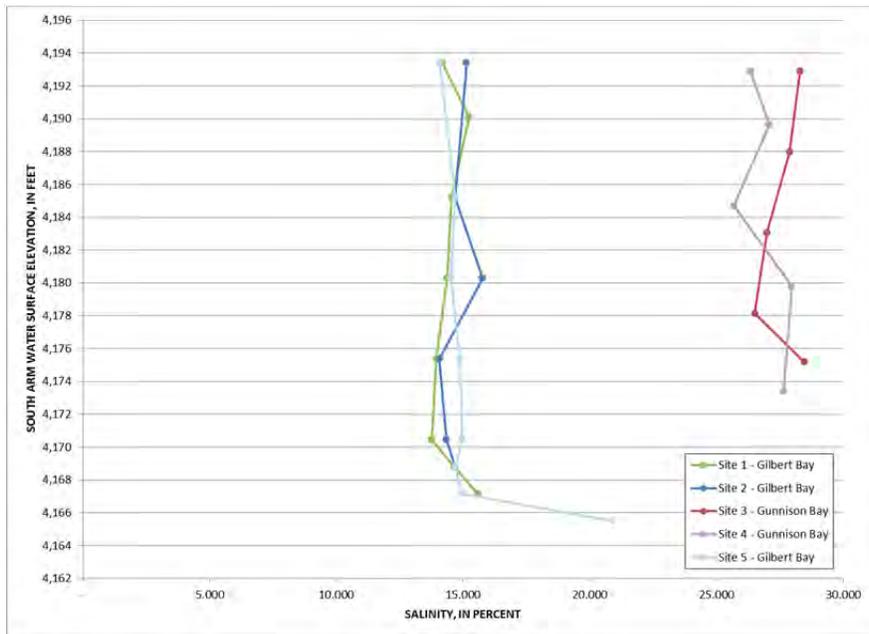


Table 6. Metals Concentrations in Surface and Deep Water Samples – September 2014

Parameter	Units	Gilbert Bay			Gunnison Bay	
		Site 1	Site 2	Site 5	Site 3	Site 4
Upper Water Column						
Hardness, total	mg/L	24,900	24,800	24,600	55,700	54,900
Sulfate ^a	mg/L	10,900	10,900	11,100	26,300	26,300
Arsenic	µg/L	102 V	90.5 V	86.4 V	136 V	163 V
Copper	µg/L	< 0.60	1.66	2.37	0.96	1.06
Lead	µg/L	< 0.065	1.71	1.84	0.079	< 0.065
Mercury	ng/L	5.35	10.1	5.37	25.7	26.6
Selenium	µg/L	< 1.05	< 1.05	< 1.05	< 1.05	1.35
Zinc	µg/L	< 3.75	< 3.75	< 3.75	< 3.75	< 3.75
Lower Water Column						
Hardness, total	mg/L	27,200	24,700	38,00	57,400	54,900
Sulfate ^a	mg/L	11,700	10,900	16,500	26,500	26,200
Arsenic	µg/L	93.6 V	83.2 V	163 V	134 V	165 N, V
Copper	µg/L	3.36	3.13	22.5	5.36	1.22
Lead	µg/L	2.37	1.86	10.7	< 0.065	< 0.065
Mercury	ng/L	19.5 V	14.6 V	36.8 V	30.2 V	30.8 V
Selenium	µg/L	< 1.05	< 1.05	1.42	< 1.05	1.23
Zinc	µg/L	< 3.75	< 3.75	20.4	< 3.75	< 3.75

^a Data quality objectives for sulfate met quality assurance objectives (UPRR 2014); UPRR notes that historical UGS data were analyzed to a greater level of resolution.

mg/L = milligrams per liter

µg/L = micrograms per liter

ng/L = nanograms per liter

N = Laboratory reports that quantity reported is estimated.

V = Determined during data review and verification to be estimated.

< = Not detected at the Method Reporting Limit.

3.4 Brine Shrimp Samples

Metals concentrations in brine shrimp tissue are provided in Table 7 with greater detail available in Appendix D, Brine Shrimp Analytical Results (data tables), and Appendix G, Field and Analytical Laboratory Data Reports (field data sheets and laboratory data packages).

In September 2014, shrimp were abundant with densities between 64,601 and 127,187 per cubic meter (Table 8 below). Nearly all individuals were in the egg stage. These individuals were a distinct cohort from those observed in the May and July 2014 monitoring periods. In May, most individuals were in the nauplii or metanauplii stage. Nauplii mature to adults in 2 to 3 weeks depending on food availability and temperature. In July, most individuals were in the egg stage. Great Salt Lake brine shrimp produce an average of two to four generations per year. Life stage definitions, subsample counts, and subsample quantities are provided in Appendix E, Brine Shrimp Taxonomic Results.

Table 7. Brine Shrimp Metals Tissue Concentrations

Parameter	Units	Gilbert Bay		
		Site 1	Site 2	Site 5
Total solids	%	29.16	20.58	27.70
Wet-weight				
Arsenic	mg/kg	5.76 V	5.15 V	6.05 V
Copper	mg/kg	2.89	3.90	3.35
Lead	mg/kg	0.270 V	0.670 V	0.245 V
Mercury	ng/g	57.0	48.3	61.3
Selenium	mg/kg	0.79	0.76	0.99
Zinc	mg/kg	18.7	17.8	20.4
Dry-weight				
Arsenic	mg/kg	19.7 V	25.0 V	21.8 V
Copper	mg/kg	9.93	18.9	12.1
Lead	mg/kg	0.927 V	3.26 V	0.885 V
Mercury	ng/g	195	235	221
Selenium	mg/kg	2.69	3.70	3.59
Zinc	mg/kg	64.0	86.6	73.5

mg/kg = milligrams per kilogram; ng/g = nanograms per gram

V = Determined during data review and verification to be estimated.

Table 8. Brine Shrimp Density (Individuals per cubic meter) and Percent Composition of Life Stages

Brine Shrimp Life Stage	Gilbert Bay		
	Site 1	Site 2	Site 5
Egg	73,761 (97.4%)	64,601 (95.2%)	127,187 (98.0%)
Nauplius	363 (0.5%)	544 (0.8%)	325 (0.3%)
Early metanauplius	1,424 (1.9%)	2,558 (3.8%)	2,013 (1.6%)
Mid metanauplius	0 (0.0%)	0 (0.0%)	65 (0.1%)
Late metanauplius	0 (0.0%)	0 (0.0%)	0 (0.0%)
Subadult	56 (0.1%)	32 (0.0%)	65 (0.1%)
Adult	140 (0.2%)	96 (0.1%)	130 (0.1%)
Total	82,984	64,689	174,627

Life stage definitions, subsample counts, and subsample quantities are provided in Appendix E, Brine Shrimp Taxonomic Results.

4.0 References

[EPA] United States Environmental Protection Agency

- 1996 Method 1669. Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels. July.

Rupke, Andrew

- 2014 Personal communication between Andrew Rupke, UGS, and Karen Nichols, HDR, regarding laboratory density and TDS concentration analyses and associated precision. July 25.

[UDWQ] Utah Division of Water Quality

- 2013 401 Water Quality Certification No. SPK 2011-00755. Temporary Closure of the East Culvert of Great Salt Lake Causeway. December 16.

[UPRR] Union Pacific Railroad

- 2011 Nationwide Permit Pre-construction Notification Form. Great Salt Lake Northern Railroad Causeway – Culvert Closure and Bridge Construction. July.
- 2014 Interim Monitoring Plan. Temporary Closure of the East Culvert, Great Salt Lake Causeway. Revised March 10.

[USACE] United States Army Corps of Engineers

- 2013 Nationwide Permit 14, Linear Transportation Projects, No. SPK 2011-00755. December 6.
- 2014 Approval of Interim Monitoring Plan, Modification of Special Condition 2b, and Time Extension of May 2014 Monitoring Report. April 18.

[USGS] United States Geological Survey

- 2014 Great Salt Lake – Lake Elevations. ut.water.usgs.gov/greatsaltlake/elevations. Accessed November 3, 2014.

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Appendix A. Surface Water Elevation Data

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Saltair - South Arm						Saline - North Arm							
Agency	Gage #	Date	Time	WSE (ft)	Qualifier	Agency	Gage #	Date	Time	WSE (ft)	Qualifier		
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USGS	10010000	9/9/2014	4:15	MDT	4193.5	P	USGS	10010100	9/9/2014	4:15	MDT	4192.6	P
USGS	10010000	9/9/2014	4:30	MDT	4193.4	P	USGS	10010100	9/9/2014	4:30	MDT	4192.8	P
USGS	10010000	9/9/2014	4:45	MDT	4193.4	P	USGS	10010100	9/9/2014	4:45	MDT	4193.1	P
USGS	10010000	9/9/2014	5:00	MDT	4193.6	P	USGS	10010100	9/9/2014	5:00	MDT	4193.1	P
USGS	10010000	9/9/2014	5:15	MDT	4193.7	P	USGS	10010100	9/9/2014	5:15	MDT	4192.9	P
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USGS	10010000	9/9/2014	7:15	MDT	4193.6	P	USGS	10010100	9/9/2014	7:15	MDT	4192.8	P
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USGS	10010000	9/9/2014	9:00	MDT	4193.5	P	USGS	10010100	9/9/2014	9:00	MDT	4193	P
USGS	10010000	9/9/2014	9:15	MDT	4193.5	P	USGS	10010100	9/9/2014	9:15	MDT	4192.9	P
USGS	10010000	9/9/2014	9:30	MDT	4193.7	P	USGS	10010100	9/9/2014	9:30	MDT	4192.8	P
USGS	10010000	9/9/2014	9:45	MDT	4193.6	P	USGS	10010100	9/9/2014	9:45	MDT	4192.8	P
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USGS	10010000	9/9/2014	14:45	MDT	4193.6	P	USGS	10010100	9/9/2014	14:45	MDT	4192.8	P
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USGS	10010000	9/9/2014	20:00	MDT	4193.4	P	USGS	10010100	9/9/2014	20:00	MDT	4192.6	P
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USGS	10010000	9/10/2014	5:00	MDT	4193.6	P	USGS	10010100	9/10/2014	5:00	MDT	4192.8	P
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USGS	10010000	9/10/2014	5:30	MDT	4193.6	P	USGS	10010100	9/10/2014	5:30	MDT	4193	P
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USGS	10010000	9/10/2014	6:00	MDT	4193.6	P	USGS	10010100	9/10/2014	6:00	MDT	4192.9	P
USGS	10010000	9/10/2014	6:15	MDT	4193.5	P	USGS	10010100	9/10/2014	6:15	MDT	4193	P

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USGS	10010000	9/10/2014	8:30	MDT	4193.6	P	USGS	10010100	9/10/2014	8:30	MDT	4192.8	P
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USGS	10010000	9/10/2014	9:00	MDT	4193.6	P	USGS	10010100	9/10/2014	9:00	MDT	4192.9	P
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USGS	10010000	9/10/2014	11:00	MDT	4193.6	P	USGS	10010100	9/10/2014	11:00	MDT	4192.9	P
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USGS	10010000	9/10/2014	12:30	MDT	4193.6	P	USGS	10010100	9/10/2014	12:30	MDT	4192.9	P
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USGS	10010000	9/10/2014	14:00	MDT	4193.6	P	USGS	10010100	9/10/2014	14:00	MDT	4192.8	P
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USGS	10010000	9/10/2014	15:30	MDT	4193.6	P	USGS	10010100	9/10/2014	15:30	MDT	4192.9	P
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USGS	10010000	9/10/2014	16:15	MDT	4193.6	P	USGS	10010100	9/10/2014	16:15	MDT	4192.9	P
USGS	10010000	9/10/2014	16:30	MDT	4193.6	P	USGS	10010100	9/10/2014	16:30	MDT	4192.8	P
USGS	10010000	9/10/2014	16:45	MDT	4193.6	P	USGS	10010100	9/10/2014	16:45	MDT	4192.8	P
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USGS	10010000	9/11/2014	2:45	MDT	4193.6	P	USGS	10010100	9/11/2014	2:45	MDT	4192.9	P
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USGS	10010000	9/11/2014	7:30	MDT	4193.6	P	USGS	10010100	9/11/2014	7:30	MDT	4193	P
USGS	10010000	9/11/2014	7:45	MDT	4193.6	P	USGS	10010100	9/11/2014	7:45	MDT	4192.9	P
USGS	10010000	9/11/2014	8:00	MDT	4193.6	P	USGS	10010100	9/11/2014	8:00	MDT	4192.9	P
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USGS	10010000	9/11/2014	20:00	MDT	4193.8	P	USGS	10010100	9/11/2014	20:00	MDT	4193.1	P
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USGS	10010000	9/11/2014	21:30	MDT	4193.8	P	USGS	10010100	9/11/2014	21:30	MDT	4193	P
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USGS	10010000	9/11/2014	23:15	MDT	4193.8	P	USGS	10010100	9/11/2014	23:15	MDT	4193	P
USGS	10010000	9/11/2014	23:30	MDT	4193.9	P	USGS	10010100	9/11/2014	23:30	MDT	4193.1	P

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USGS	10010000	9/12/2014	2:45	MDT	4193.7	P	USGS	10010100	9/12/2014	2:45	MDT	4193	P
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USGS	10010000	9/12/2014	5:30	MDT	4193.6	P	USGS	10010100	9/12/2014	5:30	MDT	4192.9	P
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USGS	10010000	9/12/2014	6:00	MDT	4193.6	P	USGS	10010100	9/12/2014	6:00	MDT	4192.9	P
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USGS	10010000	9/12/2014	7:30	MDT	4193.6	P	USGS	10010100	9/12/2014	7:30	MDT	4192.9	P
USGS	10010000	9/12/2014	7:45	MDT	4193.6	P	USGS	10010100	9/12/2014	7:45	MDT	4192.9	P
USGS	10010000	9/12/2014	8:00	MDT	4193.5	P	USGS	10010100	9/12/2014	8:00	MDT	4192.9	P
USGS	10010000	9/12/2014	8:15	MDT	4193.5	P	USGS	10010100	9/12/2014	8:15	MDT	4192.9	P
USGS	10010000	9/12/2014	8:30	MDT	4193.5	P	USGS	10010100	9/12/2014	8:30	MDT	4192.9	P
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USGS	10010000	9/12/2014	9:30	MDT	4193.5	P	USGS	10010100	9/12/2014	9:30	MDT	4192.9	P
USGS	10010000	9/12/2014	9:45	MDT	4193.5	P	USGS	10010100	9/12/2014	9:45	MDT	4193	P
USGS	10010000	9/12/2014	10:00	MDT	4193.5	P	USGS	10010100	9/12/2014	10:00	MDT	4192.9	P
USGS	10010000	9/12/2014	10:15	MDT	4193.5	P	USGS	10010100	9/12/2014	10:15	MDT	4192.9	P
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USGS	10010000	9/12/2014	11:00	MDT	4193.5	P	USGS	10010100	9/12/2014	11:00	MDT	4192.9	P
USGS	10010000	9/12/2014	11:15	MDT	4193.5	P	USGS	10010100	9/12/2014	11:15	MDT	4192.9	P
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USGS	10010000	9/12/2014	12:30	MDT	4193.6	P	USGS	10010100	9/12/2014	12:30	MDT	4192.9	P
USGS	10010000	9/12/2014	12:45	MDT	4193.5	P	USGS	10010100	9/12/2014	12:45	MDT	4192.9	P
USGS	10010000	9/12/2014	13:00	MDT	4193.6	P	USGS	10010100	9/12/2014	13:00	MDT	4192.9	P
USGS	10010000	9/12/2014	13:15	MDT	4193.6	P	USGS	10010100	9/12/2014	13:15	MDT	4192.9	P

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USGS	10010000	9/21/2014	8:15	MDT	4193.4	P	USGS	10010100	9/21/2014	8:15	MDT	4192.9	P
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USGS	10010000	9/21/2014	11:15	MDT	4193.3	P	USGS	10010100	9/21/2014	11:15	MDT	4192.9	P
USGS	10010000	9/21/2014	11:30	MDT	4193.4	P	USGS	10010100	9/21/2014	11:30	MDT	4192.8	P
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USGS	10010000	9/21/2014	12:00	MDT	4193.4	P	USGS	10010100	9/21/2014	12:00	MDT	4193	P
USGS	10010000	9/21/2014	12:15	MDT	4193.4	P	USGS	10010100	9/21/2014	12:15	MDT	4192.9	P
USGS	10010000	9/21/2014	12:30	MDT	4193.4	P	USGS	10010100	9/21/2014	12:30	MDT	4192.8	P
USGS	10010000	9/21/2014	12:45	MDT	4193.4	P	USGS	10010100	9/21/2014	12:45	MDT	4192.8	P
USGS	10010000	9/21/2014	13:00	MDT	4193.4	P	USGS	10010100	9/21/2014	13:00	MDT	4192.7	P
USGS	10010000	9/21/2014	13:15	MDT	4193.4	P	USGS	10010100	9/21/2014	13:15	MDT	4192.8	P
USGS	10010000	9/21/2014	13:30	MDT	4193.5	P	USGS	10010100	9/21/2014	13:30	MDT	4192.7	P
USGS	10010000	9/21/2014	13:45	MDT	4193.5	P	USGS	10010100	9/21/2014	13:45	MDT	4192.7	P
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USGS	10010000	9/21/2014	14:15	MDT	4193.5	P	USGS	10010100	9/21/2014	14:15	MDT	4192.8	P
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USGS	10010000	9/21/2014	15:15	MDT	4193.6	P	USGS	10010100	9/21/2014	15:15	MDT	4192.8	P
USGS	10010000	9/21/2014	15:30	MDT	4193.6	P	USGS	10010100	9/21/2014	15:30	MDT	4192.8	P
USGS	10010000	9/21/2014	15:45	MDT	4193.6	P	USGS	10010100	9/21/2014	15:45	MDT	4192.8	P
USGS	10010000	9/21/2014	16:00	MDT	4193.3	P	USGS	10010100	9/21/2014	16:00	MDT	4192.8	P
USGS	10010000	9/21/2014	16:15	MDT	4193.4	P	USGS	10010100	9/21/2014	16:15	MDT	4192.9	P
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USGS	10010000	9/21/2014	18:45	MDT	4193.3	P	USGS	10010100	9/21/2014	18:45	MDT	4192.8	P
USGS	10010000	9/21/2014	19:00	MDT	4193.4	P	USGS	10010100	9/21/2014	19:00	MDT	4192.8	P
USGS	10010000	9/21/2014	19:15	MDT	4193.4	P	USGS	10010100	9/21/2014	19:15	MDT	4192.8	P
USGS	10010000	9/21/2014	19:30	MDT	4193.4	P	USGS	10010100	9/21/2014	19:30	MDT	4192.8	P
USGS	10010000	9/21/2014	19:45	MDT	4193.3	P	USGS	10010100	9/21/2014	19:45	MDT	4192.8	P
USGS	10010000	9/21/2014	20:00	MDT	4193.5	P	USGS	10010100	9/21/2014	20:00	MDT	4192.8	P
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USGS	10010000	9/21/2014	21:00	MDT	4193.5	P	USGS	10010100	9/21/2014	21:00	MDT	4192.9	P
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USGS	10010000	9/21/2014	21:30	MDT	4193.5	P	USGS	10010100	9/21/2014	21:30	MDT	4192.8	P
USGS	10010000	9/21/2014	21:45	MDT	4193.5	P	USGS	10010100	9/21/2014	21:45	MDT	4192.9	P
USGS	10010000	9/21/2014	22:00	MDT	4193.5	P	USGS	10010100	9/21/2014	22:00	MDT	4192.9	P
USGS	10010000	9/21/2014	22:15	MDT	4193.5	P	USGS	10010100	9/21/2014	22:15	MDT	4192.9	P
USGS	10010000	9/21/2014	22:30	MDT	4193.5	P	USGS	10010100	9/21/2014	22:30	MDT	4192.9	P
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USGS	10010000	9/21/2014	23:00	MDT	4193.4	P	USGS	10010100	9/21/2014	23:00	MDT	4192.9	P
USGS	10010000	9/21/2014	23:15	MDT	4193.4	P	USGS	10010100	9/21/2014	23:15	MDT	4192.9	P
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USGS	10010000	9/22/2014	0:00	MDT	4193.4	P	USGS	10010100	9/22/2014	0:00	MDT	4192.8	P
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USGS	10010000	9/22/2014	1:00	MDT	4193.4	P	USGS	10010100	9/22/2014	1:00	MDT	4192.8	P
USGS	10010000	9/22/2014	1:15	MDT	4193.4	P	USGS	10010100	9/22/2014	1:15	MDT	4192.8	P
USGS	10010000	9/22/2014	1:30	MDT	4193.4	P	USGS	10010100	9/22/2014	1:30	MDT	4192.9	P
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USGS	10010000	9/22/2014	2:00	MDT	4193.4	P	USGS	10010100	9/22/2014	2:00	MDT	4192.8	P
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USGS	10010000	9/22/2014	2:45	MDT	4193.4	P	USGS	10010100	9/22/2014	2:45	MDT	4192.9	P
USGS	10010000	9/22/2014	3:00	MDT	4193.5	P	USGS	10010100	9/22/2014	3:00	MDT	4193	P
USGS	10010000	9/22/2014	3:15	MDT	4193.5	P	USGS	10010100	9/22/2014	3:15	MDT	4193	P
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USGS	10010000	9/22/2014	5:15	MDT	4193.4	P	USGS	10010100	9/22/2014	5:15	MDT	4192.8	P
USGS	10010000	9/22/2014	5:30	MDT	4193.4	P	USGS	10010100	9/22/2014	5:30	MDT	4192.8	P
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USGS	10010000	9/24/2014	14:00	MDT	4193.4	P	USGS	10010100	9/24/2014	14:00	MDT	4192.7	P
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USGS	10010000	9/24/2014	16:30	MDT	4193.5	P	USGS	10010100	9/24/2014	16:30	MDT	4192.8	P
USGS	10010000	9/24/2014	16:45	MDT	4193.5	P	USGS	10010100	9/24/2014	16:45	MDT	4192.8	P
USGS	10010000	9/24/2014	17:00	MDT	4193.4	P	USGS	10010100	9/24/2014	17:00	MDT	4192.8	P
USGS	10010000	9/24/2014	17:15	MDT	4193.4	P	USGS	10010100	9/24/2014	17:15	MDT	4192.8	P
USGS	10010000	9/24/2014	17:30	MDT	4193.4	P	USGS	10010100	9/24/2014	17:30	MDT	4192.8	P
USGS	10010000	9/24/2014	17:45	MDT	4193.4	P	USGS	10010100	9/24/2014	17:45	MDT	4192.8	P
USGS	10010000	9/24/2014	18:00	MDT	4193.3	P	USGS	10010100	9/24/2014	18:00	MDT	4192.8	P
USGS	10010000	9/24/2014	18:15	MDT	4193.4	P	USGS	10010100	9/24/2014	18:15	MDT	4192.8	P
USGS	10010000	9/24/2014	18:30	MDT	4193.4	P	USGS	10010100	9/24/2014	18:30	MDT	4192.8	P
USGS	10010000	9/24/2014	18:45	MDT	4193.4	P	USGS	10010100	9/24/2014	18:45	MDT	4192.8	P
USGS	10010000	9/24/2014	19:00	MDT	4193.4	P	USGS	10010100	9/24/2014	19:00	MDT	4192.8	P
USGS	10010000	9/24/2014	19:15	MDT	4193.4	P	USGS	10010100	9/24/2014	19:15	MDT	4192.8	P
USGS	10010000	9/24/2014	19:30	MDT	4193.4	P	USGS	10010100	9/24/2014	19:30	MDT	4192.8	P
USGS	10010000	9/24/2014	19:45	MDT	4193.4	P	USGS	10010100	9/24/2014	19:45	MDT	4192.8	P
USGS	10010000	9/24/2014	20:00	MDT	4193.4	P	USGS	10010100	9/24/2014	20:00	MDT	4192.8	P
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USGS	10010000	9/24/2014	20:30	MDT	4193.4	P	USGS	10010100	9/24/2014	20:30	MDT	4192.8	P
USGS	10010000	9/24/2014	20:45	MDT	4193.4	P	USGS	10010100	9/24/2014	20:45	MDT	4192.8	P
USGS	10010000	9/24/2014	21:00	MDT	4193.4	P	USGS	10010100	9/24/2014	21:00	MDT	4192.8	P
USGS	10010000	9/24/2014	21:15	MDT	4193.4	P	USGS	10010100	9/24/2014	21:15	MDT	4192.8	P
USGS	10010000	9/24/2014	21:30	MDT	4193.4	P	USGS	10010100	9/24/2014	21:30	MDT	4192.8	P
USGS	10010000	9/24/2014	21:45	MDT	4193.4	P	USGS	10010100	9/24/2014	21:45	MDT	4192.8	P
USGS	10010000	9/24/2014	22:00	MDT	4193.4	P	USGS	10010100	9/24/2014	22:00	MDT	4192.8	P
USGS	10010000	9/24/2014	22:15	MDT	4193.4	P	USGS	10010100	9/24/2014	22:15	MDT	4192.8	P
USGS	10010000	9/24/2014	22:30	MDT	4193.4	P	USGS	10010100	9/24/2014	22:30	MDT	4192.8	P
USGS	10010000	9/24/2014	22:45	MDT	4193.4	P	USGS	10010100	9/24/2014	22:45	MDT	4192.8	P
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USGS	10010000	9/24/2014	23:15	MDT	4193.4	P	USGS	10010100	9/24/2014	23:15	MDT	4192.8	P
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USGS	10010000	9/24/2014	23:45	MDT	4193.4	P	USGS	10010100	9/24/2014	23:45	MDT	4192.8	P
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USGS	10010000	9/25/2014	0:30	MDT	4193.4	P	USGS	10010100	9/25/2014	0:30	MDT	4192.8	P
USGS	10010000	9/25/2014	0:45	MDT	4193.4	P	USGS	10010100	9/25/2014	0:45	MDT	4192.7	P
USGS	10010000	9/25/2014	1:00	MDT	4193.3	P	USGS	10010100	9/25/2014	1:00	MDT	4192.7	P
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USGS	10010000	9/25/2014	1:30	MDT	4193.3	P	USGS	10010100	9/25/2014	1:30	MDT	4192.8	P
USGS	10010000	9/25/2014	1:45	MDT	4193.3	P	USGS	10010100	9/25/2014	1:45	MDT	4192.8	P
USGS	10010000	9/25/2014	2:00	MDT	4193.3	P	USGS	10010100	9/25/2014	2:00	MDT	4192.7	P
USGS	10010000	9/25/2014	2:15	MDT	4193.4	P	USGS	10010100	9/25/2014	2:15	MDT	4192.7	P
USGS	10010000	9/25/2014	2:30	MDT	4193.3	P	USGS	10010100	9/25/2014	2:30	MDT	4192.7	P
USGS	10010000	9/25/2014	2:45	MDT	4193.3	P	USGS	10010100	9/25/2014	2:45	MDT	4192.8	P
USGS	10010000	9/25/2014	3:00	MDT	4193.4	P	USGS	10010100	9/25/2014	3:00	MDT	4192.8	P

USGS	10010000	9/25/2014	3:15	MDT	4193.4	P	USGS	10010100	9/25/2014	3:15	MDT	4192.8	P
USGS	10010000	9/25/2014	3:30	MDT	4193.4	P	USGS	10010100	9/25/2014	3:30	MDT	4192.8	P
USGS	10010000	9/25/2014	3:45	MDT	4193.4	P	USGS	10010100	9/25/2014	3:45	MDT	4192.8	P
USGS	10010000	9/25/2014	4:00	MDT	4193.4	P	USGS	10010100	9/25/2014	4:00	MDT	4192.8	P
USGS	10010000	9/25/2014	4:15	MDT	4193.4	P	USGS	10010100	9/25/2014	4:15	MDT	4192.8	P
USGS	10010000	9/25/2014	4:30	MDT	4193.4	P	USGS	10010100	9/25/2014	4:30	MDT	4192.8	P
USGS	10010000	9/25/2014	4:45	MDT	4193.4	P	USGS	10010100	9/25/2014	4:45	MDT	4192.8	P
USGS	10010000	9/25/2014	5:00	MDT	4193.4	P	USGS	10010100	9/25/2014	5:00	MDT	4192.8	P
USGS	10010000	9/25/2014	5:15	MDT	4193.4	P	USGS	10010100	9/25/2014	5:15	MDT	4192.7	P
USGS	10010000	9/25/2014	5:30	MDT	4193.4	P	USGS	10010100	9/25/2014	5:30	MDT	4192.8	P
USGS	10010000	9/25/2014	5:45	MDT	4193.4	P	USGS	10010100	9/25/2014	5:45	MDT	4192.8	P
USGS	10010000	9/25/2014	6:00	MDT	4193.3	P	USGS	10010100	9/25/2014	6:00	MDT	4192.8	P
USGS	10010000	9/25/2014	6:15	MDT	4193.3	P	USGS	10010100	9/25/2014	6:15	MDT	4192.7	P
USGS	10010000	9/25/2014	6:30	MDT	4193.3	P	USGS	10010100	9/25/2014	6:30	MDT	4192.7	P
USGS	10010000	9/25/2014	6:45	MDT	4193.4	P	USGS	10010100	9/25/2014	6:45	MDT	4192.7	P
USGS	10010000	9/25/2014	7:00	MDT	4193.4	P	USGS	10010100	9/25/2014	7:00	MDT	4192.8	P
USGS	10010000	9/25/2014	7:15	MDT	4193.3	P	USGS	10010100	9/25/2014	7:15	MDT	4192.8	P
USGS	10010000	9/25/2014	7:30	MDT	4193.3	P	USGS	10010100	9/25/2014	7:30	MDT	4192.7	P
USGS	10010000	9/25/2014	7:45	MDT	4193.3	P	USGS	10010100	9/25/2014	7:45	MDT	4192.7	P
USGS	10010000	9/25/2014	8:00	MDT	4193.4	P	USGS	10010100	9/25/2014	8:00	MDT	4192.8	P
USGS	10010000	9/25/2014	8:15	MDT	4193.3	P	USGS	10010100	9/25/2014	8:15	MDT	4192.8	P
USGS	10010000	9/25/2014	8:30	MDT	4193.3	P	USGS	10010100	9/25/2014	8:30	MDT	4192.7	P
USGS	10010000	9/25/2014	8:45	MDT	4193.3	P	USGS	10010100	9/25/2014	8:45	MDT	4192.7	P
USGS	10010000	9/25/2014	9:00	MDT	4193.4	P	USGS	10010100	9/25/2014	9:00	MDT	4192.7	P
USGS	10010000	9/25/2014	9:15	MDT	4193.4	P	USGS	10010100	9/25/2014	9:15	MDT	4192.8	P
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USGS	10010000	9/25/2014	10:00	MDT	4193.4	P	USGS	10010100	9/25/2014	10:00	MDT	4192.8	P
USGS	10010000	9/25/2014	10:15	MDT	4193.4	P	USGS	10010100	9/25/2014	10:15	MDT	4192.7	P
USGS	10010000	9/25/2014	10:30	MDT	4193.4	P	USGS	10010100	9/25/2014	10:30	MDT	4192.8	P
USGS	10010000	9/25/2014	10:45	MDT	4193.4	P	USGS	10010100	9/25/2014	10:45	MDT	4192.8	P
USGS	10010000	9/25/2014	11:00	MDT	4193.4	P	USGS	10010100	9/25/2014	11:00	MDT	4192.8	P
USGS	10010000	9/25/2014	11:15	MDT	4193.4	P	USGS	10010100	9/25/2014	11:15	MDT	4192.6	P
USGS	10010000	9/25/2014	11:30	MDT	4193.4	P	USGS	10010100	9/25/2014	11:30	MDT	4192.7	P
USGS	10010000	9/25/2014	11:45	MDT	4193.4	P	USGS	10010100	9/25/2014	11:45	MDT	4192.8	P
USGS	10010000	9/25/2014	12:00	MDT	4193.4	P	USGS	10010100	9/25/2014	12:00	MDT	4192.9	P
USGS	10010000	9/25/2014	12:15	MDT	4193.4	P	USGS	10010100	9/25/2014	12:15	MDT	4192.8	P
USGS	10010000	9/25/2014	12:30	MDT	4193.4	P	USGS	10010100	9/25/2014	12:30	MDT	4192.7	P
USGS	10010000	9/25/2014	12:45	MDT	4193.4	P	USGS	10010100	9/25/2014	12:45	MDT	4192.7	P
USGS	10010000	9/25/2014	13:00	MDT	4193.4	P	USGS	10010100	9/25/2014	13:00	MDT	4192.7	P
USGS	10010000	9/25/2014	13:15	MDT	4193.4	P	USGS	10010100	9/25/2014	13:15	MDT	4192.8	P
USGS	10010000	9/25/2014	13:30	MDT	4193.4	P	USGS	10010100	9/25/2014	13:30	MDT	4192.8	P
USGS	10010000	9/25/2014	13:45	MDT	4193.4	P	USGS	10010100	9/25/2014	13:45	MDT	4192.8	P
USGS	10010000	9/25/2014	14:00	MDT	4193.5	P	USGS	10010100	9/25/2014	14:00	MDT	4192.7	P
USGS	10010000	9/25/2014	14:15	MDT	4193.4	P	USGS	10010100	9/25/2014	14:15	MDT	4192.7	P
USGS	10010000	9/25/2014	14:30	MDT	4193.4	P	USGS	10010100	9/25/2014	14:30	MDT	4192.8	P
USGS	10010000	9/25/2014	14:45	MDT	4193.4	P	USGS	10010100	9/25/2014	14:45	MDT	4192.8	P
USGS	10010000	9/25/2014	15:00	MDT	4193.3	P	USGS	10010100	9/25/2014	15:00	MDT	4192.7	P
USGS	10010000	9/25/2014	15:15	MDT	4193.4	P	USGS	10010100	9/25/2014	15:15	MDT	4192.7	P
USGS	10010000	9/25/2014	15:30	MDT	4193.3	P	USGS	10010100	9/25/2014	15:30	MDT	4192.7	P
USGS	10010000	9/25/2014	15:45	MDT	4193.4	P	USGS	10010100	9/25/2014	15:45	MDT	4192.8	P
USGS	10010000	9/25/2014	16:00	MDT	4193.3	P	USGS	10010100	9/25/2014	16:00	MDT	4192.8	P
USGS	10010000	9/25/2014	16:15	MDT	4193.3	P	USGS	10010100	9/25/2014	16:15	MDT	4192.7	P
USGS	10010000	9/25/2014	16:30	MDT	4193.4	P	USGS	10010100	9/25/2014	16:30	MDT	4192.7	P
USGS	10010000	9/25/2014	16:45	MDT	4193.2	P	USGS	10010100	9/25/2014	16:45	MDT	4192.6	P

USGS	10010000	9/25/2014	17:00	MDT	4193.2	P	USGS	10010100	9/25/2014	17:00	MDT	4192.7	P
USGS	10010000	9/25/2014	17:15	MDT	4193.2	P	USGS	10010100	9/25/2014	17:15	MDT	4192.8	P
USGS	10010000	9/25/2014	17:30	MDT	4193.3	P	USGS	10010100	9/25/2014	17:30	MDT	4192.7	P
USGS	10010000	9/25/2014	17:45	MDT	4193.4	P	USGS	10010100	9/25/2014	17:45	MDT	4192.7	P
USGS	10010000	9/25/2014	18:00	MDT	4193.4	P	USGS	10010100	9/25/2014	18:00	MDT	4192.7	P
USGS	10010000	9/25/2014	18:15	MDT	4193.3	P	USGS	10010100	9/25/2014	18:15	MDT	4192.6	P
USGS	10010000	9/25/2014	18:30	MDT	4193.4	P	USGS	10010100	9/25/2014	18:30	MDT	4192.6	P
USGS	10010000	9/25/2014	18:45	MDT	4193.3	P	USGS	10010100	9/25/2014	18:45	MDT	4192.6	P
USGS	10010000	9/25/2014	19:00	MDT	4193.3	P	USGS	10010100	9/25/2014	19:00	MDT	4192.6	P
USGS	10010000	9/25/2014	19:15	MDT	4193.3	P	USGS	10010100	9/25/2014	19:15	MDT	4192.6	P
USGS	10010000	9/25/2014	19:30	MDT	4193.3	P	USGS	10010100	9/25/2014	19:30	MDT	4192.6	P
USGS	10010000	9/25/2014	19:45	MDT	4193.4	P	USGS	10010100	9/25/2014	19:45	MDT	4192.7	P
USGS	10010000	9/25/2014	20:00	MDT	4193.3	P	USGS	10010100	9/25/2014	20:00	MDT	4192.6	P
USGS	10010000	9/25/2014	20:15	MDT	4193.2	P	USGS	10010100	9/25/2014	20:15	MDT	4192.6	P
USGS	10010000	9/25/2014	20:30	MDT	4193.2	P	USGS	10010100	9/25/2014	20:30	MDT	4192.6	P
USGS	10010000	9/25/2014	20:45	MDT	4193.4	P	USGS	10010100	9/25/2014	20:45	MDT	4192.7	P
USGS	10010000	9/25/2014	21:00	MDT	4193.4	P	USGS	10010100	9/25/2014	21:00	MDT	4192.7	P
USGS	10010000	9/25/2014	21:15	MDT	4193.4	P	USGS	10010100	9/25/2014	21:15	MDT	4192.7	P
USGS	10010000	9/25/2014	21:30	MDT	4193.3	P	USGS	10010100	9/25/2014	21:30	MDT	4192.7	P
USGS	10010000	9/25/2014	21:45	MDT	4193.4	P	USGS	10010100	9/25/2014	21:45	MDT	4192.7	P
USGS	10010000	9/25/2014	22:00	MDT	4193.3	P	USGS	10010100	9/25/2014	22:00	MDT	4192.8	P
USGS	10010000	9/25/2014	22:15	MDT	4193.3	P	USGS	10010100	9/25/2014	22:15	MDT	4192.7	P
USGS	10010000	9/25/2014	22:30	MDT	4193.3	P	USGS	10010100	9/25/2014	22:30	MDT	4192.6	P
USGS	10010000	9/25/2014	22:45	MDT	4193.3	P	USGS	10010100	9/25/2014	22:45	MDT	4192.6	P
USGS	10010000	9/25/2014	23:00	MDT	4193.2	P	USGS	10010100	9/25/2014	23:00	MDT	4192.6	P
USGS	10010000	9/25/2014	23:15	MDT	4193.2	P	USGS	10010100	9/25/2014	23:15	MDT	4192.7	P
USGS	10010000	9/25/2014	23:30	MDT	4193.2	P	USGS	10010100	9/25/2014	23:30	MDT	4192.6	P
USGS	10010000	9/25/2014	23:45	MDT	4193.2	P	USGS	10010100	9/25/2014	23:45	MDT	4192.5	P

Appendix B. Site Photographs

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Photograph B-1. Site 1, looking south.



Photograph B-3. Site 1, water quality sampling and representative water color.



Photograph B-2. Site 1, looking north, with the causeway in the distance.



Photograph B-4. Site 5, facing north, with the causeway in the distance.



Photograph B-5. Site 4, facing south, with causeway in the distance.



Photograph B-7. Site 4, Sechi training.



Photograph B-6. Site 4, facing north.



Photograph B-8. Site 3, facing south, with the causeway in the distance.



Photograph B-9. Site 3, facing north.



Photograph B-6. Great Salt Lake South Arm water color.

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Appendix C. Surface Water Analytical Results

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Table C-1. September 2014 Water Quality Data

Analyte	Sample Location	Method Detection Limit	Method Reporting Limit	Gilbert Bay						Gunnison Bay			
	Sample ID			Site 1		Site 2		Site 5		Site 3		Site 4	
				Coordinates	8180-1	8180-2	8180-5	8180-3	8180-4				
	Date			41.21379	-112.718	41.21329	-112.615	41.16935	-112.657	41.23184	-112.72	41.23085	-112.611
	Sample Type			09/23/14		09/23/14		09/23/14		09/10/14		09/10/14	
	Units			Original		Original		Original		Original		Original	
	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier			
PHYSICAL CHARACTERIZATION													
Secchi Depth	m	--	0.1	1.8	--	2.1	--	2.0	--	0.8	--	0.8	--
Depth	m	--	0.1	7.95	--	7.75	--	8.57	--	5.90	--	6.45	--
Brine Layer Interface Depth	m	--	0.1	7.25	--	7.5	--	7.35	--	--	--	--	--
Brine Layer Thickness	m	--	--	0.70	--	0.25	--	1.22	--	--	--	--	--
UPPER WATER COLUMN													
Specific conductance	µSiemens/cm	--	0.001	162,400	--	165,900	--	164,210	--	198,700	--	200,500	--
Dissolved Oxygen ^a	mg/L	--	0.1	6.67	--	6.36	--	5.56	--	5.96	--	4.49	--
pH	su	--	0.1	8.17	--	8.18	--	8.17	--	7.62	--	7.58	--
Temperature	°C	--	0.1	21.86	--	22.52	--	22.35	--	22.95	--	22.75	--
Alkalinity, Total (as CaCO ₃)	mg/L	--	1.0	481	--	462	--	746	--	395	--	403	--
Hardness, Total	mg/L	--	1	24,900	--	24,800	--	24,600	--	55,700	--	54,900	--
Sulfate	mg/L	--	1	10,900	--	10,900	--	11,100	--	26,300	--	26,300	--
Arsenic	µg/L	0.250	0.750	102	--	90.5	--	86.4	--	136	--	163	--
Copper	µg/L	0.20	0.60	0.20	U	1.66		2.37	--	0.96	--	1.06	--
Mercury	ng/L	0.1	0.41	5.35	--	10.1	--	5.37	--	25.7	--	26.6	--
Lead	µg/L	0.285	0.855	0.015	U	1.71	--	1.84	--	0.00.079	--	0.043	B
Selenium	µg/L	0.350	1.05	0.872	B	0.488	B	0.503	B	0.747	B	1.35	--
Zinc	µg/L	1.30	3.75	1.30	U	1.30	U	1.50	B	2.25	B	2.34	B
LOWER WATER COLUMN													
Specific conductance	µSiemens/cm	--	0.001	189,600	--	197,400	--	195,100	--	201,700	--	198,400	--
Dissolved Oxygen ^a	mg/L	--	0.1	0.69	--	1.70	--	0.16	--	4.34	--	3.7	--
pH	su	--	0.1	7.15	--	7.18	--	7.10	--	7.60	--	7.60	--
Temperature	°C	--	0.1	20.42	--	20.4	--	18.61	--	22.29	--	22.45	--
Alkalinity, Total (as CaCO ₃)	mg/L	--	1.0	478	--	459	--	618	--	389	--	390	--
Hardness, Total	mg/L	--	1	27,200	--	24,700	--	38,000	--	57,400	--	54,900	--
Sulfate	mg/L	--	1	11,700	--	10,900	--	16,500	--	26,500	--	26,200	--
Arsenic	µg/L	0.250	0.750	93.6	--	83.2	--	163	--	134	--	165	N
Copper	µg/L	0.20	0.60	3.36	--	3.13	--	22.5	--	5.36	--	1.22	--
Mercury	ng/L	0.1	0.41	19.5	V	14.6	V	36.8	V	30.2	V	30.8	V
Lead	µg/L	0.285	0.855	2.37	--	1.86	--	10.7	--	0.00.046	-- B	0.040	B
Selenium	µg/L	0.350	1.05	0.350	U	0.488	B	1.42	--	0.752	B	1.23	--
Zinc	µg/L	1.30	3.75	2.78	B	1.30	U	20.4	--	3.16	B	2.75	B

NOTES: Consistent with the Great Salt Lake Water Quality Strategy, samples were collected within 0.2 meters of the surface (surface location) and 0.5 meters of the bottom (deep location).

Dissolved oxygen, pH, and temperature results were extracted from sonde profiles. Results represent depth within 0.2 meters of the surface (surface location) and 0.5 meters of the bottom (deep location).

FOOTNOTES:

- a Results are sonde measurements.
- b USGS 10010100 Great Salt Lake Near Saline, Utah
- c Conductivity was not measured at this location.

QUALIFIER DEFINITIONS

- Not collected, not applicable or not required
- B Detected by the instrument, but the result is > the method detection limit (MDL) and ≤ the method reporting limit (MRL). Result is considered an estimate.
- J Estimated value. A full explanation is presented in the laboratory's narrative in Appendix G.
- M Duplicate precision was outside of acceptance criteria. Result may be biased low and is estimated.
- N Spike recovery was not within acceptance criteria. Result is estimated.
- V Concentration is estimated; metal was observed in associated equipment rinsate OR filed duplicate percent recovery was greater than 20%
- U Not detected at the MDL

ACRONYMS:

- m meters
- µg/L micrograms per liter
- mg/L milligrams per liter
- su standard units
- ng/L nanograms per liter
- mg/kg milligrams per kilogram
- µg/kg micrograms per kilogram
- ng/g nanograms per gram
- ft feet
- msl mean sea level

Table C-2. September 2014 Density and Total Dissolved Solid Data

Sample Location	Gilbert Bay												Gunnison Bay																											
	Site 1 8180-1				Site 2 8180-2				Site 5 8180-5				Site 3 8180-3				Site 4 8180-4																							
Sample ID	41.213792				-112.718006				41.213294				-112.614617				41.169347				-112.657169				41.231839				-112.719936				41.23085				-112.611308			
Coordinates	09/23/14				09/23/14				09/23/14				09/10/14				09/10/14																							
Date	Original				Original				Original				Original				Original																							
Sample Type	Density	Qual	TDS	Qual	Density	Qual	TDS	Qual	Density	Qual	TDS	Qual	Density	Qual	TDS	Qual	Density	Qual	TDS	Qual																				
Depth/Analyte	Units	g/ml	mg/L	mg/L	g/ml	mg/L	mg/L	g/ml	mg/L	mg/L	mg/L	mg/L	g/ml	mg/L	mg/L	mg/L	g/ml	mg/L	mg/L	mg/L																				
0.0 m	1.111	--	158,000	--	1.117	--	169,000	--	1.106	--	157,000	--	1.207	-- ^a	347,000	-- ^a	1.222	-- ^a	323,000	-- ^a																				
1.0 m	1.112	--	170,000	--	NC	--	NC	--	--	--	--	--	--	--	--	--	1.195	-- ^a	332,000	-- ^a																				
1.5 m	--	--	--	--	--	--	--	--	--	--	--	--	1.229	-- ^a	342,000	-- ^a	--	--	--	--																				
2.0 m	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--																				
2.5 m	1.110	--	162,000	--	1.110	--	164,000	--	1.111	--	164,000	--	--	--	--	--	1.232	-- ^a	315,000	-- ^a																				
3.0 m	--	--	--	--	--	--	--	--	--	--	--	--	1.213	-- ^a	331,000	-- ^a	--	--	--	--																				
3.5 m	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--																				
4.0 m	1.108	--	160,000	--	1.109	--	176,000	--	1.118	--	162,000	--	--	--	--	--	--	--	--	--																				
4.5 m	--	--	--	--	--	--	--	--	--	--	--	--	1.234	-- ^a	325,000	-- ^a	1.203	-- ^a	343,000	-- ^a																				
5.0 m	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--																				
5.5 m	1.104	--	155,000	--	1.116	--	157,000	--	1.120	--	166,000	--	--	--	--	--	--	--	--	--																				
6.0 m	--	--	--	--	--	--	--	--	--	--	--	--	1.212	-- ^a	349,000	-- ^a	1.228	-- ^a	339,000	-- ^a																				
6.5 m	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--																				
7.0 m	1.116	--	153,000	--	1.105	--	160,000	--	1.115	--	167,000	--	--	--	--	--	--	--	--	--																				
7.5 m	1.106	--	163,000	--	1.111	--	164,000	--	1.114	--	164,000	--	--	--	--	--	--	--	--	--																				
8.0 m	1.119	--	174,000	--	--	--	--	--	1.109	--	167,000	--	--	--	--	--	--	--	--	--																				
8.5 m	--	--	--	--	--	--	--	--	1.159	--	245,000	--	--	--	--	--	--	--	--	--																				
Depth to bottom (m)	7.95	--	--	--	7.75	--	--	--	8.57	--	--	--	5.9	--	--	--	6.45	--	--	--																				

a Sample collection depths were confirmed by field forms (side 2).

QUALIFIER DEFINITIONS

-- not collected, not applicable or not required

NC Not collected, non conformance with Interium Monitoring Plan

ACRONYMS:

m meters

µg/L micrograms per liter

mg/L milligrams per liter

su standard units

ng/L nanograms per liter

mg/kg milligrams per kilogram
μg/kg micrograms per kilogram
ng/g nanograms per gram
ft feet
msl mean sea level.

Table C-3. September 2014 Specific Gravity Data

Sample Location	Sample ID	Round 1		Round 2		Round 3		Average		Corrected		
		Depth	Temp (F)	Specific Gravity	Specific Gravity							
Gilbert Bay	8180-1	0.0	71.27	1.112	71.25	1.112	71.15	1.112	71.22	1.112	1.114	
		1.0	70.61	1.114	70.50	1.114	70.50	1.114	70.54	1.114	1.116	
		2.5	70.71	1.112	70.68	1.112	70.62	1.112	70.67	1.112	1.114	
		4.0	70.62	1.112	70.61	1.112	70.62	1.110	70.62	1.111	1.114	
		5.5	70.80	1.110	70.77	1.112	70.73	1.112	70.77	1.111	1.112	
		7.0	70.75	1.110	70.66	1.110	70.59	1.112	70.67	1.111	1.112	
		7.5	70.84	1.110	70.77	1.110	70.75	1.110	70.79	1.110	1.112	
		8.0	70.61	1.114	70.52	1.116	70.48	1.114	70.54	1.115	1.116	
	8180-2	0	70.93	1.114	70.64	1.114	70.46	1.114	70.68	1.114	1.116	
		2.5	71.33	1.114	71.29	1.114	71.18	1.114	71.27	1.114	1.116	
		4.0	70.95	1.114	70.88	1.114	70.79	1.114	70.87	1.114	1.116	
		5.5	71.06	1.114	70.88	1.114	70.79	1.114	70.91	1.114	1.116	
		7.0	71.02	1.114	70.79	1.114	70.55	1.114	70.79	1.114	1.116	
		7.5	70.95	1.114	70.62	1.114	70.41	1.114	70.66	1.114	1.116	
	8180-5	0	71.92	1.112	71.96	1.114	71.92	1.114	71.93	1.113	1.114	
		2.5	71.24	1.114	70.98	1.114	70.88	1.114	71.03	1.114	1.116	
		4.0	71.13	1.114	70.84	1.114	70.88	1.114	70.95	1.114	1.116	
		5.5	71.33	1.114	71.33	1.114	71.31	1.114	71.32	1.114	1.116	
		7.0	70.95	1.114	70.80	1.114	70.75	1.114	70.83	1.114	1.116	
		7.5	71.07	1.114	70.77	1.114	70.50	1.114	70.78	1.114	1.116	
		8.0	71.00	1.114	70.32	1.114	70.34	1.116	70.55	1.115	1.116	
		8.5	70.82	1.172	70.79	1.172	70.79	1.172	70.80	1.172	1.174	
	Gunnison Bay	8180-3	TOP	70.21	1.224	70.05	1.224	69.98	1.224	70.08	1.224	1.226
			TOP-DUP	70.03	1.224	69.89	1.224	69.72	1.224	69.88	1.224	1.226
1.5			70.26	1.224	69.96	1.224	69.63	1.224	69.95	1.224	1.226	
3.0			70.14	1.224	69.99	1.224	69.80	1.224	69.98	1.224	1.226	
4.5			70.26	1.224	70.07	1.224	69.92	1.224	70.08	1.224	1.226	
BOTTOM			70.34	1.224	70.05	1.224	69.94	1.224	70.11	1.224	1.226	
8180-4			TOP	70.17	1.224	70.05	1.224	69.98	1.224	70.07	1.224	1.226
		1.0	70.21	1.224	70.01	1.224	69.85	1.224	70.02	1.224	1.226	
		2.5	70.14	1.224	70.17	1.224	70.05	1.224	70.12	1.224	1.226	
		4.0	70.30	1.224	70.08	1.224	70.01	1.224	70.13	1.224	1.226	
		BOTTOM	70.34	1.224	70.08	1.224	70.07	1.224	70.16	1.224	1.226	

Specific gravity correction (Appendix H):

For every 5 °C the sample is above the hydrometer's calibrated temperature, add 0.001. For every 5 °C the sample is below the hydrometer's calibrated temperature, subtract 0.001.

For every 3 °C the sample is above the hydrometer's calibrated temperature, add 0.001. For every 3 °C the sample is below the hydrometer's calibrated temperature, subtract 0.001.

For every 2 °C the sample is above the hydrometer's calibrated temperature, add 0.001. For every 2 °C the sample is below the hydrometer's calibrated temperature, subtract 0.001.

Refer to the method provided in Appendix H for specific gravity measurement procedure.

Appendix D. Brine Shrimp Analytical Results

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Table D-1. September 2014 Brine Shrimp Tissue Data

Analyte	Sample Location	Method Detection Limit	Method Reporting Limit	Gilbert Bay					
	Sample ID			Site 1		Site 2		Site 5	
	Coordinates			8180-1		8180-2		8180-5	
	Date			41.2138	-112.72	41.1693	-112.66	41.1693	-112.66
	Sample Type			09/23/14		09/23/14		09/23/14	
	Units			Original		Original		Original	
				Result	Qual	Result	Qual	Result	Qual
Percent Solids									
Total Solids	%	0.30	1.00	29.16	—	20.58	—	27.70	—
Metals, wet-weight									
Arsenic	mg/kg	0.013	0.037	5.76	V	5.15	V	6.05	V
Copper	mg/kg	0.009	0.03	2.89	--	3.90	--	3.35	--
Mercury	ng/g	0.15	0.37	57.0	--	48.3	--	61.3	--
Lead	mg/kg	0.004	0.037	0.270	V	0.670	V	0.245	V
Selenium	mg/kg	0.06	0.14	0.79	--	0.76	--	0.99	--
Zinc	mg/kg	0.37	0.93	18.7	--	17.8	--	20.4	--
Metals, dry-weight									
Arsenic	mg/kg	0.63	0.179	19.7	V	25.0	V	21.8	V
Copper	mg/kg	0.04	0.14	9.93	--	18.9	--	12.1	--
Mercury	ng/g	0.72	1.79	195	--	235	--	221	--
Lead	mg/kg	0.018	0.179	0.927	V	3.26	V	0.885	V
Selenium	mg/kg	0.27	0.67	2.69	--	3.70	--	3.59	--
Zinc	mg/kg	1.79	4.47	64.0	--	86.6	--	73.5	--

QUALIFIER DEFINITIONS

- Not applicable or none.
- V Concentration is estimated; the metal's duplicate percent recovery was greater than 20%.

ACRONYMS:

- µg/kg micrograms per kilogram
- µg/L micrograms per liter
- ft feet
- m meters
- mg/kg milligrams per kilogram
- mg/L milligrams per liter
- msl mean sea level
- ng/g nanograms per gram
- ng/L nanograms per liter
- su standard units

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Appendix E. Brine Shrimp Taxonomic Results

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Table E-1. Subsample Data

EcoA #	HDR Sample #	Collection Date	Egg	Nauplius	Early Metanauplius	Mid Metanauplius	Late Metanauplius	Subadult	Adult	Initial Mass	Final Mass	Tare	% Subsample
6733.03-1	8181-1	9/23/2014	2,641	13	51	0	0	2	5	234	232	0	0.6%
6733.03-2	8180-1-DUP	9/23/2014	2,052	10	35	0	0	1	1	277	276	0	0.5%
6733.03-3	8180-2	9/23/2014	2,020	17	80	0	0	1	3	269	268	0	0.5%
6733.03-4	8180-5	9/23/2014	3,917	10	62	2	0	2	4	278	276	0	0.5%

Table E-2. Calculated Whole Sample Data

EcoA #	HDR Sample #	Collection Date	Egg	Nauplius	Early Metanauplius	Mid Metanauplius	Late Metanauplius	Subadult	Adult	Tow Length; 0.5 m from Bottom to Surface (m)	Tow Opening Diameter (m)	Tow Opening Area (m ²)	Volume of Water Towed (m ³)
6733.02-1	8181-1	7/15/2014	431,536	2,124	8,333	0	0	327	817	7.45	0.5	0.79	5.85
6733.02-2	8181-1-DUP	7/15/2014	378,991	1,847	6,464	0	0	185	185	7.45	0.5	0.79	5.85
6733.02-3	8180-2	7/15/2014	367,804	3,095	14,566	0	0	182	546	7.25	0.5	0.79	5.69
6733.02-4	8180-5	7/15/2014	806,032	2,058	12,758	412	0	412	823	8.07	0.5	0.79	6.34

Table E-3. Calculated Whole Sample Density (Individuals per cubic meter)

EcoA #	HDR Sample #	Collection Date	Egg	Nauplius	Early Metanauplius	Mid Metanauplius	Late Metanauplius	Subadult	Adult	Total
6733.01-1	8180-1	7/15/2014	73,761	363	1,424	0	0	56	140	75,744
6733.01-2	8180-1-DUP	7/15/2014	64,779	316	1,105	0	0	32	32	66,263
6733.01-3	8180-2	7/15/2014	64,601	544	2,558	0	0	32	96	67,832
6733.01-4	8180-5	7/15/2014	127,187	325	2,013	65	0	65	130	129,785

Table E-4. Life Stage Composition (% of sample)

EcoA #	HDR Sample #	Collection Date	Egg	Nauplius	Early Metanauplius	Mid Metanauplius	Late Metanauplius	Subadult	Adult
6733.01-1	8180-1	5/23/2014	97.4	0.5	1.9	0.0	0.0	0.1	0.2
6733.01-2	8180-1-DUP	5/23/2014	97.8	0.5	1.7	0.0	0.0	0.0	0.0
6733.01-3	8180-2	5/23/2014	95.2	0.8	3.8	0.0	0.0	0.0	0.1
6733.01-4	8180-5	5/23/2014	98.0	0.3	1.6	0.1	0.0	0.1	0.1

LIFE STAGE DEFINITIONS

Egg: Intact sphere; chorion unbroken, or, if broken, filled with material.

Nauplius: First instar; no post-mandibular appendages.

Early metanaupliu: Trunk elongate; limb buds developing; compound eyes absent or minute.

Mid metanaupliu: Some thoracopods (less than 11) formed, less than or equal to second antenna in size; compound eyes larger; becoming pedunculate.

Late metanaupliu: All 11 thoracopods developed; second antenna still modified for swimming; significantly smaller than larger thoracopods; compound eyes well developed.

Subadult: Second antenna not modified for swimming; generally adult in form; genitalia and modified second antennae of males only partially developed.

Adult: Genitalia fully developed; male second antennae fully developed; ovisac of female large, typically filled with eggs.

Appendix F. Data Quality Assurance Documentation

Data were acquired in accordance with UPRR's Quality Assurance Program Plan (QAPP), which was provided as Appendix C to the Interim Monitoring Plan (IMP; UPRR 2014). Following each event, UPRR subjected all data to quality assurance/quality control (QA/QC) procedures including, but not limited to, spot-checks of transcription; review of data submissions for completeness; comparison of geographic information systems (GIS) maps with field notes on locations; and identification of any inconsistent data (Figure F-1).

The QAPP specifies representativeness, accuracy, precision, comparability, and completeness objectives for data acquisition (UPRR 2014, Table 7-1). Representativeness was ensured via the location of sample sites as well as the sampling intervals. Representative locations and measurement intervals were prescribed by the U.S. Army Corps of Engineers (USACE) and the Utah Division of Water Resources (UDWQ) and are described in Table 2, Interim Monitoring Sampling Site Coordinates and Descriptions, of the main report.

Accuracy for field and laboratory measurements is defined as the degree of conformity of a measured/calculated quantity to its actual (true) value. The accuracy objective provided in the QAPP for the study (UPRR 2014) was met by using standard methods and calibrated instruments. Calibration records for the Troll 9500 are provided in Table F-1. All sonde probes were calibrated, including conductivity. Laboratory data packages (Level 2) are provided in Appendix G. Quality assurance samples (method blanks, laboratory control samples, method spikes, and others) were analyzed as appropriate for each method. In the few conditions when laboratory quality control analyses were outside of acceptable limits, data are qualified and flagged accordingly.

The comparability objective provided in the QAPP for the study (UPRR 2014) was ensured by meeting the target reporting limits provided in *Table 4, Water Quality Parameters and Constituents To Be Measured and Methods, with Detection Limits, Reporting Limits, and Laboratory Hold Time*, of the main report. Though the brine matrix required dilutions, method reporting limits (MRL) and method detection limits (MDL) were met. In the analytical data package and Appendix C, some lead, selenium and zinc data were flagged to account for concentrations found below MRLs but above MDLs. Per the IMP, these data are shown "as is" in Appendix C and Appendix G but are reported as non-detect at the method reporting limit (MRL) in the main report.

The precision objective provided in the QAPP for the study consisted of the laboratory meeting all of its QA requirements and field duplicate results within 20% (UPRR 2014). Precision is an assessment of reproducibility under a particular set of conditions. Equipment rinsates and field blanks also provide insight into the sampling results' precision.

- Level 2 laboratory data packages are provided in Appendix G. The laboratory met its QA requirements (See Appendix G).
- A field duplicate is a second sample collected at the same time or immediately after the primary environmental sample; a field duplicate indicates the precision of field sample collection. Arsenic and lead relative percent differences were greater than 20% and samples were qualified (V). An equipment blank is a sample of analyte-free water poured over or through decontaminated field sampling equipment prior to the collection of samples. It indicates the adequacy of the decontamination processes for shared equipment. Only lower-water-column samples were

collected using shared equipment; near-surface samples were collected directly into the sampling container. Two equipment blanks were collected in September, one along with samples collected from the North Arm and one along with samples collected from the South Arm. Mercury was detected in each equipment rinsate at 35.6 ng/L and 12.6 ng/L, respectively. The laboratory confirmed both results by reanalysis (Appendix G). Mercury was also detected in May and July rinsates. Upon data review and verification, all lower water column mercury were qualified estimated (V).

- A trip blank is a sample of analyte-free water poured into the container before sampling begins and travels with the cooler throughout the day. A trip blank indicates whether volatile contaminants are getting into the sample. A trip blank accompanied samples collected on September 23, to see if mercury might be entering samples through the sampling process. All trip blank results were non-detect.
- A field blank is a sample of analyte-free water poured into the container in the field and then preserved and shipped to the laboratory with the samples. A field blank indicates whether there was contamination from field conditions during sampling. All field blank results non-detect.

The completeness objective provided in the QAPP for the study was 90% (UPRR 2014) and is defined as the number of valid measurements divided by the number of measurements collected. Forty-one analytes were measured for each of the five water samples, and 14 analytes were measured for each of the three brine shrimp samples. Though some project variances/non-conformances resulted in data loss or qualification (see Section 2.6, Study Variances and Corrective Action, of the main report), the completeness objective of 90% for the July 2014 was met: valid measurements were obtained for 93% of the surface water analytes and 100% of the brine shrimp analytes.

Reference:

[UPRR] Union Pacific Railroad

- 2014 Interim Monitoring Plan. Temporary Closure of the East Culvert, Great Salt Lake Causeway. Appendix C. Quality Assurance Project Plan. Revised March 10.

Figure F-1. Data Verification Checklist

General	
<input checked="" type="checkbox"/>	For each sample event, samples have been collected and analyzed at all locations and for all analyses specified in the monitoring plan.
<input checked="" type="checkbox"/>	For each sample and analyses, the project file contains records field notes, chain-of-custody, and analytical results, including quality assurance documentation (hardcopy and electronic)
Field Data	
<input checked="" type="checkbox"/>	Field notes and/or data sheets include date, time of sample collection, field sampling staff, time arrived at site, time left site, site identification, description of site conditions (weather), field parameters, lake level, sample collection procedures, and call-out quality assurance samples collected. If mistakes are found on the field data sheet, changes can be made by crossing out the mistake and marking the change with a date of change, initials, and reason for change.
<input checked="" type="checkbox"/>	Documentation of field equipment calibration is in the field notes and/or project records.
<input checked="" type="checkbox"/>	Field data entered into Excel, have been checked by a second-party.
Laboratory Report	
<input checked="" type="checkbox"/>	Field duplicates, blanks, and rinsates were submitted to the laboratory at the frequency specified in the monitoring plan.
<input checked="" type="checkbox"/>	Any constituents found in blanks or rinsates are discussed in the report.
<input checked="" type="checkbox"/>	Any duplicate concentrations that differ by more than 10% are discussed in the report.
<input checked="" type="checkbox"/>	Samples were received by the laboratory intact and analyzed within method and/or study specified holding times.
<input checked="" type="checkbox"/>	On laboratory reports, sample IDs, analyses, reporting/detection limits, units, column labels, footnotes, and titles are accurate. Have lab re-issue report with corrections if there are inconsistencies.
<input checked="" type="checkbox"/>	Check that non-detects are always reported in the same manner using consistent notation. For example, either "ND" or "<." Have lab re-issue report with corrections if there are inconsistencies.

Table F-1. Field Equipment Calibration Records – September 2014

pH	Oxidation Reduction Potential, ORP	Conductivity, High Range	Dissolved Oxygen, RDO
Device Serial Number 51118	Device Serial Number 51118	Device Serial Number 51118	Device Serial Number 51118
Sensor Serial Number PP15865	Sensor Serial Number PP15865	Sensor Serial Number HC03068	Sensor Serial Number 373780
Sensor Mfg Date 8/13/2014	Sensor Mfg Date 8/13/2014	Sensor Mfg Date 8/31/2007	Sensor Mfg Date 5/23/2014
Method Quick Cal	Method Quick Cal	Sensor Type Conductivity, High Range	Method Traditional
Action COMPLETED	Action COMPLETED	Method Quick Cal	Action COMPLETED
Status Point 1 Not provided	Status Point 1 Not provided	Action COMPLETED	Status Point 1 STABLE
Status Point 2 Not provided	Status Point 2 Not provided	Status Point 1 STABLE	Status Point 2 STABLE
Date 2014-08-28	Date 2014-08-28	Date 2014-08-28	Date 2014-08-28
Time 134052	Time 134052	Time 134052	Time 133226
Last Calibrated 8/13/2014	Last Calibrated 8/28/2014	Last Calibrated 8/28/2014	Last Calibrated 8/28/2014
Cal Points: 3	Cal Points: 1	Cal Points:	Sensor Firmware Ver 10
Point 1:	Cal Type: Quick Cal Solution pH7	1	Cap Serial Number 368359
Stimulus = 4.00 pH	Point1:	Custom Cal Solution	Cap Mfg Date 4/7/2014
Response = 170.791 mV	Quick Cal Solution pH7	Stimulus = 7980 μ S/cm	Cap Expiration Date 5/30/2015
Final Reading = 4.00 pH	Stimulus = 222.072 mV	Response = 698.921 ohms	Saturation Point: NEW CALIBRATION VALUES
Temperature = 25.3818 C	Response = 214.298 mV	Final Reading = 7980 μ S/cm	7.24 mg/l
Point 2:	Final Reading = 222.072 mV	Temperature = 22.0495 C	23.02 °C
Stimulus = 7.01 pH	Temperature = 26.1362 C	Kcell = 5.24229	851.29 mbar
Response = -6.37747 mV	Offset = -7.77383 mV		Zero Point: NEW CALIBRATION VALUES
Final Reading = 7.01 pH			0.04 mg/l
Temperature = 25.3506 C			22.59 °C
Point 3:			
Stimulus = 10.01 pH			
Response = -180.994 mV			
Final Reading = 10.01 pH			
Temperature = 25.2931 C			
Segment 1:			
Slope = -58.8598 mV/pH			
Offset = 406.23 mV			
Segment 2:			
Slope = -58.2056 mV/pH		--	Calibration slope 0.99 (mg/l) / (mg/l)
Offset = 401.715 mV		--	Calibration offset -0.04 mg/l

Table F-2. Field Quality Assurance Data – September 2014

Analyte	Media	Method Detection Limit	Method Reporting Limit	SURFACE WATER												Media	BRINE SHRIMP TISSUE								
	Sample Location			Gunnison Bay								Equipment Blank	Field Blank	Equipment Blank	Trip Blank	Sample Location	Gilbert Bay								
	Sample ID			Site 3				RPD	8180-EB	8180-FB	8180-EB	8180-FB	Sample ID	Site 1											
	Coordinates			8180-3A ¹	8180-3A DUP				--	--	--	--	--	--	8180-1	8180-1-DUP			RPD						
	Date			41.23085	-112.611308				09/10/14	09/10/14	09/23/14	09/23/14	Date	41.213792	-112.718006										
	Sample Type			09/10/14	09/10/14				Original	Original	Original	Original	Sample Type	09/23/14	09/23/14										
	Units			Original	Duplicate				Original	Original	Original	Original	Units	Original	Duplicate										
				Result	Qual	Result	Qual		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual							
GENERAL CHEMISTRY																									
Alkalinity, Total (as CaCO ₃)	mg/L	--	1.0	395	--	394	--	0.3	1.0	ND	1.0	ND	--	--	--	--	--	--	--	--	--	--	--	--	
Chloride	mg/L	--	1	187,000	--	188,000	--	0.5	2	--	1	ND	--	--	--	--	--	--	--	--	--	--	--	--	
Hardness, Total	mg/L	--	1	55,700	--	55,300	--	0.7	1	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	
Sulfate	mg/L	--	1	26,300	--	26,600	--	1.1	1	ND	1	ND	--	--	--	--	--	--	--	--	--	--	--	--	
Calcium	mg/L	--	0.2	377	--	390	--	3.4	4.0	ND	4.0	ND	--	--	--	--	--	--	--	--	--	--	--	--	
Magnesium	mg/L	--	0.100	13,300	--	13,200	--	0.8	0.315	--	0.264	--	--	--	--	--	--	--	--	--	--	--	--	--	
Potassium	mg/L	--	0.5	8,150	--	8,100	--	0.6	0.4	--	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	
Sodium	mg/L	--	0.300	103,000	--	103,000	--	0.0	3.68	--	5.44	--	--	--	--	--	--	--	--	--	--	--	--	--	
DENSITY AND TOTAL DISSOLVED SOLIDS																									
Density	g/ml	--	0.0010	1.207	--	1.209	--	0.2	1.006	--	0.9924	--	--	--	--	--	--	--	--	--	--	--	--	--	
Total Dissolved Solids	mg/L	--	32	347,000	--	346,000	--	0.3	32	--	236	--	--	--	--	--	--	--	--	--	--	--	--	--	
PERCENT SOLIDS																									
Total Solids	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	%	0.30	1.00	29.16	--	21.04	--	32
METALS																									
																	METALS, dry-weight								
Arsenic	µg/L	0.250	0.750	136	--	175	--	25	0.050	U	0.050	U	0.250	U	0.250	U	mg/kg	0.045	0.129	19.7	--	28.0	--	35	
Copper	µg/L	0.20	0.60	0.96	--	0.88	--	4--	12.2	--	0.04	U	0.20	U	0.20	U	mg/kg	0.13	0.52	9.93	--	11.7	--	16	
Mercury	ng/L	0.1	0.41	25.7	--	26.6	--	2	35.6	--	0.10	U	12.6	--	0.10	U	ng/g	0.52	1.29	195	--	212	--	8	
Lead	µg/L	0.285	0.855	0.079	--	0.515	--	73	0.019	--	0.003	U	0.285	U	0.285	U	mg/kg	0.013	0.129	0.927	--	2.22	--	82	
Selenium	µg/L	0.350	1.05	0.747	B	1.22	--	-- ²	0.070	U	0.070	U	0.350	U	0.350	U	mg/kg	0.19	0.48	2.69	--	2.67	--	1	
Zinc	µg/L	1.30	3.75	2.25	B	2.42	B	-- ²	0.46	B	0.26	U	1.30	U	1.30	U	mg/kg	0.65	3.23	64.0	--	53.6	--	18	

¹ "A" designation represents surface sample.

² Due to the large quantitative uncertainty, Relative Percent Difference (RPD) calculations were not performed on estimated results.

QUALIFIER DEFINITIONS

--	not collected, not applicable or not required
B	Detected by the instrument, the result is > the method detection limit (MDL) but ≤ the method reporting limit (MRL). Result is considered an estimate.
H	Result is estimated. Samples warmed above 4 C during shipping.
J	Estimated value. A full explanation is presented in the laboratory's narrative in Appendix G.
J1	Detected by the instrument, the result is > the method detection limit (MDL) but ≤ the method reporting limit (MRL). Result is considered an estimate.
M	Duplicate precision was outside of acceptance criteria. Result may be biased low and is estimated.
N	Spike recovery was not within acceptance criteria. Result is estimated.
ND	Not detected at the Method Reporting Limit
R	Rejected upon review; not of sufficient precision.
U	Not detected at the Method Detection Limit

ACRONYMS:

m	meters
µg/L	micrograms per liter
mg/L	milligrams per liter
su	standard units
ng/L	nanograms per liter
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
ng/g	nanograms per gram
ft	feet
msl	mean sea level

Appendix G. Field and Analytical Laboratory Data Reports

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HDR INC - UPRR GSL WQ

General Site Information								
Date: 9.10.14		Time: 1120			Field Crew: C.V N.N A.B			
Weather: sunny, breeze		Sample ID: 8180# 4			Sample Location: North Arm # 84			
Northing: GPS		Easting:			GPS Point Saved		YES	<input checked="" type="checkbox"/> NO
Total Depth (m): 6.45 m		Brine Depth (m): —			Secchi Depth (m): 0.8			
Vertical Profile File Name: Sec reverse				Photo Numbers and descriptions: 2014 - looking @ causeway 2015 - looking upstream 2016 - secchi training				
Surface Water Samples (check when done)								
A - Surface (0.2m)	DO	meter	Mercury	<input checked="" type="checkbox"/>	Metals	<input checked="" type="checkbox"/>	Sulfate	<input checked="" type="checkbox"/>
	Hardness	<input checked="" type="checkbox"/>	Cations	<input checked="" type="checkbox"/>	Anions	<input checked="" type="checkbox"/>	Alkalinity	<input checked="" type="checkbox"/>
B - Bottom (0.5m)	DO	meter	Mercury	<input checked="" type="checkbox"/>	Metals	<input checked="" type="checkbox"/>	Sulfate	<input checked="" type="checkbox"/>
	Hardness	<input checked="" type="checkbox"/>	Cations	<input checked="" type="checkbox"/>	Anions	<input checked="" type="checkbox"/>	Alkalinity	<input checked="" type="checkbox"/>
Field duplicate collected (1 per trip)?				YES		NO		
Brine Shrimp Samples (check when done)								
Tow 1		Tow 2		Tow 3		Composited:		
Field duplicate collected (1 per trip)?				YES		NO		
Tow 4 (taxon)		Taxon Field duplicate collected (1 per trip)?				YES		NO
Notes: no shrimp								

HDR INC - UPRR GSL WQ

General Site Information								
Date: 9.10.14		Time: 1200			Field Crew: CV AL NN			
Weather: sunny, calm		Sample ID: 8180#3			Sample Location: North Arm #3			
Northing: GPS		Easting:			GPS Point Saved		YES	<input checked="" type="radio"/> NO
Total Depth (m): 5.9		Brine Depth (m):			Secchi Depth (m): 0.8m			
Vertical Profile File Name: see reverse				Photo Numbers and descriptions: 2017 - looking @ causeway 2018 - looking @ upstream				
Surface Water Samples (check when done)								
A - Surface (0.2m)	DO	<input checked="" type="checkbox"/>	Mercury	<input checked="" type="checkbox"/>	Metals	<input checked="" type="checkbox"/>	Sulfate	<input checked="" type="checkbox"/>
	Hardness	<input checked="" type="checkbox"/>	Cations	<input checked="" type="checkbox"/>	Anions	<input checked="" type="checkbox"/>	Alkalinity	<input checked="" type="checkbox"/>
B - Bottom (0.5m)	DO	<input checked="" type="checkbox"/>	Mercury	<input checked="" type="checkbox"/>	Metals	<input checked="" type="checkbox"/>	Sulfate	<input checked="" type="checkbox"/>
	Hardness	<input checked="" type="checkbox"/>	Cations	<input checked="" type="checkbox"/>	Anions	<input checked="" type="checkbox"/>	Alkalinity	<input checked="" type="checkbox"/>
Field duplicate collected (1 per trip)?				YES		NO		
Brine Shrimp Samples (check when done)								
Tow 1		Tow 2		Tow 3		Composited:		
Field duplicate collected (1 per trip)?				YES		NO		
Tow 4 (taxon)		Taxon Field duplicate collected (1 per trip)?				YES		NO
Notes: no shrimp. duplicate metals WQ TDS/density 5.6								

HDR INC - UPRR GSL WQ

General Site Information									
Date: 9.23		Time: 1330			Field Crew: CW, NN, CN				
Weather: sunny, breeze		Sample ID: 8180-2			Sample Location: 2				
Northing: see GPS		Easting: _____			GPS Point Saved		YES		<input checked="" type="radio"/> NO
Total Depth (m): 7.75		Brine Depth (m): 87.5			Secchi Depth (m): 2.1				
Vertical Profile File Name: see back				Photo Numbers and descriptions:					
Surface Water Samples (check when done)									
A - Surface (0.2m)	DO	<input checked="" type="checkbox"/>	Mercury	<input checked="" type="checkbox"/>	Metals	<input checked="" type="checkbox"/>	Sulfate	<input checked="" type="checkbox"/>	
	Hardness	<input checked="" type="checkbox"/>	Cations	<input checked="" type="checkbox"/>	Anions	<input checked="" type="checkbox"/>	Alkalinity	<input checked="" type="checkbox"/>	
B - Bottom (0.5m)	DO	<input checked="" type="checkbox"/>	Mercury	<input checked="" type="checkbox"/>	Metals	<input checked="" type="checkbox"/>	Sulfate	<input checked="" type="checkbox"/>	
	Hardness	<input checked="" type="checkbox"/>	Cations	<input checked="" type="checkbox"/>	Anions	<input checked="" type="checkbox"/>	Alkalinity	<input checked="" type="checkbox"/>	
Field duplicate collected (1 per trip)?					YES		NO		
Brine Shrimp Samples (check when done)									
Tow 1	<input checked="" type="checkbox"/>	Tow 2	-	Tow 3	-	Composited:		-	
Field duplicate collected (1 per trip)?					YES		<input checked="" type="radio"/> NO		
Tow 4 (taxon)	<input checked="" type="checkbox"/>	Taxon Field duplicate collected (1 per trip)?				YES		<input checked="" type="radio"/> NO	
Notes:									
<p>Brine layer very shallow here but identified by DO, pH, turb + conductivity change.</p> <p>- 1 Metals tow for shrimp.</p> <p>* no TDS/ Density or S. Grav @ 1m = ran out of bottles.</p>									

General Site Information								
Date: 9.23.14		Time: 1200			Field Crew: C.W., C.N., N.N			
Weather: Sunny, breeze		Sample ID: 8180-5			Sample Location: # 5			
Northing: see GPS		Easting: →			GPS Point Saved	YES	NO	
Total Depth (m): 8.57		Brine Depth (m): 7.2-7.5m			Secchi Depth (m): 2.0			
Vertical Profile File Name: see back				Photo Numbers and descriptions: 2023 - looking @ causeway.				
Surface Water Samples (check when done)								
A - Surface (0.2m)	DO	X	Mercury	X	Metals	X	Sulfate	X
	Hardness	X	Cations	X	Anions	X	Alkalinity	X
B - Bottom (0.5m)	DO	X	Mercury	X	Metals	X	Sulfate	X
	Hardness	X	Cations	X	Anions	X	Alkalinity	X
Field duplicate collected (1 per trip)?					YES	NO		
Brine Shrimp Samples (check when done)								
Tow 1	X	Tow 2		Tow 3		Composited:		
Field duplicate collected (1 per trip)?					YES	NO		
Tow 4 (taxon)	X	Taxon Field duplicate collected (1 per trip)?				YES	NO	
Notes: - 1 Tow for metals - deep brine color very different (photo 2022) - brine very abundant here shrimp								

HDR INC - UPRR GSL WQ

General Site Information								
Date: 9.23.14		Time: 1015			Field Crew: CV, NN, CN			
Weather: Sunny slight breeze		Sample ID: 8180-1			Sample Location: #1			
Northing: see GPS		Easting:			GPS Point Saved	YES	NO	
Total Depth (m): 7.95 m		Brine Depth (m): 7-7.5 m			Secchi Depth (m): 1.8			
Vertical Profile File Name: see back			Photo Numbers and descriptions: 2020 - looking South 2021 - looking @ causeway					
Surface Water Samples (check when done)								
A - Surface (0.2m)	DO	X	Mercury	X	Metals	X	Sulfate	X
	Hardness	X	Cations	X	Anions	X	Alkalinity	X
B - Bottom (0.5m)	DO	X	Mercury	X	Metals	X	Sulfate	X
	Hardness	X	Cations	X	Anions	X	Alkalinity	X
Field duplicate collected (1 per trip)?				YES		NO		
Brine Shrimp Samples (check when done)								
Tow 1	X	Tow 2	—	Tow 3	—	Composited:		
Field duplicate collected (1 per trip)?				YES		NO		
Tow 4 (taxon)	X	Taxon Field duplicate collected (1 per trip)?				YES		NO
Notes: Deep Brine layer estimated @ 7-7.5m ① DO drop, ② turbidity increase ③ conductivity increase lots of dead brine shrimp floating on surface (photo # 2019) only 1 brine sample low for metals.								

December 8, 2014

HDR Engineering, Inc.
ATTN: Carin Loy
2373 Gateway Oaks Dr., Suite 200
Sacramento, CA 95833
carin.loy@hdrinc.com

RE: Project HDR-CA1401

Client Project: 217879

Revision 1: In the original report, all Cu sample results were qualified **J** due to a lower than expected recovery of standard reference material SLEW-3. Additionally, there were a number of qualified Cu and Zn samples results due to poor recovering matrix spike/matrix spike duplicate (MS/MSD) sets. In this revised report all samples were re-prepared and re-analyzed for Cu and Zn. Additionally, samples were re-prepared for Pb analysis as further confirmation.

Dear Ms. Loy,

On September 12, 2014, Brooks Rand Labs (BRL) received seven (7) Great Salt Lake (GSL) water samples. The samples were logged-in for the analyses of total mercury (Hg), arsenic (As), copper (Cu), lead (Pb), selenium (Se), and zinc (Zn) according to the chain-of-custody form. All samples were received, prepared, analyzed, and stored according to BRL SOPs and EPA methodology.

The results were method blank corrected as described in the calculations section of the relevant BRL SOP(s) and may have been evaluated using reporting limits that have been adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details.

Instances when the native sample and/or the corresponding duplicate (DUP) produced non-detectable results, the relative percent difference (RPD) was not calculated (**N/C**).

The recovery criteria limits did not apply to specific elements when the standard reference materials (SRMs) only listed information values. The recovery limits were not applicable (N/A). Not all SRMs provided certified or information values for all elements; therefore, not all elements were reported.

Sequence 1400811 & 1400819, batch B141747 (Hg)

The concentration of equipment blank sample *8180-EB* (1437060-07) was confirmed by re-analyses. The final reported concentration was 35.6 ng/L. The bottle lot used (14-0106) was confirmed to be acceptable for Hg use and was not a source of contamination.

Sequence 1400850, batch B141752 (Se)

Samples *8180-3B* (1437060-01) and *8180-3A* (1437060-03) were designated for additional batch quality control (QC) samples. Historically, mixed recoveries have been achieved from this sample site. To conserve volume, full DUP/MS/MSD sets were not performed on either sample and good recoveries achieved thankfully.

The third method blank was determined to be a Grubb's outlier with a result of 0.032 µg/L. The method blank was omitted from the batch and samples were method blank-corrected by the average of the three remaining method blanks.

Sequence 1400865, batch B141864 (As)

The analysis of B141864-MS7 is native seawater from Puget Sound.

The method blank BLK3 was removed from the batch due to water entering the digestion apparatus and over-diluting the sample. The samples were method blank-corrected by the average of the three remaining method blanks.

The As result for sample 8180-4B (1437060-05) was qualified **N** for a low MS3 recovery (67%).

Sequence 1401028, batch B142155 (Cu, Pb, Zn)

The spiking concentration of MS4 (native seawater from Puget Sound) was less than the background concentration when analyzed for Cu and Zn and are not valid indicators of data quality. The SRM SLEW-3 recovered very well for Cu and all other MS/MSD sets recovered well for both elements. SRM SLEW-3 had a certified value for Zn at a level less than the MRL and was therefore not reportable. No further corrective action was warranted.

The Cu and Zn concentrations of equipment blank sample 8180-EB (1437060-07) were elevated. The Cu and Zn were confirmed by re-analysis of the original preparation, and also a second preparation and analysis.

BRL, an accredited laboratory, certifies that the reported results of all analyses for which BRL is NELAP accredited meet all NELAP requirements. For more information please see the *Report Information* page in your report. Please feel free to contact us if you have any questions regarding this report.

Sincerely,



Tiffany Stilwater
Client Services Manager
tiffany@brooksrnd.com



Amanda Royal
Project Manager
amanda@brooksrnd.com

Report Information

Laboratory Accreditation

BRL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BRL is also certified by many other states to perform environmental analyses. For a current list of our accreditations/certifications, please visit our website at <http://www.brooksrand.com/about/accreditations-certifications/>. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

BLK	method blank	MS	matrix spike
BRL	Brooks Rand Labs	MSD	matrix spike duplicate
BS	laboratory fortified blank	ND	non-detect
CAL	calibration standard	NR	non-reportable
CCB	continuing calibration blank	N/C	not calculated
CCV	continuing calibration verification	PS	post preparation spike
COC	chain of custody record	REC	percent recovery
D	dissolved fraction	RPD	relative percent difference
DUP	duplicate	RSD	relative standard deviation
IBL	instrument blank	SCV	secondary calibration verification
ICV	initial calibration verification	SOP	standard operating procedure
MDL	method detection limit	SRM	standard reference material
MRL	method reporting limit	T	total recoverable fraction

Definition of Data Qualifiers

(Effective 9/23/09)

B	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Result is estimated.
J	Estimated value. A full explanation is presented in the narrative.
J-M	Duplicate precision (RPD) for associated QC sample was not within acceptance criteria. Result is estimated.
J-N	Spike recovery for associated QC sample was not within acceptance criteria. Result is estimated.
M	Duplicate precision (RPD) was not within acceptance criteria. Result is estimated.
N	Spike recovery was not within acceptance criteria. Result is estimated.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.

These qualifiers are based on those previously utilized by Brooks Rand Labs, those found in the EPA SOW ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review; USEPA; January 2010. These supersede all previous qualifiers ever employed by BRL.



Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
8180-3B	1437060-01	Water	QC Sample	09/10/2014	09/12/2014
8180-3ADUP	1437060-02	Water	Field Duplicate	09/10/2014	09/12/2014
8180-3A	1437060-03	Water	QC Sample	09/10/2014	09/12/2014
8180-4A	1437060-04	Water	Sample	09/10/2014	09/12/2014
8180-4B	1437060-05	Water	QC Sample	09/10/2014	09/12/2014
8180-FB	1437060-06	DIW	Field Blank	09/10/2014	09/12/2014
8180-EB	1437060-07	DIW	Equip. Blank	09/10/2014	09/12/2014

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
As	Water	EPA 1640 RP	10/03/2014	10/09/2014	B141864	1400865
Cu	Water	EPA 1640 RP	11/21/2014	11/27/2014	B142155	1401028
Hg	Water	EPA 1631	09/22/2014	09/23/2014	B141747	1400811
Hg	Water	EPA 1631	09/22/2014	09/24/2014	B141747	1400819
Pb	Water	EPA 1640 RP	11/21/2014	11/27/2014	B142155	1401028
Se	Water	EPA 1640 RP	10/03/2014	10/06/2014	B141752	1400850
Zn	Water	EPA 1640 RP	11/21/2014	11/27/2014	B142155	1401028



Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
8180-3A										
1437060-03	As	Water	T	136		0.250	0.750	µg/L	B141864	1400865
1437060-03	Cu	Water	T	0.96		0.20	0.60	µg/L	B142155	1401028
1437060-03	Hg	Water	T	25.7		0.26	1.02	ng/L	B141747	1400811
1437060-03	Pb	Water	T	0.079		0.015	0.065	µg/L	B142155	1401028
1437060-03	Se	Water	T	0.747	B	0.350	1.05	µg/L	B141752	1400850
1437060-03	Zn	Water	T	2.25	B	1.30	3.75	µg/L	B142155	1401028
8180-3ADUP										
1437060-02	As	Water	T	175		0.250	0.750	µg/L	B141864	1400865
1437060-02	Cu	Water	T	0.88		0.20	0.60	µg/L	B142155	1401028
1437060-02	Hg	Water	T	26.6		0.26	1.02	ng/L	B141747	1400811
1437060-02	Pb	Water	T	0.515		0.015	0.065	µg/L	B142155	1401028
1437060-02	Se	Water	T	1.22		0.350	1.05	µg/L	B141752	1400850
1437060-02	Zn	Water	T	2.42	B	1.30	3.75	µg/L	B142155	1401028
8180-3B										
1437060-01	As	Water	T	134		0.250	0.750	µg/L	B141864	1400865
1437060-01	Cu	Water	T	5.36		0.20	0.60	µg/L	B142155	1401028
1437060-01	Hg	Water	T	30.2		0.26	1.02	ng/L	B141747	1400811
1437060-01	Pb	Water	T	0.046	B	0.015	0.065	µg/L	B142155	1401028
1437060-01	Se	Water	T	0.752	B	0.350	1.05	µg/L	B141752	1400850
1437060-01	Zn	Water	T	3.16	B	1.30	3.75	µg/L	B142155	1401028
8180-4A										
1437060-04	As	Water	T	163		0.250	0.750	µg/L	B141864	1400865
1437060-04	Cu	Water	T	1.06		0.20	0.60	µg/L	B142155	1401028
1437060-04	Hg	Water	T	26.6		0.26	1.02	ng/L	B141747	1400811
1437060-04	Pb	Water	T	0.043	B	0.015	0.065	µg/L	B142155	1401028
1437060-04	Se	Water	T	1.35		0.350	1.05	µg/L	B141752	1400850
1437060-04	Zn	Water	T	2.34	B	1.30	3.75	µg/L	B142155	1401028
8180-4B										
1437060-05	As	Water	T	165	N	0.250	0.750	µg/L	B141864	1400865
1437060-05	Cu	Water	T	1.22		0.20	0.60	µg/L	B142155	1401028
1437060-05	Hg	Water	T	30.8		0.26	1.02	ng/L	B141747	1400811
1437060-05	Pb	Water	T	0.040	B	0.015	0.065	µg/L	B142155	1401028
1437060-05	Se	Water	T	1.23		0.350	1.05	µg/L	B141752	1400850
1437060-05	Zn	Water	T	2.75	B	1.30	3.75	µg/L	B142155	1401028



Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
8180-EB										
1437060-07	As	DIW	T	0.050	U	0.050	0.150	µg/L	B141864	1400865
1437060-07	Cu	DIW	T	12.2		0.04	0.12	µg/L	B142155	1401028
1437060-07	Hg	DIW	T	35.6		0.10	0.40	ng/L	B141747	1400819
1437060-07	Pb	DIW	T	0.019		0.003	0.013	µg/L	B142155	1401028
1437060-07	Se	DIW	T	0.070	U	0.070	0.210	µg/L	B141752	1400850
1437060-07	Zn	DIW	T	0.46	B	0.26	0.75	µg/L	B142155	1401028
8180-FB										
1437060-06	As	DIW	T	0.050	U	0.050	0.150	µg/L	B141864	1400865
1437060-06	Cu	DIW	T	0.04	U	0.04	0.12	µg/L	B142155	1401028
1437060-06	Hg	DIW	T	0.10	U	0.10	0.40	ng/L	B141747	1400811
1437060-06	Pb	DIW	T	0.003	U	0.003	0.013	µg/L	B142155	1401028
1437060-06	Se	DIW	T	0.070	U	0.070	0.210	µg/L	B141752	1400850
1437060-06	Zn	DIW	T	0.26	U	0.26	0.75	µg/L	B142155	1401028



Accuracy & Precision Summary

Batch: B141747
 Lab Matrix: Water
 Method: EPA 1631

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B141747-SRM1	Certified Reference Material (1435056, NIST 1641d 1000x dilution) Hg		15.57	16.09	ng/L	103% 75-125	
B141747-MS1	Matrix Spike (1437060-01) Hg	30.24	204.1	230.3	ng/L	98% 71-125	
B141747-MSD1	Matrix Spike Duplicate (1437060-01) Hg	30.24	204.1	219.6	ng/L	93% 71-125	5% 24
B141747-MS2	Matrix Spike (1437060-03) Hg	25.74	204.1	215.0	ng/L	93% 71-125	
B141747-MSD2	Matrix Spike Duplicate (1437060-03) Hg	25.74	204.1	192.4	ng/L	82% 71-125	11% 24
B141747-MS3	Matrix Spike (1437060-05) Hg	30.80	204.1	221.0	ng/L	93% 71-125	
B141747-MSD3	Matrix Spike Duplicate (1437060-05) Hg	30.80	204.1	223.1	ng/L	94% 71-125	1% 24



Accuracy & Precision Summary

Batch: B141752
 Lab Matrix: Water
 Method: EPA 1640 RP

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B141752-BS1	Laboratory Fortified Blank (1441004) Se		10.50	9.708	µg/L	92% 70-130	
B141752-MS7	Matrix Spike (1331056-25) Se	0.257	10.50	9.432	µg/L	87% 70-130	
B141752-MS1	Matrix Spike (1437060-01) Se	0.752	52.50	40.74	µg/L	76% 70-130	
B141752-MS2	Matrix Spike (1437060-03) Se	0.747	52.50	49.38	µg/L	93% 70-130	
B141752-MSD2	Matrix Spike Duplicate (1437060-03) Se	0.747	52.50	41.91	µg/L	78% 70-130	16% 30
B141752-DUP3	Duplicate (1437060-05) Se	1.233		1.658	µg/L		29% 30
B141752-MS3	Matrix Spike (1437060-05) Se	1.233	52.50	47.84	µg/L	89% 70-130	
B141752-MSD3	Matrix Spike Duplicate (1437060-05) Se	1.233	52.50	51.34	µg/L	95% 70-130	7% 30



Accuracy & Precision Summary

Batch: B141864
 Lab Matrix: Water
 Method: EPA 1640 RP

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B141864-BS1	Laboratory Fortified Blank (1441004) As		40.00	34.61	µg/L	87% 70-130	
B141864-SRM1	Certified Reference Material (1405056, SLEW-3) As		1.360	1.43	µg/L	105% 75-125	
B141864-MS7	Matrix Spike (1331056-25) As	1.277	40.00	40.05	µg/L	97% 70-130	
B141864-MS1	Matrix Spike (1437060-01) As	133.6	200.0	288.39	µg/L	77% 70-130	
B141864-MS2	Matrix Spike (1437060-03) As	136.3	200.0	361.84	µg/L	113% 70-130	
B141864-MSD2	Matrix Spike Duplicate (1437060-03) As	136.3	200.0	355.98	µg/L	110% 70-130	2% 30
B141864-DUP3	Duplicate (1437060-05) As	164.9		176.5	µg/L		7% 30
B141864-MS3	Matrix Spike (1437060-05) As	164.9	200.0	298.74	µg/L	67% 70-130	
B141864-MSD3	Matrix Spike Duplicate (1437060-05) As	164.9	200.0	377.93	µg/L	107% 70-130	23% 30



Accuracy & Precision Summary

Batch: B142155
Lab Matrix: Water
Method: EPA 1640 RP

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B142155-BS1	Laboratory Fortified Blank (1447025)						
	Cu		4.000	3.66	µg/L	91% 70-130	
	Pb		1.998	1.724	µg/L	86% 70-130	
	Zn		10.00	8.49	µg/L	85% 70-130	
B142155-SRM1	Certified Reference Material (1445026, SLEW-3)						
	Cu		1.550	1.47	µg/L	95% 75-125	
B142155-MS4	Matrix Spike (1331056-29)						
	Pb	0.030	1.998	1.822	µg/L	90% 70-130	
B142155-MS1	Matrix Spike (1437060-01)						
	Cu	5.36	20.00	26.04	µg/L	103% 70-130	
	Pb	0.046	9.990	9.508	µg/L	95% 70-130	
	Zn	3.16	50.00	42.98	µg/L	80% 70-130	
B142155-MS2	Matrix Spike (1437060-03)						
	Cu	0.96	20.00	20.59	µg/L	98% 70-130	
	Pb	0.079	9.990	9.102	µg/L	90% 70-130	
	Zn	2.25	50.00	46.33	µg/L	88% 70-130	
B142155-MSD2	Matrix Spike Duplicate (1437060-03)						
	Cu	0.96	20.00	18.73	µg/L	89% 70-130	9% 30
	Pb	0.079	9.990	8.916	µg/L	88% 70-130	2% 30
	Zn	2.25	50.00	37.35	µg/L	70% 70-130	21% 30
B142155-DUP3	Duplicate (1437060-05)						
	Cu	1.22		1.13	µg/L		8% 30
	Pb	0.040		0.032	µg/L		24% 30
	Zn	2.75		2.74	µg/L		0.2% 30



Accuracy & Precision Summary

Batch: B142155
Lab Matrix: Water
Method: EPA 1640 RP

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B142155-MS3	Matrix Spike (1437060-05)						
	Cu	1.22	20.00	17.45	µg/L	81% 70-130	
	Pb	0.040	9.990	8.954	µg/L	89% 70-130	
	Zn	2.75	50.00	41.96	µg/L	78% 70-130	
B142155-MSD3	Matrix Spike Duplicate (1437060-05)						
	Cu	1.22	20.00	20.01	µg/L	94% 70-130	14% 30
	Pb	0.040	9.990	9.211	µg/L	92% 70-130	3% 30
	Zn	2.75	50.00	40.82	µg/L	76% 70-130	3% 30



Method Blanks & Reporting Limits

Batch: B141747
Matrix: Water
Method: EPA 1631
Analyte: Hg

Sample	Result	Units		
B141747-BLK1	0.23	ng/L		
B141747-BLK2	0.21	ng/L		
B141747-BLK3	0.26	ng/L		
B141747-BLK4	0.17	ng/L		
	Average: 0.22		Standard Deviation: 0.04	MDL: 0.10
	Limit: 0.50		Limit: 0.10	MRL: 0.40



Method Blanks & Reporting Limits

Batch: B141752
Matrix: Water
Method: EPA 1640 RP
Analyte: Se 82

Sample	Result	Units		
B141752-BLK1	-0.008	µg/L		
B141752-BLK2	0.002	µg/L		
B141752-BLK4	0.018	µg/L		
	Average: 0.004		Standard Deviation: 0.013	MDL: 0.070
	Limit: 0.210		Limit: 0.070	MRL: 0.210



Method Blanks & Reporting Limits

Batch: B141864
Matrix: Water
Method: EPA 1640 RP
Analyte: As 75

Sample	Result	Units
B141864-BLK1	-0.004	µg/L
B141864-BLK2	-0.004	µg/L
B141864-BLK4	-0.001	µg/L

Average: -0.003
Limit: 0.150

Standard Deviation: 0.002
Limit: 0.050

MDL: 0.050
MRL: 0.150



Method Blanks & Reporting Limits

Batch: B142155
Matrix: Water
Method: EPA 1640 RP
Analyte: Cu 63

Sample	Result	Units			
B142155-BLK1	0.01	µg/L			
B142155-BLK2	0.01	µg/L			
B142155-BLK3	0.01	µg/L			
B142155-BLK4	0.01	µg/L			
Average:	0.01		Standard Deviation:	0.00	MDL: 0.04
Limit:	0.12		Limit:	0.04	MRL: 0.12

Analyte: Pb

Sample	Result	Units			
B142155-BLK1	0.002	µg/L			
B142155-BLK2	0.001	µg/L			
B142155-BLK3	0.001	µg/L			
B142155-BLK4	0.002	µg/L			
Average:	0.002		Standard Deviation:	0.001	MDL: 0.003
Limit:	0.013		Limit:	0.003	MRL: 0.013

Analyte: Zn 66

Sample	Result	Units			
B142155-BLK1	0.07	µg/L			
B142155-BLK2	0.06	µg/L			
B142155-BLK3	0.06	µg/L			
B142155-BLK4	0.07	µg/L			
Average:	0.07		Standard Deviation:	0.01	MDL: 0.26
Limit:	0.75		Limit:	0.26	MRL: 0.75



Sample Containers

Lab ID: 1437060-01

Sample: 8180-3B

Report Matrix: Water

Sample Type: QC Sample

Collected: 09/10/2014

Received: 09/12/2014

Comments: Only perform a Single MS

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250mL	14-0106	none	n/a		Cooler
B	Bottle HDPE ICP-RP	1L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler
C	Bottle HDPE ICP-ChelC	125mL	14-0111	0.1% HNO3 (BRL)	1418010	<2	Cooler

Comments: 60mL split from 1L

Lab ID: 1437060-02

Sample: 8180-3ADUP

Report Matrix: Water

Sample Type: Field Duplicate

Collected: 09/10/2014

Received: 09/12/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250mL	14-0106	none	n/a		Cooler
B	Bottle HDPE ICP-RP	1L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler
C	Bottle HDPE ICP-ChelC	125mL	14-0111	0.1% HNO3 (BRL)	1418010	<2	Cooler

Comments: 60mL split from 1L

Lab ID: 1437060-03

Sample: 8180-3A

Report Matrix: Water

Sample Type: QC Sample

Collected: 09/10/2014

Received: 09/12/2014

Comments: Perform MS/MSD if possible.. single MS okay

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250mL	14-0106	none	n/a		Cooler
B	Bottle HDPE ICP-RP	1L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler
C	Bottle HDPE ICP-ChelC	125mL	14-0111	0.1% HNO3 (BRL)	1418010	<2	Cooler

Comments: 60mL split from 1L

Lab ID: 1437060-04

Sample: 8180-4A

Report Matrix: Water

Sample Type: Sample

Collected: 09/10/2014

Received: 09/12/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250mL	14-0106	none	n/a		Cooler
B	Bottle HDPE ICP-RP	1L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler
C	Bottle HDPE ICP-ChelC	125mL	14-0111	0.1% HNO3 (BRL)	1418010	<2	Cooler

Comments: 60mL split from 1L

Lab ID: 1437060-05

Sample: 8180-4B

Report Matrix: Water

Sample Type: QC Sample

Collected: 09/10/2014

Received: 09/12/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250mL	14-0106	none	n/a		Cooler
B	Bottle HDPE ICP-RP	1L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler
C	Bottle HDPE ICP-ChelC	125mL	14-0111	0.1% HNO3 (BRL)	1418010	<2	Cooler

Comments: 60mL split from 1L

Project ID: HDR-CA1401
PM: Tiffany Stilwater



BRL Report 1437060, Rev.1
Client PM: Carin Loy
Client PO: UPRR WQ

Sample Containers

Lab ID: 1437060-06

Sample: 8180-FB

Report Matrix: DIW

Sample Type: Field Blank

Collected: 09/10/2014

Received: 09/12/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250mL	14-0106	none	n/a		Cooler
B	Bottle HDPE ICP-RP	1L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler
C	Bottle HDPE ICP-ChelC	125mL	14-0111	0.1% HNO3 (BRL)	1418010	<2	Cooler

Comments: 60mL split from 1L

Lab ID: 1437060-07

Sample: 8180-EB

Report Matrix: DIW

Sample Type: Equip. Blank

Collected: 09/10/2014

Received: 09/12/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250mL	14-0106	none	n/a		Cooler
B	Bottle HDPE ICP-RP	1L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler
C	Bottle HDPE ICP-ChelC	125mL	14-0111	0.1% HNO3 (BRL)	1418010	<2	Cooler

Comments: 60mL split from 1L

Shipping Containers

Cooler

Received: September 12, 2014 9:10

Tracking No: 1ZF8R80190689982 via UPS

Coolant Type: None

Temperature: ambient

Description: Cooler

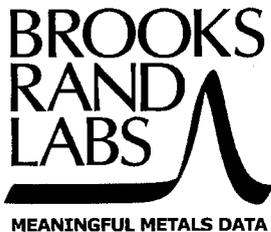
Damaged in transit? No

Returned to client? No

Custody seals present? No

Custody seals intact? No

COC present? Yes



3958 6th Avenue NW
 Seattle, WA 98107
 Phone: 206-632-6206
 Fax: 206-632-6017

samples@brooksrand.com
 www.brooksrand.com

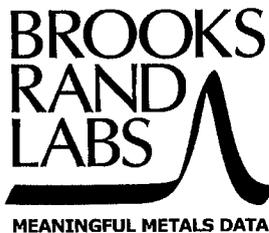
Chain of Custody Record

White: LAB COPY
 Yellow: CUSTOMER COPY

Client: HDR, Inc.	Address: 3949 South 700 East, Ste. 500 Salt Lake City, UT 84107	COC receipt confirmation? Y / N If so, by: email / fax (circle one)
Contact: Mike Funk (billing)		Email: Michael.funk@hdrinc.com carin.loy@hdrinc.com
Client project ID: 217879		
PO #: UPRR WQ	Phone #: 801-743-7818	Fax #:

Requested TAT in business days: <input type="checkbox"/> 20 (standard) <input type="checkbox"/> 15 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> Other _____ <i>Surcharges apply for expedited turn around times.</i>	Collection		Miscellaneous				Field Preservation			Analyses required						Comments		
	Date	Time	Sampler (initials)	Matrix type	# of containers	Field filtered? (Y/N)	Unpreserved / ice only	HCl / HNO ₃ (circle one)	Other (specify)	Total Hg, EPA 1631	Total Metals (As, Cu, Pb, Se, Zn), EPA 1640	Percent (%) Moisture	Total Hg, EPA 1631	Total Metals (As, Cu, Pb, Se, Zn), EPA 1638				
	Sample ID																	
	1	8180-3B	9.10	1245	CU	FW	1	N	-	-	-	X	X					
	2											X	X					
	3	8180-3ADD	9.10	1230								X	X					
	4											X	X					
	5	8180-3A	9.10	1230								X	X					
	6											X	X					
	7	8180-4A	9.10	1130								X	X					
	8											X	X					
	9	8180-4B	9.10	1145								X	X					
	10											X	X					

Relinquished by: <i>Chuli</i>	Date: 9.11.14	Time: 1300	Relinquished by:	Date:	Time:
Received by:	Date:	Time:	Received at BRL by: <i>Carin Loy</i>	Date: 9/12/14	Time: 0910
Shipping carrier:	# of coolers:	BRL work order ID: 1437060	BRL project ID: HDR-CA1401		



3958 6th Avenue NW
 Seattle, WA 98107
 Phone: 206-632-6206
 Fax: 206-632-6017

samples@brooksrand.com
 www.brooksrand.com

Chain of Custody Record

White: LAB COPY
 Yellow: CUSTOMER COPY

Client: HDR, Inc.	Address:	COC receipt confirmation? Y / N
Contact: Mike Funk (billing)	3949 South 700 East, Ste. 500 Salt Lake City, UT 84107	If so, by: email / fax (circle one)
Client project ID: 217879		Email: Michael.funk@hdrinc.com carin.loy@hdrinc.com
PO #: UPRR WQ	Phone #: 801-743-7818	Fax #:

Requested TAT in business days: <input type="checkbox"/> 20 (standard) <input type="checkbox"/> 15 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> Other _____ <i>Surcharges apply for expedited turn around times.</i>	Collection		Miscellaneous				Field Preservation			Analyses required					Comments
	Date	Time	Sampler (initials)	Matrix type	# of containers	Field filtered? (Y/N)	Unpreserved / ice only	HCl / HNO ₃ (circle one)	Other (specify)	Total Hg, EPA 1631	Total Metals (As, Cu, Pb, Se, Zn), EPA 1640	Percent (%) Moisture	Total Hg, EPA 1631	Total Metals (As, Cu, Pb, Se, Zn), EPA 1638	
Sample ID															
1	8180-FB	9-11	1000	CW	PW	1	Z	-	-	-	X				For sample collection questions please email Charles Vertucci charles.vertucci@hdrinc.com Please email results to Carin Loy (HDR) Carin.loy@hdrinc.com
2		↓	↓	↓	↓	↓	↓	↓	↓	↓	X				
3	8180-EB	↓	↓	↓	↓	↓	↓	↓	↓	↓	X				
4											X				
5															
6															
7															
8															
9															
10															

Relinquished by:	Date: 9-11-14	Time: 1300	Relinquished by:	Date:	Time:
Received by:	Date:	Time:	Received at BRL by:	Date: 9/12/14	Time: 0910
Shipping carrier:	# of coolers:	BRL work order ID:	BRL project ID:		

December 8, 2014

HDR Engineering, Inc.
ATTN: Carin Loy
2373 Gateway Oaks Dr., Suite 200
Sacramento, CA 95833
carin.loy@hdrinc.com

RE: Project HDR-CA1401

Client Project: 217879

Revision 1: In the original report, all Cu sample results were qualified **J** due to a lower than expected recovery of standard reference material SLEW-3. Additionally, there were a number of qualified sample Cu and Zn results due to poor recovering matrix spike/matrix spike duplicate (MS/MSD) sets. In this revised report all samples were re-prepared and re-analyzed for Cu and Zn. Additionally, samples were re-prepared for Pb analysis as further confirmation.

Dear Ms. Loy,

On September 25, 2014, Brooks Rand Labs (BRL) received four (4) brine shrimp samples and twelve (12) water samples. All samples were logged-in for the analyses of total mercury (Hg), arsenic (As), copper (Cu), lead (Pb), selenium (Se), and zinc (Zn) according to the chain-of-custody form. All samples were received, prepared, analyzed, and stored according to BRL SOPs and EPA methodology.

The results were method blank corrected as described in the calculations section of the relevant BRL SOP(s) and may have been evaluated using reporting limits that have been adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details. The brine shrimp sample results were reported on a wet- and dry-weight basis.

Sequence 1400850, Batch B141752 (As, Se) - Water

The preparations of the third method blank and matrix spike MS4 could not be reported due to excess water entering the preparation bombs. Therefore, neither quality control (QC) sample was reported.

The results of sample 8180-2A (1439035-01) and the associated method duplicate (DUP4) meet the secondary acceptance criteria for duplicate precision as the concentration were less than 5x the MRL and the difference between the two was within 1x the MRL value of each other.

Sequence 1400853, Batch B141795 (Hg) – Water

The result of 8180-EB2 (1439035-04) was quite elevated at 12.6 ng/L. The sample was re-analyzed in duplicate and confirmed the original result. This concentration was greater than many of the field sample results.

Sequence 1400878, Batch B141812 (Cu) – Biota

The continuing calibration verification (CCV) standards CCV5 and CCVB had elevated recoveries of 130% and 147%, respectively. Samples bracketed by CCV5 were either not

detectable or the blank spike which met acceptance criteria. No client samples were bracketed by CCVB. No further corrective action was necessary.

Sequence 1400888, Batch B141813 (As, Se) – Biota

The recovery CCVB was elevated (218%) and the concentration of continuing calibration blank (CCBB) was greater than 10x the MDL (0.312 µg/L). No client samples were bracketed however.

Sequence 1401028, Batch B142155 (Cu, Pb, Zn) - Water

The spiking concentration of MS4 (native seawater from Puget Sound) was less than the background concentration when analyzed for Cu and Zn and are not valid indicators of data quality. The SRM SLEW-3 recovered very well for Cu and all other MS/MSD sets recovered well for both elements. SRM SLEW-3 had a certified value for Zn at a level less than the MRL and was therefore not reportable. No further corrective action was warranted.

The re-preparation produced detectable Pb results for samples *8180-EB2* (1439035-04) and *8180-TRIP* (1439035-08) and a detectable Cu result of sample *8180-EB2* (1439035-04).

All data was reported without further qualification, aside from concentration qualifiers, and all other associated quality control sample results met the acceptance criteria.

BRL, an accredited laboratory, certifies that the reported results of all analyses for which BRL is NELAP accredited meet all NELAP requirements. For more information please see the *Report Information* page in your report. Please feel free to contact us if you have any questions regarding this report.

Sincerely,



Tiffany Stilwater
Client Services Manager
tiffany@brooksrnd.com



Amanda Royal
Project Manager
amanda@brooksrnd.com

Report Information

Laboratory Accreditation

BRL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BRL is also certified by many other states to perform environmental analyses. For a current list of our accreditations/certifications, please visit our website at <http://www.brooksrand.com/about/accreditations-certifications/>. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

BLK	method blank	MS	matrix spike
BRL	Brooks Rand Labs	MSD	matrix spike duplicate
BS	laboratory fortified blank	ND	non-detect
CAL	calibration standard	NR	non-reportable
CCB	continuing calibration blank	N/C	not calculated
CCV	continuing calibration verification	PS	post preparation spike
COC	chain of custody record	REC	percent recovery
D	dissolved fraction	RPD	relative percent difference
DUP	duplicate	RSD	relative standard deviation
IBL	instrument blank	SCV	secondary calibration verification
ICV	initial calibration verification	SOP	standard operating procedure
MDL	method detection limit	SRM	standard reference material
MRL	method reporting limit	T	total recoverable fraction

Definition of Data Qualifiers

(Effective 9/23/09)

B	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Result is estimated.
J	Estimated value. A full explanation is presented in the narrative.
J-M	Duplicate precision (RPD) for associated QC sample was not within acceptance criteria. Result is estimated.
J-N	Spike recovery for associated QC sample was not within acceptance criteria. Result is estimated.
M	Duplicate precision (RPD) was not within acceptance criteria. Result is estimated.
N	Spike recovery was not within acceptance criteria. Result is estimated.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.

These qualifiers are based on those previously utilized by Brooks Rand Labs, those found in the EPA SOW ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review; USEPA; January 2010. These supersede all previous qualifiers ever employed by BRL.



Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
8180-2A	1439035-01	GSL Water	Sample	09/23/2014	09/25/2014
8180-2B	1439035-02	GSL Water	Sample	09/23/2014	09/25/2014
8180-1B	1439035-03	GSL Water	Sample	09/23/2014	09/25/2014
8180-EB2	1439035-04	DIW	Equip. Blank	09/23/2014	09/25/2014
8180-1A	1439035-05	GSL Water	Sample	09/23/2014	09/25/2014
8180-5A	1439035-06	GSL Water	Sample	09/23/2014	09/25/2014
8180-5B	1439035-07	GSL Water	Sample	09/23/2014	09/25/2014
8180-TRIP	1439035-08	DIW	Trip Blank	09/23/2014	09/25/2014
8180-1	1439035-09	Water	Sample	09/23/2014	09/25/2014
8180-1	1439035-10	Shrimp	Sample	09/23/2014	09/25/2014
8180-1 DUP	1439035-11	Water	Field Duplicate	09/23/2014	09/25/2014
8180-1 DUP	1439035-12	Shrimp	Field Duplicate	09/23/2014	09/25/2014
8180-2	1439035-13	Water	Sample	09/23/2014	09/25/2014
8180-2	1439035-14	Shrimp	Sample	09/23/2014	09/25/2014
8180-5	1439035-15	Water	Sample	09/23/2014	09/25/2014
8180-5	1439035-16	Shrimp	Sample	09/23/2014	09/25/2014

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
%TS	Biota	SM 2540G	10/13/2014	10/16/2014	B141814	N/A
As	Biota	EPA 1638 DRC	10/13/2014	10/16/2014	B141813	1400888
Cu	Biota	EPA 1638 DRC	10/13/2014	10/14/2014	B141812	1400878
Hg	Biota	EPA 1631 Appendix	10/14/2014	10/17/2014	B141806	1400885
Pb	Biota	EPA 1638	10/13/2014	10/16/2014	B141811	1400884
Se	Biota	EPA 1638 DRC	10/13/2014	10/16/2014	B141813	1400888
Zn	Biota	EPA 1638	10/13/2014	10/16/2014	B141811	1400884
As	Water	EPA 1640 RP	10/03/2014	10/06/2014	B141752	1400850
Cu	Water	EPA 1640 RP	11/21/2014	11/27/2014	B142155	1401028
Hg	Water	EPA 1631	10/06/2014	10/07/2014	B141795	1400853
Pb	Water	EPA 1640 RP	11/21/2014	11/27/2014	B142155	1401028
Se	Water	EPA 1640 RP	10/03/2014	10/06/2014	B141752	1400850
Zn	Water	EPA 1640 RP	11/21/2014	11/27/2014	B142155	1401028



Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
8180-1										
1439035-10	%TS	Shrimp	NA	29.16		0.30	1.00	%	B141814	N/A
1439035-10	As	Shrimp	dry	19.7		0.045	0.129	mg/kg	B141813	1400888
1439035-10	As	Shrimp	wet	5.76		0.013	0.038	mg/kg	B141813	1400888
1439035-10	Cu	Shrimp	dry	9.93		0.13	0.52	mg/kg	B141812	1400878
1439035-10	Cu	Shrimp	wet	2.89		0.04	0.15	mg/kg	B141812	1400878
1439035-10	Hg	Shrimp	dry	195		0.52	1.29	ng/g	B141806	1400885
1439035-10	Hg	Shrimp	wet	57.0		0.15	0.38	ng/g	B141806	1400885
1439035-10	Pb	Shrimp	dry	0.927		0.013	0.129	mg/kg	B141811	1400884
1439035-10	Pb	Shrimp	wet	0.270		0.004	0.038	mg/kg	B141811	1400884
1439035-10	Se	Shrimp	dry	2.69		0.19	0.48	mg/kg	B141813	1400888
1439035-10	Se	Shrimp	wet	0.79		0.06	0.14	mg/kg	B141813	1400888
1439035-10	Zn	Shrimp	dry	64.0		0.65	3.23	mg/kg	B141811	1400884
1439035-10	Zn	Shrimp	wet	18.7		0.19	0.94	mg/kg	B141811	1400884
8180-1 DUP										
1439035-12	%TS	Shrimp	NA	21.04		0.30	1.00	%	B141814	N/A
1439035-12	As	Shrimp	dry	28.0		0.061	0.175	mg/kg	B141813	1400888
1439035-12	As	Shrimp	wet	5.89		0.013	0.037	mg/kg	B141813	1400888
1439035-12	Cu	Shrimp	dry	11.7		0.17	0.70	mg/kg	B141812	1400878
1439035-12	Cu	Shrimp	wet	2.46		0.04	0.15	mg/kg	B141812	1400878
1439035-12	Hg	Shrimp	dry	212		0.70	1.75	ng/g	B141806	1400885
1439035-12	Hg	Shrimp	wet	44.6		0.15	0.37	ng/g	B141806	1400885
1439035-12	Pb	Shrimp	dry	2.22		0.017	0.175	mg/kg	B141811	1400884
1439035-12	Pb	Shrimp	wet	0.466		0.004	0.037	mg/kg	B141811	1400884
1439035-12	Se	Shrimp	dry	2.67		0.26	0.66	mg/kg	B141813	1400888
1439035-12	Se	Shrimp	wet	0.56		0.06	0.14	mg/kg	B141813	1400888
1439035-12	Zn	Shrimp	dry	53.6		0.87	4.37	mg/kg	B141811	1400884
1439035-12	Zn	Shrimp	wet	11.3		0.18	0.92	mg/kg	B141811	1400884
8180-1A										
1439035-05	As	GSL Water	T	102		0.250	0.750	µg/L	B141752	1400850
1439035-05	Cu	GSL Water	T	0.20	U	0.20	0.60	µg/L	B142155	1401028
1439035-05	Hg	GSL Water	T	5.35		0.51	2.04	ng/L	B141795	1400853
1439035-05	Pb	GSL Water	T	0.015	U	0.015	0.065	µg/L	B142155	1401028
1439035-05	Se	GSL Water	T	0.872	B	0.350	1.05	µg/L	B141752	1400850
1439035-05	Zn	GSL Water	T	1.30	U	1.30	3.75	µg/L	B142155	1401028



Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
8180-1B										
1439035-03	As	GSL Water	T	93.6		0.250	0.750	µg/L	B141752	1400850
1439035-03	Cu	GSL Water	T	3.36		0.20	0.60	µg/L	B142155	1401028
1439035-03	Hg	GSL Water	T	19.5		0.51	2.04	ng/L	B141795	1400853
1439035-03	Pb	GSL Water	T	2.37		0.015	0.065	µg/L	B142155	1401028
1439035-03	Se	GSL Water	T	0.350	U	0.350	1.05	µg/L	B141752	1400850
1439035-03	Zn	GSL Water	T	2.78	B	1.30	3.75	µg/L	B142155	1401028
8180-2										
1439035-14	%TS	Shrimp	NA	20.58		0.30	1.00	%	B141814	N/A
1439035-14	As	Shrimp	dry	25.0		0.066	0.189	mg/kg	B141813	1400888
1439035-14	As	Shrimp	wet	5.15		0.014	0.039	mg/kg	B141813	1400888
1439035-14	Cu	Shrimp	dry	18.9		0.19	0.75	mg/kg	B141812	1400878
1439035-14	Cu	Shrimp	wet	3.90		0.04	0.16	mg/kg	B141812	1400878
1439035-14	Hg	Shrimp	dry	235		0.75	1.89	ng/g	B141806	1400885
1439035-14	Hg	Shrimp	wet	48.3		0.16	0.39	ng/g	B141806	1400885
1439035-14	Pb	Shrimp	dry	3.26		0.019	0.189	mg/kg	B141811	1400884
1439035-14	Pb	Shrimp	wet	0.670		0.004	0.039	mg/kg	B141811	1400884
1439035-14	Se	Shrimp	dry	3.70		0.28	0.71	mg/kg	B141813	1400888
1439035-14	Se	Shrimp	wet	0.76		0.06	0.15	mg/kg	B141813	1400888
1439035-14	Zn	Shrimp	dry	86.6		0.94	4.72	mg/kg	B141811	1400884
1439035-14	Zn	Shrimp	wet	17.8		0.19	0.97	mg/kg	B141811	1400884
8180-2A										
1439035-01	As	GSL Water	T	90.5		0.250	0.750	µg/L	B141752	1400850
1439035-01	Cu	GSL Water	T	1.66		0.20	0.60	µg/L	B142155	1401028
1439035-01	Hg	GSL Water	T	10.1		0.51	2.04	ng/L	B141795	1400853
1439035-01	Pb	GSL Water	T	1.71		0.015	0.065	µg/L	B142155	1401028
1439035-01	Se	GSL Water	T	0.488	B	0.350	1.05	µg/L	B141752	1400850
1439035-01	Zn	GSL Water	T	1.30	U	1.30	3.75	µg/L	B142155	1401028
8180-2B										
1439035-02	As	GSL Water	T	83.2		0.250	0.750	µg/L	B141752	1400850
1439035-02	Cu	GSL Water	T	3.13		0.20	0.60	µg/L	B142155	1401028
1439035-02	Hg	GSL Water	T	14.6		0.51	2.04	ng/L	B141795	1400853
1439035-02	Pb	GSL Water	T	1.86		0.015	0.065	µg/L	B142155	1401028
1439035-02	Se	GSL Water	T	0.488	B	0.350	1.05	µg/L	B141752	1400850
1439035-02	Zn	GSL Water	T	1.30	U	1.30	3.75	µg/L	B142155	1401028



Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
8180-5										
1439035-16	%TS	Shrimp	NA	27.70		0.30	1.00	%	B141814	N/A
1439035-16	As	Shrimp	dry	21.8		0.046	0.132	mg/kg	B141813	1400888
1439035-16	As	Shrimp	wet	6.05		0.013	0.036	mg/kg	B141813	1400888
1439035-16	Cu	Shrimp	dry	12.1		0.13	0.53	mg/kg	B141812	1400878
1439035-16	Cu	Shrimp	wet	3.35		0.04	0.15	mg/kg	B141812	1400878
1439035-16	Hg	Shrimp	dry	221		0.53	1.32	ng/g	B141806	1400885
1439035-16	Hg	Shrimp	wet	61.3		0.15	0.36	ng/g	B141806	1400885
1439035-16	Pb	Shrimp	dry	0.885		0.013	0.132	mg/kg	B141811	1400884
1439035-16	Pb	Shrimp	wet	0.245		0.004	0.036	mg/kg	B141811	1400884
1439035-16	Se	Shrimp	dry	3.59		0.20	0.49	mg/kg	B141813	1400888
1439035-16	Se	Shrimp	wet	0.99		0.05	0.14	mg/kg	B141813	1400888
1439035-16	Zn	Shrimp	dry	73.5		0.66	3.29	mg/kg	B141811	1400884
1439035-16	Zn	Shrimp	wet	20.4		0.18	0.91	mg/kg	B141811	1400884
8180-5A										
1439035-06	As	GSL Water	T	86.4		0.250	0.750	µg/L	B141752	1400850
1439035-06	Cu	GSL Water	T	2.37		0.20	0.60	µg/L	B142155	1401028
1439035-06	Hg	GSL Water	T	5.37		0.51	2.04	ng/L	B141795	1400853
1439035-06	Pb	GSL Water	T	1.84		0.015	0.065	µg/L	B142155	1401028
1439035-06	Se	GSL Water	T	0.503	B	0.350	1.05	µg/L	B141752	1400850
1439035-06	Zn	GSL Water	T	1.50	B	1.30	3.75	µg/L	B142155	1401028
8180-5B										
1439035-07	As	GSL Water	T	163		0.250	0.750	µg/L	B141752	1400850
1439035-07	Cu	GSL Water	T	22.5		0.20	0.60	µg/L	B142155	1401028
1439035-07	Hg	GSL Water	T	36.8		0.67	2.67	ng/L	B141795	1400853
1439035-07	Pb	GSL Water	T	10.7		0.015	0.065	µg/L	B142155	1401028
1439035-07	Se	GSL Water	T	1.42		0.350	1.05	µg/L	B141752	1400850
1439035-07	Zn	GSL Water	T	20.4		1.30	3.75	µg/L	B142155	1401028
8180-EB2										
1439035-04	As	DIW	T	0.250	U	0.250	0.750	µg/L	B141752	1400850
1439035-04	Cu	DIW	T	0.27		0.04	0.12	µg/L	B142155	1401028
1439035-04	Hg	DIW	T	12.6		0.10	0.41	ng/L	B141795	1400853
1439035-04	Pb	DIW	T	0.023		0.003	0.013	µg/L	B142155	1401028
1439035-04	Se	DIW	T	0.350	U	0.350	1.05	µg/L	B141752	1400850
1439035-04	Zn	DIW	T	0.72	B	0.26	0.75	µg/L	B142155	1401028
8180-TRIP										
1439035-08	As	DIW	T	0.250	U	0.250	0.750	µg/L	B141752	1400850
1439035-08	Cu	DIW	T	0.04	U	0.04	0.12	µg/L	B142155	1401028
1439035-08	Hg	DIW	T	0.10	U	0.10	0.41	ng/L	B141795	1400853
1439035-08	Pb	DIW	T	0.026		0.003	0.013	µg/L	B142155	1401028
1439035-08	Se	DIW	T	0.350	U	0.350	1.05	µg/L	B141752	1400850
1439035-08	Zn	DIW	T	0.26	U	0.26	0.75	µg/L	B142155	1401028



Accuracy & Precision Summary

Batch: B141752
 Lab Matrix: Water
 Method: EPA 1640 RP

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B141752-BS1	Laboratory Fortified Blank (1441004)						
	As		40.00	31.87	µg/L	80% 70-130	
	Se		10.50	9.708	µg/L	92% 70-130	
B141752-SRM1	Certified Reference Material (1405056, SLEW-3)						
	As		1.360	1.32	µg/L	97% 75-125	
B141752-MS7	Matrix Spike (1331056-25)						
	As	1.218	40.00	37.43	µg/L	91% 70-130	
	Se	0.257	10.50	9.432	µg/L	87% 70-130	
B141752-DUP4	Duplicate (1439035-01)						
	As	90.47		106.1	µg/L		16% 30
	Se	0.488		0.998	µg/L		69% 30
B141752-MSD4	Matrix Spike Duplicate (1439035-01)						
	As	90.47	200.0	297.08	µg/L	94% 70-130	
	Se	0.488	52.50	46.57	µg/L	88% 70-130	



Accuracy & Precision Summary

Batch: B141795
 Lab Matrix: Water
 Method: EPA 1631

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B141795-SRM1	Certified Reference Material (1439050, NIST 1641d 1000x dilution)						
	Hg		15.57	16.62	ng/L	107% 75-125	
B141795-MS1	Matrix Spike (1439035-01)						
	Hg	10.05	204.1	228.1	ng/L	107% 71-125	
B141795-MSD1	Matrix Spike Duplicate (1439035-01)						
	Hg	10.05	204.1	223.7	ng/L	105% 71-125	2% 24



Accuracy & Precision Summary

Batch: B141806
 Lab Matrix: Biota
 Method: EPA 1631 Appendix

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B141806-BS1	Laboratory Fortified Blank (1435092) Hg		2000	1824	ng/g	91% 75-125	
B141806-SRM1	Certified Reference Material (1426021, TORT-3) Hg		292.0	262.1	ng/g	90% 75-125	
B141806-SRM2	Certified Reference Material (0822035, NIST 1547 - peach leaves) Hg		31.00	25.75	ng/g	83% 75-125	
B141806-DUP1	Duplicate (1439035-10) Hg	195.5		177.9	ng/g		9% 30
B141806-MS1	Matrix Spike (1439035-10) Hg	195.5	6191	6223	ng/g	97% 70-130	
B141806-MSD1	Matrix Spike Duplicate (1439035-10) Hg	195.5	6583	6616	ng/g	98% 70-130	6% 30



Accuracy & Precision Summary

Batch: B141811
Lab Matrix: Biota
Method: EPA 1638

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B141811-BS1	Laboratory Fortified Blank (1442005)						
	Pb		4.996	4.960	mg/kg	99% 75-125	
	Zn		100.0	89.24	mg/kg	89% 75-125	
B141811-SRM1	Certified Reference Material (1426021, TORT-3)						
	Zn		136.0	131.8	mg/kg	97% 75-125	
B141811-SRM2	Certified Reference Material (1426021, TORT-3)						
	Pb		0.2250	0.193	mg/kg	86% 75-125	
B141811-SRM3	Certified Reference Material (0822035, NIST 1547 - peach leaves)						
	Pb		0.8700	0.759	mg/kg	87% 75-125	
	Zn		17.90	16.62	mg/kg	93% 75-125	
B141811-DUP3	Duplicate (1439035-10)						
	Pb	0.927		0.942	mg/kg		2% 30
	Zn	63.98		70.93	mg/kg		10% 30
B141811-MS3	Matrix Spike (1439035-10)						
	Pb	0.927	15.46	15.03	mg/kg	91% 70-130	
	Zn	63.98	309.5	334.1	mg/kg	87% 70-130	
B141811-MSD3	Matrix Spike Duplicate (1439035-10)						
	Pb	0.927	16.44	16.66	mg/kg	96% 70-130	10% 30
	Zn	63.98	329.2	366.1	mg/kg	92% 70-130	9% 30



Accuracy & Precision Summary

Batch: B141812
Lab Matrix: Biota
Method: EPA 1638 DRC

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B141812-BS1	Laboratory Fortified Blank (1442005) Cu		20.00	20.73	mg/kg	104% 75-125	
B141812-SRM2	Certified Reference Material (1426021, TORT-3) Cu		497.0	528.2	mg/kg	106% 75-125	
B141812-SRM3	Certified Reference Material (0822035, NIST 1547 - peach leaves) Cu		3.700	3.93	mg/kg	106% 75-125	
B141812-DUP3	Duplicate (1439035-10) Cu	9.93		10.94	mg/kg		10% 30
B141812-MS3	Matrix Spike (1439035-10) Cu	9.93	61.91	66.16	mg/kg	91% 70-130	
B141812-MSD3	Matrix Spike Duplicate (1439035-10) Cu	9.93	65.83	76.18	mg/kg	101% 70-130	14% 30



Accuracy & Precision Summary

Batch: B141813
Lab Matrix: Biota
Method: EPA 1638 DRC

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B141813-BS1	Laboratory Fortified Blank (1442005)						
	As		20.00	18.68	mg/kg	93% 75-125	
	Se		5.000	4.59	mg/kg	92% 75-125	
B141813-SRM1	Certified Reference Material (1327017, TORT-3)						
	As		59.50	62.70	mg/kg	105% 75-125	
	Se		10.90	10.25	mg/kg	94% 75-125	
B141813-DUP3	Duplicate (1439035-10)						
	As	19.74		19.14	mg/kg		3% 30
	Se	2.69		2.76	mg/kg		2% 30
B141813-MS3	Matrix Spike (1439035-10)						
	As	19.74	61.91	80.79	mg/kg	99% 70-130	
	Se	2.69	15.48	17.19	mg/kg	94% 70-130	
B141813-MSD3	Matrix Spike Duplicate (1439035-10)						
	As	19.74	65.83	89.24	mg/kg	106% 70-130	10% 30
	Se	2.69	16.46	19.03	mg/kg	99% 70-130	10% 30

Project ID: HDR-CA1401
PM: Tiffany Stilwater



BRL Report 1439035, Rev.1
Client PM: Carin Loy
Client PO: UPRR WQ

Accuracy & Precision Summary

Batch: B141814
Lab Matrix: Biota
Method: SM 2540G

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B141814-DUP1	Duplicate (1439035-16) %TS	27.70		26.68	%		4% 15



Accuracy & Precision Summary

Batch: B142155
 Lab Matrix: Water
 Method: EPA 1640 RP

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B142155-BS1	Laboratory Fortified Blank (1447025)						
	Cu		4.000	3.66	µg/L	91% 70-130	
	Pb		1.998	1.724	µg/L	86% 70-130	
	Zn		10.00	8.49	µg/L	85% 70-130	
B142155-SRM1	Certified Reference Material (1445026, SLEW-3)						
	Cu		1.550	1.47	µg/L	95% 75-125	
B142155-MS4	Matrix Spike (1331056-29)						
	Pb	0.030	1.998	1.822	µg/L	90% 70-130	
B142155-MS1	Matrix Spike (1437060-01)						
	Cu	5.36	20.00	26.04	µg/L	103% 70-130	
	Pb	0.046	9.990	9.508	µg/L	95% 70-130	
	Zn	3.16	50.00	42.98	µg/L	80% 70-130	
B142155-MS2	Matrix Spike (1437060-03)						
	Cu	0.96	20.00	20.59	µg/L	98% 70-130	
	Pb	0.079	9.990	9.102	µg/L	90% 70-130	
	Zn	2.25	50.00	46.33	µg/L	88% 70-130	
B142155-MSD2	Matrix Spike Duplicate (1437060-03)						
	Cu	0.96	20.00	18.73	µg/L	89% 70-130	9% 30
	Pb	0.079	9.990	8.916	µg/L	88% 70-130	2% 30
	Zn	2.25	50.00	37.35	µg/L	70% 70-130	21% 30
B142155-DUP3	Duplicate (1437060-05)						
	Cu	1.22		1.13	µg/L		8% 30
	Pb	0.040		0.032	µg/L		24% 30
	Zn	2.75		2.74	µg/L		0.2% 30
B142155-MS3	Matrix Spike (1437060-05)						
	Cu	1.22	20.00	17.45	µg/L	81% 70-130	
	Pb	0.040	9.990	8.954	µg/L	89% 70-130	
	Zn	2.75	50.00	41.96	µg/L	78% 70-130	

Project ID: HDR-CA1401
PM: Tiffany Stilwater



BRL Report 1439035, Rev.1
Client PM: Carin Loy
Client PO: UPRR WQ

Accuracy & Precision Summary

Batch: B142155
Lab Matrix: Water
Method: EPA 1640 RP

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B142155-MSD3	Matrix Spike Duplicate (1437060-05)						
	Cu	1.22	20.00	20.01	µg/L	94% 70-130	14% 30
	Pb	0.040	9.990	9.211	µg/L	92% 70-130	3% 30
	Zn	2.75	50.00	40.82	µg/L	76% 70-130	3% 30



Method Blanks & Reporting Limits

Batch: B141752
Matrix: Water
Method: EPA 1640 RP
Analyte: As 75

Sample	Result	Units		
B141752-BLK1	0.002	µg/L		
B141752-BLK2	-0.0009	µg/L		
B141752-BLK4	0.005	µg/L		
Average:	0.002		Standard Deviation:	0.003
Limit:	0.150		Limit:	0.050
			MDL:	0.050
			MRL:	0.150

Analyte: Se 82

Sample	Result	Units		
B141752-BLK1	-0.008	µg/L		
B141752-BLK2	0.002	µg/L		
B141752-BLK4	0.018	µg/L		
Average:	0.004		Standard Deviation:	0.013
Limit:	0.210		Limit:	0.070
			MDL:	0.070
			MRL:	0.210



Method Blanks & Reporting Limits

Batch: B141795
Matrix: Water
Method: EPA 1631
Analyte: Hg

Sample	Result	Units
B141795-BLK1	0.30	ng/L
B141795-BLK2	0.20	ng/L
B141795-BLK3	0.18	ng/L
B141795-BLK4	0.25	ng/L

Average: 0.23
Limit: 0.50

Standard Deviation: 0.05
Limit: 0.10

MDL: 0.10
MRL: 0.40



Method Blanks & Reporting Limits

Batch: B141806
Matrix: Biota
Method: EPA 1631 Appendix
Analyte: Hg

Sample	Result	Units		
B141806-BLK1	0.21	ng/g wet		
B141806-BLK2	0.20	ng/g wet		
B141806-BLK3	0.18	ng/g wet		
B141806-BLK4	0.21	ng/g wet		
	Average: 0.20		Standard Deviation: 0.01	MDL: 0.16
	Limit: 0.32		Limit: 0.11	MRL: 0.40



Method Blanks & Reporting Limits

Batch: B141811
Matrix: Biota
Method: EPA 1638
Analyte: Pb

Sample	Result	Units		
B141811-BLK1	-0.0008	mg/kg wet		
B141811-BLK2	-0.0009	mg/kg wet		
B141811-BLK3	-0.0009	mg/kg wet		
B141811-BLK4	-0.0008	mg/kg wet		
Average:	-0.001		Standard Deviation:	0.000
Limit:	0.040		Limit:	0.004
			MDL:	0.004
			MRL:	0.040

Analyte: Zn 66

Sample	Result	Units		
B141811-BLK1	0.07	mg/kg wet		
B141811-BLK2	0.01	mg/kg wet		
B141811-BLK3	0.05	mg/kg wet		
B141811-BLK4	0.04	mg/kg wet		
Average:	0.04		Standard Deviation:	0.03
Limit:	1.00		Limit:	0.20
			MDL:	0.20
			MRL:	1.00



Method Blanks & Reporting Limits

Batch: B141812
Matrix: Biota
Method: EPA 1638 DRC
Analyte: Cu 63

Sample	Result	Units			
B141812-BLK1	-0.003	mg/kg wet			
B141812-BLK2	-0.003	mg/kg wet			
B141812-BLK3	-0.004	mg/kg wet			
B141812-BLK4	-0.006	mg/kg wet			
	Average: 0.00		Standard Deviation: 0.00	MDL: 0.04	
	Limit: 0.16		Limit: 0.04	MRL: 0.16	



Method Blanks & Reporting Limits

Batch: B141813
Matrix: Biota
Method: EPA 1638 DRC
Analyte: As 91

Sample	Result	Units		
B141813-BLK1	0.002	mg/kg wet		
B141813-BLK2	0.004	mg/kg wet		
B141813-BLK3	0.004	mg/kg wet		
B141813-BLK4	0.002	mg/kg wet		
Average: 0.003			Standard Deviation: 0.001	MDL: 0.014
Limit: 0.040			Limit: 0.014	MRL: 0.040

Analyte: Se 78

Sample	Result	Units		
B141813-BLK1	0.02	mg/kg wet		
B141813-BLK2	0.02	mg/kg wet		
B141813-BLK3	0.02	mg/kg wet		
B141813-BLK4	0.02	mg/kg wet		
Average: 0.02			Standard Deviation: 0.00	MDL: 0.06
Limit: 0.15			Limit: 0.06	MRL: 0.15



Method Blanks & Reporting Limits

Batch: B142155
Matrix: Water
Method: EPA 1640 RP
Analyte: Cu 63

Sample	Result	Units			
B142155-BLK1	0.01	µg/L			
B142155-BLK2	0.01	µg/L			
B142155-BLK3	0.01	µg/L			
B142155-BLK4	0.01	µg/L			
Average:	0.01		Standard Deviation:	0.00	MDL: 0.04
Limit:	0.12		Limit:	0.04	MRL: 0.12

Analyte: Pb

Sample	Result	Units			
B142155-BLK1	0.002	µg/L			
B142155-BLK2	0.001	µg/L			
B142155-BLK3	0.001	µg/L			
B142155-BLK4	0.002	µg/L			
Average:	0.002		Standard Deviation:	0.001	MDL: 0.003
Limit:	0.013		Limit:	0.003	MRL: 0.013

Analyte: Zn 66

Sample	Result	Units			
B142155-BLK1	0.07	µg/L			
B142155-BLK2	0.06	µg/L			
B142155-BLK3	0.06	µg/L			
B142155-BLK4	0.07	µg/L			
Average:	0.07		Standard Deviation:	0.01	MDL: 0.26
Limit:	0.75		Limit:	0.26	MRL: 0.75



Sample Containers

Lab ID: 1439035-01

Sample: 8180-2A

Report Matrix: GSL Water

Sample Type: Sample

Collected: 09/23/2014

Received: 09/25/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250 mL	14-0106	none	none		Cooler 1
B	Bottle HDPE ICP-RP	1 L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler 1
C	Bottle HDPE ICP-ChelC	125 mL	n/a	0.1% HNO3 (BRL)	1418010	<2	Cooler 1

Comments: 60 mL split from 1 L

Lab ID: 1439035-02

Sample: 8180-2B

Report Matrix: GSL Water

Sample Type: Sample

Collected: 09/23/2014

Received: 09/25/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250 mL	14-0106	none	none		Cooler 1
B	Bottle HDPE ICP-RP	1 L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler 1
C	Bottle HDPE ICP-ChelC	125 mL	n/a	0.1% HNO3 (BRL)	1418010	<2	Cooler 1

Comments: 60 mL split from 1 L

Lab ID: 1439035-03

Sample: 8180-1B

Report Matrix: GSL Water

Sample Type: Sample

Collected: 09/23/2014

Received: 09/25/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250 mL	14-0106	none	none		Cooler 1
B	Bottle HDPE ICP-RP	1 L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler 1
C	Bottle HDPE ICP-ChelC	125 mL	n/a	0.1% HNO3 (BRL)	1418010	<2	Cooler 1

Comments: 60 mL split from 1 L

Lab ID: 1439035-04

Sample: 8180-EB2

Report Matrix: DIW

Sample Type: Equip. Blank

Collected: 09/23/2014

Received: 09/25/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250 mL	14-0106	none	none		Cooler 1
B	Bottle HDPE ICP-RP	1 L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler 1
C	Bottle HDPE ICP-ChelC	125 mL	n/a	0.1% HNO3 (BRL)	1418010	<2	Cooler 1

Comments: 60 mL split from 1 L

Lab ID: 1439035-05

Sample: 8180-1A

Report Matrix: GSL Water

Sample Type: Sample

Collected: 09/23/2014

Received: 09/25/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250 mL	14-0106	none	none		Cooler 1
B	Bottle HDPE ICP-RP	1 L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler 1
C	Bottle HDPE ICP-ChelC	125 mL	n/a	0.1% HNO3 (BRL)	1418010	<2	Cooler 1

Comments: 60 mL split from 1 L



Sample Containers

Lab ID: 1439035-06

Sample: 8180-5A

Report Matrix: GSL Water

Sample Type: Sample

Collected: 09/23/2014

Received: 09/25/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250 mL	14-0106	none	none		Cooler 1
B	Bottle HDPE ICP-RP	1 L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler 1
C	Bottle HDPE ICP-CheIC	125 mL	n/a	0.1% HNO3 (BRL)	1418010	<2	Cooler 1

Comments: 60 mL split from 1 L

Lab ID: 1439035-07

Sample: 8180-5B

Report Matrix: GSL Water

Sample Type: Sample

Collected: 09/23/2014

Received: 09/25/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250 mL	14-0106	none	none		Cooler 1
B	Bottle HDPE ICP-RP	1 L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler 1
C	Bottle HDPE ICP-CheIC	125 mL	n/a	0.1% HNO3 (BRL)	1418010	<2	Cooler 1

Comments: 60 mL split from 1 L

Lab ID: 1439035-08

Sample: 8180-TRIP

Report Matrix: DIW

Sample Type: Trip Blank

Collected: 09/23/2014

Received: 09/25/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250 mL	14-0106	none	none		Cooler 1
B	Bottle HDPE ICP-RP	1 L	14-0110	0.2% HNO3 (BRL)	1418010	<2	Cooler 1
C	Bottle HDPE ICP-CheIC	125 mL	n/a	0.1% HNO3 (BRL)	1418010	<2	Cooler 1

Comments: 60 mL split from 1 L

Lab ID: 1439035-09

Sample: 8180-1

Report Matrix: Water

Sample Type: Sample

Collected: 09/23/2014

Received: 09/25/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle HDPE ICP-W	1 L	14-0110	none	none		Cooler 2

Lab ID: 1439035-10

Sample: 8180-1

Report Matrix: Shrimp

Sample Type: Sample

Collected: 09/23/2014

Received: 09/25/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Vial Glass	40 mL	n/a	none	none		Cooler 2

Lab ID: 1439035-11

Sample: 8180-1 DUP

Report Matrix: Water

Sample Type: Field Duplicate

Collected: 09/23/2014

Received: 09/25/2014

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle HDPE ICP-W	1 L	14-0110	none	none		Cooler 2



Sample Containers

Lab ID: 1439035-12 Sample: 8180-1 DUP			Report Matrix: Shrimp Sample Type: Field Duplicate		Collected: 09/23/2014 Received: 09/25/2014
Des Container A Vial Glass	Size 40 mL	Lot n/a	Preservation none	P-Lot none	pH Ship. Cont. Cooler 2
Lab ID: 1439035-13 Sample: 8180-2			Report Matrix: Water Sample Type: Sample		Collected: 09/23/2014 Received: 09/25/2014
Des Container A Bottle HDPE ICP-W	Size 1 L	Lot 14-0110	Preservation none	P-Lot none	pH Ship. Cont. Cooler 2
Lab ID: 1439035-14 Sample: 8180-2			Report Matrix: Shrimp Sample Type: Sample		Collected: 09/23/2014 Received: 09/25/2014
Des Container A Vial Glass	Size 40 mL	Lot n/a	Preservation none	P-Lot none	pH Ship. Cont. Cooler 2
Lab ID: 1439035-15 Sample: 8180-5			Report Matrix: Water Sample Type: Sample		Collected: 09/23/2014 Received: 09/25/2014
Des Container A Bottle HDPE ICP-W	Size 1 L	Lot 14-0110	Preservation none	P-Lot none	pH Ship. Cont. Cooler 2
Lab ID: 1439035-16 Sample: 8180-5			Report Matrix: Shrimp Sample Type: Sample		Collected: 09/23/2014 Received: 09/25/2014
Des Container A Vial Glass	Size 40 mL	Lot n/a	Preservation none	P-Lot none	pH Ship. Cont. Cooler 2

Project ID: HDR-CA1401
PM: Tiffany Stilwater



BRL Report 1439035, Rev.1
Client PM: Carin Loy
Client PO: UPRR WQ

Shipping Containers

Cooler 1

Received: September 25, 2014 9:20
Tracking No: 1ZF8R8010191485995 via UPS
Coolant Type: None
Temperature: ambient

Description: Cooler 1
Damaged in transit? No
Returned to client? No

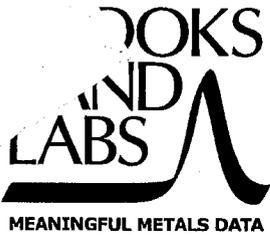
Custody seals present? No
Custody seals intact? No
COC present? Yes

Cooler 2

Received: September 25, 2014 9:20
Tracking No: 1ZF8R8010190010203 via UPS
Coolant Type: None
Temperature: 2.8 °C

Description: Cooler 2
Damaged in transit? No
Returned to client? No

Custody seals present? No
Custody seals intact? No
COC present? Yes



3958 6th Avenue NW
 Seattle, WA 98107
 Phone: 206-632-6206
 Fax: 206-632-6017

samples@brooksrand.com
 www.brooksrand.com

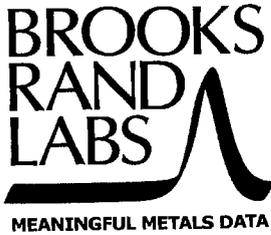
Chain of Custody Record

White: LAB COPY
 Yellow: CUSTOMER COPY

Client: HDR, Inc.	Address:	COC receipt confirmation? Y / N
Contact: Mike Funk (billing)	3949 South 700 East, Ste. 500 Salt Lake City, UT 84107	If so, by: email / fax (circle one)
Client project ID: 217879		Email: Michael.funk@hdrinc.com carin.loy@hdrinc.com
PO #: UPRR WQ	Phone #: 801-743-7818	Fax #:

Requested TAT in business days: <input type="checkbox"/> 20 (standard) <input type="checkbox"/> 15 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> Other _____ <i>Surcharges apply for expedited turn around times.</i>	Collection		Miscellaneous				Field Preservation			Analyses required					Comments	
	Date	Time	Sampler (initials)	Matrix type	# of containers	Field filtered? (Y/N)	Unpreserved / ice	HCl / HNO ₃ (circle one)	Other (specify)	Total Hg, EPA 1631	Total Metals (As, Cu, Pb, Se, Zn), EPA 1640	Percent (%) Moisture	Total Hg, EPA 1631	Total Metals (As, Cu, Pb, Se, Zn), EPA 1638		
Sample ID																
1	8180-2A	9-23 1330	CW	PW	1	N	X			X						For sample collection questions please email Charles Vertucci charles.vertucci@hdrinc.com Please email results to Carin Loy (HDR) Carin.loy@hdrinc.com
2	↓									X						
3	8180-2B	1330								X						
4	↓									X						
5	8180-1B	1015								X						
6	↓									X						
7	8180-EB2	1400								X						
8	↓									X						
9	8180-1A	1015								X						
10	↓									X						

Relinquished by: <i>[Signature]</i>	Date: 9-24	Time: 1500	Relinquished by:	Date:	Time:
Received by:	Date:	Time:	Received at BRL by: <i>[Signature]</i>	Date: 9/25/14	Time: 0920
Shipping carrier:	# of coolers:	BRL work order ID: 28 of 30	BRL project ID:		



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 Seattle, WA 98107
 Phone: 206-632-6206
 Fax: 206-632-6017

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Chain of Custody Record

White: LAB COPY
 Yellow: CUSTOMER COPY

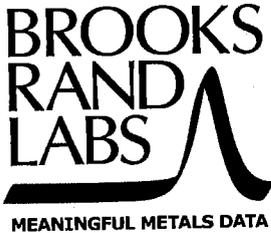
Client: HDR, Inc.	Address:	COC receipt confirmation? Y / N
Contact: Mike Funk (billing)	3949 South 700 East, Ste. 500 Salt Lake City, UT 84107	If so, by: email / fax (circle one)
Client project ID: 217879		Email: Michael.funk@hdrinc.com carin.loy@hdrinc.com
PO #: UPRR WQ	Phone #: 801-743-7818	Fax #:

Requested TAT in business days: <input type="checkbox"/> 20 (standard) <input type="checkbox"/> 15 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> Other _____ <i>Surcharges apply for expedited turn around times.</i>	Collection		Miscellaneous				Field Preservation			Analyses required					Comments
	Date	Time	Sampler (initials)	Matrix type	# of containers	Field filtered? (Y/N)	Unpreserved /	HCl / HNO ₃ (circle one)	Other (specify)	Total Hg, EPA 1631	Total Metals (As, Cu, Pb, Se, Zn), EPA 1640	Percent (%) Moisture	Total Hg, EPA 1631	Total Metals (As, Cu, Pb, Se, Zn), EPA 1638	
Sample ID															
1	8180-5A	1215	FW	CV	1	Y	X		X						
2	↳		↓	↓	↓	↓	↓			X					
3	8180-5B	1215	↓	↓	↓	↓	↓		X	X					
4	↳		↓	↓	↓	↓	↓		X	X					
5	8180-TRIP	810	↓	↓	↓	↓	↓		X	X					
6	↳		↓	↓	↓	↓	↓								
7															
8															
9															
10															

For sample collection questions please email Charles Vertucci charles.vertucci@hdrinc.com

Please email results to Carin Loy (HDR) Carin.loy@hdrinc.com

Relinquished by:	Date: 9-24	Time: 1500	Relinquished by:	Date:	Time:
Received by:	Date:	Time:	Received at BRL by:	Date: 9/25/14	Time: 0920
Shipping carrier:	# of coolers:	BRL work order ID:	BRL project ID:		



3958 6th Avenue NW
 Seattle, WA 98107
 Phone: 206-632-6206
 Fax: 206-632-6017

samples@brooksrand.com
 www.brooksrand.com

Chain of Custody Record

White: LAB COPY
 Yellow: CUSTOMER COPY

Client: HDR, Inc.	Address: 3949 South 700 East, Ste. 500 Salt Lake City, UT 84107	COC receipt confirmation? Y / N If so, by: email / fax (circle one)
Contact: Mike Funk (billing)		Email: <u>Michael.funk@hdrinc.com</u> <u>carin.loy@hdrinc.com</u>
Client project ID: 217879		Fax #:
PO #: UPRR WQ	Phone #: 801-743-7818	

Requested TAT in business days: <input type="checkbox"/> 20 (standard) <input type="checkbox"/> 15 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> Other _____ <i>Surcharges apply for expedited turn around times.</i>	Collection		Miscellaneous				Field Preservation			Analyses required						Comments		
	Date	Time	Sampler (initials)	Matrix type	# of containers	Field filtered? (Y/N)	Unpreserved / ice only	HCl / HNO ₃ (circle one)	Other (specify)	Total Hg, EPA 1631	Total Metals (As, Cu, Pb, Se, Zn), EPA 1640	Percent (%) Moisture	Total Hg, EPA 1631	Total Metals (As, Cu, Pb, Se, Zn), EPA 1638				
	Sample ID																	
	1	8180-1	9-23	115	W	BIO	1	Z	X			X	X	X				
	2	8180-1 DUP	↓	1115	↓	↓	↓	↓	↓			X	X	X				
	3	8180-2	↓	1400	↓	↓	↓	↓	↓			X	X	X				
	4	8180-5	↓	1200	↓	↓	↓	↓	↓			X	X	X				
	5																	
	6																	
	7																	
	8																	
	9																	
	10																	

For sample collection questions please email Charles Vertucci charles.vertucci@hdrinc.com

Please email results to Carin Loy (HDR) Carin.loy@hdrinc.com

Relinquished by: <i>[Signature]</i>	Date: 9-24	Time: 1500	Relinquished by:	Date:	Time:
Received by:	Date:	Time:	Received at BRL by: <i>[Signature]</i>	Date: 9/25/14	Time: 0920
Shipping carrier:	# of coolers:	30 BRL work order ID:	BRL project ID:		



10/10/2014

Work Order: 1409901

**HDR Engineering, Inc.
Attn: Carin Loy
3949 South 700 E, Suite 500
Salt Lake City, UT 84107**

Client Service Contact: 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.



Approved By:

Dave Gayer, Laboratory Director



Certificate of Analysis

Lab Sample No.: 1409901-01

Name: HDR Engineering, Inc.	Sample Date: 9/10/2014 11:30 AM
Sample Site: 8180-4A	Receipt Date: 9/11/2014 11:45 AM
Comments: UPRR GSL WQ	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	5830		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:01	
Cation/Anion Balance	-0.04		%	SM 1030 E	10/07/2014 12:48	10/07/2014 12:53	
Cations, Total	5820		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:04	
Hardness, Dissolved as CaCO3	54900	1	mg/L	SM 2340 B	09/30/2014 11:25	9/30/2014 12:32	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	492	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - CO2	383	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Total (as CaCO3)	403	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Chloride	187000	2500	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Sulfate	26300	250	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Metals							
Calcium, Dissolved	383	50.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:26	
Magnesium, Dissolved	13100	25.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:26	
Potassium, Dissolved	7980	125	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:26	
Sodium, Dissolved	104000	75.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:26	



Certificate of Analysis

Lab Sample No.: 1409901-02

Name: HDR Engineering, Inc.	Sample Date: 9/10/2014 12:30 PM
Sample Site: 8180-3A	Receipt Date: 9/11/2014 11:45 AM
Comments: UPRR GSL WQ	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	5830		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:01	
Cation/Anion Balance	-0.2		%	SM 1030 E	10/07/2014 12:48	10/07/2014 12:53	
Cations, Total	5800		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:04	
Hardness, Dissolved as CaCO3	55700	1	mg/L	SM 2340 B	09/30/2014 11:25	9/30/2014 12:32	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	481	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - CO2	374	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Total (as CaCO3)	395	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Chloride	187000	2500	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Sulfate	26300	250	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Metals							
Calcium, Dissolved	377	50.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:30	
Magnesium, Dissolved	13300	25.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:30	
Potassium, Dissolved	8150	125	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:30	
Sodium, Dissolved	103000	75.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:30	



Certificate of Analysis

Lab Sample No.: 1409901-03

Name: HDR Engineering, Inc.	Sample Date: 9/10/2014 11:45 AM
Sample Site: 8180-4B	Receipt Date: 9/11/2014 11:45 AM
Comments: UPRR GSL WQ	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	5740		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:01	
Cation/Anion Balance	-0.04		%	SM 1030 E	10/07/2014 12:48	10/07/2014 12:53	
Cations, Total	5740		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:04	
Hardness, Dissolved as CaCO3	54900	1	mg/L	SM 2340 B	09/30/2014 11:25	9/30/2014 12:32	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	475	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - CO2	371	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Total (as CaCO3)	390	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Chloride	184000	2500	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Sulfate	26200	250	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Metals							
Calcium, Dissolved	384	50.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:34	
Magnesium, Dissolved	13100	25.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:34	
Potassium, Dissolved	7990	125	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:34	
Sodium, Dissolved	102000	75.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:34	



Certificate of Analysis

Lab Sample No.: 1409901-04

Name: HDR Engineering, Inc.	Sample Date: 9/10/2014 12:30 PM
Sample Site: 8180-3A DUP	Receipt Date: 9/11/2014 11:45 AM
Comments: UPRR GSL WQ	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	5860		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:01	
Cation/Anion Balance	-0.6		%	SM 1030 E	10/07/2014 12:48	10/07/2014 12:53	
Cations, Total	5790		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:04	
Hardness, Dissolved as CaCO3	55300	1	mg/L	SM 2340 B	09/30/2014 11:25	9/30/2014 12:32	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	480	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - CO2	373	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Total (as CaCO3)	394	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Chloride	188000	2500	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Sulfate	26600	250	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Metals							
Calcium, Dissolved	390	50.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:38	
Magnesium, Dissolved	13200	25.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:38	
Potassium, Dissolved	8100	125	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:38	
Sodium, Dissolved	103000	75.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:38	



Certificate of Analysis

Lab Sample No.: 1409901-05

Name: HDR Engineering, Inc.	Sample Date: 9/10/2014 12:45 PM
Sample Site: 8180-3B	Receipt Date: 9/11/2014 11:45 AM
Comments: UPRR GSL WQ	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	5860		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:01	
Cation/Anion Balance	1.3		%	SM 1030 E	10/07/2014 12:48	10/07/2014 12:53	
Cations, Total	6020		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:04	
Hardness, Dissolved as CaCO3	57400	1	mg/L	SM 2340 B	09/30/2014 11:25	9/30/2014 12:32	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	474	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - CO2	369	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Total (as CaCO3)	389	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Chloride	188000	2500	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Sulfate	26500	250	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Metals							
Calcium, Dissolved	403	50.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:42	
Magnesium, Dissolved	13700	25.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:42	
Potassium, Dissolved	8410	125	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:42	
Sodium, Dissolved	107000	75.0	mg/L	EPA 6010B	09/22/2014 09:45	9/25/2014 16:42	



Certificate of Analysis

Lab Sample No.: 1409901-06

Name: HDR Engineering, Inc.	Sample Date: 9/11/2014 10:00 AM
Sample Site: 8180-FB	Receipt Date: 9/11/2014 11:45 AM
Comments: UPRR GSL WQ	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	0.0		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:01	
Cation/Anion Balance	0.0		%	SM 1030 E	10/07/2014 12:48	10/07/2014 12:53	
Cations, Total	0.3		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:04	
Hardness, Dissolved as CaCO3	1	1	mg/L	SM 2340 B	09/30/2014 11:25	9/30/2014 12:32	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - CO2	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Total (as CaCO3)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Chloride	ND	1	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Sulfate	ND	1	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Metals							
Calcium, Dissolved	ND	0.2	mg/L	EPA 6010B	09/23/2014 07:49	9/23/2014 10:21	
Magnesium, Dissolved	0.264	0.100	mg/L	EPA 6010B	09/23/2014 07:49	9/23/2014 10:21	
Potassium, Dissolved	0.5	0.5	mg/L	EPA 6010B	09/23/2014 07:49	9/23/2014 10:21	
Sodium, Dissolved	5.44	0.300	mg/L	EPA 6010B	09/23/2014 07:49	9/23/2014 10:21	



Certificate of Analysis

Lab Sample No.: 1409901-07

Name: HDR Engineering, Inc.	Sample Date: 9/11/2014 10:00 AM
Sample Site: 8180-EB	Receipt Date: 9/11/2014 11:45 AM
Comments: UPRR GSL WQ	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	0.08		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:01	
Cation/Anion Balance	44		%	SM 1030 E	10/07/2014 12:48	10/07/2014 12:53	
Cations, Total	0.2		meq/L	SM 1030 E	10/07/2014 12:48	10/07/2014 14:04	
Hardness, Dissolved as CaCO3	1	1	mg/L	SM 2340 B	09/30/2014 11:25	9/30/2014 12:32	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - CO2	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Alkalinity - Total (as CaCO3)	ND	1.0	mg/L	SM 2320 B	09/18/2014 02:30	9/18/2014 15:08	
Chloride	2	1	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Sulfate	ND	1	mg/L	EPA 300.0	09/12/2014 06:30	9/12/2014 6:30	
Metals							
Calcium, Dissolved	ND	0.2	mg/L	EPA 6010B	09/23/2014 07:49	9/23/2014 10:25	
Magnesium, Dissolved	0.315	0.100	mg/L	EPA 6010B	09/23/2014 07:49	9/23/2014 10:25	
Potassium, Dissolved	0.4	0.5	mg/L	EPA 6010B	09/23/2014 07:49	9/23/2014 10:25	J
Sodium, Dissolved	3.68	0.300	mg/L	EPA 6010B	09/23/2014 07:49	9/23/2014 10:25	



Certificate of Analysis

Lab Sample No.: 1409901-08

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-EB</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/11/2014 10:00 AM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
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Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.006	0.0010	g/mL	SM 2710 F	09/17/2014 10:17	9/17/2014 11:22	
Total Dissolved Solids (TDS)	32	20	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-09

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-FB</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/11/2014 10:00 AM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
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Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	0.9924	0.0010	g/mL	SM 2710 F	09/17/2014 10:17	9/17/2014 11:22	
Total Dissolved Solids (TDS)	236	20	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-10

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-4A</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/10/2014 11:45 AM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
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Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.222	0.0010	g/mL	SM 2710 F	09/17/2014 10:17	9/17/2014 11:22	
Total Dissolved Solids (TDS)	323000	500	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-11

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-4-1</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/10/2014 11:45 AM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
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Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.195	0.0010	g/mL	SM 2710 F	09/17/2014 10:17	9/17/2014 11:22	
Total Dissolved Solids (TDS)	332000	500	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-12

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-4-2.5</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/10/2014 11:45 AM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
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Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.232	0.0010	g/mL	SM 2710 F	09/17/2014 10:17	9/17/2014 11:22	
Total Dissolved Solids (TDS)	315000	500	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-13

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-4-4</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/10/2014 11:45 AM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
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Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.203	0.0010	g/mL	SM 2710 F	09/17/2014 10:21	9/17/2014 11:23	
Total Dissolved Solids (TDS)	343000	500	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-14

Name: HDR Engineering, Inc.	Sample Date: 9/10/2014 11:45 AM
Sample Site: 8180-4-B	Receipt Date: 9/11/2014 11:45 AM
Comments: UPRR GSL WQ	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.228	0.0010	g/mL	SM 2710 F	09/17/2014 10:21	9/17/2014 11:23	
Total Dissolved Solids (TDS)	339000	500	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-15

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-3A</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/10/2014 12:30 PM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
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Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.207	0.0010	g/mL	SM 2710 F	09/17/2014 10:21	9/17/2014 11:23	
Total Dissolved Solids (TDS)	347000	500	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-16

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-3ADUP</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/10/2014 12:30 PM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
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Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.209	0.0010	g/mL	SM 2710 F	09/17/2014 10:21	9/17/2014 11:23	
Total Dissolved Solids (TDS)	346000	500	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-17

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-3-1.5</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/10/2014 12:45 PM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
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Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.229	0.0010	g/mL	SM 2710 F	09/17/2014 10:21	9/17/2014 11:23	
Total Dissolved Solids (TDS)	342000	500	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-18

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-3-3</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/10/2014 12:45 PM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.213	0.0010	g/mL	SM 2710 F	09/17/2014 10:21	9/17/2014 11:23	
Total Dissolved Solids (TDS)	331000	500	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-19

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-3-4.5</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/10/2014 12:45 PM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.234	0.0010	g/mL	SM 2710 F	09/17/2014 10:21	9/17/2014 11:23	
Total Dissolved Solids (TDS)	325000	500	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	



Certificate of Analysis

Lab Sample No.: 1409901-20

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-B</p> <p>Comments: UPRR GSL WQ</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/10/2014 12:45 PM</p> <p>Receipt Date: 9/11/2014 11:45 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Specific Gravity	1.212	0.0010	g/mL	SM 2710 F	09/17/2014 10:21	9/17/2014 11:23	
Total Dissolved Solids (TDS)	349000	500	mg/L	SM 2540 C	09/11/2014 15:53	9/11/2014 15:53	

CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF CUSTODY

1 of 4 *kr*

COMPANY: HDR
 ADDRESS: 3949 South 700 East
 CITY/STATE/ZIP: Salt Lake City, Utah 84107
 PHONE #: 801-743-7800 FAX: _____
 CONTACT: Carin Loy (916-679-8737) PROJECT: UPRR GSL WQ
 EMAIL: carin.loy@hdrinc.com

BILLING ADDRESS: HDR
 BILLING CITY/STATE/ZIP: 3949 South 700 East
 PURCHASE ORDER #: _____



TURNAROUND REQUIRED:* Standard

* Expedited turnaround subject to additional charge

Level 2 QC for all

BRINE SAMPLES

Lab Use Only	CLIENT SAMPLE INFORMATION						TESTS REQUESTED										Bacteria					
	LOCATION / IDENTIFICATION	DATE	TIME	MATRIX	Field: Residual Chlorine	SM 2710F, Density	SM 2540 C, TDS	EPA 300.0, Anions (Cl, SO4)	SM2320 B, Alkalinity	^{DISOLVED} EPA 6010 B, Cations (NA,K,Mg, CA)	SM 4500, Dissolved Oxygen	SM 2340 C, Hardness							Total Coliform + E. coli (Present/Absent)	Total Coliform + E. coli (Enumerated)	HPC (Plate Count)	E. Coli Only
09901	1. 8180-4A	9.10	1130	FW					X	X												
	2.							X	X													
-02	3. 8180-3A		1230						X	X												
	4.							X	X													
-03	5. 8180-4B		1145						X	X												
	6.							X	X													
-04	7. 8180-3A DUP		1230						X	X												
	8.							X	X													
-05	9. 8180-3B		1245						X	X												
	10.							X	X													
Sampled by: [print]						Sampled by: [signature]						ON ICE <input type="radio"/> NOT ON ICE <input checked="" type="radio"/> Temp (C°): 22.1										
Special Instructions:												Samples received outside the EPA recommended temperature range of 0-5 C° may be rejected.										
Relinquished by: [signature]						Date/Time: 9/11/14 11:45						Received by: [signature]						Date/Time: 9/11/14 11:45				
Relinquished by: [signature]						Date/Time:						Received by: [signature]						Date/Time:				
Relinquished by: [signature]						Date/Time:						Received by: [signature]						Date/Time:				

CHEMTECH-FORD
 9632 South 500 West
 Sandy, UT 84070
 801.262.7299 PHONE
 866.792.0093 FAX
 www.chemtechford.com

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.

★ - Filter Unpreserved sample for EPA 6010 B, Cations

CHEMTECH - FORD ANALYTICAL LABORATORY

2 CHAIN OF CUSTODY 4

COMPANY: HDR
 ADDRESS: 3949 South 700 East
 CITY/STATE/ZIP: Salt Lake City, Utah 84107
 PHONE #: 801-743-7800 FAX: _____
 CONTACT: Carin Loy (916-679-8737) PROJECT: UPRR GSL WQ
 EMAIL: carin.loy@hdrinc.com

BILLING ADDRESS: HDR
 BILLING CITY/STATE/ZIP: 3949 South 700 East
 PURCHASE ORDER #: _____



Billing questions to Mike Funk @ 801-743-7818

TURNAROUND REQUIRED:* Standard

* Expedited turnaround subject to additional charge

Lab Use Only	CLIENT SAMPLE INFORMATION					TESTS REQUESTED										Bacteria							
	LOCATION / IDENTIFICATION	DATE	TIME	MATRIX	Field: Residual Chlorine	SM 2710F, Density	SM 2540 C, TDS	EPA 300.0, Anions (Cl, SO4)	SM2320 B, Alkalinity	DISSOLVED EPA 6010 B, Cations (NA, K, Mg, CA)	SM 4500, Dissolved Oxygen	SM 2340 C, Hardness							Total Coliform + E. coli (Present/Absent)	Total Coliform + E. coli (Enumerated)	HPC (Plate Count)	E. Coli Only	
-06	1. 8180 - FB	9.11	1000	FW				X	X														
	2.									X	X												
-07	3. 8180 - EB							X	X														
	4.									X	X												
-08	5. 8180 - EB	9.11	1000	FW		X	X																
-09	6. 8180 - FB	9.11	1000	FW		X	X																
	7.																						
	8.																						
	9.																						
	10.																						
Sampled by: [print]		Sampled by: [signature]				ON ICE										NOT ON ICE		Temp (C°): 22.1					
Special Instructions:						Samples received outside the EPA recommended temperature range of 0-5 C° may be rejected.																	
Relinquished by: [signature]		Date/Time: 9/11/14 11:45		Received by: [signature]												Date/Time: 9/11/14 11:45							
Relinquished by: [signature]		Date/Time:		Received by: [signature]												Date/Time:							
Relinquished by: [signature]		Date/Time:		Received by: [signature]												Date/Time:							

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★ Filter Unpreserved Sample for EPA 6010 B Cations

3-f4

CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF CUSTODY

COMPANY: HDR
 ADDRESS: 3949 South 700 East
 CITY/STATE/ZIP: Salt Lake City, Utah 84107
 PHONE #: 801-743-7800 FAX: _____
 CONTACT: Carin Loy (916-679-8737) PROJECT: UPRR GSL WQ
 EMAIL: carin.loy@hdrinc.com

BILLING ADDRESS: HDR
 BILLING CITY/STATE/ZIP: 3949 South 700 East
 PURCHASE ORDER #: _____



TURNAROUND REQUIRED:* Standard

* Expedited turnaround subject to additional charge

Billing questions to Mike Funk @ 801-743-7818

Lab Use Only	CLIENT SAMPLE INFORMATION						TESTS REQUESTED										Bacteria					
	LOCATION / IDENTIFICATION	DATE	TIME	MATRIX	Field: Residual Chlorine	SM 2710F, Density	SM 2540 C, TDS	EPA 300.0, Anions (Cl, SO4)	SM2320 B, Alkalinity	EPA 6010 B, Cations (NA,K,Mg, CA)	SM 4500, Dissolved Oxygen	SM 2340 C, Hardness							Total Coliform + E. coli (Present/Absent)	Total Coliform + E. coli (Enumerated)	HPC (Plate Count)	E. Coli Only
-10	1. 8180-4 A.	9.10	1145	FW		X	X															
-11	2. 8180-4-1	↓	↓	↓		X	X															
-12	3. 8180-4-2.5	↓	↓	↓		X	X															
-13	4. 8180-4-4	↓	↓	↓		X	X															
-14	5. 8180-4-B	↓	↓	↓		X	X															
	6.																					
	7.																					
	8.																					
	9.																					
	10.																					
Sampled by: [print]					Sampled by: [signature]					ON ICE <input checked="" type="radio"/> NOT ON ICE <input type="radio"/> Temp (C°): <u>22.1</u>												
Special Instructions:										Samples received outside the EPA recommended temperature range of 0-6 C° may be rejected.												
Relinquished by: [signature]					Date/Time: <u>9/10/14 11:45</u>					Received by: [signature]					Date/Time: <u>9/10/14 11:45</u>							
Relinquished by: [signature]					Date/Time:					Received by: [signature]					Date/Time:							
Relinquished by: [signature]					Date/Time:					Received by: [signature]					Date/Time:							

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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.

40F4

CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF CUSTODY

COMPANY: HDR
 ADDRESS: 3949 South 700 East
 CITY/STATE/ZIP: Salt Lake City, Utah 84107
 PHONE #: 801-743-7800 FAX: _____
 CONTACT: Carin Loy (916-679-8737) PROJECT: UPRR GSL WQ
 EMAIL: carin.loy@hdrinc.com

BILLING ADDRESS: HDR
 BILLING CITY/STATE/ZIP: 3949 South 700 East
 PURCHASE ORDER #: _____



TURNAROUND REQUIRED:* Standard

* Expedited turnaround subject to additional charge

Billing questions to Mike Funk @ 801-743-7818

BRINES

Lab Use Only	CLIENT SAMPLE INFORMATION				
	LOCATION / IDENTIFICATION	DATE	TIME	MATRIX	Field: Residual Chlorine
-15	1. 8180-3A	9.10	1230	FW	
-16	2. 8180-3AD4	↓	↓	↓	
-17	3. 8180-3-1.5	↓	1245	↓	
-18	4. 8180-3 3.	↓	↓	↓	
-19	5. 8180-3 4.5	↓	↓	↓	
-20	6. 8180-B	↓	↓	↓	
	7.				
	8.				
	9.				
	10.				

TESTS REQUESTED										Bacteria				
SM 2710F, Density	SM 2540 C, TDS	EPA 300.0, Anions (Cl, SO4)	SM2320 B, Alkalinity	EPA 6010 B, Cations (NA,K,Mg, CA)	SM 4500, Dissolved Oxygen	SM 2340 C, Hardness					Total Coliform + E. coli (Present/Absent)	Total Coliform + E. coli (Enumerated)	HPC (Plate Count)	E. Coli Only
X	X													
X	X													
X	X													
X	X													
X	X													

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

Special Instructions: _____

ON ICE NOT ON ICE Temp (C°): 20.1

Samples received outside the EPA recommended temperature range of 0-6 C° may be rejected.

Relinquished by: [signature] [Signature] Date/Time 9/19/14 11:45 Received by: [signature] [Signature] Date/Time 9/16/14 11:25

Relinquished by: [signature] _____ Date/Time _____ Received by: [signature] _____ Date/Time _____

Relinquished by: [signature] _____ Date/Time _____ Received by: [signature] _____ Date/Time _____

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 Sandy, UT 84070

801.262.7299 PHONE
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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.



Certificate of Analysis

Report Footnotes

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).



10/30/2014

Work Order: 1410519

**HDR Engineering, Inc.
Attn: Charles Vertucci
3949 South 700 E, Suite 500
Salt Lake City, UT 84107**

Client Service Contact: 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.



Approved By:

Dave Gayer, Laboratory Director



Certificate of Analysis

Lab Sample No.: 1410519-01

Name: HDR Engineering, Inc.	Sample Date: 9/23/2014 12:15 PM
Sample Site: 8180-5-A	Receipt Date: 9/24/2014 10:30 AM
Comments:	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	2810		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:19	
Cation/Anion Balance	1.4		%	SM 1030 E	10/13/2014 12:15	10/13/2014 12:17	
Cations, Total	2880		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:21	
Hardness, Dissolved as CaCO3	24600	1	mg/L	SM 2340 B	10/10/2014 11:38	10/10/2014 11:49	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	580	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - CO2	422	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Total (as CaCO3)	476	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Chloride	91000	2500	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Sulfate	11100	250	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Metals							
Calcium, Dissolved	300	50.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:30	
Magnesium, Dissolved	5800	25.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:30	
Potassium, Dissolved	3570	125	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:30	
Sodium, Dissolved	52900	75.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:30	



Certificate of Analysis

Lab Sample No.: 1410519-02

Name: HDR Engineering, Inc.	Sample Date: 9/23/2014 12:15 PM
Sample Site: 8180-5-B	Receipt Date: 9/24/2014 10:30 AM
Comments:	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	4220		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:19	
Cation/Anion Balance	3.3		%	SM 1030 E	10/13/2014 12:15	10/13/2014 12:17	
Cations, Total	4510		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:21	
Hardness, Dissolved as CaCO3	38000	1	mg/L	SM 2340 B	10/10/2014 11:38	10/10/2014 11:49	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	754	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - CO2	605	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Total (as CaCO3)	618	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Chloride	137000	2500	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Sulfate	16500	250	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Metals							
Calcium, Dissolved	343	50.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:34	
Magnesium, Dissolved	9010	25.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:34	
Potassium, Dissolved	5500	125	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:34	
Sodium, Dissolved	82900	75.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:34	



Certificate of Analysis

Lab Sample No.: 1410519-03

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-5-0.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 12:15 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.106	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	157000	500	mg/L	SM 2540 C	09/26/2014 13:49	9/26/2014 13:49	



Certificate of Analysis

Lab Sample No.: 1410519-04

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-5-0.0 Dup</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 12:15 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.109	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	147000	500	mg/L	SM 2540 C	09/26/2014 13:49	9/26/2014 13:49	



Certificate of Analysis

Lab Sample No.: 1410519-05

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-5-2.5</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 12:15 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.111	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	164000	500	mg/L	SM 2540 C	09/26/2014 13:49	9/26/2014 13:49	



Certificate of Analysis

Lab Sample No.: 1410519-06

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-5-4.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 12:15 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.118	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	162000	500	mg/L	SM 2540 C	09/26/2014 13:49	9/26/2014 13:49	



Certificate of Analysis

Lab Sample No.: 1410519-07

Name: HDR Engineering, Inc.	Sample Date: 9/23/2014 12:15 PM
Sample Site: 8180-5-5.5	Receipt Date: 9/24/2014 10:30 AM
Comments:	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.120	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	166000	500	mg/L	SM 2540 C	09/26/2014 13:49	9/26/2014 13:49	



Certificate of Analysis

Lab Sample No.: 1410519-08

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-5-7.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 12:15 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.115	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	167000	500	mg/L	SM 2540 C	09/26/2014 13:49	9/26/2014 13:49	



Certificate of Analysis

Lab Sample No.: 1410519-09

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-5-7.5</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 12:15 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.114	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	164000	500	mg/L	SM 2540 C	09/26/2014 13:49	9/26/2014 13:49	



Certificate of Analysis

Lab Sample No.: 1410519-10

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-5-8.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 12:15 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.109	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	167000	500	mg/L	SM 2540 C	09/26/2014 13:49	9/26/2014 13:49	



Certificate of Analysis

Lab Sample No.: 1410519-11

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-5-8.5</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 3:45 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	--

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.159	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	245000	500	mg/L	SM 2540 C	09/26/2014 13:49	9/26/2014 13:49	



Certificate of Analysis

Lab Sample No.: 1410519-12

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-1-A</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 10:15 AM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	2780		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:19	
Cation/Anion Balance	2.3		%	SM 1030 E	10/13/2014 12:15	10/13/2014 12:17	
Cations, Total	2900		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:21	
Hardness, Dissolved as CaCO3	24900	1	mg/L	SM 2340 B	10/10/2014 11:38	10/10/2014 11:49	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	586	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - CO2	429	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Total (as CaCO3)	481	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Chloride	90000	2500	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Sulfate	10900	250	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Metals							
Calcium, Dissolved	307	50.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:38	
Magnesium, Dissolved	5860	25.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:38	
Potassium, Dissolved	3590	125	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:38	
Sodium, Dissolved	53200	75.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:38	



Certificate of Analysis

Lab Sample No.: 1410519-13

Name: HDR Engineering, Inc.	Sample Date: 9/23/2014 10:15 AM
Sample Site: 8180-1-B	Receipt Date: 9/24/2014 10:30 AM
Comments:	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	2930		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:19	
Cation/Anion Balance	4.1		%	SM 1030 E	10/13/2014 12:15	10/13/2014 12:17	
Cations, Total	3180		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:21	
Hardness, Dissolved as CaCO3	27200	1	mg/L	SM 2340 B	10/10/2014 11:38	10/10/2014 11:49	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	582	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - CO2	429	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Total (as CaCO3)	478	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Chloride	95000	2500	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Sulfate	11700	250	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Metals							
Calcium, Dissolved	315	50.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:42	
Magnesium, Dissolved	6410	25.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:42	
Potassium, Dissolved	3920	125	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:42	
Sodium, Dissolved	58400	75.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:42	



Certificate of Analysis

Lab Sample No.: 1410519-14

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-1-0.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 10:45 AM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.111	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	158000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-15

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-1-1.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 10:45 AM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.112	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	170000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-16

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-1-2.5</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 10:45 AM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.110	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	162000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-17

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-1-4.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 10:45 AM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.108	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	160000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-18

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-1-5.5</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 10:45 AM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.104	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	155000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-19

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-1-7.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 10:45 AM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.116	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	153000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-20

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-1-7.5</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 10:45 AM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.106	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	163000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-21

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-1-8.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 10:15 AM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	---

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.119	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	174000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-22

Name: HDR Engineering, Inc.	Sample Date: 9/23/2014 1:30 PM
Sample Site: 8180-2-A	Receipt Date: 9/24/2014 10:30 AM
Comments:	Sampler: Client
Sample Matrix: Water	Project: Water
PO Number:	Project Number:

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	2770		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:19	
Cation/Anion Balance	1.8		%	SM 1030 E	10/13/2014 12:15	10/13/2014 12:17	
Cations, Total	2880		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:21	
Hardness, Dissolved as CaCO3	24800	1	mg/L	SM 2340 B	10/10/2014 11:38	10/10/2014 11:49	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	563	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - CO2	410	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Total (as CaCO3)	462	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Chloride	90000	2500	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Sulfate	10900	250	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Metals							
Calcium, Dissolved	304	50.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:45	
Magnesium, Dissolved	5840	25.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:45	
Potassium, Dissolved	3580	125	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:45	
Sodium, Dissolved	52600	75.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:45	



Certificate of Analysis

Lab Sample No.: 1410519-23

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-2-B</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 1:30 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	--

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	2770		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:19	
Cation/Anion Balance	1.6		%	SM 1030 E	10/13/2014 12:15	10/13/2014 12:17	
Cations, Total	2860		meq/L	SM 1030 E	10/13/2014 12:15	10/13/2014 12:21	
Hardness, Dissolved as CaCO3	24700	1	mg/L	SM 2340 B	10/10/2014 11:38	10/10/2014 11:49	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	559	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - CO2	407	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Alkalinity - Total (as CaCO3)	459	1.0	mg/L	SM 2320 B	09/30/2014 20:30	10/1/2014 1:09	
Chloride	90000	2500	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Sulfate	10900	250	mg/L	EPA 300.0	10/10/2014 15:00	10/10/2014 15:00	A-01
Metals							
Calcium, Dissolved	299	50.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:49	
Magnesium, Dissolved	5810	25.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:49	
Potassium, Dissolved	3540	125	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:49	
Sodium, Dissolved	52400	75.0	mg/L	EPA 6010B	10/02/2014 07:08	10/2/2014 8:49	



Certificate of Analysis

Lab Sample No.: 1410519-24

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-2-0.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 1:30 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	--

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.117	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	169000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-25

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-2-2.5</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 1:45 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
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Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.110	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	164000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-26

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-2-4.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 1:45 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
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Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.109	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	176000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-27

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-2-5.5</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 1:45 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	--

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.116	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	157000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-28

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-2-7.0</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 1:45 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	--

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.105	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	160000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	



Certificate of Analysis

Lab Sample No.: 1410519-29

<p>Name: HDR Engineering, Inc.</p> <p>Sample Site: 8180-2-7.5</p> <p>Comments:</p> <p>Sample Matrix: Water</p> <p>PO Number:</p>	<p>Sample Date: 9/23/2014 1:30 PM</p> <p>Receipt Date: 9/24/2014 10:30 AM</p> <p>Sampler: Client</p> <p>Project: Water</p> <p>Project Number:</p>
---	--

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Inorganic							
Density	1.111	0.0010	g/mL	SM 2710 F	09/26/2014 13:35	9/26/2014 16:02	
Total Dissolved Solids (TDS)	164000	500	mg/L	SM 2540 C	09/26/2014 13:56	9/26/2014 13:56	

1 of 3

PR

CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF CUSTODY

COMPANY: HDR
 ADDRESS: 3949 South 700 East
 CITY/STATE/ZIP: Salt Lake City, Utah 84107
 PHONE #: 801-743-7800 FAX: _____
 CONTACT: Carin Loy (916-679-8737) PROJECT: UPRR GSL WQ
 EMAIL: carin.loy@hdrinc.com

BILLING ADDRESS: HDR
 BILLING CITY/STATE/ZIP: 3949 South 700 East
 PURCHASE ORDER #: _____



Billing questions to Mike Funk @ 801-743-7818

TURNAROUND REQUIRED:* Standard

* Expedited turnaround subject to additional charge

Lab Use Only	CLIENT SAMPLE INFORMATION				
	LOCATION / IDENTIFICATION	DATE	TIME	MATRIX	Field: Residual Chlorine
<u>10519</u>					
<u>-01</u>	1. <u>8Q 8180-5a</u>	<u>9/23/14</u>	<u>12:15</u>	<u>Ag</u>	
<u>-02</u>	2. <u>8180-5b</u>	<u>9/23/14</u>	<u>12:15</u>	<u>Ag</u>	
<u>-03</u>	3. <u>8180-5-0.0</u>	<u>9/23/14</u>	<u>12:15</u>	<u>Ag</u>	
<u>-04</u>	4. <u>8180-5-0.0 Dup</u>	<u>9/23/14</u>	<u>12:15</u>	<u>Ag</u>	
<u>-05</u>	5. <u>8180-5-2.5</u>	<u>9/23/14</u>	<u>12:15</u>	<u>Ag</u>	
<u>-06</u>	6. <u>8180-5-4.0</u>	<u>9/23/14</u>			
<u>-07</u>	7. <u>8180-5-5.5</u>	<u>9/23/14</u>			
<u>-08</u>	8. <u>8180-5-7.0</u>				
<u>-09</u>	9. <u>8180-5-7.5</u>				
<u>-10</u>	10. <u>8180-5-8.0</u>				

20

TESTS REQUESTED										Bacteria				
SM 2710F, Density	SM 2540 C, TDS	EPA 300.0, Anions (Cl, SO4)	SM2320 B, Alkalinity	EPA 6010 B, Cations (NA, K, Mg, CA)	SM 4500, Dissolved Oxygen	SM 2340 C, Hardness					Total Coliform + E. coli (Present/Absent)	Total Coliform + E. coli (Enumerated)	HPC (Plate Count)	E. Coli Only
X	X	X	X	X	X	X								
X	X	X	X	X		X								
X	X													
X	X													

BRINE

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

Special Instructions: _____

ON ICE NOT ON ICE Temp (C°): 21.10C

Samples received outside the EPA recommended temperature range of 0-6 C° may be rejected.

Relinquished by: [signature] <u>Carin Nulsen HDR</u>	Date/Time <u>9/24/14 10:30</u>	Received by: [signature] <u>[Signature]</u>	Date/Time <u>9/24/14 10:30</u>
Relinquished by: [signature] _____	Date/Time _____	Received by: [signature] _____	Date/Time _____
Relinquished by: [signature] _____	Date/Time _____	Received by: [signature] _____	Date/Time _____

CHEMTECH-FORD
 9632 South 500 West
 Sandy, UT 84070

801.262.7299 PHONE
 866.792.0093 FAX
 www.chemtechford.com

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.

2 of 3

CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF CUSTODY

COMPANY: HDR
 ADDRESS: 3949 South 700 East
 CITY/STATE/ZIP: Salt Lake City, Utah 84107
 PHONE #: 801-743-7800 FAX: _____
 CONTACT: Carin Loy (916-679-8737) PROJECT: UPRR GSL WQ
 EMAIL: carin.loy@hdrinc.com

BILLING ADDRESS: HDR
 BILLING CITY/STATE/ZIP: 3949 South 700 East
 PURCHASE ORDER #: _____



TURNAROUND REQUIRED:* Standard

* Expedited turnaround subject to additional charge

Billing questions to Mike Funk @ 801-743-7818

Lab Use Only	CLIENT SAMPLE INFORMATION						TESTS REQUESTED										Bacteria						
	LOCATION / IDENTIFICATION	DATE	TIME	MATRIX	Field: Residual Chlorine	SM 2710F, Density	SM 2540 C, TDS	EPA 300.0, Anions (Cl, SO4)	SM2320 B, Alkalinity	EPA 6010 B, Cations (NA,K,Mg, CA)	SM 4500, Dissolved Oxygen	SM 2340 C, Hardness							Total Coliform + E. coli (Present/Absent)	Total Coliform + E. coli (Enumerated)	HPC (Plate Count)	E. Coli Only	
10519																							
-11	1. 8180-2-8.5	9/23/14	12:45	AG		X	X																
-12	2. 8180-1a	9/23/14	10:15					X	X	X	X												
-13	3. 8180-1B	9/23/14	10:15					X	X	X	X												
-14	4. 8180-1-0.0		10:45																				
-15	5. 8180-1-1.0		10:45																				
-16	6. 8180-1-2.5																						
-17	7. 8180-1-4.0																						
-18	8. 8180-1-5.5																						
-19	9. 8180-1-7.0																						
-20	10. 8180-1-7.5		10:45																				
Sampled by: [print]						Sampled by: [signature]						ON ICE <u>NOT ON ICE</u> Temp (C°):											
Special Instructions:												Samples received outside the EPA recommended temperature range of 0-6 C° may be rejected.											
Relinquished by: [signature]				Date/Time		Received by: [signature]				Date/Time													
<i>Carin Loy HDR</i>				9/24/14 10:30		<i>[Signature]</i>				9/24/14 10:30													
Relinquished by: [signature]				Date/Time		Received by: [signature]				Date/Time													
Relinquished by: [signature]				Date/Time		Received by: [signature]				Date/Time													

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3 of 3

VR

CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF CUSTODY

COMPANY: HDR
 ADDRESS: 3949 South 700 East
 CITY/STATE/ZIP: Salt Lake City, Utah 84107
 PHONE #: 801-743-7800 FAX: _____
 CONTACT: Carin Loy (916-679-8737) PROJECT: UPRR GSL WQ
 EMAIL: carin.loy@hdrinc.com

BILLING ADDRESS: HDR
 BILLING CITY/STATE/ZIP: 3949 South 700 East
 PURCHASE ORDER #: _____



TURNAROUND REQUIRED:* Standard

* Expedited turnaround subject to additional charge

Billing questions to Mike Funk @ 801-743-7818

Lab Use Only	CLIENT SAMPLE INFORMATION				
	LOCATION / IDENTIFICATION	DATE	TIME	MATRIX	Field: Residual Chlorine
10519					
-21	1 8180-1-8.0	9/23/14	10:15	AQ	
-22	2 8180-2A	9/23/14	13:30	AQ	
-23	3 8180-2B		1330		
-24	4 8180-2-0.0		1330		
-25	5 8180-2-2.5		1345		
-26	6 8180-2-4.0		1345		
-27	7 8180-2-5.5		1345		
-28	8 8180-2-7.0		1345		
-29	9 8180-2-7.5		1330		
10.					

TESTS REQUESTED										Bacteria				
SM 2710F, Density	SM 2540 C, TDS	EPA 300.0, Anions (Cl, SO4)	SM2320 B, Alkalinity	EPA 6010 B, Cations (NA,K,Mg, CA)	SM 4500, Dissolved Oxygen	SM 2340 C, Hardness					Total Coliform + E. coli (Present/Absent)	Total Coliform + E. coli (Enumerated)	HPC (Plate Count)	E. Coli Only
X	X													
			X	X	X	X								
			X	X	X	X								
X	X													
X	X													
X	X													
X	X													
X	X													

10. Sampled by: [print] _____ Sampled by: [signature] _____

ON ICE **NOT ON ICE** Temp (C°): _____

Special Instructions: _____
 Samples received outside the EPA recommended temperature range of 0-6 C° may be rejected.

Relinquished by: [signature] Carin Loy HDR Date/Time 9/24/14 10:30 Received by: [signature] [Signature] Date/Time 9/24/14 10:30

Relinquished by: [signature] _____ Date/Time _____ Received by: [signature] _____ Date/Time _____

Relinquished by: [signature] _____ Date/Time _____ Received by: [signature] _____ Date/Time _____

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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.



Certificate of Analysis

Report Footnotes

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

A-01 = This sample was re-analyzed a second time and the result was confirmed for this analyte.

QC Summary for Sample Delivery Group - 1410519

QC ID	Analyte	% Rec	RPD	LCL	UCL	RPD Max	Result	QC Source	Source Conc	Spk Value	Surr?	Batch	Sampled	Prepared	Analyzed	MDL	MRL	DF	
Blank - Method EPA 300.0																			
B409749-BLK1	Chloride						0					B409749	09/26/14	09/26/14	0.07	1	1		
B409749-BLK1	Sulfate						0.7					B409749	09/26/14	09/26/14	0.2	1	1		
B409749-BLK2	Chloride						0					B409749	09/26/14	09/26/14	0.07	1	1		
B409749-BLK2	Sulfate						0.7					B409749	09/26/14	09/26/14	0.2	1	1		
Calibration Blank - Method EPA 300.0																			
4J03016-CCB1	Chloride						0					4J03016	10/03/14	10/03/14			1		
4J03016-CCB1	Sulfate						0.7					4J03016	10/03/14	10/03/14			1		
4J03016-CCB2	Chloride						0.3					4J03016	10/03/14	10/03/14			1		
4J03016-CCB2	Sulfate						0.7					4J03016	10/03/14	10/03/14			1		
4J03016-CCB3	Chloride						0.3					4J03016	10/03/14	10/03/14			1		
4J03016-CCB3	Sulfate						0.7					4J03016	10/03/14	10/03/14			1		
4J03016-CCB4	Chloride						0					4J03016	10/03/14	10/03/14			1		
4J03016-CCB4	Sulfate						0.7					4J03016	10/03/14	10/03/14			1		
4J03016-CCB5	Chloride						0					4J03016	10/03/14	10/03/14			1		
4J03016-CCB5	Sulfate						0.8					4J03016	10/03/14	10/03/14			1		
Calibration Check - Method EPA 300.0																			
4J03016-CCV1	Chloride	102		90	110		20			20.0		4J03016	10/03/14	10/03/14			1		
4J03016-CCV1	Sulfate	99.9		90	110		40			40.0		4J03016	10/03/14	10/03/14			1		
4J03016-CCV2	Chloride	103		90	110		21			20.0		4J03016	10/03/14	10/03/14			1		
4J03016-CCV2	Sulfate	101		90	110		40			40.0		4J03016	10/03/14	10/03/14			1		
4J03016-CCV3	Chloride	102		90	110		20			20.0		4J03016	10/03/14	10/03/14			1		
4J03016-CCV3	Sulfate	99.1		90	110		40			40.0		4J03016	10/03/14	10/03/14			1		
4J03016-CCV4	Chloride	102		90	110		20			20.0		4J03016	10/03/14	10/03/14			1		
4J03016-CCV4	Sulfate	99.6		90	110		40			40.0		4J03016	10/03/14	10/03/14			1		

QC ID	Analyte	% Rec	RPD	LCL	UCL	RPD Max	Result	QC Source	Source Conc	Spk Value	Surr?	Batch	Sampled	Prepared	Analyzed	MDL	MRL	DF
4J03016-CCV5 -	Chloride	102		90	110		20			20.0		4J03016	10/03/14	10/03/14				1
4J03016-CCV5 -	Sulfate	99.6		90	110		40			40.0		4J03016	10/03/14	10/03/14				1

LCS - Method EPA 300.0

B409749-BS1 -	Chloride	100		90	110		50			50.0		B409749	09/26/14	09/26/14	0.07	1	1
B409749-BS1 -	Sulfate	99.3		90	110		99			100		B409749	09/26/14	09/26/14	0.2	1	1
B409749-BS2 -	Chloride	101		90	110		51			50.0		B409749	09/26/14	09/26/14	0.07	1	1
B409749-BS2 -	Sulfate	101		90	110		101			100		B409749	09/26/14	09/26/14	0.2	1	1

Matrix Spike - Method EPA 300.0

B409749-MS1 -	Chloride	100		80	120		14	XXXXXXX-XX	4	10.0		B409749	09/26/14	09/26/14	0.07	1	1	
B409749-MS1 -	Sulfate	75.7		80	120		135	XXXXXXX-XX	120	20.0		B409749	09/26/14	09/26/14	0.2	1	1	
QM-010 - The MS recovery was outside acceptance limits but passed Duplicate Spike acceptance limits. The batch was accepted based on the acceptability of the MSD as the batch Spike.																		
B409749-MS2 -	Chloride	75.5		80	120		64	XXXXXXX-XX	56	10.0		B409749	09/26/14	10/03/14	0.07	1	1	
QM-RPD - The recovery was outside acceptance limits for the MS and/or MSD. The RPD between the MS and MSD was acceptable and indicates the recovery is due to matrix interference. The batch was accepted based on the acceptable recovery of the LCS and the RPD.																		
B409749-MS2 -	Sulfate	92.1		80	120		48	XXXXXXX-XX	29	20.0		B409749	09/26/14	10/03/14	0.2	1	1	

Matrix Spike Dup - Method EPA 300.0

B409749-MSD1 -	Chloride	102	1.23	80	120	20	14	XXXXXXX-XX	4	10.0		B409749	09/26/14	09/26/14	0.07	1	1	
B409749-MSD1 -	Sulfate	88.3	1.84	80	120	20	137	XXXXXXX-XX	120	20.0		B409749	09/26/14	09/26/14	0.2	1	1	
B409749-MSD2 -	Chloride	76.2	0.117	80	120	20	64	XXXXXXX-XX	56	10.0		B409749	09/26/14	10/03/14	0.07	1	1	
QM-RPD - The recovery was outside acceptance limits for the MS and/or MSD. The RPD between the MS and MSD was acceptable and indicates the recovery is due to matrix interference. The batch was accepted based on the acceptable recovery of the LCS and the RPD.																		
B409749-MSD2 -	Sulfate	92.4	0.115	80	120	20	48	XXXXXXX-XX	29	20.0		B409749	09/26/14	10/03/14	0.2	1	1	

QC ID	Analyte	% Rec	RPD	LCL	UCL	RPD Max	Result	QC Source	Source Conc	Spk Value	Surr?	Batch	Sampled	Prepared	Analyzed	MDL	MRL	DF	
Blank - Method EPA 6010B																			
B410036-BLK1	Calcium, Dissolved						0.01					B410036	10/02/14	10/02/14	0.03	0.2	1		
B410036-BLK1	Magnesium, Dissolved						-0.005					B410036	10/02/14	10/02/14	0.03	0.10	1		
B410036-BLK1	Potassium, Dissolved						0.005					B410036	10/02/14	10/02/14	0.06	0.5	1		
B410036-BLK1	Sodium, Dissolved						0.0369					B410036	10/02/14	10/02/14	0.02	0.30	1		
Calibration Blank - Method EPA 6010B																			
4J02001-CCB1	Calcium, Dissolved						0.002					4J02001	10/02/14	10/02/14			1		
4J02001-CCB1	Magnesium, Dissolved						0.0040					4J02001	10/02/14	10/02/14			1		
4J02001-CCB1	Potassium, Dissolved						0.02					4J02001	10/02/14	10/02/14			1		
4J02001-CCB1	Sodium, Dissolved						0.0435					4J02001	10/02/14	10/02/14			1		
Calibration Check - Method EPA 6010B																			
4J02001-CCV1	Calcium, Dissolved	103		90	110		2.1		2.00			4J02001	10/02/14	10/02/14			1		
4J02001-CCV1	Magnesium, Dissolved	101		90	110		2.01		2.00			4J02001	10/02/14	10/02/14			1		
4J02001-CCV1	Potassium, Dissolved	98.0		90	110		19.6		20.0			4J02001	10/02/14	10/02/14			1		
4J02001-CCV1	Sodium, Dissolved	95.1		90	110		19.0		20.0			4J02001	10/02/14	10/02/14			1		
Initial Cal Blank - Method EPA 6010B																			
4J02001-ICB1	Calcium, Dissolved						0.008					4J02001	10/02/14	10/02/14			1		
4J02001-ICB1	Magnesium, Dissolved						0.0161					4J02001	10/02/14	10/02/14			1		
4J02001-ICB1	Potassium, Dissolved						-0.02					4J02001	10/02/14	10/02/14			1		
4J02001-ICB1	Sodium, Dissolved						0.0102					4J02001	10/02/14	10/02/14			1		
Initial Cal Check - Method EPA 6010B																			
4J02001-ICV1	Calcium, Dissolved	101		90	110		2.0		2.00			4J02001	10/02/14	10/02/14			1		
4J02001-ICV1	Magnesium, Dissolved	97.8		95	105		1.96		2.00			4J02001	10/02/14	10/02/14			1		
4J02001-ICV1	Potassium, Dissolved	99.8		95	105		20.0		20.0			4J02001	10/02/14	10/02/14			1		
4J02001-ICV1	Sodium, Dissolved	97.3		95	105		19.5		20.0			4J02001	10/02/14	10/02/14			1		
LCS - Method EPA 6010B																			
B410036-BS1	Calcium, Dissolved	105		85	115		10.7		10.2			B410036	10/02/14	10/02/14	0.03	0.2	1		

QC ID	Analyte	% Rec	RPD	LCL	UCL	RPD Max	Result	QC Source	Source Conc	Spk Value	Surr?	Batch	Sampled	Prepared	Analyzed	MDL	MRL	DF
B410036-BS1 -	Magnesium, Dissolved	106		85	115		10.8			10.2		B410036	10/02/14	10/02/14	0.03	0.10	1	
B410036-BS1 -	Potassium, Dissolved	106		85	115		10.6			10.0		B410036	10/02/14	10/02/14	0.06	0.5	1	
B410036-BS1 -	Sodium, Dissolved	106		85	115		10.6			10.0		B410036	10/02/14	10/02/14	0.02	0.30	1	

Matrix Spike - Method EPA 6010B

B410036-MS1 -	Calcium, Dissolved	99.1		75	125		2830	1410519-23	299	2550		B410036	10/02/14	10/02/14	7.5	50.0	1
B410036-MS1 -	Magnesium, Dissolved	96.1		75	125		8260	1410519-23	5810	2550		B410036	10/02/14	10/02/14	8.05	25.0	1
B410036-MS1 -	Potassium, Dissolved	93.4		75	125		5870	1410519-23	3540	2500		B410036	10/02/14	10/02/14	14.8	125	1
B410036-MS1 -	Sodium, Dissolved	38.5		75	125		53300	1410519-23	52400	2500		B410036	10/02/14	10/02/14	5.00	75.0	1

QM-4X - The spike recovery was outside of QC acceptance limits for the MS and/or MSD due to analyte concentration at 4 times or greater the spike concentration. The QC batch was accepted based on LCS and/or LCSD recoveries within the acceptance limits.

Matrix Spike Dup - Method EPA 6010B

B410036-MSD1 -	Calcium, Dissolved	103	3.15	75	125	20	2920	1410519-23	299	2550		B410036	10/02/14	10/02/14	7.5	50.0	1
B410036-MSD1 -	Magnesium, Dissolved	91.4	1.45	75	125	20	8140	1410519-23	5810	2550		B410036	10/02/14	10/02/14	8.05	25.0	1
B410036-MSD1 -	Potassium, Dissolved	91.3	0.926	75	125	25	5820	1410519-23	3540	2500		B410036	10/02/14	10/02/14	14.8	125	1
B410036-MSD1 -	Sodium, Dissolved	-31.2	3.32	75	125	25	51600	1410519-23	52400	2500		B410036	10/02/14	10/02/14	5.00	75.0	1

QM-4X - The spike recovery was outside of QC acceptance limits for the MS and/or MSD due to analyte concentration at 4 times or greater the spike concentration. The QC batch was accepted based on LCS and/or LCSD recoveries within the acceptance limits.

QC ID	Analyte	% Rec	RPD	LCL	UCL	RPD Max	Result	QC Source	Source Conc	Spk Value	Surr?	Batch	Sampled	Prepared	Analyzed	MDL	MRL	DF	
Blank - Method SM 2320 B																			
B409757-BLK1	Alkalinity - Bicarbonate (HCO3)						0.0					B409757	09/30/14	10/01/14	0.2	1.0	1		
B409757-BLK1	Alkalinity - Carbonate (CO3)						0.0					B409757	09/30/14	10/01/14	0.2	1.0	1		
B409757-BLK1	Alkalinity - CO2						0.0					B409757	09/30/14	10/01/14	0.2	1.0	1		
B409757-BLK1	Alkalinity - Hvdroxide (OH)						0.0					B409757	09/30/14	10/01/14	0.2	1.0	1		
B409757-BLK1	Alkalinity - Total (as CaCO3)						0.0					B409757	09/30/14	10/01/14	0.2	1.0	1		
B409757-BLK2	Alkalinity - Bicarbonate (HCO3)						0.0					B409757	09/30/14	10/01/14	0.2	1.0	1		
B409757-BLK2	Alkalinity - Carbonate (CO3)						0.0					B409757	09/30/14	10/01/14	0.2	1.0	1		
B409757-BLK2	Alkalinity - CO2						0.0					B409757	09/30/14	10/01/14	0.2	1.0	1		
B409757-BLK2	Alkalinity - Hvdroxide (OH)						0.0					B409757	09/30/14	10/01/14	0.2	1.0	1		
B409757-BLK2	Alkalinity - Total (as CaCO3)						0.0					B409757	09/30/14	10/01/14	0.2	1.0	1		
Calibration Blank - Method SM 2320 B																			
4J01001-CCB1	Alkalinity - Total (as CaCO3)						0.0					4J01001	10/01/14	10/01/14				1	
4J01001-CCB2	Alkalinity - Total (as CaCO3)						0.0					4J01001	10/01/14	10/01/14				1	
Calibration Check - Method SM 2320 B																			
4J01001-CCV1	Alkalinity - Total (as CaCO3)	99.8		90	110		2360			2360		4J01001	10/01/14	10/01/14				1	
4J01001-CCV2	Alkalinity - Total (as CaCO3)	99.8		90	110		2360			2360		4J01001	10/01/14	10/01/14				1	
Initial Cal Blank - Method SM 2320 B																			
4J01001-ICB1	Alkalinity - Total (as CaCO3)						0.0					4J01001	10/01/14	10/01/14				1	
Initial Cal Check - Method SM 2320 B																			
4J01001-ICV1	Alkalinity - Total (as CaCO3)	100		90	110		2360			2360		4J01001	10/01/14	10/01/14				1	
LCS - Method SM 2320 B																			
B409757-BS1	Alkalinity - Total (as CaCO3)	99.9		90	110		2360			2360		B409757	09/30/14	10/01/14	0.2	1.0	1		
B409757-BS2	Alkalinity - Total (as CaCO3)	100		90	110		2360			2360		B409757	09/30/14	10/01/14	0.2	1.0	1		
Matrix Spike - Method SM 2320 B																			
B409757-MS1	Alkalinity - Total (as CaCO3)	97.5		80	120		245	XXXXXX-XX	199	47.2		B409757	09/30/14	10/01/14	0.2	1.0	1		

QC ID	Analyte	% Rec	RPD	LCL	UCL	RPD Max	Result	QC Source	Source Conc	Spk Value	Surr?	Batch	Sampled	Prepared	Analyzed	MDL	MRL	DF
B409757-MS2 -	Alkalinity - Total (as CaCO3)	104		80	120		508	1410519-23	459	47.2		B409757	09/30/14	10/01/14	0.2	1.0	1	
Matrix Spike Dup - Method SM 2320 B																		
B409757-MSD1 -	Alkalinity - Total (as CaCO3)	97.5	0.00	80	120	20	245	XXXXXXX-XX	199	47.2		B409757	09/30/14	10/01/14	0.2	1.0	1	
B409757-MSD2 -	Alkalinity - Total (as CaCO3)	102	0.197	80	120	20	507	1410519-23	459	47.2		B409757	09/30/14	10/01/14	0.2	1.0	1	

QC ID	Analyte	% Rec	RPD	LCL	UCL	RPD Max	Result	QC Source	Source Conc	Spk Value	Surr?	Batch	Sampled	Prepared	Analyzed	MDL	MRL	DF	
Blank - Method SM 2540 C																			
B409800-BLK1 -	Total Dissolved Solids (TDS)						4					B409800	09/26/14	09/26/14	10	10	2		
B409801-BLK1 -	Total Dissolved Solids (TDS)						0					B409801	09/26/14	09/26/14	10	10	2		
Duplicate - Method SM 2540 C																			
B409800-DUP1 -	Total Dissolved Solids (TDS)		1.28		20	928	XXXXXXX-XX	940				B409800	09/26/14	09/26/14	20	20	4		
B409800-DUP2 -	Total Dissolved Solids (TDS)		0.613		20	244000	1410519-11	245000				B409800	09/26/14	09/26/14	500	500	100		
B409801-DUP1 -	Total Dissolved Solids (TDS)				20	0	1410519-14	158000				B409801	09/26/14	10/09/14	5	5	1		
B409801-DUP2 -	Total Dissolved Solids (TDS)		2.79		20	2820	XXXXXXX-XX	2900				B409801	09/26/14	09/26/14	20	20	4		
Reference - Method SM 2540 C																			
B409800-SRM1 -	Total Dissolved Solids (TDS)	108		90	110	216				200		B409800	09/26/14	09/26/14	10	10	2		
B409801-SRM1 -	Total Dissolved Solids (TDS)	104		90	110	208				200		B409801	09/26/14	09/26/14	10	10	2		

QC ID	Analyte	% Rec	RPD	LCL	UCL	RPD Max	Result	QC Source	Source Conc	Spk Value	Surr?	Batch	Sampled	Prepared	Analyzed	MDL	MRL	DF	
Duplicate - Method SM 2710 F																			
B409798-DUP1 -	Density		0.034			10	1.158	1410519-11	1.159			B409798	09/26/14	09/26/14	09/26/14	0.00		1	
B409798-DUP2 -	Density		0.054			10	1.111	1410519-25	1.110			B409798	09/26/14	09/26/14	09/26/14	0.00		1	

Appendix H. Standard Operating Procedure for Specific Gravity Determinations Using a Hydrometer

Hydrometer method for estimating brine specific gravity

The instructions here are for a specific gravity (SG) hydrometer (ASTM 2008).

Equipment required:

- Measuring cylinder
- hydrometer
- thermometer
- temperature correction equations
- data sheet (Figure H-1, provided at the end of this document)

To determine brine specific gravity:

- Fill a measuring cylinder with brine sample to the point of overflowing.
- Insert thermometer in brine sample.
- Read and record temperature of sample.
- Float a hydrometer in brine sample.
- Read and record SG from scale located on the hydrometer's shaft.
- Add or subtract specific gravity units according to the temperature of the sample (see *Temperature Correction* below).
- Record corrected SG on data sheet.

Things to keep in mind:

- If the hydrometer either sinks to the bottom or floats too high for a reading to be made, you are using an incorrect hydrometer. Select one with a differing range.
- All hydrometer readings must be corrected from the sample's temperature to the temperature the hydrometer was designed for. Most hydrometers are calibrated at 15.6 °C (60 °F). Some hydrometers calibrated at 20 °C. The calibration temperature is noted on the shaft of the hydrometer. Check any hydrometer prior to use!
- Always record the uncorrected SG and the temperature as well as the corrected SG. In the event of a miscalculation, there is no way of correcting a "corrected" value unless the raw data are available!

Temperature correction:

Temperature correction equations were extracted from ISSLR (2014), which refers to the CRC Handbook of Physics and Chemistry and to Bonython (1948).

- For brines between SG 1.000 and SG 1.100, the difference that each degree of temperature makes to the SG is not constant; however, very approximate corrections are as follows:

For every 5 °C the sample is above the hydrometer's calibrated temperature, add 0.001. For every 5 °C the sample is below the hydrometer's calibrated temperature, subtract 0.001. This is sufficiently accurate for temperatures between 0 °C and 40 °C but should not be used outside this temperature range. A more accurate formula is:

$$\text{Correction (to add on to raw hydrometer reading)} = \text{Raw SG} + (0.00000359 \times \text{temp}^2 + 0.00006971 \times \text{temp} - 0.00151687)$$

- For brines between SG 1.100 and SG 1.200, the difference that each degree of temperature makes to the SG is not constant; however, very approximate corrections are as follows:

For every 3 °C the sample is above the hydrometer's calibrated temperature, add 0.001. For every 3 °C the sample is below the hydrometer's calibrated temperature, subtract 0.001. This is sufficiently accurate for temperatures between 0 °C and 40 °C but should not be used outside this temperature range. A more accurate formula is:

$$\text{Correction (to add on to raw hydrometer reading)} = \text{Raw SG} + (0.000012 \times \text{temp}^2 + 0.000016 \times \text{temp} - 0.00288)$$

- For brines above SG 1.200, the difference that each degree of temperature makes to the SG is not constant; however, very approximate corrections are as follows:

For every 2 °C the sample is above the hydrometer's calibrated temperature, add 0.001. For every 2 °C the sample is below the hydrometer's calibrated temperature, subtract 0.001. This is sufficiently accurate for temperatures between 0 °C and 40 °C but should not be used outside this temperature range. A more accurate formula is:

$$\text{Correction (to add on to raw hydrometer reading)} = \text{Raw SG} + (0.000009 \times \text{temp}^2 + 0.000235 \times \text{temp} - 0.005475)$$

References:

ASTM International

2008 Standard Test Methods for Specific Gravity of Water and Brine. Designation D 1429 – 08.

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1948 *O/143*, Technical Report for Imperial Chemical Industries Australia. Osborne, South Australia.

[ISSLR] International Society of Salt Lake Research

2014 Methods Manual for Salt Lake Studies: A manual of proposed standard methods for studies in brackish to hypersaline aquatic environments. Available from WikiBooks. en.wikibooks.org/wiki/Methods_Manual_for_Salt_Lake_Studies/Salinity_measuring_brine_density. Accessed October 2, 2014.

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