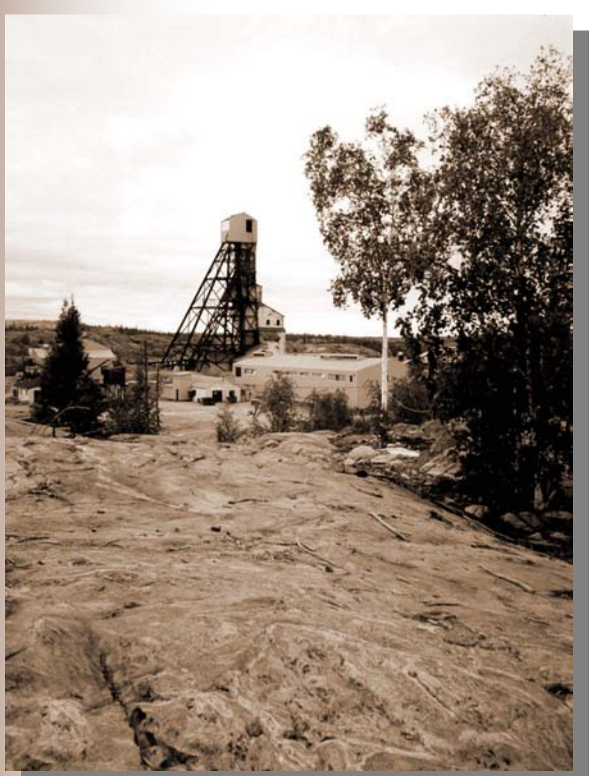
Indian and Northern Affairs Canada

Giant Mine Arsenic Trioxide Management Plan Groundwater Monitoring System Installation Report



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GIANT MINE ARSENIC TRIOXIDE MANAGEMENT PLAN GROUNDWATER MONITORING SYSTEM INSTALLATION REPORT

Prepared for:

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1. INTRODUCTION

1.1 Report Outline

This report describes the design and implementation of a monitoring system to collect data on the groundwater conditions around the Giant Mine, Yellowknife, NWT.

The purpose of the monitoring system is to assess the hydrogeological conditions in the bedrock mass on the periphery of the site, outside of the mined "envelope" that will be dominated by flow in the tunnels and mine workings. This information will be helpful in establishing the probable flow system in a flooded mine scenario and the hydrogeological controls for water entering and exiting the mine workings.

The report outlines the available information used to build a conceptual model of groundwater conditions at the site, and to identify the areas where data were lacking. The installation of the monitoring wells is described, and initial results presented. A revision of the conceptual model based on this initial data is also presented. This model will need to be updated as further testing is undertaken during and after the spring freshet. It should be noted that only preliminary chemical testing on several "non-developed" zones has been carried out at this time, and that the data presented here consists only of hydraulic pressure and hydraulic conductivity data for the bedrock zones monitored.

A chemical monitoring report will be prepared once a full round of zone development (removal of mixed drilling/open drillhole/zone water from each zone and equilibration with discrete zone water) and sampling has occurred. This work was delayed until the summer of 2002. Well development under freezing conditions can be problematic, as large volumes of water need to be pumped from the well. However, once development has been completed, groundwater sampling can be carried out during the winter months and winter sampling will be part of the regular seasonal monitoring program.

Figure 1 illustrates the general layout of the mine workings and the main structural features (faults) on the site. The collar and trace of deep exploration drillholes are also shown.

1.2 Hydrogeology Experts Review Panel Recommendations

Meetings of the Hydrogeology Experts Group were held in February 2000 and June 2001. The group reviewed available information and made recommendations for future work. Recommendations for the 2001/2002 fiscal year fieldwork are discussed in detail in the report "Giant Mine Hydrogeology Experts Group Meeting #2", Duke Engineering & Services (September 2001). The recommendations that were directly related to the groundwater monitoring program consisted of:

a) Review and reassessment of groundwater flow conceptual model;
b) Design and installation of a groundwater monitoring system;
   - multiple level monitoring recommended;
   - minimum depth of 100m for sampling system;
   - enhanced spatial coverage across mine area
c) Collection of background pressure and chemistry data for program design purposes

Other recommendations from the experts meeting were addressed in supporting programs and results are presented in separate reports.

2. AVAILABLE INFORMATION

2.1 Geology

The Giant Mine has had a long and successful history of gold production. Production began in May 1948, with the first brick being poured on August 24, 1948. Production to the end of 1999 totaled 17,424,137 tons @ 0.468 opt Au, for a total of 7,019,886 recovered ounces.

The Archean aged Yellowknife Greenstone belt hosts the Giant Mine. The Yellowknife Greenstone Belt is located in the southeast corner of the Slave Structural Province. The Giant Mine ore bodies are predominantly located within the Yellowknife Bay formation of the Kam Group.

2.1.1 Lithology

Lithology in the Giant Mine area is well documented in numerous reports and will not be discussed in detail here. In general, the Giant Mine gold deposits occur within a succession of massive and pillow breccia flows, and are intruded by gabbroic sills and dykes. The dykes are typically sub-perpendicular to stratigraphy and the auriferous mineralized zones.

2.1.2 Mineralization

Mineralization occurs within the north-south trending alteration/shear zone with a strike length of approximately 5 kilometres. The Giant alteration/shear zones are bounded to the west by the West Bay Fault, to the north by the Akaitcho Fault, and to the east by the angular unconformity with the sediments of the Jackson Lake Formation along the Yellowknife Bay shoreline.

The general trend of the Giant alteration/shear zone is N – S in the A shaft area between the West Bay Fault and the Townsite Fault, and is approximately N30E from the Townsite fault north through to the Akaitcho fault. The alteration/shear zone typically dips east, but the angle of dip is highly variable locally in the central section of the mine.

The alteration zone is characterized by variable chloritic and/or sericitic alteration of the country rocks. The major ore bodies have generally been located in sericite schist, but the intensity of alteration and schistocity varies widely. Large ore lenses have been found in weakly to moderately foliated, chlorite-to-chlorite sericite altered zones. The alteration zones are characterized by a strong increase in K_2O and a similar, coincident decrease in Na_2O. In the zones, increasing K_2O corresponds with decreasing Na_2O. The strongest alteration zone appears to correspond with the lowest Na_2O values and high K_2O values. CO_2 content increases from the unaltered wall rocks through to the sericite schists. Al_2O_3 and MgO contents peak in the chlorite schists and decrease in the chlorite-sericite and sericite schists (Gates, 1979).

Mineralization in the south and central portions of the mine is generally recognizable as quartz-carbonate-sericite schist with disseminated sulphide mineralization, bounded by sericite to chlorite schist. In the northern portion of the mine, gold is located within generally narrow, shallow dipping chlorite to sericite altered zones in relatively narrow (1 to 5 m wide) composite quartz carbonate veins that are often folded or boudined. Foliation is generally weakly to moderately developed.

Ore zones tend to be broadly linear within the plane of the alteration zones. These linear zones most commonly have either a gentle or a steep plunge, and are characterized by the presence of complex folding and contortions of the host sericite schist, and ore bodies. The alteration zones appear to crosscut the stratigraphy of the mine. Tracing the alteration zones down dip or along strike is difficult due to the complex folding and late faulting which results in the discontinuous nature of the alteration zones.

The Giant ore zones contain pyrite, arsenopyrite, sphalerite, chalcopyrite, stibnite, sulphosalts, and pyrrhotite in varying amounts. Gold is most commonly associated with arsenopyrite and pyrite. All ore zones within the mine are not uniformly refractory. The High Grade zone at B Shaft typically contained less sulphides and more quartz with visible gold being fairly common in diamond drill core.

2.2 Structural Geology

2.2.1 Major Structures

Two main faults occur in the Giant Mine area; the Westbay Fault, located on the west side of the site, and the Townsite Fault, which splays off the Westbay to the South East at the southern end of the mine site. The Westbay Fault only contacts mine workings in the vicinity of the A1 Pit in the very southern section of the mine. The Townsite Fault cuts directly through the mine workings between the A and C Shafts, after which it continues out into Yellowknife Bay to the south of the old Giant Mine townsite. The Akaitcho Fault, located on the north Eastern edge of the property extends out into Yellowknife Bay from the Supercrest area.

Other faults (312, Rudolph, #2, and other minor faults) also occur in the mine area. These are discussed in more detail below in respect to their potential interaction with groundwater flow.

Three predominate fault trends are present in the mine. Sinistral strike slip faults are generally N-S striking and sub-vertical with sub-horizontal slip directions. Dextral strike slip faults are generally ENE - WSW striking with sub vertical dips; sense of motion along the faults is sub horizontal. Reverse faults generally strike sub parallel to the foliation (average trend ~025E). The reverse faults are either high angle reverse faults with dips greater than 60E, or thrust faults with dips ranging from 35 - 50E.

The reverse faults and the N – S faults may be indicated by a ½ inch to 6-inch zone of clay gouge, while the ENE – WSW faults often appear as hairline fractures, or more commonly appear to be joints (Brown 1992). These characteristics will play an important role in the potential for the different fault orientations to serve as groundwater conduits within the site.

2.2.2 Domains

A desktop structural analysis of the site was carried out by SRK in February 2001 to assist in developing a conceptual model of groundwater flow in and around the mine site. This work is discussed in Supporting Document A2 “Characterization of Litho-structural Domains Around the Giant Mine, NWT”, as part of the Prefeasibilty Study, SRK (May 2001). The study aimed to identify those major structures and background discontinuities in the surrounding rock mass that have the potential to form discrete groundwater conduits, and, thus, provide a context for prioritizing different areas for follow-up testing and monitoring programs.

Following a brief surface and underground inspection in October 2000 of the structural setting of the Giant Mine, it was felt that the structures most likely to be important in terms of groundwater flow, outside the mine workings, belong to the Proterozoic fault system developed between the West Bay and Akaitcho faults. These structures were mapped in detail by Kelly and Polk (1968-69), who produced a set of 8 hand-drafted maps at a scale of 1:1200. Approximately 3500 individual structures were digitized from these maps in MapInfo format, and formed the basis for the structural analysis.

The structural framework defined by the Proterozoic fault system around the Giant Mine consists of a broad interconnected network of major structures, separating discrete domains of minor structures. Each domain is characterized by a unique orientation distribution of dominant fault sets, as shown by the rose diagrams in, and coincides, to some extent, with sharp changes in the dominant rock types. These observations allowed definition of 11 distinct ‘lithostructural’ domains.

Figure 2 illustrates the distribution of interpreted ‘lithostructural domains’, described in the report (#1CI001.06.230). The boundaries of the domains coincide with major structural and/or lithological breaks. Major structures (red) have each been assigned a ‘zone of influence’ (blue), which reflects the higher densities of discrete minor structures (observed or assumed) in these areas. Rose diagrams illustrate the dominant structural trends in each domain, which may have some influence on groundwater flow by imparting an anisotropy to hydraulic conductivity. This is addressed below in the discussion regarding the conceptual groundwater model for the site.

The potential influence of the structures on groundwater flow will vary according to their scale of development and transmissivity. Major structures include those faults that are continuous over significant distances, and intersect many other structures. These faults also tend to be associated with a higher density of faults and fractures in their adjacent wall rock, and have therefore been assigned a ‘zone of influence’ (shown in blue in Figure 2) to indicate the estimated dimensions of their connectivity. Minor faults, on the other hand, are discrete, yet pervasive, features, that may or may not intersect other structures. The minor fault population may, therefore, be thought of as a background anisotropy in the rock mass, but these features are not expected to channel large volumes of groundwater.

The data used in the SRK (2001) structural study was confined to surface expressions only. To provide a basis for the conceptual hydrogeology model, it was necessary to extrapolate the structural data to depth. For the major structures, this was achieved either by interpolation between known intersections with the underground workings, as with the Rudolph and 3-12 faults, or by projecting from surface, using the measured dips on Kelly and Polk’s maps. The minor faults are predominantly steep structures and, for ease of treatment, were considered to be essentially vertical.

2.2.3 Observed Structural Controls on Underground Water Flow

Groundwater flow, while not significant in volume, is quite common in the Giant Mine. Mine geologists recorded many instances of groundwater inflow into the mine when they mapped the drifts on the main levels of the mine. Groundwater inflow was noted to occur along faults, joints and fractures, but rarely along the contacts of intrusive bodies. Water flow through faults and joints is irregular, making predictions of flow rates through specific structures difficult, if not impossible (T.Canam – pers comm.).

A brief review of the original mapping for 575 Ft Level indicates water inflow is predominantly along faults that average 220º. The exception is the Supercrest area where the strike of water bearing faults is approximately north – south. While the presence of water was noted, flow rates were not estimated other than “dripping” or “medium H_20 dripping”.

Further reviews of the mine geology notes have not been carried out at this time. However, this may prove to be useful in areas such as below the North West Tailings pond, Baker Creek, and the extension of the 2000 Foot level below the lake.

2.3 Mine Layout and Geometry

The mine layout follows the north-south trending shear zone. The tunnel system can be seen in Figure 1 to be elongated along this trend, and so is expected to act as an extended “envelop” with respect to intercepting and altering groundwater flow paths in the mine area.

Vertically, the mined volume extends along the axis of the mine fairly uniformly in the south and central area. This changes in the northern section (Supercrest Zone) where the tunnels do not extend below the 1500 Ft Level (~460m depth) and to the south of “C” Shaft where the mine only extends to the 700 Level (~200m depth). A small section of the 2000 Ft Level also extends eastward under Yellowknife Bay. This is discussed in more detail below when examining water levels in the open and instrumented S-1955 drillhole.

2.4 Available Piezometric Data

2.4.1 Data from Existing Drillholes

The GSC-EXTECH program (1998 to 2002) collected water level data from the existing deep exploration drillholes during their site work in 1999. No formal monitoring system was carried out, so only sporadic data are available. Table 1 presents measurements from the drillholes investigated in that program. Several of the drillholes were blocked with debris or ice, or the angle of the drillhole was not sufficient for a water level tape to slide down. Therefore, no data are available for these drillholes.

It should be noted that the water level measured represents an averaged pressure for the entire drillhole length. As some of these drillholes are up to 1600m in length, and likely intersect faults and/or come close to open mine workings at depth, the water levels measured need to be assessed carefully to see if they provide useful data. Note, the “depths” measured are length along drillhole and they have not been corrected for dip. However, the data plotted in Figure 3 have been corrected for dip and represent the elevation of the averaged piezometric data for the most recent measurement available (underlined in Table 1). Data from the shallow drillholes completed by Golder Associates Ltd (2001) are also shown in Figure 3, and indicated by the “MW00-XX” designation..

Table 1
Open Drillhole Piezometric Levels

	Position of Averaged Piezometric Level in Open Drillhole (m below ground surface - Not Corrected for Dip)			**Elev (masl) (corrected for dip)**
Drillhole ID	**Aug, 1999**	**Oct, 2000**	**Dec, 2001**	**Plotted Data**
S-1848	<u>110.0</u>	> 50 *	-	< 1724
S-1853	-	<u>4.4</u>	-	1843
S-1857	<u>84.7</u>	> 50 *	-	1758
S-1859	-	> 10 [ǂ]	-	< 1850
S-1860	-	1.2	<u>2.1</u>	1841
S-1954	-	Blocked near collar	-	-
S-1955	na [ǂ]	na [ǂ]	<u>>150</u> [#]	< 1698
S-1956	-	Blocked at 20m? [ǂ]	-	< 1838
S-2138	-	0.9	<u>1.6</u>	1844
S-2141	-	<u>1.0</u>	-	1845
S-DIAND-001	not drilled	not drilled	<u>15.0</u>	1812
S-DIAND-002	not drilled	not drilled	<u>2.4</u>	1848
			Great Slave Lake	**1826**

Notes:

- = not measured
na = unable to collect data
* = water level > length of tape (50m)
masl = meters above sea level
ǂ = rod grease on footwall and dip angle interfered with lowering water tape down hole
= drill rods run in to a depth of 150 m during development No water detected in rods.
"not drilled" = drillhole was not drilled when data collected.
Underlined data = most recent data available. Data used in elevation calculation.

2.4.2 Limitations of Available Piezometric Data

Open drillhole piezometric data is useful for representing the averaged piezometric level (water level) intersected by the drillhole. However, using open drillhole data for mapping the surface expression of the drawdown cone across the site can be problematic. This is due to the "averaging" effect caused by the extremely long drillholes and the heterogeneity of the rock mass and related hydrogeological features intersected. For example, the deep drillholes extend through the dewatered section of the mine and into the underlying rock. This will connect shallower, dewatered rock with deeper faults/fractures at depth, which could mask specific effects caused by discrete groundwater zones. Furthermore, the angled drillholes also cut across the drawdown cone and so will cut across varying piezometric levels.

The measured water levels illustrated in Figure 3 demonstrate the difficulty in producing a reasonable drawdown cone from open drillhole data. For example, the apparent piezometric elevations in drillholes S-1853 and S-1857, both of which intersect the Westbay Fault and extend eastward under the mine workings, differ by 96m. Even when compared to the isolated zone pressures in the instrumented S-1857, the piezometric levels are still 5 to 6 times deeper than in S-1853. Because of these discrepancies, it was decided that attempting to generate a drawdown cone from the open drillhole data would be misleading.

2.5 Groundwater Flow Patterns inferred from Available Data

2.5.1 Predicted Flooded Mine Flow

The underground mine workings are roughly perpendicular to the expected regional groundwater flow path, and therefore, will act as a collector system for any flow passing through the site. In a flooded state, flow within the region of the mine will be dominated by the open tunnel system, rather than any bedrock features (i.e.: faults, joints, primary media, etc.). If the tunnels collapse in the future, it is assumed that piezometric levels within the tunnel system, because of the large contrast between the collapsed tunnels and the relatively low K rock surrounding the mine, will continue to equilibrate throughout the workings. Therefore, the external boundary effects are expected to channel flow from dominant source(s) to a dominant drain(s) i.e.: the highest permeability flowpath “source” and “drain” that intersect the envelope.

The identification of these source and drain features will help define the general flowpath of water through the mine workings. This, in turn, will provide a more reliable prediction of the volume of water that passes through the arsenic trioxide storage zones within the mine after reflooding. The possibility also exists that these areas could be in a stagnant section of the mine, thereby reducing the mobilization of dissolved arsenic that would be carried to receiving bodies.

2.5.2 Preferred Flow Paths

If “entry” and “exit” feature(s) control flow through the mine, it is likely that these flow points will be related to local preferred flow paths features such as faults, areas of interlinked jointing, lithology contacts, etc. Therefore, identifying these preferred pathways and modelling their interaction and control on the hydrogeology is crucial step in producing a more accurate conceptual model of the site.

Groundwater movement in bedrock systems occurs through two main flow media: primary and secondary porosity. Primary porosity consists of the interconnected pores within the rock mass itself. In material such as sandstone, the primary porosity can be very high, with a correspondingly high hydraulic conductivity, "K", values of 10^{-5} to 10^{-8} m/s. The altered volcanics found at Giant are likely to have a significantly lower primary porosity, with corresponding matrix K values of 10^{-8} to 10^{-13} m/s. Secondary porosity refers to flow through features such as cracks and separations in the rock formed later by structural movement, glacial unloading, etc. These features are important in that a very small opening can form a significant flowpath within the rock. A useful example of this is the comparison of a 1 m thick sandstone to a 1 mm wide crack; both of which can convey a similar amount of water. As the flow through the fracture is related to the cube of its open width, it is apparent that these secondary features are likely to play the dominant role in an inherently low permeability geological setting.

2.5.3 Locations for Monitoring Wells

To help identify potential preferential groundwater flow pathways, the groundwater monitoring system was positioned to collect data on the hydrogeological system as water enters and leaves this zone of interest. The envelope used in the planning is illustrated in Figure 3.

An inherent problem with monitoring a structurally controlled hydrogeological system is that while it may be possible to determine that a specific geological feature is not a significant pathway, it is not certain if unrecognized features may be present in areas where monitoring is sparse. Therefore, a groundwater monitoring program in a fractured environment must prioritize expected pathways/hydrogeological controls and assess them in sequence. Because of this, it is also important that the hydrogeological model recognizes that unidentified pathways are likely to exist in the system and that these undetermined pathways may still dominate the groundwater flow system. Even in the case of a large scale hydraulic disturbance (e.g.: drawdown due to mine workings), interpretation of the hydraulic head distribution can be confounded if the monitoring wells are not located in the dominant hydraulic features.

The domain map and existing deep drillhole data (Figures 2 and 3) indicated that insufficient data were available for the Townsite and Rudolph Faults as they transect the rock between the mine workings and the lake. If these faults have higher permeability than the surrounding rock, they would probably form preferential pathways between the mine and the lake. To investigate these faults, the two new drillholes budgeted for the program (S-DIAND-001 and –002) were positioned to intersect the faults.

The section of the existing deep drillholes that were instrumented with the multilevel equipment and the new, instrumented drillholes are indicated in red (Figure 3). It should be noted that the faults, as illustrated, are the surface expressions, and so may not appear to intersect the drillholes at the expected position.

Positioning the monitoring wells had to take into account that the system design was limited due to budget constraints. Consequently, monitoring installations were located in areas where saturated conditions were well within approximately 150m lineal depth. Water levels above the mine workings are expected to be below this depth due to current dewatering. Therefore, as the locations chosen required the wells to be positioned near the outer edge of the drawdown cone exerted by the current dewatering effort, away from the mine envelop, groundwater intercepted by the wells will be flowing towards the mine and is not expected to contain water directly influenced by the mining operations or arsenic storage chambers. This will limit the geochemical information available from the wells, however, they will serve as background monitoring sites for characterizing the local geochemistry.

3. INSTALLATION OF GROUNDWATER MONITORING SYSTEM

3.1 Monitoring System Requirements

3.1.1 Multiple Level Monitoring

To obtain more data on the groundwater gradients and potential changes in hydrogeologic properties in the shallow rock mass, a multiple level monitoring system was installed in three existing drillholes (S-1857, S-1860, and S-1955), and two (2) new drillholes (S-DIAND-001 and S-DIAND-002). Multiple level Westbay systems were used in order to gain as much information as possible from each drillhole.

3.1.2 Multiple Level Well Design

A brief description of the Westbay MP System ™ is presented to clarify the system design and components used in the subsequent testing and monitoring discussions below.

The multilevel wells consist of a single, closed PVC pipe system (38mm ID) that is designed to isolate zones of hydrogeological interest in a single drillhole. As shown in Figure 4, the different levels (monitoring zones) in a borehole are separated by using water inflated packers. The system is installed in the borehole with a series of modular hydraulically inflated packers that are mounted on the PVC pipe. Once all of the well components have been lowered into the borehole, a packer inflation tool is lowered into the borehole and packers are inflated individually. No permanent packer inflation hoses are left in the borehole.

To measure pressures and collect fluid samples within each monitoring zone, a special coupling referred to as a measurement port is used. Each measurement port coupling has a small check valve containing a spring that keeps the valve closed so that it will not open due to the application of an exterior fluid pressure. As shown in Figure 5, the measurement port is operated by means of a MOSDAX® pressure/sampler probe that is lowered into the borehole, locates the measurement port and opens the port valve using an o-ring sealed faceplate. At this point the probe is hydraulically connected to the monitoring zone outside of the PVC pipe, and isolated from the water inside the pipe.

During the pressure measurement or sampling, because the probe is connected to the exterior water in the monitoring zone and unaffected by the interior water levels, it is possible to collect fluid samples, as well as monitor the pressure from the zone. This fact is key to the operating of the system, and for carrying out pressure response testing as discussed below. Because of the limited hydraulic movement through the valve, pressure response (i.e.: rising head) tests carried out through the measurement port are limited to zones in low K (10^{-9} m/s or less) geological units.

To test zones in moderate and high permeability units (10^{-4} to 10^{-8} m/s), a pumping port coupling is employed, as shown in Figure 6. This coupling has an o-ring equipped slide valve that seals several relatively large openings. The total area of these openings is approximately equal to the cross-sectional area of the inside of the casing. Pumping ports remain closed until opened. The slide valve can be opened using a mechanical tool, at which point the pipe system is connected to the outer zone hydraulic system (i.e.: same as an open standpipe). Standard “slug” tests can then be carried out and monitored using the pressure probe to measure changes in the inside water pressure. Pumping ports are also used for purging prior to initial sampling (not required after this as the system is sealed) and for taking large volume samples.

3.2 Inspection of Historic Drillholes for use in Monitoring System

Two deep drilling programs were carried out at the Giant Mine in the 1980’s as part of a deep ore exploration program. These drillholes were cased in the upper 5 to 10m’s, and otherwise have been left open since that time. Water levels for the drillholes were not recorded as part of the drilling process, and only sporadic water level data is available since that time (see Table 1).

Three of the deep drillholes were selected for use in the monitoring system based on their location around the periphery of the Giant Mine surface and underground operations. Two of these holes, S1857 and S1860 are located along the western limits of the Giant Mine property (see Figure 3). The third hole, S1955 is located on the East side the mine property. All of these drillholes are NQ size in diameter.

3.3 New Locations and Reasoning

3.3.1 Expected Flowpath Areas

New drillholes were located in areas of suspected groundwater flow from the mine workings to the lake under reflooded conditions (Figure 3). These areas, as discussed above, are located along the major interconnecting faults (Townsite and Rudolph).

The drillholes were also positioned to test both North-South and East-West striking faults to see if regional compressive forces have affected the transmissivity of either fault orientation.

Actual drillhole setups were located based on access to drill sites, as well as the expected downhole position of the faults. In order to intersect the steeply dipping faults, the drillholes were planned at an angle of approximately 62° from horizontal at the collar. The intersection distance on the 150m long drillhole was planned to be 100m. This was expected to allow for sufficient saturated material above the fault for monitoring, as well as a significant length of drillhole on the other side of the feature to test what hydraulic conditions were across the fault.

3.4 Drilling and Testing Program

3.3.1 Relogging of Upper Section (Monitoring Zones) of Existing Drillholes

The top 150m of boreholes S-1857, S-1860, and S-1955 were re-logged in preparation for installation of Westbay MP™ monitoring equipment. The relogging process was carried out to ensure that the MP casing installed in the existing holes was properly positioned to monitor possible lithological and/or structural features that may not have been recorded in the original inspection. The scope of the exploration drilling was to identify deep mineralogical targets, and not shallow hydrogeological features.

The core was retrieved from the Akaitcho core racks and brought back to the Giant Mine core shack. During re-logging, the core was compared to the original log for lithologies and structural features noted in the original work. In addition, the re-logging focused on identifying structural features not noted during the original logging. Particular attention was focused on jointing and iron and other geochemical staining of joint surfaces. RQD was recorded for these holes.

Revised drill logs are presented in Appendix A. When compared to the original drill logs, it is felt that the relogging process was worthwhile as the previous inspection did not contain sufficient detail on smaller fractures/joints for monitoring well design.

3.3.2 Cleaning and Development of Existing Drillholes

Connors Drilling Ltd of Yellowknife was contracted to perform drilling and testing of boreholes. In order to ensure that the existing drillholes were open to the design depth of the proposed monitoring equipment, and also to remove/reduce the effects of geochemical precipitation and/or siltation in open cracks since drilled, it was decided to "develop" the wells.

The inspection of the drill holes consisted of setting a diamond drill rig over the existing surface casing, and then lowering drill rods to a depth of 150 m (500 feet) to check for, and remove any obstructions in the borehole. The drill rods were then pulled from the borehole, the bottom rod was capped, and a 5 m section of perforated rod was added to the drill rods. The top and bottom of the perforated section of rods was equipped with rubber surge blocks that sealed the interval from the remainder of the hole. The drill rods were then lowered to 150m again. A swabbing tool (series of upwards facing rubber cups with a one-way flow through valve) was attached to the wireline hoist assembly on the drill rig, and lowered to the bottom of the drill rods. The swabbing tool was then raised quickly up the drillhole approximately 30m, or until a strong return flow of water came from the open drill rod on the drill rig. This process was repeated three times for each station. The perforated section was then raised 3 m (10 feet) by removing one drill rod, and the swabbing process was repeated. This procedure was continued up the hole until the standing water table was reached.

Whether the cleaning process (running in the drill rods) was necessary is not clear. Small obstructions, which may have prevented the installation of the PVC monitoring casing, may have been pushed out of the way by the far heavier drill bit/rods. However, the development process, which required the drill rods, was felt to be worthwhile. Observations of the water flowing from the drillhole showed that significant amounts of fines (mud, drill cuttings, etc.) as well as some oil in S-1857, were pulled from the monitoring zones. These materials could potentially affect hydraulic and geochemical testing, and so are best removed from the drillhole.

S-1955 was dry to a depth of 150m. Since water is required to create suction to clear fractures and faults of dirt and any drill additives, the cleaning process was not carried out in this drillhole, or in upper sections of the other holes that were dry. Therefore, fractures and other hydrogeological features in these sections may be blocked by drill debris.

It is also known that drill grease is found on the drillhole wall in the upper section of the deep drillholes. This may also interfere with hydraulic testing and sampling if the zones become saturated once isolated by packers. However, long term pressure monitoring should not be affected as the zones will be able to equilibrate if piezometric changes are not too rapid.

3.3.3 Drilling New Monitoring Wells

Two HQ diameter (96mm) boreholes were drilled to intersect specific structural features around the Giant Mine. Borehole S-DIAND-001 was drilled to intersect the Townsite fault and S-DIAND-002 was designed to intersect the Rudolph fault (Figure 3). The target depth of intersections for both holes was approximately of 75m (250 feet) below surface. No drilling additives were used while drilling these holes, therefore hydrogeological features such as faults and joints should be reasonably intact from drilling effects.

The boreholes were located by the Giant Mine survey crew on the Engineering co-ordinate system. The core was logged utilizing the Giant Mine logging system for lithologies. Furthermore, RQD and a modified Rock Mass Rating (RMR) were recorded. This information is included in the attached well logs in Appendix A. The core is currently stored on pallets outside of the Giant Mine core shack.

S-DIAND-001 intersected the Townsite fault as planned. The fault section was described as a 2 to 3cm thick gouge section separating a weakly foliated, low RQD chlorite schist and a more competent pillow flow basalt unit. No subparallel splay faults or fractures of significance were observed.

S-DIAND-002 intersected a zone, approximately 2.1m along intersection, of jointing where the Rudolph fault was expected. This area was described as having fractures at approximately 20 degrees from core axis, with no apparent staining observed. The fault surface was smooth (epidote present?), with only minor slickenslides. Sub-parallel shearing was observed to contain calcite infilling. It is felt that this jointed zone probably represents the Rudolph fault.

The section identified as the Rudolph Fault is located in pillow flow volcanics. Of interest is a 10m intersection of brecciated pillow flow intersected just before the fault. This brecciation is likely controlled by the fault and may run parallel to it for some distance.

Core orientation tests were conducted at 10m (30ft) intervals down hole. The core orientation tests were conducted using the clay imprint method. This method was successful in the full length of S-DIAND-002, and in S-DIAND-001 after it intersected the Townsite fault. Orientation measurements made in S-DIAND-001 from the collar of the borehole to the Townsite fault, drilled through chlorite schist, returned a low quality of core. Therefore, orientation was not possible with this method as it was not possible to align the core more than a meter or so past the clay test locations in chlorite schist.

Down hole surveys were conducted by the drill crews on both holes utilizing a Sperry Sun “Single Shot” instrument. The drill logs have not been converted to true depth, but are recorded with respect to location along drillhole trace. However, all hydraulic testing and pressure data have been corrected for dip and deviation.

Upon completion drilling, the borehole was cleaned in the same manner as the old drill holes, in preparation for packer testing. Packer testing was conducted on selected intervals in both boreholes utilizing a double packer assembly through the drill rods. Results from the packer testing are presented in Appendix B and in Section 4 below, along with results from monitoring pressure response tests.

3.5 MP Casing Installation Program

3.5.1 Installation Procedures

Installation of the Westbay MP casing consists of the following:

- Design of modular component layout for each well (see well logs in Appendix C);
- Lowering and field testing of components to design depth;
- Hydraulic integrity testing of MP casing (see if it can maintain a differential water level between it and the open drillhole) to check for leaks;
- Individual inflation of hydraulic packers;
- Initial pressure profile to test for ability to maintain differential pressures across packers.

For further information on the installation procedures, details can be viewed on the Westbay website at: www.westbay.com

3.5.2 MP Casing Designs and Installation Documentation

Well designs and installation QA documentation are provided in Appendix C. It must be noted that the casings "depths" listed refer to a position along the drillhole, and therefore are not true depth (i.e.: not corrected for dip/deviation). True depth locations of the components are illustrated in Figures 7 through 12. These drill and well installation logs have been corrected for both dip and deviation.

True depths are used when discussing the results of the data analysis. These are converted to elevations for purposes of presenting the groundwater pressure data in the accompanying figures.

4. MONITORING

4.1 Hydraulic Testing

4.1.1 Hydraulic (Packer) Testing in New Drillholes

Hydraulic packer tests utilizing commercially available nitrogen inflated packers are often used to measure the hydraulic conductivity of specific zones in the drillhole. The packers are inflated to isolate a section of drillhole, after which water is pumped down the test rods into the measurement zone while recording the flow rate at specific pressure "steps". The resulting flow vs. pressure relationship can then be used to estimate the hydraulic conductivity of the rock tested, as well as the possible characteristics of the fractures in the rock. Results of the tests are illustrated in Appendix B and in Table 2 below.

The tests were planned as part of the original summer/fall drilling problem. Unfortunately, delays in budgeting and contracting lead to the drilling being carried out in the early winter (November and December).

Budget limitations, and the need for installing water lines during extremely cold weather ($\leq$ -30°C) for the rehabilitated drillholes, restricted the hydraulic packer testing program to the two new drillholes (S-DIAND-001 and 002). The tests were found to be problematic due to inflation lines freezing, etc, and so only a limited number were carried out (4 tests in S-DIAND-001 and 1 test in S-DIAND-002).

Table 2
Calculated Hydraulic Conductivity Values from Packer Tests

Drillhole ID	Depth Range (m)	Hydrogeological Feature Tested	Hydraulic Conductivity (m/s)
S-DIAND-001	35.0 – 37.7	Fault (splay)	3×10^{-8}
	80.7 – 83.4	Pillow Flow Basalt	1×10^{-8}
	91.0 – 93.7	Pillow Flow Basalt	7×10^{-10}
	98.8 – 101.5	Pillow Flow Basalt	3×10^{-9}
S-DIAND-002	13.0 – 15.7	Mafic bedrock	3×10^{-9}

Depth ranges have been corrected for drillhole dip.

It should be noted that packer testing estimates are considered to be suspect when measuring below 10^{-7} or 10^{-8} m/s using normal equipment. At these low K's, the potential errors induced by small leaks in the system become significant. However, even if the data does not result in a reliable quantitative estimate, it is evident that the calculated hydraulic conductivity values are quite low. Later testing supports this observation (see below), as well as behaviour of the zones pressures during and after installation (see below), and correlates well with underground observations where water inflow along faults has always been reported to be moderate to low.

4.1.2 Hydraulic (Slug) Testing in Drillholes using Multi-Level System

Hydraulic response tests were also carried out in selected zones using the multiple level monitoring system. These tests consisted of two types:

- Pressure pulse tests conducted with the pressure transducer (for low K zones);
- Rising head (slug) tests in areas of higher K (faults and joints, etc.)

Pressure pulse tests consist simply of recording the pressure spike and decay caused through an open measurement port valve. The sampler probe is used to open the measurement port valve (Figure 5) and measure the static pressure in the monitoring zone ($P_{outside}$). With the pressure inside (P_{inside}) the MP casing less than outside, a pressure "spike" can be caused by momentarily opening the sampler valve and allowing water to drain from the monitoring zone in to the MP casing. Once the sampler valve is again closed, it is possible to measure the pressure response in the zone.

Results of the tests are illustrated in Appendix D. It should be noted that these types of tests are subject to significant errors induced by “skin” effects (i.e.: drilling mud on drillhole wall, drill induced cracking, etc) and have a very limited radius of effect. Therefore, the data should not be used to calculate quantitative values of hydraulic conductivity unless a very through data collection and analysis program is carried out. This level of analysis was not warranted under the current scope of work due to the uncertainty of extrapolating the values to other sections of the site. However, the results are useful in assessing the general hydraulic conductivity behaviour (i.e.: fast, medium, slow) of the monitored zones. A discussion of the detailed analysis procedure is given in Novakowski and Bickerton (1997).

Rising head tests were conducted by bailing the internal water level (P_{inside}) down in the closed multi-level system to a level below that of the monitoring zone ($P_{outside}$). The rate of change in the water level inside the casing was then recorded when a slide valve (pumping port) was opened “instantaneously”, as illustrated in Figure 6. This action transforms the closed MP system into a simple standpipe piezometer. Hydraulic conductivity values calculated from pumping port data are considered to be more accurate, but still can be affected by skin effects, hydraulic limitations of the port openings, etc. However, for the range of values observed, the results of this method are considered to be reasonable.

Rising head tests (RHT) were carried out in S-1860, S-DIAND-001 and –002. These tests were conducted in the zones monitoring the Townsite and the Rudolph fault. Results are included in Appendix D. An RHT was not completed in S-1857 due to the significant depth to water (136m) making operation of monitoring tools and related cables problematic.

Pressure pulse tests were not carried out in S-1857, S-1860, and S-DIAND-002. Tests were not completed in S-DIAND-001 due to equipment problems that day. These tests may be carried out at a later date. Hydraulic conductivity test results of either type are not available for S-1955 due to the unsaturated conditions in zones 1 to 5. Pressure response tests in zones 6 and 7 were inconclusive and should be redone.

A summary of the K values calculated in the monitoring zones is given in Table 3.

Table 3
Calculated Range of K Values from Zone Tests

Drillhole ID	Test Type	Range of K Values (m/s)	Geometric Mean (m/s)
S-1857	PP	2×10^{-5} to 2×10^{-8}	5×10^{-7}
S-1860	PP and RHT	3×10^{-6} to 1×10^{-8}	3×10^{-7}
S-1955	Not tested	NA	NA
S-DIAND-001	RHT (Zone 4 only)	3×10^{-7} to 2×10^{-8}	9×10^{-8}
S-DIAND-002	PP and RHT	12×10^{-6} to 1×10^{-8}	2×10^{-7}

PP: pressure pulse
RHT: rising head tests (slug tests)

It should be noted that either the entire zone length (section of drillhole contained between the hydraulic packers), or in zones intersecting a fault, the true width of the fault zone, was used when calculating the hydraulic conductivity of the zone. The later assumes that all of the hydraulic effects are due to the fault flow, whereas the zone length assumes the recovery data represents the transmissivity of the full length of rock isolated.

4.2 Pressure Monitoring

Pressure profiles for each of the monitoring wells are illustrated in Figures 7 through 12. Piezometric levels in each monitoring zone are plotted as the "equivalent depth to water" on the plots. This refers to the depth the water would be observed in an open standpipe if screened across the MP zone. The equivalent depth to water is calculated by adding the pressure head (height of water column calculated from the zone pressure measured) to the depth of the measurement port where the pressure was measured. Any zone that has an equivalent depth to water greater than ground surface would have water flowing from the open standpipe and is classified as flowing artesian.

Pressure measurements have been corrected for atmospheric effects and in all of the plots the vertical depth (corrected for drillhole dip and curvature) is illustrated. The general geology/lithology features and the corresponding MP casing design (i.e.: packer locations) are shown to indicate where the zones are situated. The "error bars" illustrated are for presentation purposes and indicate the zone length monitored (section between hydraulic packers) and not calculated error.

The plots also show an "atmospheric line". This line indicates where the pressure head equals zero. This condition will occur if the zone is unsaturated ("dry"), and is analogous to an open borehole where the water level is below the measurement zone. Therefore, unsaturated zones will plot along, or below, the atmospheric line while saturated zones will plot above this line.

The profile data is useful in indicating where vertical pressure gradients are present, and in what direction they are acting. This is especially important for determining the effects of faults and other hydrogeologic features in the rock mass. This information can then be used to suggest potential paths of preferential flow in the rock, and therefore indicate areas of concern for contaminant flow.

The initial data were collected in February, when surface recharge is expected to be minimal. The second data collection profile was carried out in Late April (20^{th} to 22^{nd}, 2002), just as the surface temperatures were starting to rise above 0°C. It is assumed that the surface water interaction was still insignificant at this point, and therefore represents "pre-freshet" hydraulic conditions.

It should be noted that the monitoring zones are numbered from the bottom up. Therefore, Zone 1 will be at the bottom of the well, and higher numbered zones would be shallower. Also, in the retrofitted exploration holes, Zone 1 is measuring the hydraulic effects from the deepest packer to the bottom of the open drillhole (i.e.: in S-1955, Zone 1 is approximately 1,220m long.

4.2.1 Initial Data (Post Installation) vs. Equilibrated Data

Groundwater pressure data were collected from all of the monitoring wells immediately upon installation to document the pre-equilibration water pressures. As some of the monitoring zones are in low K rock (very little jointing, etc. observed), the packer inflation is likely to cause a "squeeze pressure" to form as the packer gland expands into the zone during inflation, compressing the water trapped between the two packers. This condition was initially observed in the lower zones in S-DAIND-002. Zone 2, in particular, showed an elevated response and initially appeared to indicate flowing artesian conditions. However, the pressures are observed to dissipate between the February and April measurements. The squeeze pressure will dissipate over time, but monitoring of the pressure dissipation is a simple means of recognizing low zone permeability.

Pressure data were collected two months later in late April. Considering the time (2 months) that had elapsed between data collection rounds, it is assumed that these pressure data represent equilibrated data (i.e.: the pressure measured represents the true groundwater pressure in the isolated zone, and not the averaging affect from the open drillhole pressure and/or installation effects) Comparison of initial and equilibrated pressure is very useful in that it reveals important information about the zones:

- Changes in pressure within a zone between the initial and the equilibrated pressures illustrates the effects of “averaging” effects in the open drillhole;
- Maintenance or development of differential pressures between adjacent zones indicates both that the packers are producing a hydraulic seal between the zones, and that hydrogeological features (i.e.: fractures) within the zones are controlling the hydraulic pressures (especially in zones that have similar lithology);
- Zones that show significant changes between the initial and equilibrated pressures are likely to be very low K environments (i.e.: high K zones would equilibrate immediately during the installation process). This is a good indication of the bulk zone characteristics.

4.2.1.1 S-1857

MP well S-1857 intersects the Westbay fault at depth of 131 m. A secondary fault feature is also present at 97 m depth. The monitoring well (Figure 7) was designed to bracket these faulted sections to measure their effects on the groundwater system. Zones 1 and 2 are located below the Westbay Fault, on the dewatered “mine side”, whereas Zones 3 to 10 are located upgradient of the Fault (to the west) on the regional side.

The pressure data in Figure7 shows the significant differences that can occur between initial installation pressures and equilibrated data in low K environments. Pressure data measured during the initial profile do not show the same pressure differential across the lower 5 zones as during the April measurements. This indicates that the zones were slow to equilibrate back to the individual zone pressures. The low K value assumed from the slow equilibration time does not support the concept that the Westbay Fault (Zone 3) may act as a lateral (north-south) groundwater conduit on the site. The changes in zone pressures between the initial and equilibrated pressures also indicate the effect that the "averaged" open drillhole pressure had on the discrete zone pressures.

More significantly, the data illustrates that piezometric levels are higher on the west side of both the "secondary" fault at 97m (first "break" in piezometric data) and the Westbay Fault. This is important in that it shows the fault(s) are acting as a hydraulic barrier, or impediment to groundwater flow, and that the current dewatering process has a far greater impact on the downgradient (mine side) of the fault(s).

4.2.1.2 S-1860

The two pressure profiles from S-1860 do not show a significant change in piezometric levels. This indicates that the zones equilibrated to formation pressure rapidly following installation and packer inflation. The slight rise in piezometric level observed may be due to infiltration, as the snow pack was starting to melt just prior to the April data collection.

Piezometric levels in MP well S-1860 are seen to generally decrease with depth (Figure 8). This type of pressure distribution would be expected, both as a downwards gradient would be expected due to the dewatering, and because the drillhole is angled towards the dewatered mine (therefore the pressures would not be hydrostatic along the length of the drillhole).

The exception to this pattern is the brecciated mafic volcanics in zone 3. This zone has a significantly higher piezometric level than the two neighbouring zones and likely represents a dominant hydraulic feature in the drillhole (fracture system extending to surface, etc). This zone was chosen for long term monitoring through the freshet

Because this monitoring well represents an up gradient section of the flow system at Giant, groundwater chemistry will be monitored to provide "background' levels for geochemical constituents as the enter the mine area.

4.2.1.3 S-1955

Prior to installation of the MP casing, drillhole 1955 was observed to be "dry" to a depth of 20 to 30m (limit water level tape could be lowered down inclined drillhole). When the drill rods were lowered to 141m during well cleaning and development, no water was detected when probed with a water level tape through the drill rods. This depth corresponds to an elevation of 1700 m (5577 ft), or approximately 126m (413ft) below lake level.

Given the proximity to the lake shore (~150m), it appears that the rock in this section of the site is very low K and that a very steep dewatering drawdown cone exists. It is possible that the observed water levels (Figure 9) could also be affected by the proximity of the drillhole to the 2000 Ft Level (82m separation, see Figure 10). Water in the open drillhole may have been draining to the tunnel system via stress release fracturing, pre-existing jointing, other drillholes, etc.

The probability of the rock mass having a very low K, and that water was flowing down the well and either being picked up by the general mine dewatering drawdown or draining to the 2000 ft level directly is supported by the following:

- Pressure measurement in zones 6 and 7 (upper two zones) indicate that the zones became saturated and equilibrated to the local formation piezometric level once the hydraulic packers isolated the zones within the drillhole.
- The lower zones are observed to have slightly negative pressure, thus indicating drainage suction in the deeper zones.

The 2000 Ft Level workings project out under Yellowknife Bay (see Figures 1 and 10). Observations of flow, as it drains to the C-Shaft sump, support the argument that the rockmass between the lake and the mine in this area is very low K. A flow of approximately 25 L/min was measured in the drainage ditch exiting the workings on April 20, 2002, when the pressure monitoring at S-1955 was taking place.

The 1650 Ft Level also projects out towards the bay beyond the "mine envelope". Ditch flows of approximately 2 L/min in July 2001 and 4 to 6 L/min, on April 20, 2002 were recorded at the C-Shaft sump. This again supports the premise that the rock between the lake and the mine has a very low bulk hydraulic conductivity.

It is also possible that the drillholes intersects a section of perched water in zones 6 and 7. This water may be perched on a section of lower K bedrock, while the rock below this, in zones 1 to 5, is dewatered at a rate higher than can be supplied through this low K zone.

4.2.1.4 S-DIAND-001

Pressure data from the two data collection rounds in S-DIAND-001 (Figure 11) do not differ in pattern, and only slightly in piezometric level. It is possible that the April round represents a slight rise in groundwater levels during the beginning of the freshet. While the differential pressures observed in the drillhole are not as great as those in other drillholes, there appears to be a significant change in piezometric levels to the east of the Townsite Fault (Zones 1 to 4). An upwards gradient is observed in these lower zones, which is not what would be expected in the vicinity of a dewatered mine.

The "rise" in piezometric levels may be affected by the fact that the drillhole is inclined towards the lake. However, these zones are also on the opposite side of the fault from the dewatered tunnels in the "A" Shaft area. This suggests that the bedrock to the east of the Townsite Fault, away from the main workings to the north, is not as strongly affected by the dewatering as on the west side of the fault. As with the Westbay Fault, this fact suggests that the Townsite Fault may impede lateral flow across it. Furthermore, as the piezometric level measured in the fault zone is considerably lower than the lake level (100 m to the south), it is apparent that it will not serve as a significant lateral path for flow either under current dewatered or reflooded conditions.

4.2.1.5 S-DIAND-002

A comparison of initial and subsequent monitoring data from S-DIAND-002 indicated that the piezometric levels in the bottom 2 zones (Figure 12) were most likely due to installation induced pressures as they have dissipated between the initial and the second pressure monitoring profile. This is also supported by the high RQD observed in the drill core.

Following equilibration, the drillhole exhibits a downward gradient along its length. While there isn't a significant pressure differential across the fault, the differential between zones increases below that point. This may indicate that the rock mass to the south of the fault, in structural domain 9 (see Figure 2) may have a higher bulk hydraulic conductivity than the rock to the north of the fault in domain 8, and so is draining more efficiently into the underlying 1650 and 2000 Ft Levels.

4.2.2 Summary of Equilibrated Data

The main features illustrated by the equilibrated data are:

S-1857: Data suggests that the Westbay Fault is acting as a hydraulic barrier, or impediment to groundwater flow, and that the current dewatering process has a far greater impact on the downgradient (mine side) of the fault;

S-1860: Water levels in this area were near surface (2m) in the open drillhole, whereas they are between 10 and 40m below ground surface in the newly instrumented sections. The multi-level data also shows a distinct downwards gradient except for in a brecciated section at ~100m depth where piezometric levels are near ground surface. This suggests that the mine dewatering effects does reach this far out, but that the open hole water levels may have been dominated by either the brecciated zone and/or hydrogeological features deeper in the drillhole;

S-1955: The rock mass is very low K and indicates a very deep, steep drawdown cone exists between the lake and the mine workings. Combined with the low inflow observed in the adjacent tunnel system, this supports the original concept that the areal extent of the drawdown cone is limited to a narrow band around the workings.

S-DIAND-001: The Townsite Fault may also act as a lateral barrier to flow across the feature. The section tested does not appear to be a significant conduit to flow due to the low measured hydraulic conductivity.

S-DIAND-002: Pressure data from the Rudolph Fault zone also shows that the fault is fairly low K, so it may not act as a significant conduit for flow between the mine and the lake if this persists across the entire feature. The differences in piezometric levels across the fault may signify a difference in bulk rock hydraulic conductivity in the two structural domains it separates.

4.3 Continuous Monitoring

4.3.1 Changes in Open Zone Water Levels

In order to monitor the possible changes in water level in specific zones in the MP monitoring wells, a single pumping port was left open in each of the monitoring wells (excluding S-1955) following the April monitoring period. In this configuration, the normally closed MP casing operates like a simple standpipe piezometer, thereby making it possible to measure changes in piezometric levels over the expected freshet using a simple downhole datalogger.

To measure changes in water levels, simple pressure transducer dataloggers, Solinst "Diver Leveloggers"™, were installed in the open casing and referenced to the depth to water at time of installation. These dataloggers will be used to record the changes in open standpipe water levels (if the zone can supply enough flow to equilibrate to the change in pressure head).

The zones that have been opened and equipped with the dataloggers are listed in Table 4.

Table 4
Open Pumping Port Monitoring Zones

Well ID	Zone number	Geological Feature Monitored
S-1857	3	Westbay Fault
S-1860	3	Brecciated zone at 96m
S-1955	Na (see below)	All Pumping Ports left closed
S-DIAND-001	4	Townsite Fault
S-DIAND-002	4	Rudolph Fault

The pumping ports in S-1955 have been left in a closed position due to the unsaturated conditions within the drillhole. During normal installation in a saturated drillhole, it is necessary to add water to the sealed MP casing in order to sink it into position. However, as S-1955 was unsaturated during installation, the MP casing was not filled with water during installation. Currently, the casing has only 5 to 6 m of water inside it from packer inflation and QA testing during installation.

Following packer inflation, it appeared that the MP casing was slipping down the drillhole. It is unlikely that the packer glands are not contacting the drillhole walls as packer inflation records indicate that the glands have sealed against the drillhole walls and differential pressures measured across zones following packer inflation. It is possible, however that grease on the drillhole walls, observed during the rehabilitation work, is causing the packers to slip. The casing was pulled back into position and is currently clamped at surface under approximately 230 kg of tension (estimated by installer).

In order to open the pumping ports in zones 6 and 7 and measure changes in water levels, it would be necessary to fill the MP casing to above the static water level in these zones (approximately 11m below ground surface). The water in the casing would then produce an extra load of approximately 1kg/m (the casing holds approximately 1L/m) in the unsaturated drillhole, for a total load of approximately 250 kg (casing and contained water) to be supported by the hydraulic packers or the clamp at the top of the MP casing. Therefore, as the additional load could stress the packers and/or top casing section, it was decided that it was not prudent to load the casing further.

At this point it is not known whether the packers between zones 1 to 5 are providing hydraulic seals as the pressures are all equal to atmospheric. However, pressure differentials do exist between zones 5 and 6, and zones 6 and 7, so these packers are providing at least partial hydraulic seals. Packer seal integrity can be tested by means of inter-zone pressure tests. These tests will be carried out in the future if freshet water infiltration does not produce differential pressures.

4.3.2 Changes in Closed Zone Hydraulic Pressure

The Westbay™ pressure probe can also be used for datalogging purposes, which makes it possible to monitor a “closed” zone via the measurement port valve. This is advantageous in low K zones where the pressure head fluctuates at a faster rate than could be monitored by a fluctuating water level in an open standpipe. It can also be used to monitor negative or unsaturated zones such as in S-1955. Therefore, during the freshet the probe could be installed in S-1955 to measure potential changes in suction pressure/saturation within the drillhole during freshet infiltration. If so, it is recommended that Zone 5 be monitored to see if it becomes saturated during increased infiltration events.

4.4 MP Well Monitoring Log

In order to maintain a clear record of the installation, development, monitoring, and servicing that is carried out on each MP installation over time, a log of these events will be recorded in a Monitoring System Well Log. A preliminary log is attached in Appendix E. This information should be updated any time work is carried out on the MP well(s).

5. INTERPRETATION

5.1 Inferences about Groundwater Flow Patterns

The results of the recent (equilibrated) pressure monitoring and the hydraulic conductivity testing indicate that the major fault zones may not form the dominant transmissive features in the region of the mining envelope. In the limited region investigated, the fault zones are in fact, acting more as an impediment to groundwater flow, possibly due to the fault zone fabric being dominated by gouge development,.

If these results hold for the other regions, the flowing consequences must be considered:

a) The Westbay Fault could form a hydraulic impediment to regional (west to east) flow. This would reduce the flux through the mine site under flooded conditions, and potentially redirect some of the regional flow around the mine site and into Great Slave where the Westbay Fault intersects the lake itself.

b) If the Townsite and Rudolph Fault do not behave as high K conduits between the mine workings and the lake, the uncertainty will be greater in the predictions of groundwater flowpaths. This will reduce the ability to plan contaminant monitoring:

c) Fault strike orientation does not appear to affect the transmissivity of the features. Therefore, regional compressive forces do not appear to have significant influence on flow patterns within faults.

d) If readily identifiable fracture zones are no longer the obvious targets for geochemical monitoring (i.e.: installing monitoring wells), it will make verification of contaminant flux more difficult. Therefore, the confidence level associated with any groundwater monitoring or control system will be reduced.

This report, Groundwater Monitoring System Installation Report, 1CI005.07.318, has been prepared by:

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Senior Hydrogeologist, (Associate)

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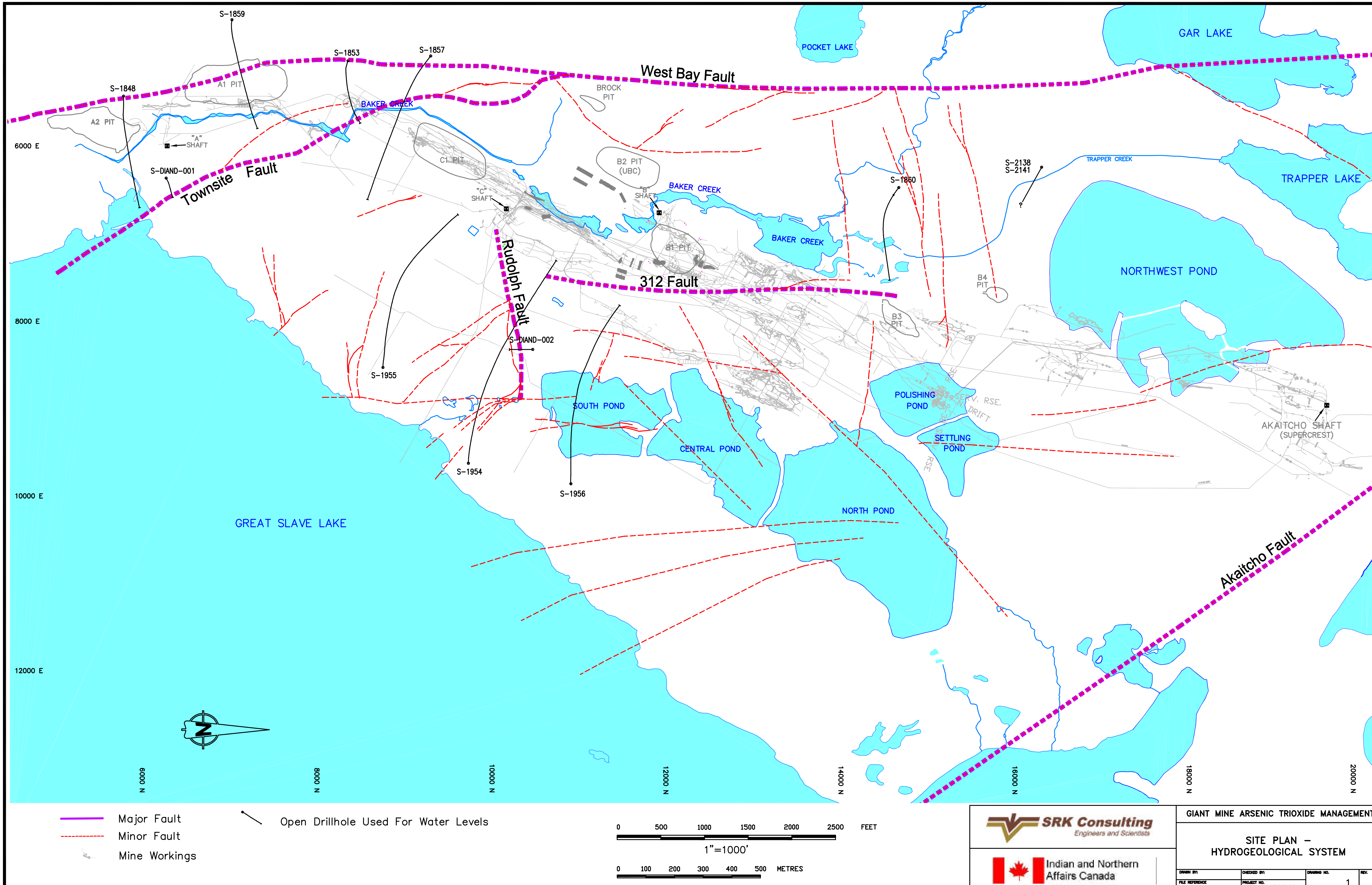
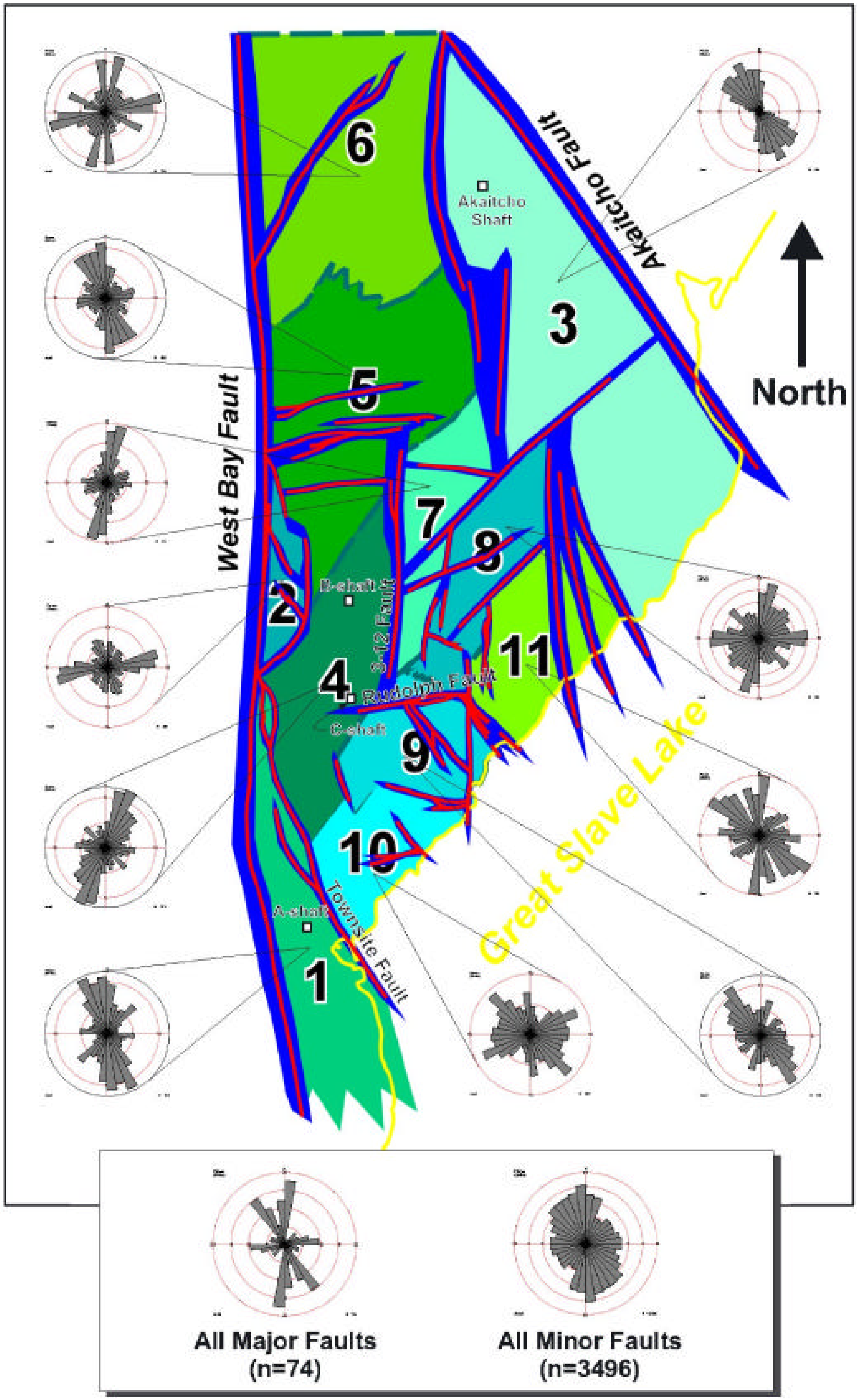
FIGURES


West Bay Fault
Townsite Fault
Rudolph Fault
312 Fault
Akaitcho Fault
S-1859
S-1853
S-1857
S-1848
S-DIAND-001
S-DIAND-002
S-1860
S-2138
S-2141
S-1955
S-1954
S-1956
A1 PIT
A2 PIT
B1 PIT
B2 PIT (UBC)
B3 PIT
B4 PIT
C1 PIT
BROCK PIT
"A" SHAFT
"B" SHAFT
"C" SHAFT
AKAITCHO SHAFT (SUPERCREST)
BAKER CREEK
TRAPPER CREEK
POCKET LAKE
GAR LAKE
TRAPPER LAKE
NORTHWEST POND
POLISHING POND
SETTLING POND
SOUTH POND
CENTRAL POND
NORTH POND
GREAT SLAVE LAKE
6000 E
8000 E
10000 E
12000 E
6000 N
8000 N
10000 N
12000 N
14000 N
16000 N
18000 N
20000 N
Major Fault
Minor Fault
Mine Workings
Open Drillhole Used For Water Levels
0 500 1000 1500 2000 2500 FEET
1"=1000'
0 100 200 300 400 500 METRES
SRK Consulting
Engineers and Scientists
Indian and Northern Affairs Canada
GIANT MINE ARSENIC TRIOXIDE MANAGEMENT
SITE PLAN – HYDROGEOLOGICAL SYSTEM
1CI001.06
1



SRK Consulting
Engineers and Scientists

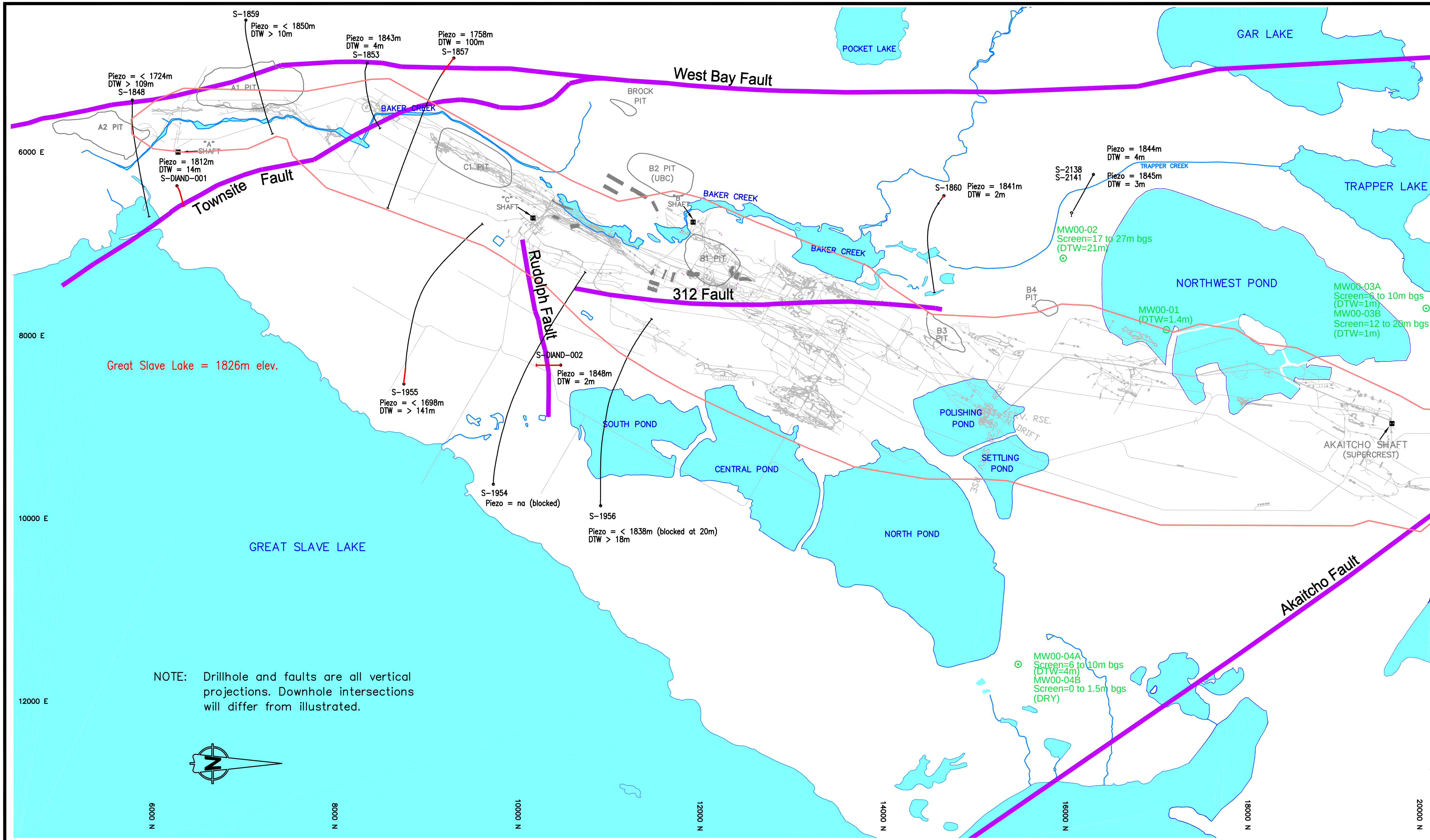
Indian and Northern Affairs Canada

GIANT MINE

Distribution of Interpreted "Lithostructural Domains"

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.07.318	April 2002		2

Dwg Ref: Figure2.dwg



Major Fault
Mine Workings
Mine "Envelope"
Open Drillhole Used For Water Levels
Multilevel Monitoring Well (red section)
DTW Depth to water below ground surface
Shallow GW Monitoring Wells

0 500 1000 1500 2000 2500 FEET
1"=1000'
0 100 200 300 400 500 METRES

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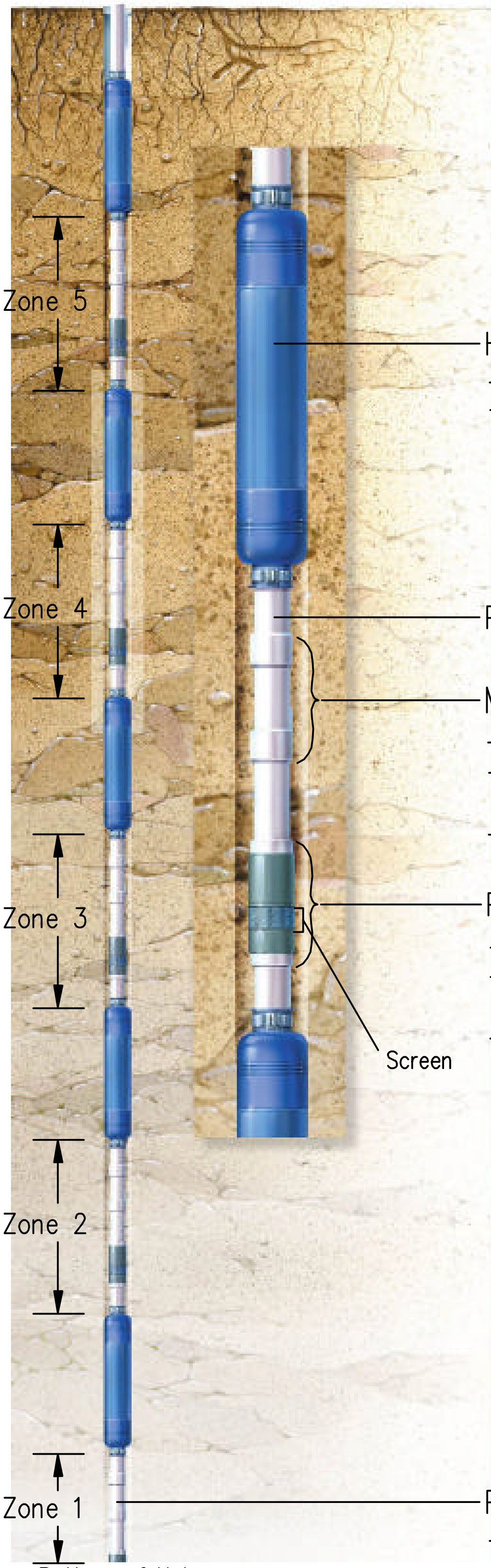
GIANT MINE ARSENIC TRIOXIDE MANAGEMENT

SITE PIEZOMETRIC LEVELS
(Elev and DTW)

PROJECT NO. 1CI001.06
DRAWING NO. 3

Monitoring Zone Components



Hydraulic Packer
- Provides hydraulic seal between zones
- Controlled, individual hydraulic inflation

PVC Casing (38 mm ID)

Measurement Port Coupling
- Equipped with spring loaded valve
- For fluid pressure monitoring, fluid sampling, and low K pressure response tests
- Used in all zones

Pumping Port Coupling
- Equipped with screen section closed by slide valve
- For purging/development, hydraulic conductivity testing and quality assurance testing
- Only used in primary zones

PVC Casing and regular couplings
- All couplings are sealed with O-rings to provide watertight system

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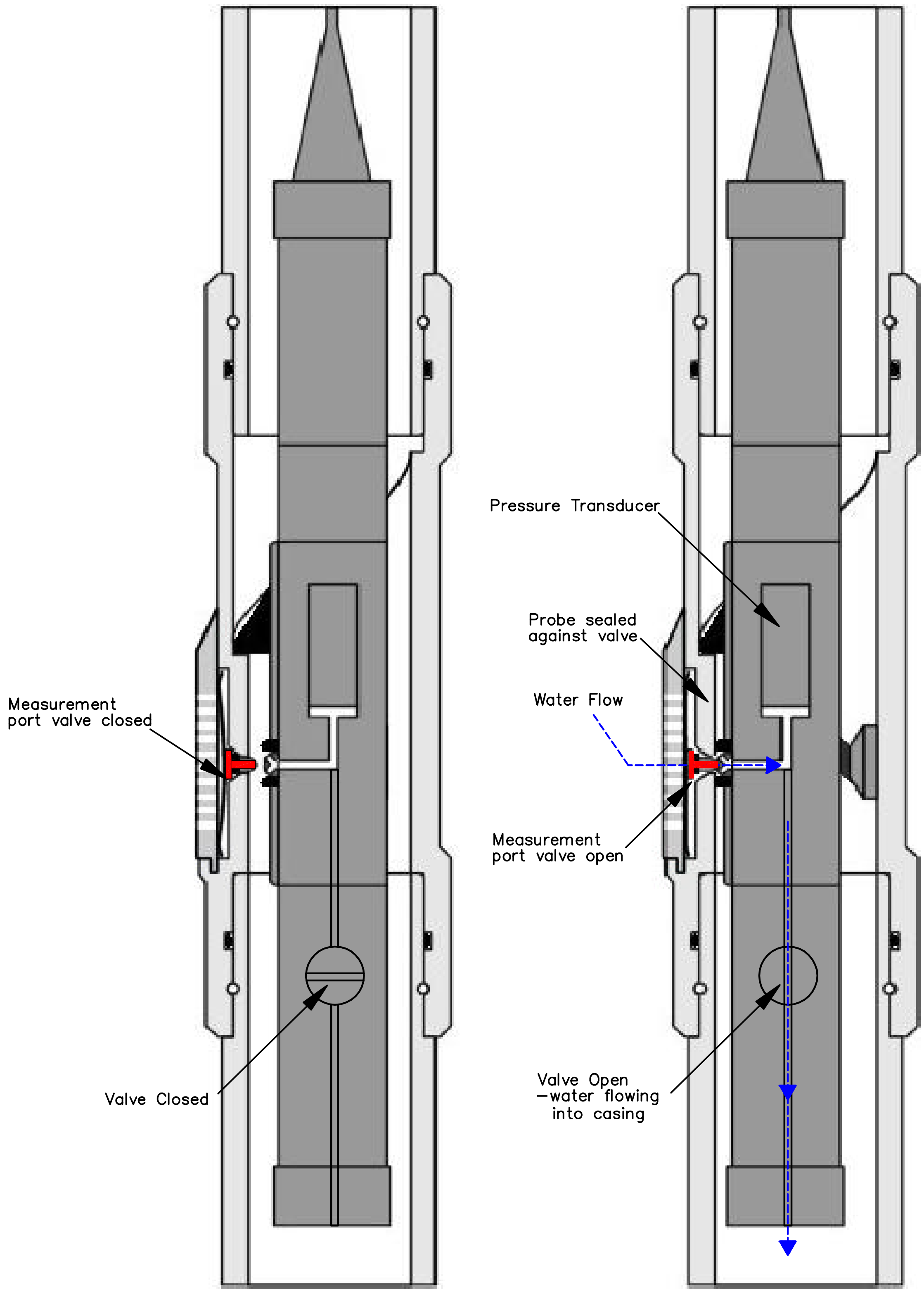
GIANT MINE

MP Casing Components

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.07.318	April 2002		4

Dwg Ref: 1955_view.dwg



Probe Deactivated
–measuring P (inside)
Probe valve closed

Probe Activated
–measuring P (outside)
Probe valve open

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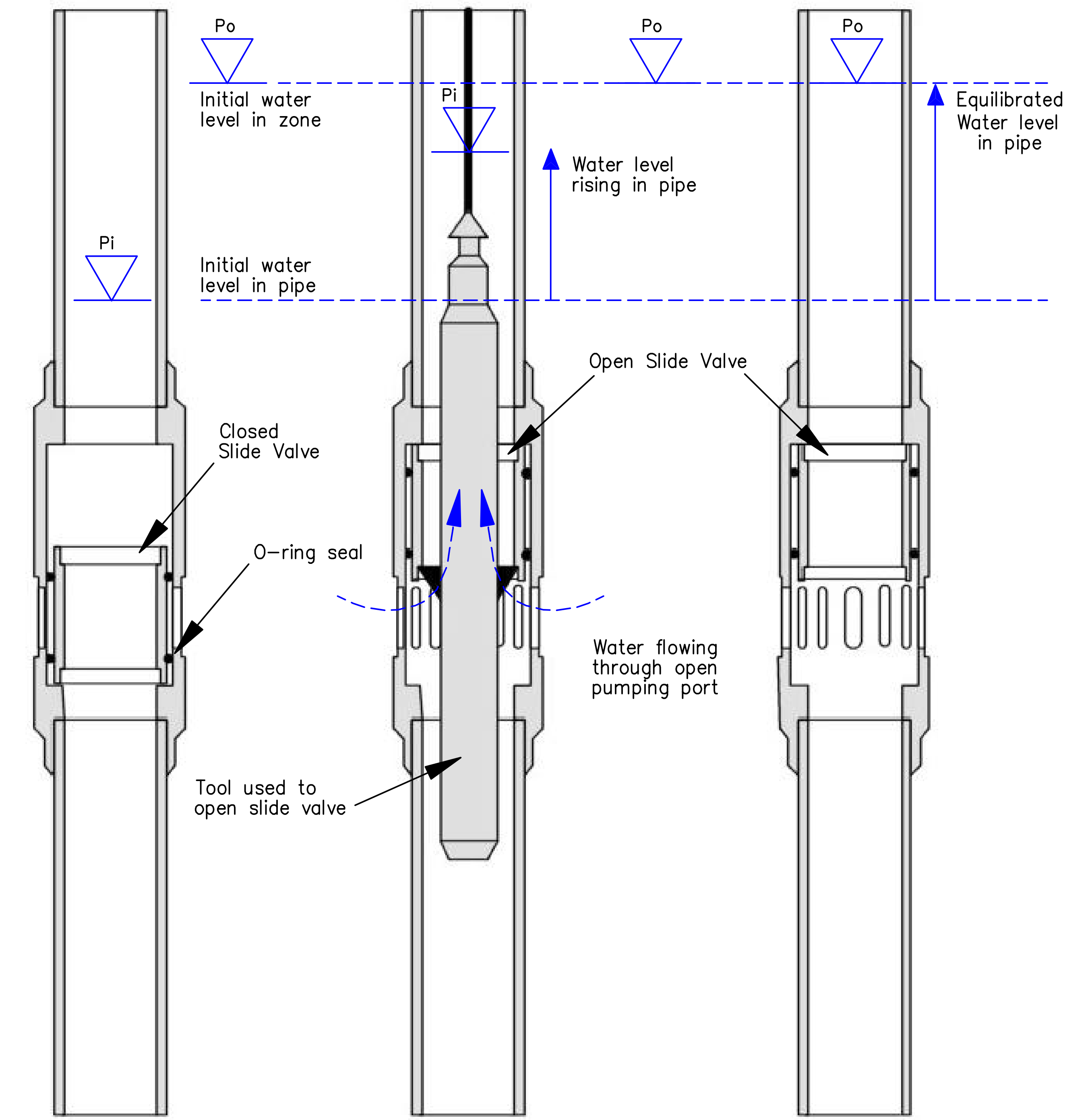
GIANT MINE

K Testing through a Measurement Port Coupling

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.07.318	April 2002		5

Dwg Ref: 1955_view.dwg



Poutside > Pinside

Poutside > Pinside

$\text{Poutside}_{Tn} > \text{Pinside}_{To}$

Poutside = Pinside

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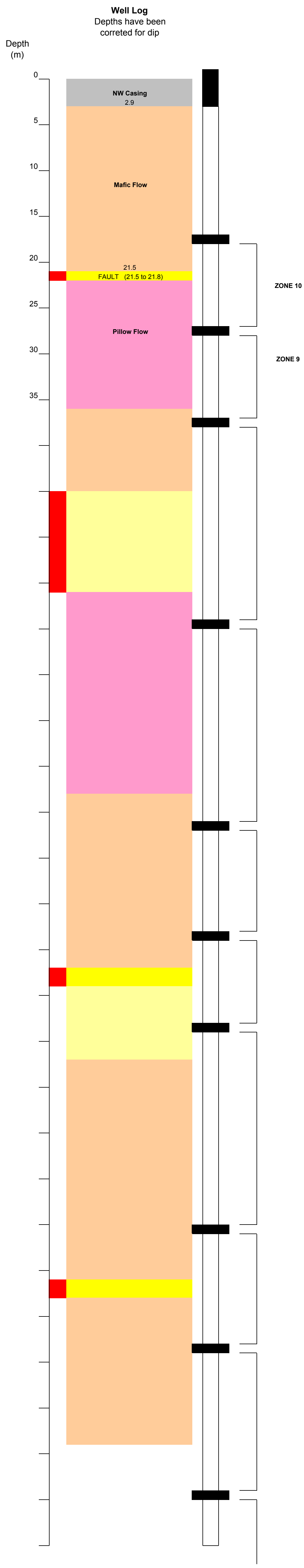
GIANT MINE

K Testing through Pumping Port Coupling

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.07.318	April 2002		6

Dwg Ref: 1955_view.dwg

Well Log and **Pressure Profile Data**
S-1857



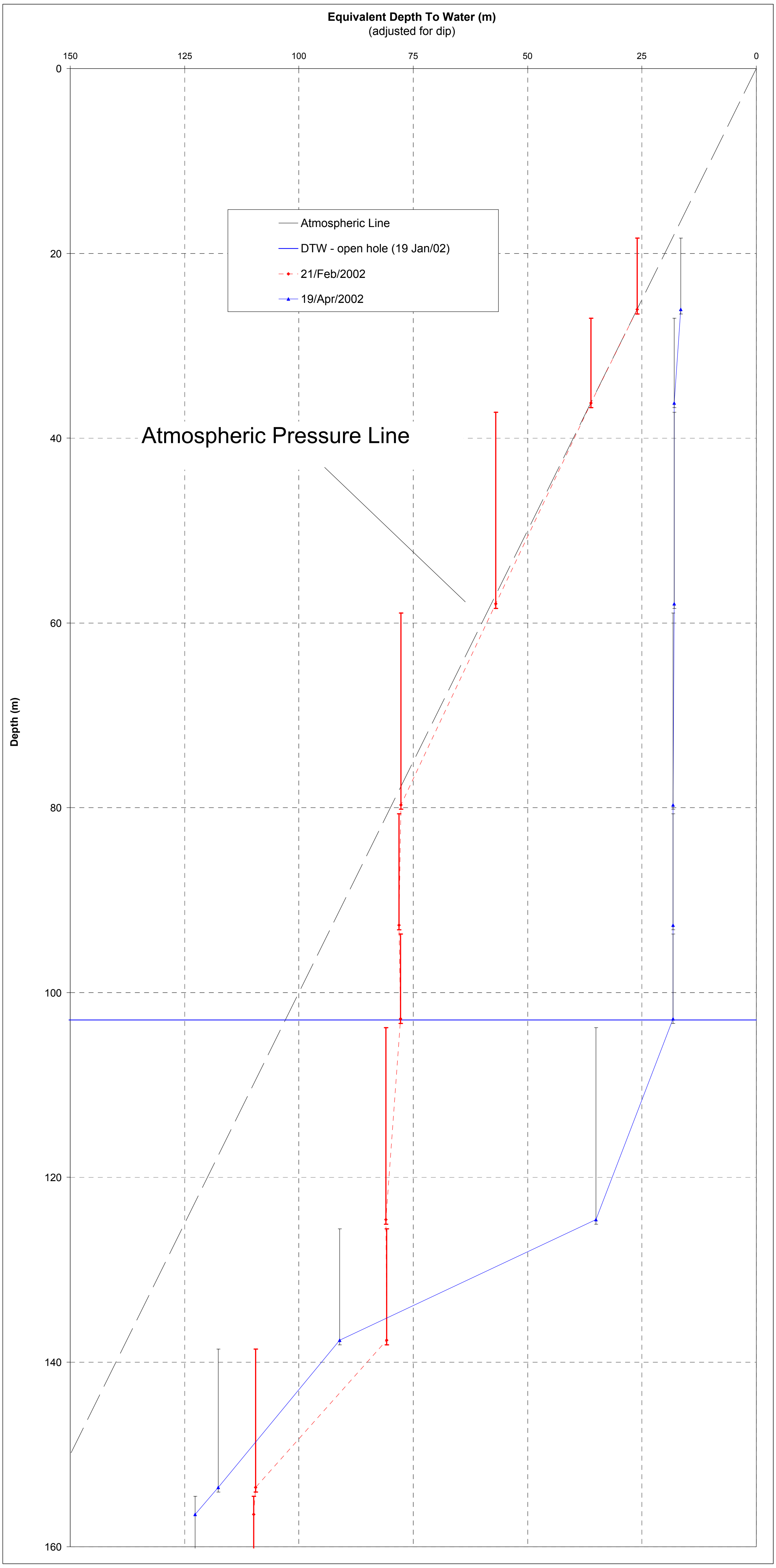


Figure 7
SRK Consulting
7/17/2002

Well Log and **Pressure Profile Data**
S-1860

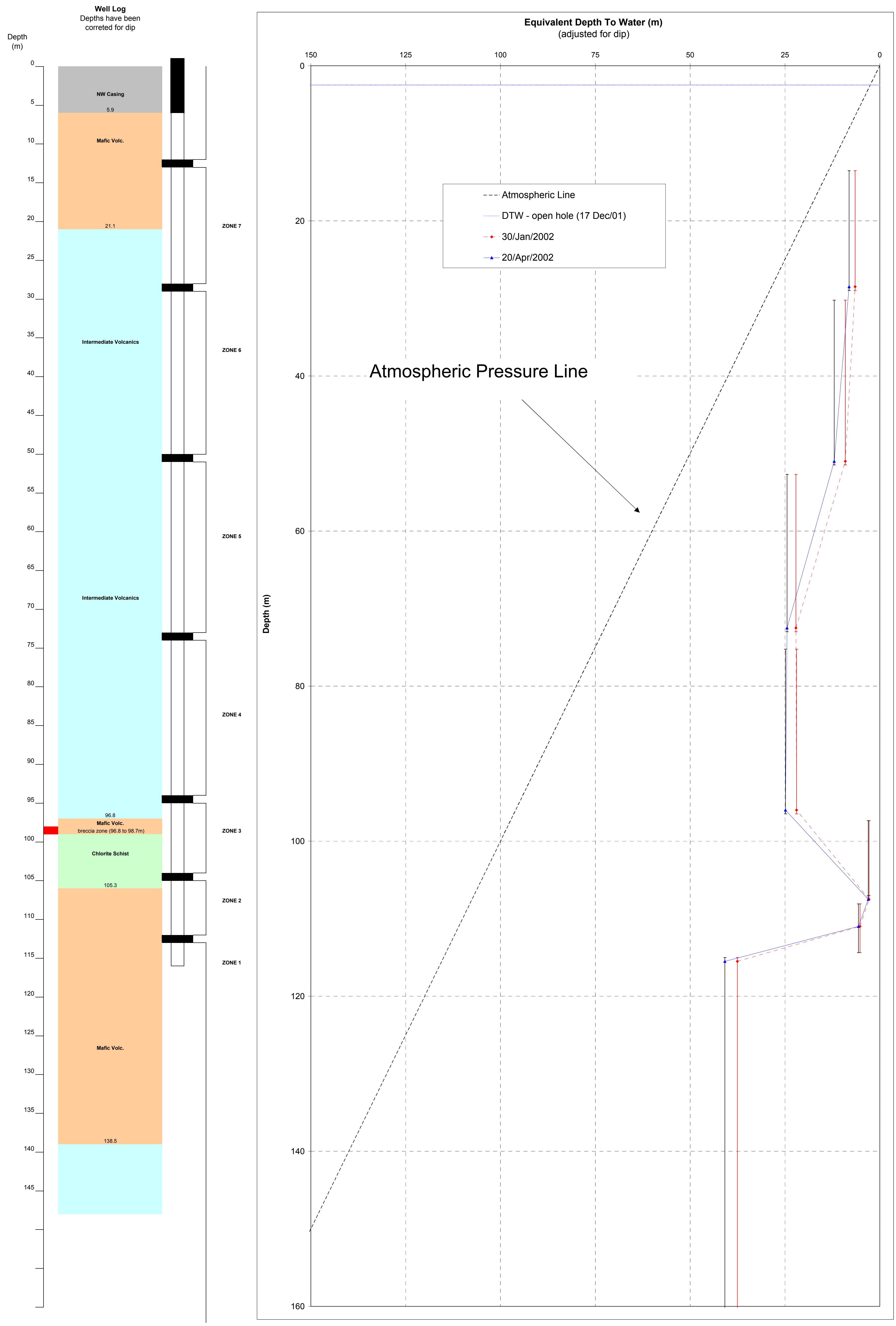


Figure 8
SRK Consulting
7/17/2002

Well Log and Pressure Profile Data
S-1955

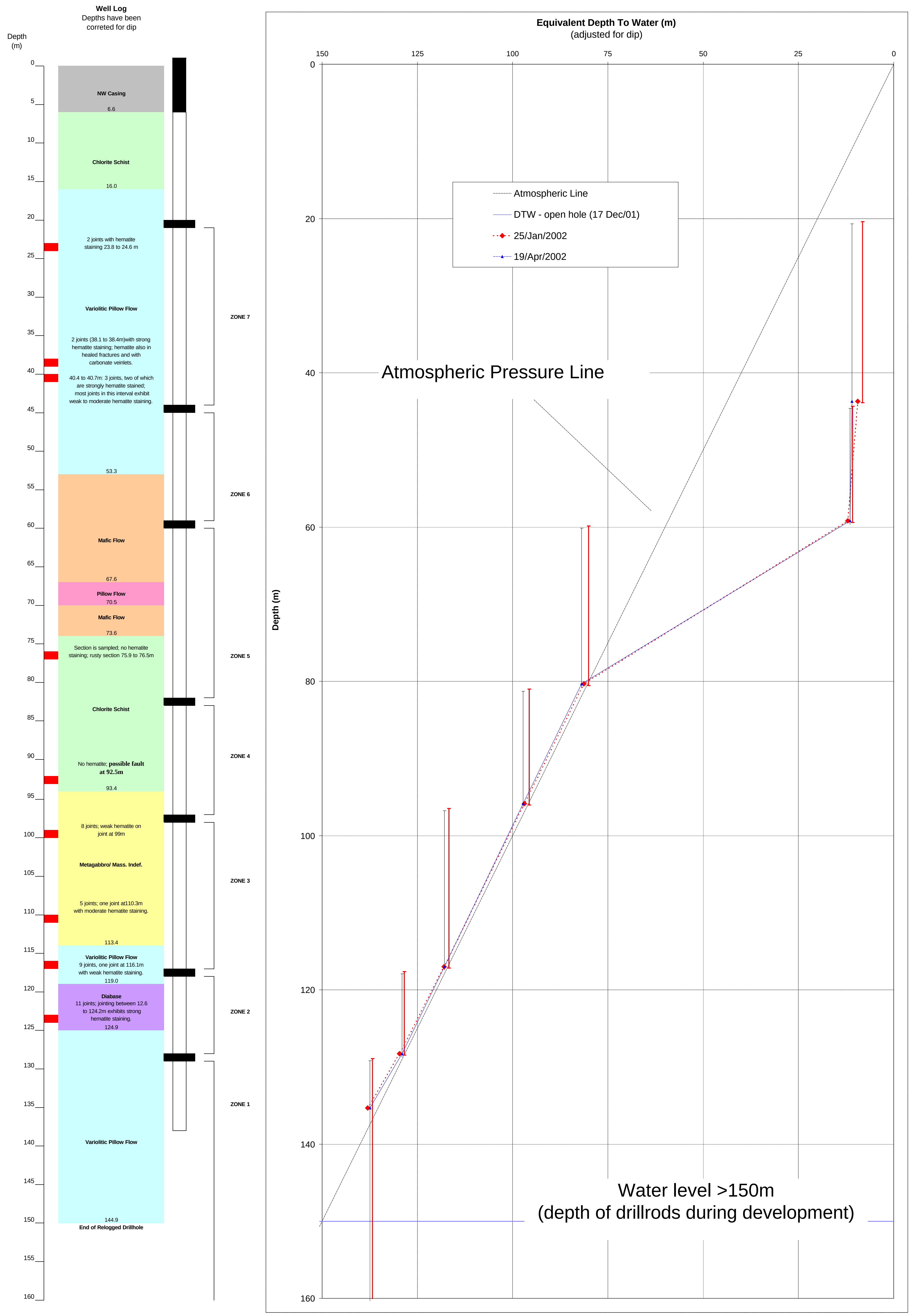
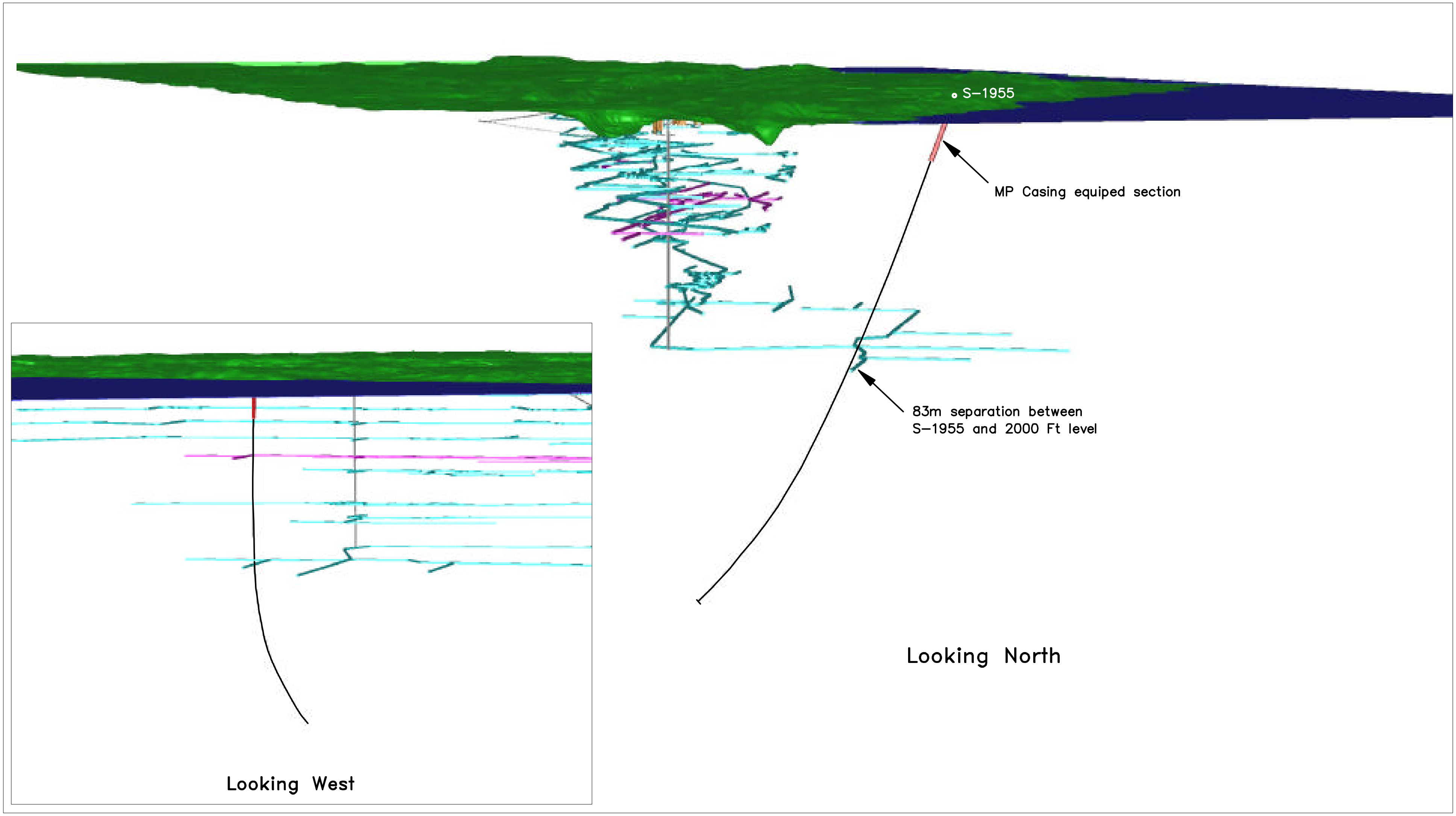


Figure 9
SRK Consulting
7/18/2002



SRK Consulting Engineers and Scientists	GIANT MINE			
Indian and Northern Affairs Canada	3D view of DDH S–1955			
	PROJECT NO. 1CI001.07 318	DATE April 2002	APPROVED	FIGURE 10

Well Log and Pressure Profile Data
S-DIAND-001

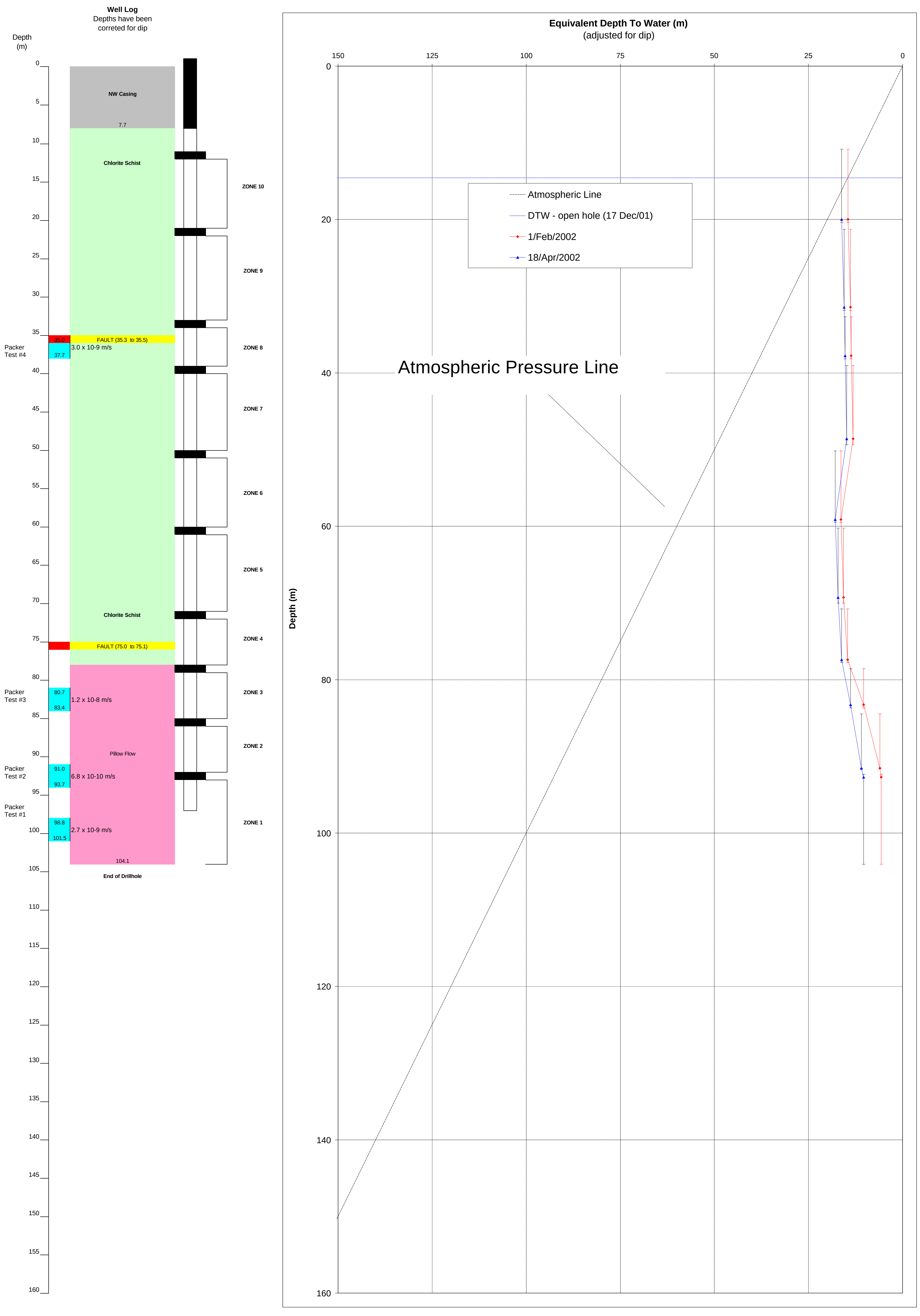
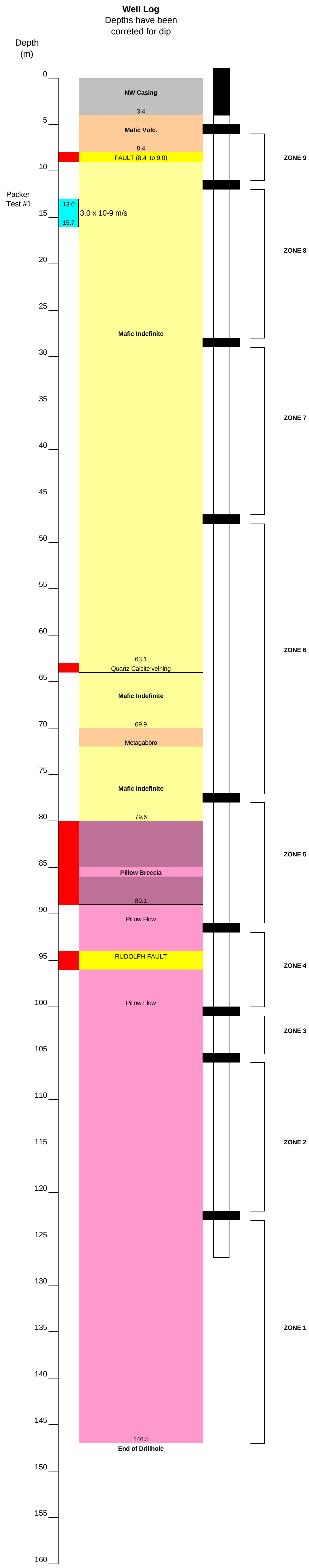


Figure 11
SRK Consulting
7/18/2002

Well Log and Pressure Profile Data
S-DIAND-002



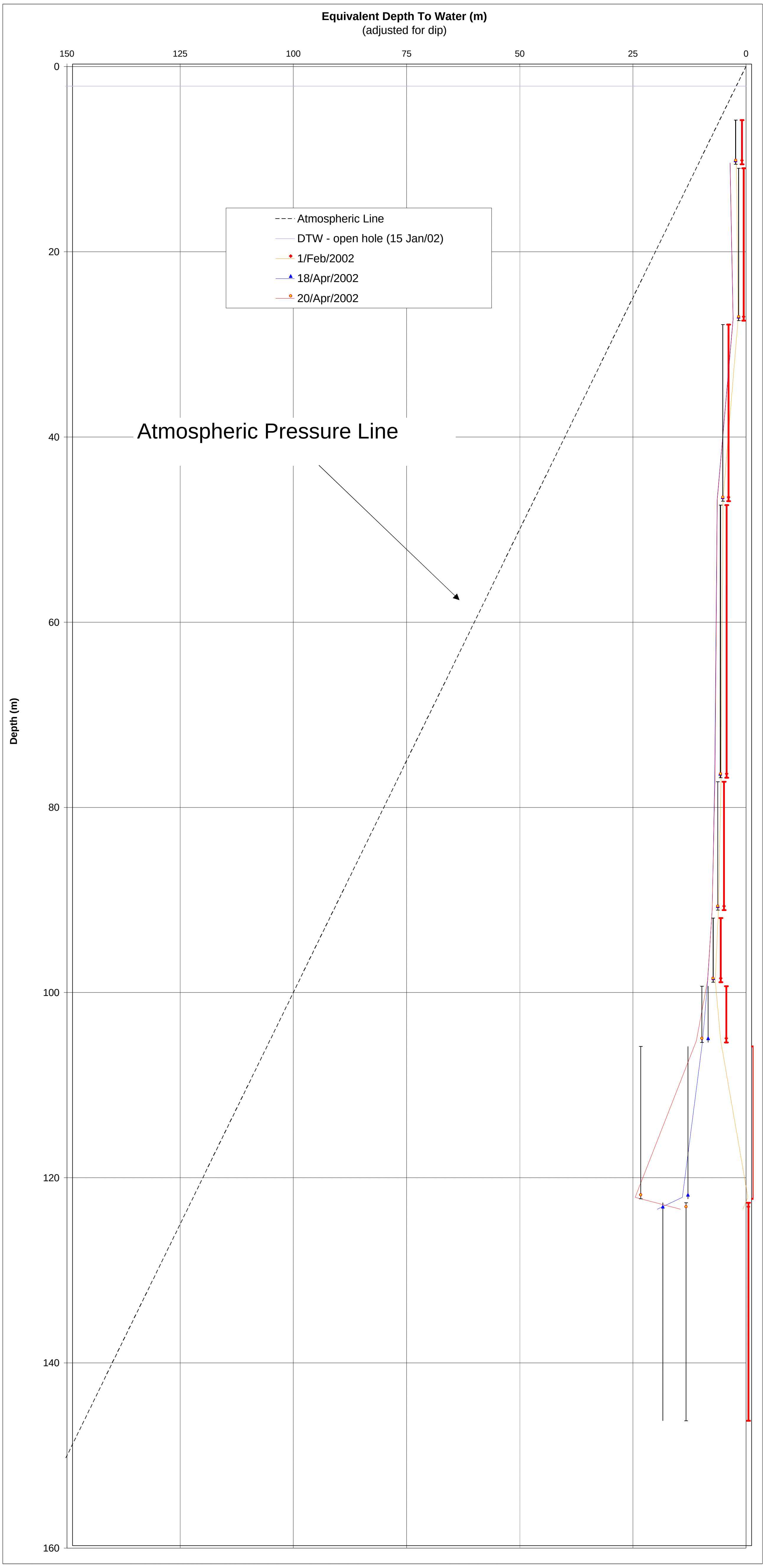


Figure 12
SRK Consulting
7/18/2002

S-DIAND-002_Pressure_Log.xls / Well Log

APPENDIX A
Drillhole Logs
(Revised and New)

S-1857
Revised Drillhole Log

Hole: S-1857

Shaft C Heading Hole Completed:

Down hole Survey:

Dist	Dip	Az	Dist	Dip	Az	Dist	Dip	Az	Dist	Dip	Az	Dist	Dip	Az

Drill Hole: S-1857 North East Length ft m Logged by T. Canam Date: 28-Dec-01 Page of

Dip 75

Corrected for Dip

Dip = 75

						Rock Description						Structure				Minerals						Au Assay Data					
												B/S		J/F		% Gangue		% Metallic									
From (m)	**To (m)**	From (m)	To (m)	From (ft)	To (ft)	**Nam**	**Col**	**Grs**	**Com**	**Text**	**Alt**	**S**	**A1**	**F**	**A2**	**Qtz**	**Car**	**Grs**	**Py**	**Grs**	**Asp**	**Dist**	**Smpl#**	**Wdth**	**Assy1**	**Assy2**	Comments
0.0	**2.9**	0.0	3.0	0	10	CAS																					Casing
2.9	**21.5**	3.0	22.2	10	73	MF	DGR	FG	MS																		
21.5	**21.8**	22.2	22.6	73	74	**FLT**																					Core lost from box.
21.8	**35.3**	22.6	36.6	74	120	PF	GR	FG	MS																		
35.3	**44.2**	36.6	45.7	120	150	MF	GR	FG	MS																		
44.2	**56.2**	45.7	58.2	150	191	MG	DGR	FMG	MS	POR																	Metagabbro?:contacts gradational over 1 foot; Highly fractured and jointed; possibly a metamorphosed coarse grained mafic flow.
56.2	**77.7**	58.2	80.5	191	264	PF	GR	VFG	MS																		
77.7	**97.2**	80.5	100.6	264	330	MF	GR	FG	MS																		numerous hairline fractures with calcite, rare patches of quartz with orange to pink Kspar. Occasional hematite staining along healed fractures.
97.2	**98.5**	100.6	102.0	330	334.5	**FLT**	GR	FG	MS																		**Zone of moderate healed brecciation** ~ 40 dtca; Joints and/or fractures contain vugs with quartz and calcite; thin areas of gouge as described in the original log; jointing crosscuts the fault fabric at varying angles.
98.5	**106.9**	102.0	110.6	334.5	363	MG	GR	FG	MS																		Joint ~ 5 dtca; grain size variable from fine to medium grained with the interval; the lower contact is gradational to mafic flow. More suggestive of preferential recrystallization during metamorphism due to emplacement of the granites to the west.
106.9	**111.0**	110.6	114.9	363	377	MF	GG	FG	MS																		
111.0	**117.8**	114.9	121.9	377	400	MF	GR	FG	MS																		Interval is moderately disrupted, but healed. Hairline fractures containing calcite are common, epidote veinlets and stringers are present locally; a joint is parallel to the core axis, a weak breccia zone parallel to the core axis is present adjacent to the joint. Angular mafic flow fragments are hosted in a quartz matrix.
117.8	**131.1**	121.9	135.8	400	445.4	MF	GR	FG	MS	FRAG																	Weakly to moderately brecciated mafic flow with up to 10% patchy and stringered epidote, 2-5% .5 - 1.5 cm carbonate veinlets. Patchy hematite staining . Hairline fractures filled with calcite, epidote, or rarely, carbonate. Core in this interval is quite competent.
131.1	**131.4**	135.8	136.0	445.4	446.2	**FLT**	GG	FG	MS					F	25												**West Bay Fault.: zone of greenish clay gouge.**
131.4	**132.7**	136.0	137.4	446.2	450.8	**FLT**	BR	FMG	MS	FRAG				F	25												**Fault breccia zone:** consists of 1mm to 1cm angular to subangular fragments which vary in colour from beige to greyish green. The matrix or groundmass is grey to dark brown, and fine grained. Lower contact is 25 dtca.
132.7	**148.7**	137.4	153.9	450.8	505	MF	GR	FG	MS	FRAG								FG	0.01								Hairline fractures still present, but decreasing away from the West Bay Fault. Carbonate stringers vary from parallel to 25 dtca; rare quartz stringers, trace fine grained anhedral pyrite. One box of core (461.5ft - 475ft, 140.7 - 144.8m) missing.
END OF RELOGGED SECTION																											

S-1860
Revised Drillhole Log

Hole: S-1860
Shaft B Heading Hole Completed:

Down hole Survey:

Dist	Dip	Az	Dist	Dip	Az	Dist	Dip	Az	Dist	Dip	Az	Dist	Dip	Az
65	-75													
185	-75													
305	-75													

Relog of hole to 499 feet

Drill Hole: S-1860 North East Elev 6046 Length 3922 feet Az. 130 Logged by T. Canam Date: 7-Jan-02 Page 1 of 1
Dip 75

Corrected for Dip
Dip = 75

												Structure				Minerals											
						Rock Description						B/S		J/F		% Gangue		% Metallic				Au Assay Data					
From (m)	To (m)	From (m)	To (m)	**From (ft)**	**To (ft)**	**Nam**	**Col**	**Grs**	**Com**	**Text**	**Alt**	**S**	**A1**	**F**	**A2**	**Qtz**	**Car**	**Grs**	**Py**	**Grs**	**Asp**	**Dist**	**Smpl#**	**Wdth**	**Assy1**	**Assy2**	Comments
0.0	5.9	0.0	6.1	0	20	CAS																					Casing:
5.9	21.1	6.1	21.9	20	71.7	Mafic Volcanics	Gy	FG	MS		SNF	S	40														
21.1	37.4	21.9	38.7	71.7	127	Intermediate Volcanics	Gy	FG	MS	VAR		S	45														Possibly Pillows; variolitic.
37.4	47.7	38.7	49.4	127	162	Intermediate Volcanics	Gy	FG	MS	VAR		S	30														Possibly Pillows; variolitic.
47.7	96.8	49.4	100.2	162	328.9	Intermediate Volcanics	Gy	FG	MS	VAR																	Possibly Pillows; variolitic.
96.8	97.9	100.2	101.3	328.9	332.5	Mafic Volcanics	Gy	FG	MS		CAR																One small patch of vuggy carbonate, no hematite.
97.9	98.7	101.3	102.2	332.5	335.4	Mafic Volcanics	Gy	FG	MS	**BX**	CAR																Weakly foliated with vuggy patches along the core; joints in this interval are vuggy containing 2-4 mm coatings of medium grained crystalline quartz and calcite. One patch of hematite in a 6" zone of brecciation; zone is 50 brown carbonate matrix and 1mm to 1.5 cm angular mafic flow fragments.
98.7	105.3	102.2	109.1	335.4	357.8	Chlorite Schist	Gy	FG	S	BND	BIO	S	25			0.5	3	fg	3								Weakly foliated, weakly to moderately biotized with patchy fine disseminated pyrite.
105.3	138.4	109.1	143.2	357.8	470	Mafic Volcanics	Gy	FG	MS																		
138.4	146.9	143.2	152.1	470	499	Intermediate Volcanics	Gy	FG	MS	VAR																	Possibly Pillows; variolitic.
END OF RELOGGED SECTION																											

S-1955
Revised Drillhole Log

Hole: S-1955

Shaft B Heading Hole Completed:

Down hole Survey:

Dist	Dip	Az	Dist	Dip	Az	Dist	Dip	Az	Dist	Dip	Az	Dist	Dip	Az
200 ft	-69	248												

Relog of hole to 506 feet (154m)

Drill Hol S-1955 North 8811.769 East 8605.991 Elev. 6032 Length 4436 feet Az. 240 Logged by: T. Canam Date: 16-Jan-02 Page of

Dip **-70** 1352 m

Corrected for Dip

Dip = 70

												Structure				Minerals											
						Rock Description						B/S		J/F		% Gangue		% Metallic				Au Assay Data					
From (m)	**To (m)**	**From (m)**	**To (m)**	From (ft)	To (ft)	**Nam**	**Col**	**Grs**	**Com**	**Text**	**Alt**	**S**	**A1**	**F**	**A2**	**Qtz**	**Car**	**Grs**	**Py**	**Grs**	**Asp**	**Dist**	**Smpl#**	**Wdth**	**Assy1**	**Assy2**	Comments
0.0	**6.6**	0.0	7.0	0	23	CAS																					Casing:
6.6	**15.8**	7.0	16.8	23	55	CLS	GG	FG	SS	BND	CAR			F	10	2	2										Gradational contact into variolitic pillow flow.
15.8	**34.4**	16.8	36.6	55	120	VPF	LGR	FG	MS	VAR						1	1										Variolites typically 1-10 mm, light grey to white, typically in a fine grained, dark green matrix. Pillow selvages appear weakly developed. Occasional 1-2cm bands of epidote represent the pillow selvages.
34.4	**53.3**	36.6	56.7	120	186	VPF	LGR	FG	MS	VAR						1	5										
53.3	**57.8**	56.7	61.5	186	201.7	MF	GR	FG	MS	HOM						1	1										
57.8	**67.0**	61.5	71.3	201.7	234	MI	GG	MG	MS	HOM						1	1										Coarse grained mafic flow, or possibly a fine grained gabbro.
67.0	**70.0**	71.3	74.5	234	244.5	VPF	LGR	FG	MS	VAR						2	3										
70.0	**73.6**	74.5	78.3	244.5	257	MF	GR	FG	MS	HOM						2	3										4% epidote
73.6	**94.2**	78.3	100.3	257	329	CLS	GG	FG	SS	BND	CAR					8	12	MG	0.5								Foliation/shearing undulates along the core axis varying from 0 to 45 dtca; occasional patches of subhedral fine to medium grained pyrite. Foliation is locally crenulated. Lower contact is gradational into the MI below. Local rusty section between 265 and 267 feet (80.8 to 81.4m) with the Fe oxidation on joint surfaces and on the surface of the core. Core is somewhat broken up through this interval.
94.2	**112.8**	100.3	120.1	329	394	MI	GG	MG	MS	HOM	CAR					2	2										Possibly a coarser grained mafic flow which locally appears porphyritic. Veining is carbonate at varying angles to the core axis. Massive and homogeneous; some hematite staining on some joint surfaces.
112.8	**119.0**	120.1	126.6	394	415.4	VPF	LGR	FG	MS	VAR	BLD					1	1										
119.0	**124.6**	126.6	132.6	415.4	435	DIA	GY	MG	MS	HOM						0.5	0.5										Upper and lower contacts are sharp and distinct. Upper contact is 10 dtca; the lower contact is 30 dtca. Hematite staining typically weak or non-existant except for 2 joints between 431.5 and 433.7ft (131.5 to 132.2m) where hematite staining is strong.
124.6	**144.9**	132.6	154.2	435	506	VPF	LGR	FG	MS	VAR	BLD					0.5	0.5										
END OF RELOGGED SECTION																											

S-DIAND-001
Drillhole Log

Hole: S-DIAND-01

Shaft A | Heading | Hole Completed:

Metric

Dist	Dip
0	-62
21.3	-58.3
45.7	-58.0
88.4	-54.3
100.6	-54.0
128.0	-53.5

Down hole Survey

Imperial

Dist	Dip	Az	Dist	Dip	Az
70	-58.3		330	-54.0	73.8
150	-58.0	73.8	420	-53.5	73.8
290	-54.3	74.8			

Metric

Dist	Dip	Az	Dist	Dip	Az
21.3	-58.3		100.58	-54.0	73.8
45.7	-58.0	74	128.01	-53.5	73.8
88.4	-54.3	75			

NOTE: Hole azimuth is probably 062 degrees; there has always been a problem with downhole survey azimuths at Giant (T. Canam)

Drill Hole: S-DIAND- North 6330 East 6438 Elev. 6000 Length 425 **feet** Az. **62** Logged by: T. Canam Date: Page of

Dip -61 129.53 **m**

Corrected for Dip

Dip = **variable (see lookup table below)**

						Rock Description						Structure: B/S		Structure: J/F		Minerals: % Gangue		Minerals: % Metallic				Au Assay Data					
From (m)	**To (m)**	From (m)	To (m)	From (ft)	To (ft)	**Nam**	**Col**	**Grs**	**Com**	**Text**	**Alt**	**S**	**A1**	**F**	**A2**	**Qtz**	**Car**	**Grs**	**Py**	**Grs**	**Asp**	**Dist**	**Smpl#**	**Wdth**	**Assy1**	**Assy2**	Comments
0.0	**7.7**	0.0	8.8	0.0	29.0	CAS																					Casing
7.7	**12.8**	8.8	14.8	29.0	48.6	CLS	GG	FG	SS	MOT		S	60			3	10	FG	0.5								Carbonate veinlets parallel to shearing, 60 dtca.
12.8	**17.2**	14.8	20.1	48.6	66.0	CLS	GG	FG	SS	MOT		S	60			5	15	FG	0.5								Core broken up; joints 20 dtca; joints 85 degrees to foliation (~40 dtca) at 62 feet (18.9m)
17.2	**22.0**	20.1	25.9	66.0	85.0	CLS	GG	FG	SS	BND		S	60			3	10	MG	0.5								
22.0	**28.5**	25.9	33.6	85.0	110.2	CLS	GG	FG	SS	BND		S	60			1	5										Local kink banding.
28.5	**29.8**	33.6	35.1	110.2	115.0	CLS	GG	FG	SS	BND		S	60			5	30	FG	0.5								Predominantly chlorite, minor sericite.
29.8	**31.9**	35.1	37.5	115.0	123.1	CLS	GG	FG	SS	FRAG						2	20										
31.9	**33.1**	37.5	39.0	123.1	128.0	CLS	GG	FG	SSS	LAM		S	55			1	5	FG	0.5								
33.1	**33.9**	39.0	39.9	128.0	131.0	CLS	GG	FG	SS	MOT						10	20	FG	0.5								Weak sericite stringers.
33.9	**35.3**	39.9	41.6	131.0	136.6	CLS	GG	FG	SSS	MOT						5	7	FG	0.5								
35.3	**35.5**	41.6	41.9	136.6	137.4	**FLT**	GR	FG	S	BND				F	25		5										
35.5	**39.9**	41.9	47.1	137.4	154.4	CLS	GR	FG	S	MOT		S	50			1	5	FG	0.5								Weakly foliated.
39.9	**44.9**	47.1	53.3	154.4	175.0	CLS	TGR	FG	S	COT							25	MG	0.5								Weakly to moderately developed wispy bands of sericite.
44.9	**46.7**	53.3	55.5	175.0	182.2	CLS	GG	FG	SS	MOT		S	55			1	20										Foliation angle to core axis is variable, typically 55 degrees, but as low as 25 degrees.
46.7	**51.8**	55.5	62.1	182.2	203.8	CLS	GG	FG	S	BND						1	10	FG	0.25								Weak development of sericite; carbonate veinlets parallel to core axis and perpendicular to core axis.
51.8	**53.5**	62.1	64.2	203.8	210.7	CLS	GG	FG	SS	FRAG						5	30										
53.5	**62.7**	64.2	76.2	210.7	250.0	CLS	GG	FG	SS	BND		S	50			1	5	MG	0.25								Joint 10 degrees to core axis, undulates along the core at 216 feet (65.8m).
62.7	**64.4**	76.2	78.4	250.0	257.2	CLS	GG	FG	MS	MOT						7	10	FG	0.1								
64.4	**64.8**	78.4	79.0	257.2	259.2	QAC	WH	MG	S							70	15										White quartz - 15% pink carbonate, 15% chlorite fragments.
64.8	**66.2**	79.0	80.8	259.2	265.0	CLS	GG	FG	S	BND		S	45			1	10										
66.2	**68.9**	80.8	84.4	265.0	277.0	CLS	GG	FG	S	BND						10	25										
68.9	**70.7**	84.4	86.9	277.0	285.0	CLS	GG	FG	SS	BND						1	5										
70.7	**73.0**	86.9	89.9	285.0	295.0	CLS	GG	FG	SS	LAM						1	7										
73.0	**75.0**	89.9	92.4	295.0	303.3	CLS	GG	FG	SS	LAM		S	45			1	7										Well developed chlorite schist, weakly disrupted.
75.0	**75.1**	92.4	92.5	303.3	303.6	**FLT**	GG	FG	MS	COT							5										**Townsite fault**, 40 dtca, 1 inch of gouge at 303.5 - 303.6 (92.4 to 92.5m)
75.1	**76.4**	92.5	94.3	303.6	309.3	MVO	TGY	FG	MS	MOT							1										Bleached and **brecciated** mafic volcanic?, fine grained black mineral as patches and along fractures
76.4	**77.6**	94.3	95.7	309.3	314.0	FP	TGY	FG	MS								1										Possibly as above, but the contact at 314 feet (95.7m) is sharp; contact is 42 degrees to core axis.
77.6	**104.1**	95.7	129.5	314.0	425.0	PF	LGR	FG	MS								1										Patchy variolites up to 1 cm in diameter.
	END OF DRILLHOLE																										

S-DIAND-002
Drillhole Log

Hole: S-DIAND-002

Shaft C   Heading ______   Hole Completed: ______

Down hole Survey:

Imperial							Metric					
Dist	Dip	Az	Dist	Dip	Az		Dist	Dip	Az	Dist	Dip	Az
50	-60.00	180	350	-60.00	180		15.24	-60.00	180	106.7	-60.00	180
150	-60.00	180	450	-59.50	180		45.72	-60.00	180	137.2	-59.50	180
250	-60.00	180	550	-59.50	180		76.2	-60.00	180	167.6	-59.50	180

NOTE: Hole azimuth is probably 180 degrees; there has always been a problem with downhole survey azimuths at Giant (T. Canam).

Drill Hole: S-DIAND-002 North 10527 East 8400 Elev. 6065 Length 555 feet Az. 180   Logged by: T. Canam   Page 1 of 1

Dip -60   169 m   Date: 3-Dec-01

Corrected for Dip
Dip = 60

						Rock Description						Structure				Minerals						Au Assay Data					
												B/S		J/F		% Gangue		% Metallic									
From (m)	**To (m)**	From (m)	To (m)	From (ft)	To (ft)	Nam	Col	Grs	Com	Text	Alt	S	A1	F	A2	Qtz	Car	Grs	Py	Grs	Asp	Dist	Smpl#	Wdth	Assy1	Assy2	Comments
0.0	**3.4**	0.0	4.0	0	13	CAS																					Casing
3.4	**8.4**	4.0	9.7	13	31.9	MVO	LGR	FMG	S	HOM	SNF					1	1										Mafic Volcanic: with wispy stringers of epidote; 1% 5mm quartz - calcite stringers.
8.4	**9.0**	9.7	10.4	31.9	34.2	**FLT**	LGR	FG	S	MOT	SNF					2	4										**Fault?: fractured zone** of carb veining with **hematite staining in the carbonate veinlets and along fractures**.
9.0	**14.8**	10.4	17.1	34.2	56.1	MI	GG	MG	MS	MOT	SNF					1	4										53 - 56.1 ft (16.2 to 17.1m): hematite staining along joint surfaces, hematite stringer @ 56ft (17.1m) is 30 degrees to the core axis.
14.8	**28.2**	17.1	32.6	56.1	106.8	MI	LGR	FG	MS	HOM	CAR					2	5										Occasional epidote stringers, rare epidote in carbonate stringers and veinlets.
28.2	**63.1**	32.6	72.9	106.8	239.2	MI	LGR	FMG	MS	HOM	CAR					1	3	FG	0.1								Wispy carbonate stringers and veinlets, grain size variable from fine to medium grained with out discrete contacts.
63.1	**63.7**	72.9	73.5	239.2	241.2	QCV	WH	MG	MS	MOT																	Quartz-Calcite- pink Kspar vein; 50% veining with massive flow or shallow intrusive (mafic indefinite); vein contact is sub parallel to the core axis.
63.7	**69.9**	73.5	80.8	241.2	265	MI	LGR	FMG	MS	HOM	CAR					1	3										
69.9	**71.6**	80.8	82.7	265	271.4	MG	LGR	MG	MS	HOM																	Gabbro?: gradual change in grain size, no change in texture or veining.
71.6	**79.7**	82.7	92.1	271.4	302.1	MI	LGR	FMG	MS	HOM						1	3										Patches of wispy carbonate - epidote stringers.
79.7	**89.1**	92.1	102.9	302.1	337.5	**PBX**	LGR	FG	MS	MOT	CAR						4										**Pillow Breccia** or Hyaloclastite: Contact at 302.1ft (92.1m) is abrupt, but % of fragments increases toward 315' (96.0m)where the unit is entirely pillow fragments in a fine grained black chloritic matrix. Where the matrix is slightly coarser grained, the matrix has a salt and pepper appearance due to very small white fragments. Larger fragments, >10cm appear to have chill margins. Moderate hematite staining on joint surfaces
89.1	**94.5**	102.9	109.1	337.5	358	PF	LGR	FG	MS	HOM	CAR					1	2										Well developed 1 cm thick pillow selvages.
94.5	**96.3**	109.1	111.2	358	365	**FLT**	LGR	FG	MS	HOM	CAR					1	2										**Rudolph Fault**: poorly developed, appears to be a zone of jointing approximately 15 degrees to the core axis. Host lithology is pillow flow.
96.3	**146.5**	111.2	169.2	365	555	PF	LGR	FG	MS	HOM	CAR					1	2										Wispy carbonate - epidote veinlets; wispy quartz-calcite veinlets; good pillow selvages with occasional 5mm amydules; pillow selvages contain black chlorite, jointing or separation occurs along the pillow selvages. Pillow selvages are less evident in the last 50 feet (15m). Approximately 10% quartz veinlets in the last 30ft (9m) of the hole; this veining occasionally contains patches of epidote and orange K spar.
146.5	**EOH**	169.2	EOH	555	EOH																						

APPENDIX B
Hydraulic Packer Testing Program
Open Drillhole Testing

Appendix B
Packer Test Data

Drillhole S-DIAND-001
Dip = 62

Test Number	Down-dip "Depth" (ft)		Down-dip "Depth" (m)		True Depth (m)		Est. K (m/s)
1	367	377	111.9	114.9	98.8	101.5	2.7×10^{-9}
2	338	348	103.0	106.1	91.0	93.7	6.8×10^{-10}
3	300	310	91.4	94.5	80.7	83.4	1.2×10^{-8}
4	130	140	39.6	42.7	35.0	37.7	2.9×10^{-8}

Drillhole S-DIAND-002
Dip = 61

Test Number	Down-dip "Depth" (ft)		Down-dip "Depth" (m)		True Depth (m)		Est. K (m/s)
1	49	59	14.9	18.0	13.0	15.7	3.0×10^{-9}
na - frozen lines							na
na - frozen lines							na

Packer Test Results and Estimation of Hydraulic Conductivity

Borehole number: 01-DIAND-001

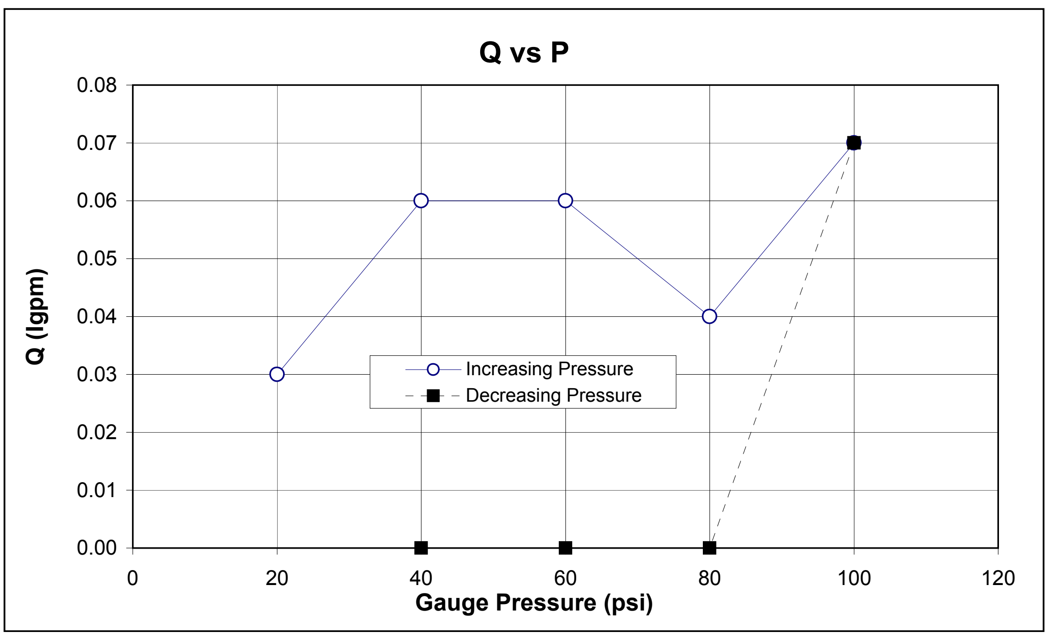
November 21, 2001

$$K = \frac{Q \ln(R/r_b)}{2\pi L P_i}$$

Hydraulic conductivity (m/day) = K
Flow rate (m^3/day) = Q
Packer spacing (m) = L
Measured test pressure (m) = P_g
Height of gauge above Datum (m) = h_g = 1.5
Friction loss in pipe (m) = h_f
__x__ *by Darcy-Weisbach equation*
_____ *from empirical test data (field) = ____________ m/m for a given Q*

Datum ***Drill Head***
Initial depth to water (m) = h_s = 13.72
Net injection pressure (m) = $P_i = P_g + h_g + h_s - h_f$
Total depth of borehole (m) = 129.6
Radius of borehole (m) = r_b = 0.048
Radius of influence (m) = R = 5
Diameter of drop pipe (m) = D = 0.025
Angle of borehole (°) = 61 *(from horizontal)*

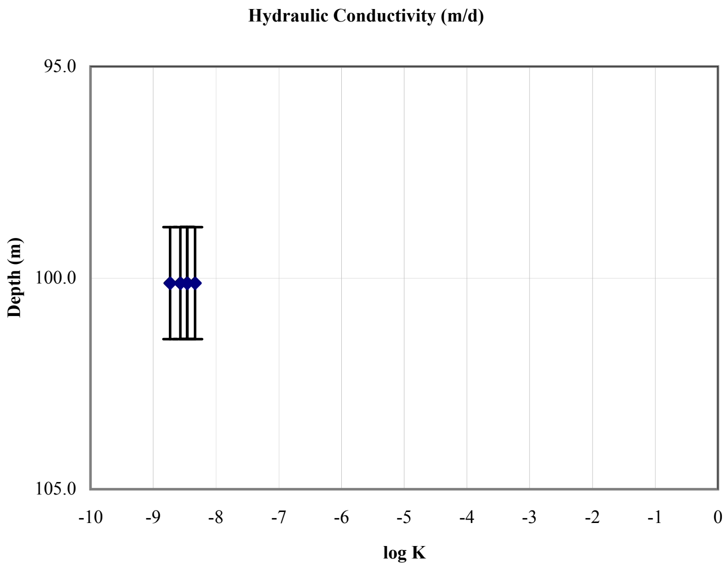
Test Number	Test Depth (m)		L (m)	Q (m^3/day)	P_g (m)	P_i (m)	K (m/s)	Comments
	From	To						
1A	98.80	101.5	2.6	0.03	14	27.6	3.5E-09	
1B	98.80	101.5	2.6	0.06	28	41.7	4.7 E-09	
1C	98.80	101.5	2.6	0.06	42	55.7	3.5 E-09	
1D	98.80	101.5	2.6	0.04	56	69.8	1.9 E-09	
1E	98.80	101.5	2.6	0.07	70	83.9	2.7 E-09	
1F	98.80	101.5	2.6	NA			NA	TEST APPARATUS LEAKING
1G	98.80	101.5	2.6	NA			NA	TEST APPARATUS LEAKING
1H	98.80	101.5	2.6	NA			NA	TEST APPARATUS LEAKING
					GEOMETRIC MEAN =		3.1 E-09	
						Max =	4.7 E-09	
						Min =	1.9 E-09	



Hydraulic Conductivity Data
Borehole S-DIAND-001

Test	Length (m) from	Length (m) to	*K* (m/S)	log *K*	mid-pt (m)	1/2 range (m)
1A	98.80	101.5	3.5E-09	-8.45	100.1	1.32
1B	98.80	101.5	4.7E-09	-8.33	100.1	1.32
1C	98.80	101.5	3.5E-09	-8.46	100.1	1.32
1D	98.80	101.5	1.9E-09	-8.73	100.1	1.32
1E	98.802	101.5	2.7E-09	-8.57	100.1	1.32
1F	98.802	101.5	NA	NA		
1G	98.802	101.5	NA	NA		
1H	98.802	101.5	NA	NA		

	m/s	m/day
Geometric mean=	3.1 E-09	2.7E-04
Max =	4.7 E-09	4.0E-04
Min =	1.9 E-09	1.6E-04



S-DIAND-001_Test1.xls / K graph linked to Packer sheet

Packer Test Results and Estimation of Hydraulic Conductivity

Borehole number: 01-DIAND-001

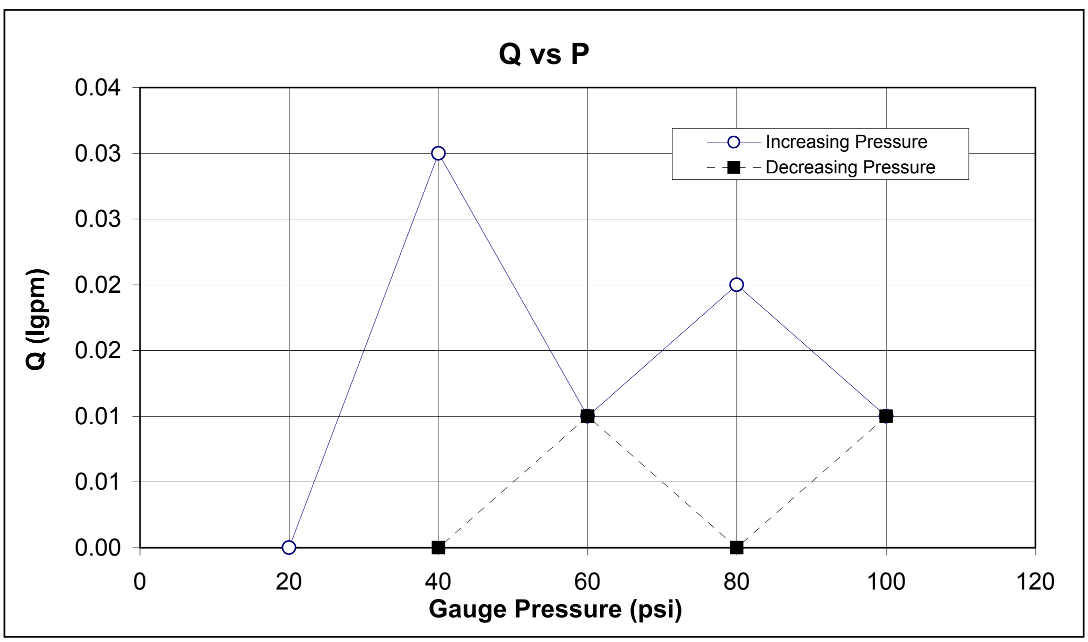
November 21, 2001

$$K = \frac{Q \ln(R/r_b)}{2\pi L P_i}$$

Hydraulic conductivity (m/day) = K
Flow rate (m^3/day) = Q
Packer spacing (m) = L
Measured test pressure (m) = P_g
Height of gauge above Datum (m) = h_g = 1.5
Friction loss in pipe (m) = h_f
__x__ *by Darcy-Weisbach equation*
_____ *from empirical test data (field) =____________ m/m for a given Q*

Datum ***Drill Head***
Initial depth to water (m) = h_s = 13.72
Net injection pressure (m) = P_i = $P_g + h_g + h_s - h_f$
Total depth of borehole (m) = 129.6
Radius of borehole (m) = r_b = 0.048
Radius of influence (m) = R = 5
Diameter of drop pipe (m) = D = 0.025
Angle of borehole (°) = 61 *(from horizontal)*

Test Number	Test Depth (m)		L (m)	Q (m^3/day)	P_g (m)	P_i (m)	K (m/s)	Comments
	From	To						
2A	90.94	93.59	2.6	0.00	14	27.6	NA	
2B	90.94	93.6	2.6	0.03	28	41.7	2.3 E-09	
2C	90.94	93.6	2.6	0.01	42	55.7	5.8 E-10	
2D	90.94	93.6	2.6	0.02	56	69.8	9.3 E-10	
2E	90.94	93.6	2.6	0.01	70	83.9	3.9 E-10	
2Dr	90.94	93.6	2.6	0.00	56	69.8	0.0 E+00	
2Cr	90.94	93.6	2.6	0.01	42	55.7	5.8 E-10	
2Br	90.94	93.6	2.6	0.00	28	41.7	NA	
						GEOMETRIC MEAN =	7.7 E-10	
						Max =	2.3 E-09	
						Min =	3.9 E-10	

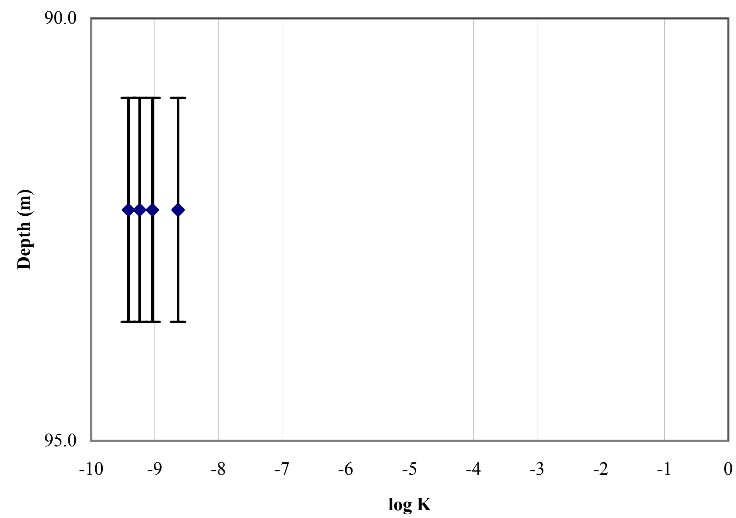


Hydraulic Conductivity Data
Borehole S-DIAND-001

Test	Length (m) from	Length (m) to	*K* (m/s)	log *K*	mid-pt (m)	1/2 range (m)
2A	90.9	93.6	NA	NA	92.3	1.32
2B	90.9	93.6	2.3E-09	-8.63	92.3	1.32
2C	90.9	93.6	5.8E-10	-9.24	92.3	1.32
2D	90.9	93.6	9.3E-10	-9.03	92.3	1.32
2E	90.9	93.6	3.9E-10	-9.41	92.3	1.32
2Dr	90.9	93.6	NA	NA		
2Cr	90.9	93.6	NA	NA		
2Br	90.9	93.6	NA	NA		

	m/s	m/day
Geometric mean=	8.3 E-10	7.2E-05
Max =	2.3 E-09	2.0E-04
Min =	3.9 E-10	3.3E-05

Hydraulic Conductivity (m/d)



S-DIAND-001_Test2.xls / K graph linked to Packer sheet

Packer Test Results and Estimation of Hydraulic Conductivity

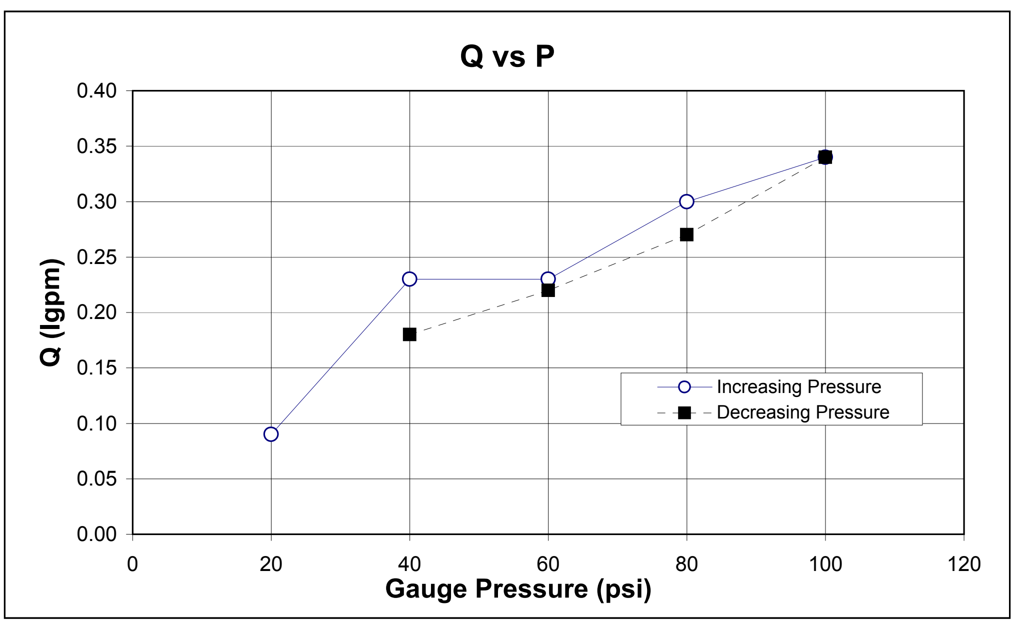
Borehole number: 01-DIAND-001

November 21, 2001

$$K = \frac{Q \ln\left(R/r_b\right)}{2\pi L P_i}$$

Hydraulic conductivity (m/day) = K
Flow rate (m^3/day) = Q
Packer spacing (m) = L

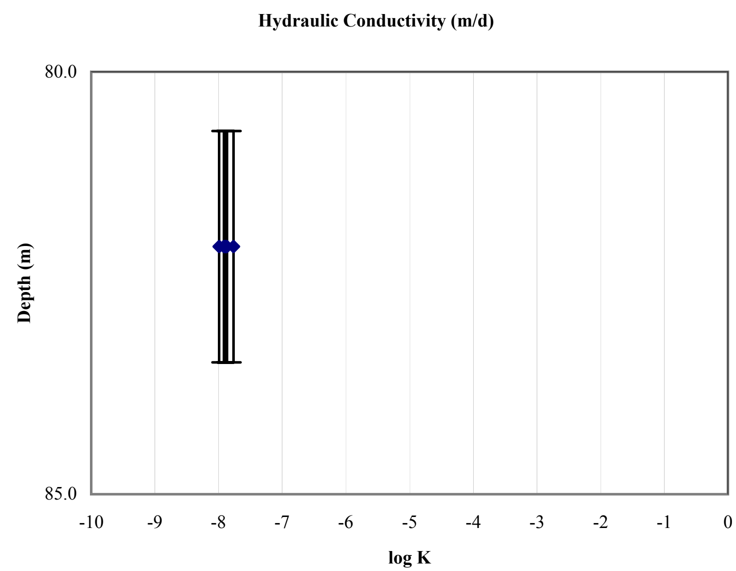
Datum ***Drill Head***
Initial depth to water (m) = h_s = 13.72
Net injection pressure (m) = $P_i = P_g + h_g + h_s - h_f$



Hydraulic Conductivity Data
Borehole S-DIAND-001

Test	Length (m) from	Length (m) to	*K* (m/S)	log *K*	mid-pt (m)	1/2 range (m)
3A	80.70	83.4	1.0E-08	-7.99	82.1	1.37
3B	80.70	83.4	1.7E-08	-7.76	82.1	1.37
3C	80.70	83.4	1.3E-08	-7.89	82.1	1.37
3D	80.70	83.4	1.3E-08	-7.87	82.1	1.37
3E	80.701	83.4	1.3E-08	-7.90	82.1	1.37
3Dr	80.701	83.4	1.2E-08	-7.92	82.1	1.37
3Cr	80.701	83.4	1.2E-08	-7.91	82.1	1.37
3Br	80.701	83.4	1.4E-08	-7.87	82.1	1.37

	m/s	m/day
Geometric mean=	1.3 E-08	1.1E-03
Max =	1.7 E-08	1.5E-03
Min =	1.0 E-08	8.8E-04



Packer Test Results and Estimation of Hydraulic Conductivity

Borehole number: S-DIAND-001

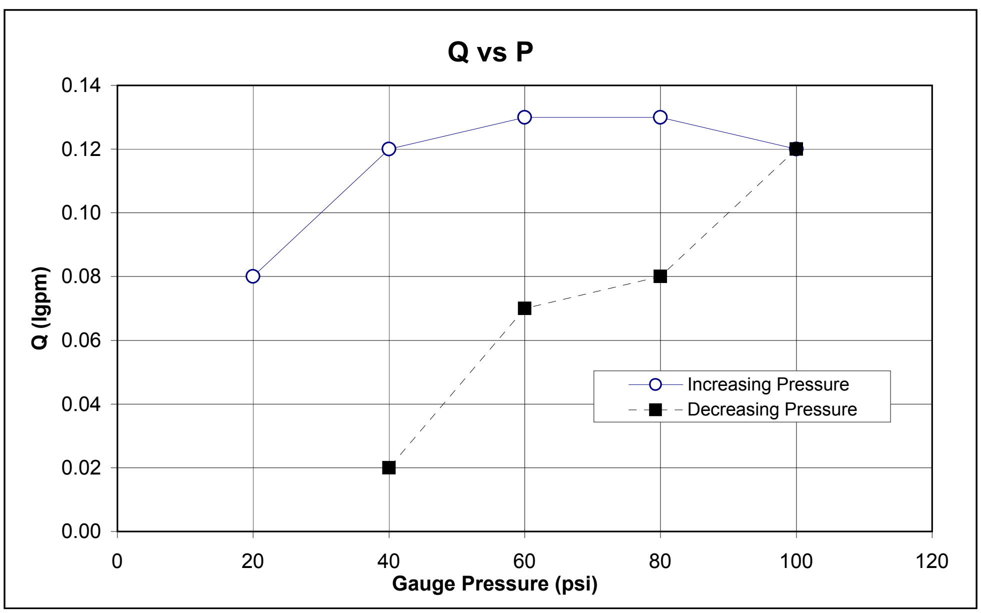
November 22, 2001

$$K = \frac{Q \ln(R/r_b)}{2\pi L P_i}$$

Hydraulic conductivity (m/day) = K
Flow rate (m^3/day) = Q
Packer spacing (m) = L
Measured test pressure (m) = P_g
Height of gauge above Datum (m) = h_g = 1.5
Friction loss in pipe (m) = h_f
__x__ *by Darcy-Weisbach equation*
_____ *from empirical test data (field) =* ____________ *m/m for a given Q*

Datum ***Drill Head***
Initial depth to water (m) = h_s = 13.72
Net injection pressure (m) = P_i = P_g + h_g + h_s - h_f
Total depth of borehole (m) = 129.6
Radius of borehole (m) = r_b = 0.048
Radius of influence (m) = R = 5
Diameter of drop pipe (m) = D = 0.025
Angle of borehole (°) = 61 *(from horizontal)*

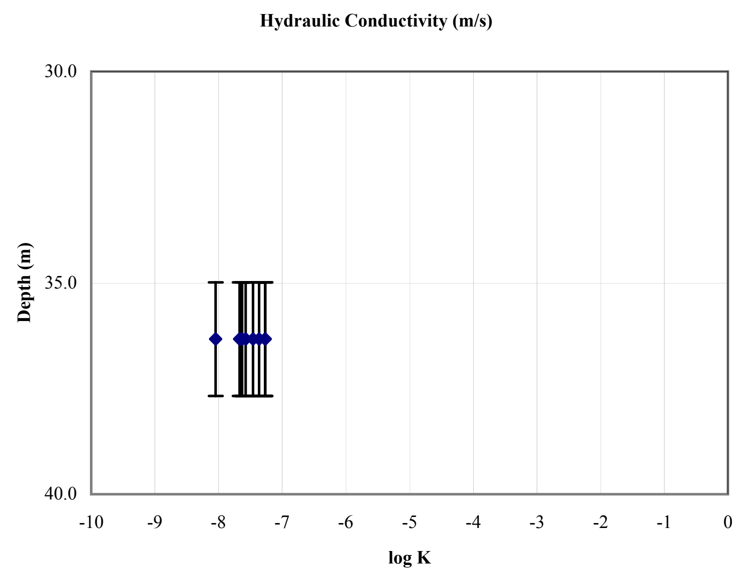
Test Number	Test Depth (m)		L (m)	Q (m^3/day)	P_g (m)	P_i (m)	K (m/s)	Comments
	From	To						
4A	35.0	37.7	3.0	0.52	14	27.6	5.4E-08	
4B	35.0	37.7	3.0	0.79	28	41.7	5.4 E-08	
4C	35.0	37.7	3.0	0.85	42	55.7	4.4 E-08	
4D	35.0	37.7	3.0	0.85	56	69.8	3.5 E-08	
4E	35.0	37.7	3.0	0.79	70	83.9	2.7 E-08	
4Dr	35.0	37.7	3.0	0.52	56	69.8	2.1 E-08	
4Cr	35.0	37.7	3.0	0.46	42	55.7	2.3 E-08	
4Br	35.0	37.7	3.0	0.13	28	41.7	9.0 E-09	
				GEOMETRIC MEAN =			2.9 E-08	
						Max =	5.4 E-08	
						Min =	2.7 E-08	



Hydraulic Conductivity Data
Borehole S-DIAND-001

Test	Depth (m) from	Depth (m) to	*K* (m/s)	log *K*	mid-pt (m)	1/2 range (m)
4A	34.99	37.7	5.4E-08	-7.27	36.3	1.35
4B	34.99	37.7	5.4E-08	-7.27	36.3	1.35
4C	34.99	37.7	4.4E-08	-7.36	36.3	1.35
4D	34.99	37.7	3.5E-08	-7.46	36.3	1.35
4E	34.986	37.7	2.7E-08	-7.57	36.3	1.35
4Dr	34.986	37.7	2.1E-08	-7.67	36.3	1.35
4Cr	34.986	37.7	2.3E-08	-7.63	36.3	1.35
4Br	34.986	37.7	9.0E-09	-8.05	36.3	1.35

	m/s	m/day
Geometric mean=	4.1 E-08	3.6E-03
Max =	5.4 E-08	4.7E-03
Min =	9.0 E-09	7.7E-04



S-DIAND-001_Test4.xls / K graph linked to Packer sheet

Packer Test Results and Estimation of Hydraulic Conductivity

Borehole number: S-DIAND-002

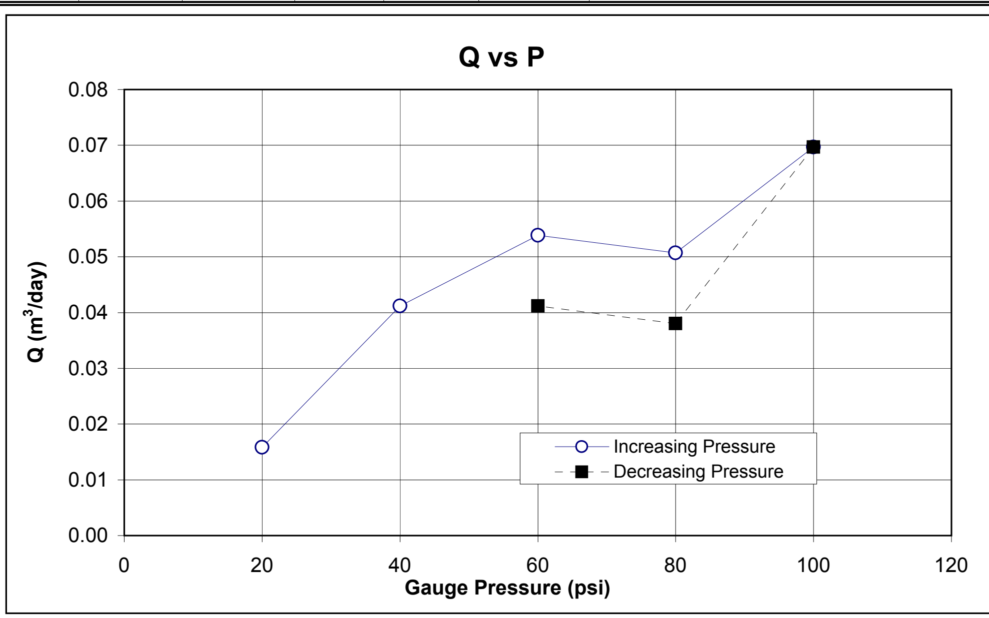
December 5, 2001

$$K = \frac{Q \ln(R/r_b)}{2\pi L P_i}$$

Hydraulic conductivity (m/day) = K
Flow rate (m^3/day) = Q
Packer spacing (m) = L
Measured test pressure (m) = P_g
Height of gauge above Datum (m) = h_g = 1.5
Friction loss in pipe (m) = h_f
__x__ *by Darcy-Weisbach equation*
_____ *from empirical test data (field) =* __________ *m/m for a given Q*

Datum ***Drill Head***
Initial depth to water (m) = h_s = 1.2
Net injection pressure (m) = $P_i = P_g + h_g + h_s - h_f$
Total depth of borehole (m) = 169
Radius of borehole (m) = r_b = 0.048
Radius of influence (m) = R = 5
Diameter of drop pipe (m) = D = 0.025
Angle of borehole (°) = 61 *(from horizontal)*

Test Number	Test Depth (m)		*L* (m)	*Q* (m^3/day)	P_g (m)	P_i (m)	*K* (m/s)	Comments
	From	To						
1A	14.26	17.0	3.0	0.02	14	16.6	2.7E-09	
1B	14.26	17.0	3.0	0.04	28	30.7	3.8E-09	
1C	14.26	17.0	3.0	0.05	42	44.8	3.4E-09	
1D	14.26	17.0	3.0	0.05	56	58.9	2.5E-09	
1E	14.26	17.0	3.0	0.07	70	72.9	2.7E-09	
1F	14.26	17.0	3.0	0.04	56	58.9	1.8E-09	
1G	14.26	17.0	3.0	0.04	42	44.8	2.6E-09	
				GEOMETRIC MEAN =			3.0 E-09	
						Max =	3.8 E-09	
						Min =	2.5 E-09	

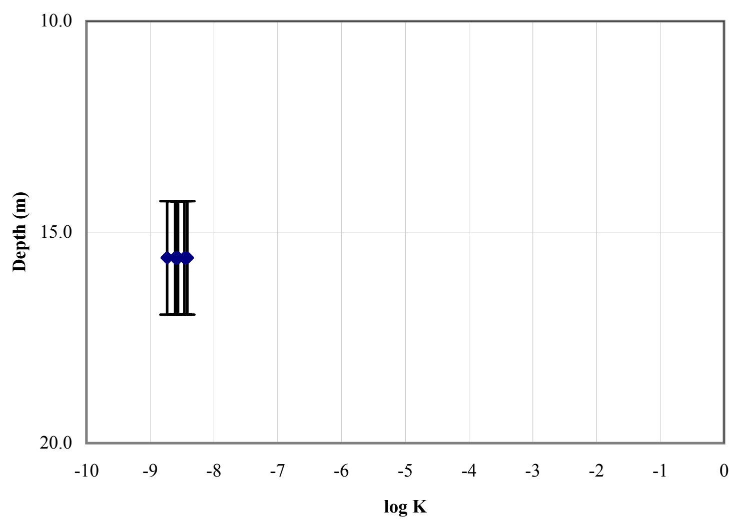


Hydraulic Conductivity Data
Borehole S-DIAND-002

Test	Length (m) from	Length (m) to	*K* (m/s)	log *K*	mid-pt (m)	1/2 range (m)
1A	14.3	17.0	2.7E-09	-8.57	15.6	1.35
1B	14.3	17.0	3.8E-09	-8.42	15.6	1.35
1C	14.3	17.0	3.4E-09	-8.46	15.6	1.35
1D	14.3	17.0	2.5E-09	-8.61	15.6	1.35
1E	14.3	17.0	2.7E-09	-8.56	15.6	1.35
1F	14.3	17.0	1.8E-09	-8.73	15.6	1.35
1G	14.3	17.0	2.6E-09	-8.58	15.6	1.35

	m/s	m/day
Geometric mean=	3.0 E-09	2.6E-04
Max =	3.8 E-09	3.3E-04
Min =	1.8 E-09	1.6E-04

Hydraulic Conductivity (m/s)



S-DIAND-002_Test1.xls / K graph linked to Packer sheet

Packer Test Results and Estimation of Hydraulic Conductivity

Borehole number: S-DIAND-002

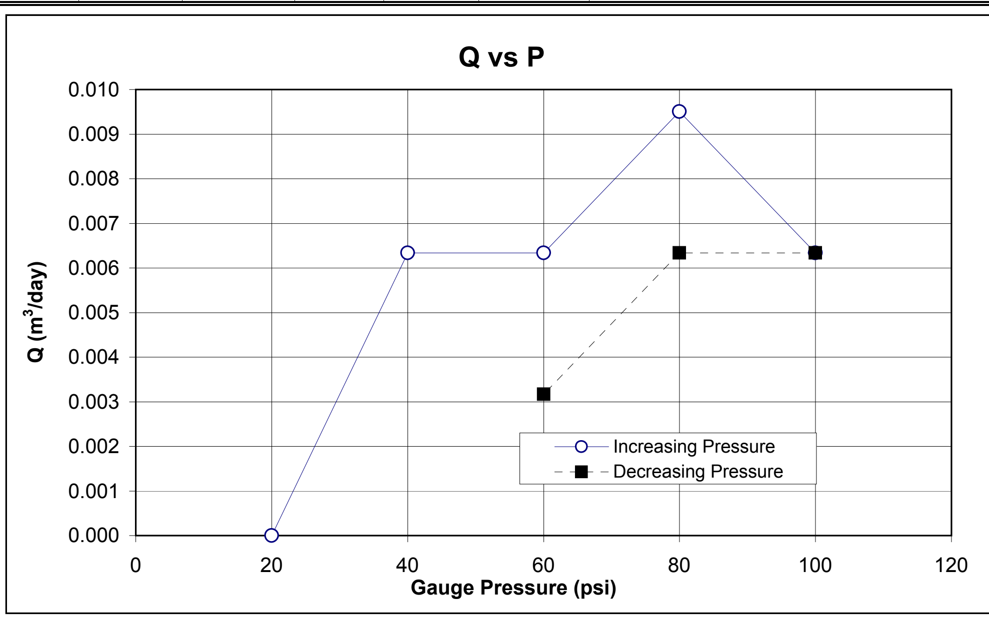
December 5, 2001

$$K = \frac{Q\ln(R/r_b)}{2\pi L P_i}$$

Hydraulic conductivity (m/day) = K
Flow rate (m^3/day) = Q
Packer spacing (m) = L
Measured test pressure (m) = P_g
Height of gauge above Datum (m) = h_g = 1.5
Friction loss in pipe (m) = h_f
__x__ *by Darcy-Weisbach equation*
_____ *from empirical test data (field) =* ____________ *m/m for a given Q*

Datum ***Drill Head***
Initial depth to water (m) = h_s = 1.2
Net injection pressure (m) = $P_i = P_g + h_g + h_s - h_f$
Total depth of borehole (m) = 169
Radius of borehole (m) = r_b = 0.048
Radius of influence (m) = R = 5
Diameter of drop pipe (m) = D = 0.025
Angle of borehole (°) = 61 *(from horizontal)*

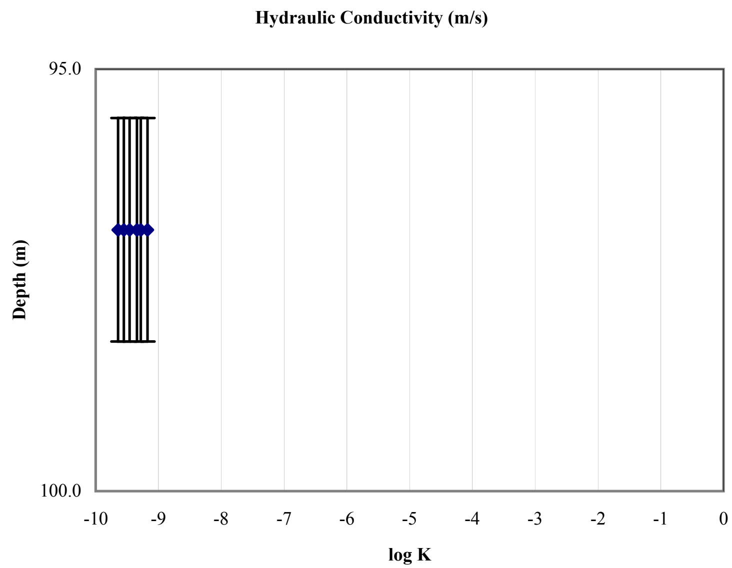
Test Number	Test Depth (m)		*L* (m)	*Q* (m^3/day)	P_g (m)	P_i (m)	*K* (m/s)	Comments
	From	To						
2A	95.6	98.2	2.6	0.00	14	na	na	
2B	95.6	98.2	2.6	0.01	28	30.7	6.7E-10	
2C	95.6	98.2	2.6	0.01	42	44.8	4.6E-10	
2D	95.6	98.2	2.6	0.01	56	58.9	5.2E-10	
2E	95.6	98.2	2.6	0.01	70	72.9	2.8E-10	
2F	95.6	98.2	2.6	0.01	56	58.9	3.5E-10	
2G	95.6	98.2	2.6	0.00	42	44.8	2.3E-10	
				GEOMETRIC MEAN =			4.6 E-10	
						Max =	6.7 E-10	
						Min =	2.8 E-10	



Hydraulic Conductivity Data
Borehole S-DIAND-002

Test	Length (m) from	Length (m) to	*K* (m/s)	log *K*	mid-pt (m)	1/2 range (m)
2A	95.6	98.2	na	na	96.9	1.32
2B	95.6	98.2	6.7E-10	-9.18	96.9	1.32
2C	95.6	98.2	4.6E-10	-9.34	96.9	1.32
2D	95.6	98.2	5.2E-10	-9.28	96.9	1.32
2E	95.6	98.2	2.8E-10	-9.55	96.9	1.32
2F	95.6	98.2	3.5E-10	-9.46	96.9	1.32
2G	95.6	98.2	2.3E-10	-9.64	96.9	1.32

	m/s	m/day
Geometric mean=	4.6 E-10	4.0E-05
Max =	6.7 E-10	5.8E-05
Min =	2.3 E-10	2.0E-05



S-DIAND-002_Test2.xls / K graph linked to Packer sheet

APPENDIX C
MP Monitoring Well Casing Design and Installation Records

Appendix C
Multilevel Casing Logs

Installation logs for the Westbay MP™ casing are provided to show where the zones are located with respect to geological features in the drillholes. As the drillholes are inclined, it must be noted that the log "depth" refers to the position in the drillhole and not the true depth.

Dip corrected depths for the various zones, measurement ports (used to measure pressure and collect water samples) and the pumping ports (used for developing the zones or carrying out hydraulic tests) are listed in Table C1.

Table C1
MP Casing Zones and Ports
True Depth Measurements

Drillhole	Zone Number	Measurement Port Depth (m)	Zone Top Depth (m)	Zone Bottom Depth (m)	Zone Length (m)	Bottom of MP Casing (m)	Bottom of Drillhole (m)
S-1857	1	156.48	154.5	1444.1	1289.5	159.4	1444.1
	2	153.58	138.6	154.1	15.5		
	3	137.64	125.6	138.1	12.6		
	4	124.60	103.8	125.1	21.3		
	5	102.87	93.7	103.4	9.7		
	6	92.73	80.7	93.2	12.6		
	7	79.69	58.9	80.2	21.3		
	8	57.96	37.2	58.4	21.3		
	9	36.22	27.0	36.7	9.7		
	10	26.08	18.4	26.6	8.2		
S-1860	1	111.56	111.1	1154.3	1043.2	114.5	1154.3
	2	107.22	104.3	110.6	6.3		
	3	103.84	93.7	103.4	9.7		
	4	92.73	72.0	93.2	21.3		
	5	70.03	50.2	70.5	20.3		
	6	49.26	28.5	49.7	21.3		
	7	27.53	12.6	28.0	15.5		
S-1955	1	135.32	129.2	1270.5	1141.3	141.0	1270.5
	2	128.27	117.9	128.7	10.8		
	3	116.99	96.8	117.5	20.7		
	4	95.85	81.3	96.3	15.0		
	5	80.34	60.1	80.8	20.7		
	6	59.20	44.6	59.7	15.0		
	7	43.70	20.7	44.2	23.5		
S-DIAND-001	1	92.73	92.3	104.1	11.8	96.3	104.1
	2	91.56	84.5	91.6	7.1		
	3	83.28	78.6	83.7	5.1		
	4	77.40	70.8	77.8	7.0		
	5	69.28	60.3	70.0	9.8		
	6	59.14	50.2	59.5	9.3		
	7	48.61	39.0	49.4	10.4		
	8	37.75	32.7	38.2	5.5		
	9	31.41	21.3	31.8	10.6		
	10	19.99	10.8	20.4	9.6		
S-DIAND-002	1	123.41	123.0	146.5	23.6	127.3	146.5
	2	122.11	106.1	122.5	16.5		
	3	105.22	99.6	105.7	6.1		
	4	98.73	92.2	99.2	6.9		
	5	90.93	77.5	91.4	13.9		
	6	76.64	47.6	77.1	29.4		
	7	46.77	28.1	47.2	19.1		
	8	27.28	11.3	27.7	16.5		
	9	10.39	6.1	10.8	4.8		

Note: all depth calcaulations adjusted for dip and hole deviation

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project:
Borehole No.: S-1857
Borehole Depth: 1495 m   Dip: -75°
Borehole Diameter: NQ (76 mm)
Measurement Datum: Top of steel casing

Project No.: 1CI0~~0~~7.09.316
Date Drawn: Jan 16/02
Date Installed:
Installed By:

1/19/02; 10:00: Depth to water in open borehole = 103.80 m (TOC)

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install/Test
0		NW Casing				
3						
			60 ✓			
6						
			59 ✓			
9						
			58 ✓			
12						
			57 ✓			
15		MF				
			56 ✓			
18			55	12588	150 psi	
			54 ✓			
21					Zone 10	
	Fault at 22.2 to 22.6 m		53 ✓			
24			O ✓	5885		
		PF	52 ✓			
27			● ✓	0557		
			51	12479	135 psi	
			50		Zone 9	
30						

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Page 1 of ____

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project:
Borehole No.: S-1857
Borehole Depth:
Borehole Diameter:
Measurement Datum:

Project No.:
Date Drawn:
Date Installed:
Installed By:

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install/Test
30			50			
					Zone 9	
33		PF	49 ✓			
36			48 ✓			
				0563		
			47	12480	140 psi	
39						
		MF	46 ✓			
42						
			45 ✓			
45						
			44 ✓			
48					Zone 8	
			43 ✓			
51						
			42 ✓			
54		MG				
			41 ✓			
57						
		PF	40 ✓			
60				0350		

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Page 2 of

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project:
Borehole No.: S-1857
Borehole Depth:
Borehole Diameter:
Measurement Datum:

Project No.:
Date Drawn:
Date Installed:
Installed By:

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install/Test
60			39	12481	145 psi	
63		PF	38			
66			37 ✓			
69			36 ✓			
72			35 ✓		Zone 7	
75			34 ✓			
78			33 ✓			
81		MF	32 ✓	0562		
			31	12594	140	
84	water level = 85m (15 Aug/99)	▽				
87			30 ✓		Zone 6 ↓	
		MF	29 ✓			
90						

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project:
Borehole No.: 5-1857
Borehole Depth:
Borehole Diameter:
Measurement Datum:

Project No.:
Date Drawn:
Date Installed:
Installed By:

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install/Test
90			28 ✓		↑ Zone 6	
93		MF	27 ✓			
96			26	0564 12593	145 psi	
99			25 ✓			
102	zone of moderate healed breccia (100.6 to 102.0 m)	Fault?	24 ✓		Zone 5	
			✓	5872		
105		MG	23 ✓	0579 12589		
			22		140 psi	
108			21 ✓			
111		MF	20 ✓			
114			19 ✓		Zone 4 ↓	
117		MF	18 ✓			
120						

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Page 4 of ____

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project: ______
Borehole No.: S-1857
Borehole Depth: ______
Borehole Diameter: ______
Measurement Datum: ______

Project No.: ______
Date Drawn: ______
Date Installed: ______
Installed By: ______

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install/Test
120		MF	17 ✓			
123			16 ✓		↑ Zone 4	
126		MF	15 ✓			
129			14	0576 12590	150 psi	
132			13 ✓			
135	WESTBAY FAULT (135.8 to 136.0m) - zone of greenish clay gouge		12	5871	using lifting sub to lower with wireline	
138	Fault brx (136.0 to 137.4m)		11 ✓		Zone 3	
141			10 ✓	0578		
144		MF	9	12591	150 psi	
147			8 ✓		Zone 2 ↓	
150			7 ✓			

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

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Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project: ____________________
Borehole No.: S-1857
Borehole Depth: ____________________
Borehole Diameter: ____________________
Measurement Datum: ____________________

Project No.: ____________________
Date Drawn: ____________________
Date Installed: ____________________
Installed By: ____________________

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install/Test
150						
		MF	6 ✓			
153					↑	
	Relogged to 154m depth	— —	5 ✓		Zone 2	
156	TDH = 1495m		✓	5870		
			4			
156 159			✓	0565		
			3	12592	135	
157.5			✓	5869		
			2		Zone 1	
159 162			✓	13227		
			1			
162 165			✓			
			EOC			
168						
171						
174						
177						
180						

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Westbay

Sheet 1 of 4

MP System Casing Installation Log

Project: Giant Mine - Arsenic Trioxide Remediation Program
WB Ref:
Location: Giant Mine
Hole No.: 5-1860
Installed by:
Hole Depth: 119.5 m MP Depth: 118.5 m
Hole Diameter: NQ (76 mm)
Date Installed:
Measurement Datum: Top of steel casing
Datum Elevation:
Date Drawn:

Depth, (m)	Geological Description	Geologic Log	MP Casing Log	Serial No. Batch No.	Final Packer Pres./Volume	Comments	Joint Install	Joint Tool
	NW casing to 6.1 m					Hydraulic Integrity		
		NW Casing	43			DTW Time		
3						34.09 m 15:39		
						34.10 m 15:54		
			42					
6						34.105 m 16:03 34.10 m 09:30		
		Mafic Volc.	41					
9		MV					✓	
			40					
12							✓	
			39	12602 (150 psi)				
15		RQD = 95	38				✓	
		RQD = 67						
18			37				✓	
						Zone 7		
21	Hematite staining on joints from 19.3 to 22.3 m	22.3	36				✓	
		RQD = 97 Intermed Volc.						
24		IV	35				✓	✓
				5875				
27			34				✓	✓
				0551	Mag Collar ✓			
30			33	12603 (145 psi)			✓	

MP Casing · MP Packer · Magnetic collar · Filter sleeve · Measurement Port Coupling · Pumping Port Coupling · Regular Coupling

18/06/90

Westbay

Sheet 3 of 4

MP System Casing Installation Log

Project:
Location: WB Ref:
Hole Depth: MP Depth: Hole No.: S-1880 Installed by:
Measurement Datum: Hole Diameter: Date Installed:
Datum Elevation: Date Drawn:

Depth, (m)	Geological Description	Geologic Log	MP Casing Log	Serial No. Batch No.	Final Packer Pres./Volume	Comments	Joint Install	Joint Test
30		IM	32					
33			31					
36			30			↑	✓	
39		38.7				Zone 6	✓	
42	38.7 to 47.9m, possibly pillows, variolitic, occasional hematite in healed fractures, rare on joint surfaces		29				✓	
45			28				✓	
48		47.9	27				✓	
51			26	0550✓ 12604 (145 psi)	mag. collar ✓		✓	
54			25 / 24				✓	
57			23			Zone 5 ↓	✓	
60			22 ↓				✓	

MP Casing | MP Packer | Magnetic collar | Filter sleeve | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

18/06/90

Westbay

Sheet 3 of 4

MP System Casing Installation Log

Project:

Location: WB Ref:

Hole Depth: MP Depth: Hole No.: S-1860 Installed by:

Measurement Datum: Hole Diameter: Date Installed:

Datum Elevation: Date Drawn:

Depth, (m)	Geological Description	Geologic Log	MP Casing Log	Serial No. Batch No.	Final Packer Pres./Volume	Comments	Joint Install	Joint Test
60			22					
63		IM	21			↑ Zone 5	✓	
66	66.1 to 72.2m RQD=80 possibly pillows, no hematite staining, joints 45° to 15° to core axis	RQD=80	20				✓	
69			19	5876			✓	
72			18	0553	MAG. COLLAR ✓		✓	
75			17	12605 (145 psi)			✓	✓
78		IM	16				✓	
81	81.4 to 99.7m possibly pillow Variolitic hematite staining on joint surfaces		15			Zone 4 ↓	✓	
84		IM	14				✓	
87			13				✓	✓
90			12				✓	✓

MP Casing · MP Packer · Magnetic collar · Filter sleeve · Measurement Port Coupling · Pumping Port Coupling · Regular Coupling

18/06/90

Westbay

Sheet 4 of 4

MP System Casing Installation Log

Project:

Location:

WB Ref:

Hole Depth: 1195m (3922') MP Depth:

Hole No.: S-1860

Installed by:

Measurement Datum:

Hole Diameter:

Date Installed:

Datum Elevation:

Date Drawn:

Depth, (m)	Geological Description	Geologic Log	MP Casing Log	Serial No. Batch No.	Final Packer Pres./Volume	Comments	Joint Install	Joint Tool
90								
			11			↑		
93								
		IM		5880		Zone 4		
			10				✓	✓
96								
				0552	MAG COLLAR			
			9	12606 (145 psi)			✓	✓
99								
		99.7	8				✓	✓
	Brecciated and vuggy section	Chlorite Schist						
102	Joints typically 45° to core axis, occasionally 25°		7			Zone 3	✓	✓
	RQD=83							
				5881				
105		105.8	6				✓	✓
				0555	MAG. COLLAR			
108	Mafic volcanics		5	12607 (145 psi)				
				5879			✓	✓
	- sampling between 105.8 to 111.8	MF	4			Zone 2	✓	✓
111		111.8		0559	BLUE COLLAR		✓	✓
	joints with hematite staining occasional healed fractures with wispy stringers of hematite		3				✓	✓
114							✓	✓
			2	12601 ✓ 145 psi			✓	✓
117				0598 ✓	MAG. COLLAR	*mag collar below M Port	✓	✓
			1			Zone 1	✓	✓
120				EOH				

MP Casing | MP Packer | Magnetic collar | Filter sleeve | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

18/06/90

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project: Giant Mine - Arsenic Trioxide Mngmt.
Project No.: ICI009.07.316
Borehole No.: S-1955
Date Drawn: Jan 17, 2002
Borehole Depth: 1352 m Angle: -70°
Date Installed:
Borehole Diameter: NQ (76mm)
Installed By:
Measurement Datum: Top of steel casing
2 m above gs.

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install	Joint Test
0	0-7.0m ; NW casing		~~56~~ 56			✓	
		NW	~~55~~ 54			✓	
3						✓	
		Casing	~~54~~ 53				
			~~53~~	used spare 201 length			
6			52			✓	
			51			✓	
9						✓	
			50				
12		CLS				✓	
			49				
15						✓	
			48				
18						✓	
			47				
21			46	12598 ✓	140 psi		
		VPF		0566 ✓		✓	✓
24			45				
	2 joints with hematite staining				Zone 7		
			44			✓	
27							
			43			✓	
30							

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project:
Borehole No.: 5-1955
Borehole Depth:
Borehole Diameter:
Measurement Datum:

Project No.:
Date Drawn:
Date Installed:
Installed By:

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install	Joint Test
30							
						✓	
33			42				
		VPF				✓	
36			41				
					Zone 7		
39			40			✓	
	2 joints with strong hematite staining. Hematite also in healed joints and calcite veinlets					✓	
42		43.0-43.3	39				
	3 joints, two of which are strongly hematite stained; most joints from 41.5 to 44.5 mod. to weakly stained					✓	
45			38				
		VPF		0664 ✓			✓
			37	12622 ✓	145 psi	✓	
48				0567 ✓		✓	✓
			36				
51						✓	
			35		Zone 6		
54							
			34			✓	
57						✓	
		MF	33				
60							

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project:
Borehole No.: S-1955
Borehole Depth:
Borehole Diameter:
Measurement Datum:

Project No.:
Date Drawn:
Date Installed:
Installed By:

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install	Joint Test
60		MF	32		Zone 6	✓	
63				0667✓			✓
			31	12626✓ 0568✓	135 psi	✓	✓
						✓	
66	3 joints; moderate staining		30				
		MI				✓	
69			29				
						✓	
72		VPF	28		Zone 5		
						✓	
75			27				
		MF				✓	
78			26				
						✓	
81	Sampled section, no hematite sta rusty section 80.8 to 81.4m		25				
		CLS				✓	
84			24				
				0666✓			✓
87			23	12619✓ 0569✓	150 psi	✓	✓
	no hematite staining	broken core	22		↑ Zone 4	✓	
90							

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project:
Borehole No.: S-1955
Borehole Depth:
Borehole Diameter:
Measurement Datum:

Project No.:
Date Drawn:
Date Installed:
Installed By:

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install/Test
90	no hematite staining	broken core	21			✓
93					↑	
					Zone 4	✓
96		CLS	20		↓	
	Possible fault at 98.4 m					✓
99	< 35° to core axis, no hematite	F ?	19	5883✓		
						✓
102			18 ✓	06679✓		
			17	12620✓ 0570✓	135 psi	✓ ✓ ✓
105	8 joints; weak hematite at 105.3 m		16			✓
108					↑	✓
			15		Zone 3	
111					↓	✓
		MI	14			
114	5 joints; one joint at 117.3 m					✓
	with moderate hematite staining		13			
117						✓
			12			
120			11 ✓			

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project:
Borehole No.: S-1955
Borehole Depth:
Borehole Diameter:
Measurement Datum:

Project No.:
Date Drawn:
Date Installed:
Installed By:

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install/Test
120	10 joints; one at 123.6m with weak hematite staining		✓		Zone 3	
		VPF		5868		
123			10 ✓			
			✓	0668		
			9	12618	155 psi	
126			8 ✓	0573		
	3 joints w minor hematite					
129		DIA	7 ✓			
	11 joints; jointing between				Zone 2	
132	131.5 to 132.2 m exhibits strong hematite staining		6 ✓			
			✓	5882		
135	6 joints; no hematite stain		5 ✓			
			✓	0572		
			4	12621	150 psi	
138	11 joints; no hematite stain					
	5 joints; no hematite stain	VPF	3 ✓		Zone 1	
141			✓	5884		
	6 joints; no hematite stn.		2 ✓			
144			✓	0571		
	4 joints; no hematite stn		1 ✓			
147						
	2 joints; no hematite staining		EOC			
150						

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project: ______
Borehole No.: 5-1955
Borehole Depth: ______
Borehole Diameter: ______
Measurement Datum: ______

Project No.: ______
Date Drawn: ______
Date Installed: ______
Installed By: ______

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install/Test
150	5 joints, no hematite stn.	VPF				
153						
156		END OF RELOGGED SECTION				
159						
162						
165						
168						
171						
174						
177						
180						

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project: Giant Mine-Arsenic Trioxide Management
Borehole No.: S- DIAND - 01
Borehole Depth: 129.5 m Borehole Diameter: HQ (96mm)
Measurement Datum: Top of steel casing (HW)

Project No.: 1CI009.07.316
Date Drawn: Jan 13, 2002
Date Installed: Jan 13, 2002
Installed By: DM/MDR/TC

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install	Joint Test
0			46		Time 16:23 DTW 59.43 m	✓	
			45		16:39 59.43 m	✓	
3	* Note: Casing 0.5 m shallower than drawn here (ie: 0.5 m stick up)	HW CASING			Jan 14		
			44		09:20 59.43 m	✓	
6							
			43			✓	
9							
			42	12612 ✓	reseal = 150 psi	✓	
12			41			✓	
15	14.8 - 20.1 m, broken ground		40		Zone 10	✓	
18			39			✓	
21			38	5865 ✓		✓	✓
						✓	
24	Depth of port =	23.5 m		0561 ✓		✓	✓
			37	12617 ✓	reseal = 145 psi	✓	
27			36			✓	
					Zone 9		
30			35			✓	

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project: ______ Project No.: ______
Borehole No.: ______ Date Drawn: ______
Borehole Depth: ______ Borehole Diameter: ______ Date Installed: ______
Measurement Datum: Top of steel casing (HW) Installed By: ______

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install	Joint Test
30			↑ 35				
			34		Zone 9	✓	
33							
			33			✓	
36		Port at 37.0 m		0560 ✓		✓	✓
			32	12616 ✓	reseal = 150 psi	✓	
39			31			✓	
42	fault at 41.7 m			5874 ✓	Zone 8	✓	✓
			30			✓	
45		Port at 44.5 m		0596 ✓			
			29	12615 ✓	reseal = 145 psi	✓	✓
48			28			✓	
51			27		Zone 7	✓	
54			26			✓	
57			25			✓	
		Port at 58.0 m		0597 ✓			
60			24	12614 ✓	reseal = 140 psi	✓	✓

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project:
Borehole No.: S-DIAND-01
Borehole Depth: 129.5 m Borehole Diameter:
Measurement Datum: Top of steel casing (H/W)

Project No.:
Date Drawn:
Date Installed:
Installed By:

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install	Joint Test
60			23			✓	
63			22			✓	
					Zone 6		
66	joint		21				
						✓	
69			20		mag collar	✓	
		Port at 71.5 m		0595 ✓		✓	✓
72			19	12613 ✓	reseal = 140 psi	✓	
			18			✓	
75							
			17		Zone 5		
78						✓	
			16			✓	
81				5864 ✓		✓	✓
			15			✓	
84		Port at 85.0 m		0593 ✓		✓	✓
			14	12611 ✓	reseal = 150 psi		
87			13		Zone 4	✓	
90							

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project:
Borehole No.: S-DIAND-01
Borehole Depth: Borehole Diameter:
Measurement Datum: Top of steel casing (HW)

Project No.:
Date Drawn:
Date Installed:
Installed By:

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install	Joint Test
90			12			✓	
93	Townsite Fault			5877 ✓	Zone 4	✓	✓
			11			✓	
96		Port at 95.5 m		0592 ✓			✓
			10	12610 ✓	reseal = 150psi	✓	
99			9			✓	
				5866 ✓	Zone 3	✓	✓
102			8			✓	
		Port at 103 m		0590 ✓			✓
105			7	12609 ✓	packer reseal = 150psi	✓	
			6			✓	
108					Zone 2		
			5				
111						✓	
			4			✓	
114		Port at 113.5 m		0591 ✓	m. port * mag collar 0.5m above m port	✓	
			3	12608 ✓	(145 psi)	✓	
				0594 ✓	m. port * Mag collar below m. port on this piece only	✓	✓
117		Port at 115.0 m	2	5887 ✓	p. port	✓	✓
	DTW in casing = 16.60m (top of casing)		1		Zone 1		
120						✓	✓

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project:
Borehole No.: S-DIAND-002
Borehole Depth: 169.2 m Borehole Diameter: HQ (96 mm)
Measurement Datum: Top of steel casing (HW) ~ 0.20 m ags

Project No.:
Date Drawn: Jan. 14/02
Date Installed: Jan 15/02
Installed By:

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install/Test
0		HW Casing	55 ✓		Water depth 44.88 m 12:42; 13:05 44.875 m; 17:47 43.60 m (after packer inflation)	✓
3			54 ✓			✓
6		mafic volc.	53 ✓	12600 ✓	(140 psi)	✓
9			52 ✓	5867 ✓		✓ ✓
	Fault (9.7 to 10.4 m)		51 ✓		Zone 9	✓
12		mafic		0587 ✓		✓
			50 ✓	12686 ✓	(140 psi)	✓
15			49 ✓			✓
	~3x10^{-9} m/s	Packer Test				
			48 ✓			✓
18						
21			47 ✓			✓
					Zone 8 ↓	
24		mafic	46 ✓			✓
27			45 ✓			✓
			44 ✓	5878 ✓		✓
30			↓			

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project: ____________________ Project No.: ____________
Borehole No.: S-DIAND-002 Date Drawn: ____________
Borehole Depth: ______ Borehole Diameter: ______ Date Installed: ____________
Measurement Datum: ____________________ Installed By: ____________

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install	Joint Test
30		mafic volc.	↑ 44 ✓	0589 ✓	↑ Zone 8	✓	✓
			43	12685 ✓	(140 psi)	✓	
33			42 ✓			✓	
36			41 ✓				
39	hematite staining in healed fractures		40 ✓			✓	
					Zone 7		
42			39			✓	
45			38			✓	
48			37			✓	
51			36			✓	
54			✓	0588 ✓			✓
			35	12473 ✓	(145 psi)	✓	
57			34			✓	
					Zone 6		
60			33 ↓		↓	✓	

MP Casing — MP Packer — Magnetic Collar — Measurement Port Coupling — Pumping Port Coupling — Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project: ______________________
Borehole No.: S-DIAND-002
Borehole Depth: ________ Borehole Diameter: ________
Measurement Datum: ______________________

Project No.: ______________________
Date Drawn: ______________________
Date Installed: ______________________
Installed By: ______________________

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install	Joint Test
60			↑ 33				
	marginally lower RQD	Mafic (indefinite)	32			✓	
63							
			31			✓	
66							
			30			✓	
69							
			29			✓	
72		Qtz-calcite veins - parallel to core					
			28		↑	✓	
75					Zone 6		
			27			✓	
78							
			26			✓	
81							
			25			✓	
84							
			24			✓	
87			✓	0586✓	mag collar		✓
90			23	12478✓	(145 psi)	✓	

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project: ____________________
Borehole No.: S-DIAND-002
Borehole Depth: ________ Borehole Diameter: ________
Measurement Datum: ____________________

Project No.: ____________
Date Drawn: ____________
Date Installed: ____________
Installed By: ____________

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install	Joint Test
90		mafic volc	22			✓	
93		Pillow Breccia	21			✓	
					↑		
96			20		Zone 5	✓	
99			19			✓	
102			18			✓	
				0584✓			✓
105		Pillow Basalt	17	12476✓	(140 psi) INFLATED	✓	
			16			✓	
108	Rudolph Fault		15		Zone 4	✓	
	Packer Test						
111			14	5873✓		✓	✓
114			13	0585✓ 12477✓	(135 psi) INFLATED	✓	✓
			12			✓	
117					Zone 3		
			11		↓		
120							

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project: ____________________
Borehole No.: S-DIAND-002
Borehole Depth: __________ Borehole Diameter: __________
Measurement Datum: ____________________

Project No.: ____________________
Date Drawn: ____________________
Date Installed: ____________________
Installed By: ____________________

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install	Joint Test
120			11 ✓		mag collar Zone 3	✓	✓
			10	0582 ✓ 12475 ✓	(140 psi) INFLATED	✓	
123		Pillow Basalt	9			✓	
126			8			✓	
					Zone 2		
129			7			✓	
132			6			✓	
135			5			✓	
138			4		mag collar 0.5 m above m.port	✓	
			✓				
141			3	0583 ✓ 12474 ✓	(140 psi) INFLATED	✓	✓
			2 ✓	0554 ✓	mag collar 0.5 m below m.port	✓	✓
144			1	5886 ✓	Zone 1	✓	✓
147							
150					Water level below top of Steel 2.44 m		

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Casing Installation Log

Westbay Instruments Inc.
A Schlumberger Company

Project: ______________________ Project No.: ______________
Borehole No.: 5-DIAND-002 Date Drawn: ______________
Borehole Depth: ________ Borehole Diameter: ________ Date Installed: ______________
Measurement Datum: ______________ Installed By: ______________

Depth (m)	Geological Description	Geologic Log	MP Casing	Serial No.	Comments	Joint Install/Test
150		pillow basalt				
153						
156	153.9 to 163.1 m - separation planes along pillow selvages, as well as joints					
159		pillow basalt				
162						
165						
168	EOH = 169.2 m					
171						
174						
177						
180						

MP Casing | MP Packer | Magnetic Collar | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

APPENDIX D
Hydraulic Testing
Monitoring Installation Testing Program

Appendix D
Pressure Response Testing – K and T Estimates

As discussed in the main report, hydraulic response tests were carried out in selected zones using the multiple level monitoring system. These tests consisted of two types:

- Pressure pulse tests conducted with the pressure transducer (for low K zones);
- Rising head (slug) tests in areas of higher K (faults and joints, etc.)

Data from the pressure tests were analysed using the software package "AquiferTest"™ by Waterloo Hydrogeologic Inc. using the Hvorslev (1951) slug test method. This analysis method is designed to estimate the hydraulic conductivity of an aquifer. However, it should be kept in mind that a slug test only stresses a small portion of the aquifer. Therefore, the representative volume "tested" is limited to a cylindrical area of small radius (r) immediately around the well screen.

Slug test analysis methods were designed for use with standpipe piezometers. The Westbay MP System, as it can have multiple test zones within an aquifer, requires that several of the test variables be defined to indicate what interval of monitoring well is represented by each test analysis.

These changes may affect the quantitative results of the analysis results, but as they will be used for all of the tests, the resultant transmissivity values should give a reasonable qualitative comparison between zones. As discussed in the report, it is possible to more accurately determine true hydraulic parameters from the test data, but was not considered worthwhile as correlating the data to nearby rock mass and hydraulic features would entail greater potential error than the methods used.

The two variables that need to be defined are "b" and "L", where:

b = aquifer thickness (confined aquifer); or
= depth from water level to bottom of well screen (unconfined aquifer)

and

L = length of the screen

For the analysis, it was decided that “b” would represent the depth from static water level to bottom of zone. This was chosen seeing as no specific aquifer and/or aquiclude units are identified in the rock sequence, and because the groundwater flow is potentially dominated by fracture flow that will cross lithological boundaries.

Two values were used to represent “L”. In all zones, the distance between the hydraulic packers was used. This value assumes the recovery data represents the transmissivity of the full length of rock isolated. In zones where a fault is present, the true width of the fault zone was also used when calculating the hydraulic conductivity of the zone. This assumes that all of the hydraulic effects are due to the fault flow, and therefore calculates the transmissivity of the structural feature itself.

The zones tested and the values used in the analysis are listed in Table D1.

Table D1
Test Zone Data

Bore Hole	Zone	Zone K Tested?	Test Type	Fault/Joint/Fracture	RQD	Zone Length, "L_Z" (m)	Fault Width "L_F" (m)	b (m)	Port Depth (m) *	Static DTW (m)	Saturated Aquifer Thickness	DTW at t=0 (m)	Change from Static to t=0 (m)	% Recovery	Confidence Level (time used)	Hydraulic Conductivity "K" (m/s)	
S-1857	1	YES	PP	end of logged section --no data	No Data	1335.0		33.75	156.48	122.73	33.75	123.08	0.35	97%	L	1.7E-06	
	2	YES	PP	hairline fractures	90-93	16.0		35.93	153.58	117.65	35.93	139.77	22.12	25%	M to H	**2.9E-08**	
	3	YES	PP	**Westbay Fault** (131.1 to 131.4m), flt brx (131.4 to 132.7m)	90-97	13.0		46.53	137.64	91.11	46.53	98.42	7.31	99%	M (mid-late)	**5.2E-07**	
	3	YES	PP	**Westbay Fault** (131.1 to 131.4m), flt brx (131.4 to 132.7m)	90-97		0.3	46.53	137.64	91.11	46.53	98.42	7.31	99%	M (mid-late)	**8.1E-06**	
	4	YES	PP	2 joints/filled hairlines	64-97	22.0		85.40	124.60	39.20	85.40	83.29	44.09	26%	H	**1.5E-08**	
NQ drillhole	5	YES	PP	**Fault** (97.2 to 98.5m)	72-100	10.0		84.68	102.87	18.19	84.68	20.68	2.49	95%	L to M	**3.0E-06**	
D = 0.076m	5	YES	PP	**Fault** (97.2 to 98.5m)			1.3	84.67	102.87	18.20	84.67	20.68	2.48	95%	L to M	**1.7E-05**	
	6	YES	PP	numerous hairline fractures	98-100	13.0		74.50	92.73	18.23	74.50	40.86	22.63	98%	H (mid-late)	**4.5E-07**	
	7	YES	PP	numerous hairline fractures	92-97	22.0		61.50	79.69	18.19	61.50	25.94	7.75	91%	M (mid to late)	**7.6E-08**	
	8	YES	PP	**highly fractured and jointed**	No Data	22.0		40.03	57.96	17.93	40.03	18.05	0.12	76%	L (early)	9.3E-07	
	9	YES	PP	—	No Data	10.0		18.25	36.22	17.97	18.25	18.11	0.14	100%	L (early)	2.0E-06	**1.7E-05** max
	10	YES	PP	**Fault** (21.5 to 21.8)	No Data	8.5		9.54	26.08	16.54	9.54	17.03	0.49	59%	M (mid to late)	**7.3E-08**	**1.5E-08** min
	10	YES	PP	**Fault** (21.5 to 21.8)	No Data		0.3	9.54	26.08	16.54	9.54	17.03	0.49	59%	M (mid to late)	**8.9E-07**	**4.3E-07** geo' mean
S-1860	1	YES	PP	11 joints	93-100	1080.0		70.72	111.56	40.84	70.72	40.17	0.67	79%	L (early to mid)	**1.4E-08**	
	2	NO	PP	5 joints	90	6.5		101.57	107.22	5.65	101.57	--	--	--	--	--	
NQ drillhole	3	YES	PP	**breccia zone** (96.8 to 98.7m)	83-94	10.0		100.79	103.84	3.05	100.79	3.49	0.44	98%	M (mid to late)	**2.7E-06**	
D = 0.076m	3	YES	RHT	**breccia zone** (96.8 to 98.7m)	83-94		1.9	100.79	103.84	3.05	100.79	3.49	0.44	98%	M (mid to late)	**1.6E-06**	
	4	YES	PP	possibly pillow baslts; variolitic.	94-96	22.0		67.86	92.73	24.87	67.86	25.79	0.92	97%	M (mid to late)	**2.9E-07**	
	5	YES	PP	possibly pillow baslts; variolitic.	80-100	21.0		45.58	70.03	24.45	45.58	24.73	0.28	58%	L (mid to late)	9.3E-08	**2.7E-06** max
	6	YES	PP	possibly pillow baslts; variolitic.	94-99	22.0		37.25	49.26	12.01	37.25	12.86	0.85	99%	M (mid)	**1.9E-07**	**1.4E-08** min
	7	YES	PP	6 joints	67-97	16.0		19.42	27.53	8.11	19.42	10.51	2.40	98%	M (mid to late)	**3.5E-07**	**3.2E-07** geo' mean
S-1955	1	nt	nt	variolitic pillow flow	88-100	1214.5		-2.11	135.32	137.43	-2.11	--	--	--	--	--	
	2	nt	nt	diabase/variolitic pillow flow	86-93	11.5		-0.75	128.27	129.02	-0.75	--	--	--	--	--	
NQ drillhole	3	nt	nt	metagabbro/ massive Indefinite/variolitic pillow flow	74-93	22.0		-0.88	116.99	117.87	-0.88	--	--	--	--	--	
D = 0.076m	4	nt	nt	chlorite schist/metagabbro/ massive Indefinite	63-83	16.0		-1.36	95.85	97.21	-1.36	--	--	--	--	--	
	5	nt	nt	variolitic pillow/mafic flow/chlorite schist	60-100	22.0		-1.56	80.34	81.90	-1.56	--	--	--	--	--	
	6	nt	nt	variolitic pillow/mafic flow	58-100	16.0		47.75	59.20	11.45	47.75	--	--	--	--	--	
	7	nt	nt	variolitic pillow flow	80-98	25.0		32.76	43.70	10.94	32.76	--	--	--	--	--	
S-DIAND-001	1	nt	nt	minor jointing	72-82	15.0		86.99	92.73	5.74	86.99	--	--	--	--	--	
	2	nt	nt	minor jointing	71-75	9.0		85.46	91.56	6.10	85.46	--	--	--	--	--	
	3	nt	nt	patchy variolities	73-77	6.5		72.86	83.28	10.42	72.86	--	--	--	--	--	
HQ drillhole	4	YES	RHT	**Townsite Fault** (75.0 to 75.1m), breccia (75.1 to 76.4m)	68-76	9.0	0.1	61.32	77.40	16.08	61.32	42.22	26.14	88%		**2.4E-08**	
D = 0.096m	4	YES	RHT	**Townsite Fault** (75.0 to 75.1m), breccia (75.1 to 76.4m)	68-76	9.0	0.1	61.32	77.40	16.08	61.32	42.22	26.14	88%		**3.0E-07**	
	5	nt	nt	1 joint	68-77	13.0		53.51	69.28	15.77	53.51	--	--	--	--	--	
	6	nt	nt	1 joint	66-77	12.0		42.65	59.14	16.49	42.65	--	--	--	--	--	
	7	nt	nt	—	68-78	13.0		35.33	48.61	13.28	35.33	--	--	--	--	--	
	8	nt	nt	**Fault** (35.3m to 35.5)	68-73	6.5	0.2	24.04	37.75	13.71	24.04	--	--	--	--	--	**3.0E-07** max
	9	nt	nt	Kink Banding	73-75	12.5		17.52	31.41	13.89	17.52	--	--	--	--	--	**2.4E-08** min
	10	nt	nt	2 joints	64-73	11.5		5.41	19.99	14.58	5.41	--	--	--	--	--	**8.5E-08** geo' mean
S-DIAND-002	1	YES	PP	planes of separation and joints	0-82	27.2		97.60	123.41	25.81	97.60	36.56	10.75	100%	M (mid to late)	**9.5E-09**	
	2	YES	PP	jointing pillow selveges	79-87	19.0		108.92	122.11	13.19	108.92	26.63	13.44	100%	L - M (mid to late)	**1.1E-08**	
	3	YES	PP	jointing pillow selveges	82-87	7.0		94.25	105.22	10.97	94.25	11.55	0.58	100%	M (mid to late)	**5.9E-07**	
HQ drillhole	4	YES	PP	**Rudolph Fault** (94.5m to 96.3m), some jointing	0-87	8.0		90.21	98.73	8.52	90.21	9.17	0.65	100%	M (mid to late)	**2.4E-07**	
D = 0.096m	4	YES	RHT	**Rudolph Fault** (94.5m to 96.3m), some jointing	0-87		1.8	90.21	98.73	8.52	90.21	9.17	0.65	100%	M (mid to late)	**7.5E-07**	
	5	YES	PP	at least 3 joints	0-87	16.0		83.47	90.93	7.46	83.47	7.82	0.36	100%	M (mid to late)	**5.6E-07**	
	6	YES	PP	—	79-87	34.0		69.78	76.64	6.86	69.78	7.76	0.90	100%	M (mid to late)	**1.8E-07**	
	7	YES	PP	—	82-87	22.0		40.41	46.77	6.36	40.41	7.00	0.64	100%	M (mid)	**2.7E-07**	**9.8E-07** max
	8	YES	PP	1 joint	0-87	19.0		24.42	27.28	2.86	24.42	6.34	3.48	100%	M (mid)	**9.8E-07**	**9.5E-09** min
	9	YES	PP	**Fault** (8.4m to 9.0m)	0	5.5	0.6	6.89	10.39	3.50	6.89	3.52	0.02	50%	L, not good	--	**1.9E-07** geo' mean

Notes: * = port depths corrected for drillhole dip and deviation
DTW = depth to water (below ground surface)
L_F = zone length contributing to hydraulic response
L_F = width of fault (assumed to be responsible for hydraulic response in zone test)
When multiple tests carried out, testr with greatest initial change in water level was analysed.
BOLD "K" data used to determine geometric mean for tests (other tests considered to be suspect)

Test Types:
PP = Pressure Pulse test (through measurement port)
RHT = rising head test (through pumping port)
nt = Not Tested
Conductivity Results = Zone K, (Fault K) ie: 4.33E-08, (3.50E-08)
MP casing ID = 0.038m (38mm)

max	1.7E-05
min	9.5E-09
geometric mean	2.7E-07

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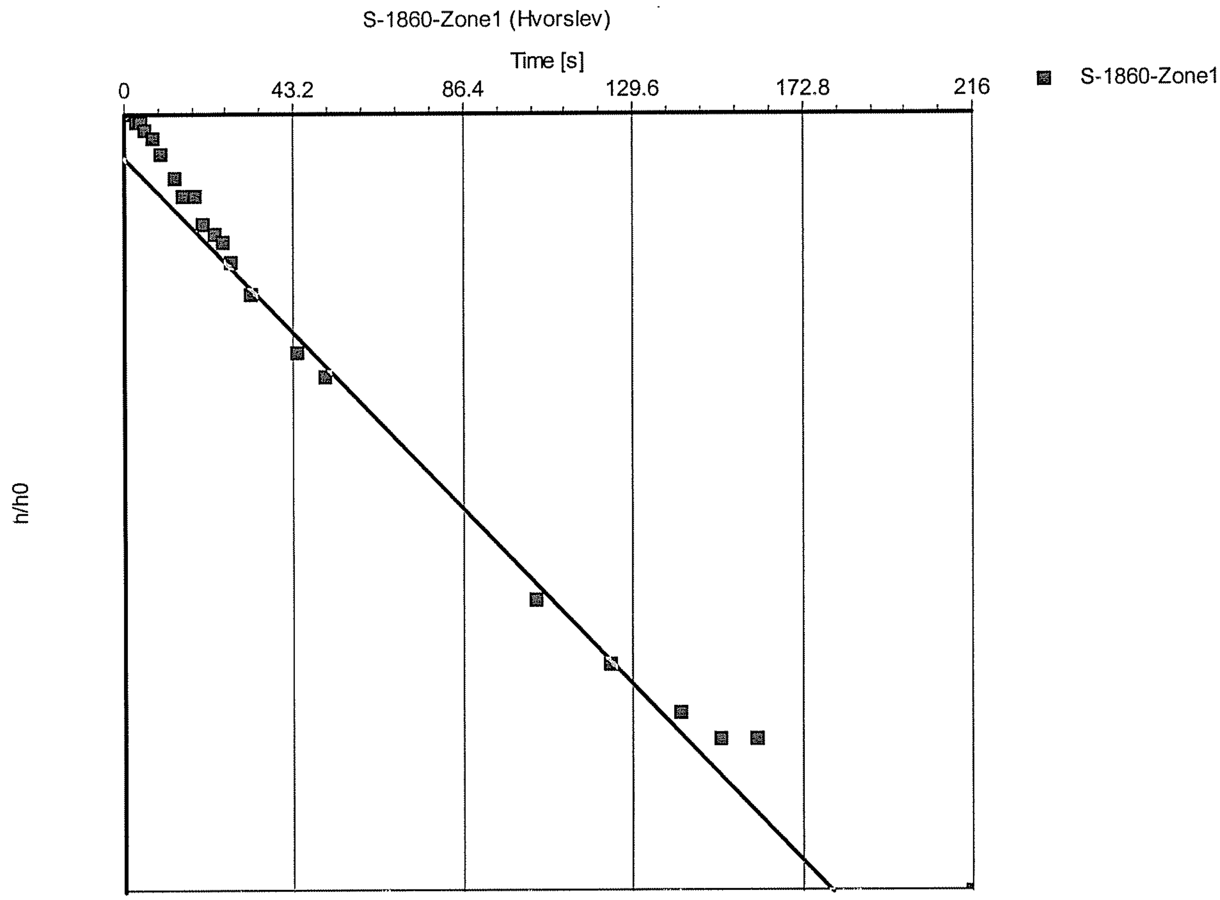
180 Columbia St. Unit 1104	Project: Giant Mine - April 2002
Waterloo, Ontario, Canada	No: 1CI001.07.317
Phone: +1 519 746 1798	Client: DIAND



Test name: **S-1860-Zone1**

Analysis method: **Hvorslev**

Analysis results:	Conductivity:	1.40E-8 [m/s]

Test parameters:				
	Test well:	S-1860-Zone1	Aquifer thickness:	70.72 [m]
	Screen radius:	0.038 [m]		
	Screen length:	1080 [m]		
	Casing radius:	0.019 [m]		

Comments:

questionable test
low Delta DTW at t=0 (0.67m)
early time, near well effects only
not used in K comparison

Evaluated by: MRoyle
Date: 09/07/20

Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
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Phone: +1 519 746 1798

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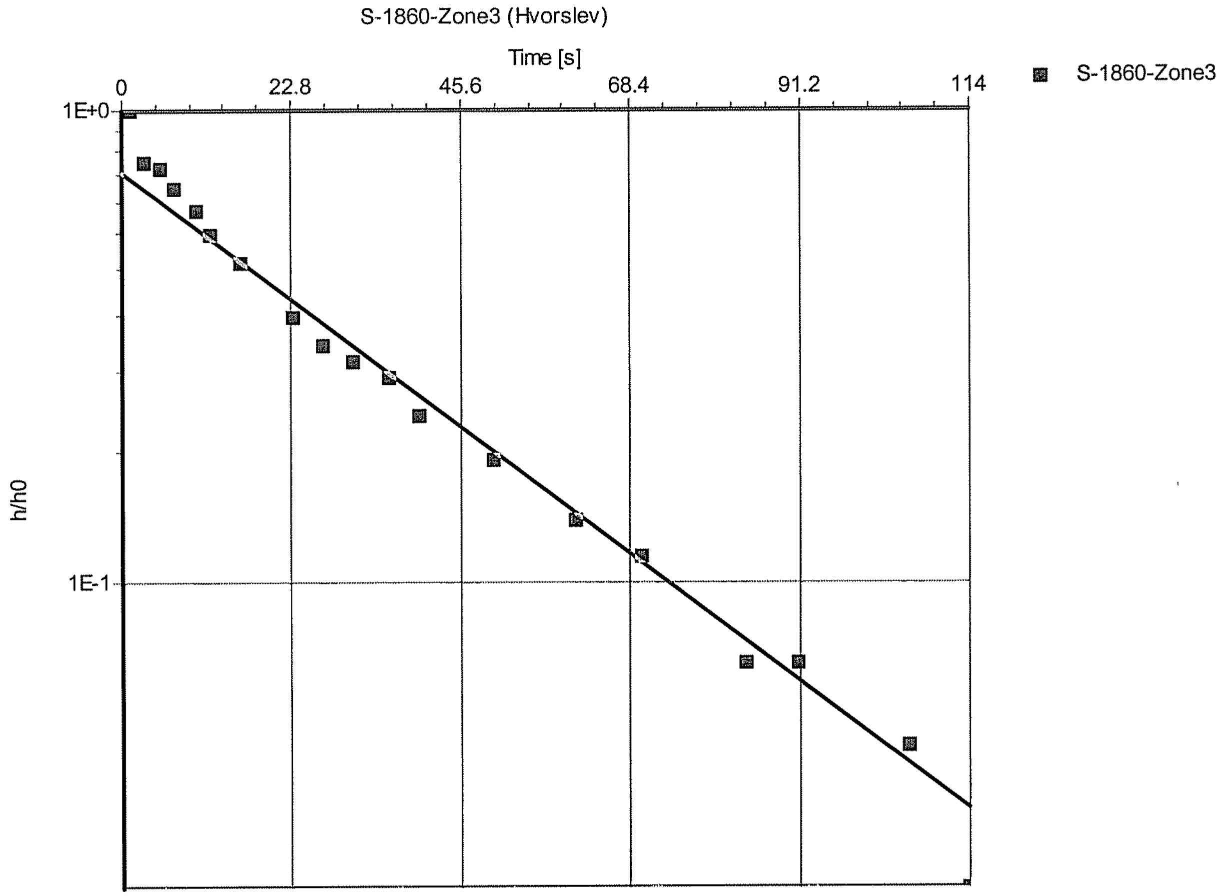


Test name: **S-1860-Zone3**

Analysis method: **Hvorslev**

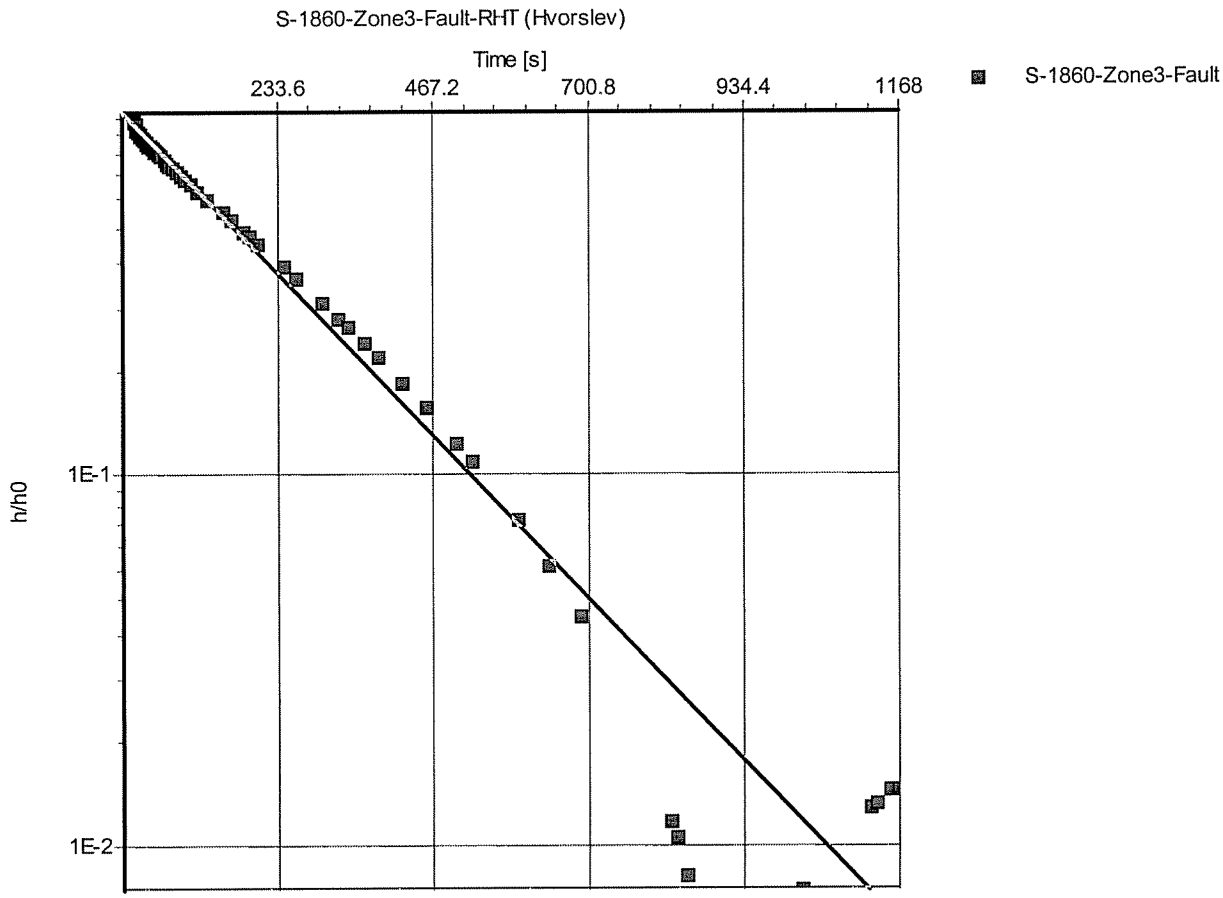
Analysis results: Conductivity: 2.74E-6 [m/s]

Test parameters:				
	Test well:	S-1860-Zone3	Aquifer thickness:	100.8 [m]
	Screen radius:	0.038 [m]		
	Screen length:	10 [m]		
	Casing radius:	0.019 [m]		

Comments:
breccia zone - entire zone length used in analysis
Pressure Pulse Test through measurement port
small initial delta DTW (0.44m)
reasonable recovery curve and resonse
mid to late data used

Evaluated by: MRoyle
Date: 09/07/20

Waterloo Hydrogeologic, Inc. 180 Columbia St. Unit 1104 Waterloo, Ontario, Canada Phone: +1 519 746 1798	**Pumping Test Analysis Report** Project: Giant Mine - April 2002 No: 1CI001.07.317 Client: DIAND



Test name: **S-1860-Zone3-Fault-RHT**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 1.61E-6 [m/s]

Test parameters:			
Test well:	S-1860-Zone3-Fault	Aquifer thickness:	100.8 [m]
Screen radius:	0.038 [m]		
Screen length:	1.9 [m]		
Casing radius:	0.019 [m]		

Comments:
Breccia length used in anlysis
Rising Head Test through pumping port
large initial delta DTW (22.7m)
good response

Evaluated by: MRoyle
Date: 09/07/20

Waterloo Hydrogeologic, Inc.	Pumping Test Analysis Report
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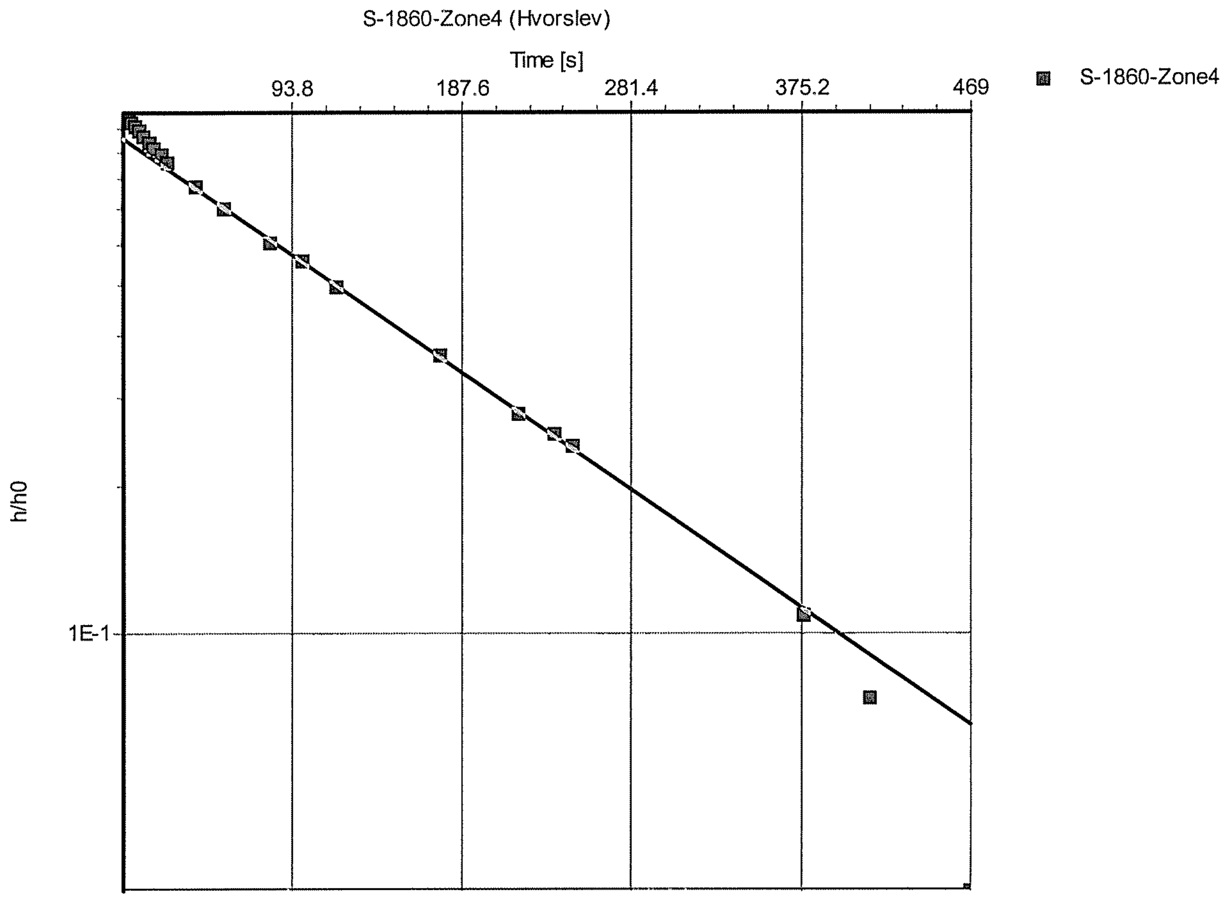


Test name: **S-1860-Zone4**

Analysis method: **Hvorslev**

Analysis results:		Conductivity:	2.87E-7 [m/s]
Test parameters:	Test well: S-1860-Zone4	Aquifer thickness:	67.86 [m]
	Screen radius: 0.038 [m]		
	Screen length: 22 [m]		
	Casing radius: 0.019 [m]		

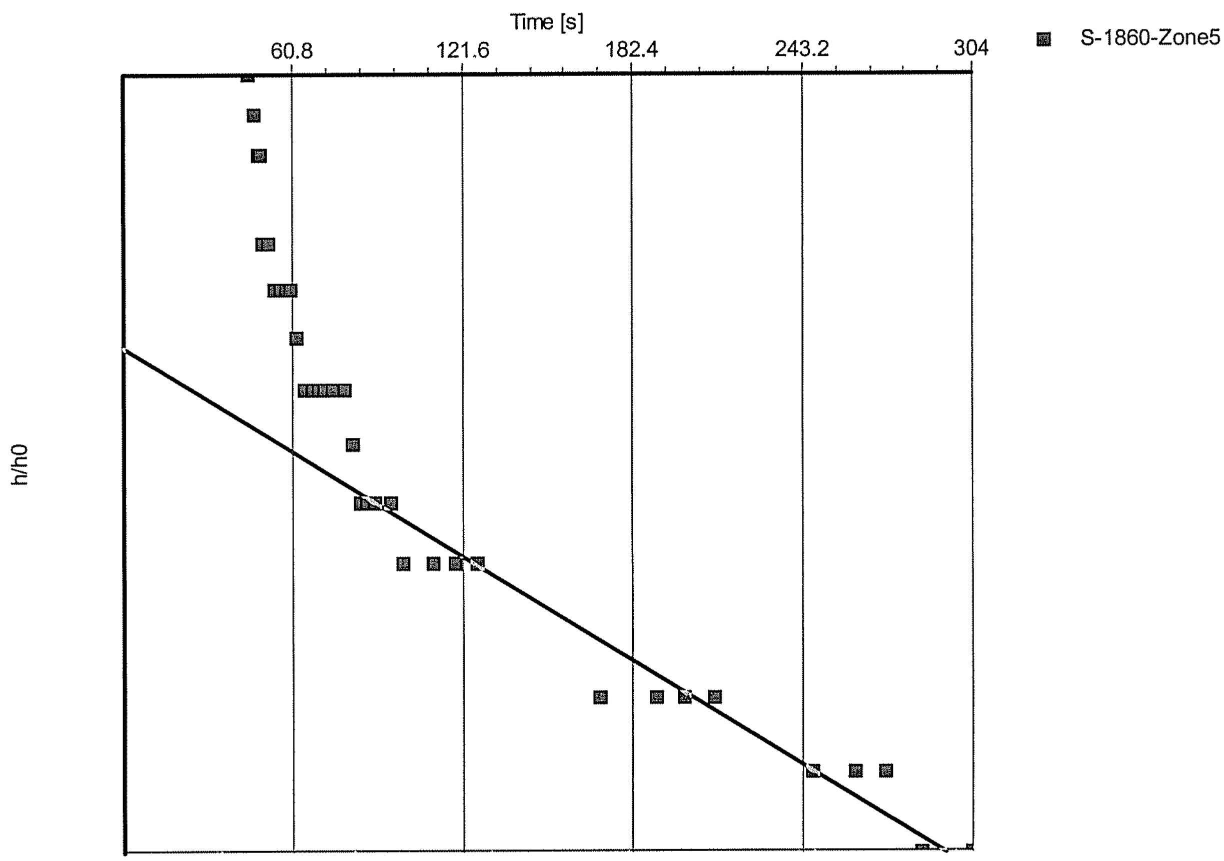
Comments: reasonable recovery ciurve
mid to late data
initial delta DTW small (0.75m)

Evaluated by: MRoyle

Date: 09/07/20

Waterloo Hydrogeologic, Inc. 180 Columbia St. Unit 1104 Waterloo, Ontario, Canada Phone: +1 519 746 1798	**Pumping Test Analysis Report** Project: Giant Mine - April 2002 No: 1CI001.07.317 Client: DIAND

S-1860-Zone5 (Hvorslev)



Test name: **S-1860-Zone5**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 9.29E-8 [m/s]

Test parameters:				
	Test well:	S-1860-Zone5	Aquifer thickness:	45.58 [m]
	Screen radius:	0.038 [m]		
	Screen length:	21 [m]		
	Casing radius:	0.019 [m]		

Comments: small initial delta DTW (0.28m) - overestimates K?
low reliability, not used in K comparison
mid to late data

Evaluated by: MRoyle

Date: 09/07/20

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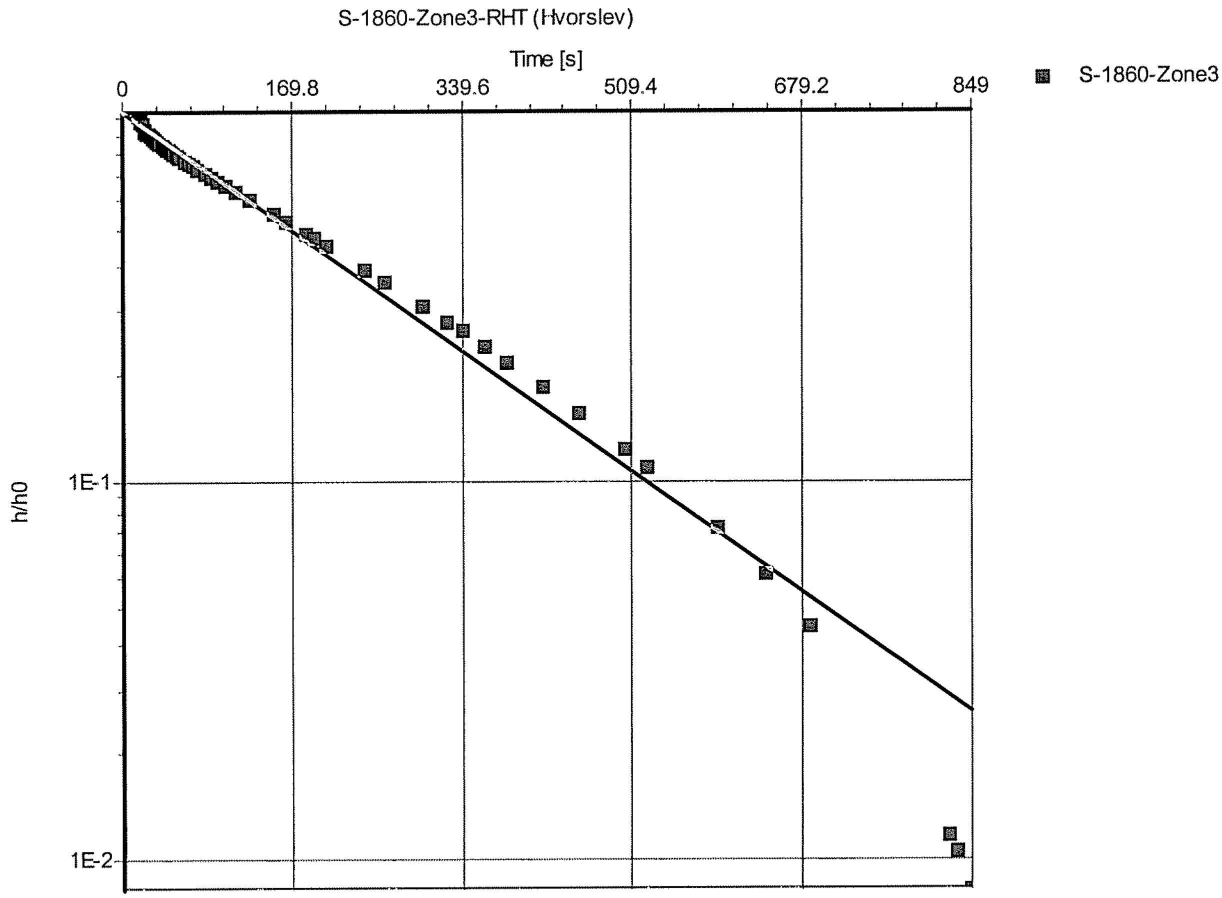

Test name: **S-1860-Zone3-RHT**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 4.35E-7 [m/s]

Test parameters:

Test well:	S-1860-Zone3	Aquifer thickness:	100.8 [m]
Screen radius:	0.038 [m]		
Screen length:	10 [m]		
Casing radius:	0.019 [m]		

Comments:

Breccia zone - zone length used in anlysis
Rising Head Test through pumping port
large initial delta DTW (22.7m)
good response

Evaluated by: MRoyle

Date: 09/07/20

Waterloo Hydrogeologic, Inc.	Pumping Test Analysis Report
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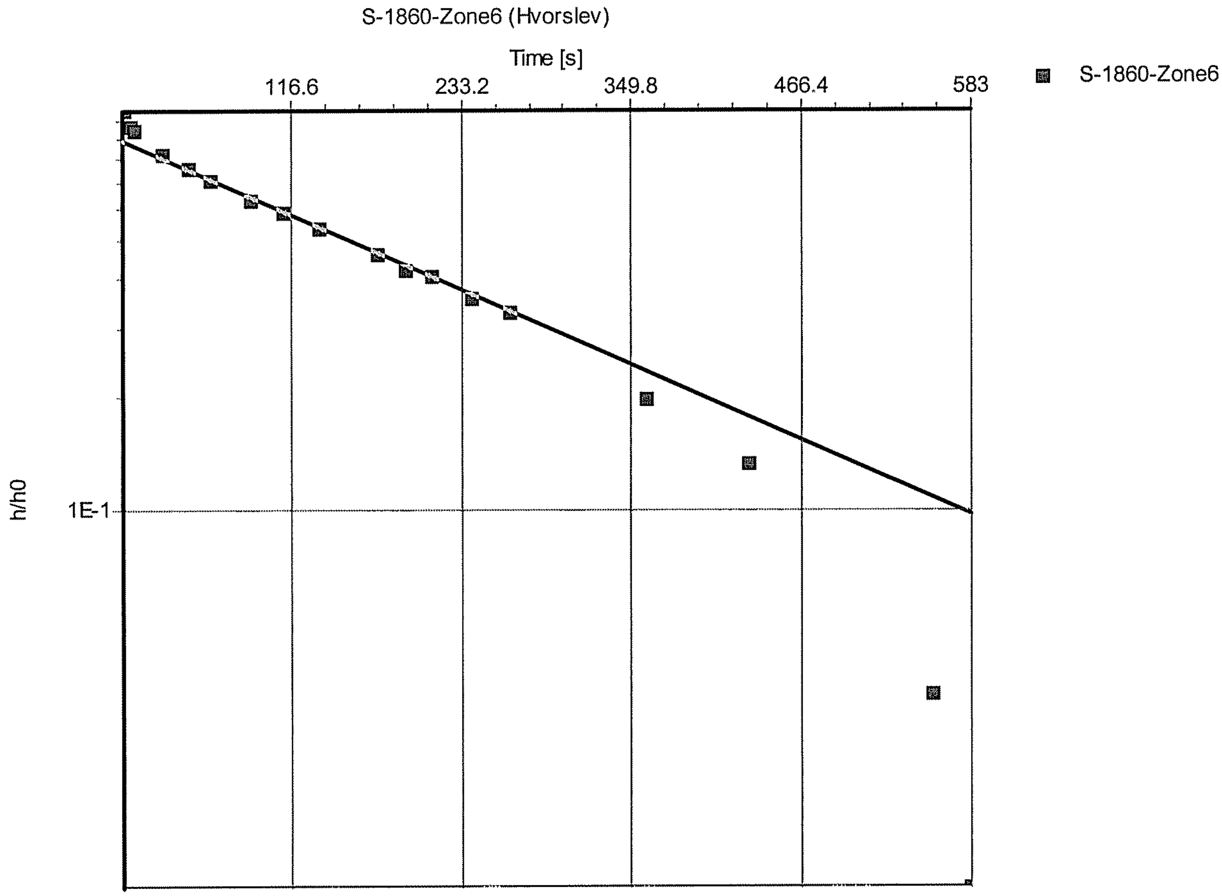

Test name: **S-1860-Zone6**

Analysis method: **Hvorslev**

Analysis results:		Conductivity:	1.91E-7 [m/s]

Test parameters:				
	Test well:	S-1860-Zone6	Aquifer thickness:	37.25 [m]
	Screen radius:	0.038 [m]		
	Screen length:	22 [m]		
	Casing radius:	0.019 [m]		

Comments:
reasonable response
initial delta DTW = 0.85m
mid to late data used

Evaluated by: MRoyle
Date: 09/07/20

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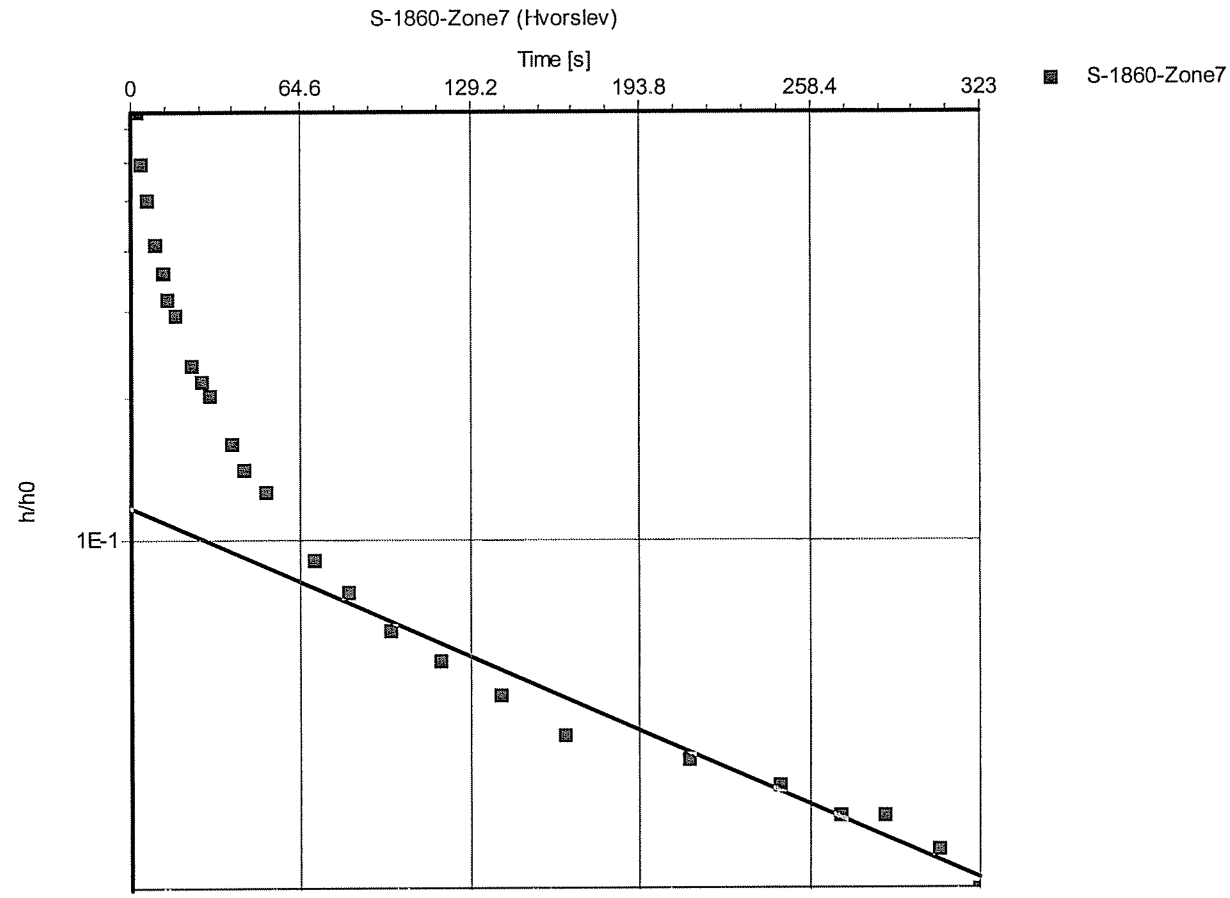

Test name: **S-1860-Zone7**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 3.52E-7 [m/s]

Test parameters:				
	Test well:	S-1860-Zone7	Aquifer thickness:	19.42 [m]
	Screen radius:	0.038 [m]		
	Screen length:	16 [m]		
	Casing radius:	0.019 [m]		

Comments: initial delta DTW = 2.4
well efects in early data?
mid to late data used

Evaluated by: MRoyle
Date: 09/07/20

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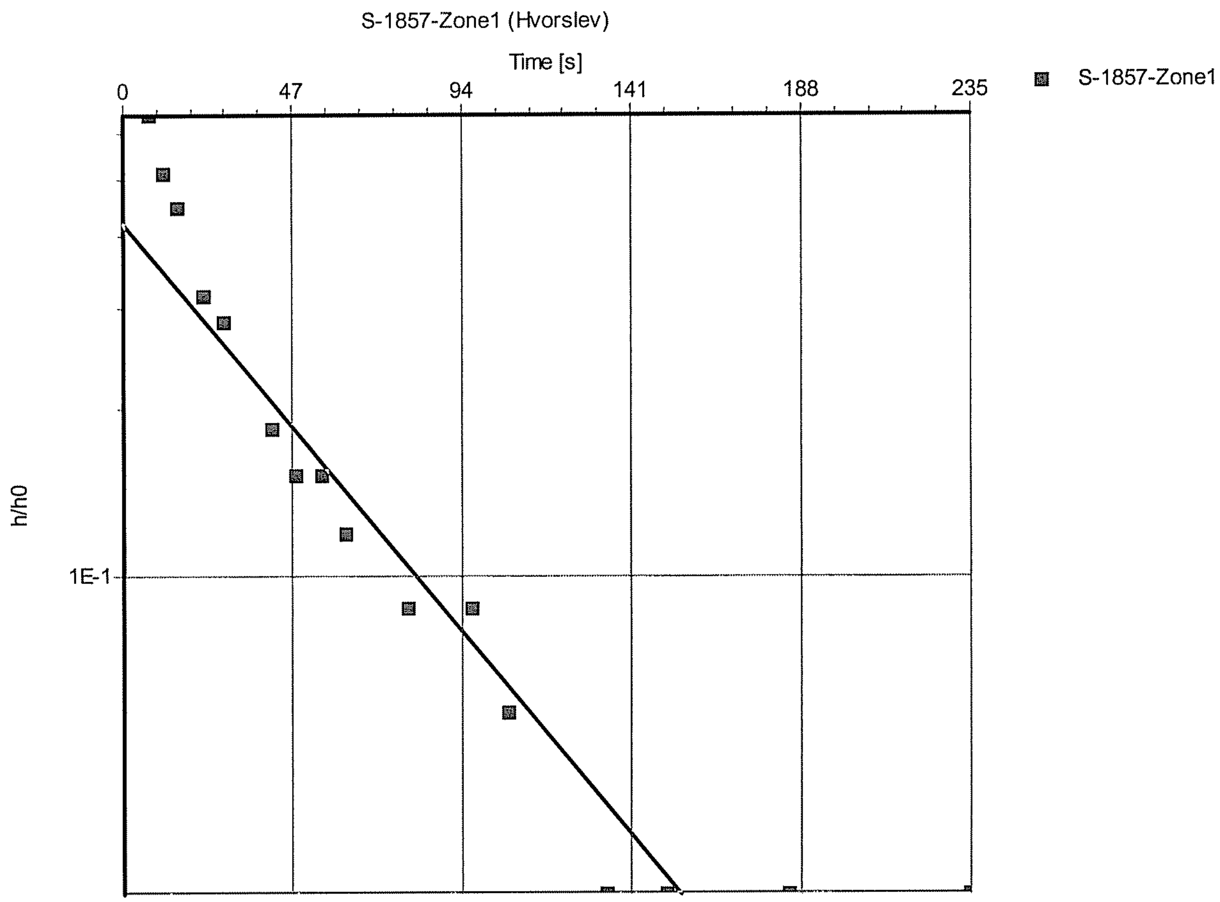

Test name: **S-1857-Zone1**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 1.68E-6 [m/s]

Test parameters:				
	Test well:	S-1857-Zone1	Aquifer thickness:	33.76 [m]
	Screen radius:	0.038 [m]		
	Screen length:	10 [m]		
	Casing radius:	0.019 [m]		

Comments: early time data only, low delta DTW (0.35m)
near well effects
low reliability, expected to overestimate K

Evaluated by: MRoyle

Date: 05/07/20

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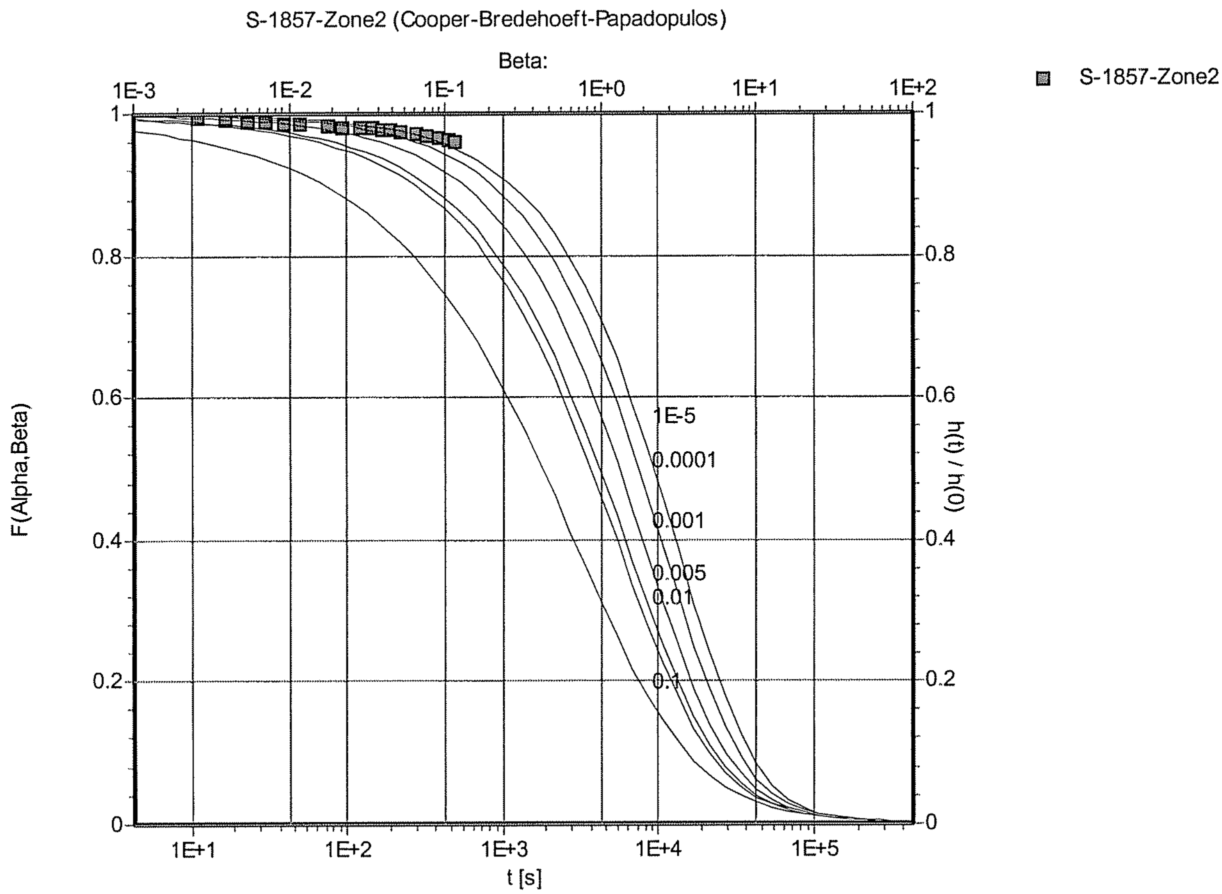

Test name: **S-1857-Zone2**

Analysis method: **Cooper-Bredehoeft-Papadopulos**

Analysis results:	Transmissivity:	8.42E-8 [m²/s]	Conductivity:	2.34E-9 [m/s]
	Storativity:	2.89E-7		

Test parameters:	Test well:	S-1857-Zone2	Aquifer thickness:	35.92 [m]
	Screen radius:	0.038 [m]	Alpha:	0.005
	Screen length:	16 [m]		
	Casing radius:	0.019 [m]		
	r(c):	2.5 [m]		

Comments: Significant delta DTW at t=0
Hign to medium reliability

Evaluated by: MRoyle
Date: 05/07/20

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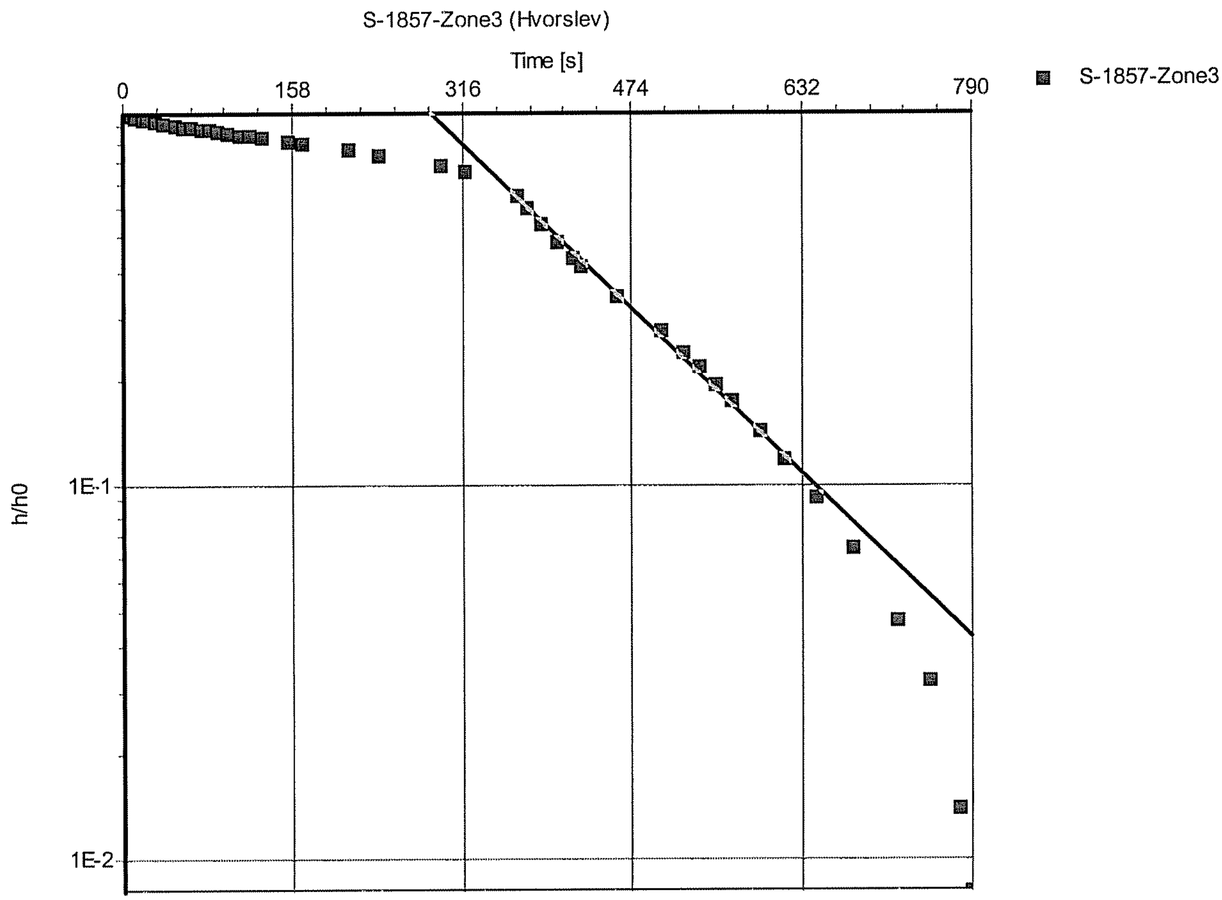

<u>Test name:</u> **S-1857-Zone3**

<u>Analysis method:</u> **Hvorslev**

<u>Analysis results:</u> Conductivity: 5.20E-7 [m/s]

<u>Test parameters:</u>

Test well:	S-1857-Zone3	Aquifer thickness:	46.53 [m]
Screen radius:	0.038 [m]		
Screen length:	13 [m]		
Casing radius:	0.019 [m]		

<u>Comments:</u>

Westbay Fault - entire zone length used in analysis
variability in recovery curve due to well effects?
reasonable reliabilty
mid time data used

Evaluated by: MRoyle

Date: 05/07/20

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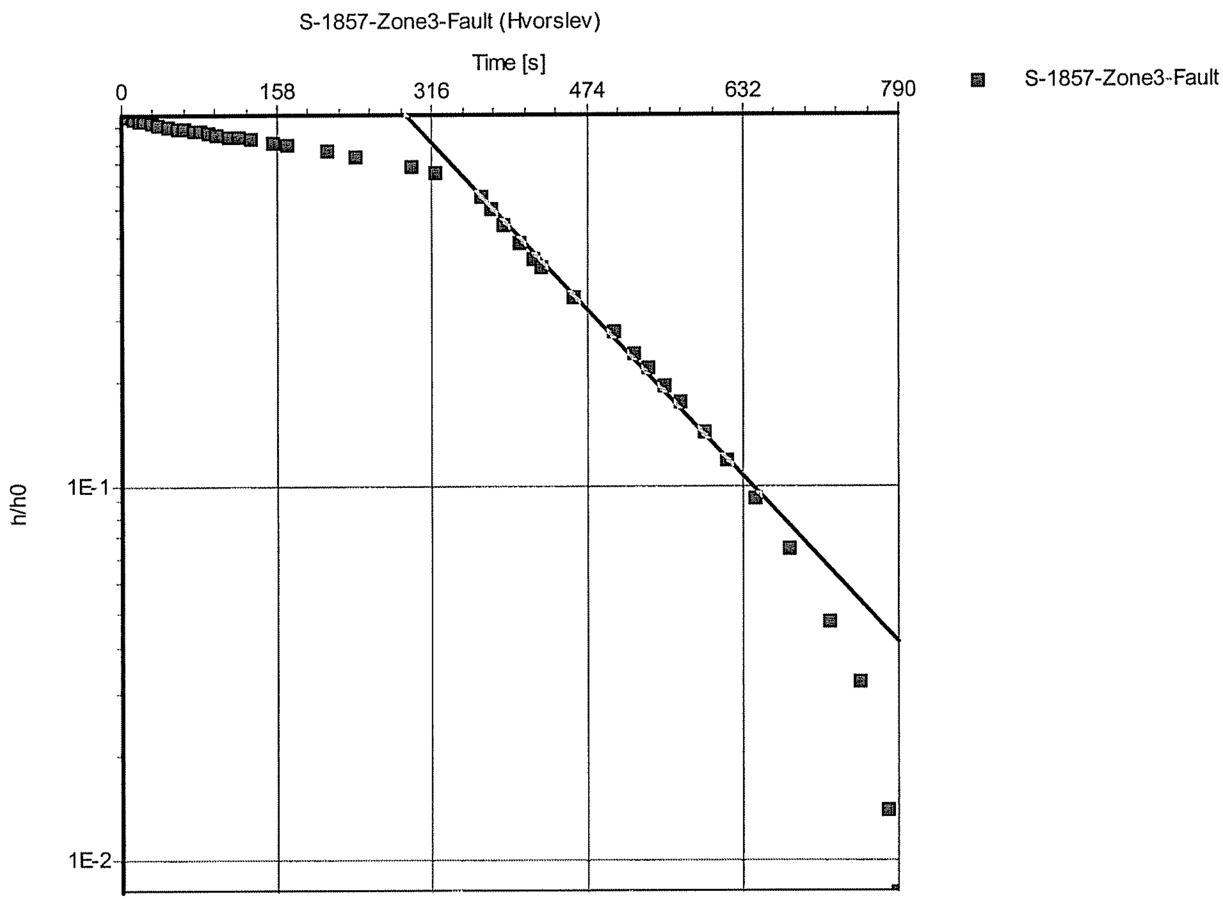

Test name: **S-1857-Zone3-Fault**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 8.10E-6 [m/s]

Test parameters:				
	Test well:	S-1857-Zone3-Fault	Aquifer thickness:	46.53 [m]
	Screen radius:	0.038 [m]		
	Screen length:	0.3 [m]		
	Casing radius:	0.019 [m]		

Comments: Westbay Fault - fault length used in analysis
variability in recovery curve due to well effects?
reasonable reliabilty

Evaluated by: MRoyle
Date: 05/07/20

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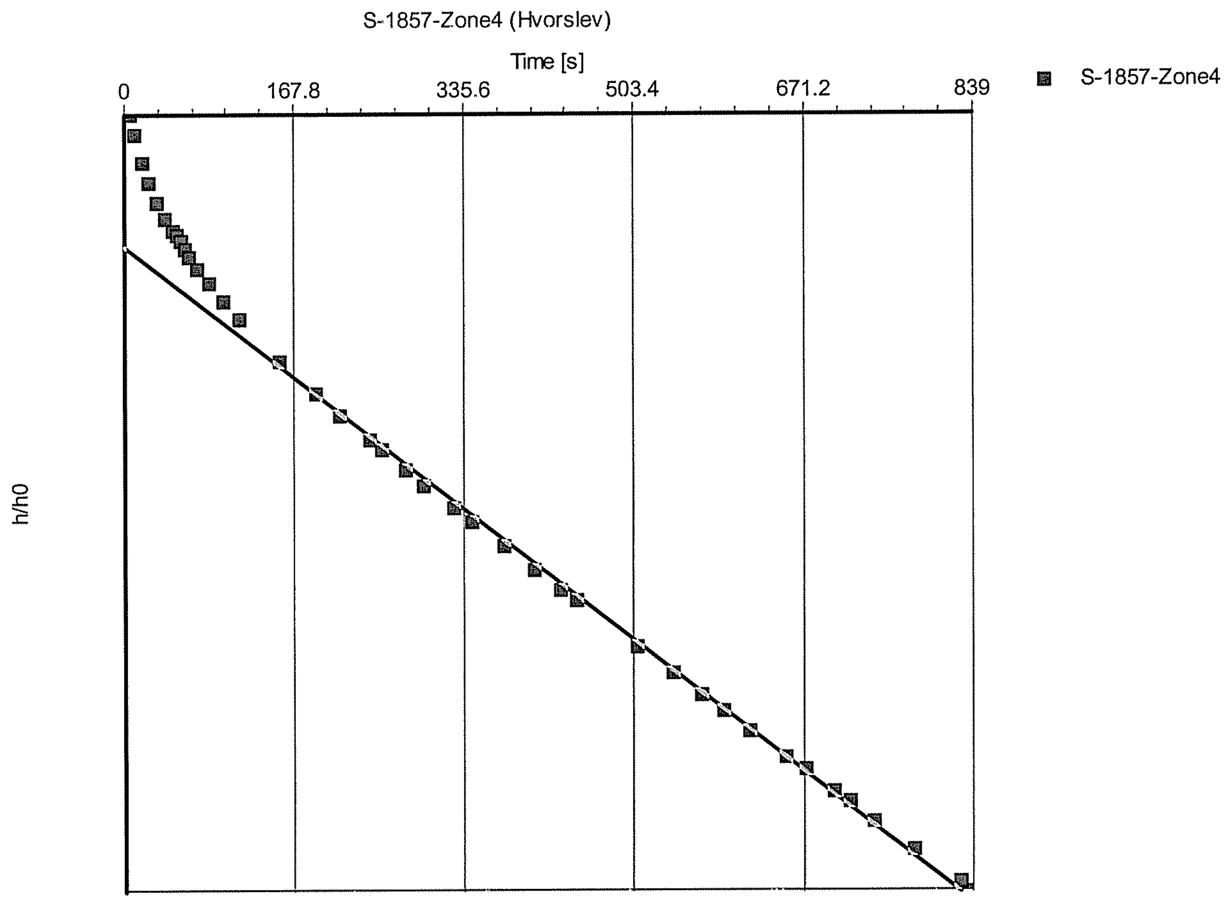

Test name: **S-1857-Zone4**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 1.46E-8 [m/s]

Test parameters:				
	Test well:	S-1857-Zone4	Aquifer thickness:	89.53 [m]
	Screen radius:	0.038 [m]		
	Screen length:	22 [m]		
	Casing radius:	0.019 [m]		

Comments: significant delta DTW at t=0 (44.1m)
good recovery curve
high reliability

Evaluated by: MRoyle
Date: 05/07/20

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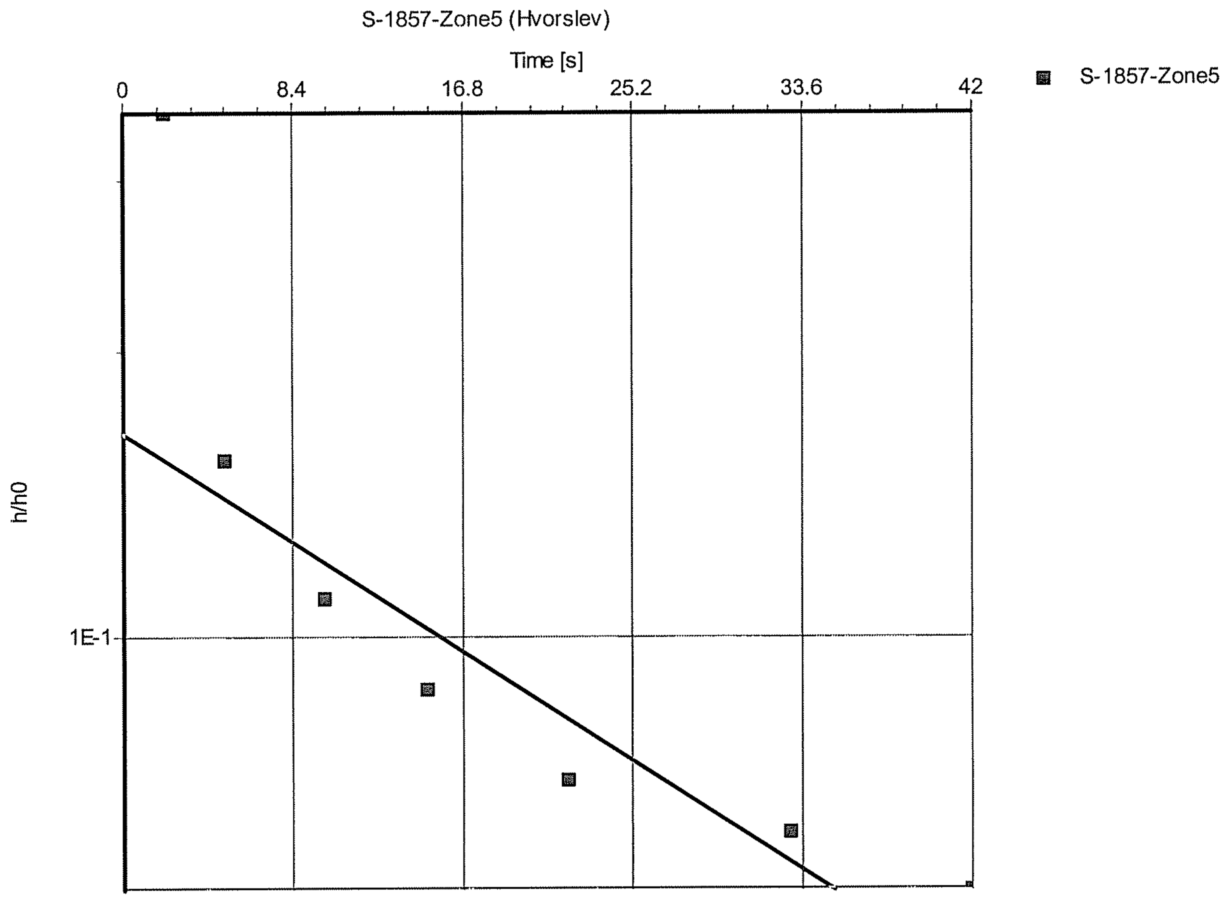

Test name: **S-1857-Zone5**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 2.96E-6 [m/s]

Test parameters:				
	Test well:	S-1857-Zone5	Aquifer thickness:	84.69 [m]
	Screen radius:	0.038 [m]		
	Screen length:	10 [m]		
	Casing radius:	0.019 [m]		

Comments: zone length used in anlysis
reasonable response
mid to late data used
initial delta DTW = 2.5m

Evaluated by: MRoyle

Date: 05/07/20

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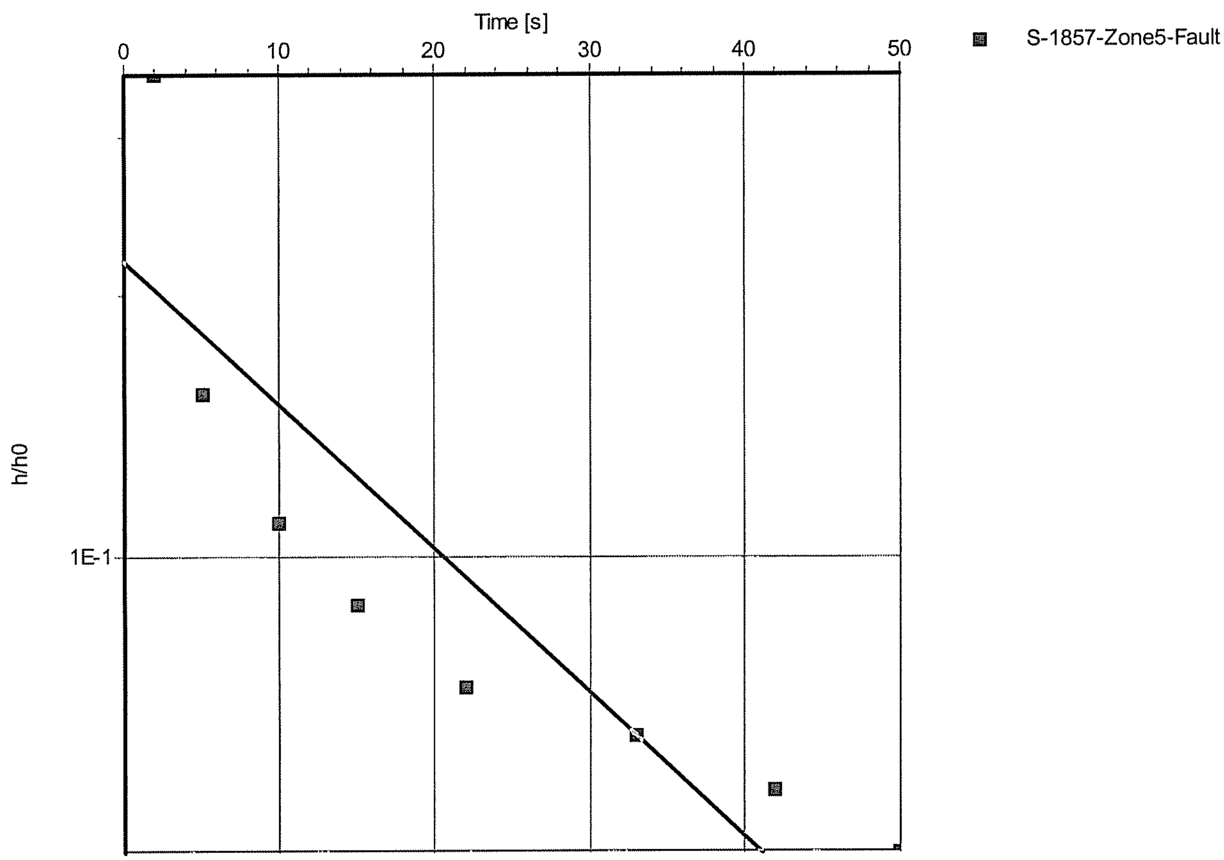
Client: DIAND

S-1857-Zone5-Fault (Hvorslev)



Test name: **S-1857-Zone5-Fault**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 1.73E-5 [m/s]

Test parameters:	Test well:	S-1857-Zone5-Fault	Aquifer thickness:	84.69 [m]
	Screen radius:	0.038 [m]		
	Screen length:	1.3 [m]		
	Casing radius:	0.019 [m]		

Comments:
fault width used for analysis (1.3m)
reasonable response
mid to late data used
initial delta DTW = 2.5m

Evaluated by: MRoyle

Date: 05/07/20

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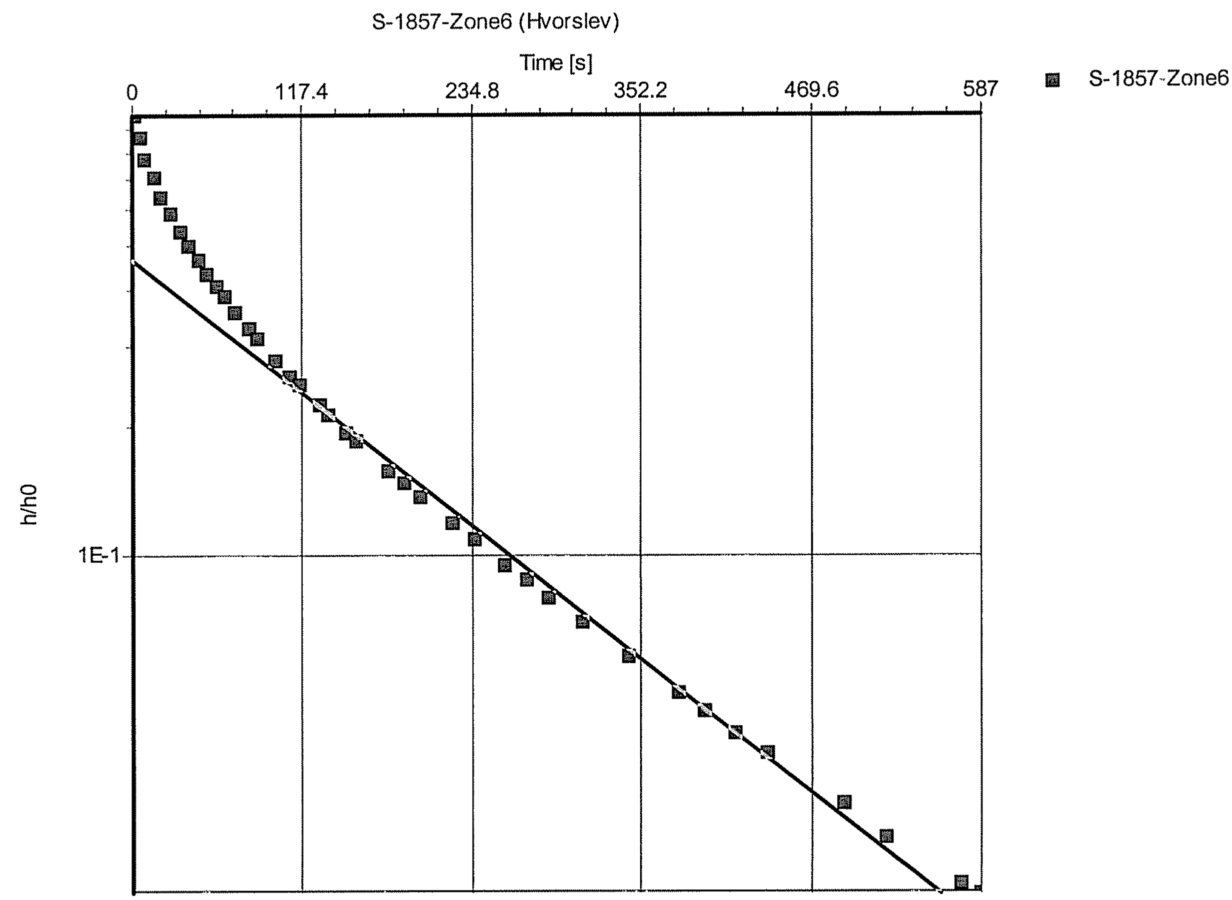

Test name: **S-1857-Zone6**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 4.54E-7 [m/s]

Test parameters:				
	Test well:	S-1857-Zone6	Aquifer thickness:	74.51 [m]
	Screen radius:	0.038 [m]		
	Screen length:	13 [m]		
	Casing radius:	0.019 [m]		

Comments:
good recovery response
large initial delta DTW (22.6m)
high reliability
mid to late data used

Evaluated by: MRoyle

Date: 05/07/20

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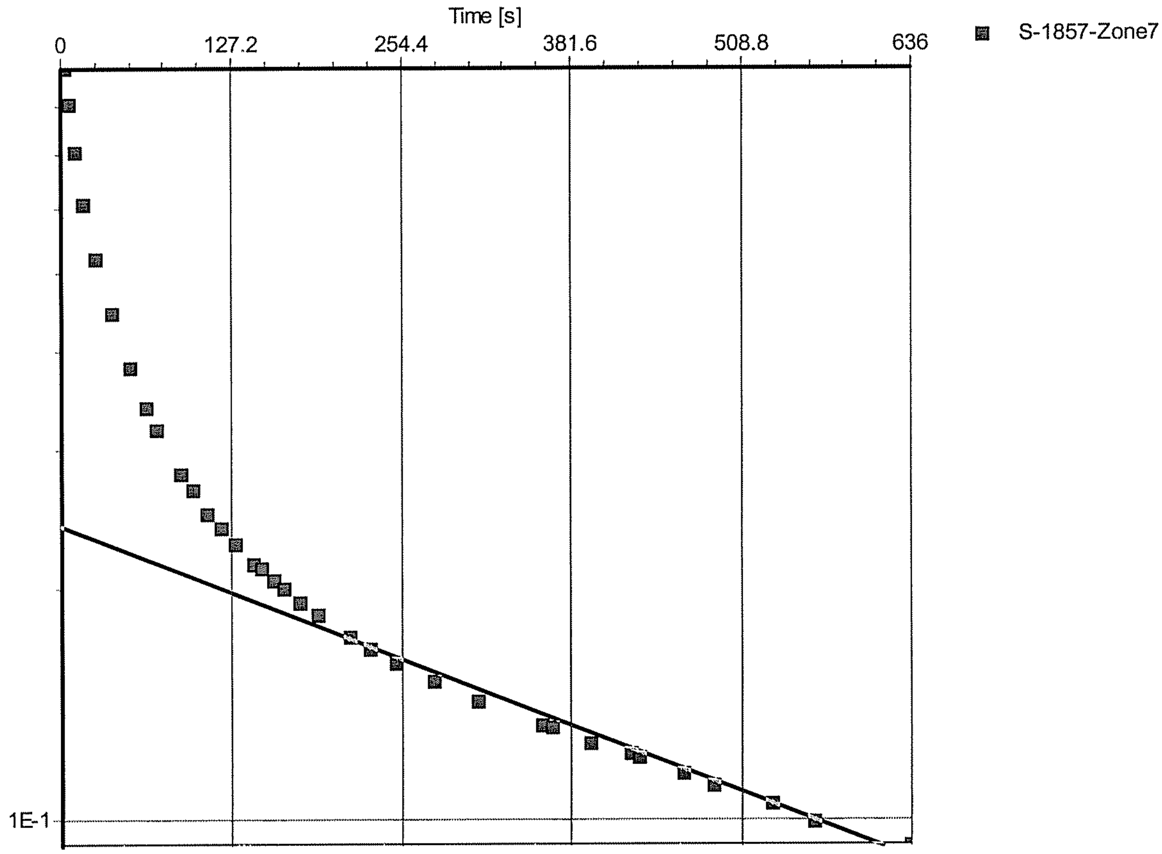
S-1857-Zone7 (Hvorslev)



Test name: **S-1857-Zone7**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 7.63E-8 [m/s]

Test parameters:

Test well:	S-1857-Zone7	Aquifer thickness:	61.51 [m]
Screen radius:	0.038 [m]		
Screen length:	22 [m]		
Casing radius:	0.019 [m]		

Comments:
good recovery response
significant initial delta DTW (7.8m)
good reliability
mid to late data used

Evaluated by: MRoyle
Date: 05/07/20

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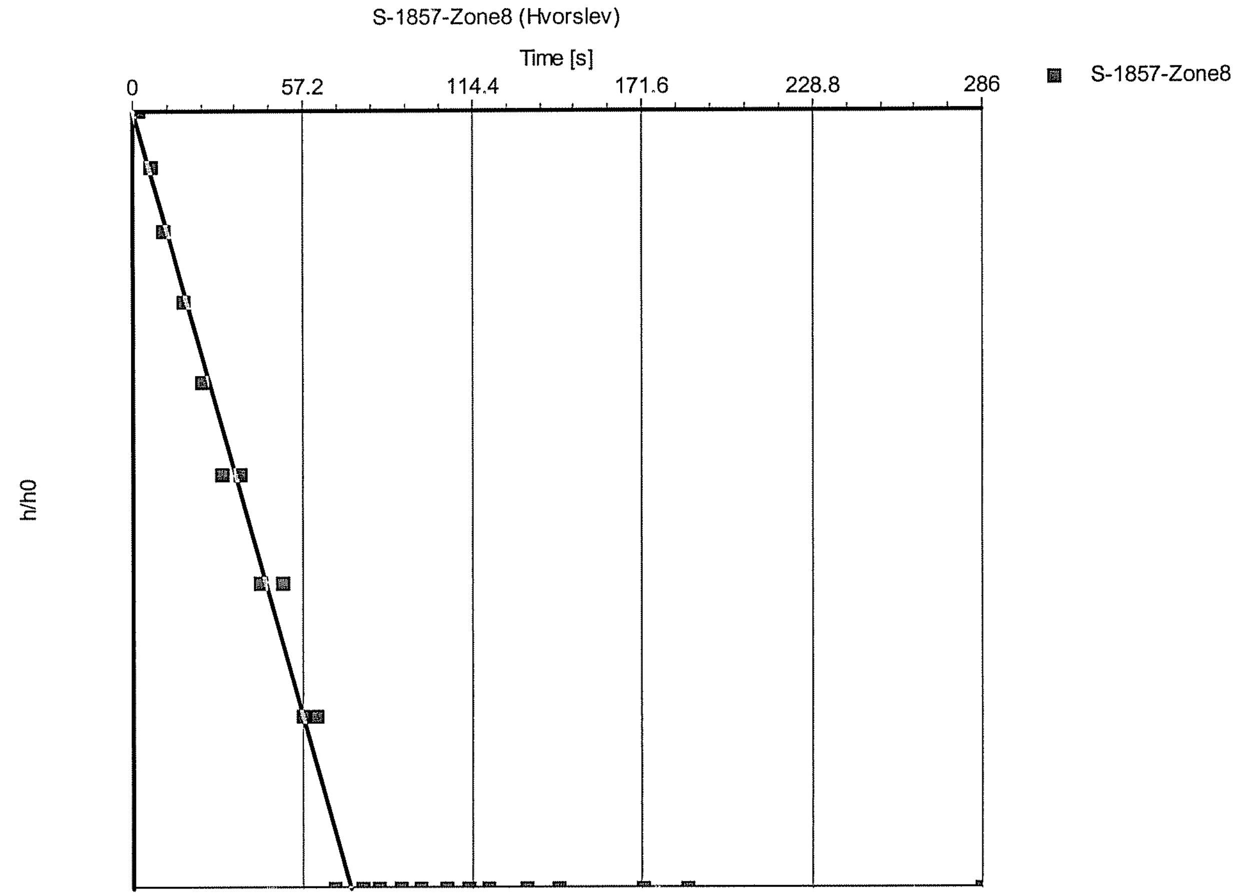

Test name: **S-1857-Zone8**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 9.33E-7 [m/s]

Test parameters:				
	Test well:	S-1857-Zone8	Aquifer thickness:	40.03 [m]
	Screen radius:	0.038 [m]		
	Screen length:	22 [m]		
	Casing radius:	0.019 [m]		

Comments: early time data
small delta DTW at t=0 (0.12m)
over estimates K, nearby effects

Evaluated by: MRoyle

Date: 05/07/20

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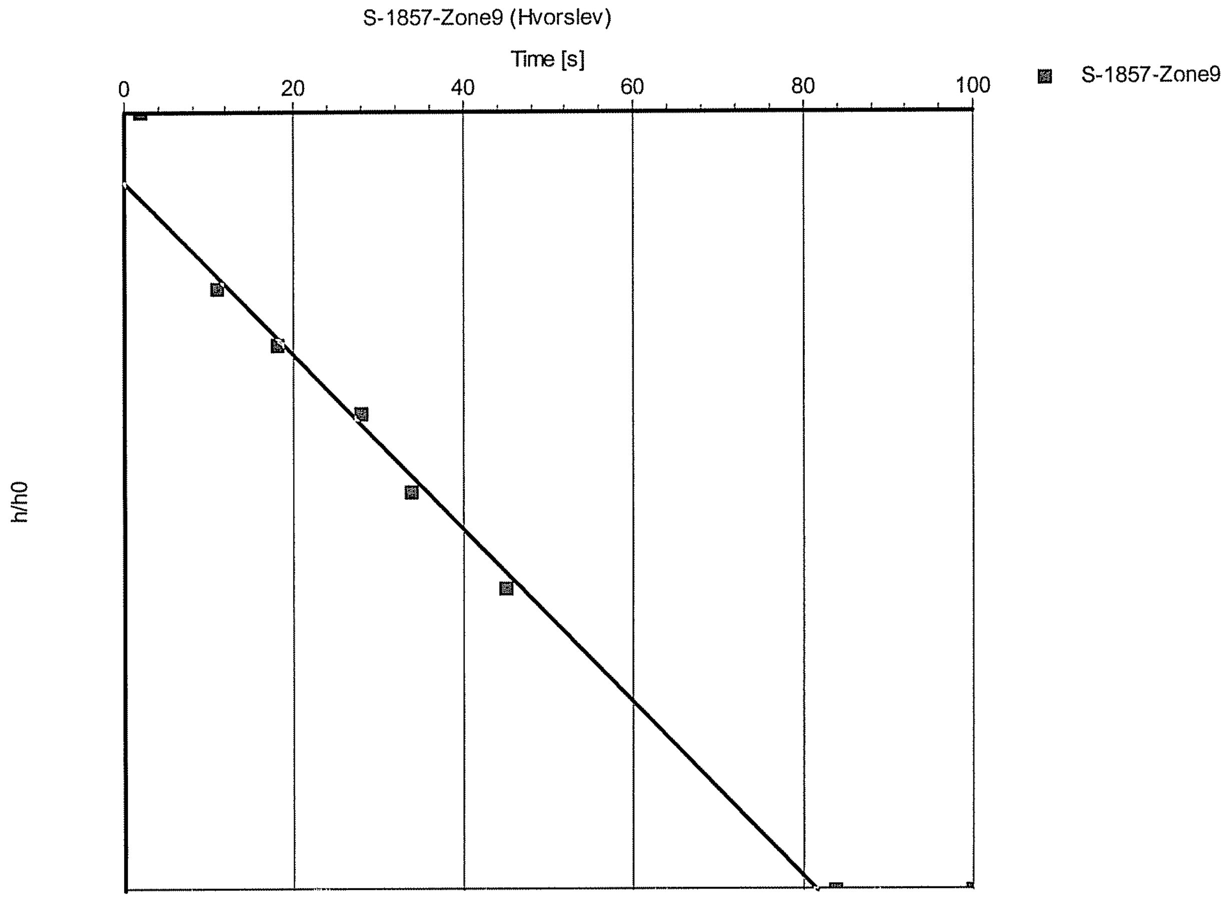

Test name: **S-1857-Zone9**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 2.02E-6 [m/s]

Test parameters:

Test well:	S-1857-Zone9	Aquifer thickness:	18.27 [m]
Screen radius:	0.038 [m]		
Screen length:	10 [m]		
Casing radius:	0.019 [m]		

Comments:
questionable test
very low Delta DTW at t=0 (0.14m)
early time, near well effects only

Evaluated by: MRoyle
Date: 05/07/20

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180 Columbia St. Unit 1104	Project:	Giant Mine - April 2002
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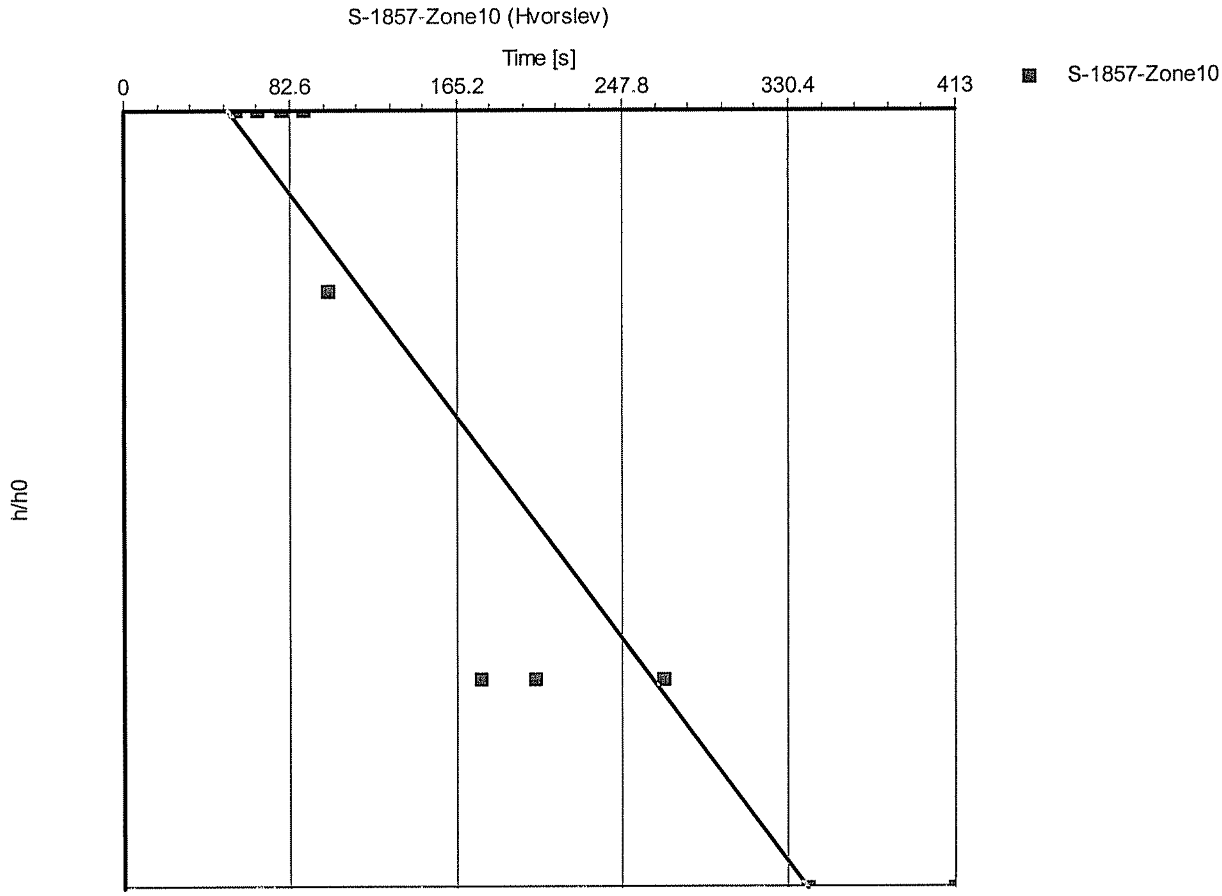

Test name: **S-1857-Zone10**

Analysis method: **Hvorslev**

Analysis results:		Conductivity:	7.32E-8 [m/s]

Test parameters:				
	Test well:	S-1857-Zone10	Aquifer thickness:	9.54 [m]
	Screen radius:	0.038 [m]		
	Screen length:	8.5 [m]		
	Casing radius:	0.019 [m]		

Comments:

zone length used in anlysis
reasonable data
low initial Delta DTW (0.49m)
late time data

Evaluated by: MRoyle

Date: 05/07/20

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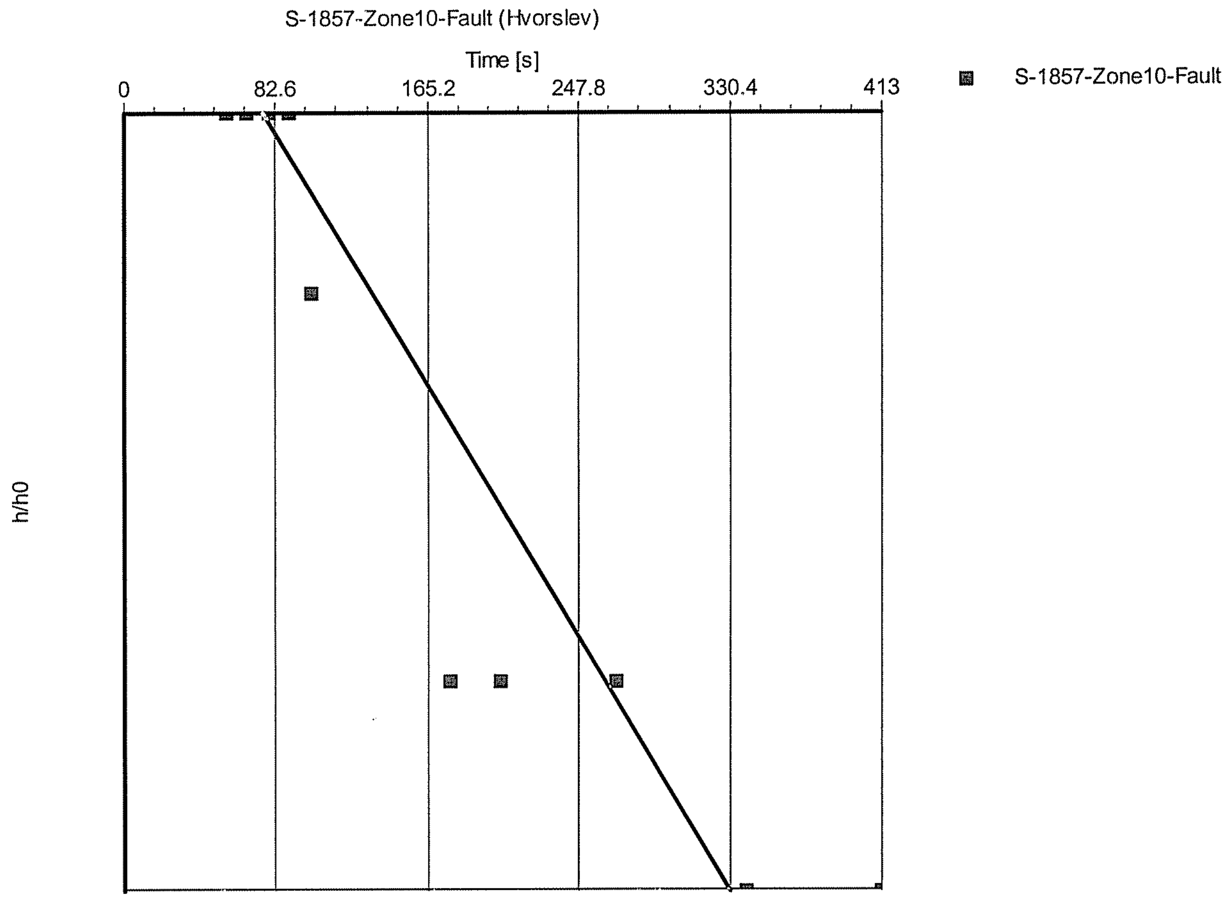

Test name: **S-1857-Zone10-Fault**

Analysis method: **Hvorslev**

Analysis results:

Conductivity:	8.93E-7 [m/s]		

Test parameters:

Test well:	S-1857-Zone10-	Aquifer thickness:	9.54 [m]
Screen radius:	0.038 [m]		
Screen length:	0.3 [m]		
Casing radius:	0.019 [m]		

Comments:

Fault width (0.3m) used in al\nlysis
reasonable data
low initial Delta DTW (0.49m)
late time data

Evaluated by:

Date: 05/07/20

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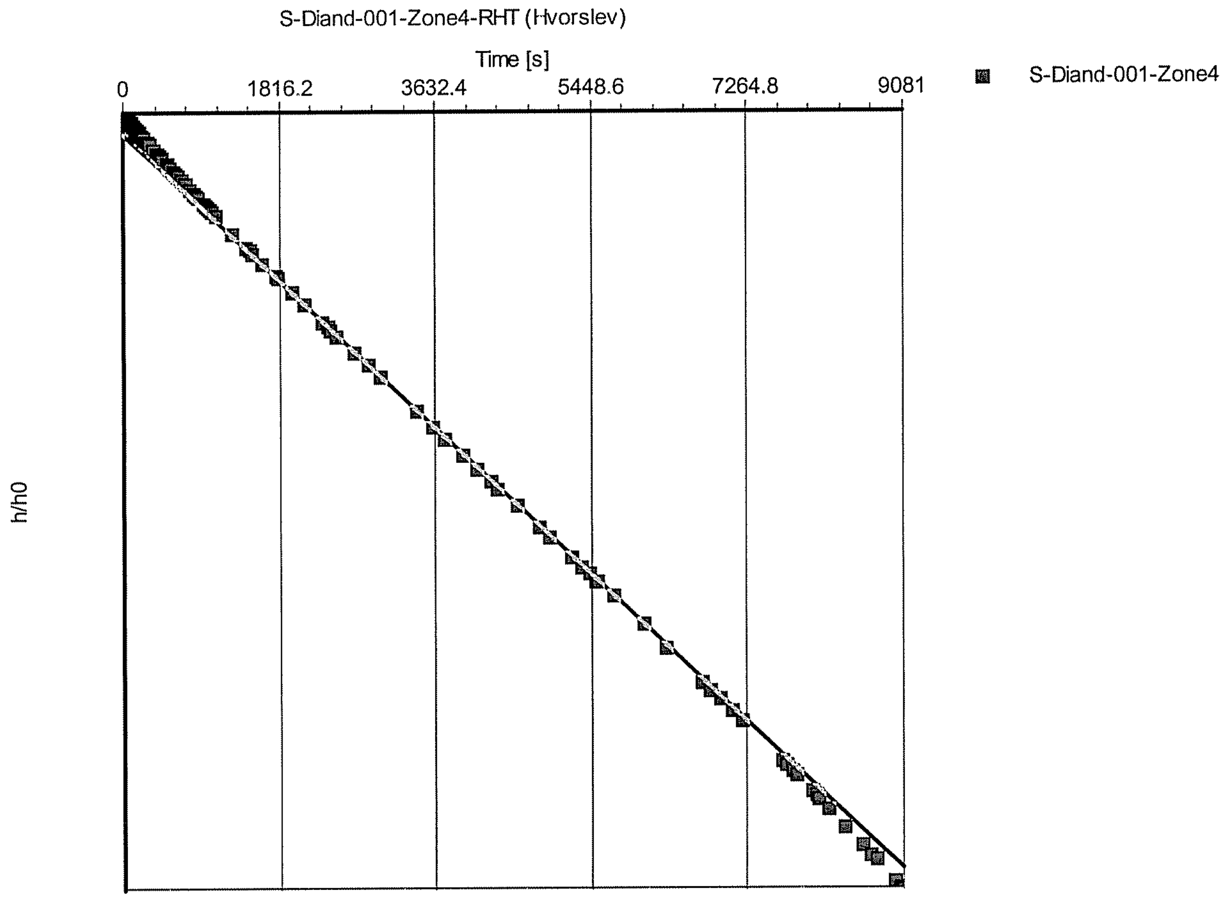

Test name: **S-Diand-001-Zone4-RHT**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 2.35E-8 [m/s]

Test parameters:				
	Test well:	S-Diand-001-Zone4	Aquifer thickness:	62.71 [m]
	Screen radius:	0.048 [m]		
	Screen length:	9 [m]		
	Casing radius:	0.019 [m]		

Comments:

Rising Head Test through pumping port
Zone length used in anlysis
large initial delta DTW (26.1m)
good response

Evaluated by:

Date: 09/07/20

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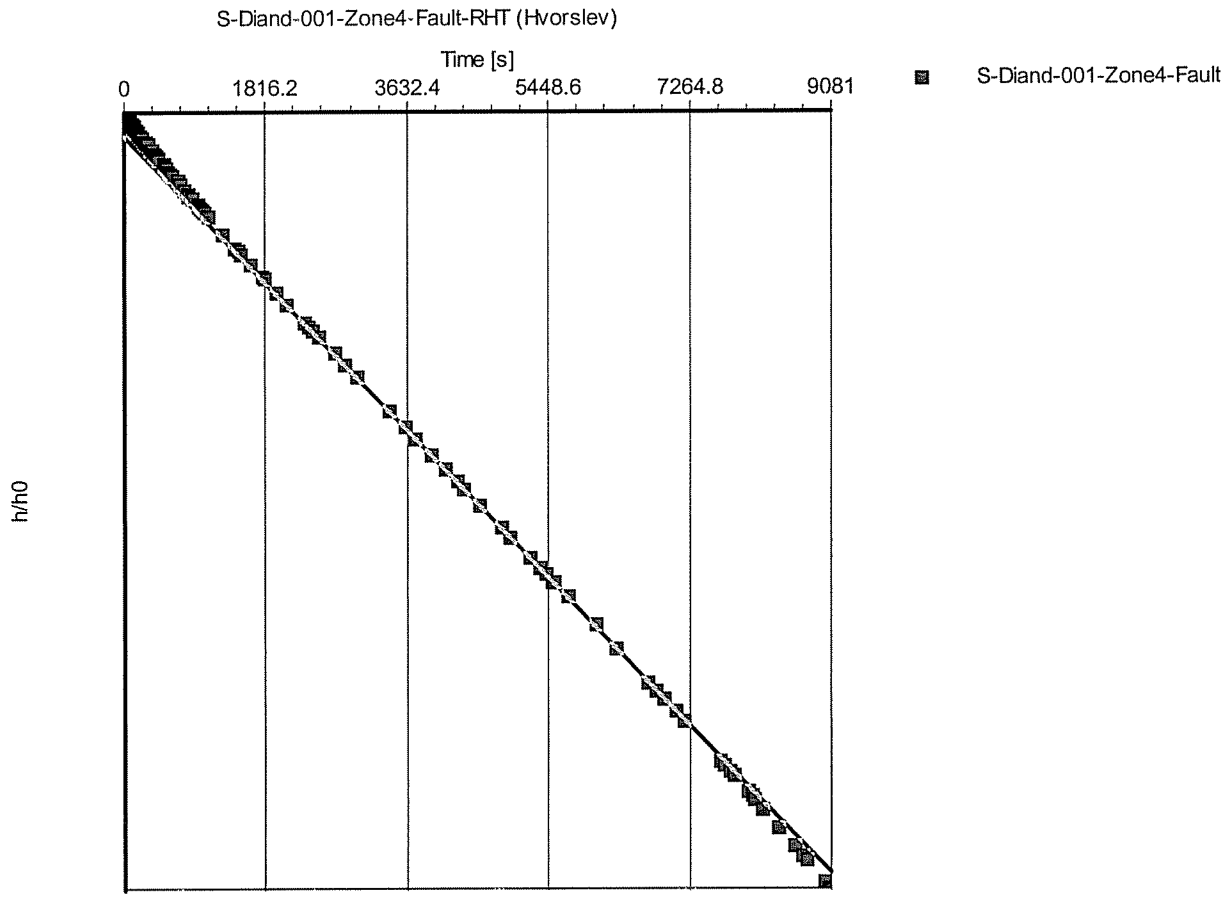
Client:	DIAND



Test name: **S-Diand-001-Zone4-Fault-RHT**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 2.98E-7 [m/s]

Test parameters:

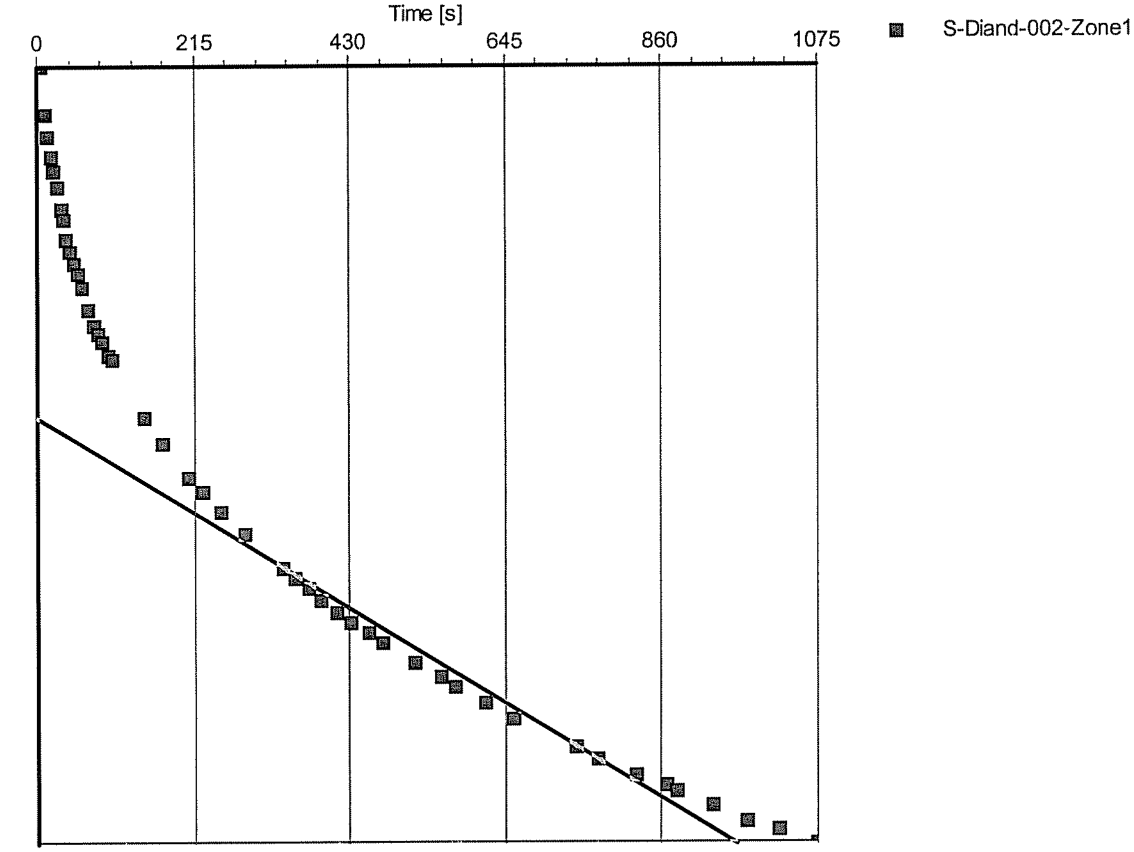
Test well:	S-Diand-001-	Aquifer thickness:	62.71 [m]
Screen radius:	0.048 [m]		
Screen length:	0.1 [m]		
Casing radius:	0.019 [m]		

Comments: Rising Head Test through pumping port
fault length used in anlysis
large initial delta DTW (26.1m)
good response

Evaluated by: MRoyle
Date: 09/07/20

Waterloo Hydrogeologic, Inc.	Pumping Test Analysis Report	
180 Columbia St. Unit 1104	Project:	Giant Mine - April 2002
Waterloo, Ontario, Canada	No:	1CI001.07.317
Phone: +1 519 746 1798	Client:	DIAND

S-Diand-002-Zone1 (Hvorslev)



Test name: **S-Diand-002-Zone1**

Analysis method: **Hvorslev**

Analysis results:		Conductivity:	9.47E-9 [m/s]

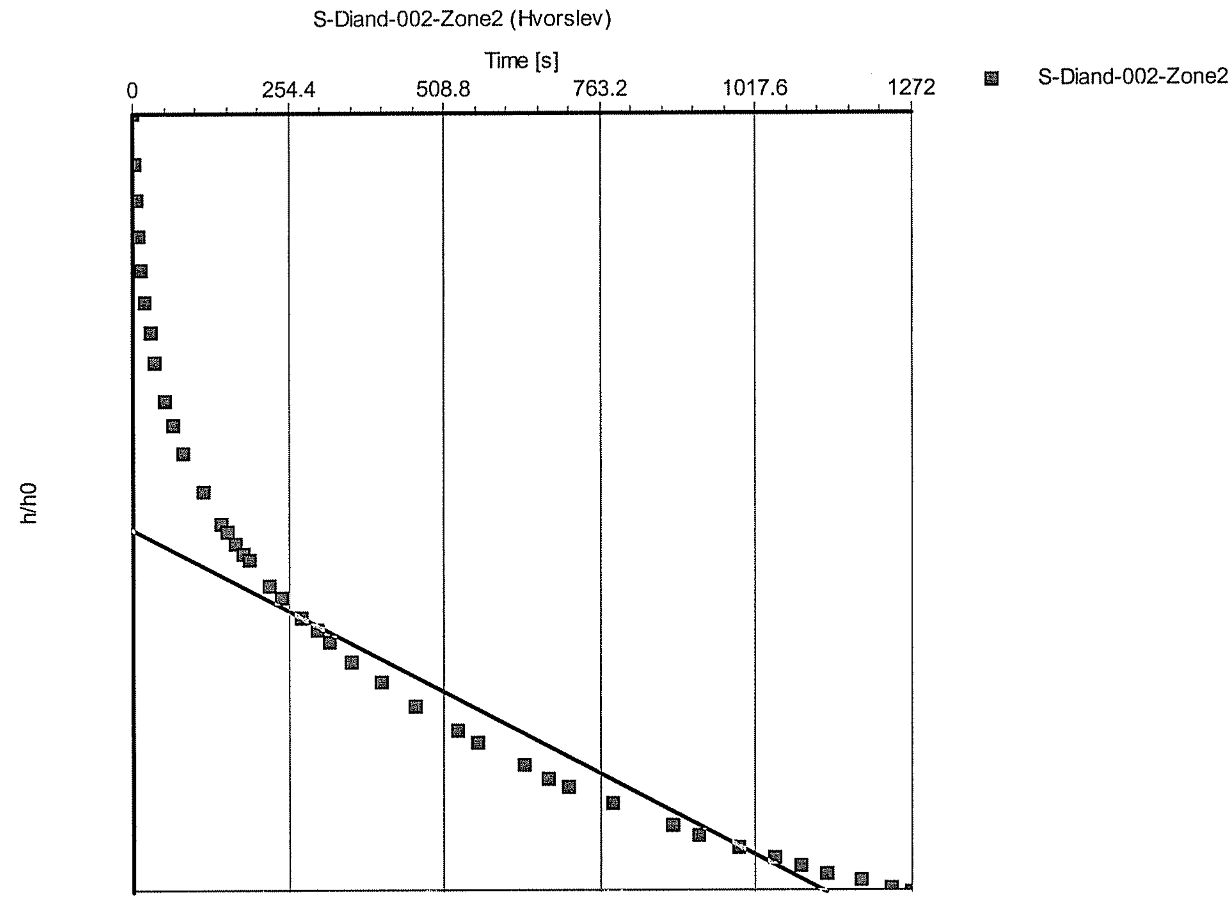
Test parameters:	Test well:	S-Diand-002-Zone1	Aquifer thickness:	103.81 [m]
	Screen radius:	0.048 [m]		
	Screen length:	27.2 [m]		
	Casing radius:	0.019 [m]		

Comments: no inflection in curve
use mid to late data
uncertain about result

Evaluated by: MRoyle

Date: 05/07/20

Waterloo Hydrogeologic, Inc.	Pumping Test Analysis Report	
180 Columbia St. Unit 1104	Project:	Giant Mine - April 2002
Waterloo, Ontario, Canada	No:	1CI001.07.317
Phone: +1 519 746 1798	Client:	DIAND



Test name: **S-Diand-002-Zone2**

Analysis method: **Hvorslev**

Analysis results:	Conductivity:	1.06E-8 [m/s]

Test parameters:				
	Test well:	S-Diand-002-Zone2	Aquifer thickness:	108.05 [m]
	Screen radius:	0.048 [m]		
	Screen length:	19 [m]		
	Casing radius:	0.019 [m]		

Comments:
no inflection in curve
use mid to late data
uncertain about result

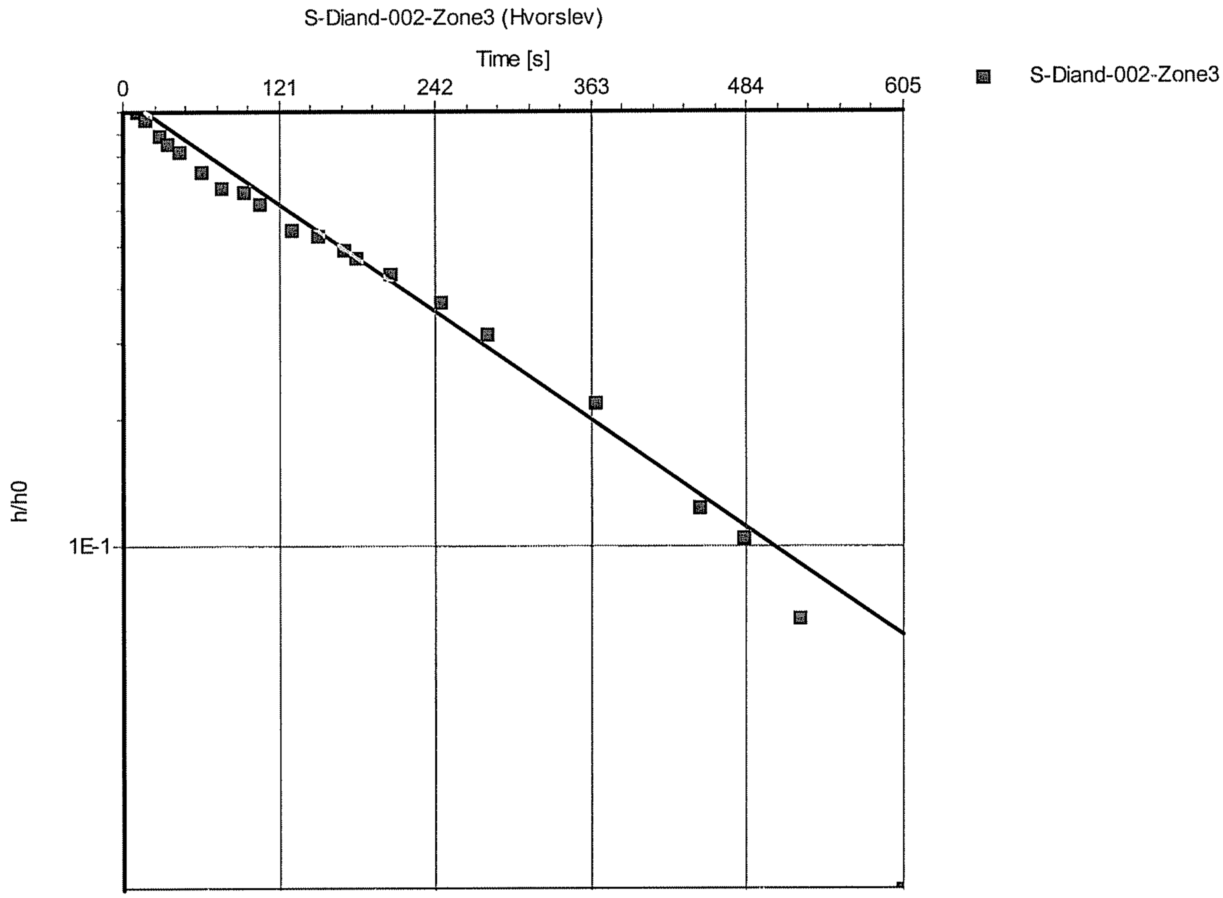
Evaluated by: MRoyle

Date: 05/07/20

Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project:	Giant Mine - April 2002
No:	1CI001.07.317
Client:	DIAND



Test name: **S-Diand-002-Zone3**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 5.85E-7 [m/s]

Test parameters:

Test well:	S-Diand-002-Zone3	Aquifer thickness:	95.6 [m]
Screen radius:	0.048 [m]		
Screen length:	7 [m]		
Casing radius:	0.019 [m]		

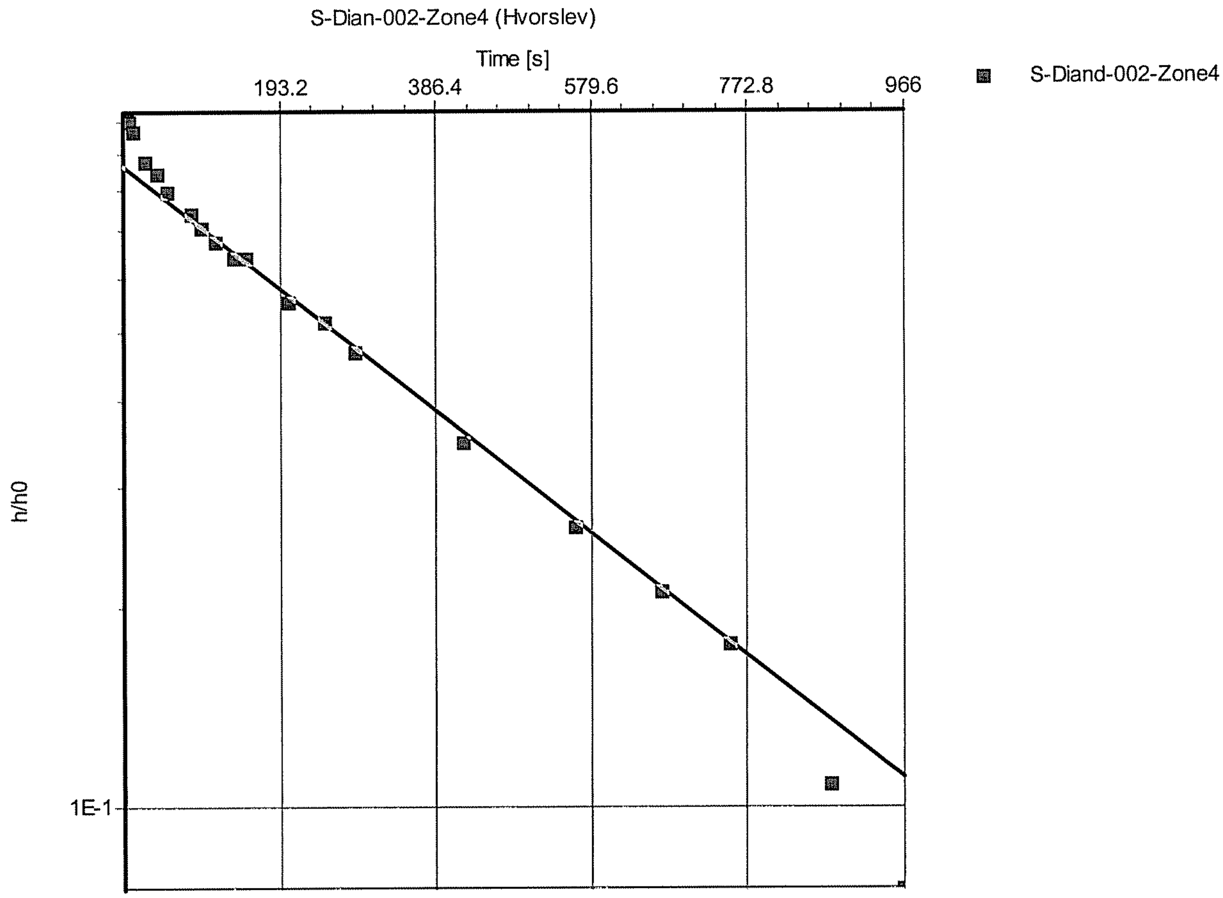
Comments: small initial delta DTW (0.58m)
good response curve
reasonable test

Evaluated by: MRoyle
Date: 05/07/20

Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project:	Giant Mine - April 2002
No:	1CI001.07.317
Client:	DIAND



Test name: **S-Dian-002-Zone4**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 2.36E-7 [m/s]

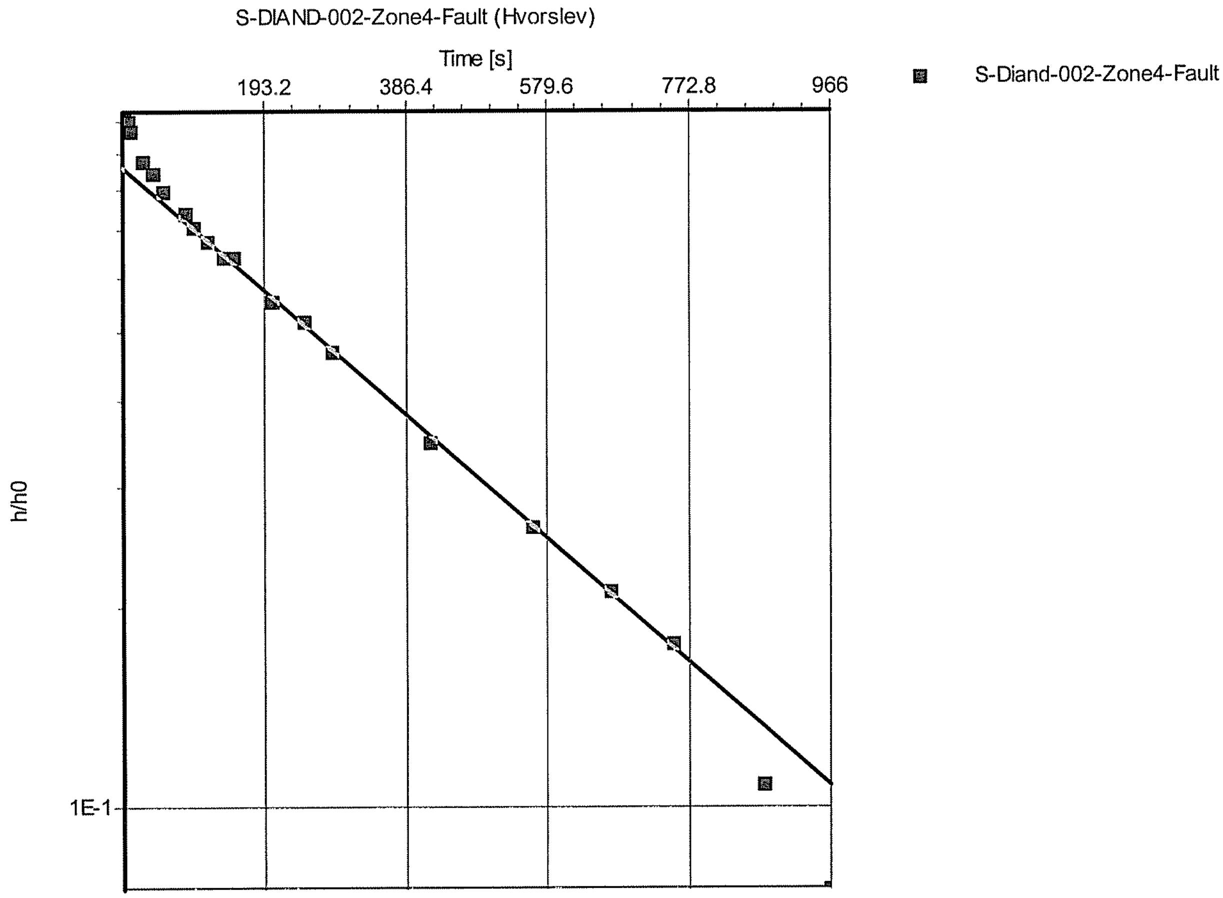
Test parameters:				
	Test well:	S-Diand-002-Zone4	Aquifer thickness:	90.25 [m]
	Screen radius:	0.048 [m]		
	Screen length:	8 [m]		
	Casing radius:	0.019 [m]		

Comments:
Rudolph Fault - zone length used in anlysis
pressure pulse test
small initial delta DTW (0.58m)
good response curve
reasonable test

Evaluated by: MRoyle
Date: 05/07/20

Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report	
Project:	Giant Mine - April 2002
No:	1CI001.07.317
Client:	DIAND



Test name: **S-DIAND-002-Zone4-Fault**

Analysis method: **Hvorslev**

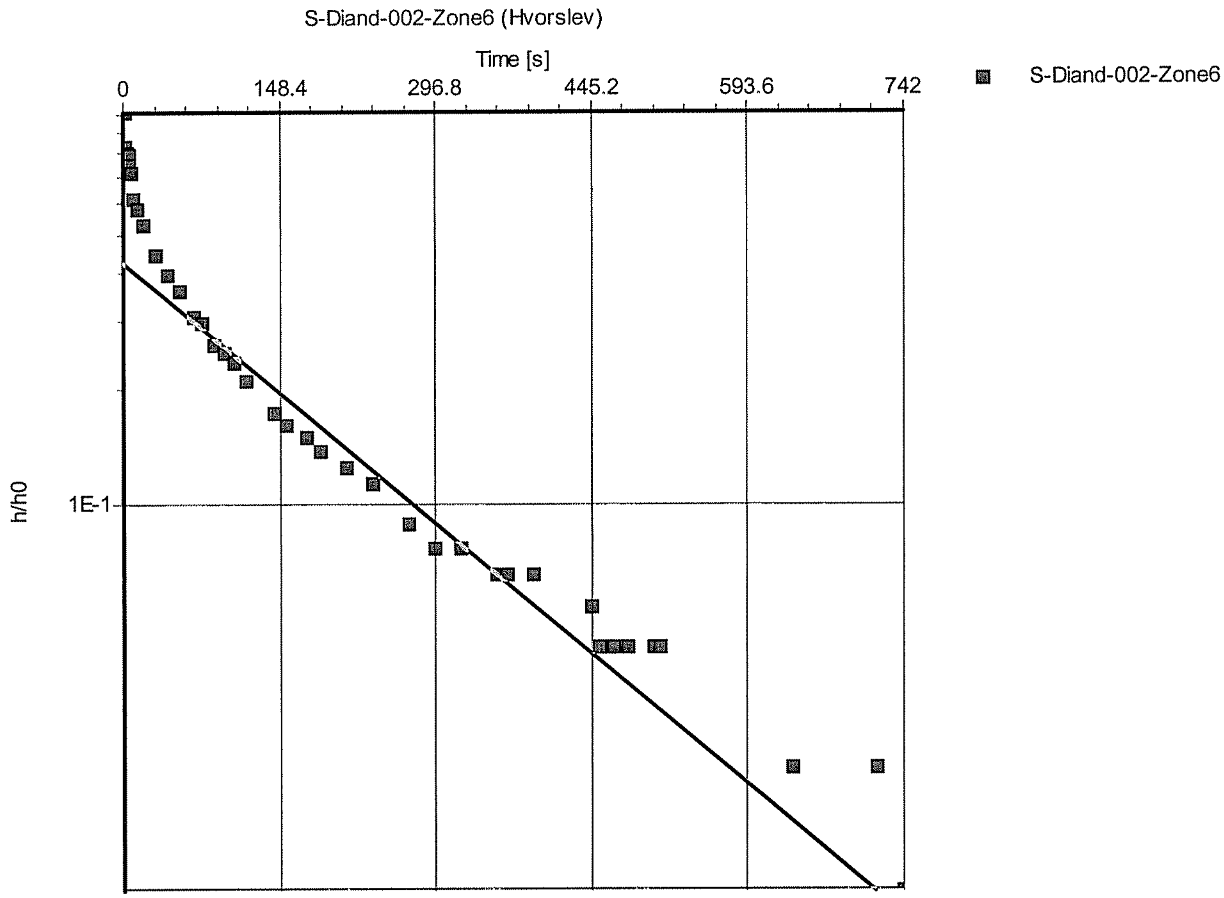
Analysis results: Conductivity: 7.51E-7 [m/s]

Test parameters:				
	Test well:	S-Diand-002-	Aquifer thickness:	90.25 [m]
	Screen radius:	0.048 [m]		
	Screen length:	1.8 [m]		
	Casing radius:	0.019 [m]		

Comments:
Rudolph Fault - fault length used in anlysis
pressure pulse test
small initial delta DTW (0.58m)
good response curve
reasonable test

Evaluated by: MRoyle
Date: 12/07/20

Waterloo Hydrogeologic, Inc. 180 Columbia St. Unit 1104 Waterloo, Ontario, Canada Phone: +1 519 746 1798	**Pumping Test Analysis Report** Project: Giant Mine - April 2002 No: 1CI001.07.317 Client: DIAND



Test name: **S-Diand-002-Zone6**

Analysis method: **Hvorslev**

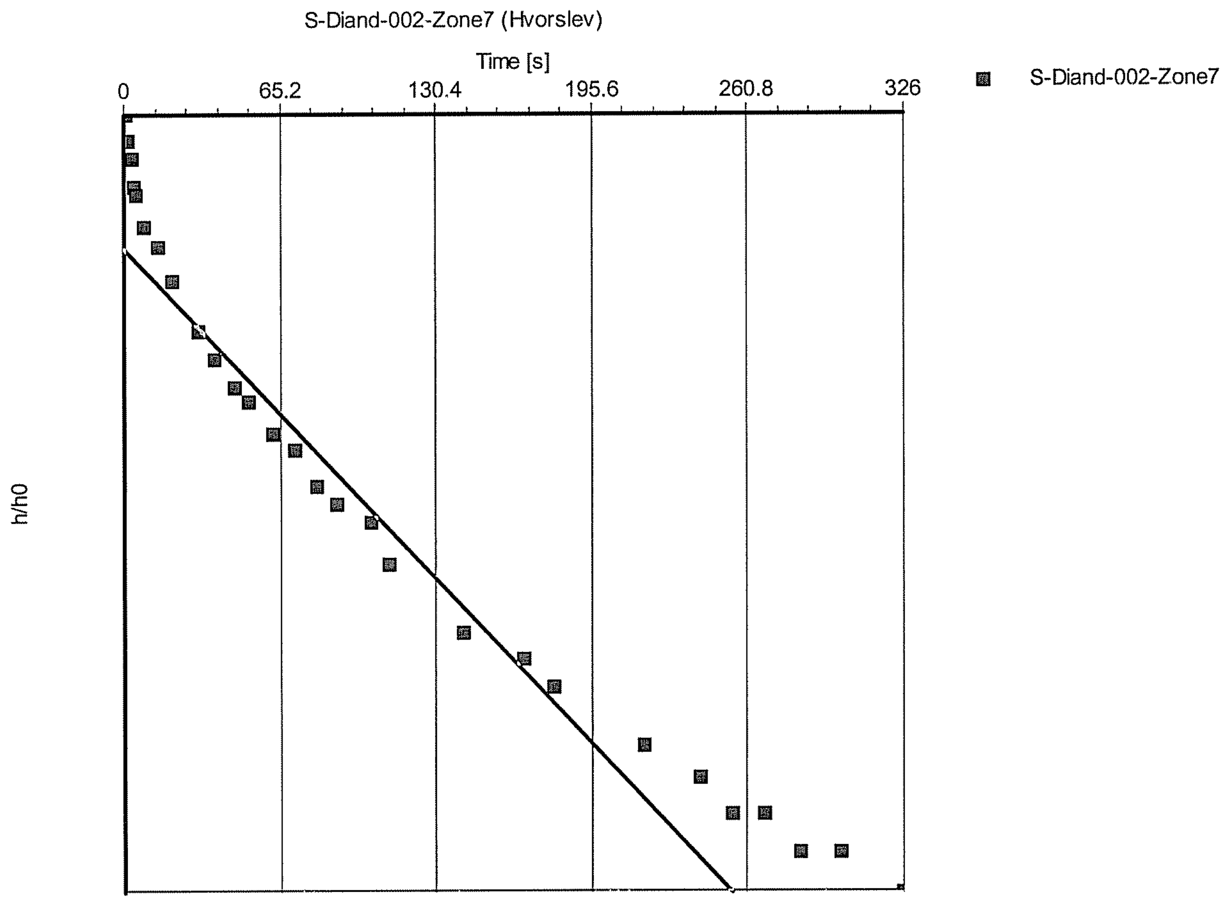
Analysis results: Conductivity: 1.75E-7 [m/s]

Test parameters:			
Test well:	S-Diand-002-Zone6	Aquifer thickness:	69.73 [m]
Screen radius:	0.048 [m]		
Screen length:	34 [m]		
Casing radius:	0.019 [m]		

Comments: Uased mid to late data
early data inferred to be nearby well effects

Evaluated by: MRoyle
Date: 05/07/20

Waterloo Hydrogeologic, Inc.	Pumping Test Analysis Report	
180 Columbia St. Unit 1104	Project:	Giant Mine - April 2002
Waterloo, Ontario, Canada	No:	1CI001.07.317
Phone: +1 519 746 1798	Client:	DIAND



Test name: **S-Diand-002-Zone7**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 2.70E-7 [m/s]

Test parameters:				
	Test well:	S-Diand-002-Zone7	Aquifer thickness:	40.38 [m]
	Screen radius:	0.048 [m]		
	Screen length:	22 [m]		
	Casing radius:	0.019 [m]		

Comments: mid time data used, unsure of inflection during later data
small initial delta DTW (0.45m), but reasonable recovery curve

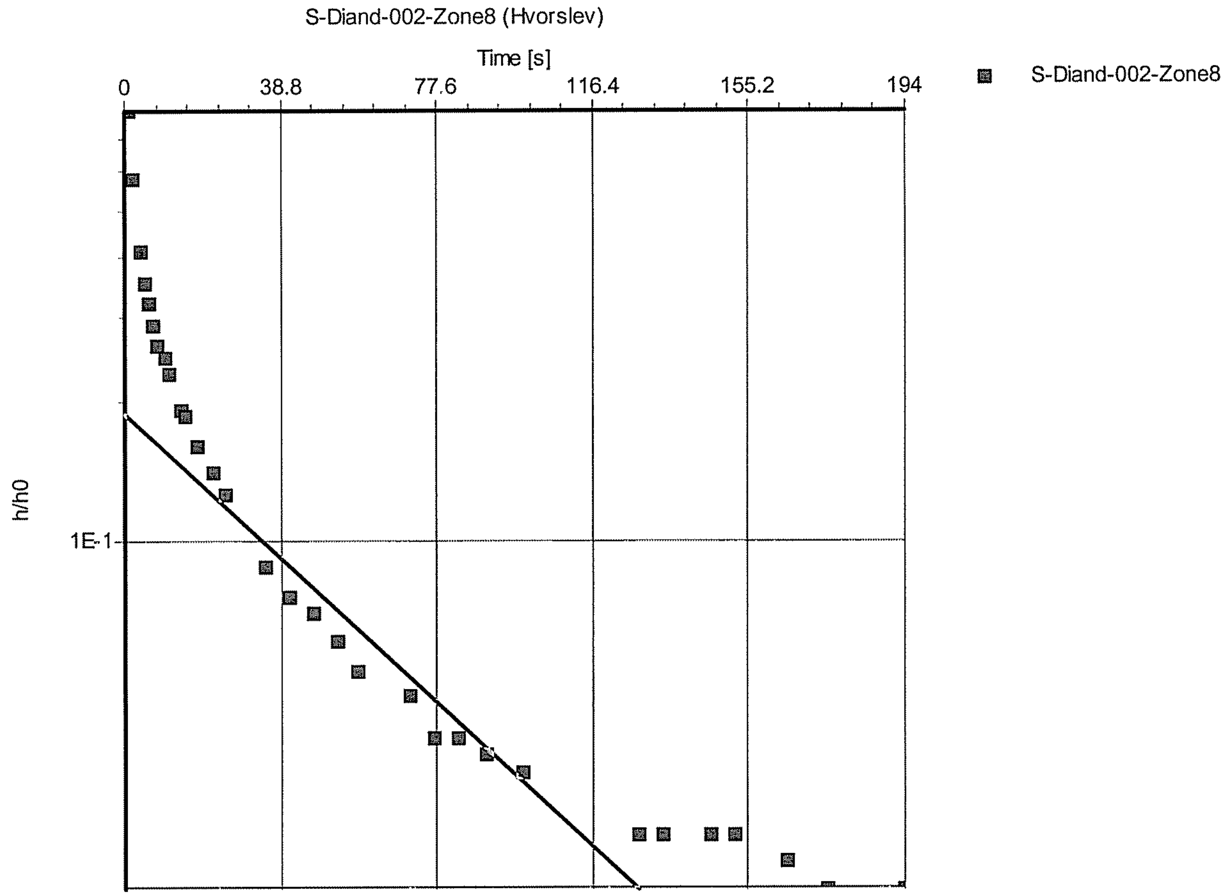
Evaluated by: MRoyle

Date: 05/07/20

Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project:	Giant Mine - April 2002
No:	1CI001.07.317
Client:	DIAND



Test name: **S-Diand-002-Zone8**

Analysis method: **Hvorslev**

Analysis results: Conductivity: 9.79E-7 [m/s]

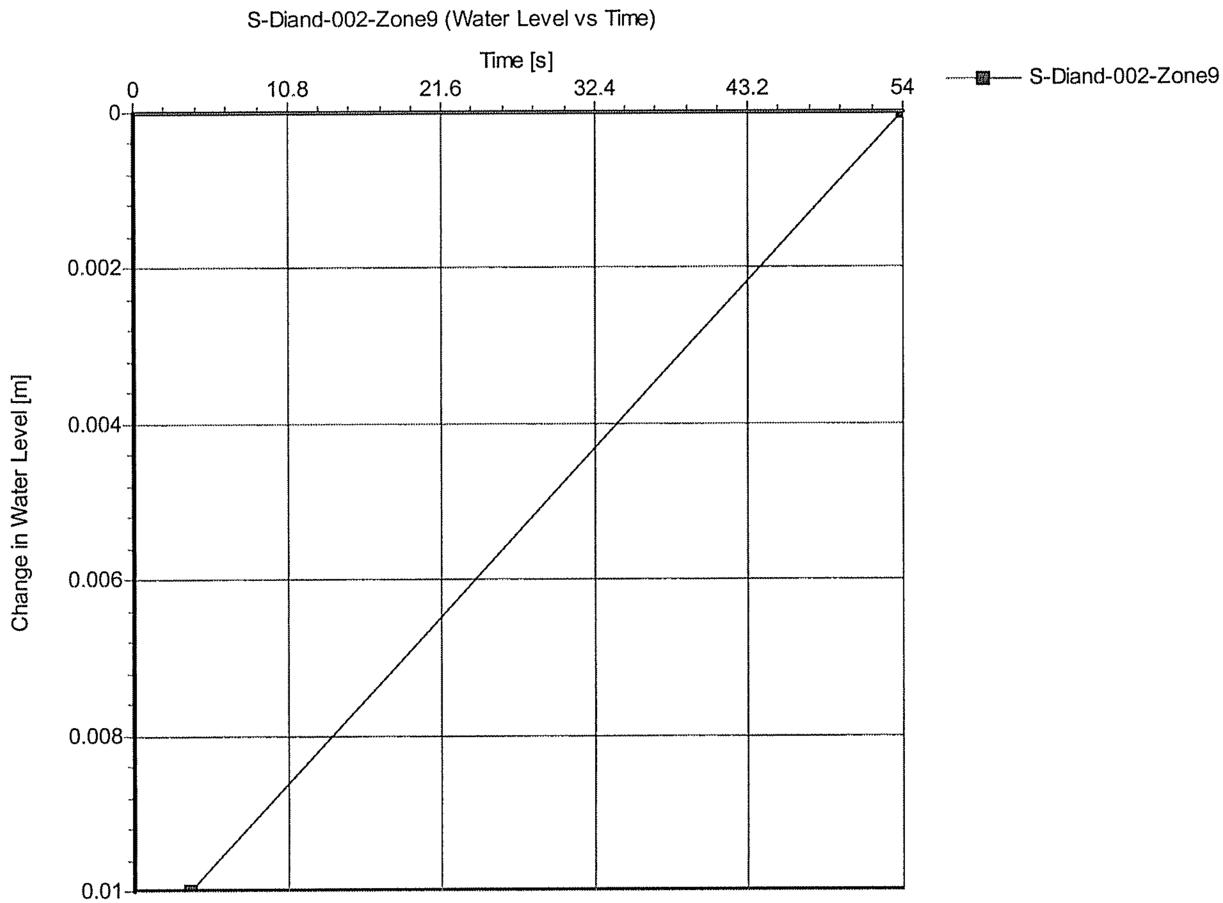
Test parameters:				
	Test well:	S-Diand-002-Zone8	Aquifer thickness:	24.4 [m]
	Screen radius:	0.048 [m]		
	Screen length:	19 [m]		
	Casing radius:	0.019 [m]		

Comments: mid time data used, unsure of inflection during later data
small initial delta DTW (0.94m), but reasonable recovery curve

Evaluated by:

Date: 05/07/20

Waterloo Hydrogeologic, Inc.	Pumping Test Analysis Report
180 Columbia St. Unit 1104	Project: Giant Mine - April 2002
Waterloo, Ontario, Canada	No: 1CI001.07.317
Phone: +1 519 746 1798	Client: DIAND



Test name: **S-Diand-002-Zone9**

Analysis method: **Water Level vs Time**

Analysis results:

Test parameters:

Test well:	S-Diand-002-Zone9	Aquifer thickness:	6.86 [m]
Screen radius:	0.048 [m]		
Screen length:	5.5 [m]		
Casing radius:	0.019 [m]		

Comments: data not good
not analysed

Evaluated by: MRoyle

Date: 10/07/20

APPENDIX E
MP Monitoring Well History Log

MP Monitoring Well History Log

MONITORING WELL	DATE	COMMENTS	PORT STATUS
S-1857	Jan 19, 02 Jan 21 – 22, 02 April 19, 02	- installed, pressure profile - Zone 1 and 3 sampled - pressure profile and K testing	- all closed - all closed - Zone 3 PPort open (Diver)
S-1860	Jan ?, 02 Jan 30, 02 April 20, 02	- installed, pressure profile - Zone 1 and 3 sampled - pressure profile and K testing	- all closed - all closed - Zone 3 PPort open (Diver)
S-1955	Jan 24 - 25, 02 April 19, 02	- installed, pressure profile - pressure profile (K testing unsuccessful)	- all closed - all closed
S-DIAND-001	Jan 13, 02 Jan 28 - 29, 02 April 17, 02	- installed, pressure profile - Zone 1 and 3 sampled - pressure profile and K testing	- all closed - all closed - Zone 4 PPort open (Diver)
S-DIAND-002	Jan 15 - 18, 02 Jan 28 - 29, 02 April 18, 02 April 20, 02	- installed, pressure profile - Zone 1 and 3 sampled - pressure profile - pressure profile and K testing	- all closed - all closed - all closed - Zone 4 PPort open (Diver)