Technical Report

Title: ***Drilling Fluid Management and Testing in DGR-5 and DGR-6***

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Authors: **Karen Raven and Sean Sterling**

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DGR Site Characterization Document
Geofirma Engineering Project 08-200

Geofirma Engineering Ltd

Geofirma Engineering DGR Site Characterization Document		
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1 Introduction

Geofirma Engineering Ltd. (formerly Intera Engineering Ltd.) has been contracted by the Nuclear Waste Management Organization (NWMO) on behalf of Ontario Power Generation to implement the Geoscientific Site Characterization Plan (GSCP) for the Bruce nuclear site located near Tiverton, Ontario. The purpose of this site characterization work is to assess the suitability of the Bruce nuclear site for the construction of a Deep Geologic Repository (DGR) to store low-level and intermediate-level radioactive waste. The GSCP is described by Intera Engineering Ltd. (2006, 2008a).

This report summarizes the preparation, handling, tracing, sampling and disposal of drilling fluid at two deep bedrock boreholes (DGR-5 and DGR-6) conducted as part of Phase 2B of the GSCP. Work described in this Technical Report (TR) was completed in accordance with Test Plan TP-08-21 – DGR-5 and DGR-6 Drilling Fluid Management (Intera Engineering Ltd., 2009a), which was prepared following the general requirements of the DGR Project Quality Plan (Intera Engineering Ltd., 2010a).

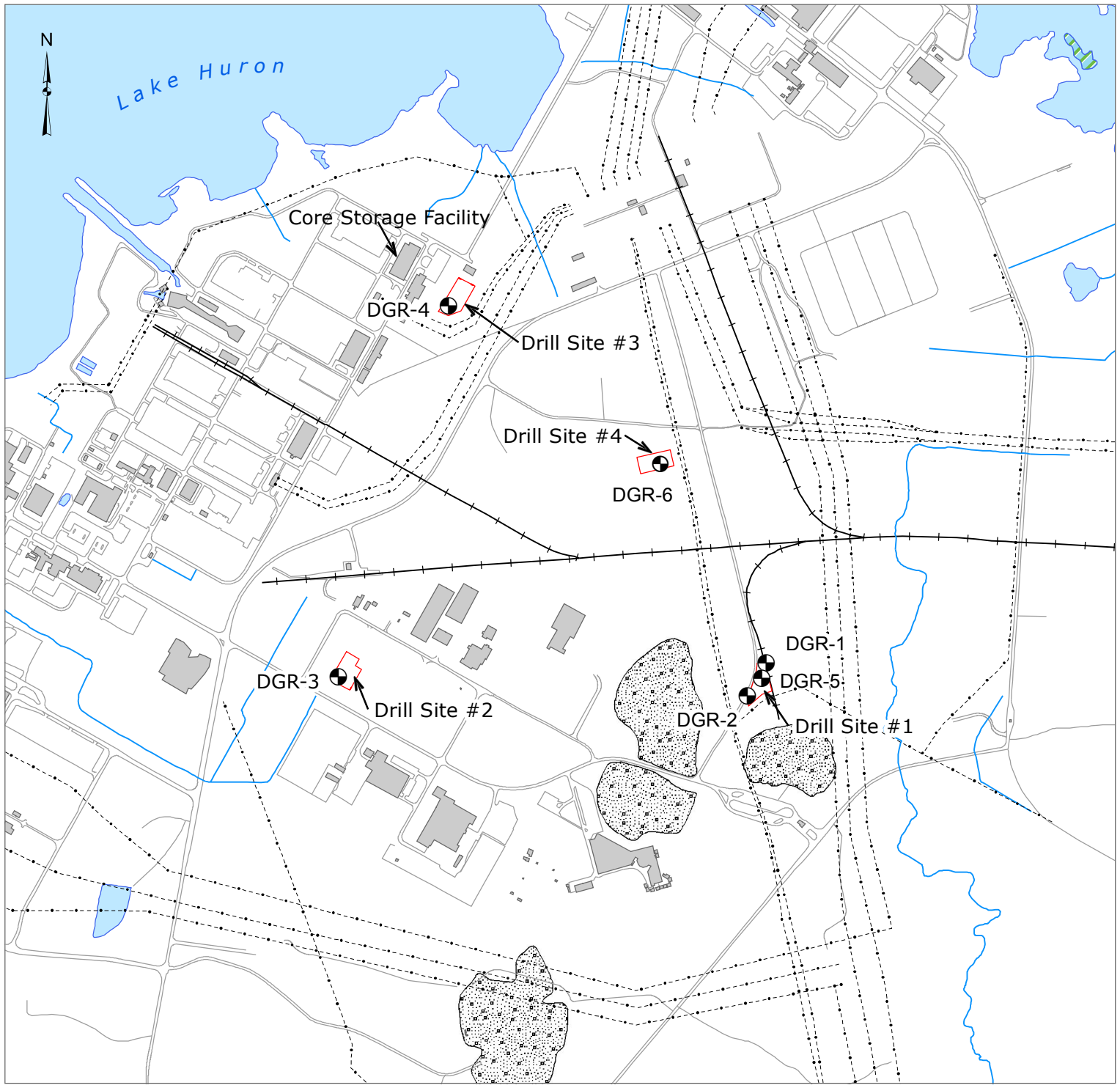
2 Background

The GSCP is composed of two phases of borehole drilling and investigations. Phase 1 included the drilling and testing of two deep boreholes, DGR-1 and DGR-2, to total depths of 462.9 and 862.3 metres below ground surface (mBGS) respectively, and the drilling and testing of one shallow borehole, US-8, to a total depth of 200 mBGS. Both of the Phase 1 DGR boreholes were drilled at one location (Drill Site #1, see Figure 1), approximately 40 metres apart from each other. The shallow borehole (US-8) was drilled at a second location (Drill Site #2); both drill sites are at the Bruce site as shown on Figure 1. Phase 1 drilling and testing was completed between December 2006 and December 2007.

Phase 2 of the GSCP included the drilling and testing of four additional deep boreholes and was divided into two smaller phases, Phase 2A and 2B. Phase 2A included the drilling and testing of two deep vertical boreholes, DGR-3 and DGR-4, to total depths of 869.2 and 857.0 mBGS respectively. DGR-3 was drilled at Drill Site #2 and DGR-4 was drilled approximately 1050 metres to the north at Drill Site #3; both drill sites are at the Bruce site as shown on Figure 1. Phase 2A drilling and testing was completed between April and October 2008.

Geofirma Engineering Ltd. recently completed Phase 2B investigations which included the drilling and testing of two deep inclined boreholes, DGR-5 and DGR-6, drilled at an inclination of approximately 65 and 60 degrees from the horizontal, respectively. DGR-5 was drilled to a total depth of 807.2 metres of length below ground surface (mLBGS) and DGR-6 was drilled to a total depth of 903.2 mLBGS. DGR-5 was drilled at Drill Site #1 and DGR-6 was drilled approximately 630 metres to the northwest at Drill Site #4; both drill sites are at the Bruce site as shown on Figure 1. Phase 2B drilling and testing was completed between December 2008 and February 2010. TR-09-01 - Drilling, Logging and Sampling of DGR-5 and DGR-6 (Geofirma Engineering Ltd., 2011) summarizes the Phase 2B drilling and core logging activities.

Davidson Drilling Ltd. (Davidson), based in Wingham Ontario, was originally contracted by Geofirma Engineering Ltd. to complete the borehole drilling and permanent casing installation for Phase 2B work. Davidson also completed the Phase 1 and Phase 2A borehole drilling and casing installation of DGR-1, DGR-2, DGR-3 and DGR-4. During the drilling program of DGR-5 and DGR-6, Davidson had difficulty maintaining the required borehole orientation (azimuth and inclination) and as a result, the objectives of borehole DGR-6 would not be met without directional drilling correction. Therefore, Geofirma contracted with Layne Christensen Canada Ltd. (Layne), based in Capreol, Ontario, in conjunction with International Directional Services (IDS), also based in Capreol, Ontario, to complete DGR-6 below a depth of 516.33 mLBGS at the top of the Queenston Formation. Layne used conventional mineral exploration drilling equipment with the assistance of directional coring equipment (IDS) as necessary.



LEGEND

- DGR Boreholes
- Transmission Line
- Roads
- Stream or Drainage
- Railways
- Drill Sites
- Buildings
- Waterbody
- Wetland Area, Permanent
- Pits or Landfills

Figure 1
DGR-1 through DGR-6
Site Location

Scale 1:15,000

0 100 200 400 600 800
Meters

PROJECTION: UTM NAD 83 Zone 17N
SOURCE: NRVIS/OBM, MNR, OPG, NWMO

PROJECT No. 08-200 TR-09-02

PROJECT NWMO DGR
Site Characterization Project

DESIGN: GDB
CAD/GIS: NMP
CHECK: GDB
REV: 0

DATE: 30/03/2011

Geofirma Engineering Ltd

P:\QMS_DGR\TR_WorkingFiles\TR-09-02 Drilling Fluid Management and Testing in DGR-5 and DGR-6\Figures\TR-09-02_Figure1_SiteLocationDGR1-6_R0.mxd

During these drilling activities, different drilling fluids were prepared to optimize success of the drilling program including removing fines from the borehole, minimization of borehole deterioration and control of downhole formation pressures and flow. All drilling fluids were traced using a naturally-present tracer (tritium) and an added tracer (Na Fluorescein) to allow future quantification of drilling fluid contamination levels in any groundwater or porewater sample collected from the boreholes during and following completion of drilling.

3 Methodology

3.1 Proposed Drilling Fluids

Proposed major ion chemistry of drilling fluids for drilling of DGR-5 and DGR-6 were specified by Geofirma Engineering Ltd. based on: [1] the groundwater and porewater chemistry measured during Phase 1 and Phase 2A drilling and testing of DGR-1, DGR-2, DGR-3 and DGR-4 (Intera Engineering Ltd, 2010b; 2010c; 2010d: 2010e; 2009b), [2] previous groundwater sampling results from the same geological formations both from on-site (Lee et al., 1995) and off-site (McNutt et al., 1987) work, and [3] practical experience gained from Phase 1 drilling of DGR-1 and DGR-2 and Phase 2A drilling of DGR-3 and DGR-4.

MiSwaco of Calgary, Alberta initially prepared drilling fluid formulations on behalf of Davidson to address hole cleaning, fluid loss reduction and corrosion inhibition requirements of the drilling fluids during Phase 1 drilling (Intera Engineering Ltd., 2007). The proposed drilling fluid formulations for Phase 2B drilling activities were similar to Phase 1 and Phase 2A with the following modifications:

- Rotary drilling through overburden and the upper 15-25 m of bedrock for the purpose of conductor and surface casing installations used air-rotary drilling methods, instead of the mud-based drilling fluid used in Phase 2A and the addition of a series of polymers that were used in Phase 1.
- Rotary drilling of the upper 200 m of bedrock (i.e. above the Salina Formation F-Unit shale) used treated Lake Huron water, without any additives, as a drilling fluid. In the event that fresh water was not sufficient to remove the drilling cuttings and fines from the borehole, a fresh water-based drilling fluid created by adding a series of polymers, similar to the formulation that were used in Phase 1 and Phase 2A, was used. As such, the formulation of drilling fluids used during Phase 1 and Phase 2A (Intera Engineering Ltd., 2007; 2008b) remained as a backup recipe in the event that the drilling program required additional additives.
- Target brine concentrations were reduced by about 50% to yield a brine total dissolved solids (TDS) of about 135 g/L and the need for corrosion inhibitors (i.e., Conqor 404) was eliminated.
- Layne used conventional mineral exploration rotary drilling equipment with diamond impregnated bits and high rotations per minute (~900 rpm) drill string settings and therefore required the use of flocculant to assist with cleaning fines from the borehole. By comparison, Davidson used poly-diamond crystal (PDC) cutter bits that turned at a lower rpm (~80 rpm) and produced coarser cuttings and therefore did not require the use of flocculant to assist with their drilling operations. MagnaFloc 338 is a non-toxic high molecular weight anionic, water-soluble flocculant drilling fluid additive that was used by Layne to increase removal of fine drill cuttings. Experience while drilling with flocculants at DGR-1 showed that some loss of Na Fluorescein to this flocculant was noted during drilling and therefore flocculant was only used sparingly when deemed necessary to prevent equipment problems while drilling and reaming of DGR-6.

Two different drilling fluids were used to complete the drilling program. One drilling fluid, prepared using fresh water, was used for shallow rotary drilling (above Salina Formation F-Unit shale approximately 210 mLBGS) in DGR-5 and DGR-6). A second drilling fluid, prepared using brine, was used for deeper coring and reaming (greater than approximately 210 mLBGS) in DGR-5 and DGR-6 to protect against dissolution and wash-out of Silurian bedrock containing gypsum, anhydrite and halite zones and to protect against weathering/deterioration of the Ordovician shale formations (Queenston, Georgian Bay and Blue Mountain). In all cases the starting

source of the drill water was Lake Huron water treated at the Bruce site water treatment plant.

Brine-based drilling fluids were prepared by addition of NaCl and $CaCl_2$ salts to fresh lake water. The proposed deep drilling fluid was a Na:Ca:Cl brine with maximum target concentrations of about 35:16:84 g/L, respectively, for a maximum target total dissolved solids content of about 135 g/L. The maximum density of this brine-based drilling fluid (~1100 kg/m^3) also provided protection against possible artesian flows and minor gas flow zones during drilling.

3.2 Drilling Fluid Preparation and Monitoring

All drilling fluids were prepared using treated Lake Huron water which was obtained from Building B-19 (Spent Solvent Treatment Facility) or Building B-25 (Heavy Water Plant Operations Building B). Water was obtained from a service outlet on the southeast side of B-19 that is normally used for filling water tankers or from a hose bibb located in the unloading area of the Core Storage Facility at B-25.

Treated Lake Huron water was trucked from Building B-19 by the drilling contractors and pumped into a multi-tank drill fluid preparation and cleaning system. Drilling fluid tanks were provided by the drilling contractors. The total number and size of tanks depended on the section of borehole being drilled (i.e., shallow bedrock drilling for surface casing installation had a much simplified drill fluid preparation and cleaning system). Geofirma added the necessary amounts of Na Fluorescein tracer to the drilling fluid tank to achieve a target tracer concentration of 1 mg/L. Drilling fluids were prepared in tanks, by addition of the necessary drilling fluid additives to traced Lake Huron water, by the drilling contractors.

Once coring started, the physical properties of the drilling fluids were monitored for fluid density and funnel viscosity on a once per drilling shift basis (i.e., once every 12 hours), or more frequently if necessary, by Davidson. During Layne drilling operations (below 516.33 mLBGS in DGR-6) Geofirma field staff monitored drilling fluid density every two to three days, or more frequently if necessary, however funnel viscosity was not measured during these drilling activities. Maintenance of the drilling fluids was the responsibility of the drilling contractor. Fluid density was monitored by Davidson using a bulb hydrometer (measured in grams per cubic centimetre, g/cc) and by Geofirma using a graduated cylinder to measure volume and a field scale to measure mass. Funnel viscosity was monitored by Davidson using a field wellhead Marsh funnel viscosity meter (measured in seconds that it takes 1 litre of drilling fluid to pass through the funnel). Additions of drilling fluid additives to maintain drilling fluid density and viscosity were the responsibility of the drilling contractors.

Geofirma retained responsibility for maintenance of Na Fluorescein drill water tracer levels.

Records of the above drilling fluid preparation and physical property measurements were retained in Scientific Notebooks (ID: SN-08-21).

3.3 Drilling Fluid Storage, Reuse and Disposal

Prepared drilling fluids (both freshwater and brine based) were stored in on-site drilling fluid storage tanks.

All drilling fluids and solids identified for disposal were disposed of in accordance with provincial regulations, including Ontario Regulation 347 (Waste Management) as well as O. Reg. 245/97 (Exploration, Drilling and Production).

3.4 Tracer Preparation

Na Fluorescein stock solutions were prepared at concentrations of 10 g/L using treated Lake Huron water with appropriate drilling fluid additives for both the fresh water and brine-based drilling fluids. Na Fluorescein stock

solutions were used for dosing the drill water tanks to achieve the target drill fluid concentration of 1 mg/L and for preparing Na Fluorescein drilling water standards.

Na Fluorescein drilling water standards were prepared at concentrations bracketing the target drill fluid concentration of 1 mg/L. Standards were prepared from Na Fluorescein stock solutions containing appropriate drilling fluid additives for either the fresh water or brine-based drilling fluids, as required. Na Fluorescein standards were prepared at concentrations of 10, 100, 500, 1000 and 1500 µg/L. The standards were then diluted 1:10 prior to calibration of the fluorometer.

These standards were identified as NaFl-mmmm.m, where NaFl is Na Fluorescein and mmmm.m is the concentration in µg/L. In addition to a name, drill water standards had the following information on the label:

1. the date of preparation;
2. the name of the person who created it;
3. the Scientific Notebook name and page number showing the record of the standard preparation; and
4. the requirement to store standard in a dark place out of direct light.

Na Fluorescein standards were stored in the field lab refrigerator, at approximately 4°C.

Records of the above tracer preparation were retained by Geofirma in Scientific Notebooks (ID: SN-08-21).

3.5 Sample Collection

Sampling and routine testing of drilling fluids was conducted on a regular basis throughout the drilling of DGR-5 and DGR-6, as specified in Table 1. Samples were collected for field and lab determination of drill water tracer concentrations and for characterization of general drill water major ion, metals and environmental isotope contents. Sample collection was based on Table 2 of TP-08-21. Na Fluorescein and electrical conductivity were regularly measured (two times per 12 hr shift = four times per day) in the field from drill water samples to both ensure maintenance of drill water tracer levels and for detection of production of formation fluids that may trigger opportunistic groundwater sampling. Drill water samples for tritium analyses were regularly collected at a frequency of once per 10 m of coring advancement within the Devonian and upper Silurian bedrock formation (i.e. above approximately 210 mLBGS) and at a frequency of once per 25 m of coring advancement below this depth. Tritium samples were then selected for analysis (35 for DGR-5, 30 for DGR-6) based on depth and site activities.

Samples were collected from the drill water tank (DWT) to quantify drill water concentrations entering the borehole during drilling.

Table 1 summarizes the total number of samples collected and analysed for different GSCP analytical parameter groups.

Samples collected for Na Fluorescein analyses were collected as well-mixed grab samples in 125 mL high density polyethylene (HDPE) containers that were protected from heat and light and stored in refrigerators. Although the drill water return was mechanically cleaned by passage through a shale shaker and silt/sand separation unit, some suspended particulate was present in water returned to the drill water return tank(s). The collected samples for Na Fluorescein analyses were allowed to settle for a reasonable period of time (i.e. up to 3 or 4 hours) to remove suspended fine particulate.

Table 1 Summary of Analyses of Drilling Fluids – DGR-5 and DGR-6			
GSCP Group and Analytes	***Total No. of Samples Collected***	***Total No. of Samples Analysed***	***Distribution of Analysed Samples***
Group E (Drill Water Tracers [Na Fluorescein and Conductivity])	407	396	152 for DGR-5; 255 for DGR-6
Group E (Drill Water Tracers [Tritium])	88	65	35 for DGR-5; 30 for DGR-6
Group A (Master Variables and Major Ions, including field pH, Conductivity and Temperature)	17	17	8 for DGR-5; 9 for DGR-6
Group B (Trace Elements and Environmental Isotopes [^{18}O, ^{2}H])	17	17	8 for DGR-5; 9 for DGR-6

Although TP-08-21 called for dilution to yield a 10:1 diluted, 20 mL sample for Na Fluorescein determination only if the sample did not clear, a 20 mL sample was created for ease of sample handling and filtration for all samples. Consequently 20 mL of sample was filtered with a 0.45 µm filter using a syringe. A 2 mL sample of the settled or filtered drilling fluid was collected with a 1-5 mL pipettor and was mixed with 18 mL of deionized water, which was collected with a 2-10 mL pipettor, to generate a 20 mL water sample for analysis of Na Fluorescein content.

Samples of drilling water were collected for specific analytical tests in high density polyethylene (HDPE) bottles. Some samples were shipped to laboratories for analysis, while others were retained for later on-site tests or for archiving. Table 2 summarizes the drilling water sample container requirements for all analytical parameters that are listed in Table 1.

Drilling water tracer samples collected from the drill-water tank (DWT) were identified by DWT-XXXX-YYY where XXXX is the borehole identifier and YYY is the index number of the sample. All drill water samples required the time and date of sampling to be recorded on the sample label, as well as the name of the person who collected the sample.

Records of the above drilling fluid sample collection were retained by Geofirma in Scientific Notebooks (ID: SN-08-21) and Scientific Notebook Supplements (ID: SNS-08-21).

Samples were kept in the field lab refrigerator or in the refrigerators in the Core Storage Facility, at approximately 4°C until analysis or shipment to laboratories. Archived water samples were stored in the Core Storage Facility refrigerators.

Table 2 Summary of Container Requirements for Drilling Fluid Samples				
Analytes	***Bottle Type***	***Volume***	***Preservation***	***Headspace***
Na Fluorescein	HDPE	125 mL	Filter to 0.45 μm	Fill to bottle neck
Major Anions and General Chemistry (includes density, TDS, pH, alkalinity) [fresh]	PET	500 mL	4 to 10°C	Fill to bottle neck
NH_3 + NH_4 [fresh]	Glass	60 mL	Acidify to pH <2 with sulphuric acid 4 to 10°C	Fill to bottle neck
Major Anions and General Chemistry (includes density, TDS, pH, alkalinity, NH_3 + NH_4) [brine]	PET	500 mL	4 to 10°C	Fill to bottle neck
Major Cations and Trace Elements [fresh]	HDPE	250 mL	Filter to 0.45 μm Acidify to pH <2 with nitric acid 4 to 10°C	Fill to bottle neck
Major Cations and Trace Elements [brine]	PET	500 mL	4 to 10°C	Fill to bottle neck
^{18}O and ^{2}H in water	HDPE	30 mL	None required	No
Tritium [direct counting method]	HDPE	250 mL	None required	No
Archive	HDPE	1 L	4 to 10°C	No

3.6 Sample Analysis

Na Fluorescein concentrations were measured in the field laboratory trailer using a Turner Designs Trilogy Model 7200-000 fluorometer following the procedures outlined in FA-08-02. The fluorometer was calibrated once per batch of Na Fluorescein tracer stock solution mixed using prepared Na Fluorescein standards. The Na Fluorescein standards were prepared using freshwater and brine-based drilling fluids. The calibration was checked using manufacturer-prepared solid state standards each time the fluorometer was used to measure drilling fluid tracer concentrations. Both standards and collected samples were diluted 1:10 to optimize tracer measurement within the fluorometer linearity range.

Na Fluorescein tracer concentrations were measured with a linearity of $0.99R^2$ and a lower detection limit that was not more the 1% of drill water tracer concentrations. Both of these tolerance levels were met by the Turner fluorometer assuming a drill water source concentration of 1 mg/L and 10:1 dilution on prepared drill water samples and standards (note maximum linear range for Na Fluorescein detection with the Trilogy Model 7200-000 fluorometer is about 150 µg/L).

Records of the above Na Fluorescein analyses and fluorometer calibrations were retained in Scientific Notebooks (ID: SN-08-21) and Scientific Notebook Supplements (ID: SNS-08-21).

Field measurements of drilling water quality were completed using a digital voltmeter (Orion 5-star benchtop multi-meter) and appropriate electrodes for pH (Orion Ross Sure-Flow combination electrode), Eh (Orion combination platinum electrode, Ag/AgCl reference electrode), dissolved oxygen (Orion dissolved oxygen probe), temperature (Orion automatic temperature compensation probe) and electrical conductivity (Orion 4-

electrode conductivity cell) measurements.

Electrical conductivity analysis was performed following the methods outlined in FA-08-03. Field measurements for pH, Eh and dissolved oxygen were carried out according to the methods outlined in FA-08-04, FA-08-06 and FA-08-05 respectively.

Records of the above field measured parameters and digital voltmeter calibrations were retained in Scientific Notebooks (ID: SN-08-21) and Scientific Notebook Supplements (ID: SNS-08-21).

Tritium analyses were completed by the Environmental Isotope Laboratory, University of Waterloo in Waterloo, Ontario. General Chemistry, Major Anions, Major Cations and Trace Elements analyses were completed by SGS Lakefield Research Limited in Lakefield, Ontario. ^{18}O and ^{2}H analyses were completed by the GG Hatch Isotope Laboratory, University of Ottawa in Ottawa, Ontario. Note that the Horita et al. (1993) correction for elevated solution salinity was not applied to the ^{18}O and ^{2}H results for samples collected from brine-based drilling fluids. Methods of laboratory analysis are described in TP-07-08 and TP-08-13 (Intera Engineering Ltd., 2008c; 2008d).

4 Results and Conclusions

4.1 Field Physical Property Measurements

Tabular results of the physical property measurements of the drilling fluids, including fluid density and funnel viscosity, for DGR-5 and DGR-6 are provided as Tables A.1 and A.2, respectively, in Appendix A. Graphical results of the physical property measurements of the drilling fluids, including plots of fluid density and funnel viscosity versus drilling depth, for DGR-5 and DGR-6 are provided as Figures C.1 and C.4, respectively, in Appendix C.

Field measurements of drilling fluid density for both DGR-5 and DGR-6 ranged from 1,000 to 1,135 kg/m^3. For DGR-5, density measurements of the fresh water drilling fluid were not collected. The density of the brine drilling fluid in DGR-5 ranged from 1,000 to 1,115 kg/m^3 with an average value of 1,098 kg/m^3. For DGR-6, the density of the fresh water drilling fluid ranged from 1,000 to 1,060 kg/m^3 with an average value of 1,007 kg/m^3. The density of the deeper brine drilling fluid in DGR-6 ranged from 1,000 to 1,135 kg/m^3 with an average value of 1,096 kg/m^3.

The funnel viscosity in DGR-5 was constant at 29 sec/qt. For DGR-6, the funnel viscosity of the fresh water drilling fluid ranged from 29 to 41 sec/qt with an average value of 36 sec/qt. The funnel viscosity of the deeper brine drilling fluid in DGR-6 ranged from 29 to 41 sec/qt with an average value of 29 sec/qt. The funnel viscosity of fresh water at 20°C is 26 sec/qt or 0.001 Pascal-seconds.

4.2 Field Chemical Property Measurements

Tabular results of the field chemical property measurements of the drilling fluids, including Na Fluorescein and electrical conductivity, for DGR-5 and DGR-6 are provided as Tables B.1 and B.4, respectively, in Appendix B. Graphical results of the field measurements of the drilling fluids, including plots of Na Fluorescein and electrical conductivity versus depth, for DGR-5 and DGR-6 are provided as Figures C.2 and C.3 and Figures C.5 and C.6, respectively, in Appendix C.

Na Fluorescein concentrations in DGR-5 ranged from 263.9 to 1609.2 µg/L, with an average concentration of 838.6 µg/L. Na Fluorescein concentrations in DGR-6 ranged from 2.9 to 13776.3 µg/L, with an average concentration of 994.0 µg/L.

Electrical conductivity measurements in the shallow (less than approximately 207 mLBGS) section of DGR-5 ranged from 212.8 to 2071 µS/cm, with an average concentration of 569.7 µS/cm. Electrical conductivity measurements in the deeper (greater than approximately 207 mLBGS) section of DGR-5 ranged from 19.2 to 207.3 mS/cm, with an average concentration of 184.2 mS/cm. Electrical conductivity measurements in the shallow (less than approximately 215 mLBGS) section of DGR-6 ranged from 220.0 to 2582 µS/cm, with an average concentration of 863.9 µS/cm. Electrical conductivity measurements in the deeper (greater than approximately 215 mLBGS) section of DGR-6 ranged from 2050 µS/cm to 239.3 mS/cm, with an average concentration of 188.2 mS/cm.

4.3 Laboratory Analyses

Tabular results of the laboratory analyses of the drilling fluids, including tritium and other environmental isotopes, major anions and cations, trace elements and general chemistry parameters, for DGR-5 and DGR-6 are provided as Tables B.2 and B.5, respectively, in Appendix B. Graphical results of the laboratory analyses of the drilling fluids, including plots of tritium versus depth, for DGR-5 and DGR-6 are provided as Figures C.3 and C.5, respectively, in Appendix C. Tabular results of the tritium analysis for DGR-5 and DGR-6 are provided as Tables B.3 and B.6, respectively, in Appendix B.

Some of the reported drilling fluid densities for fresh water determined from laboratory testing shown in Tables B.2 and B.2 are less than the field measurements of 1000 kg/m^3 given in Tables A.1 and A.2. These minor differences are due to analytical uncertainty in the laboratory analyses which are determined gravimetrically from smaller samples volumes submitted to the lab.

Tritium concentrations in DGR-5 ranged from 61.7 to 948.9 TU, with an average concentration of 585.8 TU. Tritium concentrations in DGR-6 ranged from 84.1 to 1723.0 TU, with an average concentration of 687.0 TU.

5 Data Quality and Use

The data presented in this Technical Report describe the physical and chemical properties of drilling fluids used to complete boreholes DGR-5 and DGR-6. The physical data, in particular the fluid density data, are suitable for estimation of downhole formation pressures during drilling and in reconstruction of borehole pressure histories to aid in analysis and interpretation of borehole straddle-packer hydraulic tests. The chemical data are suitable for estimation of drilling fluid contamination in subsequent groundwater and potentially in porewater samples collected for laboratory analyses and chemical/isotopic characterization.

There are no identifiable limitations on the use of the data presented in this Technical Report.

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APPENDIX A

Summary of Field Physical Property Measurements of DGR-5 and DGR-6 Drilling Fluids

Table A.1 – Summary of Field Physical Property Measurements of DGR-5 Drilling Fluids

Table A.2 – Summary of Field Physical Property Measurements for DGR-6 Drilling Fluids

Table A.1 - Summary of Field Physical Property Measurements of DGR-5 Drilling Fluids

Date	Depth (mLBGS)	Density (kg/m^3)	Funnel Viscosity (sec/qt)
2-Sep-09	207.92	1,000	29
2-Sep-09	207.92	1,000	29
2-Sep-09	207.92	1,000	29
8-Sep-09	207.92	1,040	--
8-Sep-09	207.92	1,060	--
9-Sep-09	210.58	1,080	--
9-Sep-09	213.63	1,090	--
9-Sep-09	219.73	1,095	29
9-Sep-09	219.73	1,100	29
9-Sep-09	219.73	--	29
9-Sep-09	222.78	1,100	29
10-Sep-09	228.88	1,100	29
10-Sep-09	231.93	1,100	29
10-Sep-09	234.98	1,100	29
10-Sep-09	238.03	1,100	29
10-Sep-09	244.13	1,100	29
10-Sep-09	247.18	1,100	29
11-Sep-09	253.28	1,100	29
11-Sep-09	259.38	1,100	29
11-Sep-09	268.53	1,100	29
12-Sep-09	268.53	1,100	29
12-Sep-09	271.58	1,100	29
12-Sep-09	275.56	1,100	29
12-Sep-09	287.76	1,100	29
12-Sep-09	290.81	1,100	29
13-Sep-09	293.86	1,100	29
13-Sep-09	303.01	1,100	29
13-Sep-09	306.06	1,100	29
13-Sep-09	315.21	1,100	29
13-Sep-09	315.21	1,100	29
13-Sep-09	315.21	1,100	29
14-Sep-09	318.26	1,100	29
14-Sep-09	321.31	1,100	29
14-Sep-09	324.36	1,100	29
14-Sep-09	327.41	1,100	29
14-Sep-09	330.46	1,100	29
14-Sep-09	330.46	1,100	29
15-Sep-09	333.51	1,100	29
15-Sep-09	339.61	1,100	29
15-Sep-09	339.61	1,100	29
15-Sep-09	342.66	1,100	29
15-Sep-09	345.71	1,100	29
15-Sep-09	348.76	1,100	29
16-Sep-09	351.81	1,100	29
16-Sep-09	357.91	1,100	29
16-Sep-09	360.96	1,110	29
16-Sep-09	364.01	1,100	29
16-Sep-09	364.01	1,110	29
16-Sep-09	364.01	1,100	29
17-Sep-09	364.01	1,100	29
17-Sep-09	364.01	1,100	29
17-Sep-09	364.01	1,100	29
17-Sep-09	370.11	1,100	29
18-Sep-09	370.11	1,100	29
18-Sep-09	370.11	1,100	29
18-Sep-09	370.11	1,100	29
18-Sep-09	373.16	1,100	29
18-Sep-09	376.21	1,100	29
19-Sep-09	376.21	1,100	29
19-Sep-09	379.26	1,100	29
19-Sep-09	382.31	1,110	29
19-Sep-09	388.41	1,110	--
19-Sep-09	389.21	1,100	29
20-Sep-09	389.21	1,100	29
20-Sep-09	389.21	1,100	29
20-Sep-09	389.21	1,100	29
21-Sep-09	389.21	1,100	29
21-Sep-09	389.21	1,100	29
24-Sep-09	389.21	1,100	29
24-Sep-09	394.82	1,109	29
24-Sep-09	397.87	1,110	29
24-Sep-09	400.92	1,100	29
25-Sep-09	403.97	1,100	29
25-Sep-09	407.02	1,100	29
25-Sep-09	413.12	1,100	29
25-Sep-09	416.17	1,115	29
25-Sep-09	419.22	1,100	29
25-Sep-09	419.22	1,100	29
26-Sep-09	422.27	1,100	29
26-Sep-09	425.32	1,100	29
26-Sep-09	428.37	1,100	29
26-Sep-09	431.42	1,100	29
26-Sep-09	434.47	1,100	29
26-Sep-09	434.47	1,100	29
27-Sep-09	437.52	1,100	29
27-Sep-09	443.62	1,100	29
27-Sep-09	446.67	1,100	29
27-Sep-09	449.72	1,100	29
27-Sep-09	455.37	1,100	29
28-Sep-09	455.37	1,100	29
28-Sep-09	455.37	1,100	29
29-Sep-09	455.82	1,080	--
29-Sep-09	455.82	1,085	29
30-Sep-09	455.82	1,100	29
30-Sep-09	455.82	1,100	29
2-Oct-09	458.87	1,100	29
3-Oct-09	458.87	1,100	29
3-Oct-09	458.87	1,100	29
5-Oct-09	458.87	1,100	29
6-Oct-09	458.87	1,100	29
6-Oct-09	465.50	1,100	29
6-Oct-09	465.50	1,100	29

Table A.1 - Summary of Field Physical Property Measurements of DGR-5 Drilling Fluids

Date	Depth (mLBGS)	Density (kg/m^3)	Funnel Viscosity (sec/qt)
6-Oct-09	471.60	1,100	29
7-Oct-09	471.60	1,100	29
7-Oct-09	477.70	1,100	29
7-Oct-09	480.75	1,100	29
7-Oct-09	486.85	1,100	29
7-Oct-09	492.95	1,100	29
7-Oct-09	492.95	1,100	29
8-Oct-09	496.00	1,100	29
8-Oct-09	502.10	1,100	29
8-Oct-09	502.10	1,100	29
9-Oct-09	502.10	1,100	29
9-Oct-09	502.10	1,100	29
13-Oct-09	502.10	1,100	29
13-Oct-09	511.25	1,100	29
14-Oct-09	514.30	1,100	29
14-Oct-09	523.45	1,100	29
14-Oct-09	529.55	1,100	29
14-Oct-09	529.55	1,100	29
15-Oct-09	529.55	1,100	29
15-Oct-09	529.55	1,100	29
15-Oct-09	532.65	1,100	29
15-Oct-09	535.70	1,100	29
15-Oct-09	544.85	1,100	29
16-Oct-09	547.90	1,100	29
16-Oct-09	554.00	1,100	29
16-Oct-09	560.10	1,100	29
16-Oct-09	569.25	1,100	29
17-Oct-09	572.30	1,100	29
17-Oct-09	572.30	1,100	29
17-Oct-09	575.35	1,100	29
17-Oct-09	575.35	1,100	29
17-Oct-09	578.40	1,100	29
17-Oct-09	581.45	1,100	29
18-Oct-09	587.55	1,100	29
18-Oct-09	587.55	1,100	29
18-Oct-09	587.55	1,100	29
18-Oct-09	596.70	1,100	29
19-Oct-09	602.80	1,100	29
19-Oct-09	608.90	1,100	29
19-Oct-09	611.95	1,100	--
19-Oct-09	615.00	1,100	--
19-Oct-09	621.10	1,100	--
19-Oct-09	627.20	1,100	29
20-Oct-09	630.25	1,100	29
20-Oct-09	636.35	1,100	29
20-Oct-09	639.73	1,100	29

Date	Depth (mLBGS)	Density (kg/m^3)	Funnel Viscosity (sec/qt)
20-Oct-09	639.73	1,100	29
21-Oct-09	639.73	1,100	29
21-Oct-09	642.45	1,100	29
21-Oct-09	645.50	1,100	29
21-Oct-09	648.55	1,100	29
21-Oct-09	654.65	1,100	29
22-Oct-09	660.75	1,100	29
22-Oct-09	666.85	1,100	29
22-Oct-09	666.85	1,100	29
22-Oct-09	676.00	1,100	29
23-Oct-09	682.10	1,100	29
23-Oct-09	688.20	1,100	29
23-Oct-09	691.25	1,100	29
23-Oct-09	694.30	1,100	29
23-Oct-09	700.40	1,100	29
23-Oct-09	703.45	1,100	29
24-Oct-09	706.50	1,100	29
24-Oct-09	709.55	1,100	29
24-Oct-09	709.55	1,100	29
24-Oct-09	715.65	1,100	29
24-Oct-09	718.70	1,100	29
25-Oct-09	721.75	1,100	29
25-Oct-09	727.85	1,100	29
25-Oct-09	727.85	1,100	29
25-Oct-09	730.90	1,100	29
25-Oct-09	733.95	1,100	29
25-Oct-09	737.00	1,100	29
26-Oct-09	740.05	1,100	29
26-Oct-09	746.15	1,100	29
26-Oct-09	749.20	1,100	29
26-Oct-09	752.25	1,100	29
26-Oct-09	752.25	1,100	29
26-Oct-09	755.30	1,100	29
27-Oct-09	758.35	1,100	29
27-Oct-09	764.45	1,100	29
27-Oct-09	764.45	1,090	29
27-Oct-09	770.55	1,100	29
27-Oct-09	773.60	1,100	29
27-Oct-09	776.65	1,100	29
28-Oct-09	779.70	1,100	29
28-Oct-09	782.75	1,100	29
28-Oct-09	785.80	1,100	29
28-Oct-09	791.90	1,100	29
28-Oct-09	794.95	1,100	29
29-Oct-09	801.05	1,100	29
29-Oct-09	804.10	1,100	29

Table A.2 - Summary of Field Physical Property Measurements of DGR-6 Drilling Fluids

Date	Depth (mLBGS)	Density (kg/m^3)	Funnel Viscosity (sec/qt)
28-May-09	34.80	1,000	29
28-May-09	34.80	1,000	29
28-May-09	34.80	1,000	29
29-May-09	34.80	1,000	29
29-May-09	34.80	1,000	29
29-May-09	34.80	1,000	29
30-May-09	36.77	1,000	29
30-May-09	36.77	1,000	32
30-May-09	36.77	1,000	40
31-May-09	36.77	1,000	38
31-May-09	36.77	1,000	38
31-May-09	36.77	1,000	38
1-Jun-09	40.23	1,000	38
1-Jun-09	40.23	1,000	38
1-Jun-09	40.23	1,000	38
2-Jun-09	41.41	1,000	38
2-Jun-09	41.41	1,000	38
2-Jun-09	41.41	1,000	38
3-Jun-09	42.91	1,000	38
3-Jun-09	42.91	1,000	38
3-Jun-09	42.91	1,000	38
4-Jun-09	45.61	1,000	38
4-Jun-09	45.61	1,000	38
4-Jun-09	45.61	1,000	38
5-Jun-09	50.05	1,000	38
5-Jun-09	50.05	1,000	36
5-Jun-09	50.05	1,000	34
6-Jun-09	56.15	1,000	34
6-Jun-09	56.15	1,000	37
6-Jun-09	56.15	1,000	40
7-Jun-09	63.25	1,000	38
7-Jun-09	63.25	1,000	38
7-Jun-09	63.25	1,000	38
8-Jun-09	71.21	1,000	38
8-Jun-09	71.21	1,000	38
8-Jun-09	71.21	1,000	38
9-Jun-09	74.80	1,000	38
9-Jun-09	74.80	1,000	38
9-Jun-09	74.80	1,000	36
10-Jun-09	80.90	1,000	36
10-Jun-09	80.90	1,000	36
10-Jun-09	80.90	1,000	36
11-Jun-09	86.01	1,000	36
11-Jun-09	86.01	1,000	36
11-Jun-09	86.01	1,000	36
12-Jun-09	91.61	1,000	36
12-Jun-09	91.61	1,000	35
12-Jun-09	91.61	1,000	34
13-Jun-09	96.11	1,010	34
13-Jun-09	96.11	1,010	34
13-Jun-09	96.11	1,010	34
14-Jun-09	101.11	1,020	34
14-Jun-09	101.11	1,020	34
14-Jun-09	101.11	1,020	34
15-Jun-09	105.67	1,000	30
15-Jun-09	105.67	1,000	31
15-Jun-09	105.67	1,000	32
16-Jun-09	109.76	1,000	33
16-Jun-09	109.76	1,000	33
16-Jun-09	109.76	1,000	34
17-Jun-09	115.61	1,000	32
17-Jun-09	115.61	1,000	32
17-Jun-09	115.61	1,000	32
18-Jun-09	117.13	1,005	34
18-Jun-09	117.13	1,005	36
18-Jun-09	117.13	1,005	35
18-Jun-09	130.43	1,005	35
19-Jun-09	130.43	1,010	38
19-Jun-09	130.43	1,010	37
19-Jun-09	145.00	1,010	36
20-Jun-09	145.00	1,010	34
20-Jun-09	145.00	1,010	34
20-Jun-09	170.00	1,015	36
21-Jun-09	170.00	1,015	36
21-Jun-09	170.00	1,020	35
21-Jun-09	179.80	1,020	34
22-Jun-09	179.80	1,020	36
22-Jun-09	179.80	1,020	38
22-Jun-09	200.50	1,030	40
23-Jun-09	200.50	1,030	38
23-Jun-09	200.50	1,030	37
23-Jun-09	209.91	1,020	41
23-Jun-09	209.91	1,020	41
23-Jun-09	213.11	1,020	41
24-Jun-09	213.11	1,020	40
24-Jun-09	213.11	1,020	40
24-Jun-09	213.11	1,020	38
25-Jun-09	213.11	1,020	38
25-Jun-09	213.11	1,020	38
12-Jul-09	214.81	1,010	--
13-Jul-09	214.81	1,030	--
13-Jul-09	214.81	1,060	--
13-Jul-09	215.91	1,100	29
14-Jul-09	215.91	1,100	29
14-Jul-09	215.91	1,100	29
14-Jul-09	215.91	1,070	--
14-Jul-09	218.65	1,070	--
14-Jul-09	221.70	--	--
14-Jul-09	224.75	1,070	--
15-Jul-09	224.75	1,070	--
15-Jul-09	224.75	1,070	--
15-Jul-09	224.75	1,080	29

Table A.2 - Summary of Field Physical Property Measurements of DGR-6 Drilling Fluids

Date	Depth (mLBGS)	Density (kg/m^3)	Funnel Viscosity (sec/qt)
15-Jul-09	225.67	1,080	29
15-Jul-09	226.67	1,080	29
15-Jul-09	228.72	1,080	29
16-Jul-09	231.77	1,080	29
16-Jul-09	234.82	1,080	29
16-Jul-09	237.87	1,080	--
16-Jul-09	243.97	1,090	--
16-Jul-09	247.02	1,095	29
17-Jul-09	250.07	1,095	29
17-Jul-09	253.12	1,095	29
17-Jul-09	265.32	1,100	--
17-Jul-09	265.32	1,100	29
18-Jul-09	268.37	1,100	29
18-Jul-09	271.42	1,100	29
18-Jul-09	271.42	1,100	29
18-Jul-09	274.31	1,100	29
18-Jul-09	274.31	1,100	29
18-Jul-09	274.31	1,100	29
19-Jul-09	277.44	1,100	29
19-Jul-09	280.57	1,100	29
19-Jul-09	286.67	1,100	29
19-Jul-09	292.77	1,100	29
19-Jul-09	292.77	1,100	29
20-Jul-09	295.82	1,100	29
20-Jul-09	301.92	1,100	29
20-Jul-09	304.97	1,100	29
20-Jul-09	308.02	1,100	29
20-Jul-09	314.12	1,100	29
20-Jul-09	317.17	1,100	29
21-Jul-09	320.22	1,100	29
21-Jul-09	326.32	1,100	29
21-Jul-09	329.37	1,100	29
21-Jul-09	332.42	1,100	29
21-Jul-09	335.32	1,100	29
21-Jul-09	338.37	1,100	29
22-Jul-09	338.37	1,100	29
22-Jul-09	340.73	1,100	29
22-Jul-09	343.62	1,100	29
22-Jul-09	347.67	1,100	29
22-Jul-09	347.67	1,100	29
23-Jul-09	347.67	1,100	29
23-Jul-09	347.67	1,100	29
23-Jul-09	350.70	1,100	29
23-Jul-09	353.75	1,100	29
23-Jul-09	356.30	1,100	29
24-Jul-09	357.00	1,100	29
24-Jul-09	359.85	1,100	29
24-Jul-09	359.85	1,100	29
24-Jul-09	362.90	1,100	29
24-Jul-09	365.95	1,100	29
24-Jul-09	365.95	1,100	29

Date	Depth (mLBGS)	Density (kg/m^3)	Funnel Viscosity (sec/qt)
25-Jul-09	369.00	1,100	29
25-Jul-09	372.05	1,100	29
25-Jul-09	372.05	1,100	29
25-Jul-09	372.05	1,100	29
25-Jul-09	375.10	1,100	29
26-Jul-09	375.10	1,100	29
26-Jul-09	375.10	1,100	29
26-Jul-09	375.83	1,100	29
26-Jul-09	376.66	1,100	29
26-Jul-09	376.66	1,100	29
27-Jul-09	376.66	1,100	29
27-Jul-09	378.15	1,100	29
27-Jul-09	378.15	1,100	29
27-Jul-09	381.20	1,100	29
27-Jul-09	384.25	1,100	29
28-Jul-09	387.30	1,100	29
28-Jul-09	390.35	1,100	29
28-Jul-09	390.35	1,100	29
28-Jul-09	393.40	1,100	29
28-Jul-09	399.50	1,100	29
29-Jul-09	402.55	1,100	29
29-Jul-09	408.65	1,100	29
29-Jul-09	408.65	1,100	29
29-Jul-09	411.70	1,100	29
29-Jul-09	414.75	1,100	29
29-Jul-09	417.80	1,100	29
30-Jul-09	420.85	1,100	29
30-Jul-09	423.90	1,100	29
30-Jul-09	426.95	1,100	29
30-Jul-09	433.05	1,100	29
30-Jul-09	433.05	1,100	29
30-Jul-09	436.10	1,100	29
31-Jul-09	439.15	1,100	29
31-Jul-09	439.15	1,100	29
5-Aug-09	439.15	1,100	29
6-Aug-09	442.20	1,100	29
6-Aug-09	445.25	1,100	29
6-Aug-09	448.30	1,100	29
6-Aug-09	451.35	1,100	29
6-Aug-09	454.40	1,100	29
7-Aug-09	457.45	1,100	29
7-Aug-09	463.55	1,100	29
7-Aug-09	469.65	1,060	--
7-Aug-09	475.75	1,100	29
7-Aug-09	475.75	1,100	29
8-Aug-09	475.75	1,100	29
8-Aug-09	475.75	1,100	29
8-Aug-09	479.73	1,090	--
8-Aug-09	485.56	1,100	--
8-Aug-09	494.98	1,100	29
9-Aug-09	498.03	1,100	29

Table A.2 - Summary of Field Physical Property Measurements of DGR-6 Drilling Fluids

Date	Depth (mLBGS)	Density (kg/m^3)	Funnel Viscosity (sec/qt)
9-Aug-09	507.18	1,100	29
9-Aug-09	507.18	1,090	--
9-Aug-09	516.33	1,100	29
9-Aug-09	516.33	1,100	29
10-Aug-09	516.33	1,100	29
10-Aug-09	516.33	1,100	29
22-Nov-09	516.33	1,093	--
24-Nov-09	518.15	1,118	--
27-Nov-09	563.90	1,111	--
30-Nov-09	604.96	1,123	--

Date	Depth (mLBGS)	Density (kg/m^3)	Funnel Viscosity (sec/qt)
4-Dec-09	518.70	1112	--
5-Dec-09	551.75	1,110	--
7-Dec-09	578.75	1,109	--
6-Jan-10	642.16	1,091	--
7-Jan-10	657.16	1,102	--
8-Jan-10	669.16	1,099	--
10-Jan-10	672.16	1,101	--
11-Jan-10	690.16	1,107	--
25-Jan-10	516.33	1,135	--

APPENDIX B

Summary of Field Chemical Property Measurements and Laboratory Analyses of DGR-5 and DGR-6 Drilling Fluids

Table B.1 – Summary of Field Chemical Measurements of DGR-5 Drilling Fluids

Table B.2 – Summary of Laboratory Analyses of DGR-5 Drilling Fluids

Table B.3 – Tritium Analysis of DGR-5 Drilling Fluids

Table B.4 – Summary of Field Chemical Measurements of DGR-6 Drilling Fluids

Table B.5 – Summary of Laboratory Analyses of DGR-6 Drilling Fluids

Table B.6 – Tritium Analysis of DGR-6 Drilling Fluids

Table B.1 - Summary of Field Chemical Measurements of DGR-5 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Na Fluorescein (µg/L)	Electrical Conductivity (µS/cm)
DWT-DGR5-001	17-Dec-08	--	--	--
DWT-DGR5-002	18-Dec-08	--	--	--
DWT-DGR5-003	24-Jan-09	38.49	1027.3	1020
DWT-DGR5-004	25-Jan-09	49.51	895.7	894
DWT-DGR5-005	25-Jan-09	49.51	935.3	866
DWT-DGR5-006	26-Jan-09	56.16	889.8	788
DWT-DGR5-007	26-Jan-09	56.16	889.9	608
DWT-DGR5-008	27-Jan-09	67.81	879.3	391
DWT-DGR5-009	27-Jan-09	67.81	816.7	292.6
DWT-DGR5-010	27-Jan-09	67.81	794.2	338
DWT-DGR5-011	28-Jan-09	78.64	977.1	299
DWT-DGR5-012	28-Jan-09	78.64	740.7	229.1
DWT-DGR5-013	29-Jan-09	86.66	896.1	226.8
DWT-DGR5-014	29-Jan-09	86.66	781.0	239.1
DWT-DGR5-015	30-Jan-09	99.16	606.3	256.5
DWT-DGR5-016	30-Jan-09	99.16	648.7	253.4
DWT-DGR5-017	31-Jan-09	103.10	601.0	284.5
DWT-DGR5-018	31-Jan-09	103.10	534.5	314.7
DWT-DGR5-019	1-Feb-09	117.81	337.7	489
DWT-DGR5-020	1-Feb-09	117.81	563.1	410
DWT-DGR5-021	2-Feb-09	128.96	544.8	377
DWT-DGR5-022	3-Feb-09	128.96	580.7	669
DWT-DGR5-023	3-Feb-09	128.96	684.1	650
DWT-DGR5-024	4-Feb-09	133.15	377.9	463
DWT-DGR5-025	4-Feb-09	133.15	1256.4	539
DWT-DGR5-026	5-Feb-09	145.35	1327.5	619
DWT-DGR5-027	5-Feb-09	145.35	1278.5	604
DWT-DGR5-028	6-Feb-09	160.66	952.4	650
DWT-DGR5-029	6-Feb-09	160.66	782.5	609
DWT-DGR5-030	7-Feb-09	172.66	709.6	565
DWT-DGR5-031	7-Feb-09	172.66	--	212.8
DWT-DGR5-032	7-Feb-09	172.66	842.2	666
DWT-DGR5-033	8-Feb-09	191.05	940.3	1337
DWT-DGR5-034	8-Feb-09	191.05	705.5	2071
DWT-DGR5-035	8-Sep-09	207.92	886.1	134300
DWT-DGR5-036	9-Sep-09	213.63	862.7	154800
DWT-DGR5-037	9-Sep-09	216.68	944.0	165300
DWT-DGR5-038	9-Sep-09	225.83	821.4	175100
DWT-DGR5-039	10-Sep-09	228.88	--	--
DWT-DGR5-040	10-Sep-09	228.88	777.3	176500
DWT-DGR5-041	10-Sep-09	234.98	1028.9	176000
DWT-DGR5-042	10-Sep-09	241.08	1216.1	173300
DWT-DGR5-043	10-Sep-09	250.23	1035.4	177700
DWT-DGR5-044	11-Sep-09	259.38	901.3	179100
DWT-DGR5-045	11-Sep-09	268.53	667.3	178100
DWT-DGR5-046	11-Sep-09	268.53	1481.1	179200

Table B.1 - Summary of Field Chemical Measurements of DGR-5 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Na Fluorescein (µg/L)	Electrical Conductivity (µS/cm)
DWT-DGR5-047	12-Sep-09	268.53	1043.7	184400
DWT-DGR5-048	12-Sep-09	275.56	986.7	184700
DWT-DGR5-049	12-Sep-09	284.71	871.6	181600
DWT-DGR5-050	13-Sep-09	299.96	804.5	184600
DWT-DGR5-051	13-Sep-09	303.01	--	--
DWT-DGR5-052	13-Sep-09	309.11	1030.1	185700
DWT-DGR5-053	13-Sep-09	315.21	863.7	184300
DWT-DGR5-054	13-Sep-09	318.26	1566.5	183300
DWT-DGR5-055	14-Sep-09	321.31	804.4	185100
DWT-DGR5-056	14-Sep-09	324.36	1064.2	183400
DWT-DGR5-057	14-Sep-09	327.41	969.8	191100
DWT-DGR5-058	14-Sep-09	333.51	778.3	183900
DWT-DGR5-059	15-Sep-09	336.56	1050.3	184500
DWT-DGR5-060	15-Sep-09	345.71	713.7	189700
DWT-DGR5-061	15-Sep-09	351.81	1098.7	190000
DWT-DGR5-062	16-Sep-09	357.91	1029.6	190500
DWT-DGR5-063	16-Sep-09	360.96	876.4	196700
DWT-DGR5-064	16-Sep-09	364.01	808.4	201000
DWT-DGR5-065	17-Sep-09	364.01	543.9	193600
DWT-DGR5-066	17-Sep-09	370.11	622.3	191000
DWT-DGR5-067	18-Sep-09	370.11	820.9	190300
DWT-DGR5-068	18-Sep-09	373.16	455.9	186000
DWT-DGR5-068	19-Sep-09	376.21	910.1	193300
DWT-DGR5-069	19-Sep-09	385.36	438.7	202200
DWT-DGR5-070	19-Sep-09	389.21	575.1	200200
DWT-DGR5-071	24-Sep-09	391.77	376.3	176400
DWT-DGR5-072	24-Sep-09	397.87	319.0	181200
DWT-DGR5-073	24-Sep-09	400.92	1072.4	184100
DWT-DGR5-074	25-Sep-09	403.97	942.3	185300
DWT-DGR5-075	25-Sep-09	416.17	931.3	179800
DWT-DGR5-076	25-Sep-09	416.17	616.4	180000
DWT-DGR5-077	25-Sep-09	422.27	742.4	185200
DWT-DGR5-078	26-Sep-09	425.32	1441.7	184400
DWT-DGR5-079	26-Sep-09	431.42	1350.0	183100
DWT-DGR5-080	26-Sep-09	434.47	998.3	184500
DWT-DGR5-081	26-Sep-09	437.52	775.6	186500
DWT-DGR5-082	27-Sep-09	440.57	1609.2	186400
DWT-DGR5-083	27-Sep-09	446.67	1581.9	158900
DWT-DGR5-084	27-Sep-09	449.72	1214.0	187000
DWT-DGR5-085	30-Sep-09	455.82	592.5	189100
DWT-DGR5-086	30-Sep-09	458.87	819.7	185900
DWT-DGR5-087	5-Oct-09	458.87	299.7	170000
DWT-DGR5-088	5-Oct-09	458.87	427.0	181400
DWT-DGR5-089	6-Oct-09	468.55	281.8	185800
DWT-DGR5-090	6-Oct-09	468.55	294.1	182900
DWT-DGR5-091	6-Oct-09	417.60	594.5	180600

Table B.1 - Summary of Field Chemical Measurements of DGR-5 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Na Fluorescein (µg/L)	Electrical Conductivity (µS/cm)
DWT-DGR5-092	7-Oct-09	477.70	1069.4	19200
DWT-DGR5-093	7-Oct-09	480.75	1000.2	179700
DWT-DGR5-094	7-Oct-09	489.90	1004.5	179300
DWT-DGR5-095	8-Oct-09	502.10	1291.0	183000
DWT-DGR5-096	13-Oct-09	502.10	364.0	179700
DWT-DGR5-097	13-Oct-09	508.25	1265.8	--
DWT-DGR5-098	13-Oct-09	514.30	1200.7	179100
DWT-DGR5-099	14-Oct-09	523.45	1091.2	181500
DWT-DGR5-100	14-Oct-09	529.55	1155.2	183000
DWT-DGR5-101	14-Oct-09	529.55	1083.5	180100
DWT-DGR5-102	15-Oct-09	529.55	485.3	184080
DWT-DGR5-103	15-Oct-09	532.65	504.6	180500
DWT-DGR5-104	15-Oct-09	541.80	1261.8	176300
DWT-DGR5-105	15-Oct-09	544.85	497.4	184100
DWT-DGR5-106	16-Oct-09	554.00	1407.5	186100
DWT-DGR5-107	16-Oct-09	560.10	1447.5	--
DWT-DGR5-108	16-Oct-09	566.20	1216.7	--
DWT-DGR5-109	17-Oct-09	575.35	1248.0	174800
DWT-DGR5-110	17-Oct-09	575.35	1003.0	184600
DWT-DGR5-111	17-Oct-09	587.55	493.1	186200
DWT-DGR5-112	18-Oct-09	593.65	1045.3	200500
DWT-DGR5-113	18-Oct-09	602.80	591.8	191200
DWT-DGR5-114	19-Oct-09	608.85	1067.6	188000
DWT-DGR5-115	19-Oct-09	611.95	938.6	181600
DWT-DGR5-116	19-Oct-09	624.15	775.7	184700
DWT-DGR5-117	19-Oct-09	630.25	537.1	187400
DWT-DGR5-118	20-Oct-09	636.35	864.0	188900
DWT-DGR5-119	20-Oct-09	636.35	905.6	187000
DWT-DGR5-120	21-Oct-09	648.55	1038.6	183600
DWT-DGR5-121	21-Oct-09	654.65	390.8	187500
DWT-DGR5-122	21-Oct-09	657.70	939.2	188600
DWT-DGR5-123	22-Oct-09	663.80	646.8	189900
DWT-DGR5-124	22-Oct-09	672.95	669.6	200200
DWT-DGR5-125	22-Oct-09	676.00	415.5	196300
DWT-DGR5-126	23-Oct-09	688.20	754.1	196800
DWT-DGR5-127	23-Oct-09	694.30	--	--
DWT-DGR5-128	23-Oct-09	697.35	470.1	200400
DWT-DGR5-129	23-Oct-09	697.35	263.9	199600
DWT-DGR5-130	23-Oct-09	706.50	478.8	200200
DWT-DGR5-131	24-Oct-09	709.55	668.5	198400
DWT-DGR5-132	24-Oct-09	712.60	973.5	194600
DWT-DGR5-133	24-Oct-09	715.65	756.7	199100
DWT-DGR5-134	24-Oct-09	721.75	856.9	196100
DWT-DGR5-135	25-Oct-09	727.85	753.6	197800
DWT-DGR5-136	25-Oct-09	730.90	780.7	194800
DWT-DGR5-137	25-Oct-09	733.95	642.2	195800

Table B.1 - Summary of Field Chemical Measurements of DGR-5 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Na Fluorescein (µg/L)	Electrical Conductivity (µS/cm)
DWT-DGR5-138	25-Oct-09	740.05	1081.4	195700
DWT-DGR5-139	26-Oct-09	746.15	793.4	197400
DWT-DGR5-140	26-Oct-09	746.15	397.6	207300
DWT-DGR5-141	26-Oct-09	752.25	--	--
DWT-DGR5-142	26-Oct-09	752.25	734.8	207200
DWT-DGR5-143	26-Oct-09	755.30	635.2	194400
DWT-DGR5-144	27-Oct-09	761.40	846.3	198600
DWT-DGR5-145	27-Oct-09	767.50	707.3	193400
DWT-DGR5-146	27-Oct-09	770.55	1047.3	195500
DWT-DGR5-147	27-Oct-09	773.60	627.9	195300
DWT-DGR5-148	28-Oct-09	782.75	544.6	198700
DWT-DGR5-149	28-Oct-09	788.85	528.0	189000
DWT-DGR5-150	28-Oct-09	794.95	615.0	159800
DWT-DGR5-151	28-Oct-09	798.00	992.6	158600
DWT-DGR5-152	29-Oct-09	804.10	1144.8	165300

Table B.2 - Summary of Laboratory Analyses of DGR-5 Drilling Fluids

Parameter	Units	DWT-DGR5-009	DWT-DGR5-031	DWT-DGR5-048	DWT-DGR5-068	DWT-DGR5-092	DWT-DGR5-110	DWT-DGR5-125	DWT-DGR5-147
Depth (mLBGS)>		67.81	172.66	275.56	376.21	477.70	575.35	676.00	773.60
Date Sampled>		27-Jan-09	7-Feb-09	12-Sep-09	18-Sep-09	7-Oct-09	17-Oct-09	22-Oct-09	27-Oct-09
FIELD PARAMETERS									
pH	pH units	--	7.14	7.95	6.86	6.78	6.82	7.12	7.48
Eh	mV	105.3	587.2	136.5	240.9	233	66.4	74.5	-163.7
Dissolved Oxygen	mg/L	--	10.15	8.77	13.90	--	8.05	7.03	0.66
Electrical Conductivity	µS/cm	292.6	212.8	184700	186000	179200	184600	196300	195300
Temperature	ºC	20.5	17.2	14.9	15.0	15.2	13.8	12.7	16.6
Na Fluorescein	µg/L	816.7	--	986.7	455.9	1069.4	1003.0	415.5	627.9
LAB PARAMETERS									
General Parameters									
Alkalinity	mg/L $CaCO_3$	37	85	113	101	41	37	26	36
Ammonia + Ammonium	as N mg/L	0.2	<0.1	2.3	3.8	4.0	6.9	10.1	12.2
Fluid Density	g/L	994	976	1118	1100	1100	1090	1080	1110
Hardness	mg/L as CaCO3	86	13	41600	42300	40000	41000	41000	41000
pH	pH units	10.1	8.05	7.71	6.87	6.52	6.80	6.98	6.74
Total Dissolved Solids	mg/L	300	146	167000	159000	162000	165000	175000	173000
Cations									
Calcium	mg/L	31.9	33.3	16300	16400	15600	15900	16100	15800
Iron	mg/L	<0.1	0.1	5.6	1.9	14.6	22.9	7.5	46.7
Magnesium	mg/L	1.60	12.3	201	366	245	275	239	265
Manganese	mg/L	0.00271	0.0105	0.713	3.84	3.64	5.22	5.68	5.71
Potassium	mg/L	7.0	1.1	1120	1100	703	791	845	897
Silica	mg/L	4.1	1.1	8.4	2.3	22.2	36.9	9.6	74.3
Sodium	mg/L	19.3	6.1	39900	37600	37400	39700	41000	41600
Strontium	mg/L	0.930	0.124	108	109	283	286	287	277
Anions									
Bromide	mg/L	<0.3	<0.3	440	440	440	430	450	440
Chloride	mg/L	56	9.6	95000	90000	95000	92000	100000	100000
Fluoride	mg/L	0.49	0.10	0.17	0.18	0.12	0.12	0.12	0.12
Iodide	mg/L	<0.3	<0.3	0.03	0.05	0.04	0.04	0.04	0.04
Nitrate	as N mg/L	0.34	0.33	<6	<6	<5	<5	<5	<5
Phosphorus	mg/L	<0.1	<0.1	<0.1	<0.1	0.1	0.4	<0.1	0.7
Sulphate	mg/L	26	17	850	880	850	910	850	900
Isotopes									
Tritium, ^{3}H	TU	230.1	61.7	784.2	947.5	716.2	761.0	712.2	642.9
Deuterium, ^{2}H	dD (‰)	-58.1	-54.3	-53.3	-49.1	-55.2	-51.7	-54.0	-43.2
Oxygen-18, ^{18}O	$d^{18}O$ (‰)	-7.5	-7.2	-6.4	-5.3	-6.4	-6.6	-6.6	-6.6

Table B.2 - Summary of Laboratory Analyses of DGR-5 Drilling Fluids

Parameter	Units	DWT-DGR5-009	DWT-DGR5-031	DWT-DGR5-048	DWT-DGR5-068	DWT-DGR5-092	DWT-DGR5-110	DWT-DGR5-125	DWT-DGR5-147
Depth (mLBGS)>		67.81	172.66	275.56	376.21	477.70	575.35	676.00	773.60
Date Sampled>		27-Jan-09	7-Feb-09	12-Sep-09	18-Sep-09	7-Oct-09	17-Oct-09	22-Oct-09	27-Oct-09
Selected Trace Elements									
Aluminum	mg/L	0.0640	0.0793	2.20	0.304	1.1	3.3	1.0	4.6
Antimony	mg/L	0.0017	0.0006	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02
Arsenic	mg/L	0.0027	0.0003	0.307	0.327	0.68	0.73	0.76	0.73
Barium	mg/L	0.160	0.0188	0.709	0.688	0.483	0.663	0.762	0.866
Beryllium	mg/L	<0.00002	<0.00002	<0.0002	<0.0002	<0.002	<0.002	<0.002	<0.002
Boron	mg/L	0.243	0.0141	3.61	3.58	3.91	3.84	3.72	3.14
Bismuth	mg/L	0.00010	<0.00001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.000099	0.000011	0.00037	0.00070	<0.0003	<0.0003	<0.0003	<0.0003
Cesium	mg/L	0.0003	<0.0001	0.008	0.007	0.01	0.01	0.02	0.01
Chromium	mg/L	0.0036	<0.0005	0.032	0.015	<0.05	<0.05	<0.05	0.07
Cobalt	mg/L	0.000717	0.000103	0.0236	0.0242	0.0722	0.0757	0.0731	0.0755
Copper	mg/L	0.0061	0.0141	0.108	0.052	0.20	0.28	0.23	0.15
Gadolinium	mg/L	0.00024	<0.00005	0.0009	<0.0005	<0.005	<0.005	<0.005	<0.005
Lead	mg/L	0.00036	0.00118	0.0066	0.0023	0.015	0.004	0.006	0.011
Lithium	mg/L	<0.02	<0.02	6.41	6.11	5.12	5.05	5.18	4.93
Molybdenum	mg/L	0.0950	0.00058	0.0397	0.0089	0.013	0.016	0.015	0.035
Nickel	mg/L	0.0108	0.0022	0.277	0.307	0.76	0.82	0.77	0.77
Rubidium	mg/L	0.0109	0.0013	0.902	0.857	0.85	0.82	0.90	0.89
Selenium	mg/L	0.006	<0.001	0.22	0.26	<0.1	<0.1	<0.1	<0.1
Silver	mg/L	0.00009	<0.00001	0.0035	0.0002	0.014	0.005	0.001	<0.001
Thallium	mg/L	0.000255	<0.000002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02
Tin	mg/L	<0.00001	0.00015	0.0041	<0.0001	0.008	0.004	0.001	0.001
Titanium	mg/L	0.0017	0.0021	0.098	0.025	0.06	0.16	0.06	0.35
Uranium	mg/L	0.00872	0.000279	0.00257	0.00271	0.0007	0.0007	0.0005	0.0003
Vanadium	mg/L	0.00536	0.00037	<0.0003	<0.0003	<0.003	0.011	<0.003	0.015
Zinc	mg/L	0.017	0.033	0.06	0.20	<0.1	0.7	0.2	0.4

Table B.3 - Tritium Analysis of DGR-5 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Tritium (TU)
DWT-DGR5-002	18-Dec-08	--	189.1
DWT-DGR5-006	26-Jan-09	56.16	216.0
DWT-DGR5-009	27-Jan-09	67.81	230.1
DWT-DGR5-014	29-Jan-09	86.66	233.3
DWT-DGR5-017	31-Jan-09	103.10	215.8
DWT-DGR5-021	2-Feb-09	128.96	141.1
DWT-DGR5-027	5-Feb-09	145.35	118.2
DWT-DGR5-028	6-Feb-09	160.66	125.8
DWT-DGR5-031	7-Feb-09	172.66	61.7
DWT-DGR5-033	8-Feb-09	191.05	309.3
DWT-DGR5-035	8-Sep-09	207.92	485.4
DWT-DGR5-039	10-Sep-09	228.88	545.3
DWT-DGR5-043	10-Sep-09	250.23	742.1
DWT-DGR5-048	12-Sep-09	275.56	784.2
DWT-DGR5-051	13-Sep-09	303.01	750.3
DWT-DGR5-057	14-Sep-09	327.41	812.3
DWT-DGR5-061	15-Sep-09	351.81	821.1
DWT-DGR5-068	18-Sep-09	373.16	947.5
DWT-DGR5-073	24-Sep-09	400.92	942.1
DWT-DGR5-078	26-Sep-09	425.32	948.9
DWT-DGR5-084	27-Sep-09	449.72	876.1
DWT-DGR5-092	7-Oct-09	477.70	716.2
DWT-DGR5-095	8-Oct-09	502.10	727.3
DWT-DGR5-100	14-Oct-09	529.55	775.8
DWT-DGR5-106	16-Oct-09	554.00	787.6
DWT-DGR5-110	17-Oct-09	575.35	761.0
DWT-DGR5-113	18-Oct-09	602.80	733.6
DWT-DGR5-117	19-Oct-09	630.25	678.2
DWT-DGR5-122	21-Oct-09	657.70	713.7
DWT-DGR5-125	22-Oct-09	676.00	712.2
DWT-DGR5-128	23-Oct-09	697.35	700.8
DWT-DGR5-135	25-Oct-09	727.85	697.2
DWT-DGR5-141	26-Oct-09	752.25	691.0
DWT-DGR5-147	27-Oct-09	773.60	642.9
DWT-DGR5-152	29-Oct-09	804.10	671.1

Table B.4 - Summary of Field Chemical Measurements of DGR-6 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Na Fluorescein (µg/L)	Electrical Conductivity (µS/cm)
DWT-DGR6-001	31-May-09	36.77	1045.0	671
DWT-DGR6-002	31-May-09	36.77	956.5	744
DWT-DGR6-003	01-Jun-09	40.23	716.5	700
DWT-DGR6-004	01-Jun-09	40.23	1164.1	691
DWT-DGR6-005	02-Jun-09	41.41	1016.5	690
DWT-DGR6-006	02-Jun-09	41.41	825.1	606
DWT-DGR6-007	03-Jun-09	42.91	1476.2	638
DWT-DGR6-008	03-Jun-09	42.91	1555.9	629
DWT-DGR6-009	04-Jun-09	45.61	1468.4	609
DWT-DGR6-010	04-Jun-09	45.61	1496.1	605
DWT-DGR6-011	05-Jun-09	50.05	1422.6	494
DWT-DGR6-012	05-Jun-09	50.05	1362.2	536
DWT-DGR6-013	06-Jun-09	56.15	1167.0	490
DWT-DGR6-014	06-Jun-09	56.15	1143.9	741
DWT-DGR6-015	07-Jun-09	63.25	850.8	589
DWT-DGR6-016	07-Jun-09	63.25	893.4	613
DWT-DGR6-017	08-Jun-09	71.21	1072.0	731
DWT-DGR6-018	08-Jun-09	71.21	1050.5	759
DWT-DGR6-019	08-Jun-09	71.21	--	220
DWT-DGR6-019	09-Jun-09	74.80	987.2	714
DWT-DGR6-020	09-Jun-09	74.80	956.7	784
DWT-DGR6-021	10-Jun-09	80.90	1007.5	791
DWT-DGR6-022	10-Jun-09	80.90	1152.1	789
DWT-DGR6-023	11-Jun-09	86.01	1071.9	773
DWT-DGR6-024	11-Jun-09	86.01	1075.4	778
DWT-DGR6-025	12-Jun-09	91.61	947.2	755
DWT-DGR6-026	12-Jun-09	91.61	940.9	744
DWT-DGR6-027	13-Jun-09	96.11	903.9	756
DWT-DGR6-028	13-Jun-09	96.11	857.5	736
DWT-DGR6-029	14-Jun-09	101.11	1098.7	743
DWT-DGR6-030	14-Jun-09	101.11	1076.3	716
DWT-DGR6-031	15-Jun-09	105.67	705.6	461
DWT-DGR6-032	16-Jun-09	109.76	1067.9	539
DWT-DGR6-033	16-Jun-09	109.76	1035.0	568
DWT-DGR6-034	17-Jun-09	115.61	718.6	622
DWT-DGR6-035	18-Jun-09	117.13	1059.8	879
DWT-DGR6-036	18-Jun-09	130.43	1050.6	904
DWT-DGR6-037	18-Jun-09	130.43	841.1	883
DWT-DGR6-038	19-Jun-09	142.30	660.7	918
DWT-DGR6-039	19-Jun-09	142.30	1135.9	937
DWT-DGR6-040	19-Jun-09	142.30	1087.9	989
DWT-DGR6-041	19-Jun-09	145.00	1019.8	922
DWT-DGR6-042	20-Jun-09	145.00	956.7	977
DWT-DGR6-043	20-Jun-09	156.45	944.8	1010
DWT-DGR6-044	20-Jun-09	156.45	957.7	1013
DWT-DGR6-045	20-Jun-09	170.00	609.3	888

Table B.4 - Summary of Field Chemical Measurements of DGR-6 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Na Fluorescein (µg/L)	Electrical Conductivity (µS/cm)
DWT-DGR6-046	21-Jun-09	170.00	665.9	953
DWT-DGR6-047	21-Jun-09	173.70	830.3	851
DWT-DGR6-048	21-Jun-09	179.80	402.5	619
DWT-DGR6-049	22-Jun-09	179.80	13776.3	673
DWT-DGR6-050	22-Jun-09	186.00	765.0	988
DWT-DGR6-051	22-Jun-09	186.00	1598.4	1000
DWT-DGR6-052	22-Jun-09	200.50	429.1	2582
DWT-DGR6-053	23-Jun-09	200.50	1063.3	2494
DWT-DGR6-054	23-Jun-09	209.91	962.6	2425
DWT-DGR6-055	23-Jun-09	209.91	1001.5	2450
DWT-DGR6-056	23-Jun-09	215.91	988.6	2419
DWT-DGR6-057	11-Jul-09	215.91	806.4	2050
DWT-DGR6-058	12-Jul-09	215.91	685.5	43100
DWT-DGR6-059	13-Jul-09	215.91	599.8	124500
DWT-DGR6-060	13-Jul-09	215.91	558.2	133500
DWT-DGR6-061	13-Jul-09	215.91	223.1	131900
DWT-DGR6-062	13-Jul-09	215.91	615.4	132800
DWT-DGR6-063	14-Jul-09	215.91	752.9	133500
DWT-DGR6-064	14-Jul-09	221.70	647.1	137500
DWT-DGR6-065	14-Jul-09	224.75	801.4	141800
DWT-DGR6-066	15-Jul-09	224.75	1006.3	142600
DWT-DGR6-067	15-Jul-09	226.67	922.7	150100
DWT-DGR6-068	15-Jul-09	228.72	874.2	145400
DWT-DGR6-069	15-Jul-09	231.77	876.3	148300
DWT-DGR6-070	16-Jul-09	234.82	1104.4	147600
DWT-DGR6-071	16-Jul-09	237.87	962.0	161600
DWT-DGR6-072	16-Jul-09	243.97	535.4	166800
DWT-DGR6-073	16-Jul-09	247.02	1151.7	173600
DWT-DGR6-074	17-Jul-09	253.12	1165.7	174800
DWT-DGR6-075	17-Jul-09	259.22	1067.9	190300
DWT-DGR6-076	17-Jul-09	265.32	943.5	182300
DWT-DGR6-077	17-Jul-09	268.37	924.4	182200
DWT-DGR6-078	18-Jul-09	271.42	883.3	182200
DWT-DGR6-079	18-Jul-09	271.42	783.4	182500
DWT-DGR6-080	18-Jul-09	274.31	720.3	176200
DWT-DGR6-081	19-Jul-09	280.57	1000.1	179400
DWT-DGR6-082	19-Jul-09	286.67	802.4	185600
DWT-DGR6-083	19-Jul-09	289.72	623.7	183800
DWT-DGR6-084	19-Jul-09	295.82	1125.8	183700
DWT-DGR6-085	20-Jul-09	298.87	1053.4	184600
DWT-DGR6-086	20-Jul-09	304.97	940.2	189600
DWT-DGR6-087	20-Jul-09	314.12	675.2	186600
DWT-DGR6-088	20-Jul-09	317.17	1027.1	187400
DWT-DGR6-089	21-Jul-09	326.32	999.8	188600
DWT-DGR6-090	21-Jul-09	329.37	812.0	189400
DWT-DGR6-091	21-Jul-09	335.32	887.2	188500

Table B.4 - Summary of Field Chemical Measurements of DGR-6 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Na Fluorescein (µg/L)	Electrical Conductivity (µS/cm)
DWT-DGR6-092	21-Jul-09	338.37	1064.3	188800
DWT-DGR6-093	22-Jul-09	340.73	1014.3	189100
DWT-DGR6-094	22-Jul-09	344.62	777.5	192100
DWT-DGR6-095	23-Jul-09	347.67	886.9	190000
DWT-DGR6-096	23-Jul-09	347.67	1063.2	195200
DWT-DGR6-097	23-Jul-09	350.70	985.5	195300
DWT-DGR6-098	23-Jul-09	353.75	1178.5	194900
DWT-DGR6-099	23-Jul-09	357.00	1113.7	197500
DWT-DGR6-100	24-Jul-09	357.00	1107.1	202400
DWT-DGR6-101	24-Jul-09	359.85	1056.1	202700
DWT-DGR6-102	24-Jul-09	362.90	935.1	200800
DWT-DGR6-103	24-Jul-09	365.95	1002.8	202100
DWT-DGR6-104	25-Jul-09	369.00	1025.3	203900
DWT-DGR6-105	25-Jul-09	372.05	989.5	203400
DWT-DGR6-106	25-Jul-09	375.10	1169.7	196600
DWT-DGR6-107	26-Jul-09	375.10	1113.3	198600
DWT-DGR6-108	26-Jul-09	375.83	1063.3	200200
DWT-DGR6-109	26-Jul-09	376.66	864.9	199300
DWT-DGR6-110	27-Jul-09	376.66	1196.0	204900
DWT-DGR6-111	27-Jul-09	378.15	1116.3	203700
DWT-DGR6-112	27-Jul-09	381.20	1097.2	204200
DWT-DGR6-113	27-Jul-09	381.20	848.5	201100
DWT-DGR6-114	27-Jul-09	384.25	1103.6	206800
DWT-DGR6-115	28-Jul-09	390.35	821.2	214200
DWT-DGR6-116	28-Jul-09	393.40	1017.4	215000
DWT-DGR6-117	28-Jul-09	396.45	668.0	210900
DWT-DGR6-118	28-Jul-09	399.50	1037.4	213800
DWT-DGR6-119	29-Jul-09	405.60	711.2	215200
DWT-DGR6-120	29-Jul-09	411.70	770.3	213700
DWT-DGR6-121	29-Jul-09	414.75	1140.1	213140
DWT-DGR6-122	29-Jul-09	420.85	1065.9	213100
DWT-DGR6-123	30-Jul-09	423.90	902.2	216600
DWT-DGR6-124	30-Jul-09	430.00	1050.3	219800
DWT-DGR6-125	30-Jul-09	433.05	846.3	217200
DWT-DGR6-126	30-Jul-09	436.10	1181.6	218700
DWT-DGR6-127	05-Aug-09	439.15	2.9	220800
DWT-DGR6-128	05-Aug-09	439.15	55.8	--
DWT-DGR6-129	05-Aug-09	439.15	1425.8	174100
DWT-DGR6-130	06-Aug-09	445.25	1343.3	175500
DWT-DGR6-131	06-Aug-09	448.30	1243.8	174000
DWT-DGR6-132	06-Aug-09	451.35	1100.2	172500
DWT-DGR6-133	06-Aug-09	457.45	1005.3	174100
DWT-DGR6-134	07-Aug-09	463.55	939.3	176900
DWT-DGR6-135	07-Aug-09	469.65	692.3	159100
DWT-DGR6-136	07-Aug-09	475.75	864.6	163600
DWT-DGR6-137	08-Aug-09	475.75	769.5	168300

Table B.4 - Summary of Field Chemical Measurements of DGR-6 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Na Fluorescein (µg/L)	Electrical Conductivity (µS/cm)
DWT-DGR6-138	08-Aug-09	479.73	1155.9	167710
DWT-DGR6-139	08-Aug-09	490.11	989.5	168500
DWT-DGR6-140	08-Aug-09	498.03	1023.7	172200
DWT-DGR6-141	08-Aug-09	498.03	--	--
DWT-DGR6-142	09-Aug-09	504.13	967.9	174100
DWT-DGR6-143	09-Aug-09	507.18	825.5	168900
DWT-DGR6-144	09-Aug-09	513.28	850.6	174400
DWT-DGR6-145	23-Nov-09	516.33	1346.6	202400
DWT-DGR6-146	24-Nov-09	518.15	1357.0	205500
DWT-DGR6-147	24-Nov-09	523.43	1229.0	203700
DWT-DGR6-148	24-Nov-09	528.71	1021.0	195100
DWT-DGR6-149	24-Nov-09	528.71	1395.8	189000
DWT-DGR6-150	25-Nov-09	531.76	568.9	199300
DWT-DGR6-151	25-Nov-09	531.76	982.3	200400
DWT-DGR6-152	26-Nov-09	535.00	670.6	200600
DWT-DGR6-153	26-Nov-09	542.55	836.9	190200
DWT-DGR6-154	26-Nov-09	559.21	614.6	192800
DWT-DGR6-155	27-Nov-09	563.90	1952.3	187200
DWT-DGR6-156	27-Nov-09	566.95	485.9	180100
DWT-DGR6-157	28-Nov-09	566.95	1171.2	188100
DWT-DGR6-158	28-Nov-09	571.41	747.9	189300
DWT-DGR6-159	28-Nov-09	577.51	899.1	182400
DWT-DGR6-160	28-Nov-09	577.51	1146.0	188500
DWT-DGR6-161	28-Nov-09	589.71	611.7	194300
DWT-DGR6-162	29-Nov-09	589.71	555.3	197800
DWT-DGR6-163	29-Nov-09	595.81	778.4	180500
DWT-DGR6-164	30-Nov-09	604.96	949.4	194900
DWT-DGR6-165	01-Dec-09	608.01	437.4	194500
DWT-DGR6-166	01-Dec-09	614.11	844.8	186500
DWT-DGR6-167	01-Dec-09	617.16	1138.4	188900
DWT-DGR6-168	02-Dec-09	623.26	644.4	189100
DWT-DGR6-169	02-Dec-09	629.36	1466.9	189200
DWT-DGR6-170	02-Dec-09	635.46	1362.4	191300
DWT-DGR6-171	02-Dec-09	636.96	932.0	190300
DWT-DGR6-172	04-Dec-09	518.70	543.8	--
DWT-DGR6-173	04-Dec-09	518.70	1048.6	--
DWT-DGR6-174	04-Dec-09	533.70	1277.3	192900
DWT-DGR6-175	05-Dec-09	533.70	1327.5	192800
DWT-DGR6-176	05-Dec-09	551.75	1150.9	188200
DWT-DGR6-177	06-Dec-09	562.75	516.4	196100
DWT-DGR6-178	07-Dec-09	578.75	1301.5	188600
DWT-DGR6-179	07-Dec-09	578.75	1096.3	190100
DWT-DGR6-180	07-Dec-09	578.75	1038.9	193200
DWT-DGR6-181	07-Dec-09	594.75	539.5	195400
DWT-DGR6-182	08-Dec-09	594.75	587.0	193300
DWT-DGR6-183	08-Dec-09	615.75	579.5	193100

Table B.4 - Summary of Field Chemical Measurements of DGR-6 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Na Fluorescein (µg/L)	Electrical Conductivity (µS/cm)
DWT-DGR6-184	08-Dec-09	631.75	1163.5	183700
DWT-DGR6-185	09-Dec-09	631.75	798.0	166700
DWT-DGR6-186	06-Jan-10	642.56	252.0	--
DWT-DGR6-187	06-Jan-10	648.16	1828.0	165000
DWT-DGR6-188	07-Jan-10	651.16	1176.2	163500
DWT-DGR6-189	07-Jan-10	657.16	1109.3	164600
DWT-DGR6-190	07-Jan-10	660.16	698.0	167700
DWT-DGR6-191	07-Jan-10	663.16	997.0	188500
DWT-DGR6-192	08-Jan-10	663.16	1394.2	165600
DWT-DGR6-193	08-Jan-10	669.16	1289.0	180900
DWT-DGR6-194	8-Jan-10	669.26	754.0	174100
DWT-DGR6-195	09-Jan-10	669.26	699.4	184900
DWT-DGR6-196	10-Jan-10	669.26	1738.1	174300
DWT-DGR6-197	10-Jan-10	675.16	1303.7	179900
DWT-DGR6-198	10-Jan-10	681.16	1126.4	173000
DWT-DGR6-199	11-Jan-10	684.16	1132.2	173600
DWT-DGR6-200	11-Jan-10	690.16	931.7	181100
DWT-DGR6-201	11-Jan-10	696.16	525.3	184700
DWT-DGR6-202	11-Jan-10	696.16	1191.3	180700
DWT-DGR6-203	12-Jan-10	702.16	931.0	183100
DWT-DGR6-204	15-Jan-10	711.16	737.2	187400
DWT-DGR6-205	15-Jan-10	720.16	763.5	182700
DWT-DGR6-206	16-Jan-10	726.16	577.5	174100
DWT-DGR6-207	17-Jan-10	762.16	463.3	178300
DWT-DGR6-208	17-Jan-10	780.16	688.4	181900
DWT-DGR6-209	18-Jan-10	792.16	755.8	179400
DWT-DGR6-210	18-Jan-10	--	654.2	183400
DWT-DGR6-211	18-Jan-10	807.16	1315.3	193600
DWT-DGR6-212	19-Jan-10	819.16	1048.2	181200
DWT-DGR6-213	19-Jan-10	822.16	--	--
DWT-DGR6-214	19-Jan-10	828.16	2546.5	194500
DWT-DGR6-215	19-Jan-10	834.16	3533.7	180900
DWT-DGR6-216	19-Jan-10	843.16	1084.6	--
DWT-DGR6-217	20-Jan-10	852.16	991.2	--
DWT-DGR6-218	20-Jan-10	861.16	546.5	208300
DWT-DGR6-219	21-Jan-10	876.16	290.0	207200
DWT-DGR6-220	21-Jan-10	879.16	2095.9	186700
DWT-DGR6-221	23-Jan-10	882.16	156.9	207300
DWT-DGR6-222	23-Jan-10	885.16	905.3	213300
DWT-DGR6-223	24-Jan-10	891.16	1104.4	203200
DWT-DGR6-224	24-Jan-10	897.16	861.7	203600
DWT-DGR6-225	24-Jan-10	903.16	956.0	203500
DWT-DGR6-226	25-Jan-10	516.00	521.3	212900
DWT-DGR6-227	29-Jan-10	566.75	322.2	216100
DWT-DGR6-228	29-Jan-10	592.75	643.4	203500
DWT-DGR6-229	30-Jan-10	592.75	745.9	210000

Table B.4 - Summary of Field Chemical Measurements of DGR-6 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Na Fluorescein (µg/L)	Electrical Conductivity (µS/cm)
DWT-DGR6-230	30-Jan-10	628.75	1521.8	204300
DWT-DGR6-231	30-Jan-10	628.75	1103.9	211900
DWT-DGR6-232	--	--	--	--
DWT-DGR6-233	30-Jan-10	643.00	1013.8	217600
DWT-DGR6-234	31-Jan-10	643.00	756.9	214900
DWT-DGR6-235	31-Jan-10	677.00	715.5	207900
DWT-DGR6-236	31-Jan-10	677.00	650.9	209900
DWT-DGR6-237	31-Jan-10	689.00	940.7	213900
DWT-DGR6-238	01-Feb-10	689.00	610.9	208800
DWT-DGR6-239	01-Feb-10	722.00	317.3	209000
DWT-DGR6-240	03-Feb-10	722.00	180.6	220800
DWT-DGR6-241	03-Feb-10	761.00	311.9	214600
DWT-DGR6-242	04-Feb-10	761.00	528.6	217700
DWT-DGR6-243	05-Feb-10	800.00	636.6	214300
DWT-DGR6-244	06-Feb-10	800.00	542.7	223700
DWT-DGR6-245	07-Feb-10	800.00	786.9	219500
DWT-DGR6-246	08-Feb-10	800.00	1059.5	216300
DWT-DGR6-247	08-Feb-10	806.00	827.4	224700
DWT-DGR6-248	09-Feb-10	819.00	1004.3	233700
DWT-DGR6-249	10-Feb-10	819.00	852.6	225800
DWT-DGR6-250	10-Feb-10	847.00	901.1	238800
DWT-DGR6-251	11-Feb-10	847.00	876.6	231200
DWT-DGR6-252	11-Feb-10	866.00	656.5	237100
DWT-DGR6-253	11-Feb-10	869.00	624.4	239300
DWT-DGR6-254	12-Feb-10	869.00	1025.4	238000
DWT-DGR6-255	12-Feb-10	890.00	652.9	238200

Table B.5 - Summary of Laboratory Analyses of DGR-6 Drilling Fluids

Parameter	Units	DWT-DGR6-019	DWT-DGR6-053	DWT-DGR6-080	DWT-DGR6-106	DWT-DGR6-136	DWT-DGR6-160	DWT-DGR6-194	DWT-DGR6-208	DWT-DGR6-219
Depth (mLBGS)>		72.21	200.50	274.31	375.10	475.75	577.51	669.26	780.16	876.16
Date Sampled>		8-Jun-09	23-Jun-09	18-Jul-09	25-Jul-09	7-Aug-09	28-Nov-09	8-Jan-10	17-Jan-10	21-Jan-10
Field Measuremments										
pH	pH units	7.99	7.64	7.43	6.85	6.98	6.58	6.74	6.40	6.43
Eh	mV	496.7	275.9	166.6	285.3	359.6	-28.2	249.9	208.3	244.0
Dissolved Oxygen	mg/L	9.38	10.34	6.85	4.23	6.90	3.66	2.73	6.49	8.35
Electrical Conductivity	µS/cm	220.0	249.4	176200	196600	163600	188500	174100	181900	207200
Temperature	ºC	16.9	18.2	20.7	22.6	21.2	13.2	11.4	14.4	14.3
Na Fluorescein	µg/L	--	1063.3	720.3	1169.7	864.6	1146.0	754.0	688.4	290.0
LAB PARAMETERS										
General Parameters										
Alkalinity	mg/L $CaCO_3$	81	82	75	71	109	70	46	649	9610
Ammonia + Ammonium	as N mg/L	0.1	0.2	<1.0	1.5	2.6	9.1	10.2	12.0	13.0
Fluid Density	g/L	969	976	1100	1100	1090	1110	1100	1130	1130
Hardness	mg/L as $CaCO_3$	99	101	72000	35600	39200	40500	35900	41800	42500
pH	pH units	7.97	7.97	7.53	6.77	6.86	6.34	6.12	6.46	6.50
Total Dissolved Solids	mg/L	171	160	165000	172000	158000	164300	144000	193000	193000
Cations										
Calcium	mg/L	26.9	27.2	17200	16600	15400	15900	14100	16600	16800
Iron	mg/L	<0.1	<0.1	37.1	6.9	29.1	56.5	40.3	6.6	10.1
Magnesium	mg/L	7.83	8.07	139	111	173	160	157	113	126
Manganese	mg/L	0.0004	0.0004	1.95	2.950	3.79	4.51	4.17	3.41	2.64
Potassium	mg/L	0.9	0.9	863.0	720	835	772	1130	1100	1200
Silica	mg/L	0.9	0.9	25.7	4.5	16.7	5.3	44	3.5	2.3
Sodium	mg/L	8.0	9.1	59500	37800	38100	37000	33000	61000	63000
Strontium	mg/L	0.130	0.148	454	269	285	155	198	64.2	64.7
Anions										
Bromide	mg/L	<0.3	<0.3	440	440	400	410	400	530	520
Chloride	mg/L	11	13	110000	95000	90000	95000	88000	130000	130000
Fluoride	mg/L	0.09	0.08	0.17	0.14	0.11	0.14	0.12	0.10	0.18
Iodide	mg/L	<0.3	<0.3	<0.0001	0.01	<0.01	<0.01	<0.0001	0.004	0.004
Nitrate	as N mg/L	0.35	0.35	<5	<5	<5	<6	<5	<5	<5
Phosphorus	mg/L	<0.1	<0.1	0.4	<0.1	0.6	0.2	0.4	<1	<1
Sulphate	mg/L	16	17	860	890	910	480	680	630	650
Isotopes										
Tritium, ^{3}H	TU	92.6	104.8	283.7	674.2	760.4	467.1	1172.4	1280.1	1422.7
Deuterium, ^{2}H	dD (‰)	-58.7	-58.1	-59.0	-59.6	-57.4	-55.8	-64.1	-61.8	-60.9
Oxygen-18, ^{18}O	$d^{18}O$ (‰)	-7.6	-7.2	-7.3	-7.3	-7.0	-7.1	-8.7	-8.0	-8.3

Table B.5 - Summary of Laboratory Analyses of DGR-6 Drilling Fluids

Parameter	Units	DWT-DGR6-019	DWT-DGR6-053	DWT-DGR6-080	DWT-DGR6-106	DWT-DGR6-136	DWT-DGR6-160	DWT-DGR6-194	DWT-DGR6-208	DWT-DGR6-219
Depth (mLBGS)>		72.21	200.50	274.31	375.10	475.75	577.51	669.26	780.16	876.16
Date Sampled>		8-Jun-09	23-Jun-09	18-Jul-09	25-Jul-09	7-Aug-09	28-Nov-09	8-Jan-10	17-Jan-10	21-Jan-10
Selected Trace Elements										
Aluminum	mg/L	0.005	0.012	3.49	0.649	6.03	3.28	12.8	1.45	0.51
Antimony	mg/L	<0.002	<0.002	<0.002	0.003	0.002	<0.02	<0.02	0.002	0.002
Arsenic	mg/L	<0.002	<0.002	0.289	0.414	0.413	0.36	0.33	0.43	0.45
Barium	mg/L	0.115	0.220	0.480	0.795	0.648	7.03	3.57	3.14	2.42
Beryllium	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	0.0005	<0.002	<0.002	<0.002	<0.002
Boron	mg/L	0.028	0.034	4.11	3.33	3.25	4.51	4.44	5.09	4.67
Bismuth	mg/L	<0.0001	<0.0001	0.0002	0.0002	<0.0001	<0.001	0.003	<0.001	<0.001
Cadmium	mg/L	0.00003	<0.00003	0.00086	0.00099	0.00090	0.0007	0.0009	0.0020	0.0008
Cesium	mg/L	<0.001	<0.001	0.013	0.002	0.002	0.01	<0.01	0.01	0.02
Chromium	mg/L	<0.005	<0.005	0.066	0.016	0.041	<0.05	<0.05	<0.05	<0.05
Cobalt	mg/L	0.00005	0.00004	0.01982	0.0164	0.0209	0.0353	0.0430	0.0356	0.0340
Copper	mg/L	<0.005	<0.005	0.110	0.034	0.091	0.09	<0.05	0.07	<0.05
Gadolinium	mg/L	<0.0005	<0.0005	0.0040	<0.0005	0.0017	<0.005	<0.005	<0.005	<0.005
Lead	mg/L	0.0002	0.0006	0.0109	0.0010	0.0057	0.083	0.018	0.013	0.023
Lithium	mg/L	<0.02	<0.02	4.30	7.28	6.70	8.71	7.46	8.02	8.19
Molybdenum	mg/L	0.0005	0.0011	0.0292	0.0174	0.0190	0.080	0.027	0.019	0.041
Nickel	mg/L	<0.001	0.001	0.175	0.335	0.323	0.36	0.32	0.44	0.46
Rubidium	mg/L	<0.001	<0.001	0.554	1.17	1.08	0.89	0.78	<0.01	0.27
Selenium	mg/L	<0.01	<0.01	0.55	0.05	0.05	0.8	<0.1	0.1	0.2
Silver	mg/L	<0.0001	<0.0001	0.0006	0.0006	0.0005	0.004	0.002	0.002	0.001
Thallium	mg/L	<0.002	<0.002	<0.002	0.0004	0.0006	<0.02	<0.02	<0.002	<0.002
Tin	mg/L	<0.0001	<0.0001	0.0032	0.0051	0.0028	<0.001	0.001	0.007	0.002
Titanium	mg/L	<0.001	<0.001	0.176	0.046	0.124	0.09	0.40	0.07	0.04
Uranium	mg/L	0.00044	0.00042	0.00246	0.00209	0.00143	<0.0001	0.0013	0.0012	0.0002
Vanadium	mg/L	0.0005	0.0004	0.0084	<0.0003	0.0081	0.003	0.018	<0.003	<0.003
Zinc	mg/L	0.02	0.02	0.44	0.02	0.12	0.4	0.8	0.6	0.5

Table B.6 - Tritium Analysis of DGR-6 Drilling Fluids

Sample ID	Date Collected	Depth (mLBGS)	Tritium (TU)
DWT-DGR6-019	8-Jun-09	71.21	92.6
DWT-DGR6-026	12-Jun-09	91.61	122.2
DWT-DGR6-031	15-Jun-09	105.67	93.7
DWT-DGR6-034	17-Jun-09	115.61	123.4
DWT-DGR6-044	20-Jun-09	156.45	113.9
DWT-DGR6-051	22-Jun-09	186.00	84.1
DWT-DGR6-053	23-Jun-09	200.50	104.8
DWT-DGR6-080	18-Jul-09	274.31	283.7
DWT-DGR6-106	25-Jul-09	375.10	674.2
DWT-DGR6-132	06-Aug-09	451.35	677.0
DWT-DGR6-136	7-Aug-09	475.75	760.4
DWT-DGR6-145	23-Nov-09	516.33	286.5
DWT-DGR6-154	26-Nov-09	559.21	385.2
DWT-DGR6-160	28-Nov-09	577.51	467.1
DWT-DGR6-164	30-Nov-09	604.96	491.0
DWT-DGR6-169	2-Dec-09	629.36	558.1
DWT-DGR6-174	4-Dec-09	533.70	548.9
DWT-DGR6-179	7-Dec-09	578.75	655.6
DWT-DGR6-184	8-Dec-09	631.75	711.2
DWT-DGR6-194	8-Jan-10	669.26	1172.4
DWT-DGR6-205	15-Jan-10	720.16	1723.0
DWT-DGR6-208	17-Jan-10	780.16	1280.1
DWT-DGR6-213	19-Jan-10	822.16	1215.4
DWT-DGR6-219	21-Jan-10	876.16	1422.7
DWT-DGR6-227	29-Jan-10	566.75	1169.8
DWT-DGR6-235	31-Jan-10	677.00	1234.2
DWT-DGR6-241	3-Feb-10	761.00	1152.7
DWT-DGR6-244	6-Feb-10	800.00	877.6
DWT-DGR6-248	9-Feb-10	819.00	948.4
DWT-DGR6-253	11-Feb-10	869.00	1181.5

APPENDIX C

Depth Plots of Selected Analyses of DGR-5 and DGR-6 Drilling Fluid

Figure C.1 – Fluid Density and Funnel Viscosity in DGR-5

Figure C.2 – Na Fluorescein and Tritium in DGR-5

Figure C.3 – Electrical Conductivity in DGR-5

Figure C.4 – Fluid Density and Funnel Viscosity in DGR-6

Figure C.5 – Na Fluorescein and Tritium in DGR-6

Figure C.6 – Electrical Conductivity in DGR-6

Figure C.1 - Fluid Density and Funnel Viscosity in DGR-5

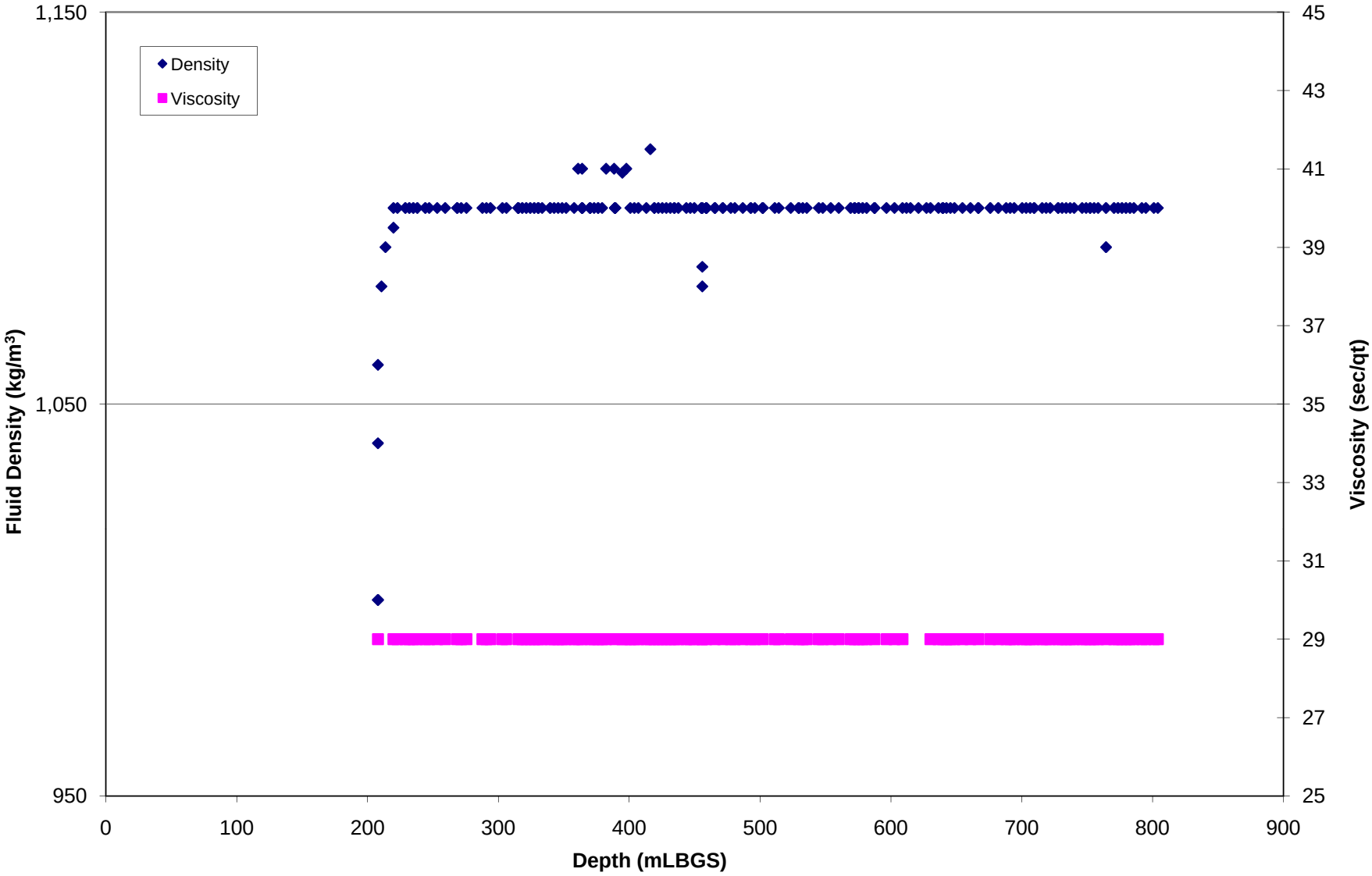

Figure C.2 - Na Fluorescein and Tritium in DGR-5

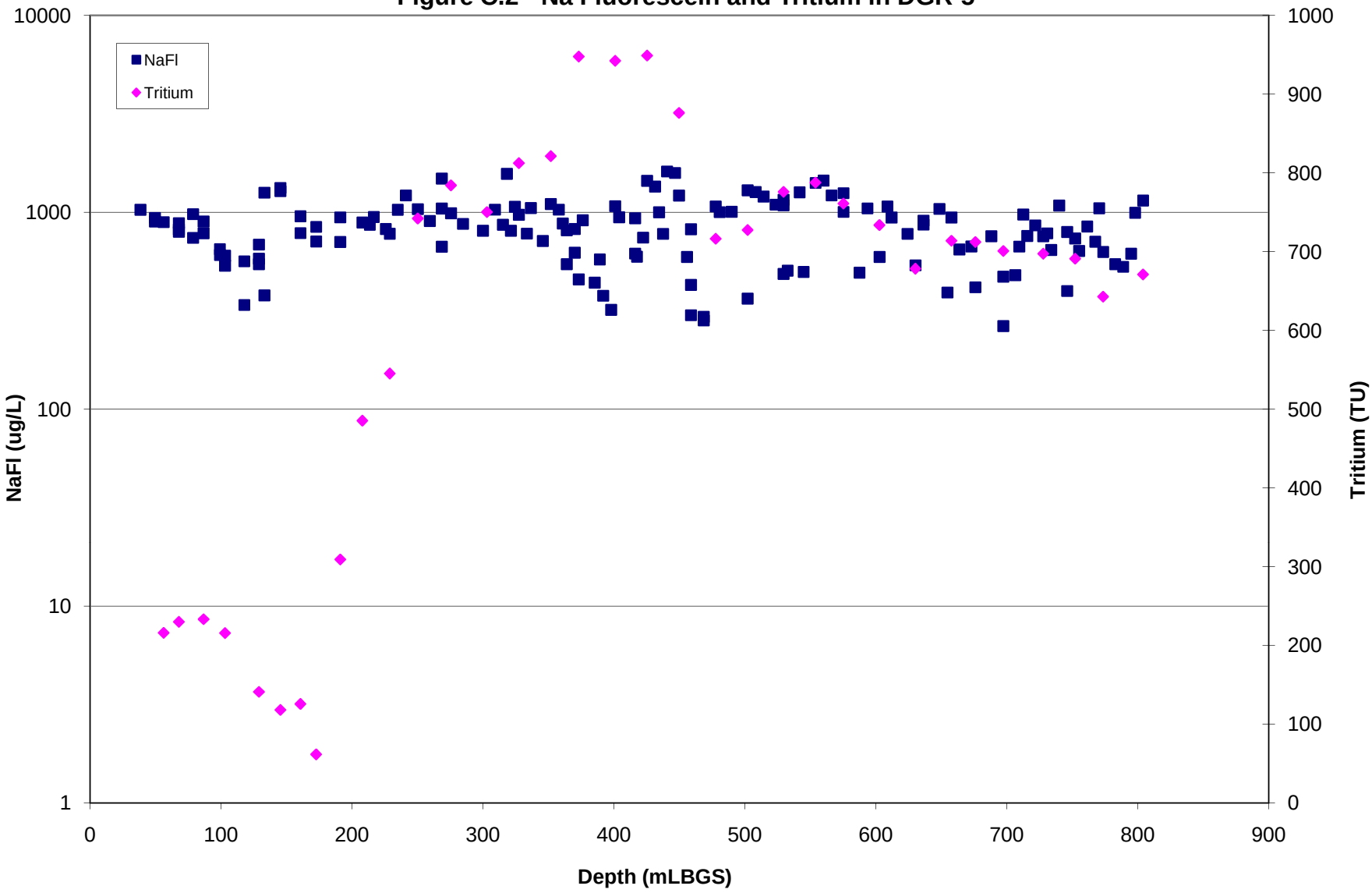

Figure C.3 - Electrical Conductivity in DGR-5

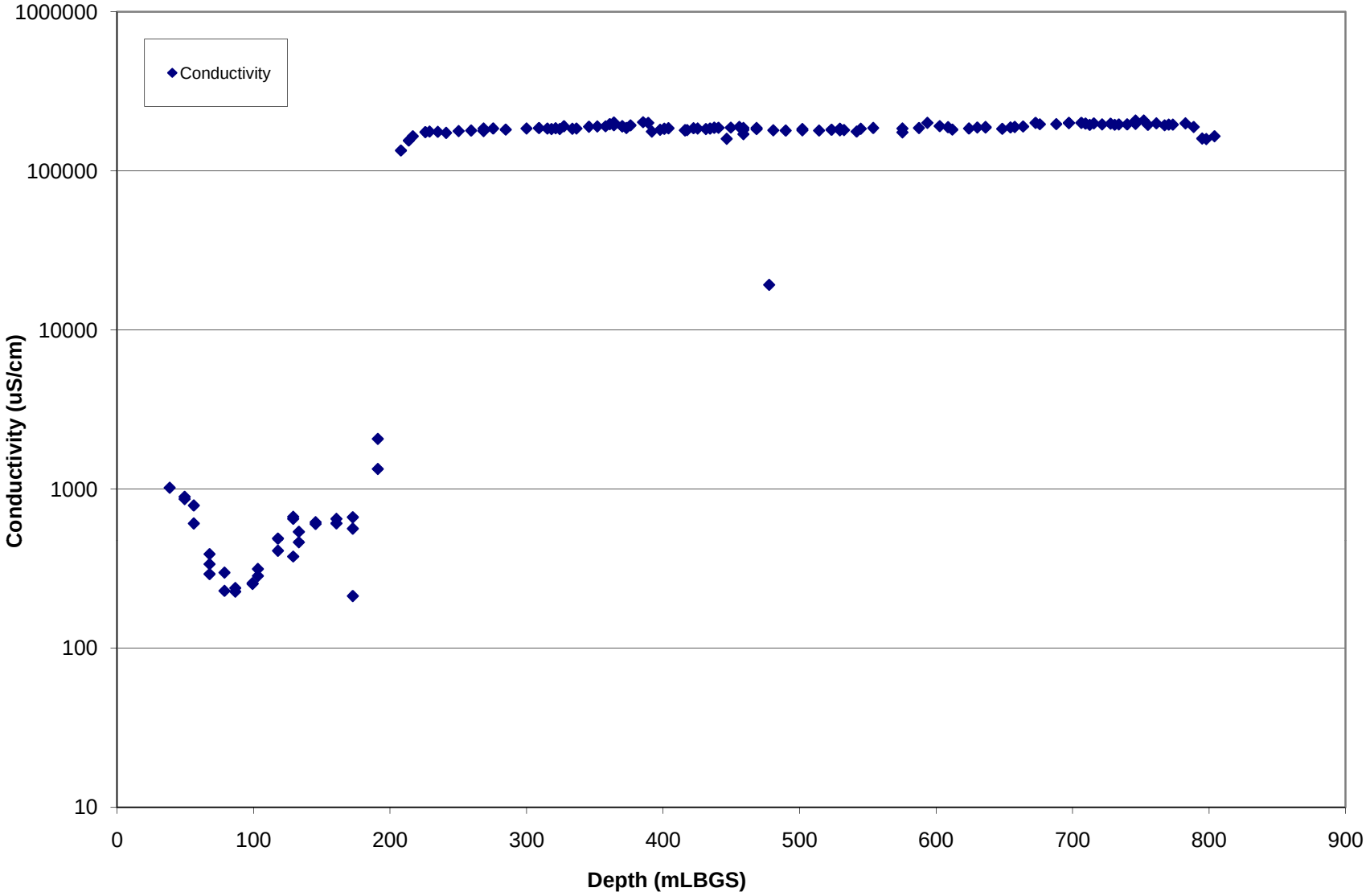

Figure C.4 - Fluid Density and Funnel Viscosity in DGR-6

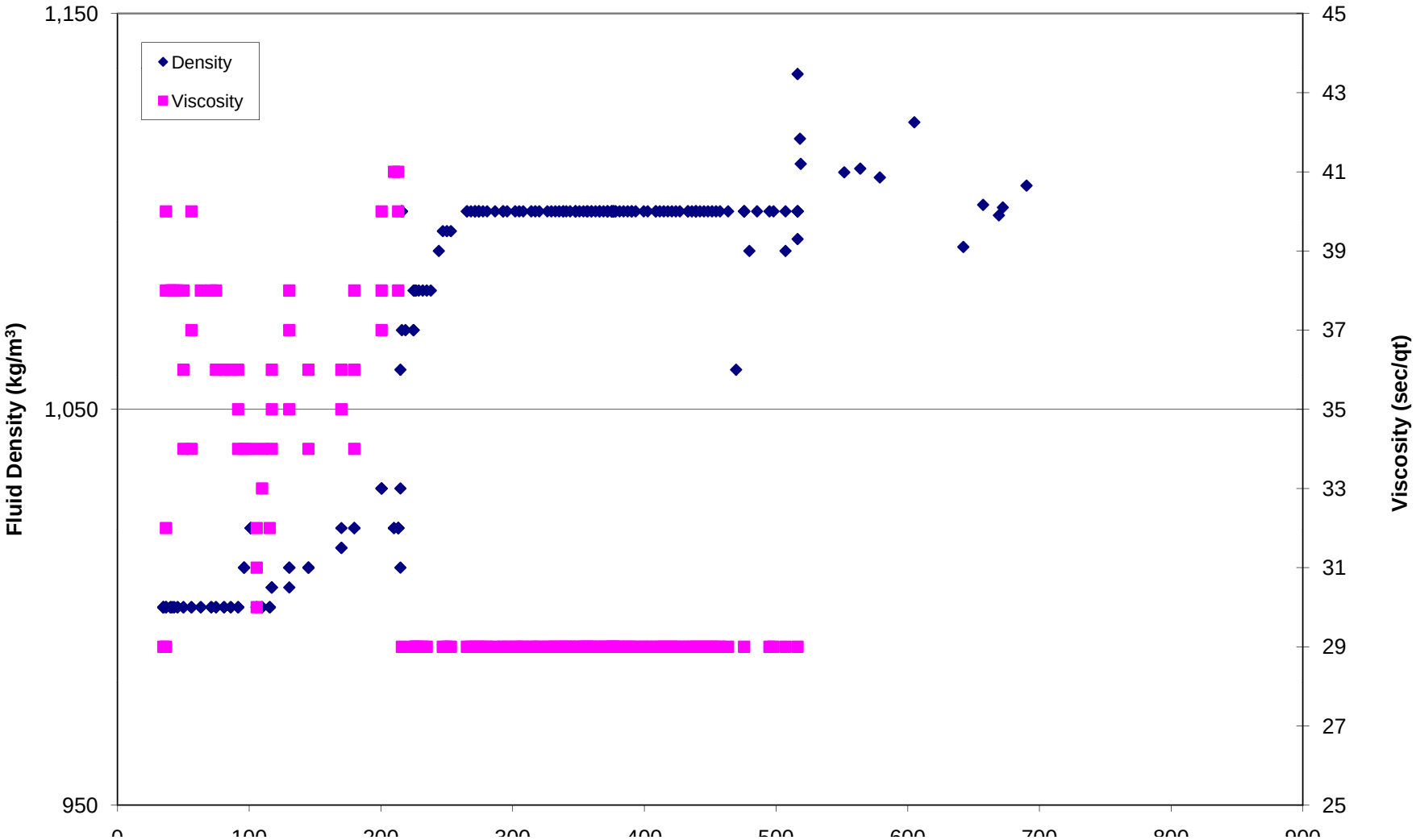

Figure C.5 - Na Fluorescein and Tritium in DGR-6

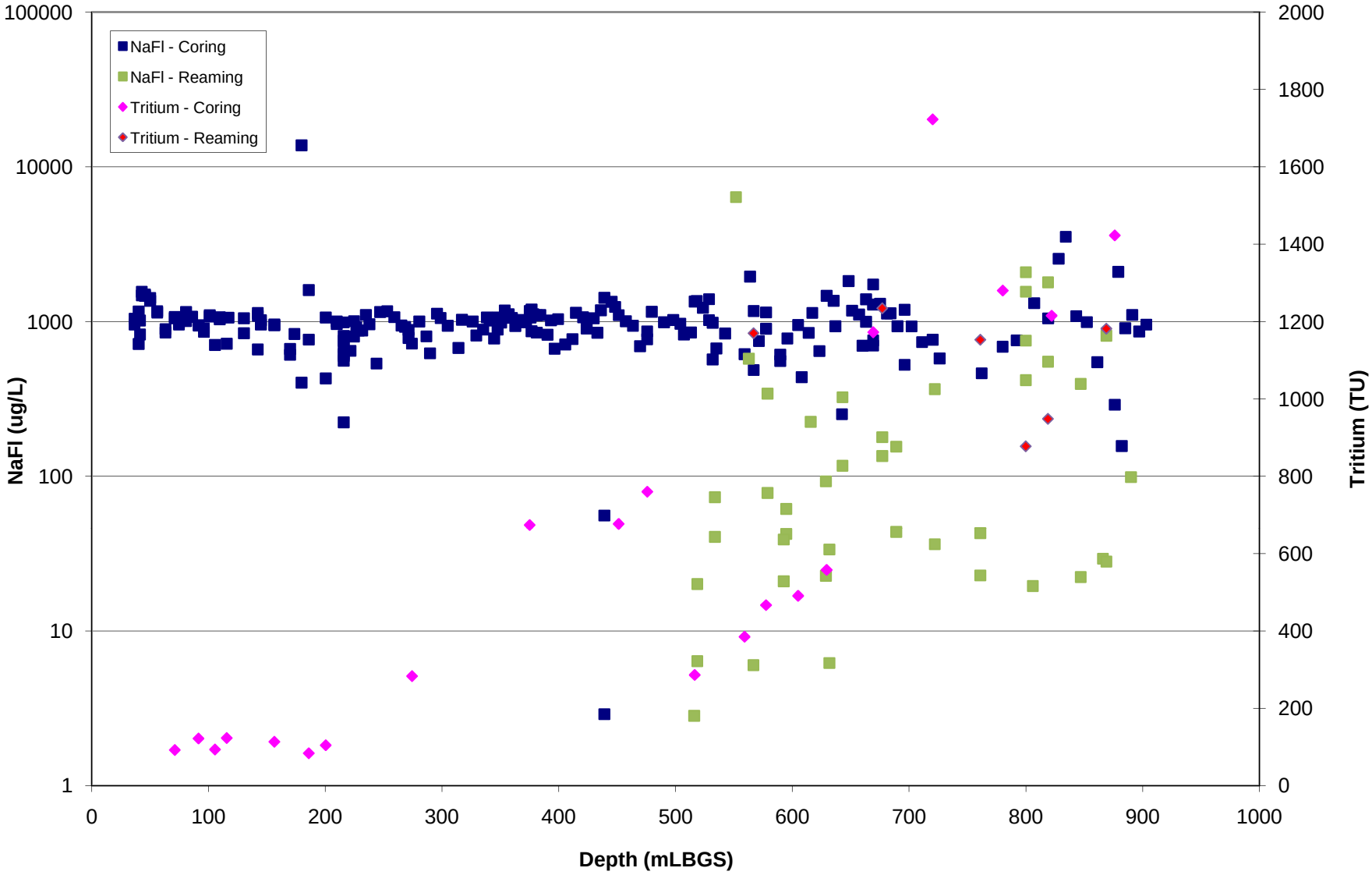

Figure C.6 - Electrical Conductivity in DGR-6