QUINSAM COAL

2012-2013 Annual Water Quality Monitoring Report

Covering Waste Management Permit-07008

Executive Summary

The water management systems for the North and South mine areas are separated geographically by the Quinsam River Valley. The systems consist of a series of diversion ditches, sumps, settling ponds, and collection ponds.

The North Mine monitoring stations include: 2 North Portal Sump, (2N-P-Sump), 2 North Pit Sump (WP), Settling Pond #4 (WD), Middle Quinsam Lake Inlet (WA), the tributary to Middle Quinsam Lake, Culvert into Middle Quinsam Lake (WC), and South Dyke Pond (SDS). Seep monitoring in the north end includes the plant ditch seep (PDS).

The South Mine monitoring stations include: Settling Pond #1 (SPD), 3 South Pit (3S), 3S77 Audit Pit (3S-77), 4 South Lower (4S Lower), roadside creek (SPC), Long Lake Outlet (LLO), No Name Lake Outlet (NNO), Middle Quinsam Lake Outlet (WB), and the culvert into Long Lake (LLE).

On January 25, 2013 Effluent Permit PE-07008 was amended to authorize discharge from the 7S mine area and update the monitoring program. The amended permit requires all receiving environmental monitoring locations (e.g. lotic and lentic) to be sampled 3 times per year for 5 consecutive weeks. This will allow for a more accurate evaluation of parameters of interest to the Provincial water quality guidelines and Middle Quinsam Lake Sub-basin objectives (Section 3.4 PE-07008) as both guidelines and objectives necessitate a 5 and 30 monitoring schedule for meaningful comparison. As such, the lake sampling results will now include a more thorough interpretation of the water quality in each lake system.

Mining commenced at the 7S area in August, 2012. Sampling locations associated with this development include 7 South Adit Sump (7SPS) and 7 South Surface Decant Pond (7SSD), which is permitted discharge point for the 7 South mine effluent. Decant water from 7SSD forms stream 1; below the confluence of Stream 1 and 2 monitoring location 7S has been established. This station is considered the receiving environment and, as such, the water quality is compared to the B.C. Water Quality Guidelines. Other receiving environment stations in the 7 South mine area include 7 South Quinsam River (7SQR) and Quinsam River Downstream Site 1 (QRDS1).

During this reporting year, samples were collected from more than 35 locations and more than 7,000 analyses were performed. All sampling was conducted in accordance with Effluent Permit PE-07008 and recommendations by the Environmental Technical Review Committee (ETRC). The samples were collected as specified by the Ministry of Environment (MOE) Sampling Guidelines for field collections and the QA/QC procedures outlined by Golder Associates Inc. in 2004.

Maxxam Analytics performs all surface analytical requirements for water quality and sediment analysis and ALS Analytical laboratory performs all groundwater analysis. Both are qualified independent laboratories based in Burnaby, B.C. Maxxam Analytics is the laboratory of choice for the Ministry of Environment in Nanaimo.

There are four permitted mine effluent points; Settling Pond #1 (SPD), Settling Pond #4 (WD) (North mine area), Block 242 (not active), and recently permitted 7 South Decant Pond (7SSD). Active discharges are equipped with continuous flow meters ensuring all water discharged is recorded on a daily basis. Automatic samplers are coupled with these meters to collect the requisite daily composite Total Suspended Solids (TSS) sample.

At monitoring location WD all permit parameters remained below the applicable permit requirements, with the exception of two TSS (26 mg/L and 28.3 mg/L) sample results. For one of the exceedances it was determined that the elevated TSS result (28.3 mg/L) was likely due to a build-up of algae in the suction line used to collect composite water samples. The sampling procedures have been modified to reduce this source of error. All remaining permitted parameters at SPD were within permit limits.

All parameters at monitoring location SPD remained below the analytical permit limits for the reporting period.

The 7S Decant Pond had one dissolved cadmium exceedance (0.000069 mg/L) on March 18, 2013; however, monitoring location 7S was below the Provincial water quality guideline. All other parameters remained within the permit limits.

According to the 5 Year Annual Average results (Table 78 to 79), the majority of parameters analyzed have exhibited a decreasing trend when compared to last year. The parameters demonstrating a marginal increase are: aluminum, arsenic, cadmium, iron, nickel and zinc. It is important to note that these increases are in year over year comparisons and if the 5 year trend is evaluated there is no significant increase. Moreover, upon further evaluation of the background or reference (outside of mine influence) stations it is apparent that some of these parameters are naturally elevated. Overall, the trends generally display stable parameters for all mine effluent.

The analytical results from the receiving environment water monitoring stations have displayed similar trends to the past years. While most of the parameters monitored at these sites remain within the limits specified in the Provincial Water Quality Guideline criteria reports, some results fell outside their respective threshold concentrations. These are listed in the supplemented table (80) entitled "*Permit Exceedances, Permit non-compliances, Unmet Water Quality Objectives and Guidelines*".

In 2010 Quinsam Coal retained Golder Associates to develop a bench scale treatment system with the objective of attenuating Sulphate and Iron concentrations in mine decant water. The results of this test were implemented on a larger scale to treat water from the 2 South underground workings in order to mitigate the potential impacts of the Long Lake Seep. A demonstration phase passive treatment system was designed according to the results of these studies and has been constructed and commissioned in the last year. The system was completed in August and has been successfully functioning at reducing sulphate in the mine effluent. The report submitted by Golder Associates and Quinsam Coal entitled "*Long Lake Seep Passive Treatment System 4th Quarterly Report*" is included in Appendix (IX).

The details of the 2012/13 groundwater monitoring results are presented in Appendix (VI). Golder Associates was contracted by QCC to initiate the first quarterly groundwater monitoring program and the report entitled "*April 2012 Quarterly Groundwater Monitoring 2 North, 3 South Areas, Quinsam Mine Campbell River, B.C*." this report was submitted to the MOE on July 16, 2012.

Lorax Environmental was contracted by QCC to monitor the groundwater for the subsequent two quarters and finally during the fourth quarter Quinsam Environmental Department assumed the full responsibility of the program. Results of the monitoring program remained consistent with previous years. Appendix (VI) includes details of the groundwater sampling program.

The effluent from the Middle Point Coal Storage and Barge Loading Facility was sampled in accordance with the requirements of the Ministry of Water, Land and Air Protection Permit PE-17181. Results of the 2012/2013 monitoring period indicate that all of the water quality samples were below permit levels.

The last ETRC meeting was conducted on December 8, 2012. Recommendations were forwarded by the various groups in relation to changes to the annual report and additional monitoring. These recommendations have been incorporated and implemented, as necessary.

This report was prepared by Kathleen Russell B.Sc., Environmental Coordinator for Quinsam Coal Corporation. The Environmental Department trusts that the information in this report meets the requirements and expectations of the stipulations required by Permit PE 07008, the MoE and the ETRC.

Sincerely,

Kathleen Russell

Kathleen Russell B.Sc,
Environmental Coordinator
Quinsam Coal Corporation

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1.0 INTRODUCTION

The Quinsam Coal Mine is located in the Quinsam River Watershed, approximately twenty-eight road kilometers southwest of Campbell River. The land occupied by the Quinsam Coal mining operation consists of approximately 143 hectares. Quinsam Coal is the only coal mine located on Vancouver Island and it is the only underground coal operation in British Columbia. The mine is operated by Quinsam Coal Corporation (QCC) and is owned by the parent company Hillsborough Resources Limited (Hillsborough).

The coal produced at the Quinsam mining operation is High Volatile Bituminous "A" thermal coal. The coal is processed at an onsite preparation plant and transported by B-train highway trucks to the Middle Point Barge Terminal, north of Campbell River where it is shipped, via barge, to local customers and to Texada Island where larger ships are loaded at the LaFarge Texada load-out facility.

Due to its location adjacent to Middle Quinsam Lake, the Quinsam River, No Name Lake and Long Lake, stringent effluent and waste quality standards have been established as part of the Mine Operating Permits issued by the Ministry of Environment (MOE) and the Ministry of Energy and Mines (formerly the Ministry of Energy Mines and Natural Gas). Quinsam Coal has maintained an environmental management system defined by the requirements of Waste Management Permit PE-07008 and has worked with the regulators to minimize the effects of the mining operation on the environment.

Sulphate concentrations in receiving environment surface waters (e.g., Long Lake) have continued to be a focal point for the water quality monitoring program at the Quinsam mine. Although there is only one permitted sulphate concentration limit at the 7 South Discharge Pond (500 mg/L) for the mine effluent, monitoring of sulphate at the designated water quality monitoring stations around the site is conducted as part of the permit PE-07008 monitoring program. The Provincial water quality guideline for Sulphate was amended by MoE in April of 2013 and is now hardness dependent. Hardness concentrations at the various discharge locations and receiving environment monitoring stations range from soft to very hard. The concentration of hardness of 30 mg/L has been established to ensure consistency and provide a framework for evaluation. Using this concentration of hardness results in a guideline sulphate concentration of 128 mg/L in the receiving environment. For the purposes of clarity, this report will only report on the previous sulphate guidelines of 100 mg/L in the receiving environment. QCC continues to assess sources

of sulphate and management options to mitigate sulphate concentrations in mine effluents and in the receiving environment.

This report outlines the results of the 2012/13 Environmental Monitoring Program conducted by QCC in accordance with the requirements of Waste Management Permit PE-07008. On January 25, 2013 PE-07008 permit amendment was approved. The monitoring program and site management components of the amendment will be reflected in this year's annual report. This report will also include previous permit limits for the first three quarters; the new permit amendment is applied to the fourth quarter.

Sample collection during the 2012/13 monitoring year was generally performed by QCC staff, except for sampling of groundwater monitoring wells and specific environmental projects, which were conducted by environmental consultants, such as Golder Associates LTD. and Lorax Environmental LTD.

Quarterly monitoring reports and annual monitoring reports are submitted to the Regional Waste Manager as required by permit PE-07008. The quarterly reports typically include a narrative and data tables as they pertain to the permit. Annual reports include an annual summary of the water quality monitoring with reference to the historical trends, data analysis, and interpretation. Analytical results include chemical, physical, and biological water quality analysis.

2.0 WATER MANAGEMENT SYSTEM

Settling ponds, sumps and ditches were constructed to treat and manage water from underground workings and surface runoff to ensure the protection of the receiving environment.

Water management at the Quinsam Mine is divided into two discrete areas; North and South.

2.1 THE NORTH WATER MANAGEMENT SYSTEM

The North water management system consists of the 2 North underground sumps and surface sumps. The water is pumped into these sumps and given time to settle before it is pumped to the

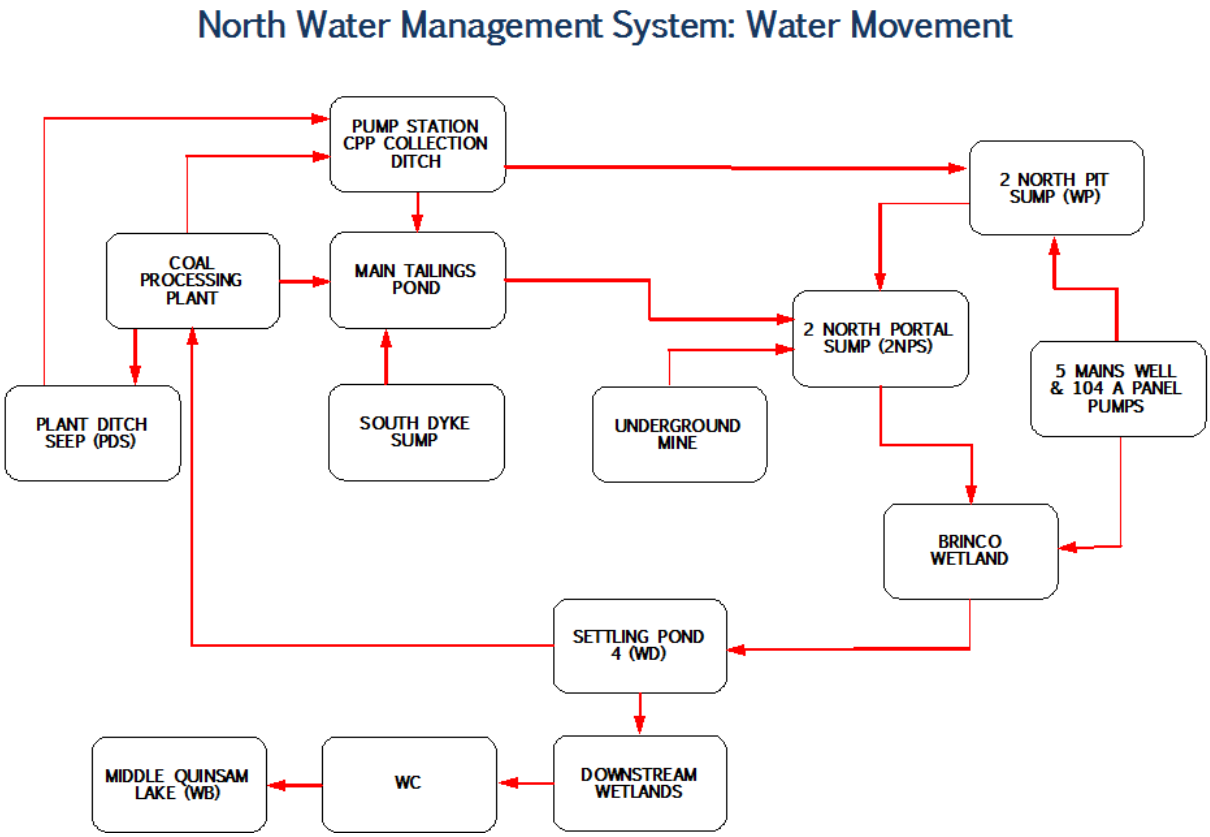
surface. There are 3 underground pump stations, these include, 6 Mains, 5 Mains, and 1 Mains. 5 Mains and 6 Mains pump stations receive water, by gravity, from the developed/depillared area of 4 Mains including all of 7 Mains areas. This water is pumped directly to the surface through vertical wells into the Brinco Brook wetlands located upstream from Settling Pond #4, or alternately to the 2 North Portal Sump. The pump station at 1 Mains collects water, by gravity, from the remaining developed/depillared sections of 4 Mains. The water from 1 Mains is pumped into a reservoir (dam), referred to as the 3 Mains pump station, which also collects water from the former mine workings (gobs). 3 x 250 HP pumps, extract 1500 gal/min each and axial pumps carry the water from the underground dam to surface and into the Brinco Brook wetland, or alternately to the 2 North Portal Sump.

The 2 North Portal Sump is located outside the portal entry, it is a settling pond that collects water from underground sumps, seepage from the tailings dam and some surface runoff in the North mine area.

The perimeter collection ditch, formerly the coal wash plant ditch, is a collection ditch that was previously used to collect all of the water and runoff from the 2 North areas and directed it into the 2 North Pit Sump.

In September 2010, following an Effluent permit amendment a 15 cm pipeline and a 58 HP pump was installed at the Coal Preparation Plant Tailings Pump Box, diverting the wash plant water from the wash plant ditch to the tailings impoundment. This pipeline eliminates the wash plant processing water from flowing into the plant ditch. The 2 North Pit Sump is no longer used for wash plant effluent as of September, 2010.

Settling Pond #4 is the final settling pond in the North water management system, where water is retained prior to being released into the receiving environment. Settling Pond #4 also provides process feed water to the Coal Preparation Plant. The decant riser (monitoring station WD) located at Settling Pond # 4 is the permitted North water management system discharge point. Middle Quinsam Lake is considered the receiving environment for the North Water Management system.



2.2 THE SOUTH WATER MANAGEMENT SYSTEM

All surface runoff from the South mine area, including the 2 South Pit, 3 South Pit, 4 South underground mine operations, catchment ditches, roadside ditches and catchment sumps is discharged through the South water management system at Settling Pond #1.

The 3 South Pit collects waters from the 2 South and 1 South areas as well as surface run-off in the 3 south areas. From 1998 until 2010 when it reached its capacity for PAG-CCR, this pit has been used as a permanent sub-aqueous disposal facility for high sulfur reject materials generated from the mine operations. The water from this pit is pumped into Settling Pond #1.

There are several sumps in the 4 south underground mine that collect underground water allowing it time to settle before it is pumped to surface, then stage pumped to Settling Pond #1. The water from the 4 South mine remains in situ.

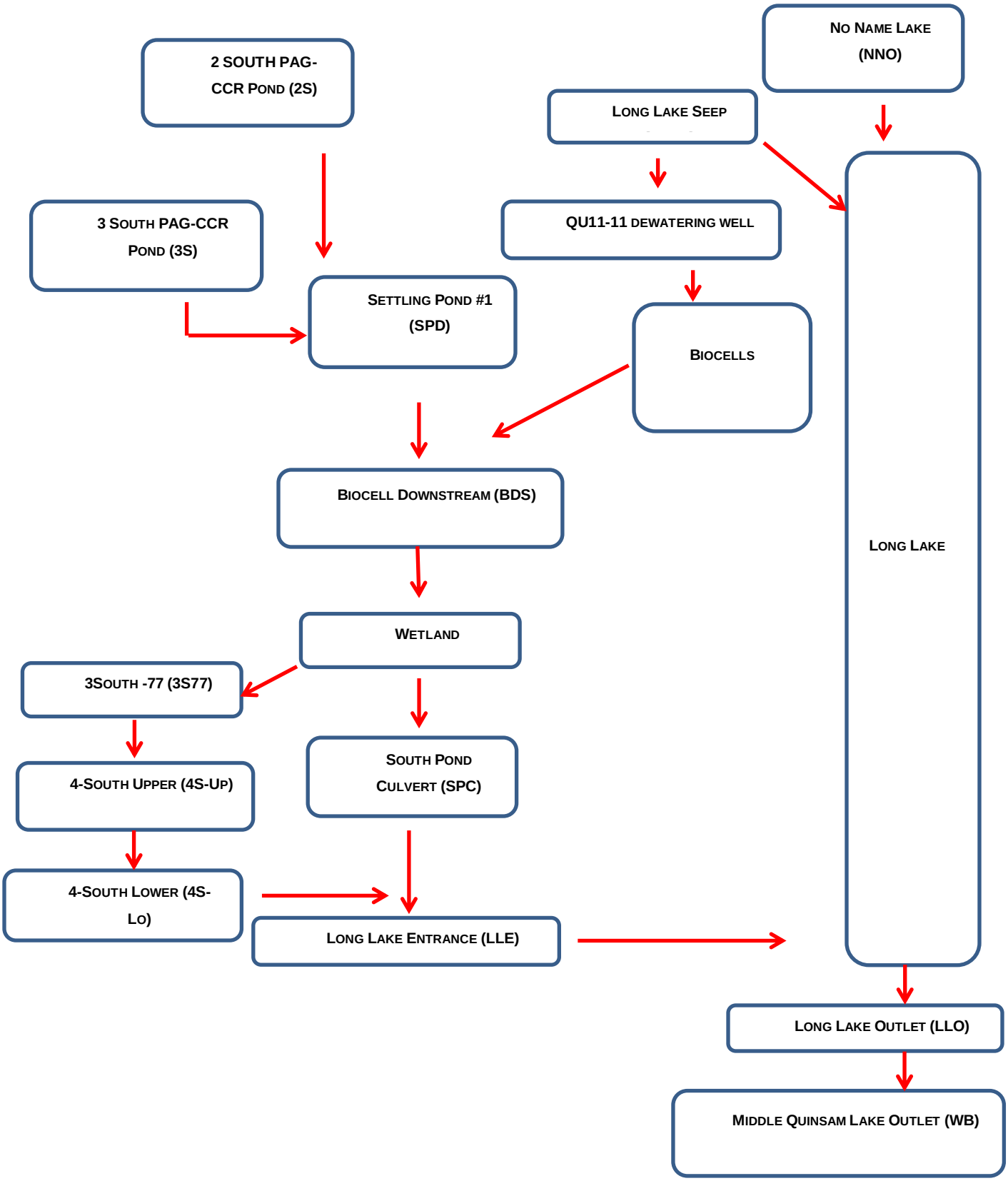
Settling Pond #1 is the final point of water collection in the South water management system before the water is discharged to the receiving environment. The decant riser (Monitoring Station SPD) located at settling pond #1 is the South water management system discharge point. The mine effluent travels from the Settling Pond #1 decant (SPD) through a series of meadow/wetland systems before entering Long Lake, the receiving environment.

In October of 2010, a siphon pipeline was installed from Settling Pond # 1 extending to the 3 South Pit. This pipeline, allows for water to be siphoned from Settling Pond #1 into 3 South Pit when required. This pipeline can be used in times of unfavorable water conditions in SPD as the 3 South Pit will provide additional settling capacity and ultimately act as a "closed loop" system, when required.

On January 25, 2013 the permit amendment was approved for PE-07008. This included the approval for discharge from 7 South Decant Pond (7SSD). 7 South Mine commenced into full mining operation in August, 2012. New surface disturbance at the 7-South area included the development of the portal opening for access to the 7-South mine and construction of the coal preparation pad.

The diagram below displays the South Water Management System.

SOUTH WATER MANAGEMENT SYSTEM: WATER MOVEMENT



2.3 7 SOUTH WATER MANAGEMENT SYSTEM

The 7-South portal opening was developed at the near-surface subcrop of the No. 4 Seam. The portal opening was developed to accommodate surface and underground infrastructure, including a conveyor system that would facilitate the transport of raw coal from the underground mined workings to the Run of Mine (ROM) pad at 7S. Coal located on the ROM pad is then transported, via haul truck, to the Coal Preparation Plant. Water management at the 7S mine area includes a series of ditches for catchment and conveyance of surface runoff from mine disturbed areas and segregation of non-contact "clean" water.

The 7 South Water management plan includes three main areas in which water is collected and stored, these include: 7 South-Adit Sump (7SPS), 7 South Pre-Settling Pond (7SSCP), and 7 South Settling Pond Decant (7SSD).

The 7SPS, contains water that is collected from dewatering processes during mining activity. Water is pumped from actively mined areas and stored at the sump nearby the conveyor belt portal entrance as a safety measure. This water is stored and used for dust suppression on the mining equipment and in the event of a fire.

Water levels at 7SPS are monitored daily and when water levels rise beyond a desired storage capacity, excess water is pumped underground into the 5 South Mining area.

7 South Settling Pond (7SSD) is the main water collection pond for the 7 South Mine area with a cumulative catchment of 3.14 hectares. The pond water at 7SSD is exclusively from surface runoff and this water is monitored for quality and quantity during discharge events. Water discharged from the settling pond is a carefully controlled process and is based on several factors. A detailed explanation of these factors is described in the following text.

Discharge from the 7S Sedimentation Pond forms the headwaters of Stream 1. Monitoring location 7S is located on Stream 1 below the confluence with Stream 2 and, for the purposes of the effluent permit, is considered the receiving environment. Thus, British Columbia water quality guidelines are used to evaluate potential effects on aquatic receptors at this location. For further information on the 7S Sedimentation Pond function, please refer to (Section 10.0) 7 South Water Management System.

2.4 WATER MANAGEMENT SYSTEM MAINTENANCE

The water management system involves the maintenance of haul roads, roadside ditches, catchment ditches, ponds, culverts, pumps and water lines through the mine site.

All of the catchment ditches, roadside ponds and culverts are regularly inspected and maintained as required. Some of the regular maintenance around the mine site includes the removal of debris from culverts, the replacement of silt fences and straw bales and the removal of sediment build-up from the catchment ditches and ponds. Pumps and water lines are inspected daily and maintained as part of the surface inspection performed by the surface supervisor.

3.0 MATERIALS AND METHODS: ENVIRONMENTAL MONITORING PROGRAM

For this reporting year (2012/13), all of the water samples collected were analyzed in accordance with Permit PE-07008. Field sampling was conducted in accordance with the methodologies as described in the most recent version of "*The British Columbia Field Sampling Manual for Continuous Monitoring of Air- Emissions, Water, Soil, Sediment, and Biological Samples* ".

Quinsam Coal contracts Maxxam Analytics of Burnaby B.C. for the analysis of surface water quality samples and ALS Environmental of Burnaby for groundwater analysis The periphyton and phytoplankton samples continue to be analyzed by Stantec.

3.1 ENVIRONMENTAL MONITORING EQUIPMENT

ISCO 4210 flow meters equipped with a paper chart plotter connected to a Sonic Depth Sensor are used to measure flow volumes at two of the permitted discharge sites, Settling Pond #1 and Settling Pond #4. Daily reports from the flow meter are printed and include maximum and average flow volumes for each day. The information that is taken from the flow meter is recorded in a spreadsheet. This information can be found in tables 3 and 18.

The 7 South Settling Pond Decant (7SSD) is equipped with a Sitrans F M MAG 8000 CT electromagnetic flow meter that records the volume of water being discharged from the setting

pond on a daily basis. The Sitrans MAG 8000 is a microprocessor-based water meter. The transmitter drives the magnetic field in the sensor and evaluates the flow signal from the sensor. It then calculates the volume of water passing through the decant pipe. This information is displayed on the digital display screen and is downloaded to a computer through a bluetooth connection. The digital screen displays a total value of water that has passed through the decant pipe (a totalizer), and a value for the real-time volume of water leaving the decant pipe in L/s. The flow data is then downloaded from the. This information can be found in Table (77).

Both Settling Pond 1 and 4 have ISCO 12-volt automatic composite samplers that are connected to the ISCO 4210 flow meters and sonic depth sensors. The automatic samplers are programmed to take a 40 mL sample every 30 minutes in the event of an overflow or flow >0.054 m^3/s for WD decant and >0.046 m^3/s for SPD decant. The automatic sampler will continue to take samples for the duration of flows exceeding 0.054 m^3/s and 0.046m3/s for WD decant and SPD decant, respectively.

The ISCO automatic sampler at 7SSD is operating independent of the flow meter; it is programed to sample 80 ml every 2 hours into a 1L bottle for 24 hours when the pond is discharging. This is manually programed and initiated once discharging is commenced from 7SSD.

Each station is now equipped with a solar panel that is connected to a 12 Volt deep cycle marine style rechargeable battery. These sites are inspected daily in order to minimize the potential loss of information due to battery failure.

There are three effluent control orifices that can be used on the settling pond decant riser structures. A 545 mm orifice is used at Settling Pond # 1 and a 375mm or a 525 mm orifice is used at Settling Pond # 4. The 525 mm orifice is used at Settling Pond # 4 during periods of high precipitation, in order to manage the high water inflow rates into Settling Pond # 4. Ker Priestman and Associates (KPA) and McElhanney Consulting formulated the calculations for the different orifice sizes and flows. The purpose of the orifices is to regulate the flow in order to detain water for a minimum of ten hours to allow for settling of suspended solids.

A YSI 600 sonde was rented from Pine environmental services of Burnaby for all depth profiling performed during the lake monitoring program. A new larger volume 8.2 liters Beta sampler was purchased in 2012. This new sampler is designed for trace metal sampling. It was used for all

lake monitoring performed in 2012-13. QCC staff calibrated the YSI 600 rental prior to each sampling session.

Davis Vantage Pro 2 weather monitor is located outside the office building. The Davis Vantage Pro 2 records rain, wind, barometric changes and temperature.

3.2 QUALITY ASSURANCE QUALITY CONTROL

All replicate sampling was performed in compliance with the British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 2003 Edition and with the recommendations made in the April 30, 2004 Golder Associates Ltd. (Golder) Technical Memorandum entitled "Quality Control for Surface Water Sampling at Quinsam Coal".

As per these recommendations and in accordance with the Quality Assurance/Quality Control (QA/QC) program, one field replicate sample was collected per sampling event. RPD (Relative Percent Difference) values were calculated in accordance with the British Columbia Field-Sampling Manual and are presented in Tables 74-75. Three field blank samples were also analyzed throughout this monitoring year. RPD values were calculated in accordance with the B.C. field-sampling manual. Replicate field samples were calculated for concentrations at or greater than five times the reported DL, the relative percent difference of these should not exceed 20%.

The acceptability criteria used for the field blank samples was calculated in accordance with the quality assurances guidelines of the B.C. Field Sampling Manual, which states that the field blank contamination should not be significantly greater in concentration nor occurrence than laboratory method blanks contamination. Where the laboratory method blanks should not exceed the detection limit reported by the laboratory for the associated (same batch) samples. If the RPD value is greater than 20% then the field blank result should not exceed two times the laboratory detection limit. Calculations of the RPD results for the field blank samples were calculated with the mean detection limit for those parameters with RPD values greater than 20%.

Replicate samples were within the acceptable range for all samples during this report period excluding those samples with RPD values greater than 20%, displayed in the tables (74 to 75).

3.3 EFFLUENT WATER QUALITY SAMPLING

3.3.1 *PERMITTED DISCHARGE POINTS*

QCC monitors water quality at the Mine regularly at three permitted discharge points: (SPD) Settling Pond #1 Decant, which is located in the South Mine Area, 7 South Settling Pond Decant (7SSD), which is located in the newly developed 7 South area and Settling Pond #4 Decant (WD), located in the North Mine Area. These sites are regulated by permit PE-07008 for both quality and quantity.

Water Quantity: Settling Pond# 1 and Setting Pond #4 monitoring stations are equipped with flow meters, which measure and record the flow at one minute intervals. In order to comply with permit PE-07008 the sampling frequency is based on the decant flow volume. The permitted maximum allowable rate of discharge at Settling Pond #1, SPD Decant is 0.46 m^3/s and Settling Pond #4 WD Decant is 0.32 m^3/s 365 days per year. Sampling of the two monitoring stations is based on the settling pond's decant flow levels which includes a daily composite sample when decant flow is >0.054m^3/s and a weekly sample when decant flow is <0.054 m^3/s for Settling Pond # 4. For Settling Pond # 1 a daily composite sample is required for decant flow of >0.046 m^3/s and a weekly sample for decant flow <0.046 m^3/s.

7 South Settling Pond Decant is equipped with a Sitrans F M MAG 8000 CT electromagnetic flow meter. The flow meter is built into the discharge pipe that requires opening a discharge valve in order to discharge water. Permitted discharge for this site is based on the downstream flow at the 7 South monitoring location (7S). Lorax Environmental LTD has established a discharge curve; for this site. The maximum authorized rate of discharge is 0.005 m^3/s for 365 days per year.

Water Quality: In 2009, the ISCO 12-Volt automatic samplers were calibrated and placed at the two settling ponds. The automated sampler is connected to the flow meter and takes a composite sample at a decant flow of >0.054 m^3/s. When there is no decant flow a weekly

sample is taken. These samples are analyzed for total suspended solids on a weekly basis. The 7SSD site is manually set up with an ISCO sampler which continuously samples until it is manually shut off. As stated in section 3.1.

3.3.2 *MONITORING STATIONS*

Water quality samples are collected from numerous designated monitoring stations as shown on the map titled Water Monitoring Stations (Appendix X).

The North Mine Area monitoring stations include: 2 North Portal Sump (2-N-P-Sump), 2 North Pit Sump CCR Cover (WP), Settling Pond #4 (WD), culvert into Middle Quinsam Lake (WC), and South Dyke Pond (SDS).

The South Mine area monitoring stations include: Settling Pond # 1 (SPD), 3 South Pit (3S), 2 South Pit (2S), Long Lake Seep (LLS), 3S77 Adit Pit (3S77), 4 South Pipe to SPD (4S-P-SPD) (only sampled when pumping from underground), 4 South Mine Coal Storage Pad (4S Lower), Culvert downstream end of access road (SPC). Settling Pond #1 currently receives water from the 3 South Pit, 2 South Pit and the overland flow from the surrounding areas.

After discharging through the decant at Settling Pond #1, the effluent flows through a series of meadows and wetlands before discharging through the culvert at LLE into Long Lake. The point that the effluent enters the lake (LLE) is approximately 50 meters up the road from Long Lake Outlet (LLO) monitoring station.

The 7 South monitoring locations include 7 South Settling Pond Decant (7SSD), 7S-Adit Sump (7SPS) and 7 South (7S) on Stream 1).

The receiving water monitoring stations are:

- Middle Quinsam Lake: Center of Middle Quinsam Lake (MQL), Middle Quinsam Lake Inlet (WA) and Middle Quinsam Lake Outlet (WB),
- No Name Lake: Centre of No Name Lake (NNL); No Name Lake Outlet (NNO),
- Long Lake: Center of Long Lake (LLM),, the outflow from Long Lake (LLO) and decant from South mine water management system (LLE).

- Quinsam River: 7 South Quinsam River (7SQR), Quinsam River upstream of 7S mining operation (QRDS1),
- Stream 1: Lower wetland outlet at the confluence of Quinsam River

In addition, eight groundwater-monitoring stations are monitored on a quarterly basis. These wells include MW00 1S and 1D, and MW00 6S and 6D located in the North area down gradient of the wash plant ditch. The 2 South / 3 South monitoring wells include MW00-2, MW00-3, MW00-4 and MW00-5.

3.3.3 *Additional Monitoring Stations 2012-2013*

Quinsam Coal frequently conducts additional monitoring at specific sites within the water management system. These sites were established for baseline monitoring requirements for the 7 South Mine, Area 5. They include Upper Iron River (UIR), and Lower Iron River (LIR), and Quinsam River downstream of the confluence with Iron River (IRQR).

In the 2-South area, construction of the sulphate reducing biocells resulted in 10 additional monitoring locations:

QU11-11 dewatering well referred to as Influent (INF), BCR Effluent, Sulphide Polishing Cell Effluent (SPC-EFF), Aerobic Lagoon Effluent (AL-EFF), Settling Pond Effluent (SP-EFF) and 5 Intermediate Sampling Ports (INT-SP 1-5). These sites are required to be monitored on a biweekly basis and a quarterly basis. For a detailed discussion of the Biocells see App (IX).

3.3.4 *Water Analysis*

Maxxam Analytical performs all of the laboratory analysis for QCC. QCC is required by permit PE-07008 to perform specific analysis on certain effluent samples. Each site has a different set of parameters required for analysis by permit. The parameters requested for effluent monitoring include the following:

- pH (standard units);
- Specific Conductance (µS/cm);

- Total suspended solids (TSS)
- Total dissolved solids (TDS) (mg/L);
- Alkalinity (mg/L as $CaCO_3$);
- Hardness (mg/L as $CaCO_3$);
- Sulphate (mg/L);
- Ammonia nitrogen,
- Nitrate/nitrite combined as nitrogen (mg/L);
- Dissolved Organic Carbon (mg/L);
- Total and dissolved phosphate (mg/L);
- Total and dissolved metals (mg/L);
- Oil and grease (for stations SPD and WD only) (mg/L); and
- Rainbow trout bioassays (for stations SPD, WD and 7SSD only).
- 7 Day *Ceriodaphinia dubia* chronic toxicity test (At station 7S only).

The required metals analyses were performed using the recommended CCME/BC WQG analytical package for both total and dissolved metals at most monitoring stations. Additionally all metals analysis was performed on all water samples within QCC water management system, which included a metals scan of thirty-one total metals and thirty-one dissolved metals. The type of analysis requested for the total and dissolved metals includes low level detection limits for all metals including a lowest level detection limit for Mercury and Cadmium. This analytical package is used for the analysis of both total and dissolved metals at all monitoring stations as per the recommendations of the MOE. Maxxam Analytics performs low level Cadmium and Mercury analysis on almost all total and dissolved metals packages. Low level metals are requested for each analysis sent out. The laboratory utilizes conventional and chromatography coupled Inductively Coupled Mass Spectrometry (ICPMS) to provide superior sensitivity and specificity.

3.3.5 *PERMITTED LIMITS*

The three permitted discharge sites, Settling Pond 1 (SPD),Settling Pond 4 (WD) and 7 South Settling Pond Decant (7SSD) have permit limits for the following parameters:

TABLE 1: PERMIT LIMITS FOR THE DISCHARGE SITES

Parameter	Sites		
	WD	**SPD**	**7SSD**
pH	6.0 to 8.5	6.0 to 8.5	6.0 to 8.0
TSS	25 mg/L (daily composite sample), 35 mg/L (hourly composite sample)		
Ammonia Nitrogen (1)	1.0 mg/L	1.0 mg/L	-
Phosphate*	0.03 mg/L	0.03 mg/L	-
Aluminum*	0.5 mg/L	0.5 mg/L	0.1 mg/L
Cadmium*	-	-	0.000045 mg/L
Copper*	0.02 mg/L	0.02 mg/L	0.014 mg/L
Iron*	0.05 mg/L	0.5 mg/L	0.35 mg/L
Lead*	0.05 mg/L	0.05 mg/L	-
Selenium*	-	-	0.016 mg/L
Sulphate*	-	-	500 mg/L
Zinc*	0.1 mg/L	0.2 mg/L	-
Oil and grease	10 mg/L	10 mg/L	-
Bioassays	No mortalities at 100% effluent concentration after 96 hours.		

[1] *The required analysis for nitrate nitrogen and nitrite nitrogen were combined as per the permit amendment of July 2004. * Indicates Dissolved.*

3.3.6 *DISCHARGE RATES*

The permitted maximum and average rate of discharge for Settling Pond #1 is 0.46m^3/s and 0.10m^3/s respectively. The maximum and average rate of discharge for Settling Pond #4 is 0.32m^3/s and 0.08m^3/s respectively. The maximum flow of 0.005 m^3/s is the peak routed outflow from the 7 South Settling Pond Decant. The authorized discharge period is for 365 d/a.

4.0 **RECEIVING ENVIRONMENT WATER MONITORING STATIONS**

4.1 **STREAM WATER COLLECTION**

The permit amendment specifies a 5 and 30 schedules for all receiving environment samples. The 5 and 30 schedules include 5 weekly samples collected over 30 days. For the lake monitoring sites this is performed 3 times per year, spring turnover, summer stratification period and fall turnover. The receiving environment water monitoring stations include stations located at Middle Quinsam Lake, No Name Lake, Long Lake and Lower Quinsam Lake. The monitoring sites for the center of all lakes include Middle Quinsam Lake (MQL), No Name Lake (NNL), Long Lake (LLM) and Lower Quinsam Lake (LQL).

The river monitoring sites are also included on the 5 and 30 schedule three times per year. This is performed during spring, summer and fall. The stream/river monitoring locations include: the inflow to Middle Quinsam Lake (WA) and outflow from Middle Quinsam Lake (WB), No Name Lake (NNO), and Long Lake (LLO). Long Lake entry (LLE) has been included as part of the initial dilution zone for the south mining area.

Other receiving environment monitoring stations for the 7 South Mining Operation include: Quinsam River Upstream of the 7 South Mining Operation, (QRDS1), and Quinsam River downstream of the 7 South Mining Operation, 7 South Quinsam River (7SQR) and the Lower Wetland Outlet at the confluence of the Quinsam River (QLW).

The Block 242 Coal Mining Operation is permitted for two receiving environmental sites. These are only required to be monitored if discharging from the setting pond. These monitoring stations include River site #1, Iron River upstream of the confluence with the discharge of the secondary

Settling Pond from the Upper Iron River (UIR), River site #2, Iron River downstream of the confluence with discharge of the Secondary Settling Pond, Lower Iron River (LIR).

4.2 LAKE WATER COLLECTION

Lake water samples were collected by Quinsam Coal Staff from Long Lake and Middle Quinsam Lake for the 2012 sampling period for the months of April to September 2012. Sampling from No Name Lake and Lower Quinsam Lake was not required until April 2013. As in previous years, QCC's 12' aluminum boat with an outboard motor was used for all lake sampling events. All sampling procedures were carried out in accordance with permit PE -07008 and following the protocols outlined in the *British Columbia Field Sampling Manual for Continuous Monitoring of Air, Air-Emissions, Water, Wastewater, Soil, Sediment, and Biological Samples, 2003 Edition.*

The lake sample collection includes depth profiles at 1 m, 4 m, 9 m and 1 m from bottom. The permitted parameters required to collect for analysis include: physical parameters, temperature, pH, dissolved oxygen, and specific conductance. Water chemistry samples are also collected at each of the depths (1, 4, 9 and 1 m from bottom). Samples for biological testing are collected at all depths except for the 1 m from bottom sample. A clear glass 8.2 liter Beta sampler, which allows for the accurate collection of replicate samples, is used for all sample collection. Depth profiling was recorded using a YSI 600. Depth profiling is recorded to determine the characteristics of the water in each lake at 1m intervals. The depth that the light penetrates the water or the transparency of the water was measured and recorded using a secchi disk.

The collection of Chlorophyll "A" and Pheopigment for depths of 1, 4 and 9 meters are collected in accordance with permit PE-07008. The sampling procedures include the collection of samples in 1L bottles at each of the stated depths including two 1L replicates for Chlorophyll "A" at each depth. The samples used for species count and identification are collected at 1, 4 and 9 m depths and preserved with Lugols solution. For details on the analysis of Chlorophyll "A" and Pheopigment see Appendix II.

Periphyton sampling at Long Lake Outlet (LLO) and at Middle Quinsam Lake Outlet (WB) took place between May 2012 and August 2012. The procedure used to collect the samples involves the placement of 4, 12 inch square glazed porcelain tiles, (2 at each site) placed in the outflows of

each lake (LLO and WB). The tiles are placed in the flowing water and left for a period of six weeks. At the cessation of the six weeks the tiles are removed and the algal growth is carefully scraped off into collection jars. These samples are then shipped on ice to Maxxam Analytics. The species count and identifications are subcontracted through Maxxam to Stantec for analysis. For details on the analysis of Periphyton see Appendix IV.

4.3 WATER ANALYSIS

Lake and river water quality monitoring focuses on the addition of large quantities of nutrients and the addition of sediment resulting from large land disturbances and traffic, and significant changes to water chemistry. As there are no permit limits for the receiving environment monitoring stations, the water quality is compared to the Water Quality Objectives a those sites that are included in the Middle Quinsam Lake Subbasin and the Working Water Quality Guidelines for those outside of the Middle Quinsam lake Subbasin. In order to make accurate assessments of the lake water quality, the parameters that are monitored include the physical, chemical and biological aspects. The 7 South River locations such as 7S, QRDS1, 7SQR and the lower wetland at the confluence of the Quinsam river and the Block 242 Coal mining Operation are compared to the Working Water Quality Guidelines for British Columbia. All other locations are compared to the Water Quality Objectives for the Middle Quinsam Lake Subbasin.

4.3.1 *PHYSICAL WATER PARAMETERS*

Physical water analyses performed at the center of the lakes includes:

- Dissolved oxygen (mg/L);
- Temperature (Celsius); and
- Light Extinction

4.3.2 *CHEMICAL PARAMETERS*

Generally, the same chemical water analysis is performed on the lake and river water samples as the mine effluent water samples. An analysis of both total and dissolved metals for lake and river samples is performed for lake samples. As with the surface water quality analysis the lake and river water quality is analyzed for Lowest Level Cadmium and Mercury concentrations. Low level detection limit analytical package are requested for all other metals.

4.3.3 *BIOLOGICAL PARAMETERS*

The biological monitoring program was designed to monitor changes in algal species as a means of detecting possible Lake nutrification that would lead to algae blooms. In the past 12 years, the focus has been on monitoring changes in lake species that may be influenced by increasing sulphate concentrations. The following biological analyses are performed on the Middle Quinsam Lake and Long Lake water samples as required by permit PE-07008;

- Phytoplankton (chlorophyll “a” and pheopigment)
- Phytoplankton (counts and identification to species)

The following biological analysis is performed on the two river sites, Middle Quinsam Lake Outlet and Long Lake Outlet as required by permit the previous permit PE-07008;

- Periphyton (chlorophyll “a” and pheopigment)
- Phytoplankton (counts and identification to species)

Monitoring requirements at the River sites includes:

Flow, total suspended solids, hardness, total metals, dissolved metals conductivity, pH, alkalinity or acidity and sulphate.

Nutrients such as ammonia (t), nitrate/nitrite, phosphorus (t) are scheduled every three years. To be conducted during low flow periods (August to early September).

5.0 SEDIMENT MONITORING STATIONS

The amended permit requires sediment monitoring to be conducted every three years at specific sites. The table below describes the sites required for sediment monitoring.

Table 2: Sediment Monitoring Locations:

Lake Name	Monitoring Sites
No Name Lake (NNL)	No Name Lake Inlet, NNLI (EMS # E224246) No Name Lake Deep, NNLD (EMS # E217018) No Name Lake Near Seep (EMS # E292114) No Name Lake Outlet (EMS # E217017)
Middle Quinsam Lake (MQL)	Middle Quisam Lake Inlet (EMS # E206901) Middle Quisam Lake Deep (EMS # E292115) Middle Quisam Lake Near Seep (EMS # E292116) Middle Quisam Lake Outlet (EMS # 0900504)
Lower Quinsam Lake (LQL)	Lower Quisam Lake Inlet (EMS # E292117) Lower Quisam Lake Deep 1 (EMS # E29118) Lower Quisam Lake Deep 2 (EMS # E292119) Lower Quisam Lake Outlet (EMS # E292120)
Long Lake (LL)	Long Lake Inlet (EMS # E292121) Long Lake Deep (EMS # E292122) Long Lake Near Seep (EMS # E292123) Long Lake Outlet (EMS # E219412)
Gooseneck Lake (GL)	Middle Gooseneck Lake (EMS # 1132502)
Lower Wetland	Lower Wetland Inlet (EMS # E292124) Lower Wetland Middle (EMS # E292125) Lower Wetland Outlet (EMS # E292112)

5.1 MONITORING REQUIREMENTS

The following table below outlines the requirements to be conducted concurrently with sediment monitoring.

TABLE 3: SEDIMENT MONITORING REQUIREMENTS

Parameters	Schedule
Lake Water Chemistry Profile	
Temp, DO, specific conductivity, pH, OPR	Every three years
Water Chemistry	
Hardness, turbidity, sulphate (d), metals (t), and (d) hydrocarbons.(At two depths: near bottom and surface of lake for all sites except for the deep sites where an additional sample will be collected at 5 m below the surface).	Every three years
Sediment Chemistry	
Mosisture, pH, [particle size, total organic carbon (TOC), total metals, PAH.	Every three years
Biological Monitoring	
Benthic invertebrate (CABIN) for all streams where benthic sampling occurs (WA, WB, LLO, NNO, 7SQR, and QRDS1)	Every three years
Benthic community taxonomy & count for all lakes.	Every three years

6.0 GROUNDWATER MONITORING WELLS

Quinsam Coal contracted the services of Golder Associates Ltd. to complete a hydrogeological assessment of sulphate in the groundwater in 2000. Eight groundwater monitoring wells were installed at the mine site by Golder in 2000. Two of the groundwater monitoring wells are multi-level monitoring wells (MW00-1 and MW00-6), which are located in the North Mine Area, down slope of the wash plant ditch. MW00-6 is located between the wash plant ditch and MW00-1. Details are provided in Appendix VI.

Single level groundwater monitoring wells MW00-2, MW00-3, MW00-4 and MW00-5 are located in the 2- South - 3 South areas. MW00-2 is located on the edge of the access road to the 3 South Pit, MW00-3, is located next to the 3 South Pit area, near the south end of Long Lake. MW00-4 and MW00-5 monitoring wells are located near MW00-3 in the former 2 South Pit and waste dump south of Long Lake.

The 5 South wells consist of 4 stations that were implemented as part of the baseline study for the 5 South/10 Mains mining operations in 2006. In order to provide baseline groundwater quality information in the 5 South "Phase 2" development area and to assess potential groundwater level changes during mining of 'Phase 1", additional drill holes and monitoring wells were included in the monitoring program. In 2005-06 a coal exploration program was carried out in the 5 South areas by QCC. In 2010, QCC obtained Golder Associates Ltd. to perform a hydrogeological assessment of groundwater monitoring wells and drill holes. As part of this, three drill holes were completed as monitoring wells these include: QU-05-15-MW1, QU-05-16-MW4 and QU-06-01-MW5 and one drill hole QU-05-14-MW2, remained as an open borehole.

Monitoring well (QU-05-16-MW4, and QU-06-01-MW5) are situated in the 5 South/11 mains development areas along the TimberWest Coal 600 logging road.

Monitoring well QU-05-15-MW1 and drill hole QU-05-14-MW2 are located in the 2-4 South Main Haul Road, located southwest of the 5 South development area.

Several ground water monitoring wells were installed in 2008 to support the 7-South (and related waste management plans) Mine Permit Amendment. In 7-South, four (QU-08-05, QU-08-08, QU-08-10, QU-08-13) previously installed exploration boreholes were developed as water quality monitoring wells.

The 4-South groundwater investigation included the installation, development and sampling of four new wells (QU-10-07, QU-10-08, QU-10-09, QU-11-01) and one previously installed borehole (QU-78-161).

The 2-North/5-South groundwater investigation included the installation, development and sampling of six new wells (QU-10-10, QU-10-11, QU-10-13, QU-11-03, QU-11-05, QU-11-09) and two previously installed boreholes (QU-05-13, QU-08-21).

In 2012 there were 24 drill holes developed and installed in the 7 South, 242 and 4 South areas. Some of these drill holes will provide future groundwater monitoring locations in order to continue to assess the groundwater. Table 4 below lists all of the drill holes for the 2012 year.

TABLE 4: EXPLORATION DRILL HOLES 2012, AREAS DISTURBED

Borehole Number	UTM 83 Easting	UTM 83 Northing	Minegrid Easting	Minegrid Northing	Minegrid Elevation	Total Depth (m)	Purpose	Total Disturbance Area (Hectares): Drill Pads only
QU-12-01	324378.3144	5532600.317	99854.8118	100464.3052	319.03298	148.29	4S/6S Exploration	0.46 Ha
QU-12-02	324137.565	5532971.96	100008.325	100879.6522	317.366919	133.05	4S/6S Exploration	
QU-12-03	324317.7145	5533222.683	100317.002	100885.4854	315.452155	158.00	4S/6S Exploration	
QU-12-04	324211.5663	5533107.104	100160.874	100901.2996	319.002268	136.86	4S/6S Exploration	
QU-12-05	323702.1658	5533473.179	100149.071	101528.4843	317.8157	79.10	4S/6S Exploration	
QU-12-06	324444.6093	5532761.165	100023.335	100507.5156	307.440062	145.00	4S/6S Exploration	
QU-12-07	324610.1353	5532859.231	100200.989	100433.6578	311.4138	147.98	4S/6S Exploration	
QU-12-08	324662.1656	5532877.133	100246.48	100402.7038	316.97442	137.62	4S/6S Exploration	
QU-12-09	323870.2503	5532918.904	99805.775	101061.9863	324.469804	93.42	4S/6S Exploration	
QU-12-10	323848.0592	5533010.578	99865.9126	101134.6499	324.79733	64.92	4S/6S Exploration	
QU-12-11	323911.0264	5532833.577	99761.848	100978.2373	324.765307	113.00	4S/6S Exploration	
QU-12-12	323817.7109	5533085.062	99907.3978	101203.554	321.182515	46.67	4S/6S Exploration	
QU-12-13	324656.8949	5533159.375	100469.381	100575.9182	302.061339	85.00	242 Exploration	
QU-12-14a	323058.2467	5533365.346	99677.1559	101979.6557	288.066	39.00	10' 20X-Cut, no	
QU-12-14b	323055.9968	5533364.868	99675.4257	101981.1713	288.0703	39.00	6' 20X-cut	
QU-12-15	323115.8538	5533572.073	99877.223	102057.2945	305.4689	83.84	109panel	
QU-12-16	323069.9399	5533338.306	99662.5	101954.1	292.9	41.44	21X-cut	
QU-12-17	323211.6867	5533919.912	100213.199	102188.808	294.851	96.50	88panel	
7SVENTR	324369.1846	5534340.572	101243.175	101513.6	304.921	4.00	7SVENTRAISE, Q12-18	
MW12-19	323006.0916	5533374.885	99653.568	102027.14	276.912	35.40	PZ at 112A	
MW12-20	323072.0348	5533408.559	99720.022	101994.486	275.978	32.30	PZ2 at 112A	
MW12-23	321894.7814	5531149.735	97205.97	101584.912	334.299	24.40	MW	
MW12-24	321896.4653	5531149.924	97207.129	101583.676	334.354	19.80	MW	

6.1 GROUNDWATER COLLECTION & ANALYSIS

Golder Associates, Lorax Environmental and the Quinsam Coal Environmental Department performed collection of groundwater samples from the groundwater wells quarterly. Monitoring events occurred on the following dates: April 27, 2012, September 25 to October 2, 2012, November 14 and 22, 2012 and February 13, 14 and 22, 2013. Monitoring and sample collection for this report period were conducted on April 24, 2012 by Golder Associates. Golder Associates submitted the first quarterly report on June 26, 2012. Methods for the second, third and fourth, 2012/13 groundwater sampling are outlined in the "*Quinsam Coal Corporation's Groundwater Quality Sampling Guide February 2013*" prepared by Lorax Environmental and are part of the Environmental Procedures Manual 2012-13. Laboratory analysis of the groundwater samples was performed by ALS Environmental. A report entitled "*Summary of Groundwater Monitoring Results at the Quinsam Mine,"* outlines the sampling methods and analytical results of the 2012-13 monitoring program and is included in Appendix VI.

7.0 ENVIRONMENTAL INSPECTIONS

7.1 WATER MANAGEMENT

QCC environmental staff performs a routine inspection of the North and South mine water management system while conducting sampling duties.

For the North system, the inspection includes visually inspecting the culvert under the main road (Brinco Brook to Settling Pond 4) to ensure that the water is still flowing with no obstructions. A visual inspection of the (Settling Pond 4) main dam is performed to ensure the integrity of the dam structure. The main dam Settling Pond #4 decant is set up with a flow meter and automatic sampler. The flow meter measures and records the level of the water as it is decanting. This is checked to ensure it is still functioning normally and the report for that day is printed ensuring compliance with the permit PE-07008. The automatic sampler is inspected and the daily TSS composite samples are collected.

The South Mine Area inspection includes ensuring all of the pumping stations are functioning and the ponds are contained as well as the roadside sumps and silt fences. The pumping stations for the South Mine Area include South Dyke pond, 1 South Pit Sump and 3 South Pit Pond. The main dam Settling Pond #1 is visually inspected ensuring the integrity of the dam structure. The flow meter at the settling pond is inspected to ensure it is functioning normally. The report from the flow meter is printed ensuring compliance with the permit PE -07008; TSS composite samples are collected as required.

7 South

The 7 South inspection includes inspecting all three sumps and ponds for water level and ensuring pumps are operating. An inspection of the pipeline leading to the QU05-13 injection well is performed ensuring there are no leaks in the pipeline. The water level at the 7SSD pond is visually inspected. If 7SSD pond is requiring discharge then the downstream staff gauge at 7S is recorded and related to the stage discharge table established for 7SSD (Table 77). The required samples are collected as per permit regulations and the discharge valve is opened at 7SSD. All monitoring is recorded in the environmental logbook. As with the other settling ponds, the automated sampler is inspected daily to ensure it is functioning and TSS samples are collected on a daily basis.

7.2 SURFACE WORKS

Routine weekly inspections are performed by QCC Environmental Department for all lake inlet and outlet water levels and pit water levels. Each of these sites is set up with staff gauges and the numbers are recorded on a weekly basis. Preventative measures are taken to avoid potential spills, seeps and acid rock drainage generation through inspections that are performed on the coarse and fine refuse material storage areas, haul road conditions, petroleum product storage areas, pumps and surface disturbance areas. These are performed by the Surface Maintenance Foreman, Environmental Department staff and the contractor for QCC site maintenance. If a problem is detected at any of the inspected sites, it is reported immediately.

7.3 ENVIRONMENTAL TECHNICAL REVIEW COMMITTEE MEETING

On an annual basis, the Environmental Technical Review Committee (ETRC) meets to discuss the annual report on Water Quality Monitoring. Committee members include representatives from various government agencies and relevant stakeholder groups. These groups include, but are not limited to the Ministry of Environment, the Ministry of Energy, Mines, Environment Canada, Department of Fisheries and Oceans, City of Campbell River, and Campbell River Environment Committee. The annual ETRC agency meeting took place on December 7, 2013 and the annual public ETRC meeting took place on March 15, 2013 both meetings took place at the Enterprise Center. The purpose of the meeting(s) was to review the QCC 2011-12 Annual Water Quality Monitoring Report for completeness, identify issues and potential changes to the monitoring program and agree on recommendations to be made to the Ministry of Environment. The minutes, including recommendations, from the meeting are included in Appendix V. The recommended actions outlined in the report and subsequent follow-up by QCC are as follows**:**

SUMMARY OF ACTIONS:

Actions for QCC in Subsequent Annual Reports:

Action Item: MoE requested that QCC use formatting that would be as obvious in black and white as in colour for future reports.

Follow up Action: This year's annual report will provide **Bold Black** for exceedances and acronyms beside unmet water quality observations and guidelines were highlighted red was previously used. There will be a footnote to explain the acronym and its abbreviated components.

Action Item: MoE requested that a summary of completed, in progress activities or studies relevant to the permitted discharges, associated authorized works and the receiving environment relevant to the reporting period, be included in the next annual reports.

Follow up Action: All annual reports will provide a summary of completed and in progress activities or studies relevant to the reports and relevant to the reporting period. This will be included in section (15).

Action Item: MoE also requested to include projected activities for the coming year that may have an impact on the environment.

Follow up Action: Section (23) in this report outlines the summary of projected activities for the 2013 year.

Action Item: MoE requested that QCC review WQG values used, to ensure they are correct and based on correct receiving environment hardness values when the guidelines are hardness dependent. Discuss with MoE to address QCC concerns with using natural background hardness, etc.

Follow up Action: QCC is committed to ensure WQG values are correct. This was an error that was amended at the ETRC meeting.

7.4 MINISTRY OF ENVIRONMENT COMPLIANCE INSPECTIONS

The Ministry of the Environment conducts annual inspections of the environmental management system. On October 15, 2012 a review was conducted with the following recommendations and QCC's follow up. This information is also available in Appendix V.

Action Required: Based on revised clause wording, the Permittee is reminded that wash plant effluent shall not be conveyed to the 2-North pit sump via the wash plant ditch. The Permittee shall keep records of the date, duration and estimated volume of any overflow of the wash plant effluent sump. Although not specifically required under this permit, inspection routines and records should be kept onsite and be made available to the Ministry during site inspections.

QCC Follow Up: QCC has ensured that this is the procedure that is followed with the Site inspector.

Action Required: Although not specifically required under the current permit, the Settling Pond 4 emergency overflow channel was somewhat overgrown. QCC should consider clearing

vegetation along the overflow channel and conduct a survey to ensure adequate elevations are maintained.

QCC Follow Up: Vegetation in the overflow channel will continue to be evaluated. If it is determined that the engineering function of the structure is being impacted the necessary corrective actions will be executed.

Action Required: No formal checklists were used and inspection records were limited to 'exceptions' logged in the supervisor's log book. It is recommended that inspections be formalized and records be kept available for future inspections.

QCC Follow Up: Going forward, the surface inspector will keep a daily inspection check sheet and logbook that has notes on each site; records will be made available during future inspections.

Action Required: The Settling Pond 4 orifice seemed to be leveled and in good condition. However, vegetation debris was covering some sections of the orifice. It is recommended that the orifice be cleaned regularly to avoid flow restriction.

QCC Follow Up: The surface inspector cleans and inspects the orifices daily.

Action Required: The 24 hour composite samples collected by the auto samplers at the settling ponds' discharge may not be kept cold (less than 4 degree C) at all times. Please present your plan to demonstrate compliance with this clause to the Ministry by March 31, 2013.

QCC Follow Up: QCC environmental staff collects the 24 hour composite samples on a daily basis from the settling ponds and refrigerates the samples until being shipped on ice to Maxxam analytical laboratory in Burnaby.

8.0 2012- 2013 EFFLUENT QUALITY RESULTS & DISCUSSION

The North and South mine water management systems are separated geographically by the Quinsam River valley and are influenced by different sources. The South Mine Area water quality is not influenced by any of the North Mine Area water circuit, but the North Mine water quality is now influenced by a portion of 7 South Mine water pumped from the 7 South Adit sump to the 5 South workings. From here the water from underground mixes with surface water and is pumped into Brinko Brook and then into Settling Pond #4.

The main contributors to the effluent quality for the North Mine Area come from the 2/3 North underground mining operations, the coal washing process, temporary waste and coal product stockpiles, the main tailings facility and mine related surface disturbance. Two important water quality/management features developed throughout the 2012 calendar year include the 2 South PAG-CCR storage facility and the Long Lake Seep treatment bio-remediation cells.

Pre-construction of the 2-South PAG-CCR storage facility commenced in June of 2012. The liner for the facility is comprised of a minimum 8% bentonite by weight thoroughly mixed with a specific size gradation of sand material (called sand-bentonite or SB) excavated from the pit prior to construction. The liner was constructed in two 20 cm lifts creating a 40 cm minimum total liner thickness. Sand-bentonite liner placement started on August 13, 2012 and concluded for the year due to increasingly inclement weather on October 12th, 2012. Final design of the facility indicates a capacity of approximately 275,000 tonnes of PAG-CCR. Thorough Quality Assurance and Quality Control testing was performed throughout the liner construction. Construction completion of the facility is expected to occur in the summer of 2013.

The 2 South pit is now functioning as a PAG-CCR pond for the all of the 7 South PAG-CCR. This has become a permitted monitoring location that is monitored on a weekly basis for water quality. During the winter months the water from this pond is pumped to the roadside ditch where it flows to Settling Pond #1. Pumping from this pond will only occur during the construction phase.

Construction of the bio-remediation cells for sulphate and iron reduction was completed in August 2012. With the exception of the Sulphide polishing cell, the bio-remediation cells are now in the demonstration phase. Appendix IX, illustrates the general layout of the bio-remediation cells. The report entitled "*Long Lake Passive Treatment System Quarterly Report Covering period up to*

January 6, 2013" prepared by QCC and Golder Associates and submitted to MOE and MEM can be found in Appendix (IX) and describes the passive treatment system in detail.

Since the commencement of the Biocells frequency of monitoring has increase in the South area. Due to the elevation difference between Settling Pond #1 and the discharge from the Biocells settling pond effluent the construction proposal was redesigned so Biocell effluent discharges across the road from the Settling Pond #1. This required QCC to apply for an authorization to bypass the works on March 28, 2013. This authorization to bypass the works permits QCC to discharge across the road. The confluence of the Settling Pond #1 discharge and the Biocell discharge was selected as a new monitoring location to compare the water quality to the permit limits and assess the combined water quality of these two effluents. This monitoring location is approximately 50 meters downstream of the where the Settling Pond #1 and the Biocell discharge.

Large scale mining in the South Mine Area ceased in April 30, 1999. Since then, there has been a small amount of coal mined (approximately 20,000 tones) from the 4 South mine in 2003, 2004 and 2005. Water originating from the inactive 4 South Mine, 3 South Pit and the un-reclaimed land are the main contributors to the effluent flows and quality in the south area.

The 2012/13 water quality data for the north and south area monitoring stations are presented in the Tables 1 to 4, 16 to 19 and 66 to 69 section of this report.

8.1 SETTLING POND # 4 (WD)

All permit quality parameters were below the applicable permit criteria during this reporting year for Settling Pond 4. Refer to Tables 1 and 2 for Settling Pond #4 water quality results.

8.1.1 *NUTRIENTS:*

Permit Limits:

Ammonia nitrogen: 1.0 mg/L;

Dissolved phosphorus: 0.03 mg/L

All permit quality parameters were below the applicable permit criteria for nutrients during this reporting year for Settling Pond 4. Since the development of underground mining in 1992, the nutrient concentrations have remained stable and at low levels, commonly below detection limits. Refer to the historical graphs (6-8) of this report. The nutrient concentrations for Settling Pond # 4 for this reporting year consist of concentration lows to highs and annual averages: ammonia nitrogen ranged between <0.005 mg/L and 0.130 mg/L and averaged 0.040 mg/L; nitrite/nitrate nitrogen ranged between <0.020 mg/L and 0.067 mg/L and averaged 0.038 mg/L, and dissolved phosphorous ranged between <0.005 mg/L and 0.005 m/L and averaged 0.005 mg/L. In summary, ammonia nitrogen was exceeded 0/12 times, and dissolved phosphorous was exceeded 0/12 times.

8.1.2 *TOTAL SUSPENDED SOLIDS (TSS)*

Permit Limit:

25 mg/L Daily Composite,

35 mg/L Hourly Composite

Concentrations of total suspended solids (TSS) were below the applicable permit criteria during this reporting year for Settling Pond 4, with the exception of two samples. The permit requires that weekly samples be collected from WD during decant flow <0.054m^3/s and daily composite samples be collected during decant flow of >0.054m^3/s. Settling Pond 4 had TSS values that ranged between <4.00 mg/L and 28.30 mg/L and averaged 5.20 mg/L. TSS samples exceeded permit requirements 2/345[1] times on September 15, 2012 (28.30 mg/L) and March 22, 2013 (26

mg/L). TSS samples collected for this report period were a combination of grab samples and composite samples.

8.1.3 *HARDNESS*

Concentrations of hardness ranged between 248 mg/L and 600 mg/L and averaged 383 mg/L for this monitoring period. Hardness has generally decreased since 1995 as discussed in the historical section (II.4.1.3 of previous annual reports).

8.1.4 *SULPHATE*

Sulphate concentrations at Settling Pond 4 ranged between 370 mg/L and 977 mg/L and averaged 633 mg/L this report period. As reported in previous years seasonal trends are apparent from the sulphate data for the monitoring stations, with lower concentrations generally occurring during late winter and early spring and higher concentrations occurring during summer and early fall. Annual cycles in precipitation are likely responsible for the seasonal variations in sulphate concentrations at the mine site.

Graph 17, Precipitation/Sulphate in Settling Pond 4, compares weekly sulphate data to weekly precipitation data for 2012/13. As seen in the graph, sulphate concentrations were higher during low precipitation months and lower during high precipitation months corresponding to the seasonal variation in precipitation.

8.1.5 *PH*

Permit Limit: 6.0 - 8.5.

Weekly Field pH and Monthly Laboratory pH

All permit quality parameters were within the applicable permit criteria range for pH during this reporting year for Settling Pond 4. pH was sampled on a weekly basis in the field from January 25 until March 31, 2013 and weekly laboratory samples were collected from April 1, 2012 until January 25, 2013 when the new permit amendment was approved.

The field pH averaged 7.95 from January 25 until March 31, 2013. The laboratory pH results ranged between 7.96 and 8.33 and averaged 8.08. pH exceeded permit limits 0/52 times. There has been a slight increase in pH values recorded since the North Mine operation began in 1989. pH has been stable and consistent from year to year since 2001. At the end of this reporting year the pH has slightly dropped from alkaline to basic as seen in the Graph 2.

8.1.6 *ALKALINITY*

Alkalinity concentrations ranged between 282 mg/L and 441 mg/L and averaged 343 mg/L.

Alkalinity appears to have a seasonal concentration trend related to precipitation with higher concentrations during the winter and lower concentrations during the summer.

8.1.7 *DISSOLVED METALS*

Permit Limits:

Dissolved Aluminum: 0.5 mg/L

Dissolved Copper: 0.02 mg/L

Dissolved Iron: 0.3 mg/L

Dissolved Lead: 0.05 mg/L

Dissolved Zinc: 0.1 mg/L

Since the commencement of the underground mining in 1992, the permitted metal concentrations have maintained low and stable, with concentrations most often below detection limits.

Concentrations of dissolved metals are monitored at Settling Pond 4 (WD). Graphs 9 -15 present the concentrations of the permitted metals and also those parameters of interest (arsenic and selenium). All of the dissolved metals were well below permit levels, with most concentrations below detection limits.

Dissolved Aluminum concentrations ranged from <0.003 mg/L to 0.0239 mg/L and averaged 0.0096 mg/L. Dissolved Copper concentrations ranged from 0.00035 mg/L to 0.0036 mg/L and averaged 0.0009 mg/L. Dissolved Iron concentrations ranged from <0.005 mg/L to 0.0240 mg/L and averaged 0.012 mg/L. Dissolved Lead concentrations were consistently less than the detection limit of <0.0002 mg/L as were dissolved Zinc concentrations measuring <0.005 mg/L. For all permitted parameters, dissolved aluminum, copper, iron, lead and zinc, results exceeded permit limits 0/12 times.

There have been no observable changes in the dissolved metal concentrations as demonstrated by graphs 9-15, all of the metals remain near or below detection limits. Dissolved arsenic (Graph 10) and selenium (Graph 14) are within concentrations remaining below or just above detection limits since 1994. The detection limit for Dissolved Selenium and Arsenic is <0.0001 mg/L and concentrations averaged 0.00015 mg/L and 0.00145 mg/L, respectively.

Water hardness and alkalinity are monitored through the concentrations of dissolved calcium, magnesium and sodium contributions. Dissolved calcium, magnesium and sodium are graphed together (Graph 16) for a simple comparison of contributions of these parameters. Dissolved calcium, magnesium and sodium show annual average concentrations of 125.5 mg/L, 15.8 mg/L and 302 mg/L, respectively. Graph 16, indicates the similarity in trends between the three dissolved metals. As with other parameters there are seasonal concentration trends dependent on the amount of precipitation. The yearly trend indicates lower concentrations during the winter months and higher concentration in the late summer/early fall months.

8.1.8 *WATER QUALITY PERMIT LIMIT EXCEEDANCES*

There were two instances where TSS sample results at Settling Pond 4 exceeded the permit limits. On September 15, 2012 and February 22, 2013, daily composite samples reported values of 28.3 mg/L and 26.0 mg/L. The sample on September 15, 2012 was not reanalyzed but the sample from February 22, 2012 was reanalyzed and the results indicated a slight TSS exceedance (26.0 mg/L). Environmental staff changed the suction line on the composite sampler and cleaned the intake suction line. The containers are replaced in rotation so that a clean bottle is put in place of the old bottle each time a sample is taken. Once per month cleaning and flushing occurs for each bottle.

8.1.9 *DISCHARGE VOLUMES AND FLOWS*

Flows remained below the permitted maximum daily discharge of 0.32 m^3/ second (Tables 3) during this report period. The rate of discharge at WD reached a maximum of (0.182 m^3/day) during April, November, December, February and March.

The higher discharges at WD occur during the winter and spring months when larger water volumes are pumped from the 2 North underground mine during periods of high precipitation. It is required that the mine be continuously dewatered during the high rainfall periods, in order to maintain mine operations and for the safety of the workers underground.

The daily average discharge limit was established by the Ministry of Environment as a way to calculate permit fees and is not a permit limit related to environmental sensitivity. Therefore, extraordinary discharges (e.g. high precipitation event) that are greater than the limit set by the permit are not considered permit exceedances.

8.1.10 *BIOASSAYS (SETTLING PONDS #1 AND SETTLING POND # 4)*

Permit Limits: Rainbow Trout Bioassay *(Oncorhynchus mykiss)*: No mortalities at 100% effluent concentration after 96 hours.

Due to the permit amendment on January 25, 2013 the bioassay sampling routine was changed and only one Bioassay was performed this reporting year for Settling Pond #4 and Settling Pond #1. Bioassays are now only required to be performed during the fall flush at Settling Ponds #1 and 4. The 96 hour bioassay performed for this report had 100% survival rates for Settling Ponds #1 and # 4. The Bioassay samples were collected from the Settling Pond #1 and 4 decants on December 4 and 5th, respectively. Samples were collected in 20 Liter plastic containers and immediately shipped to Maxxam Analytics in Burnaby for analysis. Samples were collected in accordance with the requirements of PE-07008. Maxxam conducted 96-hour pass/fail toxicity tests (LC50) with rainbow trout on the samples using a 100% survival rate as an indication of a pass (Appendix I).

8.2 **2 NORTH PIT SUMP (WP) CCR COVER**

Water quality results for the 2 North Pit Sump are presented in Tables 7 to 8. In September of 2010 following an amendment to permit PE- 07008 work was underway to remove the fines from the sump in order for it to be used as a PAG CCR disposal site. The amendment to the permit changed the monitoring schedule from a weekly to a monthly frequency for laboratory pH and conductivity and total and dissolved metals. For the current year laboratory pH ranged from 7.27 to 8.28 and averaged 8.13, field pH averaged 7.83. Sulphate ranged from 168 mg/L to 927 mg/L and averaged 690 mg/L and alkalinity ranged from 32 mg/L to 323 mg/L and averaged 249 mg/L.

Since the permit amendment in September of 2010, there has been no wash plant water purposefully conveyed into the wash plant ditch that used to report to 2 North Pit Sump. There is no water exiting the sump into the Brinco Brook wetland. All surface and wash plant water is pumped up to the tailings dam, which then reports to the 2-North Portal Sump or South Dyke Sump.

8.3 NORTH PORTAL SUMP (2-N-P-SUMP)

Following the permit amendment mentioned above, the 2 North Portal Sump has been the main settling sump for the North mine water. This is where water settles prior to it being pumped into Brinco Brook, and then flowing into Settling Pond 4. The results of the tested parameters sampled this year include laboratory pH ranging from 7.56 to 8.13 and averaging 7.97 and field pH averaging 7.48. Dissolved phosphate measured 0.005 mg/L for each sampling event. Sulphate concentrations ranged from 812 mg/L to 1420 mg/L and averaged 1069 mg/L. Concentrations of dissolved iron ranged from <0.005 mg/L to 0.073 mg/L and averaged 0.014 mg/L.

8.4 CULVERT INTO MIDDLE QUINSAM LAKE (WC)

The wetland upstream of WC into which the water flows through contributes to the additional water retention and acts as a natural filtering system to the effluent before it enters Middle Quinsam Lake. The TSS concentration at the culvert into Middle Quinsam Lake ranged from <4.0 mg/L to 5.2 mg/L and averaged 4.0 mg/L. Laboratory pH ranged from 8.08 to 8.42 and averaged 8.30 and field pH ranged averaged 8.09. Nitrite /Nitrate combined as N ranged from <0.02 mg/L to 0.098 mg/L and averaged 0.061 mg/L. Dissolved Phosphorus values were consistently below or at the reportable detection limit of <0.005 mg/L. Annual sulphate concentrations from WC ranged from 345 mg/L to 817 mg/L and averaged 590 mg/L. Historically, the meadows and wetlands around the mine site have contributed apparent natural treatment and removal of sulphate and other salts in the mine discharge water. Tables 5 to 6, present the water quality at monitoring station WC.

8.5 PLANT DITCH SEEP

The plant ditch water was rerouted to the tailings pond via a pipeline. Since then there has been no water, except surface runoff, conveyed through the plant ditch, which greatly reduced the amount of seepage below the ditch. Due to the topography of the location, which is a naturally

depressed area, surface runoff from rain water continues to collect there during heavy rain storms and during the winter months.

For this reporting year monitoring of the plant ditch seep (PDS) commenced in April of 2012, until March, 2013. Most months were sampled with the exception of October and January. The results of the analysis included concentrations of Sulphate ranging from 276 mg/L to 1170 mg/L and averaged 757 mg/L. Concentrations of hardness ranged from 248 mg/L to 1180 mg/L and averaged 537 mg/L. Concentrations of alkalinity ranged from 122 mg/L to 380 mg/L and averaged 277 mg/L and laboratory pH ranged from 7.47 to 8.14 and averaged 7.84. Concentrations of dissolved iron ranged from 0.022 mg/L to 0.464 mg/L and averaged 0.135 mg/L which fall below the permit limit for the north water management system (0.300 mg/L). The diversion of plant ditch water to the tailings dam seems to have led to lower concentrations of almost all monitored parameters.

In the last year concentrations of total and dissolved metals, such as iron, have decreased compared to the previous year. (Tables 58 to 59).

8.6 SOUTH DYKE SUMP

The South Dyke Sump receives waters from the tailings dam, which is then returned to the tailings facility where the seepage from the dam is collected and introduced to the North water management system at the 2 North Portal Sump.

The water quality at the South Dyke Sump has been monitored on a weekly basis since late February 2005 as per the request by MEM. Weekly sulphate concentrations ranged between 1330 mg/L to 1760 mg/L and averaged 1565 mg/L, laboratory pH ranged between 7.91 to 8.17 and averaged 8.03, average weekly field pH was measured as 7.82. Alkalinity ranged between 230 mg/L to 322 mg/L averaging 286 mg/L at the South Dyke Sump during this report period. Results of the South Dyke Sump water quality monitoring are presented in Tables 45 to 46.

9.0 THE SOUTH WATER MANAGEMENT SYSTEM

9.1 SETTLING POND #1 (SPD/SP1)

Refer to Tables 16 to 17 for Settling Pond #1 water quality results. All parameters were below permit limits this reporting period. Current mining activities in the South Mine Area included the construction of the 2 South PAG-CCR pond and the construction of the Sulphate Reducing Bioremediation Demonstration Cells.

Changes from the old permit compared to the amended permit include a number of frequency changes for the monitoring program. These include monitoring of pH every two months instead of monthly and weekly sulphate samples instead of monthly and the decrease of toxicity sampling from the required four times per year to only one time per year to be conducted during the first fall flush.

9.1.1 *NUTRIENTS*

Permit Limits:

Ammonia nitrogen: 1.0 mg/L;

Dissolved phosphorous: 0.03 mg/L;

All samples reported below the applicable permit criteria for nutrients during this reporting year for Settling Pond #1. For this report period, ammonia nitrogen ranged between <0.005 mg/L and 0.036 mg/L and averaged 0.017 mg/L, dissolved phosphorous ranged between <0.005 mg/L and 0.0072 mg/L and averaged 0.0052 mg/L and nitrite/nitrate nitrogen consistently measured <0.02 mg/L (Graphs 23-25). In summary, both ammonia nitrogen and dissolved phosphorous results exceeded permit limits 0/12 times.

9.1.2 *TOTAL SUSPENDED SOLIDS (TSS)*

Permitted Limits: TSS permitted for 25 mg/L daily composite and 35 mg/L hourly composite.

All samples reported below the applicable permit criteria for TSS during this reporting year for Settling Pond #1. Weekly samples were collected during decant flow of <0.046 m^3/s and daily samples were collected during decant flow of >0.046 m^3/s (Table 19). For this report period TSS ranged between <4.0 mg/L and 65.6 mg/L and averaged 4.39 mg/L. Therefore, TSS results at Settling Pond #1 exceeded permit criteria 0/151 times. The trends for TSS have been generally decreasing since 1999 (Graph 20), with the average less than 4.0 mg/L. TSS samples collected for this report period were a combination of grab samples and composite samples.

9.1.3 *HARDNESS*

Hardness concentrations ranged between 14.1 mg/L and 307 mg/L and averaged 133 mg/L. The general trend from 1997 (Graph 18) has been a gradual increase in concentration but the concentration have remained comparable since 2008, decreasing slightly.

9.1.4 *SULPHATE*

Sulphate is sampled on a weekly basis from Settling Pond #1. Sulphate concentrations for this report period ranged between 1.23 mg/L to 312 mg/L and averaged 134 mg/L. The 3 and 2 South Pits are the main contributors to Settling Pond #1 and any variations in their sulphate concentrations will be reflected in the recorded values for Settling Pond #1.

The sulphate concentrations recorded at Settling Pond #1 are significantly lower than Settling Pond #4 but show a similar trend in seasonality. Settling Pond 4, demonstrates a seasonal trend in sulphate concentration with an increase in concentrations during the summer and early fall and a decrease during the winter and early spring. When a historical comparison is made for sulphate and hardness concentration trends between Settling Pond #1 and Settling Pond #4 it is evident that the trends are similar.

Weekly sulphate and precipitation are compared in Graph 34 for Settling Pond # 1. It is notable from the graph that the general trend in sulphate concentrations increases with less precipitation and decreases with more precipitation, similar to Settling Pond 4. The spikes seen in this graph

represent the increased inputs from 3 and 2 South Pit Pond when pumping is initiated during the winter months.

9.1.5 *ALKALINITY*

Alkalinity ranged between 7.00 mg/L to 83 mg/L and averaged 50.75 mg/L. Alkalinity at Settling Pond #1 decant demonstrates a seasonal trend different than Settling Pond # 4 decant (Graph 21). As higher concentrations are apparent during the higher precipitation, months (winter and early spring) and lower concentrations are seen during the drier portions of the year (summer and early fall).

9.1.6 *PH*

Permit Limit: 6.00 to 8.50

Most permit quality parameters were within the applicable permit criteria range for pH during this reporting year for Settling Pond 1. pH was sampled on a weekly basis in the field from January 25 until March 31, 2013 and weekly laboratory samples were collected from April 1, 2012 until January 25, 2013 when the new permit amendment was approved. The new permit requires monthly Laboratory pH samples to be collected and weekly field pH samples.

Laboratory pH ranged from 6.47 to 8.13 and averaged 7.57 for Settling Pond and field pH averaged 7.03. The pH results exceeded the permit limit 0/52 times. Average pH has remained within a range of 8.20 to 7.50 since year 2000 (Graph 19). Within a given year, the general trend appears to be a decrease in pH during the late winter months, increasing during the summer months. The snow melt on the above hillside that flows into Settling Pond # 1 affects the water quality at the time of the spring melt. This year lower pH values were observed at Settling Pond #1 and the surrounding non-mine impacted watercourses. This may have been a result of the snow melt from the clear cut hillside and the low alkalinity of the water. The pH at all other ponds (3S and 2S) pumping into Settling Pond #1 were neutral to slightly basic.

9.1.7 *DISSOLVED METALS*

Permit Limits:

Dissolved Aluminum: 0.5 mg/L

Dissolved Copper: 0.02 mg/L

Dissolved Iron: 0.5 mg/L

Dissolved Lead: 0.05 mg/L

Dissolved Zinc: 0.2 mg/L

The permitted metals (dissolved aluminum, copper, lead and zinc) were below the applicable permit criteria during this reporting year for Settling Pond #1.

Concentrations of dissolved metals have generally been low or undetectable (Graph 26-32). Iron, which is normally slightly above detection limits, demonstrates seasonal trends similar to sulphate with the concentration highs during summer months and concentration lows during winter months.

Dissolved Aluminum concentrations ranged from <0.003 mg/L to 0.067 mg/L and averaged 0.0278 mg/L. Dissolved Copper concentrations ranged from 0.00025 mg/L to 0.00099 mg/L and averaged 0.00059 mg/L. Dissolved Iron concentrations ranged from 0.024 mg/L to 0.302 mg/L and averaged 0.085 mg/L. Dissolved Lead concentrations were consistently less than or equal to detection limits of <0.0002 mg/L. Finally, Dissolved Zinc concentrations measured <0.005 mg/L to 0.0056 mg/L. For all permitted parameters, dissolved aluminum, copper, iron, lead and zinc, results exceeded permit limits 0/11 times.

Dissolved calcium, magnesium and sodium showed annual average concentrations of 41.81 mg/L, 5.76 mg/L and 4.15 mg/L, respectively. In the historical graph (Graph 33) for dissolved calcium, magnesium and sodium it is evident that Settling Pond # 1 has seasonal variation trends similar to Settling Pond # 4. Settling Pond #1 has lower concentrations of dissolved calcium, magnesium and sodium during the winter months and higher concentrations in the late summer/early fall months.

As seen from the historical trend graphs dissolved arsenic and selenium concentrations (Graphs 27 and 31) averaged 0.00073 mg/L and 0.00011 mg/L, respectively.

9.1.8 *WATER QUANTITY PERMIT LIMIT EXCEEDANCES*

There were no permit limit exceedances during this sampling period at Settling Pond 1.

9.1.9 *DISCHARGE VOLUMES AND LIMITS*

Settling Pond #1 has a large amount of missing flow data for the 2012-2013 sampling year. The equipment at Settling Pond # 1 was malfunctioning due to continuous battery failure.. As a result Settling Pond # 1 had missing flow data from April 1 to 15th, May 4th to July 10th, September 30th , October 1st , 2nd , 9th to 11th , 20th to 31st and November 1st to 4th and 7th to 12th and January 27th, February 24th, and March 11th 2013. The environmental department at Quinsam Coal understands the importance of this data and is implementing changes to ensure the equipment does not fail in the future. These changes include the addition of solar panels and new marine style deep cycle 12 Volt batteries connected to the solar panel via a trickle charger. Flows that were recorded remained below the permitted maximum daily discharge of 0.46 m3/second during this report period (Tables 18). The daily discharge peaked at Settling Pond #1 on November 30th, 2013 at (0.222 m3/s) during this report period.

9.2 **SOUTH PIT CULVERT (SPC)**

The mine effluent travels from the Settling Pond #1 decant (SPD) through a meadow/wetland system before reaching the SPC monitoring station. The monitoring station is located before the mine effluent mixes with the disturbed and undisturbed water from 4 South Lower ditch and the surrounding area.

The amended permit requires that hardness and total and dissolved metals be sampled every two months. TSS is required every two weeks when the culvert is flowing. Conductivity, pH and acidity or alkalinity and sulphate are required on a monthly basis. Weekly field pH and conductivity are required on a weekly basis.

For this reporting period, the concentration of TSS ranged from <4.0 mg/L to 6.7 mg/L and averaged 4.3 mg/L over 28 samples. The laboratory pH results ranged from 7.25 to 7.85 and averaged 7.57, while field pH averaged 7.58. Laboratory conductivity ranged from 81 mg/L to 380 mg/L and averaged 222 mg/Land field conductivity averaged 298 mg/L. Alkalinity ranged from 12.3 mg/L to 54.7 mg/L and averaged 31 mg/L. Nitrite and Nitrate combined ranged from <0.02 mg/L to 0.19 mg/L and averaged 0.094 mg/L. Concentrations of dissolved phosphorous ranged from <0.005 mg/L to 0.02 mg/L and averaged 0.0061 mg/L. Sulphate ranged from <4.0 mg/L to 6.7 mg/L with an average of 4.3 mg/L.

Total Hardness results ranged from 56.7 mg/L to 163 mg/L and averaged 97.5 mg/L. Dissolved Aluminum concentrations ranged from 0.0281 mg/L to 0.071 mg/L with an average concentration of 0.0439 mg/L. Dissolved Copper concentrations ranged from 0.00031 mg/L to 0.00072 mg/L with an average concentration of 0.00051 mg/L. Dissolved Iron concentrations ranged from 0.425 mg/L to 0.128 mg/L with an average concentration of 0.0814 mg/L. Dissolved Lead and dissolved zinc concentrations were all at or lower than detection limits of <0.0002 mg/L and <0.005 mg/L respectively.

Traditionally the concentrations of TSS and sulphate have been lower at SPC than at the source of the culvert flows (Settling Pond #1).

Tables 28 to 29 present the water quality at monitoring station SPC.

9.3 3 SOUTH - 77 ADIT PIT (3S77)

The amended permit requires monitoring for weekly field pH and conductivity and quarterly laboratory pH, conductivity, alkalinity, hardness, sulphate, total, dissolved metals.

The water entering 3S-77 pit is originating from the wetland meadow that Settling Pond 1 flows through. The flow path that the wetland/meadow originally took, bypassed the 3S-77 pit prior to Timberwest clear-cutting this area. The water from the 3S-77 pit was rerouted so that it would not flow toward under the pad at the 4 South Mine and down the 4S-Lower ditch into LLE. A derision ditch was dug in October of 2012, redirecting the water from 3S-77 into the 4 South fire pond.

This ditch has been successful at diverting the majority of water away from the 4 South pad but the ground water continuous to seep through the hillside and collect at the 4 South Upper pond.

Tables (47 to 48) display the water quality and metals analysis data for 3S-77. Laboratory pH ranged between 7.35 to 7.98 averaged 7.73, field pH 7.29 averaged. Laboratory conductivity ranged between 382 mg/L to 627 mg/L and averaged 556 mg/L, field conductivity averaged 533 mg/L. Alkalinity ranged between 48.3 mg/L to 94.5 mg/L and averaged 71.6 mg/L. Total hardness concentrations ranged between 210 mg/L to 293 mg/L and averaged 257 mg/L. Sulphate concentrations ranged between 140 mg/L to 282 mg/L averaging 197 mg/L. Dissolved Aluminum ranged between <0.003 mg/L to 0.007 mg/L and averaged 0.0041 mg/L. Dissolved Arsenic ranged between 0.00035 mg/L to 0.00271 mg/l and averaged 0.00085 mg/L. Dissolved Copper ranged between 0.00045 mg/L to 0.0023 mg/l and averaged 0.00078 mg/L. Dissolved Iron ranged between <0.0050 mg/L to 0.0785 mg/l and averaged 0.0229 mg/L. Dissolved Lead and Zinc were measured lower than or at detection limits of <0.0002 mg/L and <0.005 mg/L.

9.4 **4 SOUTH**

In April of 1999, large-scale mining at the 4 South Mine ceased. Since then, there has been no coal stockpiled at the storage pad except for the temporary stockpiling of small amounts of coal that were mined in 2003, 2004 and 2005.

The 4 South Portal Pond is used as a staging pond for water pumped from the 4 South underground mine to Settling Pond # 1 and when it is actively pumping, contributes to the water quality and quantity in Settling Pond #1, depending on the scale of pumping operations at the 4 South Mine. Monthly samples were collected from the 4 South Portal Pond since October, 2001. Over the last few years, pumping has only occurred during heavy rains allowing the 4 South mine to flood. Samples are only collected when water is pumped to Settling Pond #1.

With the approval of the ETRC, the 4 South Portal Pond sampling location was changed from the 4 South Portal Pond to the point of discharge from the pipe that routes water from the 4 South Portal Pond into Settling Pond # 1. This location is considered more representative of the quality of water entering the pond from the 4 South underground mine, (2008/09 ETRC).

9.5 4 SOUTH IRON INVESTIGATION

In December of 2011, following the ETRC meeting in Nov. 2010, an investigation to determine the source of the higher iron concentrations was initiated within the vicinity of the 4 South Areas. In order to measure any effluent contributions from the 4 South coal pad on water quality, it was requested through the ETRC and MoE that QCC monitor water quality for pH, sulphate and dissolved iron within the vicinity of the coal storage pad.

Four sampling locations were chosen as the main water sources flowing into the 4 South pad area .These include, 4 South Inflow, 4 South Upper, 4 South Under the Pad and 4 South Lower.
4 South Inflow was selected as it represents water exiting the 3S-77 Adit pit, a portion of the wetland that Settling Pond 1 drains into and surface runoff in the surrounding area. If this water were high in concentrations of iron, then further sampling would have been initiated to identify the upstream source as one of the three contributing factors.
4 South Upper was selected as it is the collection point of 4 South Inflow, a larger portion of the wetland that Settling Pond 1 discharges into and surface runoff from the surrounding area. This is the last sampling location prior to the water entering the culvert that flows under the 4 South coal pad. 4 South Under the Pad represents water exiting the culvert after it flows under the pad prior to flowing under the culvert at the entrance way into the 4 South Pad. 4 South Lower represents water that discharges directly out of the culvert under the entrance of the 4 South Pad.
It was requested through the MoE that further sampling be performed in order to establish a clear understanding source of the iron contributions in the area. This report was submitted and the sampling program has been maintained on a monthly basis since it began.

As a result of this investigation the water discharging from Settling Pond 1 into the wetland/meadow will be redirected so that no water will flow under the 4 South Pad and only rain water will flow down the 4S-Lower ditch. This is intended to reduce the higher concentrations of sulphate and iron that is mobilized as the water flows under the 4 South Pad and down the 4S-Lower ditch.

9.6 4 SOUTH LOWER

The amended permit requires monitoring for weekly field pH and conductivity and monthly laboratory pH, conductivity, alkalinity, hardness, sulphate, total, dissolved metals.

The 4 South Lower water is monitored for potential chemical constituents emanating from the 4 South Pad and surrounding area as it enters the ditch. Laboratory pH ranged between 7.09 to 7.93 and averaged 7.48, field pH averaged 6.74. Laboratory conductivity ranged between 301 mg/L to 648 mg/L and averaged 483 mg/L field conductivity averaged 356 mg/L. Alkalinity ranged between 30.2 mg/L to 65.6 mg/L and averaged 45.2 mg/L. Total hardness concentrations ranged between 128 mg/L and 253 mg/L and averaged 193 mg/L. Sulphate concentrations ranged between 116 mg/L to 266 mg/L averaging 184 mg/L. Dissolved Aluminum ranged between <0.003 mg/L to 0.0341 mg/L and averaged 0.0082 mg/L. Dissolved Arsenic ranged between 0.0001 mg/L to 0.00025 mg/l and averaged 0.00015 mg/L. Dissolved Copper ranged between <0.0002 mg/L to 0.00183 mg/l and averaged 0.00046 mg/L. Dissolved Iron ranged between 0.0169 mg/L to 5.800 mg/l and averaged 2.134 mg/L. Dissolved Lead ranged between <0.0002 mg/L to 0.00027 mg/l and averaged 0.00021 mg/L. Dissolved Zinc ranged between 0.0095 mg/L to 0.113 mg/l and averaged 0.088 mg/L.

Dissolved Iron concentration was elevated from April to July and from December to March. The April to July period may be a result of lower flows resulting in high concentrations of iron, which is generally observed as a seasonal trend. The concentrations during December to March may be attributed to a combination of material weathering and leachate from the surface disturbance. Further work is required to determine the source of Iron loading in this area.

9.7 3 SOUTH PIT (3-S)

The 3 South Pit collects waters from the 2 South and 1 South areas as well as surface run-off in the 3 South vicinity. In October 2011, a siphon pipeline was installed from Settling Pond #1 extending to the 3 South Pit. This pipeline was installed in order to maintain water levels in 3 South Pit and in order to circulate any water throughout the system by means of stage pumping.

Since 1998 this pit has been used as a permitted subaqueous Potentially Acid Generating Coarse Coal Reject (PAG-CCR) disposal facility for high sulfur reject materials generated at the mine site. In September of 2010, QCC was issued approval for the subaqueous PAG-CCR disposal into the 2 North Pit.

In July, 2010 the 3 South Pit reached its storage capacity for PAG-CCR disposal with a total volume of (196,793) tones of PAG-CCR.

In order to monitor and assess the sulphate concentrations in groundwater within the vicinity of the 3 South Pit, monitoring wells were installed in 2000. These wells have been monitored on a quarterly basis since 2011, by Golder Associates, Lorax and Quinsam Environmental Staff.

Results of the weekly sampling at the 3 South Pit for this report period are presented in Tables 20 to 21 and Graphs 38-40.

The concentrations of alkalinity, sulphate, and pH have remained relatively consistent in recent years. All of the parameters follow a seasonal variation dependent of the amount of precipitation for that year.

The amended permit requires monitoring for weekly field pH and conductivity and monthly pH, conductivity, alkalinity, sulphate, and bi-monthly for hardness, total and dissolved metals.

For the 2012/13 report period, monthly laboratory pH concentrations at the 3 South Pit ranged between 7.48 to 8.07 and averaged 7.88, field pH averaged 7.43. Laboratory conductivity ranged between 590 mg/L to 1520 mg/L and averaged 1304 mg/L field conductivity averaged 1130 mg/L. Alkalinity ranged between 44.4 mg/L to 154 mg/L and averaged 80.8 mg/L. Total hardness concentrations ranged between 259 mg/L and 777 mg/L and averaged 638 mg/L. Sulphate concentrations ranged between 213 mg/L to 793 mg/L averaging 640 mg/L. Dissolved Aluminum ranged between 0.0048 mg/L to 0.0897 mg/L and averaged 0.0443 mg/L. Dissolved Arsenic ranged between <0.0001 mg/L to 0.00044 mg/l and averaged 0.00026 mg/L. Dissolved Copper ranged between 0.0005 mg/L to 0.00327 mg/l and averaged 0.00144 mg/L. Dissolved Iron ranged between <0.0050 mg/L to 0.0508 mg/l and averaged 0.0164 mg/L. Dissolved Lead was consistently at or below detection limits of <0.0002 mg/L. Finally, dissolved Zinc ranged between <0.005 mg/L to 0.0119 mg/L and averaged 0.0057 mg/L.

9.8 2 SOUTH PIT (2S)

Pre-construction of the 2-South PAG-CCR storage facility commenced in June of 2012. The 2 South pit is now functioning as a PAG-CCR pond for the all of the 7 South PAG-CCR. This has become a permitted monitoring location that is monitored on a weekly basis for water quality and monthly for total and dissolved metals. During the winter months the water from this pond is pumped to the roadside ditch where it flows to Settling Pond #1. Pumping from this pond will only occur during the construction phase.

For this reporting year laboratory pH ranged between 7.74 and 8.13, averaging 7.87, field pH averaged 7.65. Laboratory conductivity ranged between 702 mg/L to 2100 mg/L and averaged 1332 mg/L, field conductivity averaged 920 mg/L. Alkalinity ranged between 57.7 mg/L to 180 mg/L and averaged 108 mg/L. Total hardness concentrations ranged between 311 mg/L and 619 mg/L and averaged 444 mg/L. Sulphate concentrations ranged between 272 mg/L to 979 mg/L averaging 562 mg/L. Dissolved Aluminum ranged between <0.003 mg/L to 0.0112 mg/L and averaged 0.0059 mg/L. Dissolved Arsenic ranged between 0.00042 mg/L to 0.00204 mg/l and averaged 0.00096 mg/L. Dissolved Copper ranged between 0.00023 mg/L to 0.0035 mg/l and averaged 0.00122 mg/L. Dissolved Iron ranged between <0.0055 mg/L to 0.0078 mg/l and averaged 0.0055 mg/L. Dissolved Lead ranged between <0.0002 mg/L to 0.00055 mg/l and averaged 0.00025 mg/L. Dissolved Zinc ranged between <0.005 mg/L to 0.0229 mg/l and averaged 0.0086 mg/L.

10.0 7 SOUTH WATER MANAGEMENT SYSTEM

The water quality parameters monitored at sampling locations 7SSD and 7S are in accordance with Permit PE-07008. Water quality objectives have been initiated at 7SSD to protect the receiving environment. The permit requirements at 7SSD are displayed in the table below:

TABLE 5: PERMIT LIMITS AT 7SSD:

Parameters	Limit	Unit
Total Suspended Solids (daily composite)	25	mg/L
Total Suspended Solids (hourly composite)	35	mg/L
pH	6.0-8.0	mg/L
Sulphate	500	mg/L
Aluminum*	0.1	mg/L
Cadmium*	0.000045	mg/L
Copper*	0.014	mg/L
Iron*	0.35	mg/L
Selenium*	0.016	mg/L
Rainbow Trout Bioassay (Oncorhynchus mykiss)	**	-

*Dissolved

**No mortalities at 100% effluent concentration after 96 hour

Water quality results at monitoring location 7S are compared to the British Columbia water quality guidelines for the parameter(s) of interest. Any observation of an elevated concentration is investigated to determine cause with potential mitigation measures discussed and agreed to between Quinsam Coal and Ministry of Environment.

The 7 South monitoring weekly and monthly monitoring stations included in this year's sampling program are 7SSD, 7 South Adit Sump (7S-Sump) and 7 South (7S).

10.1 7 SOUTH DECANT POND (7SSD) WATER QUALITY

For this reporting year only 5 samples were taken from December 11, 2012 to March 26, 2013. The permit was approved on January 25, 2013 allowing QCC permission to discharge from 7SSD. Discharging occurred from 7SSD on March 18 to the 27th 2013. Laboratory pH ranged from 7.80 to 8.10 and averaged 7.95, field pH averaged 7.34. Hardness ranged from 146 mg/L to 218 mg/L and averaged 174 mg/L. Concentrations of composite TSS samples ranged between <4.0 mg/L to 20 mg/L and averaged 5.9 mg/L. Concentrations of dissolved organic carbon ranged from 2.16 mg/L to 3.32 mg/L and averaged 2.81 mg/L. Sulphate concentrations ranged

from 14.5 mg/L to 112 mg/L and averaged 69 mg/L. Concentrations of dissolved Aluminum ranged from 0.0063 mg/L to 0.0133 mg/L and averaged 0.0101 mg/L. Concentrations of dissolved Cadmium ranged from <0.000005 mg/L to 0.000069 mg/L and averaged 0.0000248 mg/L. Concentrations of dissolved Copper ranged from 0.00061 mg/L to 0.00084 mg/L and averaged 0.00074 mg/L. Concentrations of dissolved Copper ranged from 0.00061 mg/L to 0.00084 mg/L and averaged 0.00074 mg/L. Concentrations of dissolved Iron ranged from <0.0005 mg/L to 0.0453 mg/L and averaged 0.0125 mg/L. Concentrations of dissolved Selenium ranged from 0.00021 mg/L to 0.00091 mg/L and averaged 0.00037 mg/L.

There no permit limits exceedances with the exception of dissolved Cadmium. Cadmium exceeded the permit limit of 0.000045 mg/L by 0.000024 mg/L on March 18, 2013, resulting in and exceedance occurring (1 time out of 4) sampling sessions. Tables (66 -67) show the results of the analysis performed.

10.2 WATER QUANTITY AND PERMITTED RATES OF DISCHARGE

The maximum authorized discharge from the settling pond (7SSD) is 0.005m3/s (5L/s). This level ensures water quality standards are maintained in the receiving environment under all flow regimes based on water quality predictions for the 7S Mine development.

To facilitate determination of the appropriate discharge level at 7SSD a flow rating curve was developed for monitoring station 7S. This rating curve allows for instantaneous flow levels at 7S by reading the installed staff gauge. Figure 1 below depicts this curve.

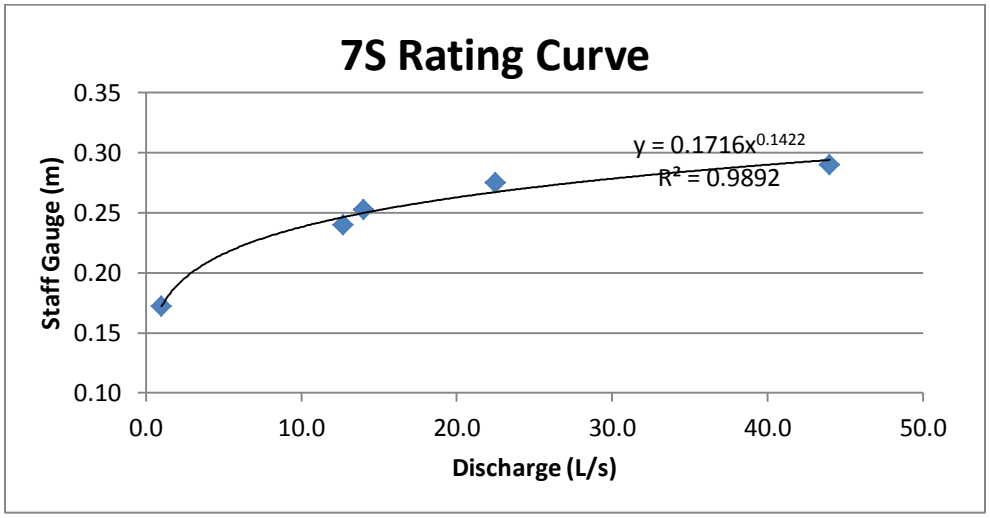


FIGURE 1: 7 SOUTH STAGE DISCHARGE RATING CURVE

Table 5 has been prepared to satisfy Section 2.4.6 of Effluent Permit PE-07008 and depicts the discharge at 7SSD based on the corresponding flow at 7S. This table represents the conceptual model included in the Effluent Permit amendment application Technical Assessment Report for an 8:1 dilution (7S:7SSD). An 8 to 1 dilution ratio is required to maintain desirable water quality in the receiving environment downstream of 7S.

TABLE 5: DILUTION RATIO AND FLOW VALUES FOR 7SSD AND 7S

Staff Gauge (m)	Discharge (L/s)	Flow at 7SSD
0.17	1.0	0.12
0.235	9.1	1.14
0.255	16.1	2.02
0.275	27	3.41
0.29	39	4.88

It is important to note that the values in Table 5 will be updated as additional water quality and flow data are collected for the 7SSD and 7S sampling locations. A correlation will be developed

to facilitate determination of allowable discharge for 7SSD (to maintain water quality objectives) that achieves Provincial water quality guidelines at 7S.

10.3 7 SOUTH (7S) STREAM 1

Baseline monitoring has been performed at 7S site since November 2011 in order to prepare for the 7 mine operation. Prior to the commencement of discharging from 7SSD site the 7S staff gauge is read by environmental personal and inferred to the stage discharge table. The 7S site is sampled weekly when the 7SSD is discharging. Once discharging is commenced sampling is conducted at 7SSD and 7S to allow for data interpretation and mass balance calculations and to ensure there is an (8:1) dilution ratio.

Parameters required by permit to be monitored at included continuous flow, TSS, field pH, conductivity and laboratory pH, conductivity, alkalinity, sulphate, dissolved organic carbon, hardness, total and dissolved metals and a 7 day *Ceriodaphnia dubia* chronic toxicity test required to be conducted 2 times per year during first fall flush and event and in the spring freshet. These parameters are compared to the *Working Water Quality Guidelines for British Columbia.*

For this sampling year field pH values ranged from 5.95 to 7.33 and averaged 6.9, field conductivity ranged from 29.7 mg/L to 51 mg/L and averaged 38.8 mg/L. Laboratory pH ranged from 7.17 to 7.6 and averaged 7.37 and conductivity ranged from 29 mg/L to 51.1 mg/L and averaged 37.3 mg/L. Total alkalinity ranged from 10.2 mg/L to 24.5 mg/L and averaged 15.3 mg/L, sulphate ranged from <0.5 mg/L to 6.75 mg/L and averaged 1.31 mg/L, dissolved organic carbon ranged from 1.64 mg/L to 2.6 mg/L and averaged 1.99 mg/L, total hardness concentrations ranged from 12 mg/L to 28 mg/L and averaged 15 mg/L. Total cadmium ranged from <0.000005 mg/L to 0.000017 mg/L and averaged 0.0000107 mg/L. Total Iron ranged from 0.0078 mg/L to 1.03 mg/L and averaged 0.1858 mg/L.

Total cadmium exceeded the water quality guidelines of 0.00001 mg/L (3 times out of 12) sampling events. The exceedance occurred on January 3, 2013, February 6, 2013 and March

19, 2013. 7SSD was discharging on March 18, 2013, but there was no discharge from 7SSD prior to this event. Total iron exceeded the water quality guidelines of 1.00 mg/L (1 time out of 12) sampling events, the exceedance occurred on April 3, 2012. All other parameters were below the water quality guidelines for the receiving environment.

10.4 7 SOUTH ADIT SUMP (7SPS)

A 55-HP pump is used to pump water from 7S adit sump to underground. Water is pumped into 5 Mains then pumped into Brincko Brook from underground 2 North mine. Sampling is only required at this sump when water from this sump is pumped to 7S Settling Pond.
Once this is commissioned the parameters required include TSS, conductivity, pH and alkalinity or acidity, hardness, total and dissolved metals and sulphate. For this reporting year all the water from this sump was used for dust suppression underground and stored in the sump in the event of a fire. No pumping was initiated to the 7 South Settling Pond.

11.0 RECEIVING ENVIRONMENT RESULTS AND DISCUSSION

Receiving water monitoring stations are located in Middle Quinsam Lake and Long Lake, and include the center of Long Lake (LLM) and Middle Quinsam Lake (MQL) and the surface of these two lakes at designated locations (LL1-3 and MQL 1-6). Outflow from Long Lake (LLO), Middle Quinsam Lake (WB) and No Name Lake (NNO) are part of the receiving water monitoring stations. The seep into Long Lake is also included as part of the receiving water monitoring stations.

The water quality objectives for Middle Quinsam Lake Sub-basin are compared to the receiving environment where applicable. These objectives are not applied to the individual results but applied for comparison purposes only. Objectives for Middle Quinsam Lake Sub-basin were applied as a part of the Province of British Columbia, Ministry of Environment (MOE) mandate to manage water bodies. The water quality objectives were created to provide a list of objectives to protect water quality and adapted to fit the specific water bodies of interest. The objectives take

into consideration the natural local water quality, water uses, water movement, waste discharges and socio-economic factors. These water quality objectives do not have any legal status: they are aimed at providing resource managers direction in order to protect the water bodies in question. These objectives are used as standards against which to measure the water quality of a particular water body in question and are used as a standard against which to measure the water quality of a particular lake or river (MOE. 2009).

Total suspended solids (TSS) results that are recorded weekly for sites (NNO, LLO, WA and WB) were graphed using a running average of 5 weekly samples and compared to the water quality objectives of the Middle Quinsam Lake Sub-basin for the 30-day mean. These results are presented in (Graphs 59-62).

11.1 LAKE CHARACTERISTICS

Thermal stratification occurs in Long Lake and Middle Quinsam Lake during the summer months resulting in little vertical mixing in the water column. This effect is more pronounced in Long Lake due to the greater depths and low summer flushing rates.

Both Middle Quinsam and Long Lake water quality data suggests an increase in sulphate with depth. Studies by MELP (2000)[2] discuss how this trend is influenced by thermal stratification and seasonal flushing of the shallow water depths. The increase in sulphate with depth could be correlated with colder, denser ground-water.

11.2 MIDDLE QUINSAM LAKE MONITORING STATIONS

11.2.1 *CHEMICAL AND PHYSICAL WATER QUALITY*

The 2012/13 chemical and physical water quality data for Middle Quinsam Lake (MQL) are presented in Tables 13 to 15.

The water chemistry of MQL varies due to the irregularity in flushing, dilution and vertical mixing within the lake. Different sources contribute and influence the water chemistry in MQL. The source waters include Middle Quinsam Lake upstream inlet (WA), Long Lake outflow (LLO), Settling Pond #4 (WD, WC) and groundwater inputs. Graphs representing hardness, pH and sulphate data from the baseline years and from the mine production years of 1996 to 2011 are presented in Graphs 42-44.

11.2.2 *THERMOCLINES*

For this reporting period the thermocline zone has followed a similar trend as in previous years. The thermocline was distinct in April between the depths of 9 to 10 meters. The thermocline was distinct for all months ranging within the 6 meter to 8 meter depth for all months. April and September measured the deepest thermoclines between 7 and 8 meter depths indicating lake turnover from the fall and summer. In the month of June the thermocline was the deepest measuring between 9 and 10 meters.

The hypolimnetic dissolved oxygen (DO) concentration was measured at all depths and was usually within the water quality objectives of a minimum of 3 mg/L during June, July and August. All bottom depths have dissolved oxygen values that are above the water quality objectives of 3 mg/L. The very bottom depths are not representative of the hypolimnetic zone due to the depth and the drop in the dissolved oxygen, which is representative of the lake bottom. These concentrations were not considered when comparing the DO results to the water quality objectives. The bottom depth is normally around 14 to 15 meters in Middle Quinsam Lake.

11.2.3 *pH*

Overall, annual pH values for all depths at Middle Quinsam Lake ranged between 6.90 and 8.00 and averaged 7.44. Annual average pH for April thru September 2012 was 7.71 at 1m, 7.60 at 4 meters, 7.40 at 9 meters and 7.25 at the 1 m above bottom depth (13 meters), similar to pervious annual averages for pH.

Historically, pH has been in the range of 7.6 to 7.9, as seen in Graph 43. This year's average pH falls within the range of existing historical trends.

11.2.4 *Sulphate/Hardness*

From April to September 2012, sulphate concentrations averaged 13.74 mg/L at the 1m depth, 13.75 mg/L at the 4m depth, 47.00 mg/L at the 9m depth and 54.53 mg/L 1 m from bottom. Annual average sulphate concentration for all depths was 32.27 mg/L. Sulphate concentrations were lower than the water quality guidelines of (100 mg/L) for all depths in all sampling events. Sulphate results show that samples exceeded the water quality guidelines 0/30 times (0% of samples).

Hardness concentrations averaged 27.53 mg/L at the 1m depth, 27.05 mg/L at the 4m depth, 47.0 mg/L at the 9m depth and 53 mg/L at the 1m from bottom depth. The annual average of hardness for all depths was 38.60 mg/L.

Historically Middle Quinsam Lake has not exceeded the water quality guidelines except on a few individual samples. This reporting sulphate and hardness concentrations have decreased significantly compared to last year's sampling events. This is especially noted at the bottom depth for all sampling events.

The trends noted this year are roughly consistent with the historical trends of alternating years of concentration highs and lows for sulphate and hardness.

11.2.5 *TOTAL SUSPENDED SOLIDS*

During this sampling period, TSS results were consistently below the detection limit of 4 mg/L. The results exceeded guidelines 0/30 times.

11.2.6 *NUTRIENTS*

The results for the annual average concentrations of ammonia nitrogen (0.038 mg/L), kjeldahl nitrogen (0.139 mg/L), dissolved phosphate (<0.005 mg/L), total phosphate (0.0084 mg/L) and nitrite/nitrate nitrogen (<0.02 mg/L) remained similar to last year at all depths. There were no peak levels of concern for this report period. Nutrients have historically been present at low concentrations at Middle Quinsam Lake. The running 30 day mean water quality objective for total phosphorous at Middle Quinsam Lake is ≤0.006 mg/L. While the annual average (0.0084 mg/L) fell below this guideline, it cannot be compared to a 30-day mean when only one sample was taken in 30 days. The amended permit stipulates a 5 and 30 sampling schedule which will be a more representative comparison for receiving environment water quality compared to the water quality objectives. Therefore, sample results exceeded water quality guidelines 0/30 times (0% of samples).

11.2.7 *TOTAL AND DISSOLVED METALS*

Total and dissolved metal concentrations remain low in Middle Quinsam Lake, most below detection limits. Concurrent with historical trends, the metal concentrations indicate that the annual averages of total calcium (0.000813 mg/L), copper (0.00088 mg/L), iron (0.0376 mg/L), lead (0.000170 mg/L), magnesium (1.66 mg/L), sodium(15.82 mg/L), and zinc (0.0049 mg/L) and dissolved aluminum (0.017 mg/L) have remained similar as in previous years, with some of the concentrations of aluminum, lead and calcium decreasing with depth as compared to previous years. Total and dissolved arsenic (0.0001 mg/L) regularly reported at less than the water quality guidelines for total arsenic of 0.005 mg/L for all depths throughout all sampling events.

Elevated mercury results led to an investigation of the potential sources of contamination and concluded that the elevation levels at Middle Quinsam Lake were exclusively attributed to equipment contamination (specifically an alpha water sampler used to collect lentic samples). Total mercury was measured below detection limits (<0.000001 mg/L) for each sampling event. Total cadmium exceeded the water quality objective during April at 1 meter depth and July at 4 and 9 meter depths. In April 2012, a new Beta non-leaching sampler was used to collect the lake samples; over this period, all total and dissolved mercury levels have been consistently below the detection limits of <0.000001 mg/L. However, total cadmium results exceeded water quality objectives 3/30 times (1% of samples) this season.

Almost all metals were below the water quality objectives for this sampling event. Low-level analyses were performed on Mercury and Cadmium for all sampling events. Results indicated there is no further cause for concern for Mercury.

11.2.8 *BIOLOGICAL MONITORING*

The results of the phytoplankton, phaeopigment, chlorophyll "A", phytoplankton counts, and identification are presented in Appendix III. The results of the periphyton analysis at the outlet of Middle Quinsam Lake (WB) are presented in Appendix IV.

11.2.9 *PHAEOPIGMENT AND CHLOROPHYLL "A"*

A common pigment to all algae is "Chlorophyll "A" which is a good indicator of biomass. Phaeopigment is the result of the degradation of chlorophyll "A" and large numbers of phaeopigment are indicative of the end of an algal bloom (G3 Consulting, 2002, personal communication). Together with the phytoplankton data, phaeopigment and chlorophyll "A" data are used to monitor the changes in the biomass.

During September Chlorophyll "a" and Pheopigment samples collected from 1m, 4m, and 9m at Middle Quinsam Lake were sent to Maxxam. An error was made in the shipping department and the samples were sent to Stantec. When the samples were discovered they were past the

holding time required in order to accurately analysis for Chlorophyll "a" and Pheopigment. Therefore there are no results for September from Middle Quinsam Lake for the requested analysis.

During the 2012/13 report period, chlorophyll "A" had the greatest concentrations in July (3.1 mg/m^3) at 9 m depth in Middle Quinsam Lake. The Chlorophyll "A" results shown indicate that phytoplankton blooms occurred in April at 1.45 mg/m^3, in May at 0.73 mg/m^3, in June at 3.1 mg/m^3, July at 3.1 mg/m^3 all at 9 meter depths and August at 2.03 mg/m^3 at 4 meters. Concentrations of phaeopigment peaked in June (8.2 mg/m^3) at 4 m depth. Results indicate that phytoplankton blooms occurred for phaeopigment in April at 0.92 mg/m^3, May at <0.5 mg/m^3 at 4 meters and August at 2.69 mg/m^3 at a depth of 9 meters.

Summer blooms are common in Middle Quinsam Lake due to the summer "turning" which distributes the nutrients throughout the lake that normally remain close to bottom.

11.2.10 *COUNTS AND IDENTIFICATION*

The following is a summary of the Stantec phytoplankton reports and data:

Species abundance was within the range as seen in previous years for all months sampled in 2012 and was greatest at the 1 meter depth in April, July, August and September at the 9 meter depth in May. Total species abundance was within the range sampled as in previous years for all months sampled except for lower abundance range noted in August and September sampling events.

The most abundant phytoplankton species during all months was the small (<5µm) chrysoflagellates *Ochromonas spp.* and *Chromulina spp.,* at all three depths. This species composition is representative for Middle Quinsam Lake.

Stantec concludes it is common for the total species abundance and composition to show discrepancy from one year to another. This could possibly be from the surrounding mining activity having an effect on the conditions of the lake or natural influences, for example when the lakes turn over in the autumn and spring. However, Middle Quinsam Lake's species abundance, composition and diversity continue to indicate oligotrophic conditions.

The complete analyses performed through Stantec are provided in Appendix III.

11.2.11 *PERIPHYTON (ARTIFICIAL SUBSTRATE)*

Two sets of artificial substrates were placed in the water for a single six week period at sites Middle Quinsam Lake Outlet (WB) and Long Lake Outlet (LLO). The substrates were collected in August of 2012. Chlorophyll "a" and Phaeophytin A, results were 136 ug/L and 58.2 ug/L respectively for LLO and 9.68 ug/L and 16.3 mg/L respectively for WB. Complete results by Stantec are provided in Appendix II for the identification to species. The following is a summary of the phaeopigment identification report (for WB and LLO) completed by Stantec:

Duplicate samples were collected at WB and LLO from adjacent artificial substrates. All samples had results consisting mainly of diatoms (>99%) with some green algae material. Samples contained fine sediment consisting of diatoms, detritus and green algae.

In the WB sample collected in 2012, Eunotia pectinalis var. minor was predominant and *Achnanthes* spp., including A. *minutissima* was common. In 2011 there were higher numbers of common and predominant species: *Synedra ulna* and *Achnanthes minutissima* were predominant and *Achnanthes spp., Eunotia spp., Eunotia pectinalis var. minor, Synedra radians, and Tabellaria fenestrata* were common (Munro *et al*., 1985).

11.1 **INLET (WA) AND OUTLET (WB) OF MIDDLE QUINSAM LAKE**

Middle Quinsam Lake's inlet (WA) and outlet (WB) offer an opportunity to assess the possible effects that mine operations may have had on lake water quality when a comparison is made of the two monitoring stations. WA (inlet to Middle Quinsam Lake) water quality data offers information on water quality that has not been influenced by mine operations. Data obtained from station WB (outlet of Middle Quinsam Lake) provides information on lake water quality after the addition with the various inputs from WA, groundwater, Long Lake and mine site effluent. Water quality data for stations WA and WB are presented in Tables 9 to 10, and 11 to 12. The historical trend graph for pH at WA is found on Graph 41.

Nutrients, TSS and most total metals are present in low concentrations, which are consistent with previously reported results. A comparison of the two stations demonstrates that increases in total calcium, magnesium and sodium are typical for both sites; slight increases in total iron are sometimes observed in Middle Quinsam Lake Outlet (WB) compared to Middle Quinsam Lake inlet (WA). Increases in conductivity and hardness correlate to increases in the metal concentrations. Sulphate concentrations have consistently shown an increase between WA and WB. The pH is sometimes higher at WB than at WA, but more frequently is higher at WA.

For the 2012/13 report period, sulphate concentrations for WA ranged from <0.05 mg/L to 23.1 mg/L and averaged 1.92 mg/L. Sample results exceeded water quality guidelines 0/43 times. At WB sulphate concentrations ranged from 5.93 mg/L to 49.5 and averaged 21.59 mg/L. These sample results exceeded water quality guidelines 0/43 times.

During this report period, pH values at WA ranged from 7.21 to 7.70 and averaged 7.49. The pH values at WB ranged from 7.15 to 7.86 and averaged 7.61.

TSS results at WA ranged from <4.0 mg/L to 67.3 mg/L and had an annual average of 5.5 mg/L. The TSS results exceeded the water quality guidelines 1/43 times. Results are presented in Graphs 60.

At WB, the TSS results range from <4.0 mg/L to 5.5 mg/L and had an annual average of 4 mg/L. The TSS results for WB exceeded the water quality guidelines 0/48 times. Results are presented in Graph 62.

All total and dissolved metals for each site were within the water quality objectives. Results for total and dissolved metals at WA exceeded water quality objectives 0/11 times, and at WB, 0/11 times.

11.1.1 *Lake Inlet and Outlet Flows*

In order to establish flow curves for the Quinsam Lake outlet (WB) and Long Lake outlet (LLO), Via-Sat Consulting was contracted by QCC in March of 1998, and they collected four discharge measurements from both stations over a period of eight months. QCC obtained the services of Via-Sat Data Systems in 2007 to collect updated data for the Long Lake Outlet and the Middle

Quinsam Lake Outlet discharge curves. The flow measurements were updated in October, 2008. The calculation curve used LLO ($y=13.093 * B^2$ -3.6553 B5+0.2677) as updated by Via-sat. The calculation curve previously used at WB is no longer a valid formula given that the original staff gauge was washed out and needs to be replaced.

Recently QCC contracted Lorax to install six new hydrometric stations each equipped with pressure transducers. These stations include LLO, LLE, LLS, WB, 7S and UIR. These stations were installed in September of 2012. Water gauge readings and flow data for Long Lake Outlet (LLO), Long Lake Entry (LLE) and) are presented in Appendix (VII). Flow data for WA has been provided by Environment Canada from the Quinsam River at the Argonaut Bridge weather monitor station from April 1, 2012 to September 30, 2012. The data is currently unapproved and subject to revision (Tables 73).

The upstream flow for WA is controlled by the B.C. Hydro diversion dam; therefore, the precipitation in the area would influence the flows at LLO significantly more than it would influence the flows at WB and WA. The annual total precipitation for this report period was 1063.60 mm, lower than the previous year's 1810.73 mm. The average annual flow for WA was 1.93 m^3/s.

In order to capture accurate flow rates with corresponding calculation curves at receiving environment river sites QCC contracted Lorax to establish five new hydrometric stations. These stations were established on July 22 and 23 2012, at 7S, LLO, Iron River and LLE. Another hydrometric station was established at MQL outlet (WB) where a second staff gauge and continuous recorder were installed on Sept 14, 2012. Levels for these stations have been downloaded from the pressure transducers with the corresponding water level measurements and stage discharge curves where established. The results have been submitted as a separate report in Appendix (VII) in the report entitled *Quinsam Baseline Hydrology Program 2012-13 Activities,* submitted on June 27, 2013 by Lorax Environmental.

11.2 **Long Lake**

Settling Pond #1 discharges water into a series of meadows and wetlands/marshlands before flowing through the culvert beneath the South Mine Area haul road and discharging near the east

end (foot) of Long Lake. Results from the May monitoring session were split up due to the sampling equipment (YSI 600) needed for depth profiling not arriving at the mine on time. Therefore, the water chemistry samples were collected on May 28, 2012 and the depth profiling was performed on June 4th, 2012. Depth profiling results collected on June 4th monitoring event are meant to represent the conditions during the month of May.

11.2.1 *Chemical and Physical Water Quality*

Physical water quality results for Long Lake for the 2012/13 report period are presented in Tables 36 to 38. Sulphate concentrations in Long Lake are generally higher than in Middle Quinsam Lake and have been a focus of monitoring over the past several years. Increased pH in Long Lake compared to background levels has also been a focus of interest.

Long Lake water chemistry is influenced by flushing, dilution and vertical mixing of the lake and by inflows from Settling Pond #1 effluent, No Name Lake (NNO) and groundwater, and the seep into Long Lake (LLS). It would be difficult to isolate the causes in lake chemistry that occur during a sampling season, as inflows may not necessarily have an immediate effect on the overall lake water quality. Over the past several years, there has been no mining activity in the South Mine Area apart from the extraction of approximately 20,000 tonnes of coal from the 4 South mine in 2003, 2004 and 2005 and the deposition of a small amount of 4 South coal refuse into the 3 South Pit in 2000, 2003, 2004 and 2005. In the first half of 2010 haul trucks were actively hauling coarse coal refuse from the coal wash plant and depositing it into the 3 south pit PAG-CCR pond. This occurred until July 2010, when the 3 South pit reached its capacity for PAG-CCR disposal. Activity in the south end for 2012 increased from previous years with the construction of the Sulphate Reducing Biocells and the construction of the 2 South Pit PAG-CCR Pond. Hauling has increased in frequency to daily hauling to 2 South Pit.

11.2.2 *Thermoclines*

Long Lake temperatures recorded for this report period demonstrate that the shallow sampling depths (1 and 4 meters) were situated above or just within the thermocline (4 meter depth) and

the 9 meter sampling depth was beneath or just within the thermocline. The thermocline was located between 3 and 4 meters in April and July; between 4 and 5 meters in August and between 5 and 6 in September. The thermocline in Long Lake was located at comparable depths for all sampling months from previous years. Some variation in temperature at the same depth over the years is expected, and may perhaps be caused by aspects such as variations in air temperature and seasonal turn over.

The hypolimnetic dissolved oxygen was below the water quality objectives of 3 mg/L during the months of June through July. Five measurements in August at 14 to 18 meter depths fell below the water quality objective of 3 mg/L (Table 38).

11.2.3 *pH*

For this reporting year, pH averages for 1m, 4m, 9m and bottom depths were 7.44, 7.46, 6.80 and 6.76 respectively, which represent slight decreases from the previous year's averages at all depths except 1m from the bottom. pH was within the range suggested in the water quality objectives and exceeded the objectives 0/30 times[3] (Tables 36-38).

[3] This proportion is based on 6 sampling months, with 4 sampling depths/month and one replicate sample per month. Each sampling date, depth and replicate is considered a separate 'sampling event' for the purposes of this comparison.

11.2.4 *SULPHATE/HARDNESS*

For the 2012/13 report period, sulphate concentrations averaged 61 mg/L, 82 mg/L, 135 mg/L and 136 mg/L at the 1 m, 4 m, 9 m, and 1m from bottom depths, respectively. Average sulphate concentrations, shown in Graph 49, were lower at the 4m depths and slightly higher at the 1meter depths. Sulphate concentrations deceased at the bottom depths for all sampling events compared to the previous year's sulphate concentrations. Concentrations of sulphate were higher than the water quality guidelines of 100 mg/L at the 9 and 1 meter from bottom samples during all sampling events. Concentrations of sulphate were higher than the water quality guidelines 14/30 times (46.6% of samples) this is a significant decrease from last year's percentage of 66% of samples.

Hardness concentrations averaged 71.13 mg/L at 1m, 91.58 mg/L at 4m, 132 mg/L at 9m, and 143.16 mg/L at bottom depths. Average hardness concentrations (Graph 47) decreased at 4m, 9m and 1m from bottom depths and increased marginally at the 1m depths in comparison to 2011.

Long Lake water chemistry is influenced by five possible sources. These include the drainage from No Name Lake, the Long Lake Seep (LLS), drainage from Settling Pond #1, local groundwater inflows (e.g. Seepage from 3S pit), and surface runoff from the local catchment area.

Precipitation influences the amount of lake flushing, impacting the pH, hardness and sulphate concentrations in the water chemistry of Long Lake. Long Lake is more influenced by the amount of precipitation than MQL and the sources that feed Long Lake can contribute to the variation of the chemical constituents within the lake.

The seasonal trend for sulphate and hardness concentrations in Long Lake was consistent with previous years. This year sulphate and hardness decreased at all depths except 1m and pH remained consistent trending towards basic at the 1 and 4 meters depths.

11.2.5 *NUTRIENTS*

Annual averages for kjeldahl nitrogen (0.153 mg/L), Ammonia nitrogen (0.021 mg/L), dissolved phosphorous (<0.005 mg/L) and nitrite/nitrate nitrogen (0.042 mg/L) remained similar or the same for all parameters. There were no peak levels of concern for this report period. Overall, average concentrations of total phosphorus were below the objective for Long Lake (≤ 0.007, 30-day running summer average).

11.2.6 *TOTAL METALS*

Total metal concentrations remain low in Long Lake. Total magnesium (4.035 mg/L), sodium (17.52 mg/L), copper (0.000415 mg/L), iron (0.526 mg/L, lead (0.0002mg/L) and zinc (0.00625 mg/L), concentrations remained similar to the previous year with no peak levels of concern for this reporting year. Some of the metal salts (eg calcium, magnesium, and sodium) were marginally higher this sampling season. Total arsenic averaged 0.00014 mg/L falling below the WQG of 0.005 mg/L. For the above-mentioned parameters, sampling results exceeded water quality guidelines 0/30 times. Total Cadmium (0.000155 mg/L) exceeded the WQG (<0.00001 mg/L based on 30 mg/L hardness) (7/30) sampling events (23% of samples). Exceedances occurred during June at all depths July at 1 m and 4 m depths and in August at 4 meters. Total Manganese exceeded WQO (6/30) sampling events (20 % of samples).

Total mercury concentrations for the season were all below the lowest level detection limits for Mercury of <0.02 ug/L and <0.01 ug/L. Annual concentrations of total mercury measured at an average of all depths were above the objective of ≤ 0.0001 mg/L. Total mercury results exceeded the water quality guidelines 0/30 times. All other water quality objectives were met for Long Lake when compared to the objectives for Middle Quinsam Lake sub-basin. Almost all metals were below the water quality objectives for this sampling event. Low-level analyses were performed on Mercury and Cadmium for all sampling events. Results indicated there is no further cause for concern for Mercury.

11.3 BIOLOGICAL MONITORING

The results of the Phytoplankton, phaeopigment and Chlorophyll "A" analyses at the center of Long Lake are presented in Table 36 and the results of the Phytoplankton counts and identification are presented in Appendix III. The results of the periphyton analysis at the outlet of Long Lake (LLO) are presented in Appendix IV.

11.3.1 *PHAEOPIGMENT AND CHLOROPHYLL "A"*

During the 2012/13 report period, concentrations of chlorophyll "A" peaked in April (2.30 mg/m^3) at 4 m, May (1.75 mg/m^3) at 9 m, June (3.4 mg/m^3) at 1 m, July (2.7 mg/m^3) at 9 m and in August (2.18 mg/m^3) at 4 m. September concentrations measured less than detection limits (<0.5 mg/m^3).

Phaeopigment peaked in April (1.15 mg/m^3) at 4 m depth, May (0.77 mg/m^3) at 1m, June (10.6 mg/m^3) at 4 m, July (2.4 mg/m^3) at 9 m, August (2.74 mg/m^3) at 1 m and September (0.59 mg/m^3) at 4 m depth (Graph 50).

The Chlorophyll "A" and the phaeopigment results indicate that phytoplankton blooms occurred during June at 1m, 4m and 9 m depths. Spring and midsummer blooms are common in Long Lake due to the spring and summer "turning" that distributes the nutrients throughout the lake that normally remain close to bottom.

11.3.2 *COUNTS AND IDENTIFICATION*

During the July sampling event the 4m species count and identification was broken during transit resulting in a loss of data. During the September sampling event the samples were collected and sent to Maxxam Analytical Laboratories, unfortunately the species count and identification samples arrived unpreserved and could not be analyzed. As a result there are no species count and identification results for Long Lake for 1m and 9m depths during September 2012.

The following is a summary of the Stantec phytoplankton reports and data:

Total species abundance was within the range sampled in previous years for all months sampled in 2012 with the exception of August. Total Abundance in August was at the low end of the range noted since 1996 as noted in Appendix III.

Total abundance was greatest at the 1 m depth in May, June and July, 4 m depth in April, August and September.

Species composition was typical for Long Lake, and as usual, the small *chrysoflagellates Ochromonas spp*. and *Chromulina* spp. were predominant during all months.

Stantec concludes that the temporal variations in phytoplankton abundance and composition are to be expected. These may be results of changing lake conditions related to discharges from mining activity (e.g. changes in sulphate or nutrients availability, shifts in pH) or to natural variation (e.g. Timing of sampling related to autumn and spring overturns). Abundance, species composition and species diversity continue to indicate oligotrophic conditions. Changes in the phytoplankton community composition in recent years indicate that shifts in nutrient dynamics of Long Lake may be occurring.

The complete results by Stantec are provided in Appendix III.

11.3.3 *PERIPHYTON (ARTIFICIAL SUBSTRATE)*

Two sets of artificial substrates were placed in the water for a single six week period at sites WB and LLO, the substrates were collected in August of 2012. Complete results by Stantec are provided in Appendix II for the identification to species. The following is a summary of the phaeopigment identification report (for WB and LLO) completed by Stantec:

Duplicate samples were collected at WB and LLO from adjacent artificial substrates. All samples had results consisting mainly of diatoms (>99%) with some green algae material. Samples contained fine sediment consisting of diatoms, detritus and green algae.

In the LL0 sample collected in 2012, there was no clearly predominant species. The distribution was spread among several common species, including Achnanthes spp., Achnanthes minutissima, Eunotia spp., Eunotia pectinalis var. minor, Gomphonema acuminatum, Gomphonema subclavatum, and Gomphonema angustatum. Similar results were reported in 2011, when the incubation period was shorter.

The species observed in 2012 have been observed in previous years.

11.4 LONG LAKE OUTLET (LLO) AND NO NAME OUTLET (NNO)

In order to comply with permit requirements and provide information on potential influences of inputs to the water quality, the outlet of Long Lake (LLO) and the outlet of No Name Lake (NNO) are monitored on a weekly basis. The flow from No Name Lake enters into the west end of Long Lake and flow from LLO discharges to Middle Quinsam Lake near the Middle Quinsam Lake outlet, water quality monitoring at NNO and LLO provides information on the two lakes. Water quality data for stations LLO and NNO are presented in (Tables 32 to 35) and the historical trend graphs for pH and sulphate for LLO and NNO (Graphs 52, 53 and 57, 58).

In the 2012/13 report period, LLO and NNO were sampled on a weekly basis until the permit amendment in January. These sites are now sampled on a 5/30 schedule 3 times per year. Laboratory pH values at LLO ranged from 7.08 to 7.87 averaged 7.54. Here, pH values exceeded the water quality guidelines 0/39 times. Sulphate ranged in concentration from 13 mg/L to 108 mg/L with an average concentration of 48 mg/L the same as the previous year's average of 47.67 mg/L. For this sampling season, sulphate levels exceeded water quality guidelines 1/48 times.

In 2012/13, the pH values at NNO ranged from 7.08 to 7.55 and averaged 7.32. The pH values at NNO exceeded water quality guidelines 0/44 times. Sulphate results ranged in concentration from 0.8 mg/L to 6.61 mg/L and averaged 3.74 mg/L, which was similar to the previous year's average. The sulphate concentrations at NNO exceeded the water quality guidelines 0/44 times.

Weekly concentrations of total suspended solids for both NNO and LLO are graphed using a running average of 5 weekly samples collected over 30 days. These include Graphs 59 and 61, for NNO and LLO, respectively. The running 30-day median was never greater than the WQO of

≤ 5 mg/L for NNO. It was greater than the WQO 30 day mean at LLO from November until December. The running average was 13 mg/L. At NNO, laboratory results exceeded the water quality guidelines 0/44 times and at LLO results exceeded the guidelines 5/39 times.

All total and dissolved metals were within the WQO and most were below laboratory detection limits. Total and dissolved Arsenic was below the WQO for total arsenic of 0.005 mg/L. Total Cadmium exceeded the WQG at NNO on two occasions in October and December measuring 0.00012 mg/L. Sample results exceeded the water quality guidelines 2/10 times at NNO and 0/10 times at LLO.

Both LLO and NNO have similar trends in pH, both have pH highs during the summer and early fall months and pH lows during the winter months. Sulphate concentrations and pH at the two outlets were much higher at LLO than at NNO, suggesting that there is a significant difference in the factors that influence water quality at these two monitoring stations.

11.5 Seep into Long Lake

The seep into Long Lake monitoring station (LLS) is a bedrock groundwater seep, which has been monitored in order to assess groundwater quality in the Long Lake area. The groundwater wells installed in 2000 in the 2-3 South area are monitored and the water quality data can be compared to the Long Lake seep water quality data. Water chemistry at the LLS is influenced by groundwater in the 2/3 South area and by water quality in the 3 South Pit. The seep is considered to be representative for the down gradient of the groundwater quality near the end of the bedrock aquifer flow path near the limits of the 2-3 South area and Long Lake.

11.5.1 *Seep Flow*

In December 2002, QCC installed a weir at the seep before it flows into the Long Lake as per the recommendations of the ETRC.

Following the landslide event, multiple seeps developed and diverted the main seep flow away from the weir. Due to the alteration of the seep flow away from the weir, flow measurements were measured on a monthly basis since March 2009 (with the exception of January, 2010). During

2011, the environmental department constructed a middle weir in order to record flow from this site. There are now two sites that measurements are taken from on a monthly basis, these include LLS and LLSM.

On April 5, 2012, a Global Logger hydrometric station was installed equipped with a pressure transducer and staff gauge was installed at LLSM, with the intention of recording continuous flow from this site. The data from this site has been extrapolated to February and is included in Appendix (VII). Water level measurements were conducted on a monthly basis from each weir. These recordings are displayed in the table below:

Date	LLS Weir 1	LLSM Weir 2	Staff Gauge reading at LLSM
	(mm)	(mm)	(m)
3-Apr-12	20	60	N/D
1-May-12	25	30	N/D
1-June-12	30	20	N/D
4-July -12	25	8	N/D
1-Aug -12	N/D	N/D	N/D
1-Sept-12	N/F	20	N/D
10-Oct-12	N/F	30	N/D
6-Nov-12	N/F	70	0.47
11-Dec-12	20	50	0.52
3-Jan-13	20	30	0.49
4-Feb-13	20	17.6	0.485
4-Mar-13	22.6	19.3	0.48

N/D= No data
N/F= No Flow

11.5.2 *SEEP WATER QUALITY*

During this reporting period monthly water quality samples were collected from the seep (Tables 30 to 31). The analytical parameters included pH, alkalinity, hardness, sulphate and total and dissolved metals. The parameters required to monitor in the previous permit were dissolved

sulphate, dissolved iron and pH. The amended permit now requires weekly flow measurements, monthly TSS, conductivity, pH, alkalinity or acidity, hardness, sulphate, total and dissolved metals. The monthly pH ranged from 7.91 to 8.18 and 8.06 averaged, which was comparable to the previous year's average of 7.87. Alkalinity ranged between 163 mg/L and 242 mg/L and averaging 209 mg/L, the same as the previous year's average of 204 mg/L. Hardness ranged between 347 mg/L and 546 mg/L and averaged 500 mg/L, comparable to last year's average of 456 mg/L. Dissolved iron ranged from <0.005 mg/L and 1.67 mg/L average 0.494 mg/L. Finally, sulphate ranged between 410 mg/L and 567 mg/L and averaged 503 mg/L, comparable to the previous year's average of 451 mg/L. (Table 31).

11.6 QUINSAM RIVER DOWNSTREAM SITE 1 (QRDS1)

The permit amendment has implemented this site on the 5 and 30 schedule sampled three times per year. From April 2012 until February 2013 this site was monitored on a weekly basis for pH, conductivity, sulphate and TSS and monthly for total and dissolved metals. The permit amendment requires that this site be monitored for sulphate weekly, when discharging is commenced from the 7SSD. Results for pH averaged 7.63; sulphate averaged 18.68 mg/L. Finally, TSS concentrations were all below laboratory detection limits of <4.0 mg/L. Results are displayed in Tables 52 to 53-2. All concentrations at this monitoring location were below the WQO and WQG for this recording year with the exception of Cadmium, which exceeded the WQG 1/9 sampling events (11% of samples).

11.7 CULVERT INTO LONG LAKE (LLE), INITIAL DILUTION ZONE

LLE is the last point of settling for mine effluent in the south area water management system before the water is discharged into Long Lake. The source inputs for LLE include natural runoff from upstream ponds and mine discharge waters originating from Settling Pond #1 and recently the addition of the Sulphate Reducing Biocells. Settling pond #1 SPD decant flows through a series of meadow/wetland features before reaching the SPC monitoring station and then into LLE. The biocell effluent mixes with SPD effluent about 15 meters downstream of the SPD

effluent point of discharge. The wetland above LLE is seasonal and subject to drying out during summer months. The addition of LLE to the monitoring stations allows for the calculation of effluent loading rates into Long Lake. This is determined through the measurement of the flow from the culvert LLE discharges through, prior to entering Long Lake. The results of the water chemistry are included in Tables 47 to 48.

The permit amendment now includes LLE as part of the receiving environments initial dilution zone. This is not included on the 5 and 30 schedule; it is monitored on a weekly and monthly basis. The weekly schedule includes flow and suphate and the monthly schedule includes pH, conductivity, and alkalinity, total and dissolved metals. This site is now compared to the WQO and WQG for the Middle Quinsam Lake Sub-basin.

pH ranged from 7.37 to 7.83 and average 7.63. Sulphate concentrations ranged from 41 mg/L to 1000 mg/L and averaged 263 mg/L. Sulphate exceeded the WQG (36/54 sample events), which is 67% of sampling events.

Total copper ranged from 0.00038 mg/L to 0.00204 mg/L and averaged 0.00083 mg/L; Total cadmium concentrations ranged from <0.000005 mg/L to 0.000035 mg/L and averaged 0.0000123 mg/L. Cadmium exceeded the WQG 5/21 sampling events (24% of samples); total iron concentrations ranged from 0.174 mg/L to 3.14 mg/L averaging 0.971 mg/L. Total iron exceeded the WQO 19/21 sampling events (90% of samples). Total manganese ranged from 0.0218 mg/L to 0.616 mg/L and averaged 0.1117 mg/L. Total manganese exceeded the WQO 14/21 sampling events (67 % of samples). All other parameters were within the WQO and WQG for Middle Quinsam Lake sub-basin.

The high concentrations of total iron coming from this site have been a concern for QCC. It was thought that the concentrations were correlated with the flow levels as higher concentrations were normally observed during the low flow periods. However, this year the high concentrations are continuous throughout the year and not dependent on low flow periods.

The graph below characterizes the high concentrations in January with a downward trend displayed as the concentrations decrease over time. Iron concentrations continue to be monitored on a monthly basis at this site.

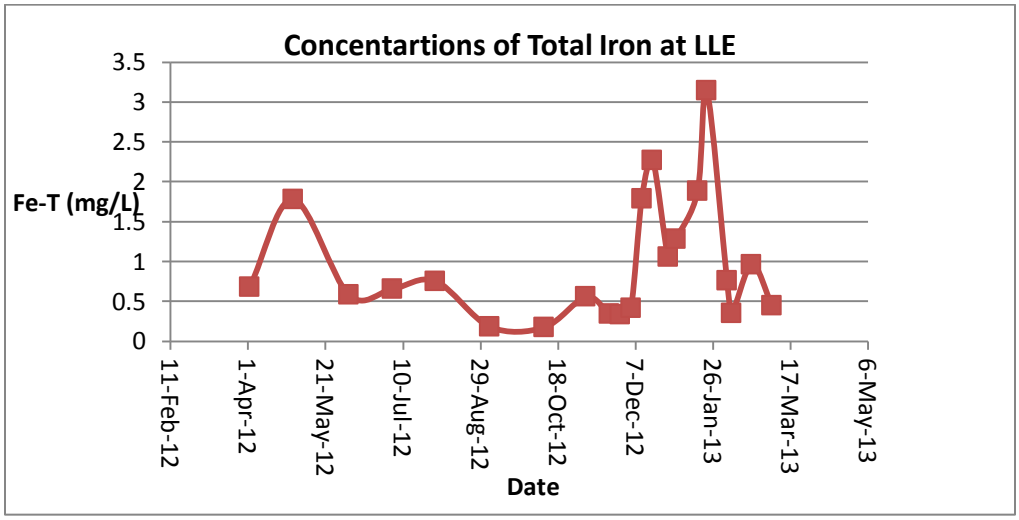


FIGURE 2: CONCENTRATIONS OF TOTAL IRON AT LLE 2012-13

12.0 GROUNDWATER

Prior to commencement of operations and up to the present time, ground water monitoring wells have been used to establish baseline groundwater data, pre-development hydrogeological information, and groundwater quality and gradient. An initial series of 15 holes were developed as part of a baseline groundwater assessment as detailed in the report “Hydrological Evaluation, Brown Erdman & Associates. August 1982", previously reported to MoE.

Currently monitoring wells are installed in the Quinsam 2 & 3 South, 2 North, and 5 South operating areas.

Based on recommendations provided in a study by AGRA Earth & Environmental in 1999, Golders Associates was contracted to implement a ground water monitoring program. In 2000 three wells were installed as detailed in the report “Preliminary Groundwater Assessment", (Golder Associates, report dated July 2000).

These included;

MW00-1S and MW00-1D: the multilevel well located down slope of the was plant ditch.

MW00-2: Located on the main access road to 3 south Pit

MW00-3: Located in the 2 south pit near the southern extent of Long Lake

The Phase II monitoring wells were installed in 2001 based on the preliminary find as detailed in the "Phase II Groundwater Assessment", by Golder Associates, dated April 2001.

MW00-4 and MW00-5 were installed in the 2 south pit areas in close proximity to the MW00-3. The additional wells were installed within voids from the underground workings of the 2 south No. 2 mains.
MW00-6 is an additional multilevel well located down slope of the plant ditch between the ditch and MW00-1.

The 5 south wells consist of 4 stations that were implemented as part of the baseline study for the 5 south/10 mains mining operations in 2006. Two holes (QU-05-16-MW4, and QU-06-01-MW5) are in the 5 mains/11 mains development situated along the TimberWest Coal 600 road.

Two additional holes are situated along the 2-4 south main haul roads: QU-05-15-MW1, and QU-05-14-MW2. Drillhole P3-1 is located in the 5 south area and was one of the original Brown-Erdman wells drilled in 1981. The piezometer tubes in this well are still functional.

12.1 BASELINE GROUNDWATER SAMPLING

Baseline ground water sampling was conducted by Brown, Erdman, & Associates LTD, in 1981 and 1982 as a part of the documentation for pre-mine conditions. Of the original wells documented, 77-30, and 78-198C are within the 3S/2S area of operations. Well number 77-30 is located approximately midpoint between the current monitored wells MW00-2 and MW00-5.

In 2006 Golder conducted a review of data for these original wells and concluded that the baseline data was generally suitable for comparison with recent monitoring data in the 2S/3S area as the wells are within comparable stratigraphic units. Golder concluded that there has been an increase in recorded values particularly sulphate, calcium, iron, manganese, potassium, and sodium. Correspondingly, there have been recorded decreases in some metals and anions, Aluminum, Arsenic, Chloride, and Fluoride.

Baseline values for conductivity in groundwater at wells 78-198c and 77-30 were 446 and 307 (µs/cm) respectively. Concentrations of hardness were recorded as 1.8 and 146 mg/L, and bicarbonate alkalinity was 230 and 177 mg/L, respectively. Sulphate and fluoride demonstrated

baseline concentrations of (2.5 and 10 mg/L) for Sulphate, and (1.4 and 0.13 mg/L) for Fluoride. Most of the dissolved metals sampled were lower or less than detection limits with the exceptions of a few notable elements including Arsenic, Iron, and the metallic salts Calcium and Sodium

12.2 GROUNDWATER LEVELS

12.2.1 *2 SOUTH / 3 SOUTH- MONITORING WELLS: MW00-2 TO MW00-5*

The following statements were summarized from the "*April 2012 Groundwater Monitoring Summary, 2 North, 3 South Areas Quinsam Mine*" submitted by Golder Associates on June 26, 2012. Supplementary information was derived from monitoring events conducted through Lorax Environmental and QCC environmental department. The annual summary for groundwater monitoring results can be found in Appendix VI.

Following a landslide that occurred at the Long Lake Seep in approximately January 2006, the groundwater elevation has declined within the 2/3 South groundwater monitoring wells MW00-3 and MW00-5 by approximately 1m to 2m; however, they continue to demonstrate a seasonal variation.

In 2011 the three portal entrances to the 2-South underground workings were plugged (pressure grouted concrete seals). The plugs could be having an effect on the water levels in MW00-3 as there was insufficient water to sample in this well since April, 2012 monitoring event.

In 2011, QCC decided to advance borehole QU11-11 within the 2 South underground workings and use this as a dewatering well for the proposed sulphate reducing biocells cells. In 2012-13 water from the former 2 South underground workings was actively pumped and used to feed the Sulphate Reducing Biocells.

So far in 2012-13 there has been no noticeable effect on the groundwater levels in the monitoring wells MW005 and MW004. However, this should to be evident in the upcoming years of monitoring.

12.2.2 *2 North- Monitoring Wells: MW00-1 and MW00-6 (Shallow and Deep)*

The ground water levels in the 2 North area, MW00-1 and MW00-6 exhibit significantly different responses in annual or seasonal fluctuations. MW00-1 demonstrates a limited response in ground water elevation and a slight seasonal response at a shallower depth. MW00-6 has an evident seasonality with obvious fluctuations in both the deeper and shallower portions. This monitoring year similar trends were apparent during all sampling events.

* *summarized from Golder Groundwater monitoring reports*

12.3 **GroundWater Quality**

Monitoring wells demonstrated relatively consistent results during the 2012/13 monitoring events, as noted in previous years. Monitoring events occurred on the following dates: April 27, 2012, September 25 to October 2, 2012, November 14 and 22, 2012 and February 13, 14 and 22, 2013. The following is a summary of Golder's assessment for the April 2012 sampling events as presented in Appendix VI and consolidated groundwater information from subsequent monitoring events. Lorax Environmental sampled MW00-2, MW00-4, MW00-5 in September and November 2012. Analytical testing was not conducted for MW00-3 during the last three quarters of the monitoring program due to insufficient groundwater for sampling. MW00-4 and MW-005 monitoring wells were missed due to sampler error during the February 2013 monitoring event. MW00-1S/D and MW00-6S/D were sampled by Lorax in September 2012 and February 2013 by QCC (these wells are sampled semi-annually).

12.3.1 *2 South/3 South*

The water quality results from MW00-2, MS00-4 and MW00-5 are similar in measured values and seasonal variations as noted in previous years for all sampling events.

Sulphate concentration trends measured in the 2012/2013 season are relatively consistent when compared to results since approximately 2004.

Sulphate concentrations at MW00-4 averaged 271.67 mg/L, which is slightly increasing from last year's average but relatively consistently with previous years with a stable trend. Sulphate concentrations at MW00-5 have continued to have a slight upward trend in concentration since approximately 2004, with strong seasonal responses as seen in graph (4). This year's average for sulphate at MW005 was 1856.63 mg/L. Measured sulphate concentrations exceeded the B.C. Contaminated Sites Regulations (CSR) of 1000 mg/l during all sampling events.

The seasonal variations noted at MW00-5 may be correlated with the oxidation of the underground workings during summer months when ground water levels are low, as well as the mobilization of the sulphate from oxidized sulphides during the winter months when the ground water levels rise.

The pH results from the 2012/13 sampling events remain near neutral to slightly basic (6.5 to 7.1). The values observed in this sampling season were generally consistent with the pH range observed since 2001.

Chloride concentrations have continued to decline since March 2010. The chloride concentrations in monitoring well MW00-4 were low and stable in 2012/2013 as in graph (6).

Concentrations of dissolved iron reported for the groundwater sampled from wells MW00-2 (0.525 mg/L) and MW00-5 (2.03 mg/ L) in September and November (2.14 mg/L) exceeded the MOE mine effluent permit of 0.5 mg/L. All other dissolved metal analytical results were below the CSR standards.

* *summarized from Golder Groundwater monitoring reports 2012/13*

12.3.2 *2 North Wash Plant Ditch Area*

The sampling results for sulphate during this monitoring period had seasonal patterns similar to those observed since 2001. A slight downward trend in sulphate levels has been noted this year, likely due to the cessation of the Wash Plant ditch flows after September 12, 2010.

MW00-6D demonstrates more seasonal fluctuation associated with precipitation than MW00-1, and also has a greater variability for the sulphate. Sulphate concentrations at MW00-6 are higher, on average, than sulphate concentrations at MW00-1D, perhaps due to MW00-1 being ~10 m deeper and therefore had less influence from the old Wash Plant ditch seepage.

An apparent pH gradient, ranging from circum-neutral (6.2 to 7.14) at MW00-1S and MW00-6S to generally more alkaline (8.22-9.47) at MW00-1D and MW00-6D was observed once again during the 2012/2013 sampling season. The groundwater appears to have stabilized during the monitoring period. pH reported for the groundwater from wells MW00-1D (9.05) in April and (9.07) in September and MW00-6D in September (8.61) exceeded the MOE Mine effluent permit of 6.0-8.5 pH.

Concentrations of dissolved metals in shallow groundwater were generally higher than the deeper groundwater, consistent with a monitoring trend since 2000. However, concentrations of some dissolved metals (aluminum, arsenic, and molybdenum) at MW00-1D were higher in the deep monitoring wells compared with the shallow wells.

* *summarized from Golder Groundwater monitoring reports 2012/13*

13.0 2012 SULPHATE REDUCING BIOREACTORS

The results of the bench scale test have led to the installation of the passive treatment system (PTS) that was constructed and commissioned in September 2012. This system includes:

- A biochemical reactor cell (BCR) designed to convert sulphate to sulphide
- A sulphide polishing cell designed to sequester the sulphide from the BCR cell effluent
- Aeration and settling pond system designed to capture any remaining total and dissolved metals.

Construction has been completed and the commissioning of the various components is underway. In the 2-South area, construction of the sulphate reducing biocells resulted in 10

additional monitoring locations. This passive treatment system was developed in an effort to mitigate seepage into Long Lake at the Long Lake Seep. The water is pumped from the underground 2-South flooded mine void via a groundwater well and sent through a series of treatment cells. The desired treatment goal for sulphate is 300 mg/L. The PTS was designed to treat 4.5 L/sec or roughly 25% of the flow a full-scale system will treat. The objective of the demonstration PTS is to operate over at least one full year to optimize the design of the system for site-specific climate and water chemistry prior to potential construction of a full-scale system (Golder Associates, 2012).

The ten additional monitoring locations for the Biocells include the QU11-12 dewatering well referred to as Influent (INF), BCR Effluent, Sulphide Polishing Cell Effluent (SPC-EFF), Aerobic Lagoon Effluent (AL-EFF), Settling Pond Effluent (SP-EFF) and 5 Intermediate Sampling Ports (INT-SP 1-5). A subset of these sites is required to be monitored on a biweekly basis and the full complement on a quarterly basis. Further information on the passive treatment system can be found in Appendix (IX).

14.0 SEDIMENT STUDIES

Over the 2012/2013 monitoring year, no new sediment studies occurred. The sediment studies required by permit are scheduled for the fall of 2013 (Lower wetland) with the full program completed concurrently with the Environmental Effects Monitoring Program.

15.0 DISPOSAL OF WASTE OIL AND SOLVENTS

Waste oil and solvents are stored in fully contained metal barrels on a concrete pad located on site and recycled by Newalta Corporation. During the 2012/13 reporting year approximately 6000 L of used oil and waste oily water was collected and recycled.

16.0 METAL RECYCLING

Scrap metal at the mine site is recycled by Steel-Pacific Recycling. There are designated metal containers for the scrap metal, which is removed from the minesite when the containers are full.

17.0 ATTAINMENT MONITORING PROGRAM

In 2010, Quinsam Coal participated in an attainment monitoring program, which is a joint venture between the Ministry of Environment and Quinsam Coal for the Upper Quinsam watershed area. This was conducted by MOE staff and QCC staff. The sampling program ran for two five-week periods from August to September and October to November. QCC incorporated this monitoring into their receiving environment monitoring program as part of the regular monitoring for five weeks.

The attainment-monitoring program is a biannual event (spring and fall). The monitoring stations included in the study consisted of the receiving environments Quinsam River at Middle Quinsam Lake inflow at the Argonaut Main (WA), Quinsam River at Middle Quinsam Lake Outflow (WB), Long Lake Outlet (LLO), and No Name Outlet (NNO). The monitoring followed the MOE's guidelines for the 5 in 30 day monitoring events. This allowed for the average of the 5 weekly samples in 30 days to be calculated for the MOE database. The parameters analyzed included the physical tests, anions, cations, nutrients, total and dissolved metals, and biological parameters. The results from this monitoring event increased the knowledge base of the upper Quinsam watershed.

As part of the permit amendment, MoE and QCC followed the MoE's CABIN 5 and 30 schedule 3 times per year for all receiving environment sites. This new monitoring program will capture a true representation of the water quality in the Middle Quinsam Lake sub-basin. The results could be applied to update the Water Quality Objectives for the Middle Quinsam Lake subbasin in the future.

18.0 MIDDLE POINT BARGE LARGE FACILITY

On January 12, 2005 Permit PE-17181 was issued as per the requirements of the Ministry of Water, Land, and Air Protection, which stipulated that the effluent from the Middle Point Coal Storage and Barge Loading Facility required routine sampling. All of the water samples collected for the 2012/13 monitoring year indicate that all of the water quality samples collected for TSS, pH and oil and grease were below the permit limits of 50 mg/L TSS, 6.5 – 8.5 pH and 10 mg/L oil and grease. pH results at Middle Point ranged from 7.47 to 8.30, while averaging 7.82. These results exceeded permit limits 0/49 times. The TSS results ranged in concentration from 1.08 mg/L to 9.8 mg/L and averaged 4.08 mg/L. The pH results exceeded permit limits 0/49 times (0% of samples). Finally, oil and grease concentrations ranged from <1 mg/L to 3.5 mg/L with an average of 1.09 mg/L. These results exceeded permit limits 0/49 times.

All permitted parameters were within permit limits indicating that the secondary treatment system that was installed in June 2002 has effectively reduced the TSS in the effluent to well below the permit limit. The results of the effluent quality and flow volumes are presented in Table 51.

19.0 SUMMARY OF MISSED FLOW DATA & MISSED PARAMETERS REQUIRED BY PERMIT

Currently Quinsam Coal conducts in excess of 7,000 water quality analyses on an annual basis and some errors occur in the sampling, shipping, analysis, and recording process. For ease of interpretation, QCC has summarized all of the significant information on one table. Table (80) *Summary of Permit Exceedances, Permit Non-Compliances, Unmet Water Quality Objectives & Guidelines*, outlines the results for 2012-13.

It is important to note that all missing flow data is due to equipment malfunction such as printer jams and battery failures. Quinsam Coal Environmental Department is working on rectifying these issues. Some examples of the environmental department's efforts to mitigate the problems of equipment malfunction include but are not limited to: the installation of solar panels at each of the permitted sites in order to eliminate the battery failure. Sending the automated samplers and flow meters away for repair and purchasing a new automated sampler and flow meter that is situated

at Settling Pond #4. Installing new parts on each of the portable samplers and checking the instruments daily to ensure they are operating properly. In the absence of the automated sampler the environmental department maintains a diligent system of collecting grab samples from these sites that are labelled as "grab samples" in order to differentiate from the permitted daily composites required.

20.0 PRECIPITATION AT THE MINE SITE

The total precipitation recorded for the mine site during the report period was 1810.73mm (Table 71). The annual precipitation for this report period was 1063.60 mm.

It should be noted that sampling results can be correlated with precipitation values. When reviewing the graphical and statistical data, the clear relationship between low precipitation and run-off and comparatively higher levels of chemical constituents such as sulphate and salts is evident.

Most of the precipitation data collected for this sampling year was gathered from a weather station on site. On occasion the weather station did not record the precipitation data correctly, due to power outages or equipment failure. For those days where data could not be collected at the mine site, precipitation data from the weather station at the Campbell River Airport was used instead. Table 70 indicates which data were collected on site and which were augmented.

20.1 PETROLEUM PRODUCT STORAGE

Bulk fuel for the underground equipment is located in a concrete sump behind the maintenance shop which drains to an oil/water separator. Bulk fuel for the surface equipment was located in an earth-bermed area located just south of the coal preparation plant. In December of 2012 this site was reclaimed and the infrastructure was decommissioned.

In 2012, a new fueling station was constructed across from the office and warehouse. The new fueling station is equipped with a concrete containment area and oil/water separator with a 50,000 L double walled tank for diesel and a 3500 L double walled tank for gas.

A 2200 L diesel tank is located at the emergency back-up generator at the Main Fan installation on the 2 North high wall. Smaller fuel storage tanks are in use in various locations on the site.

20.2 SEWAGE AND GREY WATER DISPOSAL

Sewage is collected in an underground septic tank which is pumped out by a contractor and transported off-site to disposal facilities in Campbell River. Grey water from the mine dry sinks and showers are piped into the fine refuse disposal area.

On January 18, 2013 a site inspection was performed by a local environmental health officer from the Vancouver Island Health Authority. The inspection was performed in order to renew the previous water license permit. Permit # 5327 was issued on February 4, 2013 for the year of 2012/13 operating water license permit for the premises.

20.3 SPILLS

There were two reportable spills in the 2012-13 reporting year each occurring in the first quarter. Both involved the spillage of hydrocarbon products to ground. Proper containment and remediation measures were carried out for each event.

- File Reference :DGIR 120397 on May 14, 2012,
- File Reference: DGIR 121105 on July 17, 2012

The first event occurred on May 14, 2012 when two underground vehicles collided on the main surface ramp leading to the underground portal entries. The collision resulted in a hydrocarbon spill on the ramp that included 227 liters of hydraulic oil and 97 liters of diesel fuel. A containment dyke and spill pads were used to control and mitigate the spill. The spill report is PEP DGIR: 120397.

The second spill occurred on July 17, 2012 when an excavator working at the 2 South Pit encountered a 205 liter drum of diesel fuel while digging. The barrel was punctured and approximately 205 liters of diesel fuel was spilled onto the surrounding soil. The majority of the spilled fuel was pumped into a container and the remainder of the fuel was removed through soil excavation and placed in the contaminated soil pile. The spill report is PEP DGIR: 121105.

Spill reports attached in Appendix (VIII).

20.4 MINE OPERATION PLANS FOR 2012/13

Surface development over the next five years is projected to be limited to those developments necessary for continued exploration and mine developments. A total of 21 hectares of disturbance is projected over the next five years including exploration to refine coal and mining development plans, plus remediation work on surface including construction of engineered structures to manage effluent from the 2 South PAG-CCR disposal facility, and mitigation work for sulphate reduction of mine waters affecting the Long Lake Seep including the potential construction of 4 bio-remediation cells for sulphate reduction.

21.0 MINE PLANS AFFECTING THE SURFACE FOR THE NEXT FIVE YEARS

- 2012 – Development of 7 South mine. Surface Disturbance totaling 10 hectares for portal pit construction and ancillary facilities. (Refer to section 2.8 for further details).
- Surface exploration drilling at 7 South, 242, 4 south areas and Quinsam North areas. (Approximately 3 hectares of surface disturbance).
- 2 South PAG-CCR construction and bioremediation cells (total of 7 hectares of new surface disturbance).
- 3 South PAG-CCR facility effluent drainage works (total of 0.5 hectares of new surface disturbance).
- De-watering and Tailings Injection Wells, 2N-3N mine area (total of 0.5 hectares of total surface disturbance)

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SETTLING POND 4 WATER QUALITY
2012/2013 EMS ID E207409
COMPANY IDENTITY - WD

Parameter / Sample Date	April					May						June				PERMIT	Site Description GPS (m)	
	3	10	17	17*	24	1	8	15	15*	22	29	6	12	19	26		Minegrid	
Conductivity (umhos/cm)	1340.00	1640.00	1730.00	1740.00	1790.00	1780.00	1860.00	1850.00	1880.00	1910.00	1880.00	2040.00	2010.00	2000.00	1930.00	-		
Hardness CaCO3	271.00	-	-	-	-	357.00	-	-	-	-	-	401.00	-	-	-	-	Northing	Easting
pH	8.33	8.16	8.12	8.08	8.09	8.01	8.07	8.08	8.08	8.05	8.07	8.09	8.04	8.07	8.09	6.0-8.5	104021.85	99422.31
Total Suspended Solids	6.50	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	22.80	<4.0	<4.0	<4.0	25.00	UTM ZONE 10	
Total Dissolved Solids	902.00	-	-	-	-	1210.00	-	-	-	-	-	1370.00	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	1.20	<0.50	2.00	2.50	4.68	4.61	8.16	4.72	5.35	3.90	2.73	4.31	2.74	2.91	3.68	-	5534384.00	321270.00
Alkalinity - Total CaCO3	282.00	366.00	329.00	330.00	350.00	332.00	365.00	325.00	356.00	318.00	343.00	363.00	283.00	340.00	305.00	-		
Ammonia Nitrogen	0.06	-	-	-	-	0.04	-	-	-	-	-	0.02	-	-	-	1.00		
Nitrate and Nitrite as N	0.07	-	-	-	-	0.06	-	-	-	-	-	<0.020	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-	<0.0050	-	-	-	0.03	Permitted Discharge From Settling Pond 4 Decant North Mine Water	
Total Phosphorous	0.01	-	-	-	-	<0.0050	-	-	-	-	-	0.01	-	-	-	-		
Sulphate	370	460	527	521	525	542	594	630	618	644	631	635	711	647	670	-		
Oils and Grease	<1.0	-	-	-	-	<1.0	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		10.00		
Bio Assays (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.00		

Parameter / Sample Date	July						August					September				PERMIT	Site Description GPS (m)	
	4	10	17*	17	23	23*	1	7	14	20	28	5	11	18	25		Minegrid	
Conductivity (umhos/cm)	1920.00	2030.00	1960.00	1940.00	1950.00	1940.00	2060.00	2000.00	2040.00	2060.00	2070.00	2160.00	2160.00	2190.00	2250.00	-		
Hardness CaCO3	434.00	-	-	-	-	-	463.00	-	-	-	-	500.00	-	-	-	-	Northing	Easting
pH	8.06	8.12	8.07	8.03	8.11	8.05	8.06	8.13	8.08	8.15	8.08	8.09	8.10	8.09	8.10	6.0-8.5	104021.85	99422.31
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25.00	UTM ZONE 10	
Total Dissolved Solids	1370.00	-	-	-	-	-	1490.00	-	-	-	-	1390.00	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	5.27	4.21	7.62	10.10	5.03	5.50	5.57	2.37	3.94	2.88	4.26	3.94	3.73	1.55	3.17	-	5534384.00	321270.00
Alkalinity - Total CaCO3	293.00	335.00	367.00	370.00	357.00	351.00	343.00	343.00	317.00	335.00	314.00	323.00	337.00	335.00	346.00	-		
Ammonia Nitrogen	0.01	-	-	-	-	-	<0.0050	-	-	-	-	0.01	-	-	-	1.00		
Nitrate and Nitrite as N	<0.020	-	-	-	-	-	<0.020	-	-	-	-	<0.020	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	0.03	Permitted Discharge From Settling Pond 4 Decant North Mine Water	
Total Phosphorous	<0.0050	-	-	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-		
Sulphate	635	694	658	682	656	643	696	656	689	712	736	732	733	794	835	-		
Oils and Grease	<1.0	-	-	-	-	-	1.00	-	-	-	-	<1.0	-	-	-	10.00		
Bio Assays (%)	-	-		-	-	-	-	-	-	-	-	-	-	-	-	100.00		

Parameter / Sample Date	October					November					December						PERMIT	Site Description GPS (m)	
	2	10	16	23	30	6	13	20	27	27*	4	6	11	18	28	28*		Minegrid	
Conductivity (umhos/cm)	2250.00	2470.00	2100.00	2200.00	2190.00	1880.00	1940.00	1980.00	1810.00	1820.00	1750.00	1810.00	1750.00	1940.00	1970.00	1980.00	-		
Hardness CaCO3	-	566.00	-	-	-	277.00	-	-	-	-	-	294.00	329.00	-	-	-	-	Northing	Easting
pH	8.15	8.09	8.15	8.18	8.01	8.14	8.14	8.07	8.02	8.04	8.06	8.12	8.09	8.03	8.01	8.09	6.0-8.5	104021.85	99422.31
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	5.40	5.30	<4.0	<4.0	<4.0	<4.0	25.00	UTM ZONE 10	
Total Dissolved Solids	-	1800.00	-	-	-	1210.00	-	-	-	-	-	1200.00	1200.00	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	0.83	7.55	1.28	4.82	2.14	1.99	2.39	7.84	3.54	4.63	3.65	2.40	1.22	4.59	3.55	3.77	-	5534384.00	321270.00
Alkalinity - Total CaCO3	351.00	331.00	316.00	358.00	319.00	407.00	441.00	403.00	370.00	374.00	361.00	358.00	365.00	343.00	316.00	325.00	-		
Ammonia Nitrogen	-	0.03	-	-	-	0.13	-	-	-	-	-	0.07	0.02	-	-	-	1.00		
Nitrate and Nitrite as N	-	<0.020	-	-	-	<0.020	-	-	-	-	-	0.05	0.06	-	-	-	-		
Dissolved Phosphorous	-	<0.0050	-	-	-	<0.0050	-	-	-	-	-	<0.0050	<0.0050	-	-	-	0.03	Permitted Discharge From Settling Pond 4 Decant North Mine Water	
Total Phosphorous	-	<0.0050	-	-	-	0.01	-	-	-	-	-	0.01	<0.0050	-	-	-	-		
Sulphate	849	977	769	883	801	441	431	536	580	547	487	538	481	672	673	667	-		
Oils and Grease	-	<1.0	-	-	-	-	-	-	-	-	-	<1.0	-	-	-	-	10.00		
Bio Assays (%)	-	-	-	-	-	-	-	-	-	-	100^	-	-	-	-	-	100.00		

Parameter / Sample Date	January					February				March				PERMIT	Site Description GPS (m)	
	2	8	16	21	29	5	12	18	25	4	11	19	26		Minegrid	
Conductivity (umhos/cm)	2010.00	1930.00	1960.00	1910.00	-	1700.00	-	-	-	1810.00	-	-	-	-		
Field Conductivity (uS/cm)	-	-	-	-	PNC	1711.00	1354.40	1760.00	1465.00	PNC	1812.00	1683.00	1254.50			
Hardness CaCO3	437.00	-	-	-	-	333.00	-	279.00	-	-	-	-	-	-	Northing	Easting
pH	8.03	8.06	8.06	8.07	-	7.96	-	-	-	8.07	-	-	-	6.0-8.5	104021.85	99422.31
Field pH	-	-	-	-	PNC	7.84	7.54	7.95	7.73	PNC	7.61	7.48	7.66		UTM ZONE 10	
Total Suspended Solids	<4.0	4.50	<4.0	4.70	5.30	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25.00		
Total Dissolved Solids	1390.00	-	-	-	-	1110.00	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	7.10	8.06	8.24	5.74	-	-	-	-	-	-	-	-	-	-	5534384.00	321270.00
Alkalinity - Total CaCO3	335.00	342.00	366.00	327.00	-	329.00	-	-	-	334.00	-	-	-	-		
Ammonia Nitrogen	0.07	-	-	-	-	-	-	-	-	-	-	-	-	1.00		
Nitrate and Nitrite as N	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	-	-	-	-	-	-	-	-	-	0.03	Permitted Discharge From Settling Pond 4 Decant North Mine Water	
Total Phosphorous	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	682	642	641	651	699	529	478	474	520	591	668	672	488	-		
Oils and Grease	<1.0	-	-	-	-	<1.0	-	-	-	-	-	-	-	10.00		
Bio Assays (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	100.00		

Results expressed in milligrams per litre except where noted.
Bioassays are 96-hour survival rate for Rainbow Trout.
* Field replicate sample.
Bold indicates permit exceedence.
PNC = Permit Non-Compliance

TABLE 2

SETTLING POND 4 METALS ANALYSIS

2012/2013 EMS ID E207409

COMPANY IDENTITY - WD

Parameter / Sample Date	April 3	May 1	June 6	July 4	August 1	September 5	Permit
Total Metals							
Aluminum	0.2220	0.0456	0.0661	0.0409	0.0147	0.0273	-
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-
Arsenic	0.00190	0.00136	0.00130	0.00096	0.00099	0.00102	-
Barium	0.0250	0.0230	0.0183	0.0216	0.0206	0.0214	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Boron	0.660	0.942	0.862	1.05	0.969	1.00	-
Cadmium	<0.000010	0.000044	0.000017	0.000015	<0.000010	<0.000010	-
Calcium	88.3	120	121	146	155	167	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Cobalt	0.00220	0.00139	0.00099	<0.00050	<0.00050	<0.00050	-
Copper	0.00200	0.00099	0.00137	0.00154	0.00085	0.00097	-
Hardness	-	-	-	-	-	-	-
Iron	0.593	0.27	0.382	0.236	0.183	0.187	-
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-
Lithium	0.006	0.0063	0.0068	0.0074	0.0079	0.0089	-
Magnesium	10.3	13.8	14.2	17.1	18.3	20.3	-
Manganese	0.061	0.0915	0.0739	0.0495	0.0436	0.0364	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000020	-
Molybdenum	<0.001	<0.0010	0.00130	<0.0010	0.00100	0.00110	-
Nickel	0.005	0.0041	0.0034	0.0021	0.002	0.0017	-
Phosphorus	0.00760	<0.0050	0.00610	<0.0050	<0.0050	<0.0050	-
Potassium	2.49	3.06	3.39	3.41	3.66	4	-
Selenium	<0.0001	<0.00010	<0.00010	0.00022	<0.00010	0.00012	-
Silicon	3.2	3	1.75	2.44	2.76	3.08	-
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-
Sodium	221	271	289	288	303	328	-
Strontium	0.753	1.04	1.02	1.21	1.27	1.4	-
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Titanium	0.009	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Uranium	<0.0001	0.00012	<0.00010	<0.00010	<0.00010	0.00011	-
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Zinc	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-
Dissolved Metals							
Aluminum	0.0148	0.0043	0.0044	0.0053	0.0076	<0.0030	**0.5**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**
Arsenic	0.0011	0.00108	0.00078	0.00078	0.00082	0.00078	**-**
Barium	0.0235	0.0233	0.0208	0.0198	0.0223	0.0188	**-**
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**-**
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**-**
Boron	0.704	0.903	0.944	0.901	0.975	0.968	**-**
Cadmium	<0.000010	0.000012	<0.000010	0.000019	<0.000010	<0.000010	**-**
Calcium	91.7	119	134	141	155	149	**-**
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**-**
Cobalt	0.0018	0.00146	0.00066	<0.00050	<0.00050	<0.00050	**-**
Copper	0.00065	0.00068	0.00081	0.00106	0.00099	0.00053	**0.02**
Hardness	-	-	-	-	-	-	**-**
Iron	0.0104	0.0064	0.0053	0.0059	0.0127	0.0074	**0.30**
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.05**
Lithium	0.0054	0.0066	0.0074	0.0071	0.0079	0.0086	**-**
Magnesium	10.2	14.5	16.2	16.6	19	19.8	**-**
Manganese	0.0564	0.0988	0.0631	0.0472	0.0379	<0.0010	**-**
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	**-**
Molybdenum	<0.0010	<0.0010	0.0013	<0.0010	0.0011	0.0011	**-**
Nickel	0.0048	0.0041	0.0033	0.0022	0.0021	0.0014	**-**
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Potassium	2.41	3.19	3.86	3.18	3.88	3.84	**-**
Selenium	0.00015	0.00014	0.00014	0.00021	<0.00010	<0.00010	**-**
Silicon	2.9	2.77	1.84	2.45	2.86	2.77	**-**
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**-**
Sodium	217	286	328	281	324	322	**-**
Strontium	0.725	1.03	1.16	1.1	1.33	1.34	**-**
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	**-**
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	0.0001	0.00011	**-**
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.1**
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**

Results expressed in milligrams per litre.
* indicates field replicate sample.

TABLE 2

SETTLING POND 4 METALS ANALYSIS

2012/2013 EMS ID E207409

COMPANY IDENTITY - WD

Parameter	October	November	December		January	February		
Sample Date	3	4	1	5	2	5	18	**Permit**
Total Metals								
Aluminum	0.0154	0.0483	0.1750	0.0431	0.0640	0.0812	-	-
Antimony	<0.00050	<0.00050	<0.0005	<0.00050	<0.00050	0.00060	-	-
Arsenic	0.00056	0.00824	0.00210	0.00505	0.00137	0.00152	-	-
Barium	0.0195	0.0281	0.0250	0.0325	0.0242	0.0266	-	-
Beryllium	<0.00010	<0.00010	<0.0001	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.001	<0.0010	<0.0010	<0.0010	-	-
Boron	1.010	1.19	0.76	1.25	0.888	0.859	-	-
Cadmium	0.000011	<0.000025	0.00002	<0.000013	<0.000010	0.000033	-	-
Calcium	198	84.6	90.2	104	147	117	-	-
Chromium	<0.0010	<0.0010	<0.001	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	0.0028	0.00069	0.00114	0.00173	-	-
Copper	0.00050	0.00079	0.0039	0.00111	0.00088	0.00125	-	-
Hardness	-	-	-	-	438	345	-	-
Iron	0.179	0.673	0.53	0.638	0.403	0.287	-	-
Lead	<0.00020	<0.00020	<0.0002	<0.00020	<0.00020	<0.00020	-	-
Lithium	0.0109	0.0071	0.008	0.0079	0.0091	0.0054	-	-
Magnesium	25.6	8.85	11.7	11.8	17.2	13.2	-	-
Manganese	0.0252	0.0651	0.097	0.0758	0.0888	0.0948	-	-
Mercury	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	-	-
Molybdenum	<0.0010	0.00260	<0.001	0.00220	0.00120	0.00120	-	-
Nickel	0.0014	0.0017	0.006	0.0026	0.0038	0.0062	-	-
Phosphorus	<0.0050	0.00640	0.00620	<0.0050	0.00540	-	-	-
Potassium	4.3	4.01	2.79	3.27	3.33	2.88	-	-
Selenium	0.00018	0.00011	0.00010	<0.00010	<0.00010	0.00031	-	-
Silicon	2.91	2.88	2.7	3.31	3.03	3.09	-	-
Silver	<0.000020	<0.000020	<0.00002	<0.000020	<0.000020	<0.000020	-	-
Sodium	353	345	283	317	298	266	-	-
Strontium	1.73	0.766	0.773	0.924	1.24	0.944	-	-
Thallium	<0.000050	<0.000050	<0.00005	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.005	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	0.005	<0.0050	<0.0050	<0.0050	-	-
Uranium	0.00014	<0.00010	<0.0001	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.005	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.005	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.0005	<0.00050	<0.00050	<0.00050	-	-
Dissolved Metals								
Aluminum	0.0232	<0.0030	0.0239	0.0119	0.0102	0.0066	0.0064	**0.5**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**
Arsenic	0.00048	0.00446	0.00083	0.00319	0.00095	0.00126	0.00239	**-**
Barium	0.0192	0.0293	0.0248	0.0313	0.0234	0.0274	0.0251	**-**
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**-**
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**-**
Boron	0.97	1.19	0.774	0.977	0.889	0.929	0.892	**-**
Cadmium	<0.000025	<0.000025	0.000021	<0.000010	0.000015	0.000015	<0.000010	**-**
Calcium	186	94.5	97.5	113	147	111	92.2	**-**
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**-**
Cobalt	<0.00050	<0.00050	0.0026	0.00059	0.00109	0.00149	0.00065	**-**
Copper	0.00357	0.00053	0.00096	0.00035	0.00072	0.00044	0.00039	**0.02**
Hardness	-	-	-	-	437	333	279	**-**
Iron	0.024	0.0061	0.0116	0.0206	0.0125	<0.0050	<0.0050	**0.30**
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.05**
Lithium	0.0084	0.0069	0.0081	0.007	0.0084	0.0068	0.0068	**-**
Magnesium	25	9.86	12.2	11.6	17.1	13.4	11.9	**-**
Manganese	0.0202	0.0572	0.093	0.0692	0.0831	0.0877	0.0473	**-**
Mercury	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	**-**
Molybdenum	<0.0010	0.0028	<0.0010	0.0024	0.0013	0.0012	0.0015	**-**
Nickel	0.0025	0.0018	0.0056	0.0022	0.004	0.0057	0.0027	**-**
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	**-**
Potassium	4.32	4.29	2.87	3.41	3.5	2.97	2.88	**-**
Selenium	<0.00010	<0.00010	0.00011	<0.00010	0.00023	0.00032	0.00016	**-**
Silicon	2.54	3.04	2.78	3.62	3.27	3.14	2.96	**-**
Silver	<0.000020	<0.000020	<0.000020	<0.000020	0.000037	<0.000020	0.00002	**-**
Sodium	351	373	290	311	296	265	282	**-**
Strontium	1.73	0.808	0.793	0.9	1.23	0.928	0.833	**-**
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	**-**
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Titanium	<0.0050	<0.0050	0.005	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Uranium	0.00014	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**-**
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.1**
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**

Results expressed in milligrams per litre.

* indicates field replicate sample.

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TABLE 3
WATER QUANTITY FOR SETTLING POND 4
2012/2013 EMS ID E207409
COMPANY IDENTITY-WD

Date	April Max. (m3/s)	April Daily (m3/s)	May Max. (m3/s)	May Daily (m3/s)	June Max. (m3/s)	June Daily (m3/s)	July Max. (m3/s)	July Daily (m3/s)	August Max. (m3/s)	August Daily (m3/s)	September Max. (m3/s)	September Daily (m3/s)	Permit m3/s
1	**0.1678**	0.1357	**0.1439**	0.1262	**0.0765**	0.0533	**0.0731**	0.0918	**0.0826**	0.0550	**0.0674**	0.0273	
2	**0.1828**	0.1416	**0.1365**	0.0987	**0.0664**	0.0297	0.0137	0.0917	**0.0563**	0.0348	**0.0700**	0.0242	
3	**0.1828**	0.1740	**0.1194**	0.0666	**0.0675**	0.0402	**0.0774**	0.1082	**0.0850**	0.0377	**0.0804**	0.0641	
4	**0.1828**	0.1749	**0.1292**	0.0866	**0.0658**	0.0319	**0.1202**	0.0243	**0.0852**	0.0569	**0.0791**	0.0257	
5	**0.1828**	0.1724	**0.0903**	0.0520	**0.0658**	0.0215	**0.0678**	0.0253	**0.0853**	0.0487	**0.0613**	0.0196	
6	**0.1828**	0.1759	**0.0933**	0.0586	0.0000	0.0000	0.0449	0.0146	**0.0757**	0.0715	**0.0704**	0.0266	
7	**0.1742**	0.1479	**0.0970**	0.0692	**0.0562**	0.0172	**0.0690**	0.0303	**0.0758**	0.0364	**0.0727**	0.0318	
8	**0.1828**	0.1674	**0.1180**	0.0607	0.0504	0.0155	**0.0649**	0.0239	**0.0732**	0.0666	**0.0785**	0.0506	
9	**0.1828**	0.1828	**0.0959**	0.0696	0.0265	0.0040	**0.0679**	0.0383	**0.0759**	0.0672	**0.0821**	0.0440	
10	**0.1828**	0.1768	**0.1039**	0.0865	0.0356	0.0071	0.0538	0.0238	**0.0769**	0.0296	**0.0766**	0.0682	
11	**0.1828**	0.1700	**0.1311**	0.0848	0.0363	0.0077	**0.0657**	0.0265	**0.0654**	0.0244	**0.0555**	0.0099	
12	**0.1828**	0.1655	**0.0961**	0.0562	0.0372	0.0078	**0.0664**	0.0500	**0.0731**	0.0491	**0.0714**	0.0266	
13	**0.1745**	0.1411	**0.0885**	0.0505	0.0511	0.0122	**0.0784**	0.0376	**0.0729**	0.0367	**0.0689**	0.0306	
14	**0.1673**	0.1425	**0.0830**	0.0468	**0.0671**	0.0224	**0.0853**	0.0653	**0.0732**	0.0612	**0.0698**	0.0293	
15	**0.1368**	0.0966	**0.0733**	0.0411	**0.0901**	0.0483	**0.0904**	0.0695	**0.0726**	0.0378	**0.0753**	0.0376	
16	**0.1471**	0.1280	**0.0873**	0.0656	**0.0767**	0.0424	**0.0858**	0.0748	0.0000	0.0000	**0.0757**	0.0362	
17	**0.1632**	0.1371	**0.1206**	0.0627	0.0172	0.0737	**0.1047**	0.0654	0.0000	0.0000	**0.0781**	0.0309	
18	**0.1626**	0.1403	**0.0740**	0.0311	**0.1372**	0.0827	**0.0907**	0.0490	**0.0667**	0.0128	**0.0749**	0.0267	
19	**0.1407**	0.1112	**0.0726**	0.0413	**0.1071**	0.0487	**0.0789**	0.0341	**0.0760**	0.0355	**0.0728**	0.0515	
20	**0.1394**	0.1117	**0.0962**	0.0725	**0.0708**	0.0308	**0.0727**	0.0353	**0.0756**	0.0439	**0.0767**	0.0297	
21	**0.1432**	0.1023	**0.1386**	0.1193	**0.0721**	0.0335	**0.0748**	0.0422	**0.0754**	0.0358	**0.0787**	0.0638	
22	**0.1369**	0.1147	**0.1012**	0.0544	**0.0810**	0.0437	**0.0789**	0.0636	**0.0649**	0.0302	**0.0770**	0.0465	
23	**0.1372**	0.1093	**0.0779**	0.0522	**0.1063**	0.0583	**0.0697**	0.0516	**0.0695**	0.0297	0.0000	0.0000	
24	**0.1352**	0.1064	**0.0790**	0.0429	**0.1011**	0.0542	**0.0713**	0.0254	**0.0707**	0.0235	0.0241	0.0030	
25	**0.1427**	0.1062	**0.0799**	0.0555	**0.1160**	0.0922	0.0530	0.0123	0.0000	0.0000	**0.0724**	0.0321	
26	**0.1386**	0.1149	**0.0797**	0.0358	**0.1297**	0.1081	0.0529	0.0107	0.0164	0.0018	**0.0807**	0.0431	
27	**0.1304**	0.0829	**0.0695**	0.0411	**0.1206**	0.0625	**0.0754**	0.0599	**0.0569**	0.0172	**0.0785**	0.0339	
28	**0.1358**	0.0926	**0.1166**	0.0601	**0.0869**	0.0569	**0.0775**	0.0366	**0.0663**	0.0435	**0.0760**	0.0456	
29	**0.1326**	0.0921	**0.1003**	0.0399	**0.0819**	0.0444	**0.0759**	0.0384	**0.0663**	0.0259	**0.0764**	0.0469	
30	**0.1483**	0.1071	**0.0721**	0.0469	**0.0809**	0.0439	**0.0816**	0.0416	**0.0620**	0.0203	**0.0744**	0.0266	
31			**0.0855**	0.0345			**0.0783**	0.0502	**0.0673**	0.0472			
Monthly Max	0.1828		0.1439		0.1372		0.1202		0.0853		0.0821		**0.32**
Monthly Avg	0.1341		0.0616		0.0398		0.0602		0.0349		0.0344		**0.08***

Corrected

*365-day average
^ missing data
BOLD = flow requires sample

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TABLE 3
WATER QUANTITY FOR SETTLING POND 4
2012/2013 EMS ID E207409
COMPANY IDENTITY-WD

Date	October Max. (m3/s)	October Daily (m3/s)	November Max. (m3/s)	November Daily (m3/s)	December Max. (m3/s)	December Daily (m3/s)	January Max. (m3/s)	January Daily (m3/s)	February Max. (m3/s)	February Daily (m3/s)	March Max. (m3/s)	March Daily (m3/s)
1	**0.0785**	0.0293	**0.1303**	0.1049	**0.1828**	0.1634	**No data (PNC)**		**0.1269**	0.1102	**0.1417**	0.1230
2	**0.0780**	0.0693	**0.1445**	0.1134	**0.1828**	0.1677	**No data (PNC)**		**0.1268**	0.0860	**0.1628**	0.1430
3	**0.0841**	0.0660	**0.1549**	0.1450	**0.1828**	0.1605	**No data (PNC)**		**0.1311**	0.1051	**0.1642**	0.1504
4	**0.0930**	0.0778	**0.1459**	0.1185	**0.1828**	0.1630	**0.1264**	0.0864	**0.1310**	0.0941	**0.1614**	0.1346
5	**0.0752**	0.0585	**0.1455**	0.1025	**0.1828**	0.1664	**No data (PNC)**		**No data (PNC)**		**0.1530**	0.1140
6	**0.0605**	0.0430	**0.1453**	0.1363	**0.1828**	0.1641	**No data (PNC)**		**0.1717**	0.1297	**0.1298**	0.0757
7	**0.0543**	0.0411	**0.1383**	0.1185	**0.1828**	0.1615	**No data (PNC)**		**0.1828**	0.1823	**0.1296**	0.0975
8	**0.0532**	0.0178	**0.1341**	0.1037	**0.1828**	0.1704	**No data (PNC)**		**0.1828**	0.1679	**0.1516**	0.1103
9	0.0064	0.0005	**0.1296**	0.1044	**0.1828**	0.1752	**No data (PNC)**		**0.1828**	0.1691	**0.1446**	0.1218
10	0.0434	0.0087	**0.1319**	0.1215	**0.1828**	0.1663	**0.1458**	0.1319	**0.1828**	0.1704	**0.1592**	0.1451
11	**0.0628**	0.0324	**0.1317**	0.0993	**0.1828**	0.1828	**0.1503**	0.1372	**0.1828**	0.1741	**0.1584**	0.1106
12	**0.0723**	0.0588	**0.1281**	0.1062	**No data (PNC)**		**0.1680**	0.1476	**0.1828**	0.1767	**0.1465**	0.0954
13	**0.0691**	0.0496	**0.1305**	0.1046	**No data (PNC)**		**0.1590**	0.1298	**0.1828**	0.1707	**0.1038**	0.0609
14	**0.0982**	0.0655	**0.1326**	0.0979	**No data (PNC)**		**0.0885**	0.0824	**0.1828**	0.1772	**0.1297**	0.0641
15	**0.0656**	0.0229	**0.1299**	0.1040	**No data (PNC)**		**0.1343**	0.1060	**0.1828**	0.1819	**0.0899**	0.0632
16	0.0000	0.0000	**0.0871**	0.0600	**No data (PNC)**		**0.1390**	0.0987	**0.1828**	0.1823	**0.1480**	0.1366
17	0.0000	0.0000	**0.0967**	0.0789	**No data (PNC)**		**0.1470**	0.1359	**0.1828**	0.1746	**0.1466**	0.1421
18	0.0000	0.0000	**0.1204**	0.0977	**No data (PNC)**		**0.1294**	0.0876	**0.1828**	0.1777	**0.1475**	0.1024
19	**0.0810**	0.0481	**0.1545**	0.1385	**No data (PNC)**		**0.0724**	0.0603	**0.1828**	0.1824	**0.1203**	0.0859
20	**0.0796**	0.0358	**0.1603**	0.1485	**No data (PNC)**		**0.0987**	0.0775	**0.1828**	0.1828	**0.1323**	0.0857
21	**0.0665**	0.0316	**0.1664**	0.1539	**No data (PNC)**		**0.1303**	0.1009	**0.1828**	0.1658	**0.1426**	0.0952
22	**0.0717**	0.0340	**0.1632**	0.1519	**No data (PNC)**		**0.1293**	0.0838	**0.1778**	0.1582	**0.1489**	0.1173
23	**0.0799**	0.0544	**0.1828**	0.1693	**No data (PNC)**		**0.0811**	0.0529	**0.1751**	0.1544	**0.1573**	0.1352
24	**0.0822**	0.0629	**0.1828**	0.1816	**No data (PNC)**		No data	No data	**0.1619**	0.1356	**0.1677**	0.1489
25	**0.0601**	0.0234	**0.1828**	0.1663	**No data (PNC)**		**No data (PNC)**		**0.1627**	0.1372	**0.1656**	0.1321
26	0.0000	0.0000	**0.1828**	0.1693	**No data (PNC)**		**No data (PNC)**		**0.1599**	0.1303	**0.1679**	0.1471
27	**0.0750**	0.0207	**0.1615**	0.1520	**No data (PNC)**		**No data (PNC)**		**0.1406**	0.1189	**0.1608**	0.1440
28	**0.0845**	0.0543	**0.1666**	0.1569	**No data (PNC)**		**No data (PNC)**		**0.1727**	0.1536	**0.1646**	0.1517
29	**0.0848**	0.0686	**0.1828**	0.1475	**No data (PNC)**		**No data (PNC)**				**0.1759**	0.1435
30	**0.0881**	0.0774	**0.1828**	0.1762	**No data (PNC)**		**0.0943**	0.0328			**0.1828**	0.1629
31	**0.1092**	0.0786			**No data (PNC)**		**0.0963**	0.0329			**0.1828**	0.1806
Monthly Max	0.1092		0.1828		0.1828		0.1680		0.1828		0.1828	
Monthly Avg	0.0397		0.1276		0.1674		0.0932		0.1537		0.1200	

*365-day average
^ missing data
BOLD = flow requires sample

TABLE 4
SETTLING POND 4 DAILY TSS
2012/2013 EMS ID E207409
COMPANY IDENTITY - WD
FOR DECANT FLOW > 0.054 m^3/s AND < 0.32 m^3/s

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Apr-12	<4.0	1-May-12	<4.0	1-Jun-12	<4.0
2-Apr-12	<4.0	2-May-12	<4.0	2-Jun-12	<4.0
3-Apr-12	<4.0	3-May-12	<4.0	3-Jun-12	<4.0
4-Apr-12	<4.0	4-May-12	<4.0	4-Jun-12	<4.0
5-Apr-12	<4.0	5-May-12	<4.0	5-Jun-12	<4.0
6-Apr-12	<4.0	6-May-12	<4.0	6-Jun-12	22.8*
7-Apr-12	<4.0	7-May-12	<4.0	7-Jun-12	<4.0
8-Apr-12	<4.0	8-May-12	<4.0	8-Jun-12	-
9-Apr-12	<4.0	9-May-12	<4.0	9-Jun-12	-
10-Apr-12	<4.0	10-May-12	<4.0	10-Jun-12	-
11-Apr-12	<4.0	11-May-12	<4.0	11-Jun-12	-
12-Apr-12	<4.0	12-May-12	<4.0	12-Jun-12	<4.0*
13-Apr-12	<4.0	13-May-12	<4.0	13-Jun-12	4.00
14-Apr-12	<4.0	14-May-12	<4.0	14-Jun-12	4.00
15-Apr-12	**^ (PNC)**	15-May-12	<4.0	15-Jun-12	4.00
16-Apr-12	<4.0	16-May-12	<4.0	16-Jun-12	<4.0
17-Apr-12	<4.0	17-May-12	<4.0	17-Jun-12	<4.0
18-Apr-12	<4.0	18-May-12	<4.0	18-Jun-12	<4.0
19-Apr-12	<4.0	19-May-12	<4.0	19-Jun-12	<4.0
20-Apr-12	<4.0	20-May-12	<4.0	20-Jun-12	<4.0
21-Apr-12	<4.0	21-May-12	<4.0	21-Jun-12	7.30
22-Apr-12	<4.0	22-May-12	4.80	22-Jun-12	<4.0
23-Apr-12	<4.0	23-May-12	<4.0	23-Jun-12	<4.0
24-Apr-12	<4.0	24-May-12	<4.0	24-Jun-12	<4.0
25-Apr-12	<4.0	25-May-12	<4.0	25-Jun-12	<4.0
26-Apr-12	<4.0	26-May-12	<4.0	26-Jun-12	<4.0
27-Apr-12	<4.0	27-May-12	<4.0	27-Jun-12	<4.0
28-Apr-12	<4.0	28-May-12	<4.0	28-Jun-12	<4.0
29-Apr-12	<4.0	29-May-12	<4.0	29-Jun-12	<4.0
30-Apr-12	<4.0	30-May-12	<4.0	30-Jun-12	<4.0
		31-May-12	<4.0		
Permit Limit: 25mg/L					

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Jul-12	<4.0	1-Aug-12	13.5	1-Sep-12	<4.0
2-Jul-12	<4.0	2-Aug-12	6.00	2-Sep-12	<4.0
3-Jul-12	<4.0	3-Aug-12	11.80	3-Sep-12	<4.0
4-Jul-12	5.7	4-Aug-12	6	4-Sep-12	<4.0
5-Jul-12	<4.0	5-Aug-12	4	5-Sep-12	13.7
6-Jul-12	-	6-Aug-12	<4.0	6-Sep-12	<4.0
7-Jul-12	5.00	7-Aug-12	<4.0*	7-Sep-12	4.7
8-Jul-12	<4.0	8-Aug-12	6.30	8-Sep-12	<4.0
9-Jul-12	4.50	9-Aug-12	5.50	9-Sep-12	<4.0
10-Jul-12	<4.0	10-Aug-12	6.30	10-Sep-12	<4.0
11-Jul-12	4.5	11-Aug-12	4.00	11-Sep-12	8.5
12-Jul-12	16.3	12-Aug-12	<4.0	12-Sep-12	<4.0
13-Jul-12	8.2	13-Aug-12	<4.0	13-Sep-12	6.8
14-Jul-12	5.3	14-Aug-12	<4.0	14-Sep-12	<4.0
15-Jul-12	<4.0	15-Aug-12	<4.0	15-Sep-12	**28.3 (P)**
16-Jul-12	<4.0	16-Aug-12	-	16-Sep-12	<4.0
17-Jul-12	<4.0	17-Aug-12	-	17-Sep-12	<4.0
18-Jul-12	<4.0	18-Aug-12	<4.0	18-Sep-12	14
19-Jul-12	5.5	19-Aug-12	<4.0	19-Sep-12	4.3
20-Jul-12	5	20-Aug-12	9.80	20-Sep-12	5.2
21-Jul-12	5.6	21-Aug-12	<4.0	21-Sep-12	<4.0
22-Jul-12	<4.0	22-Aug-12	8.00	22-Sep-12	<4.0
23-Jul-12	8.8	23-Aug-12	4.00	23-Sep-12	-
24-Jul-12	4.5	24-Aug-12	<4.0	24-Sep-12	-
25-Jul-12	5.3	25-Aug-12	-	25-Sep-12	6.30
26-Jul-12	7	26-Aug-12	-	26-Sep-12	<4.0
27-Jul-12	13.4	27-Aug-12	<4.0	27-Sep-12	<4.0
28-Jul-12	5.4	28-Aug-12	9.50	28-Sep-12	4.00
29-Jul-12	6.00	29-Aug-12	4.30	29-Sep-12	4.00
30-Jul-12	4.8	30-Aug-12	<4.0	30-Sep-12	<4.0
31-Jul-12	<4.0	31-Aug-12	5.00		
Permit Limit: 25mg/L					

Note: All TSS results were from composite samples except samples marked with*, * Replicate and Grab samples.
Note: Maximum and average rates of discharge are 0.32m3/s and 0.08m3/s respectively. The authorised discharge period is 365 days

^ = Missing sample
P = Permit exceedance
PNC = Permit non-compliance

TABLE 4
SETTLING POND 4 DAILY TSS
2012/2013 EMS ID E207409
COMPANY IDENTITY - WD
FOR DECANT FLOW > 0.054 m^3/s AND < 0.32 m^3/s

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Oct-12	<4.0	1-Nov-12	5	1-Dec-12	6.8
2-Oct-12	7	2-Nov-12	<4.0	2-Dec-12	8.8
3-Oct-12	<4.0	3-Nov-12	<4.0	3-Dec-12	10.3
4-Oct-12	4	4-Nov-12	5.5	4-Dec-12	<4.0
5-Oct-12	<4.0	5-Nov-12	12.3	5-Dec-12	9.2
6-Oct-12	4.2	6-Nov-12	5.7	6-Dec-12	<4.0
7-Oct-12	<4.0	7-Nov-12	<4.0	7-Dec-12	<4.0
8-Oct-12	<4.0	8-Nov-12	5	8-Dec-12	<4.0
9-Oct-12	-	9-Nov-12	14.0	9-Dec-12	<4.0
10-Oct-12	<4.0*	10-Nov-12	4.0	10-Dec-12	<4.0
11-Oct-12	<4.0	11-Nov-12	6.5	11-Dec-12	5.3
12-Oct-12	<4.0	12-Nov-12	<4.0	12-Dec-12	5
13-Oct-12	<4.0	13-Nov-12	<4.0*	13-Dec-12	4.8
14-Oct-12	<4.0	14-Nov-12	<4.0*	14-Dec-12	21.5
15-Oct-12	<4.0	15-Nov-12	7.5	15-Dec-12	4.5
16-Oct-12	<4.0*	16-Nov-12	<4.0	16-Dec-12	4.2
17-Oct-12	-	17-Nov-12	<4.0	17-Dec-12	12
18-Oct-12	-	18-Nov-12	5.7	18-Dec-12	4.3
19-Oct-12	6.3	19-Nov-12	<4.0	19-Dec-12	<4.0
20-Oct-12	<4.0	20-Nov-12	<4.0*	20-Dec-12	<4.0
21-Oct-12	<4.0	21-Nov-12	5	21-Dec-12	<4.0
22-Oct-12	<4.0	22-Nov-12	4.2	22-Dec-12	4.8
23-Oct-12	4.5	23-Nov-12	5	23-Dec-12	4
24-Oct-12	<4.0	24-Nov-12	7.5	24-Dec-12	<4.0
25-Oct-12	4.6	25-Nov-12	7.2	25-Dec-12	4.3
26-Oct-12	-	26-Nov-12	7.5	26-Dec-12	<4.0
27-Oct-12	5.3	27-Nov-12	5.7	27-Dec-12	<4.0
28-Oct-12	7.7	28-Nov-12	<4.0	28-Dec-12	<4.0*
29-Oct-12	4.5	29-Nov-12	5.5	29-Dec-12	-
30-Oct-12	7.7	30-Nov-12	9	30-Dec-12	-
31-Oct-12	6.3			31-Dec-12	-
Permit Limit: 25mg/L					

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Jan-13	6.7	1-Feb-13	4	1-Mar-13	<4.0
2-Jan-13	<4.0	2-Feb-13	4	2-Mar-13	5.20
3-Jan-13	<4.0	3-Feb-13	<4.0	3-Mar-13	<4.0
4-Jan-13	6.5	4-Feb-13	<4.0	4-Mar-13	<4.0
5-Jan-13	6.0	5-Feb-13	<4.0	5-Mar-13	4.00
6-Jan-13	5.0	6-Feb-13	<4.0	6-Mar-13	<4.0
7-Jan-13	15.3	7-Feb-13	7.5	7-Mar-13	<4.0
8-Jan-13	<4.0	8-Feb-13	<4.0	8-Mar-13	<4.0
9-Jan-13	<4.0	9-Feb-13	4.2	9-Mar-13	<4.0
10-Jan-13	19.3	10-Feb-13	5.5	10-Mar-13	<4.0
11-Jan-13	7.2	11-Feb-13	<4.0	11-Mar-13	<4.0
12-Jan-13	7.8	12-Feb-13	5.5	12-Mar-13	<4.0
13-Jan-13	4	13-Feb-13	<4.0	13-Mar-13	<4.0
14-Jan-13	<4.0	14-Feb-13	<4.0	14-Mar-13	<4.0
15-Jan-13	<4.0	15-Feb-13	<4.0	15-Mar-13	<4.0
16-Jan-13	-	16-Feb-13	<4.0	16-Mar-13	<4.0
17-Jan-13	-	17-Feb-13	<4.0	17-Mar-13	<4.0
18-Jan-13	13.5	18-Feb-13	<4.0	18-Mar-13	<4.0
19-Jan-13	13	19-Feb-13	<4.0	19-Mar-13	<4.0
20-Jan-13	8.7	20-Feb-13	<4.0	20-Mar-13	6.30
21-Jan-13	<4.0*	21-Feb-13	<4.0	21-Mar-13	6.50
22-Jan-13	<4.0	22-Feb-13	<4.0	22-Mar-13	**26.0 (P)**
23-Jan-13	6.4	23-Feb-13	<4.0	23-Mar-13	<4.0
24-Jan-13	7	24-Feb-13	<4.0	24-Mar-13	<4.0
25-Jan-13	4.2	25-Feb-13	<4.0	25-Mar-13	<4.0
26-Jan-13	5	26-Feb-13	<4.0	26-Mar-13	11.00
27-Jan-13	4.3	27-Feb-13	<4.0	27-Mar-13	5.70
28-Jan-13	<4.0	28-Feb-13	<4.0	28-Mar-13	7.00
29-Jan-13	5			29-Mar-13	4.50
30-Jan-13	<4.0			30-Mar-13	6.00
31-Jan-13	6			31-Mar-13	<4.0
Permit Limit: 25mg/L					

Note: All TSS results were from composite samples except samples marked with*, * Replicate and Grab samples.
Note: Maximum and average rates of discharge are 0.32m3/s and 0.08m3/s respectively. The authorised discharge period is 365 days

^ = Missing sample
P = Permit exceedance
PNC = Permit non-compliance

TABLE 5
NORTH PIT CULVERT WATER QUALITY
2012/2013 EMS ID- E207411
COMPANY IDENTITY - WC

Parameter	April				May					June				Site Description	
Sample Date	3	10	17	24	1	8	15	22	29	6	12	19	26	GPS (m)	
Conductivity (umhos/cm)	1300	1520	1600	1720	1710	1740	1800	1830	1820	1840	1770	1900	1840	Minegrid	
Hardness CaCO3	218	-	-	-	324	-	-	-	-	323	-	-	-	Northing	Easting
pH	8.41	8.34	8.20	8.22	8.12	8.29	8.35	8.26	8.39	8.36	8.32	8.29	8.28	104324	98878
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	5.2	<4.0	<4.0	UTM ZONE 10	
Acidity (to pH 8.3)	<0.50	0.60	<0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	Northing	Easting
Alkalinity - Total CaCO3	278	346	308	323	315	317	313	296	299	287	276	291	288	5534129	320702
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	Input to Middle Quinsam Lake, Culvert at Middle Quinsam Lake Road	
Nitrate and Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	<0.0050	-	<0.0050	-	<0.0050	-	<0.0050	<0.0050	-	<0.0050	-		
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	345	409	457	504	525	558	592	628	619	637	583	620	605		

Parameter	July						August				September				Site Description	
Sample Date	4	10*	10	17	23	31	7	14	20	28	5	11	18	25	GPS (m)	
Conductivity (umhos/cm)	1800	1810	1810	1910	1890	1930	2000	2020	2010	1990	2060	2050	2100	1840	Minegrid	
Hardness CaCO3	356	-	-	-	-	355	-	-	-	-	409	-	-	-	Northing	Easting
pH	8.25	8.38	8.41	8.25	8.27	8.33	8.32	8.34	8.42	8.38	8.21	8.39	8.32	8.28	104324	98878
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	4.2	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	UTM ZONE 10	
Acidity (to pH 8.3)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	Northing	Easting
Alkalinity - Total CaCO3	278	283	284	315	313	307	305	291	300	290	291	289	296	296	5534129	320702
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Input to Middle Quinsam Lake, Culvert at Middle Quinsam Lake Road	
Nitrate and Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-		
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	585	609	610	738	597	634	689	657	680	708	710	733	770	799		

Parameter	October					November					December				Site Description	
Sample Date	2	10	16	23	30	6	13	20	20*	27	4	4*	11	19	GPS (m)	
Conductivity (umhos/cm)	2140	2190	1990	1900	1970	1870	1850	1640	1640	1740	1490	1480	1660	1790	Minegrid	
Hardness CaCO3	-	445	-	-	-	290	-	-	-	-	-	-	297	-	Northing	Easting
pH	8.30	8.32	8.33	8.26	8.25	8.24	8.31	8.42	8.41	8.08	8.41	8.38	8.18	8.24	104324	98878
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	UTM ZONE 10	
Acidity (to pH 8.3)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.28	<0.50	<0.50	<0.50	<0.50	0.54	Northing	Easting
Alkalinity - Total CaCO3	303	297	281	268	291	363	405	346	347	342	311	304	341	335	5534129	320702
Ammonia Nitrogen	-	-	-	-	-	0.019	-	-	-	-	-	-	-	-	Input to Middle Quinsam Lake, Culvert at Middle Quinsam Lake Road	
Nitrate and Nitrite as N	-	-	-	-	-	<0.020	-	-	-	-	0.047	-	-	0.072		
Dissolved Phosphorous	-	<0.0050	-	-	-	<0.0050	-	-	<0.0050	-	<0.0050	-	<0.0050	<0.0050		
Total Phosphorous	-	-	-	-	-	0.0052	-	-	-	-	-	-	-	-		
Sulphate	812	817	736	754	715	460	428	418	413	557	403	393	458	611		

Parameter	January					February				March				Site Description	
Sample Date	2	9	16	22	30	5	12	18	25	4	11	19	26	GPS (m)	
Conductivity (umhos/cm)	1790	1470	1700	1840	-	1470	-	-	-	1640	-	-	-	Minegrid	
Field Conductivity (uS/cm)	-	-	-	-	-	1382	1551.2	1621	1064	-	1753	1428	1195.6		
Hardness CaCO3	377	-	-	-	-	-	-	-	-	172	-	-	-	Northing	Easting
pH	8.09	8.25	8.24	8.30	-	8.32	-	-	-	8.25	-	-	-	104324	98878
Field pH	-	-	-	-		8.17	8.02	8.54	7.93		7.92	8.01	8.04	UTM ZONE 10	
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	-	<4.0	-	<4.0	-	<4.0	-	<4.0		
Acidity (to pH 8.3)	<0.50	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Alkalinity - Total CaCO3	297	256	313	330	-	-	-	-	-	-	-	-	-	5534129	320702
Ammonia Nitrogen	0.26	-	-	-	-	-	-	-	-	-	-	-	-	Input to Middle Quinsam Lake, Culvert at Middle Quinsam Lake Road	
Nitrate and Nitrite as N	0.068	-	-	0.098	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	<0.0050		<0.0050	-	-	-	-	-	-	-	-	-		
Total Phosphorous	<0.0050	-	-	-	-	-	-	-	-	<0.00020	-	-	-		
Sulphate	586	473	525	612	-	456	-	-	-	502	-	-	-		

Results expressed in milligrams per litre except for where noted

TABLE 6
NORTH PIT CULVERT METALS ANALYSIS
2012/2013 EMS ID- E207411
COMPANY IDENTITY - WC

Parameter	April		May		
Sample Date	3	17	1	15	29
Total Metals					
Aluminum	0.0580	-	0.0214	-	-
Antimony	<0.0005	-	<0.00050	-	-
Arsenic	0.00090	-	0.00072	-	-
Barium	0.0160	-	0.0200	-	-
Beryllium	<0.0001	-	<0.00010	-	-
Bismuth	<0.001	-	<0.0010	-	-
Boron	0.540	-	0.752	-	-
Cadmium	<0.00001	-	0.00002	-	-
Calcium	60.8	-	100	-	-
Chromium	<0.001	-	<0.0010	-	-
Cobalt	<0.0005	-	<0.00050	-	-
Copper	0.00080	-	0.00072	-	-
Hardness	-	-	-	-	-
Iron	0.177	-	0.102	-	-
Lead	<0.0002	-	<0.00020	-	-
Lithium	<0.005	-	0.0057	-	-
Magnesium	7.42	-	12.5	-	-
Manganese	0.02	-	0.02	-	-
Mercury	<0.000010	-	<0.000010	-	-
Molybdenum	<0.001	-	<0.0010	-	-
Nickel	0.002	-	0.0011	-	-
Phosphorus	-	-	-	-	-
Potassium	1.89	-	2.89	-	-
Selenium	<0.0001	-	0.00012	-	-
Silicon	2.5	-	2.16	-	-
Silver	<0.00002	-	<0.000020	-	-
Sodium	176	-	262	-	-
Strontium	0.548	-	0.909	-	-
Thallium	<0.00005	-	<0.000050	-	-
Tin	<0.005	-	<0.0050	-	-
Titanium	<0.005	-	<0.0050	-	-
Uranium	<0.0001	-	0.00011	-	-
Vanadium	<0.005	-	<0.0050	-	-
Zinc	<0.005	-	<0.0050	-	-
Zirconium	<0.0005	-	<0.00050	-	-
Dissolved Metals					
Aluminum	0.0142	-	0.0062	-	-
Antimony	<0.00050	-	<0.00050	-	-
Arsenic	0.00076	-	0.00068	-	-
Barium	0.0179	-	0.0198	-	-
Beryllium	<0.00010	-	<0.00010	-	-
Bismuth	<0.0010	-	<0.0010	-	-
Boron	0.681	-	0.873	-	-
Cadmium	<0.000010	-	<0.000010	-	-
Calcium	73.1	-	107	-	-
Chromium	<0.0010	-	<0.0010	-	-
Cobalt	<0.00050	-	<0.00050	-	-
Copper	0.00052	-	0.00049	-	-
Hardness	-	-	-	-	-
Iron	0.0137	-	0.0082	-	-
Lead	<0.00020	-	<0.00020	-	-
Lithium	0.0052	-	0.0057	-	-
Magnesium	8.64	-	13.5	-	-
Manganese	0.0152	-	0.0133	-	-
Mercury	<0.000010	-	<0.000010	-	-
Molybdenum	<0.0010	-	<0.0010	-	-
Nickel	0.0018	-	0.0012	-	-
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Potassium	2.19	-	2.92	-	-
Selenium	<0.00010	-	0.00014	-	-
Silicon	2.58	-	1.92	-	-
Silver	<0.000020	-	<0.000020	-	-
Sodium	206	-	273	-	-
Strontium	0.63	-	0.945	-	-
Thallium	<0.000050	-	<0.000050	-	-
Tin	<0.0050	-	<0.0050	-	-
Titanium	<0.0050	-	<0.0050	-	-
Uranium	<0.00010	-	<0.00010	-	-
Vanadium	<0.0050	-	<0.0050	-	-
Zinc	<0.0050	-	<0.0050	-	-
Zirconium	<0.00050	-	<0.00050	-	-

Results expressed in milligrams per litre.
* indicates field replicate sample.

TABLE 6
NORTH PIT CULVERT METALS ANALYSIS
2012/2013 EMS ID- E207411
COMPANY IDENTITY - WC

Parameter	June		July		September
Sample Date	6	19	4	31	5
Total Metals					
Aluminum	0.0134	-	0.0155	0.0170	0.0096
Antimony	<0.00050	-	<0.00050	<0.00050	<0.00050
Arsenic	0.00053	-	0.00081	0.00093	0.00075
Barium	0.0168	-	0.0198	0.0214	0.0213
Beryllium	<0.00010	-	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	-	<0.0010	<0.0010	<0.0010
Boron	0.777	-	0.975	0.985	1.00
Cadmium	<0.000010	-	0.000012	<0.000010	<0.000010
Calcium	96.6	-	117	115	132
Chromium	<0.0010	-	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	-	<0.00050	<0.00050	<0.00050
Copper	0.0004	-	0.00058	0.00104	0.00042
Hardness	-	-	-	-	-
Iron	0.0706	-	0.0552	0.0999	0.123
Lead	<0.00020	-	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	-	0.0068	0.0066	0.0063
Magnesium	13.4	-	15.6	16.6	19
Manganese	0.0255	-	0.0203	0.0341	0.0478
Mercury	<0.010	-	<0.010	<0.010	<0.0020
Molybdenum	<0.0010	-	<0.0010	<0.0010	<0.0010
Nickel	0.0011	-	<0.0010	0.001	<0.0010
Phosphorus	-	-	-	-	-
Potassium	2.79	-	3.21	3.59	3.75
Selenium	<0.00010	-	0.00012	<0.00010	<0.00010
Silicon	1.55	-	1.97	2.78	3.38
Silver	<0.000020	-	<0.000020	<0.000020	<0.000020
Sodium	255	-	278	320	323
Strontium	0.872	-	1.09	1.11	1.25
Thallium	<0.000050	-	<0.000050	<0.000050	<0.000050
Tin	<0.0050	-	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	-	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	-	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	-	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	-	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	-	<0.00050	<0.00050	<0.00050
Dissolved Metals					
Aluminum	0.0102	-	0.007	0.0107	0.0058
Antimony	<0.00050	-	<0.00050	<0.00050	<0.00050
Arsenic	0.00057	-	0.00063	0.001	0.00061
Barium	0.0189	-	0.0183	0.0216	0.0204
Beryllium	<0.00010	-	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	-	<0.0010	<0.0010	<0.0010
Boron	0.839	-	0.983	1.01	0.933
Cadmium	<0.000010	-	<0.000010	<0.000010	<0.000010
Calcium	105	-	112	121	127
Chromium	<0.0010	-	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	-	<0.00050	<0.00050	<0.00050
Copper	0.00055	-	0.00119	0.00076	0.00041
Hardness	-	-	-	-	-
Iron	0.0132	-	0.0154	0.0179	0.0387
Lead	<0.00020	-	<0.00020	<0.00020	<0.00020
Lithium	0.0059	-	0.0063	0.0068	0.0063
Magnesium	15	-	14.7	16.8	19.2
Manganese	0.0254	-	0.0078	0.012	0.0223
Mercury	<0.010	-	<0.010	<0.010	<0.0020
Molybdenum	<0.0010	-	<0.0010	0.001	<0.0010
Nickel	0.0012	-	<0.0010	0.0013	<0.0010
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Potassium	3.23	-	2.92	3.7	3.69
Selenium	<0.00010	-	<0.00010	<0.00010	<0.00010
Silicon	1.66	-	2.01	3.03	3.23
Silver	<0.000020	-	<0.000020	<0.000020	<0.000020
Sodium	300	-	267	318	326
Strontium	1.02	-	1.01	1.13	1.26
Thallium	<0.000050	-	<0.000050	<0.000050	<0.000050
Tin	<0.0050	-	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	-	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	-	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	-	<0.0050	<0.0050	<0.0050
Zinc	0.019	-	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	-	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.
* indicates field replicate sample.

TABLE 6
NORTH PIT CULVERT METALS ANALYSIS
2012/2013 EMS ID- E207411
COMPANY IDENTITY - WC

Parameter	October	November		December		
Sample Date	10	6	20	4	11	19
Total Metals						
Aluminum	0.0073	0.0303	-	-	0.0312	-
Antimony	<0.00050	<0.00050	-	-	<0.00050	-
Arsenic	0.00031	0.00249	-	-	0.00219	-
Barium	0.0218	0.0185	-	-	0.0241	-
Beryllium	<0.00010	<0.00010	-	-	<0.00010	-
Bismuth	<0.0010	<0.0010	-	-	<0.0010	-
Boron	0.897	1.1	-	-	1.06	-
Cadmium	<0.000010	<0.000025	-	-	<0.000013	-
Calcium	142	88.9	-	-	91.1	-
Chromium	<0.0010	<0.0010	-	-	<0.0010	-
Cobalt	<0.00050	<0.00050	-	-	<0.00050	-
Copper	0.00034	0.00073	-	-	0.00074	-
Hardness	-	-	-	-	-	-
Iron	0.143	0.159	-	-	0.205	-
Lead	<0.00020	<0.00020	-	-	<0.00020	-
Lithium	0.0061	0.0069	-	-	0.0075	-
Magnesium	20.7	11.1	-	-	10.9	-
Manganese	0.0411	0.0247	-	-	0.015	-
Mercury	<0.000020	<0.000020	-	-	<0.000010	-
Molybdenum	<0.0010	0.00210	-	-	0.00180	-
Nickel	<0.0010	0.0022	-	-	0.0015	-
Phosphorus		0.00520	-	-	-	-
Potassium	3.74	3.86	-	-	2.91	-
Selenium	<0.00010	<0.00010	-	-	<0.00010	-
Silicon	2.94	2.84	-	-	3.15	-
Silver	<0.000020	<0.000020	-	-	<0.000020	-
Sodium	338	338	-	-	281	-
Strontium	1.37	0.843	-	-	0.814	-
Thallium	<0.000050	<0.000050	-	-	<0.000050	-
Tin	<0.0050	<0.0050	-	-	<0.0050	-
Titanium	<0.0050	<0.0050	-	-	<0.0050	-
Uranium	<0.00010	<0.00010	-	-	<0.00010	-
Vanadium	<0.0050	<0.0050	-	-	<0.0050	-
Zinc	<0.0050	<0.0050	-	-	<0.0050	-
Zirconium	<0.00050	<0.00050	-	-	<0.00050	-
Dissolved Metals						
Aluminum	0.0058	0.0054	-	-	0.0141	-
Antimony	<0.00050	<0.00050	-	-	<0.00050	-
Arsenic	0.00038	0.00194	-	-	0.00206	-
Barium	0.0207	0.0186	-	-	0.0209	-
Beryllium	<0.00010	<0.00010	-	-	<0.00010	-
Bismuth	<0.0010	<0.0010	-	-	<0.0010	-
Boron	1.06	1.07	-	-	0.913	-
Cadmium	<0.000025	<0.000025	-	-	<0.000010	-
Calcium	143	97.7	-	-	99.9	-
Chromium	<0.0010	<0.0010	-	-	<0.0010	-
Cobalt	<0.00050	<0.00050	-	-	<0.00050	-
Copper	0.00072	0.00047	-	-	0.00051	-
Hardness	-	-	-	-	-	-
Iron	0.0368	0.0122	-	-	0.0896	-
Lead	<0.00020	<0.00020	-	-	<0.00020	-
Lithium	0.0062	0.0064	-	-	0.0067	-
Magnesium	21.4	11.3	-	-	11.5	-
Manganese	0.0346	0.005	-	-	0.0015	-
Mercury	<0.0020	<0.0020	-	-	<0.010	-
Molybdenum	<0.0010	0.0022	-	-	0.0033	-
Nickel	<0.0010	<0.0010	-	-	0.0019	-
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Potassium	3.66	4.08	-	-	3.32	-
Selenium	<0.00010	<0.00010	-	-	0.0002	-
Silicon	3.39	3	-	-	3.41	-
Silver	<0.000020	<0.000020	-	-	<0.000020	-
Sodium	351	350	-	-	299	-
Strontium	1.33	0.83	-	-	0.863	-
Thallium	<0.000050	<0.000050	-	-	<0.000050	-
Tin	<0.0050	<0.0050	-	-	<0.0050	-
Titanium	<0.0050	<0.0050	-	-	<0.0050	-
Uranium	<0.00010	<0.00010	-	-	0.00022	-
Vanadium	<0.0050	<0.0050	-	-	<0.0050	-
Zinc	<0.0050	<0.0050	-	-	<0.0050	-
Zirconium	<0.00050	<0.00050	-	-	<0.00050	-

Results expressed in milligrams per litre.
* indicates field replicate sample.

TABLE 6
NORTH PIT CULVERT METALS ANALYSIS
2012/2013 EMS ID- E207411
COMPANY IDENTITY - WC

Parameter	January			March
Sample Date	2	9	22	4
Total Metals				
Aluminum	0.0229	-	-	0.0168
Antimony	<0.00050	-	-	<0.00050
Arsenic	0.00092	-	-	0.00120
Barium	0.0218	-	-	0.0246
Beryllium	<0.00010	-	-	<0.00010
Bismuth	<0.0010	-	-	<0.0010
Boron	0.823	-	-	0.786
Cadmium	<0.000010	-	-	<0.000010
Calcium	125	-	-	105
Chromium	<0.0010	-	-	<0.0010
Cobalt	<0.00050	-	-	<0.00050
Copper	0.00073	-	-	0.00046
Hardness	378	-	-	318
Iron	0.106	-	-	0.0993
Lead	<0.00020	-	-	<0.00020
Lithium	0.0074	-	-	0.0064
Magnesium	15.8	-	-	13.2
Manganese	0.0127	-	-	0.0132
Mercury	<0.000010	-	-	<0.000010
Molybdenum	0.00100	-	-	<0.0010
Nickel	0.0022	-	-	0.0016
Phosphorus	<0.0050	-	-	
Potassium	3.04	-	-	2.99
Selenium	0.00019	-	-	0.00011
Silicon	2.98	-	-	2.91
Silver	<0.000020	-	-	<0.000020
Sodium	259	-	-	263
Strontium	1.05	-	-	0.923
Thallium	<0.000050	-	-	<0.000050
Tin	<0.0050	-	-	<0.0050
Titanium	<0.0050	-	-	<0.0050
Uranium	<0.00010	-	-	<0.00010
Vanadium	<0.0050	-	-	<0.0050
Zinc	<0.0050	-	-	<0.0050
Zirconium	<0.00050	-	-	<0.00050
Dissolved Metals				
Aluminum	0.0085	-	-	0.0044
Antimony	<0.00050	-	-	<0.00050
Arsenic	0.00093	-	-	0.0006
Barium	0.0223	-	-	0.0137
Beryllium	<0.00010	-	-	<0.00010
Bismuth	<0.0010	-	-	<0.0010
Boron	0.768	-	-	0.413
Cadmium	<0.000010	-	-	<0.000010
Calcium	126	-	-	56.8
Chromium	<0.0010	-	-	<0.0010
Cobalt	<0.00050	-	-	<0.00050
Copper	0.00058	-	-	<0.00020
Hardness	377	-	-	172
Iron	0.0071	-	-	<0.0050
Lead	<0.00020	-	-	<0.00020
Lithium	0.0068	-	-	<0.0050
Magnesium	15.2	-	-	7.42
Manganese	0.0078	-	-	0.0056
Mercury	<0.010	-	-	<0.010
Molybdenum	<0.0010	-	-	<0.0010
Nickel	0.0013	-	-	<0.0010
Phosphorus	<0.0050	<0.0050	<0.0050	
Potassium	2.91	-	-	1.67
Selenium	0.00015	-	-	<0.00010
Silicon	3.18	-	-	1.54
Silver	<0.000020	-	-	<0.000020
Sodium	254	-	-	145
Strontium	1.05	-	-	0.519
Thallium	<0.000050	-	-	<0.000050
Tin	<0.0050	-	-	<0.0050
Titanium	<0.0050	-	-	<0.0050
Uranium	<0.00010	-	-	<0.00010
Vanadium	<0.0050	-	-	<0.0050
Zinc	<0.0050	-	-	<0.0050
Zirconium	<0.00050	-	-	<0.00050

Results expressed in milligrams per litre.
* indicates field replicate sample.

TABLE 7
2 NORTH PIT SUMP WATER QUALITY
2012/2013 EMS ID- E207412
COMPANY IDENTITY - WP

Parameter	April				May					June				Site Description	
														GPS (m)	
Sample Date	3	10	17	24	1	8	15	22	29	6	12	19	26	Minegrid	
Conductivity (umhos/cm)	1100	1500	1490	1520	1490	1540	1610	1610	1560	1470	1610	1650	1660	Northing	Easting
Hardness CaCO3	363	425	473	433	448	432	437	460	409	266	313	297	299	103726	99663.3
pH	8.19	8.19	8.21	8.28	8.25	8.24	8.23	8.22	8.23	8.13	8.11	8.21	8.21	UTM ZONE 10	
Total Suspended Solids	14.0	6.2	<4.0	4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	11.5	5.8	Northing	Easting
Acidity (to pH 8.3)	1.10	0.90	1.10	0.95	0.76	<0.50	0.82	<0.50	0.80	2.60	<0.50	<0.50	<0.50	5534400	321651
Alkalinity - Total CaCO3	145	188	186	186	183	200	204	197	199	284	273	288	266	PAG-CCR Storage	
Sulphate	396	605	604	574	565	588	636	631	601	412	512	492	555	Pond	

Parameter	July					August					September			Site Description	
														GPS (m)	
Sample Date	4	10	17	23	31	7*	7	14	20	28	5	11	18	Minegrid	
Conductivity (umhos/cm)	1740	1940	2010	2010	2010	2040	2050	2160	2190	2140	2280	2220	2230	Northing	Easting
Hardness CaCO3	341	-	-	-	402	-	-	-	-	-	481	-	-	103726	99663.3
pH	8.13	8.11	8.15	8.13	8.18	8.15	8.15	8.16	8.20	8.15	8.19	8.20	8.18	UTM ZONE 10	
Total Suspended Solids	<4.0	18.3	<4.0	<4.0	7.0	4.8	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	Northing	Easting
Acidity (to pH 8.3)	2.28	4.11	3.71	3.46	2.86	3.02	2.43	1.99	0.85	2.59	4.66	<0.50	0.90	5534400	321651
Alkalinity - Total CaCO3	252	273	298	284	287	273	275	261	266	245	263	258	247	PAG-CCR Storage	
Sulphate	588	725	774	715	726	780	763	780	859	861	869	843	881	Pond	

Parameter	October				November				December				Site Description	
													GPS (m)	
Sample Date	16	23	30*	30	6	13	20	27	4	11	19	28	Minegrid	
Conductivity (umhos/cm)	1910	1880	1940	1940	1710	1960	1900	1890	1820	1790	1800	439	Northing	Easting
Hardness CaCO3	-	-	-	-	444	-	-	-	-	436	-	-	103726	99663.3
pH	8.15	8.24	8.13	8.09	8.28	8.14	8.11	8.08	8.16	8.15	8.14	7.27	UTM ZONE 10	
Total Suspended Solids	4.2	6.5	<4.0	<4.0	29.0	<4.0	16.2	15.3	5.7	<4.0	88.0	<4.0	Northing	Easting
Acidity (to pH 8.3)	3.12	1.37	<0.50	<0.50	<0.50	1.65	5.20	2.26	<0.50	<0.50	3.07	3.47	5534400	321651
Alkalinity - Total CaCO3	265	262	246	247	214	290	323	310	293	284	282	32.1	PAG-CCR Storage	
Sulphate	711	800	732	769	670	755	681	762	640	631	672	168	Pond	

Parameter	January			February				March				Site Description	
												GPS (m)	
Sample Date	9	16	22	5	14	19	25	4	11	19	26	Minegrid	
Conductivity (umhos/cm)	1280	1850	1900	2060	-	2010	2030	2050	2080	2110	2050		
Field Conductivity (uS/cm)	-	-	-	1926	1439	1443	**PNC**	-	2027	1844	1507	Northing	Easting
Hardness CaCO3		502	488	537	523	508	577	519	569	513	537	103726	99663.3
pH	8.04	8.06	8.11	8.02	8.02	8.10	8.04	8.07	8.13	7.99	7.99	UTM ZONE 10	
Field pH	-	-	-	7.62	7.95	8.10	-	-	7.58	7.88	7.54	Northing	Easting
Total Suspended Solids	6.00	<4.0	6.50	11.80	-	<4.0	21.00	-	6.30	<4.0	8.50	5534400	321651
Alkalinity - Total CaCO3	141	271	277	279	276	275	266	269	265	265	280	PAG-CCR Storage	
Sulphate	493	683	721	848	838	790	867	843	927	877	833	Pond	

Results expressed in milligrams per litre except where noted.
* Field replicate sample.
PNC = Permit non-compliance

TABLE 8
2 NORTH PIT SUMP METALS ANALYSIS
2012/2013 EMS ID- E207412
COMPANY IDENTITY - WP

Parameter	April				May				
Sample Date	3	10	17	24	1	8	15	22	29
Total Metals									
Aluminum	1.1500	0.0650	0.0446	0.0340	0.0262	0.0933	0.0616	0.0466	0.0472
Antimony	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00150	0.00300	0.00177	0.00210	0.00196	0.00336	0.00460	0.00390	0.00388
Barium	0.0290	0.0330	0.0281	0.0279	0.0291	0.0294	0.0299	0.0291	0.0302
Beryllium	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.370	0.560	0.478	0.459	0.569	0.512	0.599	0.658	0.705
Cadmium	0.00001	<0.00001	<0.000010	<0.000010	0.000013	0.000022	0.000023	<0.000010	<0.000010
Calcium	119	145	150	146	145	136	138	131	127
Chromium	0.00200	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00160	0.00120	0.00105	0.00088	0.00088	0.00102	0.00101	<0.00050	<0.00050
Copper	0.00360	0.00140	0.00074	0.00069	0.00086	0.00189	0.00144	0.00167	0.0016
Hardness	-	-	-	-	-	-	-	-	-
Iron	0.729	0.18	0.0814	0.0699	0.0647	0.211	0.0892	0.106	0.0712
Lead	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	0.0052	0.0054	0.0059
Magnesium	14.6	18.5	19.8	18.1	19.8	18.7	18	18.3	18.8
Manganese	0.088	0.059	0.0522	0.0415	0.0401	0.0387	0.0247	0.0145	0.0097
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.010
Molybdenum	0.00300	0.00400	0.00290	0.00310	0.00310	0.00300	0.00390	0.00370	0.00390
Nickel	0.005	0.005	0.0048	0.0047	0.005	0.0049	0.0053	0.0043	0.0039
Phosphorus	-	-	-	-	-	-	-	-	-
Potassium	2.17	3.27	2.79	2.72	2.76	3.05	3.34	3.32	3.64
Selenium	0.00040	0.00070	0.00053	0.00047	0.00055	0.00046	0.00040	0.00049	0.00039
Silicon	3.9	2.5	2.68	2.37	2.47	2.35	2.2	2.11	2.07
Silver	<0.00002	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	106	164	150	141	150	162	179	186	204
Strontium	0.874	1.21	1.19	1.17	1.16	1.12	1.22	1.18	1.21
Thallium	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	0.051	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	0.0057	<0.0050	<0.0050
Uranium	0.00020	0.00030	0.00026	0.00026	0.00032	0.00027	0.00024	0.00026	0.00025
Vanadium	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	0.00050	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals									
Aluminum	0.0102	0.0051	0.0048	0.0048	0.0053	0.0033	0.0072	0.008	0.0129
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050
Arsenic	0.00096	0.0027	0.00177	0.00211	0.00172	0.00324	0.00471	0.00436	0.00387
Barium	0.0285	0.0307	0.0291	0.0301	0.0292	0.03	0.0325	0.031	0.0299
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010
Boron	0.387	0.576	0.548	0.48	0.578	0.561	0.619	0.74	0.668
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000015	0.000041	<0.000010
Calcium	122	141	155	140	145	141	144	150	132
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010
Cobalt	0.00106	0.00106	0.001	0.00101	0.00082	0.00072	0.00084	<0.0010	<0.00050
Copper	0.00097	0.00147	0.0015	0.00069	0.00097	0.00108	0.00148	0.00134	0.00203
Hardness	-	-	-	-	-	-	-	-	-
Iron	0.0112	<0.0050	<0.0050	<0.0050	0.0072	<0.0050	0.0079	<0.010	0.0177
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00040	0.00029
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0056	<0.010	0.0054
Magnesium	14.3	17.6	21.1	20.3	21	19.3	19.1	20.8	19.1
Manganese	0.0848	0.0565	0.0514	0.0443	0.0405	0.0306	0.0176	0.0097	0.0072
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	0.0025	0.0036	0.0029	0.0032	0.0031	0.0032	0.004	0.0037	0.0038
Nickel	0.0041	0.0047	0.0053	0.0051	0.0055	0.0048	0.0044	0.0041	0.004
Phosphorus	-	-	-	-	-	-	-	-	-
Potassium	2.21	3.16	2.9	2.97	2.9	3.05	3.68	3.76	3.95
Selenium	0.00051	0.00084	0.00053	0.00064	0.00067	0.00056	0.0005	0.00052	0.00039
Silicon	2.21	2.37	2.4	2.44	2.27	2.21	2.16	2.33	2.12
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000040	<0.000020
Sodium	107	157	155	157	155	170	185	205	211
Strontium	0.895	1.14	1.19	1.23	1.2	1.2	1.24	1.24	1.17
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050
Uranium	0.0002	0.00025	0.00026	0.00031	0.00028	0.00029	0.00028	0.00027	0.00022
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050

Results expressed in milligrams per litre.
* Field Replicate Samples.

TABLE 8
2 NORTH PIT SUMP METALS ANALYSIS
2012/2013 EMS ID- E207412
COMPANY IDENTITY - WP

Parameter	June				July		September	November	December
Sample Date	6	12	19	26	4	31	5	6	11
Total Metals									
Aluminum	0.0298	0.0485	0.0468	0.0788	0.0550	0.0503	0.0433	3.0400	0.1470
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00315	0.00249	0.00222	0.00216	0.00194	0.00137	0.00101	0.00219	0.00116
Barium	0.0289	0.0269	0.0256	0.0258	0.0249	0.0229	0.0193	0.0278	0.0255
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.753	0.784	0.79	0.8	0.94	0.954	0.97	0.804	1.01
Cadmium	<0.000010	0.000013	0.000022	<0.000010	0.000013	<0.000010	0.00001	<0.000025	<0.000013
Calcium	88.8	105	98.3	103	111	129	154	145	138
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00420	<0.0010
Cobalt	0.00082	0.00161	0.00083	0.00078	0.00056	0.00061	<0.00050	0.00232	0.00212
Copper	0.00118	0.00135	0.00252	0.00241	0.00175	0.00186	0.0012	0.00859	0.00169
Hardness	-	-	-	-	-	-	-	-	-
Iron	0.0966	0.138	0.101	0.231	0.109	0.142	0.169	1.62	0.345
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00024	<0.00020
Lithium	0.0053	0.0066	0.0072	0.0067	0.0078	0.011	0.013	0.0096	0.0096
Magnesium	11.2	13.3	13.6	14.1	15.5	19.3	23.4	19	18.8
Manganese	0.0244	0.0389	0.0241	0.0219	0.0313	0.0251	0.0228	0.104	0.101
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0020	<0.0020	<0.010
Molybdenum	0.00190	0.00150	0.00150	0.00150	0.00140	0.00120	0.00120	0.00170	<0.0010
Nickel	0.003	0.0046	0.0033	0.0034	0.0031	0.003	0.0025	0.0073	0.0088
Phosphorus	-	-	-	-	-	-	-	-	-
Potassium	2.75	3	3.03	3.18	3.17	3.48	3.94	3.31	2.88
Selenium	0.00020	0.00036	0.00019	0.00027	<0.00010	0.00029	0.00016	0.00068	0.00022
Silicon	3.28	2.95	2.77	2.74	2.43	2.75	3.24	6.37	3.43
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	231	263	264	255	270	325	360	234	274
Strontium	0.857	0.938	0.99	0.969	1.07	1.26	1.49	1.15	1.15
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.193	<0.0050
Uranium	0.00011	<0.00010	0.00011	<0.00010	0.00012	0.00011	0.00012	0.00017	0.00014
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0076	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	0.007	<0.0050	<0.0050	<0.0050	0.0055	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00176	<0.00050
Dissolved Metals									
Aluminum	0.0049	0.0131	0.0119	0.0172	0.0065	0.0135	0.0044	0.0064	0.0222
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00302	0.00484	0.00221	0.00191	0.00148	0.00115	0.00078	0.00141	0.00086
Barium	0.0285	0.0298	0.0243	0.0238	0.0228	0.0228	0.0174	0.0276	0.0263
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.747	0.795	0.805	0.781	0.788	0.934	0.951	0.676	0.802
Cadmium	<0.000010	0.000026	<0.000010	<0.000010	0.000012	<0.000010	<0.000010	0.000008	<0.000010
Calcium	86.9	104	96.7	97.1	107	138	137	146	145
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00078	0.00157	0.00069	0.00128	<0.00050	<0.00050	<0.00050	0.00117	0.00164
Copper	0.00099	0.00201	0.00111	0.00167	0.00218	0.00158	0.00066	0.00156	0.00049
Hardness	-	-	-	-	-	-	-	-	-
Iron	<0.0050	0.0437	<0.0050	0.0094	0.0053	0.0054	0.0054	<0.0050	<0.0050
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0053	0.007	0.0069	0.0067	0.0074	0.0107	0.0125	0.0064	0.0081
Magnesium	12	13.2	13.5	13.6	15.1	19.6	22.7	19	17.9
Manganese	0.023	0.0359	0.0205	0.0212	0.0275	0.021	<0.0010	0.0856	0.0791
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000020	<0.000010
Molybdenum	0.002	0.0017	0.0015	0.0014	0.0014	0.0012	0.0012	0.0019	0.0012
Nickel	0.003	0.0055	0.0032	0.0042	0.0027	0.0027	0.0023	0.0053	0.0046
Phosphorus	-	-	-	-	-	-	-	-	-
Potassium	2.84	3.05	2.97	3	2.91	3.62	3.78	3.59	2.99
Selenium	0.00034	0.00012	<0.00010	0.00033	0.00028	0.00011	0.00014	0.00048	0.00027
Silicon	2.95	2.82	2.74	2.39	2.46	3	2.98	2.18	3.3
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	241	267	264	262	258	328	346	215	269
Strontium	0.851	0.943	0.936	0.914	0.972	1.27	1.45	1.13	1.13
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.193	<0.0050
Uranium	0.00011	0.0001	<0.00010	0.0001	0.00011	0.00011	0.00012	0.00017	0.00014
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.
* Field Replicate Samples.

TABLE 8
2 NORTH PIT SUMP METALS ANALYSIS
2012/2013 EMS ID- E207412
COMPANY IDENTITY - WP

Parameter	January		February			
Sample Date	16	22	5	14	19	25
Total Metals						
Aluminum	0.4440	0.0443	0.3030	0.0751	0.0490	0.2440
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00206	0.00105	0.00125	0.00065	0.00069	0.00098
Barium	0.0238	0.0245	0.0226	0.0193	0.0219	0.0238
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.69	0.74	0.75	0.71	0.79	0.72
Cadmium	0.000126	<0.000010	0.000011	0.000019	0.000012	0.000024
Calcium	155	168	185	152	175	195
Chromium	0.00140	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00285	0.00171	0.00211	0.00179	0.00202	0.0023
Copper	0.00614	0.00088	0.00271	0.00095	0.00078	0.00234
Hardness	470	507	558	460	536	590
Iron	0.735	0.0633	0.576	0.209	0.171	0.496
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.008	0.0072	0.0092	0.0076	0.0088	0.0087
Magnesium	20.4	21.4	23	19.7	23.6	25.2
Manganese	0.145	0.139	0.137	0.121	0.145	0.146
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	0.00130	0.00120	<0.0010	<0.0010	0.00110	0.00100
Nickel	0.008	0.0056	0.0068	0.0054	0.0064	0.0064
Phosphorus	-	-	-	-	-	-
Potassium	3.18	3.28	3.1	2.74	3.2	3.24
Selenium	0.00061	0.00035	0.00035	0.00031	0.00037	0.00042
Silicon	3.31	3.11	3.3	2.57	2.99	3.29
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	223	243	265	226	266	254
Strontium	1.21	1.25	1.43	1.17	1.3	1.45
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	0.018	<0.0050	0.0116	0.0061	<0.0050	0.0107
Uranium	0.00021	0.00019	0.00017	0.00014	0.00022	0.00020
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.008	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals						
Aluminum	0.0079	0.0053	0.0105	0.0102	0.0099	0.0082
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00121	0.00101	0.00066	0.00054	0.0006	0.00051
Barium	0.0239	0.0233	0.0212	0.0209	0.0205	0.0228
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.726	0.676	0.899	0.784	0.767	0.759
Cadmium	0.000157	0.000019	0.000011	<0.000010	<0.000010	<0.000010
Calcium	165	161	176	172	166	189
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00181	0.00165	0.00172	0.00158	0.00177	0.00199
Copper	0.00202	0.00067	0.00087	0.00067	0.00038	0.00056
Hardness	502	488	537	523	508	577
Iron	<0.0050	0.0061	<0.0050	<0.0050	<0.0050	<0.0050
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0069	0.0077	0.0084	0.0092	0.0089	0.009
Magnesium	21.9	20.7	23.6	22.8	22.8	25.7
Manganese	0.144	0.133	0.135	0.078	0.104	0.132
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	0.0014	0.0014	0.0012	0.0012	0.0011	<0.0010
Nickel	0.0059	0.0057	0.0059	0.0053	0.0058	0.0065
Phosphorus	-	-	-	-	-	-
Potassium	3.38	3.51	3.1	3.09	3.1	3.26
Selenium	0.00056	0.00035	0.0003	0.00026	0.00034	0.00043
Silicon	3.03	2.87	2.88	2.87	2.95	3.03
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	238	233	264	267	256	260
Strontium	1.28	1.22	1.39	1.35	1.35	1.42
Thallium	<0.000050	0.000058	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	0.00022	0.00021	0.00017	0.00017	0.00018	0.00017
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.0051	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.
* Field Replicate Samples.

TABLE 8
2 NORTH PIT SUMP METALS ANALYSIS
2012/2013 EMS ID- E207412
COMPANY IDENTITY - WP

Parameter	March			
Sample Date	4	11	19	26
Total Metals				
Aluminum	0.1010	0.0752	0.1120	0.6420
Antimony	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00099	0.00073	0.00071	0.00209
Barium	0.0226	0.0223	0.0211	0.0262
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.77	0.78	0.76	0.82
Cadmium	0.000019	0.000011	0.000029	0.000044
Calcium	179	191	189	172
Chromium	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00191	0.00152	0.00144	0.00166
Copper	0.00192	0.00115	0.00121	0.00312
Hardness	546	574	577	527
Iron	0.309	0.293	0.323	1.17
Lead	<0.00020	0.00093	<0.00020	<0.00020
Lithium	0.01	0.0099	0.0105	0.0102
Magnesium	23.9	23.4	25.4	23.6
Manganese	0.122	0.118	0.111	0.101
Mercury	<0.000010	<0.000010	0.000049	0.000026
Molybdenum	<0.0010	<0.0010	<0.0010	0.00100
Nickel	0.0056	0.0045	0.0046	0.0049
Phosphorus	-	-	-	-
Potassium	3.37	3.48	3.47	3.47
Selenium	0.00033	0.00026	0.00021	0.00031
Silicon	2.84	2.96	3.03	3.74
Silver	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	269	256	273	285
Strontium	1.45	1.51	1.52	1.37
Thallium	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	0.0073	<0.0050	0.0341
Uranium	0.00020	0.00018	0.00019	0.00017
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals				
Aluminum	0.0088	0.0089	0.0082	0.0132
Antimony	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0008	0.00042	0.00049	0.00125
Barium	0.0193	0.02	0.0181	0.0227
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.783	0.778	0.819	0.865
Cadmium	<0.000010	<0.000010	<0.000025	<0.000025
Calcium	168	186	167	175
Chromium	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.0015	0.00136	0.001	0.00096
Copper	0.00051	0.001	0.00046	0.00048
Hardness	519	569	513	537
Iron	0.0165	<0.0050	<0.0050	0.0199
Lead	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0094	0.0098	0.01	0.0106
Magnesium	24.1	25.3	23.6	24.4
Manganese	0.0862	0.0902	0.0704	0.0632
Mercury	<0.000010	<0.000010	<0.000020	<0.000020
Molybdenum	<0.0010	<0.0010	<0.0010	0.001
Nickel	0.005	0.0048	0.0044	0.0038
Phosphorus	-	-	-	-
Potassium	3.32	3.38	3.1	3.58
Selenium	0.00038	0.00024	0.0003	0.0002
Silicon	2.85	2.98	3.04	2.85
Silver	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	269	274	254	300
Strontium	1.34	1.47	1.41	1.42
Thallium	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	0.00018	0.00015	0.00024	0.00017
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.
* Field Replicate Samples.

TABLE 9
MIDDLE QUINSAM LAKE INLET WATER QUALITY
2012/2013 EMS ID - E0126402
COMPANY IDENTITY - WA

Parameter	April				May					June					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description GPS (m)	
Sample Date	3	10	17	24	1	8	15	22	29	6	12	19	26	26*	Max	30-Day Mean[1]	Minegrid	
Conductivity (umhos/cm)	33.0	38.2	40.0	40.7	42.1	41.4	42.0	41.9	42.7	41.3	40.0	40.5	41.5	44.7	-	-	Northing	Easting
Hardness CaCO3	15.3	-	-	-	19.8	-	-	-	-	19.8	-	-	-	-	-	-	104805.2	98178.7
pH	7.21	7.49	7.42	7.53	7.43	7.47	7.47	7.47	7.56	7.39	7.41	7.55	7.42	7.66	-	≥ (6.5)[2] or (6.9)[3]	UTM ZONE 10	
Total Suspended Solids	<4.0	67.3 (WQO)	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5	Northing	Easting
Acidity (to pH 8.3)	<0.50	<0.50	0.70	<0.50	0.51	0.67	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	-	5533857	319898
Alkalinity - Total CaCO3	14.2	17.6	16.3	17.7	17.8	17.4	20.3	21.0	20.3	17.1	17.1	17.8	17.0	17.8	-	-	Upper Quinsam River Watershed Quinsam River at Argonaut Road Background Water Quality for the North	
Ammonia Nitrogen	0.0230	-	-	-	<0.0050	-	-	-	-	0.0067	-	-	-	-	-	-		
Nitrate and Nitrite as N	<0.020	-	-	-	<0.020	-	-	-	-	<0.020	-	-	-	-	-	-		
Kjeldahl Nitrogen	0.127	-	-	-	0.141	-	-	-	-	0.089	-	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-	-		
Total Phosphorous	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-	-		
Sulphate	<0.50	<0.50	1.39	1.25	1.17	1.45	1.63	3.99	2.24	1.05	1.43	0.67	0.70	1.54	100^	N/A		

Parameter	July					August				September				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description GPS (m)	
Sample Date	4	10	17	23	31	7	14	20	28	5	11	18	25	Max	30-Day Mean[1]	Minegrid	
Conductivity (umhos/cm)	40.9	40.4	43.3	42.1	41.5	43.7	42.6	41.8	43.1	42.3	42.4	42.2	44.9	-	-	Northing	Easting
Hardness CaCO3	19	-	-	-	19.7	-	-	-	-	20.1	-	-	-	-	-	104805	98178.73
pH	7.55	7.51	7.48	7.41	7.31	7.61	7.55	7.38	7.61	7.56	7.57	7.44	7.62	-	≥ (6.5)[2] or (6.9)[3]	UTM ZONE 10	
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5	Northing	Easting
Acidity (to pH 8.3)	0.82	<0.50	<0.50	<0.50	0.61	0.57	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.90	-	-	5533857	319898
Alkalinity - Total CaCO3	20.2	17.8	17.6	17.5	16.6	20.5	21.5	21.2	20.6	20.1	17.6	20.3	21.1	-	-	Upper Quinsam River Watershed Quinsam River at Argonaut Road Background Water Quality for the North	
Ammonia Nitrogen	0.0059	-	-	-	0.0059	-	-	-	-	0.0076	-	-	-	-	-		
Nitrate and Nitrite as N	<0.020	-	-	-	<0.020	-	-	-	-	0.025	-	-	-	-	-		
Kjeldahl Nitrogen	0.123	-	-	-	0.143	-	-	-	-	0.061	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-		
Total Phosphorous	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-		
Sulphate	<0.50	1.48	1.76	0.77	1.40	2.17	1.54	<0.50	0.93	0.66	1.06	1.65	1.11	100^	N/A		

Parameter	October					November				December			Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description GPS (m)	
Sample Date	2	10	16	23	30	6	13	20	27	4	11	19	Max	30-Day Mean[1]	Minegrid	
Conductivity (umhos/cm)	43.3	43.5	42.5	39.8	42.7	42.1	40.6	34.7	40.8	41.0	41.0	43.1	-	-	Northing	Easting
Hardness CaCO3	-	18.8	-	-	-	20	-	-	-	-	18.8	-	-	-	104805.2	98178.7
pH	7.54	7.47	7.7	7.52	7.44	7.59	7.5	7.35	7.46	7.54	7.31	7.47	-	≥ (6.5)[2] or (6.9)[3]	UTM ZONE 10	
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5	Northing	Easting
Acidity (to pH 8.3)	<0.50	2.35	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	-	5533857	319898
Alkalinity - Total CaCO3	20.1	20.2	18.0	18.0	17.1	21.1	22.7	14.2	16.5	17.5	16.6	20.1	-	-	Upper Quinsam River Watershed Quinsam River at Argonaut Road Background Water Quality for the North	
Ammonia Nitrogen	-	0.0130	-	-	-	-	-	-	-	-	-	-	-	-		
Nitrate and Nitrite as N	-	<0.020	-	-	-	-	-	-	-	-	-	-	-	-		
Kjeldahl Nitrogen	-	0.151	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	-	<0.0050	-	-	-	-	-	-	-	-	<0.0050	-	-	-		
Total Phosphorous	-	<0.0050	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	1.06	23.10	1.51	1.22	1.54	1.23	2.30	0.52	1.24	1.26	2.14	2.81	100^	N/A		

Parameter	January				February			March				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description GPS (m)	
Sample Date	2	9	16	21	12	18	25	4	11	19	26	Max	30-Day Mean[1]	Minegrid	
Conductivity (umhos/cm)	41.5	41.1	42.4	43.3	-	-	-	-	-	-	-	-	-		
Field Conductivity (uS/cm)	-	-	-	-	39.5	34.0	31.0	-	46.0	45.0	94.8	-	-	Northing	Easting
Hardness CaCO3	19.7	-	-	-	-	-	-	-	-	-	-	-	-	104805.2	98178.73
pH	7.48	7.48	7.44	7.49	-	-	-	-	-	-	-	-	≥ (6.5)[2] or (6.9)[3]	UTM ZONE 10	
Field pH	-	-	-	-	7.16	7.39	7.07	7.85	8.01	7.3	7.34	-	-		
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	-	-	-	-	-	-	-	25	5	Northing	Easting
Acidity (to pH 8.3)	0.62	<0.50	<0.50	<0.50	-	-	-	-	-	-	-	-	-	5533857	319898
Alkalinity - Total CaCO3	20.0	20.3	20.7	20.2	-	-	-	-	-	-	-	-	-	Upper Quinsam River Watershed Quinsam River at Argonaut Road Background Water Quality for the North	
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-		
Nitrate and Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-		
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	1.75	2.52	2.25	1.05	-	-	-	-	-	-	-	100^	N/A		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
[2] 30-day 90th percentile
[3]Running 30-day median
^The sulphate limit is a guideline rather than a site-specific objective

Results expressed in milligrams per litreexcept where noted.
* Field replicate samples
WQO = unmet Water Quality Objective

TABLE 10

MIDDLE QUINSAM LAKE INLET METALS ANALYSIS

2012/2013 EMS ID-0126402

COMPANY IDENTITY - WA

Parameter	April	May	June	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	3	1	6	Max	30-Day Mean[1]
Total Metals					
Aluminum	0.056	0.0355	0.0246	-	-
Antimony	<0.0005	<0.00050	<0.00050	-	-
Arsenic	0.0001	0.00011	0.0001	**0.005^**	-
Barium	0.001	<0.0010	<0.0010	-	-
Beryllium	<0.0001	<0.00010	<0.00010	-	-
Bismuth	<0.001	<0.0010	<0.0010	-	-
Boron	<0.05	<0.050	<0.050	-	-
Cadmium	<0.00001	<0.000010	<0.000010	[2]	-
Calcium	5.14	6.13	6.54	-	-
Chromium	<0.001	<0.0010	<0.0010	-	-
Cobalt	<0.0005	<0.00050	<0.00050	-	-
Copper	0.0006	0.00068	0.00063	**-**	**≤0.002**
Hardness	15.4	18.1	19.2	**-**	
Iron	0.039	0.0212	0.0153	**-**	**≤0.3**
Lead	<0.0002	<0.00020	<0.00020	**0.005**	**≤0.003**
Lithium	<0.005	<0.0050	<0.0050	-	-
Magnesium	0.623	0.681	0.691	-	-
Manganese	0.002	0.001	0.0012	-	**0.0500**
Mercury	<0.000010	<0.000010	<0.000010	**≤0.0001**	-
Molybdenum	<0.001	<0.0010	<0.0010	-	-
Nickel	<0.001	<0.0010	<0.0010	**0.025**	-
Phosphorous	<0.0050	<0.0050	<0.0050		
Potassium	0.078	0.072	0.078	-	-
Selenium	<0.0001	<0.00010	<0.00010	-	-
Silicon	2.3	1.71	1.79	-	-
Silver	<0.00002	<0.000020	<0.000020	**0.0001**	-
Sodium	0.727	0.588	0.571	-	-
Strontium	0.01	0.0103	0.0103	**-**	-
Thallium	<0.00005	<0.000050	<0.000050	-	-
Tin	<0.005	<0.0050	<0.0050	-	-
Titanium	<0.005	<0.0050	<0.0050	-	-
Uranium	<0.0001	<0.00010	<0.00010	-	-
Vanadium	<0.005	<0.0050	<0.0050	-	-
Zinc	<0.005	<0.0050	<0.0050	**0.03**	-
Zirconium	<0.0005	<0.00050	<0.00050	-	-
Dissolved Metals					
Aluminum	0.0386	0.0213	0.0194	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00012	<0.00010	<0.00010	-	-
Barium	0.0012	<0.0010	<0.0010	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	-	-
Cadmium	<0.000010	<0.000010	<0.000010	-	-
Calcium	5.14	6.79	6.73	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00074	0.00071	0.00071	-	-
Hardness	15.3	19.8	19.8	-	-
Iron	0.0202	0.0096	0.0088	-	-
Lead	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	0.603	0.699	0.722	-	-
Manganese	<0.0010	<0.0010	0.001	-	-
Mercury	<0.000010	<0.000010	<0.010	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	-	-
Phosphorous	<0.0050	<0.0050	<0.0050		
Potassium	0.104	0.079	0.082	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.17	1.92	1.74	-	-
Silver	<0.000020	<0.000020	<0.000020	-	-
Sodium	0.812	0.66	0.665	-	-
Strontium	0.0102	0.0114	0.0111	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	-	**-**

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

^: The Water Quality Guidelines are used for Arsenic for a more stringent compariso

[2]Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3

0.00002 at 60 mg/L CaCO3

0.00003 at 90 mg/L CaCO3

0.00004 at 120 mg/L CaCO3

0.00005 at 150 mg/L CaCO3

0.00006 at 210 mg/L CaCO3

TABLE 10

MIDDLE QUINSAM LAKE INLET METALS ANALYSIS

2012/2013 EMS ID-0126402

COMPANY IDENTITY - WA

Parameter	July		September	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	4	31	5	Max	30-Day Mean[1]
Total Metals					
Aluminum	0.027	0.0186	0.0195	-	-
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	<0.00010	0.0001	0.00011	**0.005^**	-
Barium	<0.0010	<0.0010	<0.0010	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	-	-
Cadmium	<0.000010	<0.000010	<0.0000050	[2]	-
Calcium	6.45	6.72	6.8	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00167	0.00063	0.00152	**-**	**≤0.002**
Hardness	19	19.7	20.1		
Iron	0.0259	0.0267	0.024	**-**	**≤0.3**
Lead	<0.00020	<0.00020	<0.00020	**0.005**	**≤0.003**
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	0.705	0.718	0.751	-	-
Manganese	0.0022	0.0015	0.0017	**0.0500**	-
Mercury	<0.000010	<0.000010	<0.000010	**≤0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	**0.025**	-
Phosphorous	<0.0050	<0.0050	<0.0050		
Potassium	0.063	0.069	0.067	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.69	1.68	1.73	-	-
Silver	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	0.59	0.586	0.602	-	-
Strontium	0.0106	0.0106	0.0107	**-**	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	**0.03**	-
Zirconium	<0.00050	<0.00050	<0.00050	-	-
Dissolved Metals					
Aluminum	0.0204	0.0209	0.0151	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	<0.00010	0.00011	0.0001	-	-
Barium	<0.0010	<0.0010	<0.0010	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	-	-
Cadmium	<0.000010	<0.000010	<0.0000050	-	-
Calcium	6.13	6.69	6.61	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00079	0.00058	0.00142	-	-
Hardness	18.2	19.7	19.5		
Iron	0.0162	0.0178	0.0134	-	-
Lead	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	0.689	0.739	0.74	-	-
Manganese	0.0015	0.001	<0.0010	-	-
Mercury	<0.000010	<0.000010	<0.000020	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	-	-
Phosphorous	<0.0050	<0.0050	<0.0050		
Potassium	0.07	0.067	0.066	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.7	1.77	1.59	-	-
Silver	<0.000020	<0.000020	<0.000020	-	-
Sodium	0.641	0.595	0.606	-	-
Strontium	0.0105	0.0106	0.0105	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	0.0114	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	-	**-**

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

^: The Water Quality Guidelines are used for Arsenic for a more stringent compariso

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

TABLE 10

MIDDLE QUINSAM LAKE INLET METALS ANALYSIS

2012/2013 EMS ID-0126402

COMPANY IDENTITY - WA

Parameter	October	November	December	January	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	10	6	11	2	**Max**	**30-Day Mean[1]**
Total Metals						
Aluminum	0.0219	0.0219	0.0303	0.0196	-	-
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00012	0.00012	<0.00010	<0.00010	**0.005^**	-
Barium	<0.0010	0.0011	<0.0010	<0.0010	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	<0.0000050	<0.0000050	<0.0000050	<0.0000050	[2]	-
Calcium	6.59	6.77	6.96	6.76	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00094	0.00073	0.00086	0.0006	**-**	**≤0.002**
Hardness	19.4	20.2	20.5	20	**-**	**-**
Iron	0.0251	0.0228	0.0253	0.0202	**-**	**≤0.3**
Lead	<0.00020	<0.00020	<0.00020	<0.00020	**0.005**	**≤0.003**
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	0.707	0.801	0.748	0.76	-	-
Manganese	0.0015	0.0016	0.002	0.0015	**0.0500**	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	**≤0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	0.0028	<0.0010	**0.025**	-
Phosphorous	<0.0050	-	-	-	**-**	-
Potassium	0.16	0.101	0.089	0.069	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.62	2.15	2.1	2.02	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	0.607	0.789	0.674	0.676	-	-
Strontium	0.0103	0.0119	0.0115	0.0122	**-**	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	**0.03**	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Dissolved Metals						
Aluminum	0.0127	0.0167	0.0156	0.0153	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	<0.00010	0.00011	<0.00010	<0.00010	-	-
Barium	<0.0010	0.0011	<0.0010	<0.0010	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	-
Calcium	6.3	6.69	6.35	6.67	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00056	0.00075	0.00059	0.00049	-	-
Hardness	18.8	20	18.8	19.7		
Iron	0.0073	0.0111	0.0071	0.0078	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	0.731	0.791	0.706	0.727	-	-
Manganese	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Mercury	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorous	<0.0050	-	<0.0050	-		
Potassium	0.082	0.139	0.071	0.078	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.71	2.02	1.86	1.98	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	0.606	0.783	0.635	0.661	-	-
Strontium	0.0104	0.0113	0.011	0.0115	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	-	**-**

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3

0.00002 at 60 mg/L CaCO3

0.00003 at 90 mg/L CaCO3

0.00004 at 120 mg/L CaCO3

0.00005 at 150 mg/L CaCO3

0.00006 at 210 mg/L CaCO3

TABLE 11
MIDDLE QUINSAM LAKE OUTLET WATER QUALITY
2012/2013 EMS ID- E0900504
COMPANY IDENTITY - WB

Parameter	April				May							June				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	2	10	17	24	2	2*	8	15	22	22*	29	5	12	19	26	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	204	203	205	171	117	117	108	94	76	78	69	69	68	59	65	-	-	Minegrid	
Hardness CaCO3	49.3	-	-	-	30.0	30.4	-	-	-	-	-	24.6	-	-	-	-	-	Northing	Easting
pH	7.80	7.86	7.82	7.84	7.49	7.48	7.60	7.44	7.50	7.57	7.60	7.46	7.60	7.59	7.67	-	≥ (6.5)[2] or (6.9)[3]	102049.06	99542.439
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.50	<0.50	<0.50	0.61	0.66	0.81	0.95	1.83	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	-	Northing	Easting
Alkalinity - Total CaCO3	42.8	44.2	43.6	40.3	30.5	32.2	29.2	25.4	24.9	24.9	23.7	23.3	23.3	22.2	22.9	-	-	5533299	322922
Ammonia Nitrogen	0.0210	-	-	-	0.0059	<0.0050	-	-	-	-	-	0.0071	-	-	-	-	-	Outflow from Middle Quinsam Lake - Input to Quinsam River	
Nitrate- Nitrite as N	<0.020	-	-	-	<0.020	<0.020	-	-	-	-	-	<0.020	-	-	-	-	-		
Kjeldahl Nitrogen	0.125	-	-	-	0.200	0.221	-	-	-	-	-	0.092	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	<0.0050	<0.0050	-	-	-	-	-	<0.0050	-	-	-	-	-		
Total Phosphorous	<0.0050	-	-	-	<0.0050	<0.0050	-	-	-	-	-	<0.0050	-	-	-	-	-		
Sulphate	49.5	49.0	48.7	35.5	20.6	21.6	19.0	15.0	10.8	10.9	8.3	9.1	9.0	5.9	7.3	100^	N/A		

Parameter	July					August				September				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	4	10	17	23	31	7	14	20	28	4	11	18	25	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	75	73	72	90	92	93	95	100	99	87	86	82	83	-	-	Minegrid	
Hardness CaCO3	25.5	-	-	-	29.1	-	-	-	-	28.2	-	-	-	-	-	Northing	Easting
pH	7.58	7.50	7.38	7.60	7.62	7.66	7.66	7.53	7.75	7.60	7.70	7.61	7.59	-	≥ (6.5)[2] or (6.9)[3]	102049.06	99542.439
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	0.61	<0.50	<0.50	<0.50	0.7	0.89	<0.50	<0.50	<0.50	0.93	<0.50	<0.50	<0.50	-	-	Northing	Easting
Alkalinity - Total CaCO3	22.5	24.4	23.2	26.2	27.1	26.2	28.2	29.6	28	27.6	28	27.7	26.2	-	-	5533299	322922
Ammonia Nitrogen	0.0080	-	-	-	0.0070	-	-	-	-	0.0110	-	-	-	-	-	Outflow from Middle Quinsam Lake - Input to Quinsam River	
Nitrate- Nitrite as N	<0.020	-	-	-	<0.020	-	-	-	-	<0.020	-	-	-	-	-		
Kjeldahl Nitrogen	0.126	-	-	-	0.115	-	-	-	-	0.103	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-		
Total Phosphorous	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-		
Sulphate	10.8	9.8	10.7	13.4	19.0	14.4	14.8	15.5	14.8	12.7	12.1	11.3	12.7	100^	N/A		

Parameter	October						November				December					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	2	9	9*	16	23	30	5	13	20	27	4	11*	11	18	28	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	85	91	90	105	125	132	122	148	137	155	175	140	140	179	120	-	-	Minegrid	
Hardness CaCO3	-	25.7	-	-	-	-	37.6	-	-	-	-	-	31.9	-	-	-	-	Northing	Easting
pH	7.15	7.62	7.64	7.77	7.68	7.54	7.63	7.65	7.49	7.69	7.83	7.72	7.70	7.56	7.63	-	≥ (6.5)[2] or (6.9)[3]	102049.06	99542.439
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.50	<0.50	0.79	<0.50	<0.50	<0.50	<0.50	<0.50	0.63	0.6	<0.50	<0.50	<0.50	<0.50	<0.50	-	-	Northing	Easting
Alkalinity - Total CaCO3	24.8	26.2	27.2	29.9	29.3	29.8	29.2	33.8	31.8	34.1	38.9	33.1	34.8	40.1	27.9	-	-	5533299	322922
Ammonia Nitrogen	-	0.0081	-	-	-	-	0.0077	-	-	-	-	-	-	-	-	-	-	Outflow from Middle Quinsam Lake - Input to Quinsam River	
Nitrate- Nitrite as N	-	<0.020	-	-	-	-	<0.020	-	-	-	-	-	-	-	-	-	-		
Kjeldahl Nitrogen	-	0.181	-	-	-	-	0.154	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-	<0.0050	-	-	-	-		
Total Phosphorous	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-	-	-	-	-	-		
Sulphate	12.1	14.2	14.1	20.4	29.1	28.3	27.7	32.1	29.2	29.4	35.7	27.8	27.4	37.5	26.2	100^	N/A		

Parameter	January				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	8	16*	16	22	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	130	153	152	136	-	-	Minegrid	
Field Conductivity (uS/cm)	-	-	-	-	-	-		
Hardness CaCO3	-	-	-	-	-	-	Northing	Easting
pH	7.48	7.59	7.57	7.66	-	≥ (6.5)[2] or (6.9)[3]	102049	99542
Field pH	-	-	-	-	-	-	UTM ZONE 10	
Total Suspended Solids	5.5	<4.0	<4.0	<4.0	25	5		
Acidity (to pH 8.3)	-	-	-	-	-	-	Northing	Easting
Alkalinity - Total CaCO3	28.9	34.3	34.3	31.3	-	-	5533299	322922
Ammonia Nitrogen	-	-	-	-	-	-	Outflow from Middle Quinsam Lake - Input to Quinsam River	
Nitrate and Nitrite as N	-	-	-	-	-	-		
Kjeldahl Nitrogen	-	-	-	-	-	-		
Dissolved Phosphorous	-	-	-	-	-	-		
Total Phosphorous	-	-	-	-	-	-		
Sulphate	28.8	31.0	28.9	29.0	100^	N/A		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
[2] 30-day 90th percentile
[3]Running 30-day median
^The sulphate limit is a guideline rather than a site-specific objective

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 12
MIDDLE QUINSAM LAKE OUTLET METALS ANALYSIS
2012/2013 EMS ID-E0900504
COMPANY IDENTITY - WB

Parameter	April	May		June	July		September	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	2	2*	2	5	4	31	4	Max	30-Day Mean[1]
Total Metals									
Aluminum	0.025	0.0231	0.0234	0.0218	0.0185	0.0172	0.0164	-	-
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0002	0.00012	0.00014	0.00015	0.00013	0.00017	0.00016	**0.005^**	-
Barium	0.003	0.0019	0.002	0.0011	0.0012	0.0014	0.0013	-	-
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	0.07	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	[2]	-
Calcium	16.5	9.91	9.72	8.13	8.58	9.75	9.38	-	-
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**0.05**	-
Copper	0.0005	0.00072	0.00068	0.00056	0.00064	0.00061	0.00066	-	**≤0.002**
Hardness CaCO3	49.6	29.9	29.6	24	25.5	29.1	28.2	-	**-**
Iron	0.057	0.0416	0.0391	0.0423	0.0475	0.0517	0.0461	-	**≤0.3**
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.005**	**≤0.003**
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	**-**
Magnesium	2.03	1.24	1.28	0.889	0.992	1.16	1.16	-	**-**
Manganese	0.005	0.0039	0.0038	0.006	0.008	0.015	0.0076	**0.0500**	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	**0.0001**	-
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.025**	-
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.312	0.237	0.248	0.109	0.105	0.14	0.151	-	-
Selenium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.3	1.81	1.76	1.75	1.62	1.69	1.75	-	-
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**≤0.0001**	-
Sodium	21	10.8	11.2	3.51	4.23	6.28	6.67	**-**	**-**
Strontium	0.1	0.0448	0.0457	0.0264	0.0288	0.0381	0.0351	-	-
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**0.03**	-
Dissolved Metals									
Aluminum	0.0203	0.0162	0.0159	0.0152	0.0155	0.0181	0.012	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00018	0.00012	0.00012	<0.00010	0.00014	0.00017	0.00017	-	-
Barium	0.0035	0.0019	0.0019	0.0014	0.0013	0.0015	0.0012	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	0.075	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	-	-
Calcium	16.3	10.1	9.95	8.31	8.55	9.58	9.28	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00121	0.00075	0.00068	0.00059	0.00084	0.00062	0.00074	-	-
Hardness CaCO3	49.3	30.4	30	24.6	25.4	28.7	27.8	-	-
Iron	0.035	0.0177	0.0171	0.0257	0.0303	0.031	0.0247	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	2.07	1.25	1.25	0.945	0.986	1.17	1.12	-	-
Manganese	0.0038	0.0027	0.0028	0.0059	0.0073	0.0107	0.002	-	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010		
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010		
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010		
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.332	0.243	0.253	0.131	0.174	0.138	0.139	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	
Silicon	2.12	1.78	1.8	1.7	1.7	1.73	1.67		-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	21.1	11.1	11.2	3.79	4.15	6.26	6.68	-	-
Strontium	0.0994	0.0491	0.049	0.0267	0.0267	0.0377	0.0349	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.

TABLE 12
MIDDLE QUINSAM LAKE OUTLET METALS ANALYSIS
2012/2013 EMS ID-E0900504
COMPANY IDENTITY - WB

Parameter	October	November	December	January	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	9	5	11	2	**Max**	**30-Day Mean[1]**
Total Metals						
Aluminum	0.0121	0.036	0.0262	0.0233	-	-
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00015	0.00023	0.00027	0.00018	**0.005^**	-
Barium	0.0015	0.0026	0.0023	0.0021	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	<0.0000050	<0.0000050	<0.0000050	<0.0000050	[2]	-
Calcium	9.51	11.9	11.2	12.2	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	**0.05**	-
Copper	0.00068	0.00091	0.00052	0.00061	-	**≤0.002**
Hardness CaCO3	25.7	37.6	31.9	36.5	-	**-**
Iron	0.0406	0.0944	0.0396	0.0366	-	**≤0.3**
Lead	<0.00020	<0.00020	<0.00020	<0.00020	**0.005**	**≤0.003**
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	-	**-**
Magnesium	1.14	1.63	1.35	1.49	-	**-**
Manganese	0.0084	0.0087	0.0034	0.0031	**0.05**	-
Mercury	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	**0.025**	-
Phosphorus	<0.0050	<0.0050		-	-	-
Potassium	0.129	0.225	0.268	0.228	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.62	2.03	2.37	1.98	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	**≤0.0001**	-
Sodium	6.74	9.46	13.9	16.2	**-**	**-**
Strontium	0.0378	0.0666	0.0548	0.0615	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	**0.03**	-
Dissolved Metals						
Aluminum	0.0072	0.0091	0.0168	0.0125	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00013	0.0002	0.00017	0.00015	-	-
Barium	0.0013	0.0025	0.0021	0.0023	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	0.053	-	-
Cadmium	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	-
Calcium	8.6	12.4	10.5	12.8	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00083	0.00049	0.00062	0.00045	-	-
Hardness CaCO3	-	-	-	38.6	-	-
Iron	0.0213	0.0295	0.0229	0.0189	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.03	1.62	1.35	1.61	-	-
Manganese	0.0034	0.0021	0.0018	0.0026	-	-
Mercury	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorus	<0.0050	<0.0050	<0.0050	-	-	-
Potassium	0.13	0.213	0.236	0.248	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	-	
Silicon	1.54	2.11	2.18	2.14	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	6.17	8.66	14.8	16.9	-	-
Strontium	0.0315	0.0634	0.0538	0.0668	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.

TABLE 13
MIDDLE QUINSAM LAKE WATER QUALITY
2012/2013 EDM ID E206618
COMPANY IDENTITY - MQL

Parameter	April					May¤					June¤¤					Water Quality Objectives for Middle Quinsam Lake sub-basin		Site Description	
Sample Date	1	1*	4	9	B	1	4	4*	9	B	1	4	9	9*	B	Max	30-Day Mean[1]		
Conductivity (umhos/cm)	161	161	157	209	231	65.8	71	69.9	208	229	63.3	63.7	198	197	225	-	-	GPS (m)	
Hardness CaCO3	35.1	35.1	35.6	45.4	52.3	22.5	22.8	-	42.2	49.8	24	23.2	44	43.6	50.6	-	-		
pH	7.64	7.88	7.69	7.75	7.7	7.51	7.52	7.5	7.74	7.72	7.57	7.59	7.82	7.66	7.83	-	≥ (6.5)[2] or (6.9)[3]	Minegrid	
Total suspended solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5		
Alkalinity - Total CaCO3	39.1	37.8	39.7	46.3	45.4	24.2	24.3	25	45.7	46.1	23.5	22.6	43	41.9	45.8	-	-	Northing	Easting
Ammonia Nitrogen	<0.0050	-	<0.0050	<0.0050	0.0052	0.048	0.074	-	0.023	0.046	0.0081	0.0088	0.01	-	0.015	-	-	102325.2	98654
Nitrite/Nitrate Nitrogen	<0.020	-	<0.020	<0.020	0.022	<0.020	<0.020	-	<0.020	<0.020	<0.020	<0.020	<0.020	-	<0.020	-	-	UTM ZONE 10	
Kjeldahl Nitrogen	0.123	-	0.117	0.118	0.105	0.092	0.103	-	0.123	0.128	0.047	0.081	0.097	-	0.068	-	-	Northing	Easting
Dissolved Phosphorous	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	-	5532753	322169
Total Phosphorous	0.0117	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	≤ 0.006[4]		
Sulphate	30.2	33.7	30.7	45.9	54.6	6.91	8.27	7.57	48.6	55.8	6.34	6.46	46.1	48.2	51.6	100^	N/A		
Chlorophyll a (mg/m3)	0.59	-	<0.50	1	-	<0.50	0.66	-	0.57	-	2.3	<1.5	2.3	-	-	-	-	Middle of Middle Quinsam Lake	
Pheopigment (mg/m3)	<0.50	-	0.8	<0.50	-	<0.50	<0.50	-	<0.50	-	<1.5	5.1	3.6	-	-	-	-		
Chlorophyll a (mg/m3)*	<0.50	-	<0.50	1.45	-	<0.50	<0.50	-	0.73	-	<1.5	1.8	3.1	-	-	-	-		
Pheopigment (mg/m3)*	<0.50	-	0.92	<0.50	-	<0.50	<0.50	-	<0.50	-	8	8.2	3.3	-	-	-	-		

Parameter	July					August					September					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	1	4	9	B	B*	1	1*	4	9	B	1	4	4*	9	B	Max	30-Day Mean[1]		
Conductivity (umhos/cm)	82.6	80.6	204	232	234	99.8	99.7	97.4	215	224	81.3	82.3	81.3	209	218	-	-	GPS (m)	
Hardness CaCO3	26.9	26.2	48.7	59.6	55.9	29.4	29.5	29.1	47.3	51.6	27.3	25.4	26.4	52.4	54	-	-		
pH	7.28	7.35	7.52	7.52	7.24	7.84	7.84	7.71	7.88	7.8	7.62	7.6	7.65	7.92	7.7	-	≥ (6.5)[2] or (6.9)[3]	Minegrid	
Total suspended solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5		
Alkalinity - Total CaCO3	24.7	26.2	43.7	44.6	37.2	28.7	30.8	28.4	46.3	44.7	27.5	27	26.3	46.2	45.9	-	-	Northing	Easting
Ammonia Nitrogen	0.038	0.1	0.13	0.036	-	0.039	-	0.093	0.024	0.047	0.033	-	0.049	0.029	0.037	-	-	102325.2	98654
Nitrite/Nitrate Nitrogen	<0.020	<0.020	<0.020	<0.020	-	0.022	-	<0.020	0.021	<0.020	<0.020	-	<0.020	<0.020	<0.020	-	-	UTM ZONE 10	
Kjeldahl Nitrogen	0.124	0.156	0.14	0.139	-	0.154	-	0.235	0.141	0.182	0.197	-	0.248	0.223	0.199	-	-	Northing	Easting
Dissolved Phosphorous	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-	5532753	322169
Total Phosphorous	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	0.0084	<0.0050	0.0051	-	<0.0050	<0.0050	<0.0050	-	≤ 0.006[4]		
Sulphate	12.1	10.8	45.6	54.4	25	16.2	15.4	15.6	48.3	56.5	10.7	10.6	11.1	47.9	54.3	100^	N/A		
Chlorophyll a (mg/m3)	<1.5	<1.5	<1.5	-	-	1.57	-	2.06	1.35	-	LE	LE	LE	LE	LE	-	-	Middle of Middle Quinsam Lake	
Pheopigment (mg/m3)	<1.5	<1.5	<1.5	-	-	1.47	-	<0.50	2.69	-	LE	LE	LE	LE	LE	-	-		
Chlorophyll a (mg/m3)*	1.9	<1.5	<1.5	-	-	1.3	-	2.03	0.96	-	LE	LE	LE	LE	LE	-	-		
Pheopigment (mg/m3)*	<1.5	<1.5	<1.5	-	-	0.88	-	<0.50	1.97	-	LE	LE	LE	LE	LE	-	-		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

[2] 30-day 90th percentile

[3]Running 30-day median

[4] Objective is for total phosphorus values and applies to an average of summer phosphorous values.

^The sulphate limit is a guideline rather than a site-specific objective

¤ Results were collected on June 4th, ¤¤ results were collected on June 28th.

Results from June 4th are meant to represent the conditions during the month of May

LE=Labortory Error

Results expressed in milligrams per litre except where noted.

* Field replicate sample.

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TABLE 14
MIDDLE QUINSAM LAKE METALS ANALYSIS
2012/2013 EMS ID E206618
COMPANY ID - MQL

Sample Date	April					May				Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Parameter	1	1*	4	9	B	1	4	9	B	Max	30-Day Mean[1]
Total Metals											
Aluminum	0.0223	-	0.0216	0.0209	0.0199	0.0208	0.0202	0.0154	0.0144	-	-
Antimony	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00015	-	0.00016	0.00018	0.00017	0.00016	0.00014	0.00019	0.00012	**0.005^**	-
Barium	0.0024	-	0.0023	0.0029	0.0033	0.0012	0.0012	0.0026	0.0033	-	-
Beryllium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	-	0.05	0.068	0.069	<0.050	<0.050	0.064	0.077	-	-
Cadmium	**0.000017(WQO)**	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	[2]	-
Calcium	11.7	11.6	11.9	15.1	17	7.57	7.64	13.8	16.1	-	-
Chromium	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00211	-	0.00097	0.00069	0.00055	0.00085	0.0006	0.00054	0.00047	-	**≤0.002**
Iron	0.0401	-	0.038	0.0381	0.0369	0.0531	0.0293	0.0198	0.0359	-	**≤ 0.3**
Hardness	35.10	35.10	35.60	45.40	52.30	22.50	22.80	42.20	49.80	-	-
Lead	<0.00020	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.0050**	**≤0.003**
Lithium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.44	1.48	1.46	1.88	2.37	0.867	0.894	1.85	2.35	-	-
Manganese	0.0039	-	0.0039	0.0036	0.0038	0.0055	0.0051	0.0019	0.0022	**0.0500**	-
Mercury	<0.0000010	-	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	**≤0.0001**	-
Molybdenum	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.0250**	-
Phosphorous	0.0117	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	**≤0.006[4]**
Potassium	0.256	-	0.251	0.314	0.329	0.096	0.101	0.29	0.334	-	-
Selenium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.84	-	1.84	1.98	1.97	1.67	1.69	1.61	1.64	-	-
Silver	<0.000020	-	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	16.7	-	17.2	24	24.3	3.75	4.42	21.8	25.8	-	-
Strontium	0.0651	-	0.0663	0.0902	0.0981	0.0222	0.0244	0.0797	0.0928	-	-
Thallium	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	0.0099	-	<0.0050	<0.0050	<0.0050	0.012	<0.0050	<0.0050	<0.0050	**0.0300**	
Zirconium	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050		-
Dissolved Metals											
Aluminum	0.0172	-	0.0164	0.0145	0.0127	0.0155	0.043	0.0447	0.038	**0.1000**	**≤0.05**
Antimony	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00014	-	0.00014	0.00018	0.00017	0.00011	0.00012	0.00017	0.00013	-	-
Barium	0.0024	-	0.0024	0.0031	0.0035	0.0012	0.0013	0.003	0.0034	-	-
Beryllium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	0.052	-	0.053	0.074	0.072	<0.050	<0.050	0.074	0.081	-	-
Cadmium	0.00001	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-
Calcium	12.1	12.2	12.2	15.2	17.7	7.86	8.07	14.8	16.5	-	-
Chromium	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00094	-	0.00059	0.00057	0.00043	0.00057	0.00052	0.00046	0.00048	-	-
Iron	0.0169	-	0.0161	0.0146	0.0126	0.014	0.0126	0.0089	0.0086	-	-
Hardness	36.60	36.90	36.90	46.30	54.60	23.20	23.90	45.40	50.70		
Lead	<0.00020	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.56	1.57	1.55	2.03	2.53	0.864	0.905	2.06	2.32	-	-
Manganese	0.0019		0.0014	<0.0010	<0.0010	0.0043	0.0038	0.0012	<0.0010	-	-
Mercury	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	-	-
Molybdenum	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorous	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.273	-	0.259	0.335	0.339	0.095	0.105	0.333	0.334	-	-
Selenium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.91	-	1.92	2.03	2.08	1.81	1.79	1.75	1.82	-	-
Silver	<0.000020	-	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	18.1	-	18.1	25.6	26.2	3.58	4.33	24.1	25.4	-	-
Strontium	0.0666	-	0.0665	0.0916	0.0992	0.0221	0.0246	0.0854	0.0913	-	-
Thallium	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	0.0091	-	<0.0050	<0.0050	<0.0050	0.0126	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from
5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided
^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre except where noted.
* Field replicate sample.
WQO = unmet Water Quality Objective

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TABLE 14
MIDDLE QUINSAM LAKE METALS ANALYSIS
2012/2013 EMS ID E206618
COMPANY ID - MQL

Sample Date	June					July					Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Parameter	1	4	9	9*	B	1	4	9	B	B*	Max	30-Day Mean[1]
Total Metals												
Aluminum	0.0193	0.0191	0.0136	-	0.0113	0.0183	0.0192	0.0151	0.0137	-	-	-
Antimony	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.000020	<0.000020	<0.000020	<0.000020	-	-	-
Arsenic	0.00012	0.00015	0.00016	-	0.00015	0.0001	0.0001	0.0001	0.0001	-	**0.005^**	-
Barium	0.0011	0.0011	0.0027	-	0.0033	0.0012	0.0013	0.0028	0.0036	-	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	-	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	-	-
Boron	<0.050	<0.050	0.065	-	0.072	<0.050	<0.050	0.0910	0.0930	-	-	-
Cadmium	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.0000050	0.00001	0.00001	<0.0000050	-	[2]	-
Calcium	8.11	7.76	14.7	14.3	16.7	9.0200	8.7700	16.0000	19.2000	18.0000	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	-	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	<0.00050	0.000020	0.000014	0.000016	0.000035	-	**0.0500**	-
Copper	0.00072	0.00065	0.00124	-	0.00054	0.0005	0.0006	0.0005	0.0011	-	-	**≤0.002**
Iron	0.0366	0.033	0.0168	-	0.019	0.0551	0.0422	0.0201	0.0360	-	-	**≤ 0.3**
Hardness	24.00	23.20	44.00	43.60	50.60	26.90	26.20	48.70	59.60	55.90	-	-
Lead	<0.00020	<0.00020	<0.00020	-	<0.00020	0.00001	0.00001	0.00001	0.00003	-	**0.0050**	**≤0.003**
Lithium	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.00050	<0.00050	<0.00050	0.0005	-	-	-
Magnesium	0.913	0.922	1.8	1.89	2.17	1.0600	1.0500	2.1300	2.8500	2.6700	-	-
Manganese	0.006	0.0061	0.003	-	0.0039	0.0118	0.0109	0.0049	0.0198	-	**0.0500**	-
Mercury	<0.00000020	<0.00000020	<0.00000020	-	<0.00000020	<0.0000010	<0.0000010	<0.0000010	<0.0000010	-	**≤0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	<0.0010	0.0002	0.0002	0.0003	0.0002	-	-	-
Nickel	<0.0010	<0.0010	<0.0010	-	<0.0010	0.0016	0.0001	0.0002	0.0003	-	**0.0250**	-
Phosphorous	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	**≤0.0064**
Potassium	0.102	0.103	0.292	-	0.326	0.1070	0.1050	0.2990	0.3010	-	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	<0.00010	0.0000	0.0001	0.0001	0.0001	-	-	-
Silicon	1.88	1.82	1.61	-	1.67	1.7500	1.7100	1.5100	1.6700	-	-	-
Silver	<0.000020	<0.000020	<0.000020	-	<0.000020	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	**0.0001**	-
Sodium	3.41	3.64	21.3	-	23.9	5.6000	5.4100	23.8000	24.6000	-	-	-
Strontium	0.0225	0.0222	0.0785	-	0.0887	0.0314	0.0320	0.0841	0.0903	-	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.0000020	<0.0000020	<0.0000020	<0.0000020	-	-	-
Tin	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.00020	<0.00020	<0.00020	0.0005	-	-	-
Titanium	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	<0.00010	0.0000	0.0000	0.0000	0.0000	-	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.00020	<0.00020	<0.00020	<0.00020	-	-	-
Zinc	<0.0050	<0.0050	<0.0050	-	<0.0050	0.0013	0.0013	0.0010	0.0017	-	**0.0300**	
Zirconium	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	-	-	-
Dissolved Metals												
Aluminum	0.0143	0.0136	0.0105	-	0.0079	0.0189	0.0160	0.0146	0.0091	-	**0.1000**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	-	<0.00050	0.0000	<0.000020	0.0000	0.0000	-	-	-
Arsenic	<0.00010	<0.00010	0.00013	-	0.00011	0.0002	0.0001	0.0001	0.0001	-	-	-
Barium	0.0011	0.001	0.0027	-	0.0034	0.0013	0.0013	0.0028	0.0036	-	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	-	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	-	-
Boron	<0.050	<0.050	0.073	-	0.079	<0.050	<0.050	0.0710	0.0710	-	-	-
Cadmium	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.0000050	<0.0000050	0.00001	<0.0000050	-	-	-
Calcium	7.69	7.79	14.4	15.7	16.6	9.0100	8.8300	14.8000	17.8000	19.4000	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.00010	<0.00010	0.0001	<0.00010	-	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	<0.00050	0.0000	0.0000	0.0000	0.0000	-	-	-
Copper	0.00265	0.00124	0.00034	-	0.00037	0.0005	0.0005	0.0005	0.0005	-	-	-
Iron	0.0187	0.0167	0.0085	-	0.0076	0.0340	0.0295	0.0112	0.0128	-	-	-
Hardness	22.70	22.90	43.50	47.90	50.80	26.70	26.10	44.80	54.90	60.10		
Lead	0.00025	<0.00020	<0.00020	-	<0.00020	<0.0000050	<0.0000050	0.0000	<0.0000050	-	-	-
Lithium	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-
Magnesium	0.85	0.848	1.85	2.1	2.28	1.0100	0.9800	1.8900	2.5500	2.8500	-	-
Manganese	0.0047	0.0046	0.0023	-	0.0027	0.0109	0.0088	0.0038	0.0168	-	-	-
Mercury	<0.00000020	<0.00000020	<0.00000020	-	<0.00000020	<0.0000010	<0.0000010	<0.0000010	<0.0000010	-	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	<0.0010	0.0002	0.0001	0.0002	0.0002	-	-	-
Nickel	<0.0010	<0.0010	<0.0010	-	<0.0010	0.0001	0.0000	0.0001	0.0001	-	-	-
Phosphorous	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-
Potassium	0.101	0.104	0.294	-	0.333	0.1190	0.1130	0.2760	0.2770	-	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.000040	<0.000040	<0.000040	<0.000040	-	-	-
Silicon	1.79	1.77	1.59	-	1.66	1.7100	1.6400	1.3700	1.5500	-	-	-
Silver	<0.000020	<0.000020	<0.000020	-	<0.000020	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	-	-
Sodium	3.31	3.41	21.2	-	24.2	5.8500	5.6800	22.8000	23.3000	-	-	-
Strontium	0.0209	0.0214	0.0778	-	0.0911	0.0324	0.0315	0.0826	0.0911	-	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.0000020	<0.0000020	<0.0000020	<0.0000020	-	-	-
Tin	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.00020	<0.00020	<0.00020	<0.00020	-	-	-
Titanium	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	<0.00010	0.0000	0.0000	0.0000	0.0000	-	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	<0.0050	0.0002	0.0002	<0.00020	<0.00020	-	-	-
Zinc	0.0056	<0.0050	<0.0050	-	<0.0050	0.0007	0.0009	0.0008	0.0004	-	-	-
Zirconium	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	-	-	-

[1]30-day average objectives apply to values calculated from
5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided
^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre except where noted.
* Field replicate sample.
WQO = unmet Water Quality Objective

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TABLE 14
MIDDLE QUINSAM LAKE METALS ANALYSIS
2012/2013 EMS ID E206618
COMPANY ID - MQL

Sample Date	August					September					Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Parameter	1	1*	4	9	B	1	4	4*	9	B	Max	30-Day Mean[1]
Total Metals												
Aluminum	0.0180	-	0.0184	0.0112	0.0093	0.0357	0.0109	0.0463	0.0460	0.0353	-	-
Antimony	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0002	-	0.0002	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	**0.005***	-
Barium	0.0014	-	0.0014	0.0029	0.0034	0.0019	0.0011	0.0016	0.0035	0.0040	-	-
Beryllium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	-	<0.050	0.0740	0.0780	<0.050	<0.050	<0.050	0.0870	0.0810	-	-
Cadmium	<0.0000050	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	<0.0000050	[2]	-
Calcium	9.8100	9.8400	9.7000	15.4000	16.7000	9.1700	8.4700	8.8200	17.2000	17.5000	-	-
Chromium	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0006	-	0.0007	0.0005	0.0016	0.0008	0.0005	0.0008	0.0034	0.0007	-	**≤0.002**
Iron	0.0466	-	0.0446	0.0267	0.0231	0.0498	0.0429	0.0457	0.0720	0.0395	-	**≤ 0.3**
Hardness	29.40	29.50	29.10	47.30	51.60	27.30	25.40	26.40	52.40	54.00	-	-
Lead	<0.00020	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.0050**	**≤0.003**
Lithium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.1900	1.1900	1.2000	2.1400	2.3900	1.0800	1.0300	1.0600	2.3000	2.4800	-	-
Manganese	0.0083	-	0.0085	0.0094	0.0077	0.0059	0.0064	0.0068	0.0085	0.0081	**0.0500**	-
Mercury	<0.0000010	-	<0.0000010	<0.0000010	<0.0000010	0.0000	-	<0.0000020	<0.0000020	<0.0000020	**≤0.0001**	-
Molybdenum	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.025**	-
Phosphorous	<0.0050	-	<0.0050	0.0084	<0.0050	0.0051	-	<0.0050	<0.0050	<0.0050	-	**≤0.006**[4]
Potassium	0.1580	-	0.1540	0.3150	0.3260	0.1360	-	0.1350	0.3530	0.3300	-	-
Selenium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.6900	-	1.6400	1.2100	1.2500	1.7000	1.3500	1.6600	1.1600	1.3000	-	-
Silver	<0.000020	-	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	7.9200	-	7.9100	24.1000	25.8000	6.0600	-	6.0800	26.8000	25.3000	-	-
Strontium	0.0384	-	0.0384	0.0894	0.0930	0.0311	0.0309	0.0301	0.0973	0.0893	-	-
Thallium	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	-	<0.0050	<0.0050	<0.0050	0.0061	<0.0050	<0.0050	<0.0050	<0.0050	**0.0300**	
Zirconium	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Dissolved Metals												
Aluminum	0.0258	-	0.0269	0.0085	0.0071	0.0119	-	0.0121	0.0068	0.0047	**0.1000**	**≤0.05**
Antimony	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0002	-	0.0002	0.0001	0.0001	0.0002	-	0.0002	0.0001	<0.00010	-	-
Barium	0.0013	-	0.0014	0.0029	0.0034	0.0016	-	0.0013	0.0030	0.0036	-	-
Beryllium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	-	<0.050	0.0730	0.0790	<0.050	-	<0.050	0.0710	0.0720	-	-
Cadmium	<0.0000050	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	<0.0000050	-	-
Calcium	9.6000	9.5600	9.6600	15.3000	16.2000	9.1900	-	9.2500	16.0000	17.6000	-	-
Chromium	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0007	-	0.0008	0.0006	0.0007	0.0029	-	0.0006	0.0006	0.0006	-	-
Iron	0.0278	-	0.0271	0.0102	0.0096	0.0244	-	0.0247	0.0073	0.0090	-	-
Hardness	28.70	28.60	28.80	46.90	50.10	27.20	-	27.40	48.20	53.90	-	-
Lead	<0.00020	-	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.1400	1.1400	1.1400	2.1200	2.3500	1.0300	-	1.0400	2.0300	2.4300	-	-
Manganese	<0.0010	-	<0.0010	0.0055	0.0045	0.0035	-	0.0026	0.0034	0.0016	-	-
Mercury	<0.0000010	-	<0.0000010	<0.0000010	<0.0000010	<0.0000020	-	0.0000	<0.0000020	<0.0000020	-	-
Molybdenum	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	-	-
Phosphorous	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.1480	-	0.1480	0.3010	0.3080	0.1180	-	0.1270	0.3050	0.3090	-	-
Selenium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.6400	-	1.6700	1.1800	1.1700	1.8400	-	1.8700	1.1300	1.3800	-	-
Silver	<0.000020	-	<0.000020	<0.000020	<0.000020	<0.000020	-	<0.000020	<0.000020	<0.000020	-	-
Sodium	7.7800	-	7.8300	23.9000	25.0000	5.7800	-	5.8700	23.8000	24.6000	-	-
Strontium	0.0392	-	0.0384	0.0864	0.0900	0.0316	-	0.0320	0.0867	0.0892	-	-
Thallium	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	-	<0.0050	<0.0050	<0.0050	0.0052	-	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from
5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided
^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre except where noted.
* Field replicate sample.
WQO = unmet Water Quality Objective

TABLE 15

MIDDLE QUINSAM LAKE WATER QUALITY - FIELD INSTRUMENTS

2012/2013 EMS ID E206618

COMPANY IDENTITY - MQL

Sample Date	April							May¤							June¤¤						
Parameter	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP
Sample Depth (m)	Celcius		µS/cm			mg/L		Celcius		mS/cm			mg/L		Celcius		µS/cm			mg/L	
1	9.910	7.750	112.000	0.102	99.600	11.250	200.800	14.060	7.590	0.051	0.041	99.200	10.200	93.100	16.780	7.480	60	0.047	100.980	9.790	103.700
2	9.960	7.740	112.000	0.102	99.600	11.280	204.000	14.040	7.590	0.051	0.041	98.100	10.100	98.600	16.698	7.470	60	0.047	99.400	9.660	108.300
3	9.530	7.710	114.000	0.105	99.100	11.310	210.000	13.890	7.570	0.050	0.041	97.000	10.020	101.200	16.200	7.430	60	0.047	97.900	9.630	109.100
4	9.030	7.680	117.000	0.110	99.000	11.420	214.200	13.490	7.510	0.051	0.042	95.100	9.910	108.500	15.780	7.410	59	0.046	97.600	9.670	110.600
5	8.750	7.670	121.000	0.114	98.700	11.460	216.600	13.180	7.500	0.056	0.047	95.400	10.010	112.100	15.320	7.420	57	0.045	99.600	9.990	111.100
6	8.510	7.650	123.000	0.117	98.300	11.500	218.800	12.290	7.520	0.071	0.061	97.800	10.460	114.600	14.390	7.420	61	0.050	101.800	10.400	113.800
7	8.210	7.640	129.000	0.123	98.300	11.580	220.500	10.120	7.660	0.110	0.099	103.000	11.580	117.200	13.050	7.440	82	0.069	105.500	11.110	119.200
8	7.320	7.620	137.000	0.135	97.700	11.750	224.200	8.770	7.670	0.139	0.131	99.800	11.580	123.100	10.600	7.460	142	0.127	112.900	12.560	130.600
9	6.810	7.580	140.000	0.140	96.500	11.770	228.500	7.930	7.590	0.145	0.140	94.700	11.230	128.800	9.170	7.480	151	0.141	108.800	12.470	134.900
10	6.430	7.540	142.000	0.143	94.200	11.600	232.000	7.430	7.500	0.148	0.145	88.000	10.570	132.300	8.460	7.450	154	0.146	99.900	11.670	136.600
11	6.260	7.520	144.000	0.145	92.000	11.370	234.700	7.180	7.440	0.150	0.147	84.200	10.170	133.800	8.140	7.430	155	0.148	96.700	11.350	137.000
12	6.220	7.510	145.000	0.147	91.100	11.270	236.100	7.110	7.430	0.150	0.148	82.600	9.990	134.500	8.040	7.400	155	0.149	91.700	10.840	138.100
13	6.160	7.490	148.000	0.151	88.900	11.020	238.100	7.050	7.410	0.151	0.149	81.200	9.830	135.000	7.990	7.390	156	0.150	89.100	10.530	138.100
14	5.830	6.900	470.000	0.482	34.000	4.240	110.200	6.980	7.080	0.241	0.257	60.400	6.950	147.900	7.970	7.370	156	0.150	87.200	10.330	138.400
15																					
15.25																					
Secchi Depth (m)	7m							-							10m						

Sample Date	July							August							September						
Parameter	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP
Sample Depth (m)	Celcius	mS/cm			mg/L			Celcius	mS/cm			mg/L			Celcius	mS/cm			mg/L		
1	20.62	0.078	0.055	108.400	9.740	7.82	49.5	21.72	0.094	0.065	99.5	8.750	7.62	296.1	17.79	0.083	0.062	102.9	9.780	7.99	120.5
2	20.62	0.077	0.055	108.700	9.760	7.73	52.5	21.72	0.094	0.065	100.8	8.860	7.70	300.6	17.80	0.083	0.062	102.7	9.760	7.82	125.5
3	20.60	0.077	0.055	108.500	9.750	7.68	53.6	21.70	0.094	0.065	100.8	8.860	7.71	300.5	17.70	0.083	0.062	102.4	9.760	7.77	129.5
4	20.30	0.076	0.054	109.000	9.850	7.58	56.4	21.43	0.092	0.064	100.6	8.900	7.70	315.2	17.60	0.082	0.062	101.8	9.670	7.74	132.0
5	18.77	0.069	0.051	115.400	10.770	7.49	60.1	19.96	0.073	0.053	111.9	10.130	7.62	331.5	17.55	0.082	0.062	101.2	9.670	7.72	135.1
6	17.03	0.065	0.049	112.800	10.890	7.41	63.3	16.17	0.096	0.075	117.6	11.560	7.46	356.8	17.48	0.083	0.064	100.4	9.610	7.70	137.8
7	14.80	0.073	0.059	115.600	11.650	7.35	66.4	13.65	0.145	0.121	118.4	12.270	7.30	377.3	17.33	0.085	0.136	100.0	9.600	7.67	140.8
8	12.75	0.125	0.106	121.000	12.810	7.28	71.8	11.46	0.159	0.139	110.8	12.080	7.21	387.9	15.28	0.169	0.151	116.0	11.610	7.52	151.5
9	10.44	0.151	0.136	123.800	13.710	7.31	77.3	10.12	0.160	0.145	99.2	11.130	7.00	401.5	12.36	0.177	0.156	104.1	11.110	7.45	156.8
10	9.42	0.154	0.142	117.900	13.390	7.26	81.1	9.57	0.161	0.148	90.3	10.270	7.00	400.2	10.89	0.176	0.159	92.5	10.220	7.36	160.0
11	8.91	0.155	0.145	111.800	12.670	7.18	83.6	9.25	0.161	0.149	85.6	9.780	7.00	398.2	10.19	0.175	0.161	82.3	9.240	7.29	161.9
12	8.59	0.155	0.146	106.100	12.270	7.10	86.5	9.12	0.161	0.150	82.3	9.380	6.98	396.0	9.70	0.175	0.162	72.0	8.170	7.20	163.7
13	8.42	0.155	0.148	98.500	11.480	7.10	86.50	8.98	0.166	0.156	37.2	4.160	6.90	64.50	9.52	0.079	0.166	64.7	7.380	7.14	164.60
14	8.39	0.155	0.147	94.200	11.080	7.07	87.40								9.36	0	0.166	51.2	5.9	7.05	166.20
15	8.09	0.463	0.4460	56.200	7.120	6.27	106.80														
15.25																					
Secchi Depth (m)	10.25m							9.5m							9.5m						

Hypolimnetic DO= 3 mg/L

Results are a minimum during June, July and August

¤ Results were collected on June 4th, ¤¤ results were collected on June 28th.

Results from June 4th are meant to represent the conditions during the month of May

TABLE 16
SETTLING POND 1 WATER QUALITY
2012/2013 EMS ID E218582
COMPANY IDENTITY - SPD

Parameter	April						May				June					Site Description	
Sample Date	2	10	10*	17	24	30	8	15	22	29	5	12	19	26	PERMIT	GPS (m)	
Conductivity (umhos/cm)	547	634	633	698	683	666	647	638	646	646	624	590	544	490	-	Minegrid	
Hardness CaCO3	264	-	-	-	-	322	-	-	-	-	319	-	-	-	-	Northing	Easting
pH	7.65	7.78	7.80	7.84	7.92	7.75	7.82	7.84	7.93	7.93	7.77	7.97	7.88	7.89	6 to 8.5	100983.82	98152.577
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	5.3	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	UTM ZONE 10	
Total Dissolved Solids	408	-	-	-	-	436	-	-	-	-	452	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	1.50	1.10	1.10	2.00	2.02	2.02	2.38	2.68	0.74	0.90	0.88	0.90	<0.50	<0.50	-	5531548	322943
Alkalinity - Total CaCO3	49.0	55.0	55.5	64.0	64.7	63.4	65.0	64.8	69.7	70.2	66.2	67.5	63.6	60.3	-	Permitted Discharge From Settling Pond 1 Decant	
Ammonia Nitrogen	0.0300	-	-	-	-	<0.0050	-	-	-	-	0.0200	-	-	-	1.0		
Nitrate and Nitrite as N	<0.020	-	-	-	-	<0.020	-	-	-	-	<0.020	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	0.03		
Total Phosphorous	<0.0050	-	-	-	-	0.0077	-	-	-	-	0.0107	-	-	-	-		
Sulphate	210	235	229	278	250	232	258	284	266	262	214	233	197	169	-		
Oil and Grease	<1.0	-	-	-	-	<1.0	-	-	-	-	<1.0	-	-	-	10		
Bio Assays (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100		

Parameter	July					August				September					PERMIT	Site Description	
Sample Date	3	10	17	23	31	7	14	20	28	5	11*	11	18	25		GPS (m)	
Conductivity (umhos/cm)	469	429	429	437	432	439	448	449	450	454	448	445	446	440	-	Minegrid	
Hardness CaCO3	218	-	-	-	205	-	-	-	-	214	-	-	-	-	-	Northing	Easting
pH	7.93	7.87	7.74	7.90	7.84	7.92	8.01	7.97	8.13	8.07	8.02	8.05	7.99	7.88	6 to 8.5	100983.82	98152.577
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	UTM ZONE 10	
Total Dissolved Solids	292	-	-	-	308	-	-	-	-	290	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	1.51	1.30	2.33	1.23	1.74	1.75	0.71	0.72	<0.50	3.44	1.07	<0.50	<0.50	0.85	-	5531548	322943
Alkalinity - Total CaCO3	60.3	59.2	62.6	67.4	70.3	71.0	76.5	82.1	81.9	80.0	79.2	79.3	80.8	82.3	-	Permitted Discharge From Settling Pond 1 Decant	
Ammonia Nitrogen	0.0120	-	-	-	0.0140	-	-	-	-	0.0230	-	-	-	-	1.0		
Nitrate and Nitrite as N	<0.020	-	-	-	<0.020	-	-	-	-	<0.020	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	0.03		
Total Phosphorous	0.007	-	-	-	0.0089	-	-	-	-	<0.0050	-	-	-	-	-		
Sulphate	151	149	152	151	141	139	1.23	140	144	138	142	153	154	149	-		
Oil and Grease	<1.0	-	-	<1.0	<1.0	-	-	-	-	<1.0	-	-	-	-	10		
Bio Assays (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100		

Parameter	October					November				December				PERMIT	Site Description	
Sample Date	2	9	16	23	30	6	13	20	27	1	11	18	28		GPS (m)	
Conductivity (umhos/cm)	452	465	434	420	350	381	142	306	119	-	92.3	148	104	-	Minegrid	
Hardness CaCO3	-	204	-	-	-	178	-	-	-	-	48.1	-	-	-	Northing	Easting
pH	7.97	7.96	7.90	7.93	7.77	7.84	7.41	7.49	7.12	7.65	7.19	7.09	6.97	6 to 8.5	100983.82	98152.577
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0		<4.0	<4.0	<4.0	25	UTM ZONE 10	
Total Dissolved Solids	-	318	-	-	-	236	-	-	-	-	84	-	-	-	Northing	Easting
Acidity (to pH 8.3)	<0.50	<0.50	<0.50	<0.50	0.70	<0.50	1.70	3.13	4.92	0.85	1.42	3.15	3.32	-	5531548	322943
Alkalinity - Total CaCO3	83.0	82.5	79.4	77.9	57.7	50.0	23.0	30.1	13.6	49.1	11.6	15.5	13.4	-	Permitted Discharge From Settling Pond 1 Decant	
Ammonia Nitrogen	-	0.0160	-	-	-	0.0210	-	-	-	-	0.0180	-	-	1.0		
Nitrate and Nitrite as N	-	<0.020	-	-	-	<0.020	-	-	-	-	<0.020	-	-	-		
Dissolved Phosphorous	-	<0.0050	-	-	-	0.0053	-	-	-	-	<0.0050	-	-	0.03		
Total Phosphorous	-	0.0085	-	-	-	0.0113	-	-	-	-	0.0062	-	-	-		
Sulphate	150	146	142	144	110	136	39.6	122	33.7	252	26.9	46	28.3	-		
Oil and Grease	-	3	-	-	-	-	-	-	-	-	-	-	-	10		
Bio Assays (%)	-	-	-	-	-	-	-	-	-	100^	-	-	-	100		

Results expressed in milligrams per litre except where noted.
Bold = Exceedence of permit limit.
* Field replicate sample.
^ Sample taken Dec 6

TABLE 16
SETTLING POND 1 WATER QUALITY
2012/2013 EMS ID E218582
COMPANY IDENTITY - SPD

Parameter / Sample Date	January						February									PERMIT	Site Description GPS (m)	
	2	8	16	21	29*	29	4	5	8	12	13	18	20	25	27		Minegrid	
Conductivity (umhos/cm)	74	75	71.7	94.4	-	-	49.5	39.7	45.5	-	47.2	-	44.9	-	470	-		
Field Conductivity (uS/cm)	-	-	-	-	-	-	44	-	-	643.5	-	275	-	392		-	Northing	Easting
Hardness CaCO3	27.8	-	-	-	-	-	18.4	15.9	19.3	-	17.3	7.06	14.8	-	212	-		
pH	6.94	6.75	6.76	7.16	-	7.22	6.90	6.89	6.91	6.47	6.64	-	6.72	-	7.54	6 to 8.5	100983.82	98152.577
Field pH	-	-	-	-	-	-	**5.76 (P)**	-	-	7.23	-	6.81	-	7.17	-	6 to 8.5	UTM ZONE 9	
Total Suspended Solids	<4.0	<4.0	12.3	<4.0	9.5	10.5	<4.0	<4.0	-	<4.0	<4.0	<4.0	<4.0	5.3	<4.0	25		
Total Dissolved Solids	-	-	-	-	-	-	24	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	1.68	3.38	2.68	4.37	-	-	-	-	-	-	3.75	-	-	-	-	-	5531548	322943
Alkalinity - Total CaCO3	13.8	12.9	13.9	14.0	-	-	11.2	9.6	8.6	-	7.0	-	8.2	-	42.9	-		
Ammonia Nitrogen	0.0094	-	-	-	-	-	0.0082	-	-	-	-	-	-	-	-	1.0		
Nitrate and Nitrite as N	<0.020	-	-	-	-	-	<0.020	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	0.0072	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	Permitted Discharge From Settling Pond 1 Decant	
Total Phosphorous	0.0081	-	-	-	-	-	0.006	-	-	-	-	-	-	-	-	-		
Sulphate	17.8	18.6	16.9	22.5	12.4	12.6	10.2	7.51	10.2	5.67	12.6	3.63	9.87	191	177	-		
Oil and Grease	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	-	-	-	10		
Bio Assays (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100		

Parameter / Sample Date	March				PERMIT	Site Description GPS (m)	
	4	11	19	26		Minegrid	
Conductivity (umhos/cm)	-	-	-	-	-		
Field Conductivity (uS/cm)	-	7785	709	532.1	-		
Hardness CaCO3	-	-	-	-	-	Northing	Easting
pH	7.40	-	-	-	6 to 8.5	100983.82	98152.577
Field pH	-	7.82	7.01	7.38	6 to 8.5	UTM ZONE 9	
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	25		
Total Dissolved Solids	298	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	-	-	-	-	-	5531548	322943
Alkalinity - Total CaCO3	39.4	-	-	-	-		
Ammonia Nitrogen	0.0360	-	-	-	1.0		
Nitrate and Nitrite as N	<0.020	-	-	-	-		
Dissolved Phosphorous	-	-	-	-	0.03	Permitted Discharge From Settling Pond 1 Decant	
Total Phosphorous	0.0069	-	-	-	-		
Sulphate	179	242	312	300	-		
Oil and Grease	-	-	-	-	10		
Bio Assays (%)	-	-	-	-	100		

Results expressed in milligrams per litre except where noted.
Bold = Exceedence of permit limit.
* Field replicate sample.
^ Sample taken Dec 6

TABLE 17
SETTLING POND 1 METALS ANALYSIS
2012/2013 EMS ID- E218582
COMPANY IDENTITY - SPD

Parameter	April		June	July		September	
Sample Date	2	30	5	3	31	5	**Permit**
Total Metals							
Aluminum	0.094	0.0184	0.0099	0.0045	0.0079	0.0387	-
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-
Arsenic	0.0005	0.0009	0.00119	0.00112	0.00186	0.0017	-
Barium	0.008	0.0115	0.0124	0.0103	0.0136	0.0157	-
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Boron	0.05	0.08	0.079	0.085	0.103	0.109	-
Cadmium	0.00001	0.000018	0.000048	<0.000010	<0.000010	<0.000010	-
Calcium	88.3	98	101	71.5	66.4	68.8	-
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Cobalt	<0.0005	0.00065	<0.00050	<0.00050	<0.00050	<0.00050	-
Copper	0.0009	0.00052	0.00064	0.00073	0.00107	0.00076	-
Iron	0.271	0.462	0.381	0.231	0.26	0.193	-
Hardness	226	229	307	218	205	214	-
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Magnesium	11.1	13.3	13.3	9.67	9.48	10.1	-
Manganese	0.04	0.171	0.0299	0.0299	0.0617	0.0403	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	-
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Nickel	0.002	0.0028	0.0015	0.0011	0.0014	0.0012	-
Phosphorus	<0.0050	0.0077	0.0107	0.007	0.0089	<0.0050	-
Potassium	0.567	0.775	0.745	0.454	0.454	0.479	-
Selenium	<0.0001	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	-
Silicon	2.9	2.04	0.86	0.79	1.06	0.63	-
Silver	0.00006	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-
Sodium	4.79	7.23	6.48	5.33	5.83	6.77	-
Strontium	0.452	0.536	0.539	0.414	0.394	0.412	-
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Titanium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Zinc	<0.005	0.0056	<0.0050	<0.0050	<0.0050	<0.0050	-
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-
Dissolved Metals							
Aluminum	0.0323	0.0058	<0.0030	0.0033	0.0057	<0.0030	**0.500**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**
Arsenic	0.00029	0.00065	0.00082	0.00086	0.00166	0.00156	**-**
Barium	0.0076	0.0125	0.013	0.0097	0.0133	0.0154	**-**
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**-**
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Boron	0.064	0.083	0.088	0.08	0.105	0.118	**-**
Cadmium	<0.000010	<0.000010	0.000022	<0.000010	<0.000010	0.000013	**-**
Calcium	87.4	106	105	67.1	67.2	66.8	**-**
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**-**
Cobalt	<0.00050	0.00056	<0.00050	<0.00050	<0.00050	<0.00050	**-**
Copper	0.00075	0.0006	0.00076	0.00054	0.00064	0.00099	**0.02**
Iron	0.0789	0.0237	0.0236	0.027	0.0443	0.0749	**0.50**
Hardness	264	322	319	206	209	210	**-**
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.05**
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Magnesium	11	14.1	13.7	9.24	9.97	10.6	**-**
Manganese	0.0409	0.165	0.0232	0.0248	0.0431	<0.0010	**-**
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	**-**
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**-**
Nickel	0.0014	0.0033	0.0015	0.0011	0.0016	0.0014	**-**
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.03**
Potassium	0.586	0.824	0.805	0.403	0.481	0.503	**-**
Selenium	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**-**
Silicon	2.63	2.02	0.93	0.78	1.07	0.59	
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**-**
Sodium	4.87	6.39	6.86	5.21	6.25	6.98	**-**
Strontium	0.46	0.61	0.578	0.388	0.403	0.422	**-**
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	**-**
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**-**
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Zinc	<0.0050	0.0056	<0.0050	<0.0050	<0.0050	<0.0050	**0.10**
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**

Results expressed in milligrams per litre.
* Indicates replicate sample.

TABLE 17
SETTLING POND 1 METALS ANALYSIS
2012/2013 EMS ID- E218582
COMPANY IDENTITY - SPD

Parameter / Sample Date	October 9	November 6	December 11	January 2	Permit
Total Metals					
Aluminum	0.0126	0.09	0.0944	0.0503	-
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-
Arsenic	0.00142	0.00125	0.00167	0.00109	-
Barium	0.0179	0.0149	0.0038	0.0028	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-
Boron	0.13	0.084	<0.050	<0.050	-
Cadmium	0.000009	0.000005	<0.000010	0.000019	-
Calcium	69	52	14.5	8.5	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-
Cobalt	<0.00050	0.00097	<0.00050	0.00064	-
Copper	0.00079	0.00111	0.00101	0.00061	-
Iron	0.184	0.415	0.277	0.507	-
Hardness	-	-	-	26.6	-
Lead	<0.00020	0.00142	<0.00020	<0.00020	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	-
Magnesium	11	7.1	1.99	1.31	-
Manganese	0.0332	0.3	0.0783	0.149	-
Mercury	<0.000020	<0.000020	<0.000010	<0.000010	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	-
Nickel	0.0016	0.0037	<0.0010	<0.0010	-
Phosphorus	0.0085	0.0113	0.0062	0.0081	-
Potassium	0.486	0.741	0.23	0.172	-
Selenium	<0.00010	0.00011	<0.00010	<0.00010	-
Silicon	0.35	2.17	4.14	2.89	-
Silver	0.000024	<0.000020	<0.000020	<0.000020	-
Sodium	7.61	6.48	2.93	1.85	-
Strontium	0.429	0.293	0.0716	0.0458	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-
Zinc	<0.0050	<0.0050	0.104	<0.0050	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	-
Dissolved Metals					
Aluminum	<0.0030	0.0168	0.0633	0.0344	**0.500**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	**-**
Arsenic	0.00127	0.00101	0.00125	0.00102	**-**
Barium	0.0164	0.0153	0.0042	0.0029	**-**
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	**-**
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	
Boron	0.125	0.084	<0.050	<0.050	**-**
Cadmium	<0.0000050	<0.0000050	<0.000010	0.000015	**-**
Calcium	65.6	58.9	15.5	8.96	**-**
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	**-**
Cobalt	<0.00050	0.00055	<0.00050	0.00062	**-**
Copper	0.00038	0.00061	0.00073	0.00045	**0.02**
Iron	0.0779	0.0897	0.19	0.302	**0.50**
Hardness	-	-	-	27.8	**-**
Lead	<0.00020	<0.00020	<0.00020	<0.00020	**0.05**
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Magnesium	9.72	7.64	2.29	1.32	**-**
Manganese	0.0034	0.264	0.0768	0.145	**-**
Mercury	<0.000020	<0.000020	<0.000010	<0.000010	**-**
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	**-**
Nickel	0.0014	0.0031	<0.0010	<0.0010	**-**
Phosphorus	<0.0050	0.0053	<0.0050	0.0072	**0.03**
Potassium	0.452	0.808	0.245	0.184	**-**
Selenium	<0.00010	0.0002	<0.00010	<0.00010	**-**
Silicon	0.38	2.37	4	3.24	**-**
Silver	<0.000020	<0.000020	<0.000020	<0.000020	**-**
Sodium	6.65	6.87	3.13	1.91	**-**
Strontium	0.408	0.315	0.0872	0.0498	**-**
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	**-**
Tin	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	**-**
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Zinc	<0.0050	<0.0050	0.096	<0.0050	**0.10**
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	**-**

Results expressed in milligrams per litre.
* Indicates replicate sample.

TABLE 17
SETTLING POND 1 METALS ANALYSIS
2012/2013 EMS ID- E218582
COMPANY IDENTITY - SPD

Parameter	February							March	
Sample Date	4	5	8	13	18	20	27	4	Permit
Total Metals									
Aluminum	0.0982	0.105	0.141	0.0458	-	0.0333	0.136	-	-
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	-	-
Arsenic	0.00079	0.00049	0.00087	0.00043	-	0.00027	0.0007	-	-
Barium	0.0025	0.0021	0.0035	0.0021	-	0.0016	0.0094	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	<0.050	-	<0.050	0.056	-	-
Cadmium	0.000798	0.000043	0.00002	<0.000010	-	<0.000010	<0.000010	-	-
Calcium	4.44	4.87	7.1	5.05	-	4.91	66.5	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	0.00064	-	-
Copper	0.00096	0.00136	0.00113	0.00052	-	0.00048	0.0008	-	-
Iron	0.158	0.202	0.33	0.169	-	0.168	0.422	-	-
Hardness	14.1	15.5	23.2	15.9	-	15.5	203	-	-
Lead	<0.00020	<0.00020	0.00026	<0.00020	-	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	-	-
Magnesium	0.731	0.808	1.33	0.808	-	0.796	8.85	-	-
Manganese	0.0179	0.0225	0.0279	0.0469	-	0.0368	0.0789	-	-
Mercury	<0.00002	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	-	-
Nickel	<0.0010	0.001	<0.0010	<0.0010	-	<0.0010	0.0014	-	-
Phosphorus	0.006	-	-	-	-	-	-	0.0069	-
Potassium	0.135	0.185	0.177	0.165	-	0.096	0.564	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	0.00011	-	-
Silicon	2.85	2.75	2.71	2.04	-	1.84	2.9	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	-	<0.000020	<0.000020	-	-
Sodium	1.33	1.19	1.48	1.12	-	1.21	11.7	-	-
Strontium	0.0181	0.0226	0.0334	0.0242	-	0.0252	0.375	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	0.005	<0.0050	-	<0.0050	0.0053	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	-	-
Zinc	0.0051	0.0116	<0.0050	<0.0050	-	0.0256	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	-	-
Dissolved Metals									
Aluminum	0.0557	0.0474	0.0615	0.0353	0.0191	0.0246	0.0189	-	**0.500**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	**-**
Arsenic	0.00032	0.00037	0.00042	0.00041	0.00019	0.00028	0.00048	-	**-**
Barium	0.0019	0.0017	0.0026	0.0022	0.0011	0.0013	0.0099	-	**-**
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	**-**
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	
Boron	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.056	-	**-**
Cadmium	0.00023	0.000012	0.000018	0.000012	0.000066	<0.000010	<0.000010	-	**-**
Calcium	5.76	4.91	5.97	5.49	2.18	4.66	70.7	-	**-**
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	**-**
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	**-**
Copper	0.00051	0.00078	0.00084	0.00076	0.00026	0.00025	0.00042	-	**0.02**
Iron	0.0618	0.0642	0.0953	0.0924	0.0367	0.0838	0.0665	-	**0.50**
Hardness	18.4	15.9	19.3	17.3	7.06	14.8	212	-	**-**
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	**0.05**
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	**-**
Magnesium	1.03	0.883	1.07	0.881	0.391	0.771	8.56	-	**-**
Manganese	0.0199	0.0215	0.0189	0.0439	0.021	0.0307	0.0731	-	**-**
Mercury	<0.00002	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	**-**
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	**-**
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	-	**-**
Phosphorus	-	-	-	-	-	-	-	-	**0.03**
Potassium	0.135	0.155	0.177	0.224	0.068	0.097	0.623	-	**-**
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00016	-	**-**
Silicon	2.91	2.52	2.59	1.98	1.37	1.71	3.14	-	**-**
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-	**-**
Sodium	1.37	1.28	1.32	1.25	0.706	1.14	11.5	-	**-**
Strontium	0.0267	0.0247	0.0296	0.0265	0.0112	0.0243	0.395	-	**-**
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	**-**
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	**-**
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	**-**
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	**-**
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	**-**
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.016	<0.0050	-	**0.10**
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	**-**

Results expressed in milligrams per litre.
* Indicates replicate sample.

TABLE 18
WATER QUANTITY FOR SETTLING POND 1
2012/2013 EMS ID E218582
COMPANY IDENTITY SPD

Date	April Max. (m3/D)	April Daily(m3/D)	May Max. (m3/s)	May Daily (m3/s)	June Max.(m3/s)	June Daily(m3/s)	July Max. (m3/D)	July Daily(m3/D)	August Max. (m3/s)	August Daily (m3/s)	September Max.(m3/s)	September Daily(m3/s)
1	**No data (PNC)**		0.00000	0.00000	**No data (PNC)**		**No data (PNC)**		0.03650	0.00365	0.00000	0.00000
2	**No data (PNC)**		0.00000	0.00000	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000
3	**No data (PNC)**		0.00000	0.00000	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000
4	**No data (PNC)**		**No data (PNC)**		**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000
5	**No data (PNC)**		**No data (PNC)**		**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000
6	0.04500	0.03059	**No data (PNC)**		**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000
7	**0.06540**	0.00501	**No data (PNC)**		**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000
8	0.01020	0.00395	**No data (PNC)**		**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000
9	0.00740	0.00108	**No data (PNC)**		**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000
10	0.00360	0.00112	**No data (PNC)**		**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000
11	0.00040	0.00112	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00610	0.00140	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
13	0.00240	0.00026	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00010	0.00001	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15	0.00000	0.00000	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
16	0.00270	0.00023	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
17	0.00020	0.00001	**No data (PNC)**		**No data (PNC)**		0.01370	0.00028	0.00000	0.00000	0.00000	0.00000
18	0.00200	0.00043	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19	0.00040	0.00002	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20	0.00050	0.00002	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	**No data (PNC)**		**No data (PNC)**		0.00270	0.00005	0.00000	0.00000	0.00000	0.00000
22	0.00060	0.00004	**No data (PNC)**		**No data (PNC)**		0.00270	0.00003	0.00000	0.00000	0.00000	0.00000
23	0.00000	0.00000	**No data (PNC)**		**No data (PNC)**		**0.20970**	0.01600	0.00000	0.00000	0.00000	0.00000
24	0.00090	0.00004	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
25	0.00250	0.00086	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
26	0.00060	0.00002	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
27	0.00000	0.00000	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
28	0.00000	0.00000	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
29	0.00150	0.00046	**No data (PNC)**		**No data (PNC)**		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
30	0.00040	0.00002	**No data (PNC)**		**No data (PNC)**		0.02110	0.00139	0.00000	0.00000	**No data (PNC)**	
31	-	-	**No data (PNC)**		**No data (PNC)**		**0.04610**	0.01730	0.00000	0.00000	-	-
Monthly Max.	0.06640		0.00000		No data		0.20970		0.00000		0.00000	
Monthly Avg.	0.00187		0.00000				0.00167		0.00000		0.00000	

Bold = flow requires sample
* = data was adjusted due to sensor error
** = partial data for day
^ = sensor activated by equipment adjustment, not flow. No sample required

TABLE 18
WATER QUANTITY FOR SETTLING POND 1
2012/2013 EMS ID E218582
COMPANY IDENTITY SPD

Date	October Max. (m3/D)	October Daily(m3/D)	November Max. (m3/s)	November Daily (m3/s)	December Max.(m3/s)	December Daily(m3/s)	January Max. (m3/D)	January Daily(m3/D)	February Max. (m3/s)	February Daily (m3/s)	March Max.(m3/s)	March Daily(m3/s)
1	**No data (PNC)**		**No data (PNC)**		**0.21280**	0.19656	0.00771	0.00376	0.02863	0.02315	**0.07219**	0.06047
2	**No data (PNC)**		**No data (PNC)**		**0.1877****	0.1877**	0.00335	0.00233	0.03251	0.02699	**0.06765**	0.05509
3	0.00000	0.00000	**No data (PNC)**		**0.1866****	0.104674**	0.01641	0.00664	0.03242	0.02981	No data	No data
4	0.00000	0.00000	**No data (PNC)**		**0.1001****	0.089408**	0.01339	0.00458	0.04224	0.02138	No data	No data
5	0.00000	0.00000	0.0072**	0.004558**	**0.09830**	0.07615	0.01594	0.00964	**0.08911**	0.00184	**0.04947**	0.03683
6	0.00000	0.00000	0.0162**	0.004065**	**0.07100**	0.05186	0.02474	0.01532	**0.13530**	0.01689	**0.05385**	0.03620
7	0.00000	0.00000	**No data (PNC)**		**0.05340**	0.03809	**0.04685**	0.03246	**0.19390**	0.15100	0.04357	0.03229
8	0.00000	0.00000	**No data (PNC)**		**0.04480**	0.03287	**0.05295**	0.03532	**0.16890**	0.13650	0.03110	0.02251
9	**No data (PNC)**		**No data (PNC)**		0.03100	0.01566	**0.05240**	0.03908	**0.11980**	0.10940	0.02438	0.01872
10	**No data (PNC)**		**No data (PNC)**		0.03070	0.01623	0.04095	0.02112	**0.10560**	0.10080	0.02020	0.01832
11	**No data (PNC)**		**No data (PNC)**		0.01980	0.01115	0.02351	0.00975	**0.10210**	0.08692	**No data (PNC)**	
12	0.00000	0.00000	**No data (PNC)**		0.0108**	.005665**	0.01408	0.00805	**0.09139**	0.05553	0.03781	0.00209
13	0.00000	0.00000	0.006*	0.006*	0.01880	0.00931	0.00988	0.00597	**0.09547**	0.07484	**0.05385**	0.03595
14	0.00000	0.00000	0.006*	0.004345*	0.01330	0.00462	0.00597	0.00480	**0.07206**	0.05219	**0.05601**	0.04493
15	0.00000	0.00000	0.006*	0.006*	0.00300	0.00268	0.00549	0.00305	**0.08161**	0.05249	**0.05240**	0.04248
16	0.00000	0.00000	0.006*	0.006*	0.01020	0.00268	0.3381^	0.03329	**0.07194**	0.04967	0.04547	0.03467
17	0.00000	0.00000	0.006*	0.006*	0.01750	0.00951	0.00955	0.00863	**0.06298**	0.04298	0.03522	0.02770
18	0.00000	0.00000	0.006*	0.006*	0.02090	0.00945	0.00887	0.00397	**0.05385**	0.04294	0.03853	0.02624
19	0.00000	0.00000	0.006*	0.006*	0.01260	0.00456	0.00282	0.00109	**0.05934**	0.03324	0.04320	0.02618
20	**No data (PNC)**		0.006*	0.006*	0.01170	0.00380	0.00258	0.00093	**0.05336**	0.03326	**0.06298**	0.01674
21	**No data (PNC)**		0.006*	0.006*	0.00620	0.00228	0.3153^	0.00564	0.02596	0.02129	0.03893	0.02580
22	**No data (PNC)**		0.006*	0.006*	0.01780	0.00406	0.01514	0.01165	0.02544	0.02129	0.03491	0.01846
23	**No data (PNC)**		0.006*	0.006*	0.01220	0.00331	0.02089	0.01241	0.02500	0.01855	0.02271	0.01932
24	**No data (PNC)**		0.006*	0.006*	0.03480	0.01439	0.01935	0.01298	**No data (PNC)**		0.02150	0.01752
25	**No data (PNC)**		0.006*	0.006*	0.00770	0.00498	0.02072	0.01339	**0.06841**	0.05581	0.04574	0.02807
26	**No data (PNC)**		0.006*	0.006*	0.01560	0.00358	0.02386	0.02022	**0.06064**	0.04641	0.04582	0.02963
27	**No data (PNC)**		0.006*	0.006*	0.01560	0.00399	**No data (PNC)**		**0.05172**	0.04076	0.02991	0.01816
28	**No data (PNC)**		0.006*	0.006*	0.00420	0.00263	0.01474	0.01393	**0.06010**	0.04564	0.02711	0.01992
29	**No data (PNC)**		0.21800	**0.10755**	0.02070	0.00702	0.01884	0.01096			0.02237	0.01472
30	**No data (PNC)**		0.22200	**0.21965**	0.01390	0.00675	0.01120	0.01075			0.02089	0.01305
31	**No data (PNC)**		-	-	0.03740	0.02085	0.02098	0.02044			0.01986	0.01241
Monthly Max.	0.00000		0.22200		0.21280		0.05295		0.19390		0.07219	
Monthly Avg.	0.00000		0.16360		0.02070		0.01274		0.05154		0.02695	

Bold = flow requires sample
* = data was adjusted due to sensor error
** = partial data for day
^ = sensor activated by equipment adjustment, not flow. No sample required

TABLE 19
SETTLING POND 1 DAILY TSS
2012/2013 EMS ID E218582
COMPANY IDENTITY SPD
FOR DECANT FLOW > 0.046 m3/s AND < 0.46 m3/s

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Apr-12	-	1-May-12	-	1-Jun-12	-
2-Apr-12	<4.0	2-May-12	-	2-Jun-12	-
3-Apr-12	-	3-May-12	-	3-Jun-12	-
4-Apr-12	-	4-May-12	-	4-Jun-12	-
5-Apr-12	-	5-May-12	-	5-Jun-12	<4.0
6-Apr-12	-	6-May-12	-	6-Jun-12	-
7-Apr-12	**^ (PNC)**	7-May-12	-	7-Jun-12	-
8-Apr-12	-	8-May-12	5.30	8-Jun-12	-
9-Apr-12	-	9-May-12	-	9-Jun-12	-
10-Apr-12	<4.0	10-May-12	-	10-Jun-12	-
11-Apr-12	-	11-May-12	-	11-Jun-12	-
12-Apr-12	-	12-May-12	-	12-Jun-12	<4.0
13-Apr-12	-	13-May-12	-	13-Jun-12	-
14-Apr-12	-	14-May-12	-	14-Jun-12	-
15-Apr-12	-	15-May-12	<4.0	15-Jun-12	-
16-Apr-12	-	16-May-12	-	16-Jun-12	-
17-Apr-12	<4.0	17-May-12	-	17-Jun-12	-
18-Apr-12	-	18-May-12	-	18-Jun-12	-
19-Apr-12	-	19-May-12	-	19-Jun-12	<4.0
20-Apr-12	-	20-May-12	-	20-Jun-12	-
21-Apr-12	-	21-May-12	-	21-Jun-12	-
22-Apr-12	-	22-May-12	<4.0	22-Jun-12	-
23-Apr-12	-	23-May-12	-	23-Jun-12	-
24-Apr-12	<4.0	24-May-12	-	24-Jun-12	-
25-Apr-12	-	25-May-12	-	25-Jun-12	-
26-Apr-12	-	26-May-12	-	26-Jun-12	<4.0
27-Apr-12	-	27-May-12	-	27-Jun-12	-
28-Apr-12	-	28-May-12	-	28-Jun-12	-
29-Apr-12	-	29-May-12	<4.0	29-Jun-12	-
30-Apr-12	<4.0	30-May-12	-	30-Jun-12	-
		31-May-12	-		
Permit Limit: 25mg/L					

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Jul-12	-	1-Aug-12	-	1-Sep-12	-
2-Jul-12	-	2-Aug-12	-	2-Sep-12	-
3-Jul-12	<4.0	3-Aug-12	-	3-Sep-12	-
4-Jul-12	-	4-Aug-12	-	4-Sep-12	-
5-Jul-12	-	5-Aug-12	-	5-Sep-12	<4.0
6-Jul-12	-	6-Aug-12	-	6-Sep-12	-
7-Jul-12	-	7-Aug-12	<4.0	7-Sep-12	-
8-Jul-12	-	8-Aug-12	-	8-Sep-12	-
9-Jul-12	-	9-Aug-12	-	9-Sep-12	-
10-Jul-12	<4.0	10-Aug-12	-	10-Sep-12	-
11-Jul-12	-	11-Aug-12	-	11-Sep-12	<4.0
12-Jul-12	-	12-Aug-12	-	12-Sep-12	-
13-Jul-12	-	13-Aug-12	-	13-Sep-12	-
14-Jul-12	-	14-Aug-12	<4.0	14-Sep-12	-
15-Jul-12	-	15-Aug-12	-	15-Sep-12	-
16-Jul-12	-	16-Aug-12	-	16-Sep-12	-
17-Jul-12	<4.0	17-Aug-12	-	17-Sep-12	-
18-Jul-12	-	18-Aug-12	-	18-Sep-12	<4.0
19-Jul-12	-	19-Aug-12	-	19-Sep-12	-
20-Jul-12	-	20-Aug-12	<4.0	20-Sep-12	-
21-Jul-12	-	21-Aug-12	-	21-Sep-12	-
22-Jul-12	-	22-Aug-12	-	22-Sep-12	-
23-Jul-12	<4.0	23-Aug-12	-	23-Sep-12	-
24-Jul-12	-	24-Aug-12	-	24-Sep-12	-
25-Jul-12	-	25-Aug-12	-	25-Sep-12	<4.0
26-Jul-12	-	26-Aug-12	-	26-Sep-12	-
27-Jul-12	-	27-Aug-12	-	27-Sep-12	-
28-Jul-12	-	28-Aug-12	<4.0	28-Sep-12	-
29-Jul-12	-	29-Aug-12	-	29-Sep-12	-
30-Jul-12	-	30-Aug-12	-	30-Sep-12	-
31-Jul-12	<4.0	31-Aug-12	-		
Permit Limit: 25mg/L					

Note: All TSS results were from composite samples except samples marked with*, * Replicate and Grab samples.

Results are expressed in milligrams per litre.
^ = missing sample
(PNC) = Permit non-compliance

TABLE 19
SETTLING POND 1 DAILY TSS
2012/2013 EMS ID E218582
COMPANY IDENTITY SPD
FOR DECANT FLOW > 0.046 m3/s AND < 0.46 m3/s

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Oct-12	-	1-Nov-12	-	1-Dec-12	10.5
2-Oct-12	<4.0	2-Nov-12	-	2-Dec-12	11.3
3-Oct-12	-	3-Nov-12	-	3-Dec-12	<4.0
4-Oct-12	-	4-Nov-12	-	4-Dec-12	6.7
5-Oct-12	-	5-Nov-12	-	5-Dec-12	<4.0
6-Oct-12	-	6-Nov-12	<4.0	6-Dec-12	<4.0
7-Oct-12	-	7-Nov-12	-	7-Dec-12	-
8-Oct-12	-	8-Nov-12	-	8-Dec-12	4.3
9-Oct-12	<4.0	9-Nov-12	-	9-Dec-12	<4.0
10-Oct-12	-	10-Nov-12	-	10-Dec-12	<4.0
11-Oct-12	-	11-Nov-12	-	11-Dec-12	<4.0
12-Oct-12	-	12-Nov-12	-	12-Dec-12	<4.0
13-Oct-12	-	13-Nov-12	<4.0	13-Dec-12	<4.0
14-Oct-12	-	14-Nov-12	-	14-Dec-12	12.5
15-Oct-12	-	15-Nov-12	<4.0	15-Dec-12	<4.0
16-Oct-12	<4.0	16-Nov-12	<4.0	16-Dec-12	<4.0
17-Oct-12	-	17-Nov-12	<4.0	17-Dec-12	<4.0
18-Oct-12	-	18-Nov-12	4	18-Dec-12	<4.0
19-Oct-12	-	19-Nov-12	5.5	19-Dec-12	4.3
20-Oct-12	-	20-Nov-12	<4.0	20-Dec-12	4.5
21-Oct-12	-	21-Nov-12	5.2	21-Dec-12	<4.0
22-Oct-12	-	22-Nov-12	4.7	22-Dec-12	<4.0
23-Oct-12	<4.0	23-Nov-12	<4.0	23-Dec-12	4
24-Oct-12	-	24-Nov-12	<4.0	24-Dec-12	<4.0
25-Oct-12	-	25-Nov-12	<4.0	25-Dec-12	4
26-Oct-12	-	26-Nov-12	<4.0	26-Dec-12	<4.0
27-Oct-12	-	27-Nov-12	<4.0	27-Dec-12	<4.0
28-Oct-12	-	28-Nov-12	<4.0	28-Dec-12	<4.0
29-Oct-12	-	29-Nov-12	6.7	29-Dec-12	-
30-Oct-12	<4.0	30-Nov-12	12.3	30-Dec-12	-
31-Oct-12	-			31-Dec-12	-
Permit Limit: 25mg/L					

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Jan-13	-	1-Feb-13	-	1-Mar-13	<4.0
2-Jan-13	23.7	2-Feb-13	-	2-Mar-13	<4.0
3-Jan-13	-	3-Feb-13	-	3-Mar-13	-
4-Jan-13	-	4-Feb-13	-	4-Mar-13	-
5-Jan-13	-	5-Feb-13	4	5-Mar-13	-
6-Jan-13	-	6-Feb-13	7.3	6-Mar-13	<4.0
7-Jan-13	6.3	7-Feb-13	8.5	7-Mar-13	-
8-Jan-13	4	8-Feb-13	11	8-Mar-13	-
9-Jan-13	**No Data (PNC)**	9-Feb-13	4.5	9-Mar-13	-
10-Jan-13	<4.0	10-Feb-13	<4.0	10-Mar-13	-
11-Jan-13	-	11-Feb-13	<4.0	11-Mar-13	<4.0*
12-Jan-13	-	12-Feb-13	<4.0	12-Mar-13	-
13-Jan-13	-	13-Feb-13	<4.0	13-Mar-13	<4.0*
14-Jan-13	-	14-Feb-13	<4.0	14-Mar-13	<4.0*
15-Jan-13	-	15-Feb-13	<4.0	15-Mar-13	<4.0*
16-Jan-13	-	16-Feb-13	<4.0	16-Mar-13	-
17-Jan-13	-	17-Feb-13	<4.0	17-Mar-13	-
18-Jan-13	-	18-Feb-13	<4.0	18-Mar-13	-
19-Jan-13	-	19-Feb-13	<4.0	19-Mar-13	-
20-Jan-13	-	20-Feb-13		20-Mar-13	<4.0*
21-Jan-13	9.5	21-Feb-13	-	21-Mar-13	-
22-Jan-13	-	22-Feb-13	-	22-Mar-13	-
23-Jan-13	-	23-Feb-13	-	23-Mar-13	-
24-Jan-13	-	24-Feb-13	**No Data (PNC)**	24-Mar-13	-
25-Jan-13	-	25-Feb-13	<5.3	25-Mar-13	-
26-Jan-13	-	26-Feb-13	<4.0	26-Mar-13	-
27-Jan-13	**No Data (PNC)**	27-Feb-13	<4.0	27-Mar-13	-
28-Jan-13	<4.0	28-Feb-13	<4.0	28-Mar-13	-
29-Jan-13	-		-	29-Mar-13	-
30-Jan-13	-		-	30-Mar-13	-
31-Jan-13	-		-	31-Mar-13	-
			-		-
Permit Limit: 25mg/L					

Note: All TSS results were from composite samples except samples marked with*, * Replicate and Grab samples.

Results are expressed in milligrams per litre.
^ = missing sample
(PNC) = Permit non-compliance

TABLE 20
3 SOUTH PIT WATER QUALITY
2012/2013 EMS ID- E217015
COMPANY IDENTITY - 3S

Parameter	April					May				June					Site Description	
Sample Date	2	10	17	24	30	8	15	22	29	5	12	12*	19	26	GPS (m)	
Conductivity (umhos/cm)	1330	1130	1260	1250	1220	1240	1290	1340	1350	1330	1300	1310	1310	1300	Minegrid	
Hardness CaCO3	757	-	-	-	666	-	-	-	-	703	-	-	-	-	Northing	Easting
pH	7.96	7.88	7.97	8.07	7.91	7.98	7.97	7.91	7.97	7.96	7.88	7.93	8.00	7.93	101583	97548
Acidity (to pH 8.3)	2.90	1.70	2.00	2.27	2.28	2.04	2.09	1.66	1.61	0.90	1.00	1.21	0.70	1.55	UTM ZONE 10	
Alkalinity - Total CaCO3	91.9	75.9	79.4	81.1	76.7	77.3	77.3	79.6	83.1	74.4	69.9	71.3	72.1	67.6	Northing	Easting
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5531548	322943
Nitrate and Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PAG-CCR Storage Pond	
Sulphate	664	546	617	590	621	628	678	671	656	638	645	634	678	624		

Parameter	July					August					September				Site Description	
Sample Date	3	10	17	23	31	7	14	20	28	28	4	11	18	25	GPS (m)	
Conductivity (umhos/cm)	1270	1310	1330	1350	1360	1400	1460	1460	1480	1470	1440	1500	1290	1300	Minegrid	
Hardness CaCO3	626	-	-	-	718	-	-	-	-	-	777	-	-	-	Northing	Easting
pH	8.01	7.95	7.92	7.79	7.86	7.93	7.86	7.88	7.95	7.92	7.80	7.82	7.77	7.76	101583	97548
Acidity (to pH 8.3)	3.92	1.94	1.92	2.80	2.43	2.42	1.51	1.59	1.94	1.63	2.22	2.21	<0.50	3.33	UTM ZONE 10	
Alkalinity - Total CaCO3	76.1	74.1	71.5	71	67.5	67.8	62.2	65.5	60.2	60.6	52.1	52.4	52.8	54.2	Northing	Easting
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5531548	322943
Nitrate and Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PAG-CCR Storage Pond	
Sulphate	583	633	706	656	667	715	698	738	775	793	757	757	616	657		

Parameter	October					November				December				Site Description	
Sample Date	2	9	16	23	30	5	13	20	27	4	11	18	28	GPS (m)	
Conductivity (umhos/cm)	1290	1340	1240	1180	1190	1200	1240	1520	1310	1320	1360	1350	1130	Minegrid	
Hardness CaCO3	-	630	-	-	-	600	-	-	-	-	671	-	-	Northing	Easting
pH	7.81	7.78	7.48	7.61	7.75	7.74	7.87	7.92	7.96	7.91	7.85	7.96	8.01	101583	97548
Acidity (to pH 8.3)	0.56	1.56	7.77	8.06	0.85	1.90	2.87	7.58	2.75	3.57	2.58	3.73	2.45	UTM ZONE 10	
Alkalinity - Total CaCO3	51.5	49.2	44.4	48.3	49.4	55.9	70.1	119	82.8	107	96.2	122	132	Northing	Easting
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	0.0066	-	-	5531548	322943
Nitrate and Nitrite as N	-	-	-	-	-	-	-	-	-	-	0.026	-	-	PAG-CCR Storage Pond	
Sulphate	667	675	626	593	587	605	609	768	725	620	681	648	470		

Parameter	January			Feburary			March				Site Description	
Sample Date	8	16	22	4	12	25	5	11	19	26	GPS (m)	
Conductivity (umhos/cm)	1280	1240	1340	590	-	-	1460	-	-	-	Minegrid	
Field Conductivity (uS/cm)	-	-	-	687	1033.2	971	-	1408	1447	1436		
Hardness CaCO3	-	-	-	284	-	-	-	-	-	-	Northing	Easting
pH	7.86	7.71	7.86	7.82	-	-	8.01	-	-	-	101583	97548
Field pH	-	-	-	7.41	7.15	7.08	-	7.01	7.66	8.12	UTM ZONE 10	
Acidity (to pH 8.3)	-	-	-	-	-	-	-	-	-	-		
Alkalinity - Total CaCO3	112	128	154	78.8	-	-	131	-	-	-	Northing	Easting
Ammonia Nitrogen	-	-	0.03	-	-	-	-	-	-	-	5531548	322943
Nitrate and Nitrite as N	-	-	0.033	-	-	-	-	-	-	-	PAG-CCR Storage Pond	
Sulphate	576	548	612	213	-	-	715	-	-	-		

Results expressed in milligrams per litre except where noted.
* Field replicate sample

TABLE 21
3 SOUTH PIT METALS ANALYSIS
2012/2013 EMS ID E217015
COMPANY IDENTITY - 3S

Parameter	April		June	July		September
Sample Date	2	30	5	3	31	4
Total Metals						
Aluminum	0.074	0.0797	0.116	0.108	0.0922	0.0453
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	<0.0001	0.00021	0.00024	0.00036	0.00038	0.00033
Barium	0.013	0.0129	0.0133	0.015	0.0178	0.0183
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.18	0.189	0.21	0.217	0.257	0.339
Cadmium	0.00002	0.000029	0.000015	0.000011	<0.000010	<0.000025
Calcium	260	217	230	209	238	257
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.0008	0.00058	<0.00050	<0.00050	<0.00050	<0.00050
Copper	0.0009	0.00106	0.00112	0.00166	0.00168	0.00104
Hardness	-	-	-	-	-	-
Iron	0.128	0.143	0.274	0.274	0.439	0.322
Lead	<0.0002	<0.00020	<0.00020	<0.00020	0.00031	<0.00020
Lithium	0.006	0.0058	<0.0050	0.0052	0.0066	0.0071
Magnesium	28.7	25.7	26.6	25.5	30.1	32.8
Manganese	0.036	0.0266	0.0166	0.0162	0.0253	0.0162
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.003	0.0022	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus	-	-	-	-	-	-
Potassium	1.49	1.61	1.97	1.98	2.66	3.21
Selenium	0.0004	0.00017	0.00022	<0.00010	0.00011	<0.00010
Silicon	1.9	1.57	0.88	0.64	0.41	0.24
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	14.4	16.8	23.7	23.7	34.7	44.7
Strontium	1.54	1.37	1.41	1.36	1.63	1.88
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.0050	<0.0050	0.0148	<0.0050	<0.0050
Uranium	0.0001	0.00013	0.00011	0.0001	0.00011	0.00011
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals						
Aluminum	0.0196	0.0568	0.0796	0.0811	0.0504	0.029
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	<0.00010	0.0002	0.00031	0.00034	0.00028	0.00029
Barium	0.0142	0.0135	0.0152	0.0151	0.0181	0.0176
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.205	0.199	0.223	0.239	0.269	0.326
Cadmium	0.000013	<0.000010	0.000012	<0.000010	<0.000010	<0.000025
Calcium	256	222	235	205	2.75	254
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00082	0.0007	<0.00050	<0.00050	<0.00050	<0.00050
Copper	0.0005	0.00075	0.00107	0.00251	0.00111	0.00124
Hardness	-	-	-	-	-	-
Iron	<0.0050	0.0062	0.0085	0.0147	0.0185	0.0262
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0061	0.006	0.0056	0.0053	0.0068	0.0067
Magnesium	28.2	27.3	28.3	24.7	28.9	32.8
Manganese	0.0353	0.0267	0.0116	0.0126	0.0136	0.0036
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0028	0.0026	0.0011	<0.0010	<0.0010	<0.0010
Phosphorus	-	-	-	-	-	-
Potassium	1.44	1.66	2.13	1.98	2.75	3.14
Selenium	0.00032	0.00031	0.00029	0.0002	0.00016	0.00015
Silicon	1.82	1.5	0.83	0.64	0.45	0.23
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	14.3	17.3	25.6	23.6	33.7	44.2
Strontium	1.51	1.43	1.51	1.34	1.7	1.83
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	0.00011	0.00011	0.00011	<0.00010	0.0001	0.0001
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 21
3 SOUTH PIT METALS ANALYSIS
2012/2013 EMS ID E217015
COMPANY IDENTITY - 3S

Parameter	October	November	Decembrer	January		March
Sample Date	9	5	11	2	22	4
Total Metals						
Aluminum	0.0262	0.395	0.0748	0.0264	-	0.541
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050
Arsenic	0.00054	0.00045	0.00026	0.00016	-	0.00045
Barium	0.0168	0.016	0.0157	0.0127	-	0.0155
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010
Boron	0.29	0.234	0.21	0.144	-	0.072
Cadmium	<0.000025	0.000032	0.000066	0.000042	-	0.000048
Calcium	208	191	231	208	-	85
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010
Cobalt	<0.00050	0.00297	0.00523	0.00056	-	<0.00050
Copper	0.0015	0.0072	0.00277	0.00061	-	0.00197
Hardness	-	-	-	630	-	259
Iron	0.251	0.648	0.0895	0.0769	-	0.583
Lead	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020
Lithium	0.005	0.006	0.0085	0.0052	-	<0.0050
Magnesium	28	24.5	29.1	26.6	-	11.3
Manganese	0.014	0.0624	0.127	0.0233	-	0.0222
Mercury	<0.000020	<0.000020	<0.000010	<0.000010	-	<0.00002
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010
Nickel	0.005	0.0064	0.0104	0.0023	-	0.0011
Phosphorus	-	-	<0.0050	<0.0050	0.0068	-
Potassium	2.64	2.41	1.82	1.37	-	0.686
Selenium	<0.00010	0.00012	0.00059	0.00035	-	0.00039
Silicon	0.15	0.87	2.48	2.18	-	3.02
Silver	<0.000020	<0.000020	<0.000020	<0.000020	-	<0.000020
Sodium	41.4	30.6	36.8	23.3	-	5.55
Strontium	1.6	1.36	1.36	1.2	-	0.424
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	-	0.033
Uranium	<0.00010	<0.00010	0.00013	0.00015	-	0.00012
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050
Zinc	0.0053	0.0159	0.0111	<0.0050	-	0.0078
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050
Dissolved Metals						
Aluminum	0.0158	0.0897	0.0454	0.0048	-	0.0153
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050
Arsenic	0.00044	0.00034	0.0002	0.00021	-	0.00013
Barium	0.0153	0.0152	0.0156	0.0121	-	0.0144
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010
Boron	0.294	0.237	0.204	0.145	-	0.069
Cadmium	<0.000025	0.000024	0.000043	0.000032	-	0.000022
Calcium	209	198	222	202	-	91.1
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010
Cobalt	<0.00050	0.0024	0.00516	0.0005	-	<0.00050
Copper	0.00223	0.00327	0.00204	0.00055	-	0.00056
Hardness	-	-	-	612	-	284
Iron	0.0508	0.0235	0.0175	<0.0050	-	<0.0050
Lead	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020
Lithium	0.0054	0.0065	0.0077	<0.0050	-	<0.0050
Magnesium	26.5	25.8	28.1	26.2	-	13.7
Manganese	0.0066	0.0529	0.123	0.0225	-	0.018
Mercury	<0.000020	<0.000020	<0.000010	<0.000010	-	<0.00002
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010
Nickel	0.002	0.0057	0.0116	0.0017	-	0.0014
Phosphorus	-	-	<0.0050	<0.0050	0.0056	-
Potassium	2.65	2.41	1.8	1.36	-	0.715
Selenium	<0.00010	0.00017	0.00045	0.00032	-	0.00039
Silicon	0.16	0.73	2.26	2.26	-	1.88
Silver	<0.000020	<0.000020	<0.000020	<0.000020	-	<0.000020
Sodium	39.4	32.1	35.2	22	-	6.48
Strontium	1.51	1.38	1.33	1.15	-	0.551
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050
Uranium	<0.00010	0.00025	0.00014	0.00015	-	0.00015
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050
Zinc	<0.0050	0.006	0.0119	<0.0050	-	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050

Results expressed in milligrams per litre.

TABLE 22
2-North Portal Sump Water Quality
2012/2013 EMS ID-E283433
COMPANY IDENTITY - 2N-P Sump

Parameter	April				May						June				Site Description	
Sample Date	4	10	17	24	1	8	8*	15	22	29	6	12	19	26	GPS (m)	
Conductivity (umhos/cm)	1950	2120	2220	2200	2130	2260	2260	2250	2330	2360	2420	2300	2400	2250	Minegrid	
Hardness CaCO3	575	-	-	-	591	-	-	-	-	-	778	-	-	-	Northing	Easting
pH	8.12	8.08	8.02	8.02	8.00	7.79	7.74	8.02	7.94	7.99	8.00	7.96	8.02	8.01	103161	99514
Acidity (to pH 8.3)	3.9	4.2	7.2	10.9	9.0	9.0	10.2	12.0	9.3	8.1	12.3	11.8	13.8	7.7	UTM ZONE 10	
Alkalinity - Total CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5533942	322014
Nitrite/Nitrate Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	-	-	-	-	-	-	<0.0050	-	-	-	2 North Portal Sump	
Total Phosphorous	<0.0050	-	-	-	-	-	-	-	-	-	0.0056	-	-	-		
Sulphate	811	900	955	880	867	975	985	964	1030	1000	1040	1020	988	940		

Parameter	July					August					September				Site Description	
Sample Date	4	9	17	23	31	7	14*	14	20	28	5	11	18	25	GPS (m)	
Conductivity (umhos/cm)	2290	2420	2480	2500	2530	2560	2580	2590	2600	2540	2660	2620	2620	2570	Minegrid	
Hardness CaCO3	-	-	-	-	819	-	-	-	-	-	-	-	-	-	Northing	Easting
pH	8.01	7.97	7.56	7.93	7.94	8.11	8.12	8.12	8.13	8.07	8.13	8.11	8.06	8.07	103161	99514
Acidity (to pH 8.3)	8.3	19.6	25.2	12.6	20.1	9.2	8.6	8.7	13.7	4.8	5.5	3.1	7.4	7.0	UTM ZONE 10	
Alkalinity - Total CaCO3	248	312	322	315	320	318	316	315	326	288	314	307	314	323	Northing	Easting
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5533942	322014
Nitrite/Nitrate Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	<0.0050	-	-	-	-	-	<0.0050	-	-	-	2 North Portal Sump	
Total Phosphorous	<0.0050	-	-	-	<0.0050	-	-	-	-	-	<0.0050	-	-	-		
Sulphate	941	1030	1140	1060	1070	1110	1110	1110	1130	1140	1130	1110	1100	1130		

Parameter	October						November				December				Site Description	
Sample Date	2	10	16	23*	23	30	6	13	20	27	4	11	19	28	GPS (m)	
Conductivity (umhos/cm)	2660	2700	2640	2570	2580	2600	2550	2580	2500	2770	2480	2480	2580	2360	Minegrid	
Hardness CaCO3	-	798	-	-	-	-	823	-	-	-	-	802	-	-	Northing	Easting
pH	7.78	7.81	7.92	7.76	7.77	7.90	7.90	8.04	8.00	7.95	7.96	7.99	8.02	8.06	103161	99514
Acidity (to pH 8.3)	7.8	8.3	12.7	12.9	11.9	13.3	12.1	19.1	15.6	18.7	12.4	5.7	11.0	7.1	UTM ZONE 10	
Alkalinity - Total CaCO3	330	329	311	307	307	311	324	296	293	318	282	275	299	261	Northing	Easting
Ammonia Nitrogen	-	0.017	-	-	-	-	-	-	-	-	-	0.015	-	-	5533942	322014
Nitrite/Nitrate Nitrogen	-	-	-	-	-	-	-	-	-	-	-	0.037	-	-		
Dissolved Phosphorous	-	<0.0050	-	-	-	-	-	-	-	-	-	<0.0050	-	-	2 North Portal Sump	
Total Phosphorous	-	<0.0050	-	-	-	-	-	-	-	-	-	0.0055	-	-		
Sulphate	1180	1170	1190	1190	1200	1180	1170	1160	1160	1420	1120	1120	1160	987		

Parameter	January					February			March				Site Description	
Sample Date	2	8	16	22	22*	4	12	19	5	11	19	26	GPS (m)	
Conductivity (umhos/cm)	-	2370	2450	2400	2390	-	-	-	2410	-			Minegrid	
Field Conductivity (uSm)	-	-	-	-	-	1572.8	1355	1691	-	PNC	2264	2254	Northing	Easting
Hardness CaCO3	722	-	-	-	-	-	-	-	724	-	-	-		
pH	7.92	7.86	7.99	7.91	7.90	-	-	-	7.95	-	-	-	103161	99514
Field pH	-	-	-	-	-	7.36	7.93	7.48	-	PNC	7.08	7.54	UTM ZONE 10	
Alkalinity - Total CaCO3	-	274	288	291	288	-	-	-	279	-	-	-	Northing	Easting
Ammonia Nitrogen	0.013	-	-	-	-	-	-	-	-	-	-	-	5533942	322014
Dissolved Phosphorous	<0.0050	-	-	-	-	-	-	-	-	-	-	-		
Total Phosphorous	0.0054	-	-	-	-	-	-	-	-	-	-	-	2 North Portal Sump	
Sulphate	1030	1030	1060	1020	1030	-	-	-	1050	-	-	-		

Results expressed in milligrams per litre.
* Field replicate sample.

TABLE 23
2-North Portal Sump Metals Analysis
2012/2013 EMS ID: E283433
COMPANY IDENTITY - 2N Portal SUMP

Parameter	April	May	June	July		August
Sample Date	4	1	6	4	31	5
Total Metals						
Aluminum	-	0.0477	-	-	0.0092	-
Antimony	-	<0.00050	-	-	<0.00050	-
Arsenic	-	0.00046	-	-	0.0005	-
Barium	-	0.0112	-	-	0.0138	-
Beryllium	-	<0.00010	-	-	<0.00010	-
Bismuth	-	<0.0010	-	-	<0.0010	-
Boron	-	0.864	-	-	1.02	-
Cadmium	-	<0.000010	-	-	<0.000010	-
Calcium	-	199	-	-	275	-
Chromium	-	<0.0010	-	-	<0.0010	-
Cobalt	-	0.00076	-	-	0.00135	-
Copper	-	0.00059	-	-	0.00065	-
Hardness	-	-	-	-	-	-
Iron	-	0.254	-	-	0.243	-
Lead	-	<0.00020	-	-	<0.00020	-
Lithium	-	0.0061	-	-	0.0114	-
Magnesium	-	19.9	-	-	32	-
Manganese	-	0.147	-	-	0.229	-
Mercury	-	<0.000010	-	-	<0.010	-
Molybdenum	-	<0.0010	-	-	<0.0010	-
Nickel	-	0.0018	-	-	0.003	-
Phosphorus	<0.0050		0.0056	<0.0050	<0.0050	<0.0050
Potassium	-	3.47	-	-	4.19	-
Selenium	-	0.00022	-	-	0.00013	-
Silicon	-	2.88	-	-	3.21	-
Silver	-	<0.000020	-	-	<0.000020	-
Sodium	-	257	-	-	300	-
Strontium	-	1.49	-	-	2.04	-
Thallium	-	<0.000050	-	-	<0.000050	-
Tin	-	<0.0050	-	-	<0.0050	-
Titanium	-	<0.0050	-	-	<0.0050	-
Uranium	-	0.00013	-	-	0.00016	-
Vanadium	-	<0.0050	-	-	<0.0050	-
Zinc	-	<0.0050	-	-	<0.0050	-
Zirconium	-	<0.00050	-	-	<0.00050	-
Dissolved Metals						
Aluminum	0.0088	0.0064	0.0046	0.0046	0.006	<0.0030
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00016	0.00035	0.00043	0.00037	0.00037	0.0004
Barium	0.0145	0.0113	0.0151	0.0179	0.0146	0.0135
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.741	0.791	0.86	0.877	0.937	1.04
Cadmium	0.000012	0.000048	0.000018	0.000025	0.000012	<0.000010
Calcium	200	202	264	249	281	281
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00084	0.00076	0.00132	0.00133	0.00128	0.00129
Copper	0.0004	0.00098	0.0006	0.00139	0.00062	0.00035
Hardness	-	-	-	-	-	-
Iron	<0.0050	0.024	0.0082	0.0083	<0.0050	0.0111
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.005	0.0062	0.009	0.0084	0.0108	0.0121
Magnesium	18.2	21.1	29	26.6	32.2	31.8
Manganese	0.0903	0.154	0.226	0.199	0.228	0.229
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020
Molybdenum	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010
Nickel	0.0025	0.0018	0.0028	0.0029	0.0031	0.0028
Phosphorus	<0.0050		<0.0050	<0.0050	<0.0050	<0.0050
Potassium	3.23	3.76	4.21	3.96	4.39	4.38
Selenium	0.00059	0.00041	0.0003	0.00018	0.00013	0.00014
Silicon	2.41	2.69	3.15	3.07	3.52	3.42
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	236	275	286	261	301	315
Strontium	1.35	1.49	1.97	1.71	2.08	2.14
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	0.00015	0.00015	0.00014	0.00017	0.00017
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 23
2-North Portal Sump Metals Analysis
2012/2013 EMS ID: E283433
COMPANY IDENTITY - 2N Portal SUMP

Parameter / Sample Date	October 10	November 6	December 11	January 2	March 5
Total Metals					
Aluminum	0.0422	0.439	-	-	0.487
Antimony	<0.00050	0.00126	-	-	0.00099
Arsenic	0.00038	0.00038	-	-	0.0008
Barium	0.0146	0.0146	-	-	0.0156
Beryllium	<0.00010	<0.00010	-	-	<0.00010
Bismuth	<0.0010	<0.0010	-	-	<0.0010
Boron	1.05	1.21	-	-	0.813
Cadmium	<0.000010	<0.000025	-	-	0.000015
Calcium	289	269	-	-	250
Chromium	<0.0010	<0.0010	-	-	0.001
Cobalt	0.00147	0.00134	-	-	0.00121
Copper	0.00066	0.00191	-	-	0.00222
Hardness	-	-	-	-	741
Iron	0.311	0.375	-	-	0.594
Lead	<0.00020	<0.00020	-	-	0.00063
Lithium	0.0131	0.0195	-	-	0.0088
Magnesium	34.5	36.8	-	-	28.4
Manganese	0.219	0.17	-	-	0.108
Mercury	<0.0020	<0.0020	-	-	<0.010
Molybdenum	<0.0010	<0.0010	-	-	<0.0010
Nickel	0.0035	0.004	-	-	0.0032
Phosphorus	<0.0050	-	0.0055	0.0054	-
Potassium	4.52	3.99	-	-	4.12
Selenium	0.00012	<0.00010	-	-	0.00055
Silicon	3.54	3.9	-	-	3.39
Silver	<0.000020	<0.000020	-	-	<0.000020
Sodium	317	285	-	-	284
Strontium	2.24	2.07	-	-	1.93
Thallium	<0.000050	<0.000050	-	-	<0.000050
Tin	<0.0050	<0.0050	-	-	<0.0050
Titanium	<0.0050	0.0172	-	-	0.015
Uranium	0.00021	0.00023	-	-	0.00018
Vanadium	<0.0050	<0.0050	-	-	<0.0050
Zinc	<0.0050	<0.0050	-	-	<0.0050
Zirconium	<0.00050	<0.00050	-	-	<0.00050
Dissolved Metals					
Aluminum	<0.0030	<0.0030	0.0063	0.0043	0.0052
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00025	0.00025	0.00045	0.00035	0.00039
Barium	0.0138	0.0145	0.0124	0.0129	0.014
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	1.01	1.13	0.893	0.836	0.843
Cadmium	<0.000025	<0.000025	<0.000010	0.000019	0.000013
Calcium	263	269	277	248	245
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00139	0.00132	0.00081	0.0007	0.00073
Copper	0.00045	0.00065	<0.00020	0.00057	0.00036
Hardness	-	-	-	722	724
Iron	0.0732	<0.0050	<0.0050	<0.0050	<0.0050
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0098	0.018	0.0091	0.0076	0.008
Magnesium	34.4	36.8	26.7	25.2	27.1
Manganese	0.226	0.179	0.134	0.103	0.102
Mercury	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0035	0.0045	0.0028	0.0022	0.0023
Phosphorus	<0.0050	-	<0.0050	<0.0050	-
Potassium	4.54	4.22	4.48	4	3.96
Selenium	<0.00010	<0.00010	0.00073	0.00051	0.00042
Silicon	3.11	3.1	3.18	3.03	2.98
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	313	294	316	291	283
Strontium	2.25	2.08	1.86	1.78	1.8
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	0.0172	-	<0.0050	<0.0050
Uranium	0.00021	0.00024	0.00017	0.00015	0.00016
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 24
4 SOUTH LOWER WATER QUALITY
2012/2013 EMS ID: E292129
COMPANY IDENTITY - 4S-Lo

Parameter	April					May				June				Site Description GPS (m)	
														Minegrid	
Sample Date	2	10	17	24	30	8	15	22	29	5	12	19	26	Northing	Easting
Conductivity (umhos/cm)	301	587	625	575	554	540	526	502	491	491	477	495	500	100984	98153
Hardness CaCO3	125	-	-	-	255	-	-	-	-	210	-	-	-	UTM ZONE 10	
pH	7.51	7.41	7.67	7.71	7.47	7.43	7.67	7.60	7.67	7.37	7.68	7.74	7.72	Northing	Easting
Acidity (to pH 8.3)	2.1	2.7	4.9	8.4	4.4	4.4	4.5	2.3	1.1	2.4	2.4	4.7	2.7	553154	3229743
Alkalinity - Total CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-	Road side ditch west of	
Sulphate	116	262	242	213	176	208	234	199	193	194	183	204	195	4S coal storage pad	

Parameter	July					August	Site Description GPS (m)	
							Minegrid	
Sample Date	3	10	17	23	31	7	Northing	Easting
Conductivity (umhos/cm)	502	491	418	468	396	464	100984	98153
Hardness CaCO3	223	-	-	-	175		UTM ZONE 10	
pH	7.84	7.39	7.18	7.61	7.56	7.93	Northing	Easting
Acidity (to pH 8.3)	2.5	9.6	8.2	4.1	4.1	2.5	553154	3229743
Alkalinity - Total CaCO3	54.8	56.1	40.2	55.8	43.9	65.6	Road side ditch west of	
Sulphate	191	190	169	174	141	155	4S coal storage pad	

Parameter	October		November				December			Site Description GPS (m)	
										Minegrid	
Sample Date	23	30	5	13	20	27	4	11	18	Northing	Easting
Conductivity (umhos/cm)	586	518	480	586	478	648	323	367	408	100984	98153
Hardness CaCO3	-	-	221	-	-	-	-	155	-	UTM ZONE 10	
pH	7.45	7.31	7.33	7.74	7.26	7.34	7.19	7.42	7.24	Northing	Easting
Acidity (to pH 8.3)	4.6	4.5	3.3	5.0	12.4	12.3	5.3	2.8	7.1	553154	3229743
Alkalinity - Total CaCO3	35.5	37.2	42.2	55.9	39.1	49.8	30.2	33.8	34.9	Road side ditch west of	
Sulphate	244	198	188	212	197	266	121	136	156	4S coal storage pad	

Parameter	January			February				March				Site Description GPS (m)	
												Minegrid	
Sample Date	8	16	22	4	12	19	25	5	11	19	26	Northing	Easting
Conductivity (umhos/cm)	424	421	430	-	-	-	-	412	-	-	-	100984	98153
Field Conductivity (uS/cm)	-	-	-	194	334	262	284	-	411	PNC	654	UTM ZONE 10	
Hardness CaCO3	-	-	-	181	-	-	-	169	-	-	-	Northing	Easting
pH	7.09	7.35	7.44	-	-	-	-	-	-	-	-	553154	3229743
Field pH	-	-	-	6.60	6.32	6.98	6.89	-	7.06	PNC	6.60		
Acidity (to pH 8.3)	-	-	-	-	-	-	-	-	-	-	-	Road side ditch west of	
Alkalinity - Total CaCO3	33.2	35	36.1	36.5	-	-	-	35.7	-	-	-	4S coal storage pad	
Sulphate	161	154	156	170	-	142	149	165	-	-	-		

Results expressed in milligrams per litre except where noted.
* Indicates replicate sample.
PNC = Permit Non-Compliance

TABLE 25
4 SOUTH LOWER METALS ANALYSIS
2012/2013 EMS ID: E292129
COMPANY IDENTITY - 4S-Lo

Parameter	April		June	July	
Sample Date	2	30	5	3	31
Total Metals					
Aluminum	0.068	0.0134	0.0109	0.0139	0.0175
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0002	0.00015	0.00019	0.00031	0.00017
Barium	0.009	0.0261	0.026	0.0272	0.0169
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.05	0.089	0.1	0.102	0.096
Cadmium	<0.00001	0.000016	0.000012	0.000014	<0.000010
Calcium	42.3	85.9	73.1	75.5	57.9
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.0011	0.00488	0.00479	0.00575	0.00119
Copper	0.0003	0.00023	<0.00020	<0.00020	0.00033
Iron	1.62	3.41	4.38	6.35	1.03
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	5.45	9.31	7.86	8.38	7.38
Manganese	0.842	5.2	4.46	5.17	1.21
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.001	0.0042	0.0036	0.0042	0.0015
Phosphorus	-	-	-	-	-
Potassium	0.388	0.765	0.82	0.881	0.749
Selenium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	3	5.22	5.26	5.38	3.78
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	4.61	5.71	5.49	5.92	7.32
Strontium	0.168	0.303	0.248	0.26	0.255
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.009	0.104	0.0909	0.0875	0.0959
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals					
Aluminum	0.0341	0.0041	0.0055	0.0101	0.0042
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00014	0.00017	0.00017	0.00025	0.00015
Barium	0.0095	0.0251	0.0279	0.0242	0.0163
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.051	0.089	0.097	0.085	0.095
Cadmium	<0.000010	0.000031	0.000011	0.000026	0.000015
Calcium	41.3	86.7	71	72.5	56.2
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00118	0.00496	0.00508	0.00605	0.00116
Copper	0.0004	0.00028	0.00032	0.00183	0.00053
Iron	1.18	3.51	4.41	5.8	0.0603
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	5.4	9.25	7.91	8.21	6.94
Manganese	0.842	5.15	4.78	4.97	1.17
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0012	0.0041	0.0036	0.0042	0.0016
Phosphorus	-	-	-	-	-
Potassium	0.408	0.782	0.86	0.852	0.752
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	3.2	4.86	4.76	5.47	3.72
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	4.65	5.67	5.68	5.8	7.08
Strontium	0.175	0.302	0.252	0.239	0.249
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.0095	0.105	0.108	0.0854	0.0769
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 25
4 SOUTH LOWER METALS ANALYSIS
2012/2013 EMS ID: E292129
COMPANY IDENTITY - 4S-Lo

Parameter / Sample Date	November 5	December 11	February 4	March 5
Total Metals				
Aluminum	0.0969	0.304	0.089	0.11
Antimony	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00024	0.00039	0.0002	0.00025
Barium	0.0294	0.0161	0.0147	0.0151
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.093	0.064	0.059	0.058
Cadmium	0.000039	0.000016	0.000023	0.000015
Calcium	71.1	56.1	59.1	58.4
Chromium	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00699	0.00196	0.00329	0.00337
Copper	0.00058	0.00077	0.00048	0.00027
Hardness	-	-	180	179
Iron	2.56	2.99	3.45	4.05
Lead	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	8.58	6.84	7.94	7.94
Manganese	3.05	1.38	1.85	2.05
Mercury	<0.000010	<0.000010	<0.00002	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0059	0.0046	0.0037	0.0034
Phosphorus	-	-	-	-
Potassium	1.5	0.608	0.558	0.636
Selenium	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	4.93	4.33	3.39	3.56
Silver	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	6.74	5.01	7.3	7.17
Strontium	0.269	0.219	0.233	0.224
Thallium	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	0.0083	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.11	0.0979	0.106	0.115
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals				
Aluminum	<0.0030	0.0073	0.006	0.0045
Antimony	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0001	0.00012	0.00016	0.00017
Barium	0.0289	0.0139	0.0157	0.0147
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.09	0.061	0.062	0.061
Cadmium	0.00003	0.000018	0.00001	0.000017
Calcium	74.9	51.1	59.2	55.3
Chromium	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00681	0.00209	0.00325	0.0031
Copper	0.00032	0.00034	<0.00020	<0.00020
Hardness	-	-	181	169
Iron	0.0169	0.59	2.58	2.4
Lead	<0.00020	<0.00020	0.00027	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	8.36	6.71	8.05	7.41
Manganese	3.01	1.41	1.89	1.91
Mercury	<0.000010	<0.000010	<0.000002	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0055	0.0027	0.0035	0.0032
Phosphorus	-	-	-	-
Potassium	1.41	0.519	0.585	0.578
Selenium	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	5.07	3.53	3.47	3.55
Silver	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	6.53	5.15	7.22	6.75
Strontium	0.26	0.2	0.24	0.221
Thallium	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	0.0083	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.0902	0.0893	0.103	0.0994
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 26
4 SOUTH INFLOW / UPPER / UNDERPAD WATER QUALITY
2012/2013
COMPANY IDENTITY 4SI / 4S-Up / 4SUPAD

Parameters	4SI			4S-Up			4SUPAD		
Sample Date	2-Apr-12	30-Apr-12	5-Jun-12	2-Apr-12	30-Apr-12	5-Jun-12	2-Apr-12	30-Apr-12	5-Jun-12
Conductivity (us/cm)	439	582	603	243	329	369	283	528	433
Hardness (as CaCO3)	199	262	273	102	137	155	117	212	184
pH	7.62	7.48	7.81	7.39	7.22	7.57	7.40	6.82	7.02
Acidity (pH=8.3)	2.40	4.70	1.59	2.00	3.33	1.63	2.80	37.70	52.40
Alkalinity-Total CaCO3	-	-	-	-	-	-	-	-	-
Sulphate	176	197	252	86.1	120	135	104	199	160

Parameters	4SI			4S-Up								4SUPAD
Sample Date	3-Jul-12	5-Nov-12	4-Feb-13	3-Jul-12	1-Aug-12	4-Sep-12	5-Nov-12	11-Dec-12	4-Feb-13	19-Feb-13	25-Feb-13	3-Jul-12
Conductivity (us/cm)	530	440	-	392	394	378	328	234	-	-	-	456
Hardness (as CaCO3)	252	197	210	164	185	181	137	-	143	-	-	199
pH	7.93	7.62	-	7.77	7.43	7.80	7.41	7.36	-	-	-	7.41
Acidity (pH=8.3)	2.90	1.44	-	2.29	9.63	1.60	1.23	2.14	-	-	-	21.20
Alkalinity-Total CaCO3	66.6	51.2	78.3	41.1	52.3	60.6	35.3	33.1	36.3	-	-	43.6
Sulphate	169	161	165	130	132	125	124	77	118	91.9	118	155

Results expressed as milligram per litre except where noted

TABLE 27
4 SOUTH INFLOW / UPPER/ UNDERPAD METALS ANLAYSIS
2012/2013
COMPANY IDENTITY 4SI / 4S-Up / 4SUPAD

Paramters	4SI						4SUPAD			
Sample Date	02-Apr	30-Apr	05-Jun	03-Jul	05-Nov	04-Feb	02-Apr	30-Apr	05-Jun	03-Jul
Total Metals										
Aluminum	0.010	0.047	0.007	0.009	0.008	0.009	0.071	0.147	0.120	0.096
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0005	<0.00050	<0.00050	<0.00050
Arsenic	0.0002	0.0003	0.0001	0.0003	0.0001	0.0002	0.0002	0.0007	0.0004	0.0007
Barium	0.011	0.017	0.017	0.016	0.013	0.013	0.008	0.026	0.021	0.025
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.0010	<0.0010	<0.0010
Boron	0.08	0.09	0.11	0.14	0.11	0.09	0.05	0.09	0.08	0.10
Cadmium	<0.00001	<0.000010	<0.000010	0.0000	<0.000010	<0.000005	<0.00001	0.0000	0.0000	0.0000
Calcium	67.30	87.30	91.60	82.30	64.30	69.20	38.90	78.00	62.40	67.40
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.0010	<0.0010	<0.0010
Cobalt	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0008	0.0096	0.0070	0.0072
Copper	0.0004	0.0005	0.0004	0.0009	0.0006	0.0006	0.0002	0.0002	0.0002	<0.00020
Hardness (as CaCO3)	-	-	-	-	197.0000	214.0000	-	-	-	-
Iron	0.011	0.052	0.013	0.011	0.013	0.010	1.350	14.200	10.800	14.000
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.0002	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.005	<0.0050	<0.0050	<0.0050
Magnesium	8.80	11.90	11.90	11.20	8.84	10.10	5.24	8.31	6.85	7.51
Manganese	<0.001	0.002	<0.0010	0.001	<0.0010	<0.0010	0.454	4.720	3.210	4.050
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00002	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.0010	<0.0010	<0.0010
Nickel	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	0.01	0.01	0.01
Phosphorous	-	-	<0.0050	<0.0050	<0.0050	-	-	-	-	-
Potassium	0.559	0.756	0.695	0.639	0.642	0.695	0.366	0.746	0.655	0.764
Selenium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.00010	<0.00010	<0.00010
Silicon	2.70	2.76	3.10	3.06	2.98	2.96	2.80	5.90	5.62	5.55
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.00002	<0.000020	<0.000020	<0.000020
Sodium	5.94	7.32	7.73	8.40	7.04	15.30	4.57	5.29	5.05	5.56
Strontium	0.375	0.512	0.503	0.464	0.378	0.401	0.160	0.237	0.204	0.217
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00005	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.005	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.005	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.005	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.008	0.343	0.301	0.170
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0005	<0.00050	<0.00050	<0.00050
Dissolved Metals										
Aluminum	0.0071	0.0103	0.0049	0.0061	0.0051	0.0047	0.0607	0.0890	0.0468	0.0608
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00019	0.00020	0.00017	0.00020	0.00016	0.00014	0.00014	0.00061	0.00038	0.00080
Barium	0.0117	0.0169	0.0183	0.0150	0.0134	0.0146	0.0083	0.0267	0.0218	0.0221
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.071	0.088	0.097	0.105	0.110	0.088	<0.050	0.084	0.082	0.082
Cadmium	<0.000010	0.00002	<0.000010	0.00001	<0.000010	<0.000005	<0.000010	0.00004	0.00003	0.00003
Calcium	65.00	85.10	89.60	76.40	65.10	68.00	38.40	71.50	62.10	66.30
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00080	0.00933	0.00701	0.00695
Copper	0.00059	0.00062	0.00052	0.00191	0.00056	0.00044	0.00068	0.00022	0.00042	0.00033
Hardness (as CaCO3)	-	-	-	-	199.00000	210.00000	-	-	-	-
Iron	<0.0050	0.0553	0.0065	0.0060	0.0075	<0.0050	1.2300	13.4000	10.0000	13.1000
Lead	<0.00020	0.00	<0.00020	<0.00020	<0.00020	0.00	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	8.78	11.90	11.90	10.60	8.87	9.85	5.02	8.24	6.96	7.36
Manganese	<0.0010	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	0.4460	4.5800	3.3300	3.9700
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00002	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	<0.0010	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0086	0.0080	0.0064
Phosphorous	-	-	<0.0050	<0.0050	<0.0050		-	-	-	-
Potassium	0.621	0.737	0.719	0.604	0.622	0.718	0.448	0.701	0.700	0.715
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	2.72	2.72	2.79	3.02	3.10	2.72	3.10	5.26	5.10	5.75
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	5.96	7.26	7.85	7.41	7.04	15.10	4.56	5.24	5.21	5.46
Strontium	0.369	0.506	0.506	0.429	0.369	0.411	0.165	0.244	0.207	0.205
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.01	0.36	0.34	0.17
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed as milligram per litre.

TABLE 27
4 SOUTH INFLOW / UPPER/ UNDERPAD METALS ANLAYSIS
2012/2013
COMPANY IDENTITY 4SI / 4S-Up / 4SUPAD

Paramters	4S-Up								
Sample Date	02-Apr	30-Apr	05-Jun	03-Jul	01-Aug	04-Sep	05-Nov	11-Dec	04-Feb
Total Metals									
Aluminum	0.014	0.045	0.031	0.046	0.057	0.029	0.047	-	0.024
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050
Arsenic	0.0001	0.0003	0.0002	0.0003	0.0008	0.0004	0.0004	-	0.0002
Barium	0.006	0.010	0.011	0.012	0.014	0.010	0.010	-	0.009
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010
Boron	0.05	0.06	0.07	0.08	0.09	0.10	0.07	-	0.07
Cadmium	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-	0.0000
Calcium	34.70	43.70	52.30	53.90	61.30	59.40	44.50	-	47.10
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010
Cobalt	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050
Copper	0.0002	0.0005	0.0004	0.0003	0.0007	0.0037	0.0007	-	0.0003
Hardness (as CaCO3)	-	-	-	-	-	-	137.0000	-	145.0000
Iron	0.034	0.132	0.099	0.155	0.567	0.281	0.207	-	0.030
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	0.0022	<0.00020	-	<0.00020
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050
Magnesium	4.65	6.25	6.89	7.21	7.75	7.88	6.28	-	6.73
Manganese	0.016	0.104	0.068	0.054	0.589	0.041	0.149	-	0.002
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00002	<0.000010	-	<0.00002
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010
Nickel	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010
Phosphorous	-	-	-	-	-	-	-	-	-
Potassium	0.318	0.439	0.390	0.380	0.524	0.597	0.491	-	0.381
Selenium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010
Silicon	2.70	2.59	2.99	2.75	3.41	2.55	3.31	-	3.00
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-	<0.000020
Sodium	4.52	5.81	6.44	7.19	7.94	8.82	6.62	-	7.96
Strontium	0.158	0.220	0.253	0.271	0.290	0.307	0.219	-	0.232
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050
Titanium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050
Zinc	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050
Dissolved Metals									
Aluminum	0.0091	0.0102	0.0055	0.0055	0.0059	<0.0030	0.0060	0.0153	0.0064
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00012	0.00022	0.00022	0.00023	0.00050	0.00035	0.00021	0.00012	<0.00010
Barium	0.0064	0.0096	0.0113	0.0122	0.0133	0.0096	0.0093	0.0055	0.0088
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.051	0.063	0.071	0.078	0.082	0.102	0.074	0.052	0.067
Cadmium	<0.000010	0.00001	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	0.00001
Calcium	33.20	44.70	50.70	57.30	56.50	57.30	45.70	26.20	46.30
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper	0.00053	0.00033	0.00042	0.00036	0.00032	0.00090	0.00063	0.00035	0.00023
Hardness (as CaCO3)	-	-	-	-	-	-	139.00000	80.70000	143.00000
Iron	0.0118	0.0719	0.0573	0.0276	0.0677	0.0292	0.0578	0.0079	<0.0050
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	4.70	6.23	6.75	7.63	7.92	7.61	6.17	3.72	6.73
Manganese	0.0063	0.1000	0.0651	0.0513	0.4020	0.0032	0.1260	0.0116	<0.0010
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00002
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorous	-	-	-	-	-	-	-	-	-
Potassium	0.370	0.435	0.410	0.452	0.513	0.582	0.486	0.321	0.405
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	2.77	2.70	2.86	2.99	3.27	2.49	3.28	2.58	2.75
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	4.77	5.78	6.52	7.17	8.07	8.53	6.32	4.09	7.41
Strontium	0.160	0.224	0.254	0.274	0.292	0.292	0.218	0.127	0.229
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed as milligram per litre.

TABLE 28
SOUTH PIT CULVERT WATER QUALITY
2012/2013 EMS ID- E217014
COMPANY IDENTITY - SPC

Parameter	April					May				June				Site Description	
Sample Date	2	10	17	24	30	8	15	22	29	5	12	19	26	GPS (m)	
Conductivity (umhos/cm)	265	299	249	222	234	199	211	215	185	145	145	163	168	Minegrid	
Hardness CaCO3	118	-	-	-	99	-	-	-	-	63	-	-	-	Northing	Easting
pH	7.54	7.63	7.54	7.56	7.51	7.51	7.53	7.51	7.65	7.41	7.51	7.61	7.60	101317	98869
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	6.0	6.7	4.2	<4.0	<4.0	<4.0	<4.0	UTM ZONE 10	
Acidity (to pH 8.3)	0.80	0.50	0.80	0.96	<0.50	1.22	1.41	<0.50	<0.50	0.92	<0.50	<0.50	0.97	Northing	Easting
Alkalinity - Total CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-	5532321	323105
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	Input to Long Lake, Culvert Downstream of Settling Pond 1	
Nitrate and Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	<0.0050	-	<0.0050	-	0.0060	-	0.0061	0.0051	-	0.0060	-		
Total Phospphorous	-	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	101	123	88	76	82	66	69	70	54	39	41	46	48		

Parameter	July				Site Description	
Sample Date	2	10	24	30	GPS (m)	
Conductivity (umhos/cm)	147	201	194	186	Minegrid	
Hardness CaCO3	57	-	-	-	Northing	Easting
pH	7.65	7.67	7.63	7.49	101317	98869
Total Suspended Solids	<4.0	<4.0	<4.0	6.5	UTM ZONE 10	
Acidity (to pH 8.3)	1.31	0.74	1.20	0.78	Northing	Easting
Alkalinity - Total CaCO3	28.4	34.4	39.8	38.1	5532321	323105
Ammonia Nitrogen	-	-	-	-	Input to Long Lake, Culvert Downstream of Settling Pond 1	
Nitrate and Nitrite as N	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-		
Total Phospphorous	-	-	-	-		
Sulphate	36	58	54	44		

Parameter	October	November				December				Site Description	
Sample Date	30	5	13	20	27	4	11	18	28	GPS (m)	
Conductivity (umhos/cm)	80.9	160	151	186	266	223	380	328	220	Minegrid	
Hardness CaCO3	-	69	-	-	-	-	154	-	-	Northing	Easting
pH	7.25	7.38	7.51	7.30	7.55	7.49	7.71	7.77	7.66	101317	98869
Total Suspended Solids	-	<4.0	-	-	-	-	<4.0	-	-	UTM ZONE 10	
Acidity (to pH 8.3)	0.69	1.15	0.57	0.59	0.64	<0.50	0.80	0.77	0.85	Northing	Easting
Alkalinity - Total CaCO3	12.3	22.2	20.1	17.4	21.8	20.8	38.6	42.5	32	5532321	323105
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	Input to Long Lake, Culvert Downstream of Settling Pond 1	
Nitrate and Nitrite as N	-	-	-	-	-	<0.020	-	0.073	-		
Dissolved Phosphorous	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	0.0051	-		
Total Phosphorous	-	-	-	-	-	-	-	-	-		
Sulphate	21	50	49	67	101	81	143	116	72		

Parameter	January				February				March					Site Description	
Sample Date	8	16	22	19	4	12	19	25	5*	5	11	19	26	GPS (m)	
Conductivity (umhos/cm)	284	244	292	-	-	-	-	-	315	314	-	-	-	Minegrid	
Field Conductivity (uS/cm)	-	-	-	-	165	357	312	151	-	-	299	412.00	391		
Hardness CaCO3	-	-	-	-	70	-	-	-	117	115	-	-	-	Northing	Easting
pH	7.74	7.62	7.85	-	-	7.47	-	-	7.76	7.69	7.98	7.33	7.65	101317	98869
Field pH	-	-	-	-	7.12	7.33	7.45	8.17	-	-	-	-	-	UTM ZONE 10	
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	-	<4.0	-	-	<4.0	-	-		
Acidity (to pH 8.3)	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Alkalinity - Total CaCO3	41.7	41.3	54.7	-	42.3	-	-	-	44.3	45.3	-	-	-	5532321	323105
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	Input to Long Lake, Culvert Downstream of Settling Pond 1	
Nitrate and Nitrite as N	-	-	0.19	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorous	0.0059	-	0.02	-	-	-	-	-	-	-	-	-	-		
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	95.8	70.1	79.3	-	44	-	-	-	111	104	-	-	24		

Results expressed in milligrams per litre except where noted.
* Field replicate sample.
No samples in August or September due to dry conditions

TABLE 29
SOUTH PIT CULVERT METALS ANALYSIS
2012/2013 EMS ID- E217014
COMPANY IDENTITY - SPC

Parameter	April			May		June		July
Sample Date	2	17	30	15	29	5	19	3
Total Metals								
Aluminum	0.049	-	0.0903	-	-	0.116	-	0.0772
Antimony	<0.0005	-	<0.00050	-	-	<0.00050	-	<0.00050
Arsenic	0.0003	-	0.00046	-	-	0.00062	-	0.00058
Barium	0.008	-	0.0082	-	-	0.0059	-	0.0061
Beryllium	<0.0001	-	<0.00010	-	-	<0.00010	-	<0.00010
Bismuth	<0.001	-	<0.0010	-	-	<0.0010	-	<0.0010
Boron	<0.05	-	<0.050	-	-	<0.050	-	<0.050
Cadmium	<0.00001	-	0.000017	-	-	0.000021	-	<0.000010
Calcium	40.2	-	30.9	-	-	19	-	18.2
Chromium	<0.001	-	<0.0010	-	-	<0.0010	-	<0.0010
Cobalt	<0.0005	-	<0.00050	-	-	<0.00050	-	<0.00050
Copper	0.0004	-	0.00061	-	-	0.00111	-	0.00038
Iron	0.08	-	0.211	-	-	0.378	-	0.245
Hardness	123	-	95.6	-	-	59	-	56.7
Lead	<0.0002	-	<0.00020	-	-	<0.00020	-	<0.00020
Lithium	<0.005	-	<0.0050	-	-	<0.0050	-	<0.0050
Magnesium	5.36	-	4.47	-	-	2.82	-	2.69
Manganese	0.006	-	0.009	-	-	0.0091	-	0.0054
Mercury	<0.000010	-	<0.000010	-	-	<0.000010	-	<0.000010
Molybdenum	<0.001	-	<0.0010	-	-	<0.0010	-	<0.0010
Nickel	<0.001	-	<0.0010	-	-	0.0075	-	<0.0010
Phosphorus	-	-	-	-	-	-	-	-
Potassium	0.397	-	0.334	-	-	0.221	-	0.128
Selenium	<0.0001	-	<0.00010	-	-	<0.00010	-	<0.00010
Silicon	2.6	-	2.02	-	-	1.79	-	1.79
Silver	<0.00002	-	<0.000020	-	-	<0.000020	-	<0.000020
Sodium	3.06	-	4.01	-	-	3.03	-	2.82
Strontium	0.202	-	0.165	-	-	0.0997	-	0.0991
Thallium	<0.00005	-	<0.000050	-	-	<0.000050	-	<0.000050
Tin	<0.005	-	<0.0050	-	-	<0.0050	-	<0.0050
Titanium	<0.005	-	<0.0050	-	-	<0.0050	-	<0.0050
Uranium	<0.0001	-	<0.00010	-	-	<0.00010	-	<0.00010
Vanadium	<0.005	-	<0.0050	-	-	<0.0050	-	<0.0050
Zinc	<0.005	-	<0.0050	-	-	<0.0050	-	<0.0050
Zirconium	<0.0005	-	<0.00050	-	-	<0.00050	-	<0.00050
Dissolved Metals								
Aluminum	0.0281	-	0.0346	-	-	0.0535	-	0.0483
Antimony	<0.00050	-	<0.00050	-	-	<0.00050	-	<0.00050
Arsenic	0.00023	-	0.00041	-	-	0.0006	-	0.00054
Barium	0.0075	-	0.0089	-	-	0.0063	-	0.006
Beryllium	<0.00010	-	<0.00010	-	-	<0.00010	-	<0.00010
Bismuth	<0.0010	-	<0.0010	-	-	<0.0010	-	<0.0010
Boron	<0.050	-	<0.050	-	-	<0.050	-	<0.050
Cadmium	<0.000010	-	<0.000010	-	-	<0.000010	-	0.000011
Calcium	38.9	-	31.6	-	-	20.1	-	18.6
Chromium	<0.0010	-	<0.0010	-	-	<0.0010	-	<0.0010
Cobalt	<0.00050	-	<0.00050	-	-	<0.00050	-	<0.00050
Copper	0.00058	-	0.00054	-	-	0.00072	-	0.00045
Iron	0.046	-	0.0746	-	-	0.128	-	0.127
Hardness	118	-	98.5	-	-	63	-	58.1
Lead	<0.00020	-	<0.00020	-	-	<0.00020	-	<0.00020
Lithium	<0.0050	-	<0.0050	-	-	<0.0050	-	<0.0050
Magnesium	5.02	-	4.72	-	-	3.1	-	2.84
Manganese	0.0044	-	0.0074	-	-	0.0017	-	0.0092
Mercury	<0.000010	-	<0.000010	-	-	<0.000010	-	<0.000010
Molybdenum	<0.0010	-	<0.0010	-	-	<0.0010	-	<0.0010
Nickel	<0.0010	-	<0.0010	-	-	<0.0010	-	<0.0010
Phosphorus	<0.0050	<0.0050	<0.0050	0.006	0.0061	0.0051	0.006	<0.0050
Potassium	0.387	-	0.364	-	-	0.254	-	0.146
Selenium	<0.00010	-	<0.00010	-	-	<0.00010	-	<0.00010
Silicon	2.36	-	1.92	-	-	1.81	-	2.06
Silver	<0.000020	-	<0.000020	-	-	<0.000020	-	<0.000020
Sodium	2.97	-	3.7	-	-	3.24	-	3.08
Strontium	0.199	-	0.183	-	-	0.112	-	0.105
Thallium	<0.000050	-	<0.000050	-	-	<0.000050	-	<0.000050
Tin	<0.0050	-	<0.0050	-	-	<0.0050	-	<0.0050
Titanium	<0.0050	-	<0.0050	-	-	<0.0050	-	<0.0050
Uranium	<0.00010	-	<0.00010	-	-	<0.00010	-	<0.00010
Vanadium	<0.0050	-	<0.0050	-	-	<0.0050	-	<0.0050
Zinc	<0.0050	-	<0.0050	-	-	<0.0050	-	<0.0050
Zirconium	<0.00050	-	<0.00050	-	-	<0.00050	-	<0.00050

Results expressed in milligrams per litre

TABLE 29
SOUTH PIT CULVERT METALS ANALYSIS
2012/2013 EMS ID- E217014
COMPANY IDENTITY - SPC

Parameter	November			December		
Sample Date	5	20	27	4	11	18
Total Metals						
Aluminum	0.0899	-	-	-	0.0864	-
Antimony	<0.00050	-	-	-	<0.00050	-
Arsenic	0.00053	-	-	-	0.00056	-
Barium	0.0086	-	-	-	0.0133	-
Beryllium	<0.00010	-	-	-	<0.00010	-
Bismuth	<0.0010	-	-	-	<0.0010	-
Boron	<0.050	-	-	-	<0.050	-
Cadmium	<0.0000050	-	-	-	<0.000010	-
Calcium	21	-	-	-	54.2	-
Chromium	<0.0010	-	-	-	<0.0010	-
Cobalt	<0.00050	-	-	-	<0.00050	-
Copper	0.0015	-	-	-	0.00047	-
Iron	0.165	-	-	-	0.16	-
Hardness	64.4	-	-	-	68.5	-
Lead	<0.00020	-	-	-	<0.00020	-
Lithium	<0.0050	-	-	-	<0.0050	-
Magnesium	3.35	-	-	-	6.65	-
Manganese	0.0021	-	-	-	0.0023	-
Mercury	<0.00002	-	-	-	<0.000010	-
Molybdenum	<0.0010	-	-	-	<0.0010	-
Nickel	<0.0010	-	-	-	0.0016	-
Phosphorus	-	-	-	-	-	-
Potassium	0.346	-	-	-	2.46	-
Selenium	<0.00010	-	-	-	0.0001	-
Silicon	3.33	-	-	-	3.36	-
Silver	<0.000020	-	-	-	<0.000020	-
Sodium	3.43	-	-	-	8.37	-
Strontium	0.128	-	-	-	0.3	-
Thallium	<0.000050	-	-	-	<0.000050	-
Tin	<0.0050	-	-	-	<0.0050	-
Titanium	<0.0050	-	-	-	<0.0050	-
Uranium	<0.00010	-	-	-	<0.00010	-
Vanadium	<0.0050	-	-	-	<0.0050	-
Zinc	0.0053	-	-	-	0.0059	-
Zirconium	<0.00050	-	-	-	<0.00050	-
Dissolved Metals						
Aluminum	0.071	-	-	-	0.0432	-
Antimony	<0.00050	-	-	-	<0.00050	-
Arsenic	0.00051	-	-	-	0.00039	-
Barium	0.0083	-	-	-	0.0122	-
Beryllium	<0.00010	-	-	-	<0.00010	-
Bismuth	<0.0010	-	-	-	<0.0010	-
Boron	<0.050	-	-	-	<0.050	-
Cadmium	<0.0000050	-	-	-	<0.000010	-
Calcium	21.9	-	-	-	50.5	-
Chromium	<0.0010	-	-	-	<0.0010	-
Cobalt	<0.00050	-	-	-	<0.00050	-
Copper	0.0007	-	-	-	0.00061	-
Iron	0.103	-	-	-	0.0822	-
Hardness	163	-	-	-	154	-
Lead	<0.00020	-	-	-	<0.00020	-
Lithium	<0.0050	-	-	-	<0.0050	-
Magnesium	3.35	-	-	-	6.79	-
Manganese	<0.0010	-	-	-	0.0016	-
Mercury	<0.000020	-	-	-	<0.000010	-
Molybdenum	<0.0010	-	-	-	<0.0010	-
Nickel	<0.0010	-	-	-	<0.0010	-
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0051
Potassium	0.362	-	-	-	2.16	-
Selenium	<0.00010	-	-	-	<0.00010	-
Silicon	3.37	-	-	-	3.12	-
Silver	<0.000020	-	-	-	<0.000020	-
Sodium	3.33	-	-	-	8.68	-
Strontium	0.119	-	-	-	0.292	-
Thallium	<0.000050	-	-	-	<0.000050	-
Tin	<0.0050	-	-	-	<0.0050	-
Titanium	<0.0050	-	-	-	<0.0050	-
Uranium	<0.00010	-	-	-	<0.00010	-
Vanadium	<0.0050	-	-	-	<0.0050	-
Zinc	<0.0050	-	-	-	<0.0050	-
Zirconium	<0.00050	-	-	-	<0.00050	-

Results expressed in milligrams per litre

TABLE 29
SOUTH PIT CULVERT METALS ANALYSIS
2012/2013 EMS ID- E217014
COMPANY IDENTITY - SPC

Parameter	January		February	March	
Sample Date	8	22	4	5*	5
Total Metals					
Aluminum	-	-	0.109	0.0441	0.045
Antimony	-	-	0.00083	<0.00050	<0.00050
Arsenic	-	-	0.00063	0.00042	0.0004
Barium	-	-	0.0072	0.0096	0.0102
Beryllium	-	-	<0.00010	<0.00010	<0.00010
Bismuth	-	-	<0.0010	<0.0010	<0.0010
Boron	-	-	<0.050	0.051	0.05
Cadmium	-	-	0.000015	<0.000010	<0.000010
Calcium	-	-	22.2	41.4	41.6
Chromium	-	-	<0.0010	<0.0010	<0.0010
Cobalt	-	-	<0.00050	<0.00050	<0.00050
Copper	-	-	0.00066	0.00042	0.00065
Iron	-	-	0.227	0.0797	0.082
Hardness	-	-	68.3	126	127
Lead	-	-	<0.00020	<0.00020	<0.00020
Lithium	-	-	<0.0050	<0.0050	<0.0050
Magnesium	-	-	3.14	5.51	5.65
Manganese	-	-	0.0073	0.0022	0.0023
Mercury	-	-	<0.00002	<0.000010	<0.000010
Molybdenum	-	-	<0.0010	<0.0010	<0.0010
Nickel	-	-	<0.0010	<0.0010	<0.0010
Phosphorus	-	-	-	-	-
Potassium	-	-	2.67	1.95	1.98
Selenium	-	-	<0.00010	<0.00010	<0.00010
Silicon	-	-	3.91	2.95	2.98
Silver	-	-	<0.000020	<0.000020	<0.000020
Sodium	-	-	8.95	11.6	12.1
Strontium	-	-	0.122	0.243	0.246
Thallium	-	-	<0.000050	<0.000050	<0.000050
Tin	-	-	<0.0050	<0.0050	<0.0050
Titanium	-	-	<0.0050	<0.0050	<0.0050
Uranium	-	-	<0.00010	<0.00010	<0.00010
Vanadium	-	-	<0.0050	<0.0050	<0.0050
Zinc	-	-	<0.0050	<0.0050	<0.0050
Zirconium	-	-	<0.00050	<0.00050	<0.00050
Dissolved Metals					
Aluminum	-	-	0.0452	0.0322	0.0322
Antimony	-	-	<0.00050	<0.00050	<0.00050
Arsenic	-	-	0.00041	0.00037	0.00037
Barium	-	-	0.007	0.0096	0.0093
Beryllium	-	-	<0.00010	<0.00010	<0.00010
Bismuth	-	-	<0.0010	<0.0010	<0.0010
Boron	-	-	<0.050	<0.050	<0.050
Cadmium	-	-	0.000009	<0.000010	<0.000010
Calcium	-	-	23	38.1	37.7
Chromium	-	-	<0.0010	<0.0010	<0.0010
Cobalt	-	-	<0.00050	<0.00050	<0.00050
Copper	-	-	0.00044	0.00031	0.00034
Iron	-	-	0.0763	0.0425	0.0435
Hardness	-	-	69.8	117	115
Lead	-	-	<0.00020	<0.00020	<0.00020
Lithium	-	-	<0.0050	<0.0050	<0.0050
Magnesium	-	-	3.04	5.2	5.09
Manganese	-	-	0.0019	0.0012	0.0012
Mercury	-	-	<0.00002	<0.000010	<0.000010
Molybdenum	-	-	<0.0010	<0.0010	<0.0010
Nickel	-	-	<0.0010	<0.0010	<0.0010
Phosphorus	0.0059	0.02	-	-	-
Potassium	-	-	2.67	1.85	1.76
Selenium	-	-	<0.00010	<0.00010	<0.00010
Silicon	-	-	3.5	2.84	2.84
Silver	-	-	<0.000020	<0.000020	<0.000020
Sodium	-	-	8.15	11.3	10.9
Strontium	-	-	0.123	0.231	0.228
Thallium	-	-	<0.000050	<0.000050	<0.000050
Tin	-	-	<0.0050	<0.0050	<0.0050
Titanium	-	-	<0.0050	<0.0050	<0.0050
Uranium	-	-	<0.00010	<0.00010	<0.00010
Vanadium	-	-	<0.0050	<0.0050	<0.0050
Zinc	-	-	<0.0050	<0.0050	<0.0050
Zirconium	-	-	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre

TABLE 30
SEEP INTO LONG LAKE AND LONG LAKE MIDDLE SEEP WATER QUALITY
2012/2013 EMS ID (LLS): E292131
COMPANY IDENTITY - LLS AND LLSM

Stations	LLS (Long Lake Seep)				
Parameter / **Sample Date**	**April**	**May**	**June**	**July**	**August**
	3	2	6	4	1
Conductivity(umhos/cm)	1150	1440	1470	1380	1230
Hardness (as CaCO3)	508	546	562	534	484
pH	7.91	7.91	8.01	8.18	8.01
Acidity (to PH 8.3)	08.0	14.0	5.2	7.80	11.60
Alkalinity-Total (as CaCO3)	163	221	222	231	222
Sulphate	**433**	**543**	**567**	**490**	**410**

Stations	LLS (Long Lake Seep)				
Parameter / **Sample Date**	**November**	**December**	**January**	**February**	**March**
	6	12	3	4	7
Conductivity(umhos/cm)	1320	1350	1380	-	1240
Hardness (as CaCO3)	347	511	556	471	477
pH	8.06	8.08	8.08	-	8.01
Acidity (to PH 8.3)	07.8	<0.50	4.5	-	-
Alkalinity-Total (as CaCO3)	242	212	206	186	188
Sulphate	**464**	**637**	**543**	**464**	**476**

Stations	LLSM (Long Lake Middle Seep)					
Parameter / **Sample Date**	**April**	**May**	**June**	**July**	**August**	**September**
	3	2	6	4	1	5
Conductivity(umhos/cm)	0960	1330	1290	1230	1340	1350
Hardness (as CaCO3)	386	507	477	472	516	518
pH	7.96	8.00	8.10	8.24	7.92	8.27
Acidity (to PH 8.3)	04.0	08.4	0.8	<0.50	19.50	<0.50
Alkalinity-Total (as CaCO3)	134	210	209	212	235	239
Sulphate	**358**	**489**	**457**	**324**	**523**	**503**

Stations	LLSM (Long Lake Middle Seep)					
Parameter / **Sample Date**	**October**	**November**	**December**	**January**	**February**	**March**
	10	6	12	3	4	7
Conductivity(umhos/cm)	1350	1140	1310	1600	-	1520
Hardness (as CaCO3)	471	420	511	636	627	649
pH	7.82	8.06	8.16	7.91	-	8.00
Acidity (to PH 8.3)	03.4	05.1	<0.50	9.80	-	-
Alkalinity-Total (as CaCO3)	241	218	206	239	230	227
Sulphate	**451**	**392**	**611**	**660**	**651**	**611**

Results expressed in milligrams per litre except where noted.

TABLE 31
SEEP INTO LONG LAKE METALS ANALYSIS
2012/2013 EMS ID (LLS): E292131
COMPANY IDENTITY - LLS

LLSM (Long Lake Middle Seep)												
Parameter / **Sample Date**	**April 3**	**May 2**	**June 6**	**July 4**	**August 1**	**September 5**	**October 10**	**November 6**	**December 12**	**January 3**	**February 4**	**March 7**
Total Metals												
Aluminum	0.211	0.0031	0.0039	0.0053	0.0069	<0.0030	0.0036	0.0204	0.0148	0.0183	0.0715	0.0272
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0013	0.00233	0.00152	0.00175	0.00712	0.00554	0.00841	0.00083	0.002	0.00319	0.00276	0.00287
Barium	0.016	0.0187	0.0185	0.0206	0.0209	0.0209	0.0213	0.0204	0.0202	0.0199	0.0191	0.0186
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.38	0.582	0.565	0.627	0.642	0.649	0.755	0.632	0.643	0.597	0.555	0.497
Cadmium	<0.00001	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	0.000044	<0.0000050	<0.0000050	0.000005	<0.000005	<0.000010
Calcium	134	178	169	166	182	183	170	158	177	198	171	171
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.0023	0.00082	0.0006	0.00053	0.00075	0.00075	0.00065	<0.00050	0.00052	0.00133	0.00189	0.00101
Copper	0.0021	<0.00020	<0.00020	0.00067	0.00038	0.00021	0.0018	0.00153	0.00048	0.00044	0.00093	0.00047
Hardness	-	-	-	-	-	-	-	-	-	565	493	492
Iron	0.717	0.753	0.716	0.826	1.9	1.91	1.92	0.232	0.627	1.28	1.39	1.07
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00086
Lithium	0.015	0.0191	0.0175	0.0182	0.0206	0.0206	0.0201	0.016	0.0204	0.0215	0.02	0.0183
Magnesium	12.5	15	13.4	13.8	15.1	15	14.5	13.1	16.8	17	16	15.4
Manganese	0.125	0.269	0.237	0.238	0.383	0.389	0.378	0.09	0.197	0.35	0.312	0.278
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000010
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.005	0.0023	0.0014	0.0013	0.0014	0.0015	0.0031	0.0019	0.0022	0.0038	0.0044	0.0027
Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-
Potassium	1.72	2.19	1.97	2.03	2.2	2.31	2.08	2.11	2.11	2.22	2.04	2.1
Selenium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	2.9	2.91	2.81	2.65	2.82	3.01	2.62	2.7	2.67	3.1	3.03	2.98
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	0.000021
Sodium	61.6	97.2	87.7	87.8	106	107	108	83.9	92.5	94.9	84.3	85
Strontium	1.14	1.64	1.5	1.54	1.69	1.69	1.73	1.41	1.67	1.79	1.55	1.58
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.006	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0052	0.0093	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals												
Aluminum	0.0238	0.0042	0.0085	0.0041	0.0049	<0.0030	<0.0030	0.0106	0.0076	0.0079	0.0241	0.0093
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00111	0.00212	0.00156	0.00135	0.0026	0.00208	0.00248	0.0005	0.00079	0.00156	0.00153	0.00147
Barium	0.0165	0.0199	0.0198	0.0185	0.0209	0.0198	0.019	0.0202	0.0205	0.0206	0.02	0.0172
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.335	0.567	0.587	0.528	0.654	0.606	0.744	0.653	0.601	0.574	0.498	0.508
Cadmium	<0.000010	0.00002	<0.000010	0.000012	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000025	<0.000010
Calcium	129	179	171	162	187	173	165	145	178	194	162	167
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00234	0.00084	0.00066	0.0005	0.00082	0.00064	0.0006	<0.00050	<0.00050	0.00135	0.0019	0.00095
Copper	0.0012	0.0005	0.00027	0.00082	0.00043	0.00053	0.00102	0.0005	0.00027	0.00024	0.00041	0.00061
Hardness	-	-	-	-	-	-	-	-	-	556	471	477
Iron	0.238	0.663	0.608	0.539	<0.0050	<0.0050	0.0096	0.0082	<0.0050	0.0314	0.0081	0.0112
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00175	<0.00020
Lithium	0.0145	0.0205	0.0183	0.0172	0.0201	0.0203	0.0216	0.0179	0.0221	0.0219	0.0179	0.0177
Magnesium	12.3	15.7	13.9	13.4	15.8	14.7	14.2	14	16	17.2	15.9	14.7
Manganese	0.129	0.275	0.267	0.222	0.4	0.373	0.365	0.0929	0.198	0.356	0.304	0.259
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0052	0.0023	0.0016	0.0014	0.0016	0.0016	0.0012	0.0026	0.0027	0.0033	0.0046	0.002
Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-
Potassium	1.79	2.2	2.13	1.92	2.43	2.21	2.15	2.19	2.18	2.34	2.06	1.88
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010
Silicon	2.97	2.54	2.76	2.72	2.89	2.72	3.01	2.56	2.53	2.94	2.79	3.12
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	62.9	97.8	91.9	87.1	112	107	109	88.4	92.4	96.4	83.7	79.8
Strontium	1.17	1.7	1.56	1.41	1.76	1.67	1.62	1.42	1.68	1.84	1.54	1.5
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.0059	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0096	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 31
SEEP INTO LONG LAKE METALS ANALYSIS
2012/2013 EMS ID (LLS): E292131
COMPANY IDENTITY - LLS

	LLS (Long Lake Seep)									
Parameter / **Sample Date**	**April** 3	**May** 2	**June** 6	**July** 4	**August** 1	**November** 6	**December** 12	**January** 3	**February** 4	**March** 7
Total Metals										
Aluminum	0.255	0.0058	0.0047	0.0051	0.0086	0.0131	0.0207	0.007	0.0107	0.0093
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0024	0.00697	0.00501	0.00607	0.00171	0.00455	0.00545	0.00739	0.00882	0.00894
Barium	0.019	0.0207	0.0194	0.02	0.0197	0.0211	0.0207	0.0211	0.0198	0.0192
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.46	0.628	0.616	0.697	0.588	0.661	0.669	0.688	0.808	0.708
Cadmium	0.00002	0.000018	<0.000010	0.000015	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.000025	<0.000010
Calcium	180	192	198	188	171	183	183	215	221	209
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.0031	0.00084	0.00105	0.00093	<0.00050	0.00062	0.00051	0.00101	0.00131	0.0006
Copper	0.0021	0.00023	<0.00020	0.00047	0.00047	0.00039	0.00055	<0.00020	0.00024	0.00046
Hardness	-	-	-	-	-	-	-	614	633	596
Iron	1.03	1.81	1.66	1.82	0.726	1.68	1.5	1.96	3.02	2.07
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.018	0.0206	0.0203	0.0204	0.0183	0.0218	0.0208	0.0239	0.026	0.0242
Magnesium	14.2	16.2	16.7	15.7	14.1	14.9	16.8	19.1	19.7	17.8
Manganese	0.218	0.392	0.451	0.408	0.203	0.343	0.309	0.492	0.544	0.414
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000020	<0.000020	<0.000020	<0.000010
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.007	0.0017	0.0022	0.0014	0.0012	0.0022	0.0018	0.0022	0.0032	0.0015
Phosphorous	-	-	-	-	-	-	-			
Potassium	1.9	2.34	2.3	2.26	2.06	2.39	2.19	2.44	2.38	2.39
Selenium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	3.3	2.89	3.05	2.91	2.7	3.16	2.84	3.08	3.2	3.15
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	77	108	104	106	96	109	97.5	114	115	113
Strontium	1.46	1.87	1.76	1.75	1.54	1.73	1.74	2.07	2.07	1.99
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.007	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals										
Aluminum	0.0244	0.0041	0.0091	0.0058	0.005	<0.0030	0.005	<0.0030	0.0088	<0.0030
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00182	0.00554	0.0049	0.00442	0.00113	0.00127	0.00101	0.00366	0.00318	0.00324
Barium	0.0186	0.0217	0.0202	0.0188	0.0217	0.0142	0.02	0.0204	0.0224	0.0186
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.441	0.609	0.662	0.609	0.58	0.452	0.642	0.736	0.789	0.661
Cadmium	0.000022	0.000018	<0.000010	0.000016	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.000025	<0.000010
Calcium	182	188	199	183	170	122	178	223	219	229
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00289	0.00083	0.00114	0.00081	<0.00050	<0.00050	<0.00050	0.00105	0.00134	0.00065
Copper	0.00505	0.00035	0.00046	0.00138	0.00046	0.00027	0.00097	<0.00020	0.00048	0.00065
Hardness	-	-	-	-	-	-	-	636	627	649
Iron	0.376	1.28	1.67	1.35	0.006	<0.0050	<0.0050	0.0495	0.197	<0.0050
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00029	<0.00020
Lithium	0.0171	0.0216	0.0213	0.02	0.0181	0.015	0.0224	0.0255	0.0242	0.0225
Magnesium	13.8	16.5	16.6	15	14.8	9.96	16.3	18.9	19.6	18.5
Manganese	0.222	0.4	0.467	0.397	0.211	0.218	0.303	0.498	0.541	0.427
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000020	<0.000020	<0.000020	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0067	0.0021	0.0032	0.0017	0.0013	0.001	0.0032	0.0023	0.0033	0.0014
Phosphorous	-	-	-	-	-	-	-	-	-	-
Potassium	2.03	2.34	2.31	2.16	2.22	1.53	2.22	2.51	2.44	2.42
Selenium	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	3.73	2.66	2.87	2.83	2.62	1.99	2.63	3.29	3.03	3.38
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	77	106	105	103	101	73.1	95.4	112	116	115
Strontium	1.4	1.87	1.79	1.64	1.61	1.07	1.75	2.07	2.05	2.02
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.0069	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0096	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 32
LONG LAKE OUTLET WATER QUALITY
2012/2013 EMS ID-E19412
COMPANY IDENTITY - LLO

Parameter	April					May				June				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton	
Sample Date	2	10	17	24	30	8	15	22	29	5	12	19	26	Max mg/L	30-Day Mean[1] mg/L	GPS (m)	
Conductivity (umhos/cm)	252	81.8	106	123	145	157	168	186	193	205	199	203	204	-	-	Minegrid	
Hardness CaCO3	88.2	-	-	-	49.1	-	-	-	-	72.8	-	-	-	-	-	Northing	Easting
pH	7.69	7.55	7.43	7.53	7.23	7.62	7.50	7.49	7.66	7.60	7.53	7.60	7.68	-	≥ (6.5)[2] or (6.9)[3]	101489.06	99155.766
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	1.30	<0.50	1.00	0.96	1.08	1.09	0.59	0.97	<0.50	2.28	<0.50	0.91	<0.50	-	-	Northing	Easting
Alkalinity - Total CaCO3	38.2	15.8	21.3	21.9	24.2	27.0	27.6	29.6	29.2	30.4	29.6	30.6	30.5	-	-	5532654	323139
Ammonia Nitrogen	0.043	-	-	-	0.019	-	-	-	-	0.014	-	-	-	-	-	Long Lake Outflow - Tributary to Middle Quinsam Lake	
Nitrate - Nitrite as N	<0.020	-	-	-	<0.020	-	-	-	-	<0.020	-	-	-	-	-		
N-TKN	0.172	-	-	-	0.180	-	-	-	-	0.383	-	-	-	-	-		
Dissolved Phosphorus	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-		
Total Phosphorus	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-		
Sulphate	78.6	20.7	26.8	30.4	38.0	43.2	49.2	55.0	58.5	56.8	59.8	59.5	60.9	100^	N/A		

Parameter	July					August				September		Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton	
Sample Date	7	14	20	28	31	7	14	21	28	4	11	Max mg/L	30-Day Mean[1] mg/L	GPS (m)	
Conductivity (umhos/cm)	201	185	185	200	212	219	230	234	252	256	265	-	-	Minegrid	
Hardness CaCO3	68.3	-	-	-	76.1	-	-	-	-	98.1	-	-	-	Northing	Easting
pH	7.69	7.59	7.45	7.52	7.63	7.55	7.72	7.77	7.84	7.72	7.77	-	≥ (6.5)[2] or (6.9)[3]	101489.06	99155.766
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.50	1.25	1.75	0.73	1.52	1.14	0.68	<0.50	0.99	1.05	0.83	-	-	Northing	Easting
Alkalinity - Total CaCO3	30.3	29.5	32.7	32.3	36.1	36.3	35.8	38.8	38.7	41.6	40.1	-	-	5532654	323139
Ammonia Nitrogen	0.0130	-	-	-	0.0095	-	-	-	-	0.0150	-	-	-	Long Lake Outflow - Tributary to Middle Quinsam Lake	
Nitrate - Nitrite as N	<0.020	-	-	-	<0.020	-	-	-	-	0.028	-	-	-		
N-TKN	0.216	-	-	-	0.181	-	-	-	-	0.141	-	-	-		
Dissolved Phosphorus	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-		
Total Phosphorus	0.0075	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-		
Sulphate	57.1	53.1	54.4	55.7	58.7	68.8	70.6	73.1	77.6	83.9	80.2	100^	N/A		

Parameter	October			November				December				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton	
Sample Date	13	23	30	5	13	20	27	4	11	18	28	Max mg/L	30-Day Mean[1] mg/L	GPS (m)	
Conductivity (umhos/cm)	310	309	237	157	192	136	97.5	64.3	62.8	98.4	127	-	-	Minegrid	
Hardness CaCO3	-	-	-	57.9	-	-	-	-	23.5	-	-	-	-	Northing	Easting
pH	7.87	7.83	7.44	7.51	7.63	7.43	7.5	7.31	7.08	7.35	7.3	-	≥ (6.5)[2] or (6.9)[3]	101489.06	99155.766
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	**52** (WQO)	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.50	<0.50	<0.50	0.64	<0.50	0.74	1.27	<0.50	<0.50	0.76	1.02	-	-	Northing	Easting
Alkalinity - Total CaCO3	44.5	44.3	35.5	28.1	29.8	22.8	17.7	12.1	12.7	16.5	20.6	-	-	5532654	323139
Ammonia Nitrogen	-	-	-	<0.0050	-	-	-	-	-	-	-	-	-	Long Lake Outflow - Tributary to Middle Quinsam Lake	
Nitrate - Nitrite as N	-	-	-	<0.020	-	-	-	-	-	-	-	-	-		
N-TKN	-	-	-	0.153	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-		
Total Phosphorus	-	-	-	<0.0050	-	-	-	-	-	-	-	-	-		
Sulphate	96.3	**108** (WQG)	76.2	41.6	55.1	38.2	21.5	14.3	13.2	26.2	31.8	100^	N/A		

Parameter	January				February				March				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton	
Sample Date	8	16	22	29	4	12	19	25	5	11	19	26	Max mg/L	30-Day Mean[1] mg/L	GPS (m)	
Conductivity (umhos/cm)	145	90.4	102	-	-	-	-	-	-	-	-	-	-	-	Minegrid	
Field Conductivity (uS/cm	-	-	-	-	-	-	-	83	-	192	178	166.3	-	-		
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
pH	7.37	7.25	7.36	-	-	-	-	-	-	-	-	-	-	≥ (6.5)[2] or (6.9)[3]	101489.06	99155.766
Field pH	-	-	-	-	-	-	-	6.95	-	8.19	7.34	7.17	-	-	UTM ZONE 10	
Total Suspended Solids	<4.0	<4.0	<4.0	-	-	-	-	-	-	-	-	-	25	5		
Acidity (to pH 8.3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Alkalinity - Total CaCO3	23.9	16	17.5	-	-	-	-	-	-	-	-	-	-	-	5532654	323139
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Long Lake Outflow - Tributary to Middle Quinsam Lake	
Nitrate - Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
N-TKN	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total Phosphorus	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	42.8	22.8	25.2	33.2	29.2	28.9	27	31	22.3	51.9	38.4	38.8	100^	N/A		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
[2] 30-day 90th percentile
[3]Running 30-day median
^The sulphate limit is a guideline rather than a site-specific objective
WQO = unmet Water Quality Objective
WQG = above Water Quality Guideline

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

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TABLE 33
LONG LAKE OUTLET METALS ANALYSIS
2012/2013 EMS ID- E219412
COMPANY IDENTITY - LLO

Parameter	April		June	July		September	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	2	30	5	3	31	4	Max	30-Day Mean[1]
Total Metals								
Aluminum	0.036	0.0256	0.0473	0.0867	0.0234	0.0109	-	-
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0004	0.00035	0.00054	0.00061	0.00061	0.00051	**0.005^**	-
Barium	0.005	0.0037	0.0054	0.0061	0.0064	0.0072	-	-
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	0.07	<0.050	0.064	0.063	0.062	0.085	-	-
Cadmium	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	[2]	-
Calcium	30.3	16.3	24.7	22.9	25.3	33.1	-	-
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0004	0.00041	0.00046	0.0006	0.00055	0.00079	-	**≤0.002**
Iron	0.113	0.0904	0.16	0.236	0.0972	0.0467	-	**≤ 0.3**
Hardness CaCO4	88.2	49.1	72.8	68.3	76.1	98.1	-	
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.005**	**≤ 0.003**
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	3.06	2	2.73	2.7	3.17	3.74	-	-
Manganese	0.022	0.0134	0.0514	0.025	0.0189	0.0116	**0.0500**	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	**≤0.0001**	-
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**-**	-
Nickel	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.025**	-
Phosphorus	<0.0050	<0.0050	<0.0050	0.0075	<0.0050	<0.0050	-	-
Potassium	0.37	0.218	0.292	0.258	0.342	0.364	-	-
Selenium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.9	2.68	2.9	2.47	2.65	2.65	-	-
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	12.5	6.74	9.49	9.37	10.1	13.1	-	-
Strontium	0.235	0.122	0.169	0.17	0.185	0.237	-	-
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.005	<0.0050	<0.0050	0.0061	<0.0050	<0.0050	-	-
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.03**	
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Dissolved Metals								
Aluminum	0.0252	0.019	0.0112	0.0114	0.012	0.0036	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00036	0.00033	0.00042	0.00055	0.00059	0.00052	-	-
Barium	0.0055	0.0038	0.0055	0.0057	0.0063	0.0069	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	0.093	<0.050	0.063	0.063	0.064	0.085	-	-
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	0.000015	<0.0000050	-	-
Calcium	30.6	16.7	24.2	23.8	25.5	31.8	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00074	0.00059	0.00042	0.00045	0.00097	0.00074	-	-
Iron	0.0648	0.0548	0.0535	0.0645	0.0553	0.0174	-	-
Hardness CaCO4	89.4	50.1	72.0	71.0	76.5	94.9	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	3.18	2.01	2.81	2.81	3.12	3.78	-	-
Manganese	0.0221	0.0119	0.0119	0.0183	0.0056	0.0025	-	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.434	0.235	0.319	0.279	0.318	0.342	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.72	2.65	2.65	2.62	2.81	2.63	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	13.2	6.78	10	9.07	9.94	13.1	-	-
Strontium	0.238	0.123	0.18	0.164	0.18	0.234		
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^ : The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.
* Field replicate samples.
WQO = unmet Water Quality Objective

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TABLE 33
LONG LAKE OUTLET METALS ANALYSIS
2012/2013 EMS ID- E219412
COMPANY IDENTITY - LLO

Parameter / Sample Date	November 5	December 11	January 2	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L) Max	30-Day Mean[1]
Total Metals					
Aluminum	0.0304	0.137	0.0493	-	-
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00044	0.0003	0.00058	**0.005^**	-
Barium	0.0047	0.023	0.0053	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	0.05	<0.050	<0.050	-	-
Cadmium	<0.0000050	<0.0000050	<0.0000050	[2]	-
Calcium	18.9	16.3	14.8	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00083	0.00217	0.00059	-	**≤0.002**
Iron	0.0891	0.147	0.4	-	**≤ 0.3**
Hardness CaCO4	57.0	60.3	45.8	-	**-**
Lead	<0.00020	<0.00020	<0.00020	**0.005**	**≤ 0.003**
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	2.38	4.75	2.17	-	-
Manganese	0.0066	0.0072	0.0253	**0.0500**	-
Mercury	<0.000020	<0.000020	<0.000020	**≤0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	**-**	-
Nickel	<0.0010	0.0016	<0.0010	**0.025**	-
Phosphorus	<0.0050	-	-	-	-
Potassium	0.28	2.44	0.463	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.96	6.46	3.55	-	-
Silver	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	7.38	20.5	3.71	-	-
Strontium	0.139	0.12	0.0793	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	0.0062	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	**0.03**	
Zirconium	<0.00050	<0.00050	<0.00050	-	-
Dissolved Metals					
Aluminum	0.0138	0.0372	0.0318	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00044	0.00034	0.00051	-	-
Barium	0.0046	0.0027	0.0052	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	-	-
Cadmium	<0.0000050	<0.0000050	<0.0000050	-	-
Calcium	19.3	7.46	14	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00056	0.00064	0.00043	-	-
Iron	0.0413	0.0728	0.2	-	-
Hardness CaCO4	57.9	23.5	44.3	-	-
Lead	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	2.36	1.2	2.24	-	-
Manganese	0.003	0.0071	0.0242	-	-
Mercury	<0.000020	<0.000020	<0.000020	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	-	-
Phosphorus	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.272	0.189	0.465	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.84	3.07	3.31	-	-
Silver	<0.000020	<0.000020	<0.000020	-	-
Sodium	7.2	2.22	3.74	-	-
Strontium	0.129	0.0396	0.0799	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	0.0062	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^ : The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.
* Field replicate samples.
WQO = unmet Water Quality Objective

TABLE 34
NO NAME LAKE OUTLET WATER QUALITY
2012/2013 EMS ID- E217017
COMPANY IDENTITY - NNO

Parameter	April					May				June				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	2	10	17	24	30	8	15	22	29	5	12	19	26	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	37.4	30.5	31.7	35	37	34.9	36.8	36.5	36.6	37.8	37.2	36.8	39	-	-	Minegrid	
Hardness $CaCO_3$	14.7	-	-	-	15	-	-	-	-	15.6	-	-	-	-	-	Northing	Easting
pH	7.11	7.24	7.2	7.27	7.25	7.12	7.21	7.22	7.35	7.31	7.28	7.39	7.44	N/A	≥ (6.5)[2] or (6.9)[3]	101767	97267.6
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	0.8	<0.5	<0.5	<0.50	0.68	1.51	0.52	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	-	Northing	Easting
Alkalinity - Total $CaCO_3$	9.93	10.7	10.2	10.6	11.2	11.1	12.2	11.5	12.2	12.1	12.9	13.3	13	-	-	5531308	321786
Ammonia Nitrogen	0.021	-	-	-	0.02	-	-	-	-	0.016	-	-	-	-	-	No Name Lake Background Water Quality	
N-TKN	0.139	-	-	-	0.305	-	-	-	-	0.177	-	-	-				
Nitrate/ Nitrite as N(mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-		
Total Phosphorus	4.83	4.26	2.92	4.36	4.36	4.21	4.29	5.3	4.3	4.03	4.73	3.09	3.37	-	-		
Sulphate	0.021	-	-	-	<0.020	-	-	-	-	<0.020	-	-	-	100^	N/A		

Parameter	July					August					September				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	3	10	17	23	31	7	14	20	20*	28	4	11	18	25	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	41.5	40.9	41.8	41.9	41.7	42.7	44.6	43.9	43.3	44.9	45	43.9	45.8	43.1	-	-	Minegrid	
Hardness $CaCO_3$	16.8	-	-	-	17.5	-	-	-	-	-	19.4	-	-	-	-	-	Northing	Easting
pH	7.46	7.37	7.27	7.42	7.42	7.45	7.47	7.38	7.36	7.55	7.45	7.49	7.44	7.2	N/A	≥ (6.5)[2] or (6.9)[3]	101767	97267.6
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	0.8	<0.50	<0.50	<0.50	1.12	1.13	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	-	Northing	Easting
Alkalinity - Total $CaCO_3$	14.5	13.2	14.7	14.3	16.2	15.1	17	17.3	16.6	17.3	16.8	16.2	16.1	15.8	-	-	5531308	321786
Ammonia Nitrogen	0.02	-	-	-	0.0051	-	-	-	-	-	0.018	-	-	-	-	-	No Name Lake Background Water Quality	
N-TKN	0.182	-	-	-	0.161	-	-	-	-	-	0.209	-	-	-				
Nitrate/ Nitrite as N(mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	<0.0050	-	-	-	<0.0050	-	-	-	-	-	<0.0050	-	-	-	-	-		
Total Phosphorus	4.41	3.99	4.62	3.64	2.93	2.71	3.31	3.09	3.07	2.92	3.72	3.28	4.51	4.16	-	-		
Sulphate	<0.020	-	-	-	<0.020	-	-	-	-	-	<0.020	-	-	-	100^	N/A		

Parameter	October					November				December			Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	3	10	17	23	31	7	14	20	28	4	11	25	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	45.3	46.5	47	47.6	48.6	44.5	48.1	44.9	40	30	28.8	29.3	-	-	Minegrid	
Hardness $CaCO_3$	-	18.5	-	-	-	18.7	-	-	-	-	11.7	-	-	-	Northing	Easting
pH	7.42	7.38	7.44	7.35	7.34	7.27	7.38	7.35	7.32	7.22	7.21	7.13	N/A	≥ (6.5)[2] or (6.9)[3]	101767	97267.6
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.52	1.25	1.02	0.78	<0.50	1.02	-	-	Northing	Easting
Alkalinity - Total $CaCO_3$	14.8	15.5	15.2	15.3	14.2	13.6	13.5	13.1	12.1	10.5	10.3	10.2	-	-	5531308	321786
Ammonia Nitrogen	-	0.0081	-	-	-	0.0052	-	-	-	-	-	-	-	-	No Name Lake Background Water Quality	
Nitrate/ Nitrite as N(mg/L)	-	<0.020	-	-	-	0.027	-	-	-	-	-	-				
N-TKN	-	0.252	-	-	-	0.236	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total Phosphorus	-	<0.0050	-	-	-	0.0074	-	-	-	-	-	-	-	-		
Sulphate	3.88	4.5	5.77	5.94	6.23	6.27	6.61	5.75	5.11	1.68	0.81	1.2	100^	N/A		

Parameter	January					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	3	8*	8	16	21	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	29.7	29.5	29.7	29.1	31.3	-	-	Minegrid	
Hardness $CaCO_3$	12.8	-	-	-	-	-	-	Northing	Easting
pH	7.12	7.09	7.08	7.28	7.39	N/A	≥ (6.5)[2] or (6.9)[3]	101767	97267.6
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	-	-	-	-	-	-	-	Northing	Easting
Alkalinity - Total $CaCO_3$	10.2	11.3	10.8	12.8	13.2	-	-	5531308	321786
Ammonia Nitrogen	-	-	-	-	-	-	-	No Name Lake Background Water Quality	
Nitrate/ Nitrite as N(mg/L)	-	-	-	-	-				
N-TKN	-	-	-	-	-	-	-		
Dissolved Phosphorus	-	-	-	-	-	-	-		
Total Phosphorus	-	-	-	-	-	-	-		
Sulphate	0.94	1.48	1.21	0.8	2.17	100^	N/A		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

[2] 30-day 90th percentile

[3]Running 30-day median

^The sulphate limit is a guideline rather than a site-specific objective

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 35
NO NAME LAKE OUTLET METALS ANALYSIS
2012/2013 EMS ID- E217017
COMPANY IDENTITY - NNO

Parameter	April		June	July		September	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	2	30	5	3	31	4	Max	30-Day Mean[1]
Total Metals								
Aluminum	0.089	0.0496	0.0228	0.0197	0.0185	0.0168	-	-
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0002	0.0003	0.00023	0.00034	0.00041	0.00044	**0.005^**	-
Barium	0.001	0.0015	0.0012	0.0013	0.0013	0.0016	-	-
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	[2]	-
Calcium	4.49	4.49	4.74	5.07	5.2	5.78	-	-
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0005	0.00052	0.00064	0.00053	0.00039	0.00064	-	**≤0.002**
Iron	0.118	0.253	0.0559	0.0769	0.0853	0.0805	-	**≤ 0.3**
Hardness	14.7	15.0	15.6	16.8	17.5	19.4	-	**-**
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.005**	**≤ 0.003**
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	0.836	0.919	0.925	0.995	1.09	1.21	-	-
Manganese	0.005	0.0912	0.0061	0.0048	0.007	0.0088	**0.0500**	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	**≤0.0001**	-
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**-**	-
Nickel	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.025**	-
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.085	0.084	0.076	0.082	0.073	0.096	-	-
Selenium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.8	2.91	2.86	2.72	2.84	3.07	-	-
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	1.03	1.08	1.12	1.26	1.31	1.38	-	-
Strontium	0.017	0.0165	0.0162	0.018	0.0184	0.0203	-	-
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.03**	-
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Dissolved Metals								
Aluminum	0.0507	0.0309	0.0178	0.0161	0.0179	0.0099	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00018	0.00033	0.00023	0.00033	0.00041	0.00044	-	-
Barium	0.0018	0.0015	0.0014	0.0013	0.0014	0.0013	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	-	-
Calcium	4.87	4.69	4.9	4.79	5.73	5.73	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0008	0.0006	0.00057	0.00079	0.00052	0.00081	-	-
Iron	0.144	0.205	0.0368	0.0518	0.0621	0.0491	-	-
Hardness	15.8	15.5	16.1	15.9	18.9	19.1	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	0.889	0.919	0.93	0.961	1.11	1.17	-	-
Manganese	0.0048	0.0951	0.005	0.003	0.0041	0.002	-	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorus	-	-	-	-	-	-	-	-
Potassium	0.148	0.085	0.099	0.107	0.077	0.096	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.85	2.81	2.67	2.78	3.1	3	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	1.46	1.25	1.27	1.35	1.42	1.41	-	-
Strontium	0.0224	0.0191	0.0182	0.018	0.0204	0.0198	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-

[1] 30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^ : The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2] Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.
* Field replicate sample.
WQO = unmet Water Quality Objective

TABLE 35
NO NAME LAKE OUTLET METALS ANALYSIS
2012/2013 EMS ID- E217017
COMPANY IDENTITY - NNO

Parameter	October	November	December	January	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	9	5	11	3	**Max**	**30-Day Mean[1]**
Total Metals						
Aluminum	0.0139	0.147	0.081	0.0439	-	-
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00039	0.00044	0.0004	0.00032	**0.005^**	-
Barium	0.0015	0.0025	0.0021	0.0012	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	**0.00012 (WQO)**	0.000008	**0.000012 (WQO)**	0.000016	[2]	-
Calcium	5.88	5.77	3.81	3.76	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00084	0.00111	0.0008	0.00055	-	**≤0.002**
Iron	0.0523	0.312	0.161	0.1	-	**≤ 0.3**
Hardness	19.2	18.9	12.9	12.7	-	**-**
Lead	<0.00020	<0.00020	<0.00020	<0.00020	**0.005**	**≤ 0.003**
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.1	1.09	0.823	0.798	-	-
Manganese	0.0072	0.0205	0.0064	0.0041	**0.0500**	-
Mercury	<0.0000020	<0.0000020	<0.0000023	<0.0000020	**≤0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	**-**	-
Nickel	<0.0010	<0.0010	0.0011	<0.0010	**0.025**	-
Phosphorus	<0.0050	0.0074			-	-
Potassium	0.143	0.133	0.118	0.073	-	-
Selenium	<0.00010	<0.00010	<0.00010	0.00017	-	-
Silicon	2.63	3.36	3.52	3.98	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	1.44	1.39	1.05	1.07	-	-
Strontium	0.0229	0.0223	0.0167	0.0109	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	0.0097	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	0.0104	<0.0050	0.0062	<0.0050	**0.03**	
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Dissolved Metals						
Aluminum	0.0069	0.0305	0.0428	0.0377	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00037	0.00031	0.00024	0.00029	-	-
Barium	0.0013	0.0016	0.0011	0.0011	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	0.000048	<0.0000050	<0.0000050	0.000008	-	-
Calcium	5.58	5.6	3.45	3.63	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00105	0.0008	0.0005	0.0005	-	-
Iron	0.0326	0.0643	0.0528	0.0636	-	-
Hardness	18.5	18.7	11.7	12.8	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.1	1.14	0.754	0.895	-	-
Manganese	0.0027	0.0047	0.0037	0.0041	-	-
Mercury	<0.0000020	<0.0000020	<0.0000020	<0.0000020	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorus	-	-	-		-	-
Potassium	0.13	0.116	0.084	0.063	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.61	3.08	3.14	3.48	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	1.33	1.4	1.06	1.17	-	-
Strontium	0.0206	0.0221	0.0116	0.0114	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	0.0097	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	0.0093	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	-	-

[1] 30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^ : The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2] Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.
* Field replicate sample.
WQO = unmet Water Quality Objective

TABLE 36
LONG LAKE MIDDLE WATER QUALITY
2012/2013 EMS ID E206619
COMPANY IDENTITY - LLM

Parameter	April					May¤					June¤¤					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Parameter	1	1*	4	9	B	1	4	4*	9	B	1	4	9	9*	B	Max	30-Day Mean[1]		
Conductivity (umhos/cm)	132	132	223	404	417	196	297	300	404	419	198	272	404	404	406	-	-	GPS (m)	
Hardness CaCO3	45.8	-	73.1	137	142	67.7	99	-	135	141	71.7	96.9	146	-	145	-	-		
pH	7.48	7.46	7.69	7.67	7.67	7.7	7.76	7.76	7.76	7.75	7.68	7.68	7.64	7.58	7.56	-	≥ (6.5)[2] or (6.9)[3]	Minegrid	
Total suspended solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5		
Aciditiy	0.78	0.62	<0.5	1.62	1.54	0.52	1.14	1.79	2.65	2.91	1.35	1.95	2.74	2.97	3.22	-	-	Northing	Easting
Alkalinity - Total CaCO3	22.3	21.2	34.8	52.4	53.2	29.4	41.4	42	52.6	53.9	30.6	39.8	51.6	51.1	52.3	-	-	101569.7	98617
Ammonia Nitrogen	0.017	-	0.017	0.01	0.008	0.029	0.011	-	0.018	0.011	0.014	0.016	0.031	-	0.017	-	-	UTM ZONE 10	
Nitrite/Nitrate Nitrogen	<0.020	-	<0.020	0.063	0.07	<0.020	<0.020	-	0.062	0.073	<0.020	<0.020	0.068	-	0.079	-	-	Northing	Easting
Kjeldahl Nitrogen	0.104	-	0.107	0.083	0.068	0.181	0.128	-	0.073	0.103	0.168	0.113	0.244	-	0.105	-	-	5532271	322752
Dissolved Phosphorous	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	-		
Total Phosphorous	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	0.0354	-	<0.0050	-	≤ 0.007[4]		
Sulphate	34.4	34.7	65.3	**136** (WQO)	**139** (WQO)	56	90.5	93	**131** (WQO)	**137** (WQO)	55.6	82.6	**139** (WQO)	**131** (WQO)	**133** (WQO)	100^	N/A	Middle of Middle Long Lake	
Chlorophyll a (mg/m3)	1.54	-	2.3	1.08	-	<0.50	1.05	-	1.75	-	3.1	<1.5	<1.5	-	-	-	-		
Pheopigment (mg/m3)	<0.5	-	<0.5	<0.5	-	0.77	<0.5	-	<0.5	-	<1.5	10.6	7.3	-	-	-	-		
Chlorophyll a (mg/m3)*	0.58	-	1.41	<0.50	-	<0.50	1	-	1.17	-	3.4	<1.5	2.6	-	-	-	-		
Pheopigment (mg/m3)*	1.11	-	1.15	1.02	-	<0.5	<0.5	-	<0.5	-	<1.5	<1.5	5.4	-	-	-	-		

Parameter	July					August					September					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Parameter	1	4	9	B	B*	1	1*	4	9	B	1	1*	4	9	B	Max	30-Day Mean[1]		
Conductivity (umhos/cm)	199	231	401	402	401	236	241	258	394	407	277	276	276	395	395	-	-	GPS (m)	
Hardness CaCO3	71	82.3	136	137	143	67.6	90.1	96.2	143	147	103	102	102	144	141	-	-		
pH	7.63	7.63	7.65	7.62	7.64	7.7	7.79	7.55	7.79	7.87	7.71	7.71	7.72	7.47	7.44	-	≥ (6.5)[2] or (6.9)[3]	Minegrid	
Total suspended solids	<4.0	<4.0	6	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5		
Aciditiy	1.79	2.46	3.83	3.96	3.54	<0.50	0.59	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	Northing	Easting
Alkalinity - Total CaCO3	31.9	35.6	51.5	52.9	52.2	39.6	39.6	38.1	52.1	52.6	43.8	42.7	42.6	52.2	53.4	-	-	101569.7	98617
Ammonia Nitrogen	0.011	0.013	0.013	0.012	-	0.017	-	0.0096	0.014	0.014	0.02	-	0.021	0.012	0.03	-	-	UTM ZONE 10	
Nitrite/Nitrate Nitrogen	<0.020	1.48	0.042	0.078	-	<0.020	-	0.02	0.057	0.093	<0.020	-	<0.020	0.035	0.091	-	-	Northing	Easting
Kjeldahl Nitrogen	0.188	<0.020	0.146	0.128	-	0.207	-	0.221	0.156	0.158	0.19	-	0.166	0.112	0.144	-	-	5532271	322752
Dissolved Phosphorous	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-		
Total Phosphorous	0.005	<0.0050	<0.0050	<0.0050	-	<0.0050	-	0.0104	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	≤ 0.007[4]		
Sulphate	58	72.7	**135** (WQO)	**135** (WQO)	**133** (WQO)	76.8	78.1	87.2	**138** (WQO)	**142** (WQO)	84.1	95.1	86.9	**132** (WQO)	**131** (WQO)	100^	N/A	Middle of Middle Long Lake	
Chlorophyll a (mg/m3)	<1.5	<1.5	<1.5	-	-	0.78	-	1.97	1.39	-	<0.50	<0.50	<0.50	<0.50	-	-	-		
Pheopigment (mg/m3)	2.7	<1.5	<1.5	-	-	2.74	-	1.73	1.48	-	<0.50	0.54	0.59	<0.50	-	-	-		
Chlorophyll a (mg/m3)*	2.1	2.6	2.7	-	-	1.97	-	2.18	1.09	-	<0.50	-	-	-	-	-	-		
Pheopigment (mg/m3)*	<1.5	<1.5	2.4	-	-	<0.5	-	1.04	1.04	-	<0.50	-	-	-	-	-	-		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
[2] 30-day 90th percentile
[3]Running 30-day median
[4] Objective is for total phosphorus values and appilies to an average of summer phosphorous values.
^The sulphate limit is a guideline rather than a site-specific objective
¤ Results were collected on June 4th, ¤¤ results were collected on June 28th.
Results from June 4th are meant to represent the conditions during the month of May

Results expressed in milligrams per litre.
* Field replicate sample.
WQO = Unmet Water Quality Objectives

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TABLE 37
LONG LAKE MIDDLE METALS ANALYSIS
2012/2013 EMS ID E206619
COMPANY IDENTITY - LLM

Sample Date	April				May				June				Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Parameter	1	4	9	B	1	4	9	B	1	4	9	B	Max	30-Day Mean[1]
Total Metals														
Aluminum	0.0295	0.0308	0.0162	0.0126	0.0173	0.0166	0.013	0.0133	0.0157	0.0136	0.0089	0.0098	-	-
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00028	0.00035	0.00029	0.00026	0.00046	0.00036	0.00024	0.00027	0.00055	0.00047	0.00023	0.0002	**0.005^**	-
Barium	0.0034	0.0043	0.0073	0.0073	0.005	0.0056	0.0071	0.0077	0.0055	0.006	0.0071	0.0076	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	0.073	0.138	0.147	0.057	0.097	0.135	0.144	0.054	0.091	0.142	0.14	-	-
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	**0.000054** (WQO)	**0.000032** (WQO)	**0.000018** (WQO)	**0.000028** (WQO)	[2]	-
Calcium	15.3	24.9	47.2	48.8	22.7	33.8	46	48.1	24.1	33	50.5	50.1	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00043	0.00042	0.00037	0.00032	0.00043	0.00031	0.00034	0.00027	0.00036	0.00038	0.00038	0.00036	-	**≤0.002**
Iron	0.07	0.0811	0.0688	0.054	0.0723	0.0554	0.0581	0.0559	0.0868	0.0786	0.0413	0.0459	-	**≤ 0.3**
Hardness	45.8	73.1	137	142	67.7	99	135	141	71.7	96.9	146	145	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00023	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.0050**	**≤0.003**
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.82	2.65	4.7	4.92	2.66	3.56	4.81	5.01	2.82	3.5	4.85	4.92	-	-
Manganese	0.0141	0.021	0.0456	**0.0688** (WQO)	0.0222	0.0128	0.0325	**0.0647**(WQO)	0.023	0.0208	0.0384	**0.127**(WQO)	**0.0500**	-
Mercury	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	**≤0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.0250**	-
Phosphorous	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0354	<0.0050	-	**≤0.007**
Potassium	0.207	0.323	0.601	0.633	0.28	0.441	0.61	0.636	0.283	0.383	0.605	0.621	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.66	2.79	3.47	3.59	2.53	2.56	3.19	3.38	2.6	2.66	3.71	3.85	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	6.07	11.2	22.7	24.1	9.12	16.1	22.7	24.2	9.15	14.4	23.4	24	-	-
Strontium	0.109	0.191	0.403	0.418	0.17	0.286	0.395	0.412	0.17	0.252	0.396	0.402	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.0300**	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**	-
Dissolved Metals														
Aluminum	0.0199	0.019	0.0082	0.0057	0.0117	0.0105	0.0068	0.0062	0.013	0.0098	0.0065	0.0059	**0.1000**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00035	0.00034	0.00026	0.00025	0.00047	0.00039	0.00022	0.0002	0.00054	0.00044	0.00019	0.00019	-	-
Barium	0.0034	0.0044	0.0067	0.007	0.005	0.0059	0.0072	0.0079	0.0051	0.0055	0.0065	0.007	-	-
Beryllium	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	0.065	0.133	0.135	0.057	0.101	0.135	0.132	0.057	0.092	0.139	0.14	-	-
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	-	-
Calcium	15.3	24.7	47.6	49.3	22.9	36.6	48.8	50.4	22.8	30.3	47.1	48.2	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00039	0.00032	0.00039	0.00037	0.00032	0.00027	0.00034	0.00034	0.00038	0.00022	0.00026	0.00027	-	-
Iron	0.0428	0.0466	0.0221	0.0123	0.0434	0.027	0.0126	0.0083	0.0717	0.0601	0.0251	0.0172	-	-
Hardness	45.8	71.9	138	142	68	105	141	144	67.8	88.5	136	140	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.84	2.48	4.62	4.72	2.6	3.41	4.75	4.5	2.61	3.13	4.47	4.68	-	-
Manganese	0.0091	0.0152	0.0145	0.0046	0.021	0.005	0.0099	0.0121	0.021	0.0177	0.0306	0.0291	-	-
Mercury	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	<0.0000010	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorous	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.212	0.321	0.63	0.645	0.309	0.458	0.657	0.65	0.271	0.352	0.57	0.596	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.71	2.84	3.53	3.54	2.77	3.01	3.72	3.9	2.77	2.8	3.93	4.09	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	5.89	10.2	22.2	22.9	8.85	15	22.1	21.4	8.38	12.6	21.1	22	-	-
Strontium	0.108	0.188	0.382	0.389	0.177	0.287	0.4	0.41	0.16	0.232	0.371	0.388	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from
5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided
in the table, but are provided for comparison purposes only.
^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
¤ Results were collected on June 4th, ¤¤ results were collected on June 28th.
Results from June 4th are meant to represent the conditions during the month of May

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

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TABLE 37
LONG LAKE MIDDLE METALS ANALYSIS
2012/2013 EMS ID E206619
COMPANY IDENTITY - LLM

Sample Date	July					August					September					Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Parameter	1	4	9	B	B*	1	1*	4	9	B	1	4*	4	9	B	Max	30-Day Mean[1]
Total Metals																	
Aluminum	0.0126	0.0122	0.0099	0.0094	-	0.0068	-	0.0086	0.0079	0.0110	0.0066	-	0.0063	0.0072	0.0065	-	-
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0006	0.0006	0.0002	0.0002	-	0.0005	-	0.0006	0.0002	0.0002	0.0009	-	0.0008	0.0003	0.0003	**0.005^**	-
Barium	0.0057	0.0060	0.0071	0.0077	-	0.0050	-	0.0067	0.0072	0.0076	0.0071	-	0.0071	0.0072	0.0093	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	-	-
Boron	0.0660	0.0770	0.1500	0.1540	-	0.0540	-	0.0850	0.1350	0.1400	0.0910	-	0.0920	0.1360	0.1360	-	-
Cadmium	**0.000019** (WQO)	<0.000010	**0.000017** (WQO)	<0.000010	-	0.0000090	-	**0.0034** (WQO)	<0.0000050	<0.0000050	0.0000070	-	0.00001	<0.0000050	<0.0000050	[2]	-
Calcium	23.50	27.40	46.20	46.60	49.00	22.60	30.20	32.60	49.00	50.70	35.00	34.40	34.80	49.80	48.80	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0003	0.0004	0.0006	0.0004	-	0.0003	-	0.0003	0.0004	0.0005	0.0007	-	0.0004	0.0004	0.0008	-	**≤0.002**
Iron	0.0710	0.0803	0.0293	0.0337	-	0.0429	-	0.0417	0.0229	0.0303	0.0333	-	0.0331	0.0276	0.0485	-	**≤ 0.3**
Hardness	71.0000	82.3000	136.0000	137.0000	143.0000	67.6000	90.1000	96.2000	143.0000	147.0000	103.0000	102.0000	102.0000	144.0000	141.0000	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	-	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020	<0.00020	**0.0050**	**≤0.003**
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Magnesium	3.0100	3.3800	5.0300	4.9100	4.9400	2.6900	3.5400	3.6300	4.9500	5.0500	3.8000	3.8700	3.7200	4.7300	4.7000	-	-
Manganese	0.0112	0.0105	0.0237	**0.152** (WQO)	-	0.0078	-	0.0071	0.0212	**0.0632** (WQO)	0.0063	-	0.0063	0.0319	**1.14** (WQO)	**0.0500**	-
Mercury	<0.0000010	<0.0000010	<0.0000010	<0.0000010	-	<0.00000020	-	-	<0.00000020	<0.00000020	<0.0000020	-	<0.0000020	0.0000	<0.0000020	**≤0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	**0.0250**	-
Phosphorous	0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	0.0104	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	**≤0.007**
Potassium	0.2790	0.4230	0.6180	0.6170	-	0.2560	-	0.3760	0.6160	0.6260	0.3960	-	0.4010	0.6160	0.6180	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.6400	2.6100	3.3600	3.6900	-	2.2100	-	2.8400	3.7500	4.2400	2.8400	-	2.8000	3.5100	4.0100	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	-	<0.000020	-	<0.000020	<0.000020	<0.000020	<0.000020	-	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	9.4500	11.9000	24.1000	23.4000	-	9.0100	-	13.9000	23.8000	24.4000	14.2000	-	14.0000	22.8000	22.5000	-	-
Strontium	0.1780	0.2100	0.4050	0.4110	-	0.1660	-	0.2490	0.4080	0.4240	0.2560	-	0.2600	0.4020	0.3970	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	-	0.0211	-	<0.0050	<0.0050	0.0187	<0.0050	-	<0.0050	<0.0050	<0.0050	**0.0300**	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	**-**	-
Dissolved Metals																	
Aluminum	0.0090	0.0080	0.0069	0.0053	-	0.0093	-	0.0136	0.0091	0.0085	0.0049	-	0.0044	0.0049	0.0031	**0.1000**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0007	0.0006	0.0002	0.0002	-	0.0007	-	0.0006	0.0002	0.0002	0.0006	-	0.0007	0.0002	0.0002	-	-
Barium	0.0056	0.0058	0.0072	0.0069	-	0.0064	-	0.0063	0.0071	0.0070	0.0069	-	0.0071	0.0074	0.0086	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	-	-
Boron	0.0580	0.0780	0.1410	0.1390	-	0.0790	-	0.0880	0.1380	0.1450	0.0920	-	0.0930	0.1350	0.1350	-	-
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.0000050	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	<0.0000050	-	-
Calcium	23.3000	27.4000	45.6000	46.0000	-	29.3000	29.5000	32.2000	47.9000	48.3000	33.8000	-	35.0000	50.6000	49.2000	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0004	0.0007	0.0004	0.0004	-	0.0009	-	0.0004	0.0004	0.0003	0.0006	-	0.0005	0.0004	0.0004	-	-
Iron	0.0542	0.0521	0.0146	0.0063	-	0.0287	-	0.0251	0.0091	<0.0050	0.0098	-	0.0139	0.0088	0.0056	-	-
Hardness	70.4000	81.9000	134.0000	135.0000	-	86.8000	88.5000	94.7000	139.0000	140.0000	100.0000	-	103.0000	146.0000	143.0000	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	-	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Magnesium	2.9300	3.2800	4.9600	4.8800	-	3.2800	3.6200	3.4600	4.7200	4.7700	3.8200	-	3.8000	4.8500	4.8400	-	-
Manganese	0.0024	0.0022	0.0162	0.0033	-	<0.0010	-	<0.0010	0.0182	0.0066	<0.0010	-	<0.0010	0.0223	1.0200	-	-
Mercury	<0.0000010	<0.0000010	<0.0000010	<0.0000010	-	<0.00000020	-	-	<0.00000020	<0.00000020	<0.0000020	-	<0.0000020	<0.0000020	<0.0000020	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	-	-
Phosphorous	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.2870	0.3540	0.6260	0.6230	-	0.3270	-	0.3650	0.5940	0.6170	0.3820	-	0.4520	0.6350	0.6380	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.7500	2.7000	3.4100	3.7200	-	2.7300	-	2.6600	3.5400	3.9000	2.6800	-	2.7700	3.5300	3.9300	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	-	<0.000020	-	<0.000020	<0.000020	<0.000020	<0.000020	-	<0.000020	<0.000020	<0.000020	-	-
Sodium	9.4500	11.8000	23.6000	23.5000	-	11.3000	-	13.0000	22.4000	23.0000	14.3000	-	14.5000	23.4000	22.9000	-	-
Strontium	0.1750	0.2100	0.4070	0.4090	-	0.2140	-	0.2410	0.3850	0.4120	0.2540	-	0.2630	0.4120	0.4080	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from
5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided
in the table, but are provided for comparison purposes only.
^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
¤ Results were collected on June 4th, ¤¤ results were collected on June 28th.
Results from June 4th are meant to represent the conditions during the month of May

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

TABLE 38

LONG LAKE MIDDLE WATER QUALITY - FIELD INSTRUMENTS

2012/2013 EMS ID E206619

COMPANY IDENTITY - LLM

Sample Date	April							May¤							June¤¤						
Parameter	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP
Sample Depth (m)	Celcius		µS/cm			mg/L		Celcius		mS/cm			mg/L		Celcius		µS/cm			mg/L	
1	10.220	7.350	82.000	0.083	93.000	40.440	174.900	14.700	7.450	0.163	0.132	95.700	9.710	160.300	17.450	6.420	194.000	0.148	104.100	9.970	117.300
2	10.100	7.290	85.000	0.087	84.200	9.500	186.600	14.700	7.480	0.163	0.132	95.400	9.680	161.300	17.340	6.920	195.000	0.148	102.700	9.840	119.800
3	9.850	7.260	103.000	0.094	91.000	10.210	193.400	14.570	7.490	0.162	0.132	94.900	9.650	161.200	17.280	7.010	195.000	0.149	101.900	9.780	122.400
4	7.890	7.130	178.000	0.173	97.000	11.270	207.800	10.470	7.250	0.218	0.196	95.200	10.630	175.700	14.350	6.960	250.000	0.204	104.900	10.730	135.500
5	6.130	7.000	202.000	0.204	92.200	11.280	217.900	7.550	7.140	0.239	0.233	81.400	9.650	179.200	10.440	6.830	278.000	0.251	95.900	10.690	146.100
6	5.300	6.890	231.000	0.241	72.700	6.980	225.900	6.000	7.020	0.250	0.255	63.400	7.800	184.300	7.530	6.720	289.000	0.282	72.100	8.600	150.200
7	5.080	6.860	241.000	0.252	60.500	7.530	229.300	5.360	6.940	0.251	0.261	51.300	6.430	185.400	6.270	6.700	287.000	0.291	58.600	7.240	151.200
8	5.000	6.850	246.000	0.259	49.800	6.270	232.300	5.100	6.910	0.252	0.264	46.000	5.830	186.600	5.950	6.700	287.000	0.293	53.700	6.660	152.100
9	4.970	6.840	248.000	0.261	46.400	5.890	234.200	5.000	6.880	0.252	0.265	42.700	5.440	187.200	5.750	6.700	286.000	0.294	48.700	6.080	150.900
10	4.960	6.820	249.000	0.262	42.700	5.450	236.800	4.910	6.850	0.253	0.266	39.700	5.070	187.800	5.600	6.700	286.000	0.295	47.200	5.930	150.400
11	4.950	6.830	250.000	0.263	42.000	5.360	237.600	4.860	6.840	0.253	0.267	37.300	4.770	188.200	5.520	6.700	286.000	0.296	43.900	5.530	150.400
12	4.930	6.830	250.000	0.263	41.400	5.290	238.800	4.830	6.830	0.254	0.268	35.900	4.600	188.200	5.460	6.700	286.000	0.297	41.700	5.250	151.200
13	4.920	6.830	251.000	0.265	40.900	5.230	239.400	4.810	6.830	0.254	0.268	35.000	4.490	188.800	5.400	6.700	286.000	0.297	39.000	4.910	151.300
14	4.910	6.830	251.000	0.265	40.100	5.120	240.200	4.770	6.830	0.254	0.269	34.000	4.360	188.300	5.300	6.700	286.000	0.298	37.000	4.680	150.800
15	4.910	6.840	253.000	0.266	38.500	4.920	240.900	4.730	6.820	0.255	0.270	32.900	4.220	188.400	5.240	6.680	286.000	0.299	34.800	4.390	151.200
16	4.900	6.830	253.000	0.267	37.500	4.790	241.600	4.720	6.820	0.255	0.271	30.800	3.960	188.600	5.210	6.680	286.000	0.299	32.100	4.070	151.400
17	4.900	6.830	253.000	0.267	36.300	4.640	242.700	4.710	6.810	0.255	0.271	29.200	3.750	188.400	5.190	6.680	286.000	0.300	29.800	3.780	151.400
18	4.900	6.830	254.000	0.268	35.300	4.520	243.700	4.710	6.810	0.256	0.271	28.500	3.650	188.500	5.180	6.680	287.000	0.300	29.300	3.710	151.400
19	4.910	6.820	255.000	0.268	33.900	4.340	244.500	4.710	6.810	0.256	0.272	27.600	3.550	188.700	5.170	6.680	287.000	0.300	26.300	3.320	138.200
20															5.170	6.700	287.000	0.300	21.800	3.740	138.200
21																					
Secchi Depth (m)	5.25m							5.5m							7.5m						

Sample Date	July							August							September						
Parameter	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP
Sample Depth (m)	Celcius	mS/cm			mg/L			Celcius	mS/cm			mg/L			Celcius	mS/cm			mg/L		
1	20.54	0.185	0.130	105.200	9.46	7.51	67.7	20.31	0.226	0.161	95.0	8.58	7.95	210.0	16.65	0.232	0.180	118.2	11.41	7.96	139.1
2	20.49	0.187	0.133	104.700	9.43	7.49	69.7	20.29	0.226	0.161	95.5	8.63	7.74	230.6	16.65	0.232	0.180	109.2	10.54	7.82	143.0
3	20.45	0.186	0.133	104.800	9.45	7.48	71.1	20.26	0.226	0.161	95.6	8.64	7.72	247.6	16.65	0.232	0.180	104.4	10.13	7.77	146.1
4	18.54	0.207	0.153	108.700	10.20	7.28	79.1	20.21	0.226	0.162	95.6	8.64	7.70	258.6	16.52	0.235	.0.183	105.2	10.25	7.72	149.7
5	14.45	0.248	0.202	112.100	11.45	7.04	89.6	15.31	0.279	0.223	100.3	10.03	7.28	290.4	16.03	0.248	0.195	98.3	9.62	7.57	154.2
6	10.90	0.264	0.235	96.600	10.66	6.86	97.4	11.07	0.281	0.249	84.5	9.05	6.99	319.9	12.09	0.294	0.249	81.2	8.53	7.08	164.0
7	8.42	0.268	0.253	77.200	9.02	6.76	101.6	8.23	0.272	0.260	63.1	7.35	6.85	336.5	9.36	0.279	0.258	61.7	7.00	6.91	170.2
8	6.93	0.262	0.259	63.100	7.64	6.70	103.5	7.06	0.266	0.263	55.4	6.63	6.85	337.9	7.83	0.269	0.261	52.4	6.21	6.85	172.5
9	6.41	0.260	0.262	56.100	6.87	6.68	104.3	6.42	0.262	0.264	45.7	5.61	6.87	338.7	6.89	0.263	0.262	46.5	5.63	6.81	174.3
10	6.06	0.257	0.262	53.100	6.58	6.67	104.1	6.15	0.261	0.265	39.5	4.89	6.86	336.2	6.47	0.262	0.263	36.8	4.51	6.77	175.9
11	5.78	0.257	0.264	49.300	6.13	6.66	104.6	5.93	0.260	0.266	34.8	4.32	6.89	332.9	6.26	0.261	0.264	33.3	4.11	6.75	1756.3
12	5.61	0.256	0.265	44.200	5.53	6.64	105.1	5.70	0.259	0.267	32.1	4.00	6.87	331.5	6.04	0.259	0.264	30.2	3.73	6.72	176.3
13	6.51	0.256	0.265	41.100	5.17	6.63	105.1	5.55	0.258	0.267	28.7	3.59	8.89	328.6	5.86	0.258	0.264	26.8	3.35	6.71	176.5
14	5.43	0.256	0.265	37.800	4.74	6.62	104.8	5.42	0.258	0.268	22.6	**2.84** (WQO)	6.89	325.8	5.58	0.257	0.265	19.9	2.45	6.69	178.1
15	5.30	0.256	0.266	36.300	4.58	6.61	104.9	5.37	0.258	0.268	19.5	**2.46** (WQO)	6.89	321.1	5.48	0.257	0.266	14.8	1.86	6.68	178.3
16	5.19	0.255	0.267	32.200	4.02	6.60	104.1	5.35	0.258	0.268	18.6	**2.34** (WQO)	6.89	319.5	5.45	0.257	0.267	13.0	1.63	6.67	180.3
17	5.16	0.256	0.267	30.500	3.81	6.59	103.7	5.33	0.258	0.269	16.4	**2.07** (WQO)	6.89	318.2	5.45	0.257	0.267	12.0	1.51	6.67	180.7
18	5.12	0.256	0.268	27.500	3.48	6.58	103.2	5.33	0.263	0.274	13.2	**1.6** (WQO)	6.95	79.9	5.44	0.257	0.267	11.5	1.45	6.68	181.1
19	5.11	0.255	0.268	25.800	3.24	6.57	103.0	-	-	-	-	-	-	-	5.43	0.257	0.267	11.3	1.43	6.68	181.9
20	5.10	0.255	0.268	24.800	3.15	6.58	102.7	-	-	-	-	-	-	-	5.43	0.257	0.267	10.9	1.37	6.69	183.60
21	5.09	0.256	0.268	24.600	3.13	6.57	102.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	5.09	0.256	0.2680	23.900	3.04	6.56	102.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Secchi Depth (m)	8.5m														8.5m						

*Hypolimnetic DO= 3 mg/L

Results are a minimum during June, July and August

¤ Results were collected on June 4th, ¤¤ results were collected on June 28th.

Results from June 4th are meant to represent the conditions during the month of May

WQO= Unmet Water Quality Objectives

TABLE 39
7 SOUTH WATER QUALITY
2012/2013 EMS ID: E292109
COMPANY IDENTITY- 7S

Parameter	April						May			June	July	Site Descripiton	
Sample Date	3*	3	10	17	24*	24	1	8	15	26	12	GPS (m)	
Conductivity (umhos/cm)	29.5	29	33.7	40.5	38.3	38.4	41.4	41.7	45	45.6	51.1	Minegrid	
Hardness CaCO3	12.6	13.1	-	-	-	-	17.3	-	-	-	21.7	Northing	Easting
pH	7.22	7.23	7.37	7.39	7.47	7.48	7.38	7.44	7.51	7.54	7.6	101595	101815
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	UTM ZONE 10	
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	<0.5	1.1	<0.5	0.7	0.55	0.71	1.12	1.09	1.75	<0.50	0.91	5534846	324646
Alkalinity - Total CaCO3	10.2	12.5	14.7	17.8	16.4	16.9	20.8	20.7	21.5	22.4	24.5	7 South Effluent Before Quinsam River Lower Wetland	
Ammonia Nitrogen	0.041	0.017	-	-	-	-	<0.0050	-	-	-	0.036		
Nitrate and Nitrite as N	0.332	0.252	-	-	-	-	0.192	-	-	-	0.059		
Kjeldahl Nitrogen	0.0087	0.0063	-	-	-	-	<0.0050	-	-	-	<0.0050		
Dissolved Phosphorus	0.0219	0.021	-	-	-	-	<0.0050	-	-	-	<0.0050		
Total Phosphorus	<0.50	<0.50	0.71	1.13	<0.50	0.72	0.85	0.73	0.85	<0.50	0.98		
Sulphate	0.084	0.084	-	-	-	-	<0.020	-	-	-	<0.020		

Parameter	November				December		Site Descripiton	
Sample Date	5	13	20	27	4	12	GPS (m)	
Conductivity (umhos/cm)	45.5	41.9	33.7	34.3	31.9	33.7	Minegrid	
Hardness CaCO3	19.5	-	-	-	-	12.9	Northing	Easting
pH	7.55	7.46	7.21	7.3	7.31	7.4	101595	101815
Total Suspended Solids	<4.0	-	-	-	-	-	UTM ZONE 10	
Total Dissolved Solids	28	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	0.5	0.57	1.07	0.6	<0.50	0.66	5534846	324646
Alkalinity - Total CaCO3	20.9	15.1	11.7	12.4	11.4	13.6	7 South Effluent Before Quinsam River Lower Wetland	
Ammonia Nitrogen	0.0084	-	-	-	-	-		
Nitrate and Nitrite as N	0.191	-	-	-	-	-		
Kjeldahl Nitrogen	0.111	-	-	-	-	-		
Dissolved Phosphorus	<0.0050	-	-	-	-	<0.0050		
Total Phosphorus	0.0057	-	-	-	-	-		
Sulphate	0.89	0.94	0.82	1.73	0.61	0.57		

Parameter	January				February		March						Site Descripiton	
Sample Date	3	9	16	21	6	19	5	12	18 Time 1	18 Time 2	19	21	GPS (m)	
Conductivity (umhos/cm)	34.1	29.1	33.8	33.7	30.9	-	32.3	-	35.3	38	37.6	45.3	Minegrid	
Field Conductivity (uS/cm)	-	-	-	-	29.7	31	-	51			-	-	Northing	Easting
Hardness CaCO3	12.9	-	-	-	11.1	-	12.4	13.6	13.4	14	14.1	18.7		
pH	7.37	7.23	7.33	7.34	7.21	-	7.4	-	7.19	7.29	7.17	7.27	101595	101815
Field pH	-	-	-	-	7.33	7.23	-	5.95			-	-	UTM ZONE 10	
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	-	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	Northing	Easting
Total Dissolved Solids	-	18	46	30	-	-	-	-			-	-		
Acidity (to pH 8.3)	-	-	-	-	-	-	-	-			-	-	5534846	324646
Alkalinity - Total CaCO3	12.5	11.1	12.1	12.8	10.5	-	13.9	14.9	12.8	15	13.2	13.6	7 South Effluent Before Quinsam River Lower Wetland	
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-		
Nitrate and Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-		
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	<0.0050	-	-	-	-	-	-	-	-	-	-	-		
Total Phosphorus	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	1.06	1.58	1.09	2.52	1.37	-	0.94	1.27	2.83	3.07	3.85	6.75		
Dissolved Organic Carbon	-	-	-	-	-	-	-	-	1.7	1.46	-	-		

Results are expressed in milligrams per litre except where noted.
No results from August or September due to no flow

TABLE 40
7 SOUTH METALS ANALYSIS
2012/2013 EMS ID: E292109
COMPANY IDENTITY - 7S

Parameter	April		May	July	November	December
Sample Date	3*	3	1	4	5	12
Total Metals						
Aluminum	0.976	1.01	0.0581	0.0236	0.0302	0.0317
Antimony	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0006	0.0006	0.00015	0.00014	0.00011	<0.00010
Barium	0.004	0.004	0.0017	0.0021	0.0019	0.0012
Beryllium	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Boron	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050
Cadmium	<0.00001	<0.00001	<0.000010	<0.000010	<0.0000050	<0.000010
Calcium	3.79	3.97	5.18	6.45	5.48	3.85
Chromium	0.001	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Copper	0.002	0.0022	0.0005	0.00042	0.00047	0.00038
Iron	1.01	1.03	0.0412	0.0105	0.0078	0.008
Hardness	12.6	13.1	17.3	21.7	19.5	12.9
Lead	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	0.756	0.776	1.06	1.36	1.21	0.866
Manganese	0.005	0.006	0.0014	<0.0010	<0.0010	<0.0010
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010
Molybdenum	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus	0.0219	0.021	<0.0050	<0.0050	0.0057	-
Potassium	0.239	0.245	0.21	0.114	0.124	0.118
Selenium	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	4.2	4.3	4.2	4.49	4.89	3.93
Silver	<0.00002	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	1.24	1.28	1.81	1.99	1.97	1.56
Strontium	0.014	0.014	0.0192	0.0257	0.0227	0.0152
Thallium	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	0.101	0.108	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals						
Aluminum	0.25	0.238	0.0229	0.0189	0.0242	0.0273
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00022	0.0002	<0.00010	0.00011	0.00028	<0.00010
Barium	0.0018	0.0018	0.0014	0.0021	0.002	0.0012
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	0.000006	<0.000010
Calcium	3.85	4.06	4.8	5.95	5.76	3.81
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper	0.00164	0.00155	0.00041	0.00051	0.00082	0.00047
Iron	0.231	0.39	0.0056	0.0058	0.0087	0.0068
Hardness	12.6	13.1	16.3	20.2	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	0.719	0.721	1.04	1.29	1.14	0.834
Manganese	0.0018	0.0032	<0.0010	<0.0010	0.0029	<0.0010
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus	0.0087	0.0063	<0.0050	<0.0050	<0.0050	<0.0050
Potassium	0.346	0.32	0.148	0.145	0.384	0.134
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	3.36	3.4	3.88	4.6	4.34	3.62
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	1.42	1.45	1.68	1.94	1.81	1.51
Strontium	0.0135	0.0138	0.0191	0.0233	0.0237	0.0154
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	0.0252	0.0247	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.
^ Dry, no flow.
* Field replicate sample.

TABLE 40
7 SOUTH METALS ANALYSIS
2012/2013 EMS ID: E292109
COMPANY IDENTITY - 7S

Parameter	January	February	March					
					Time 1 10:30 am	Time 2 2:30pm		
Sample Date	3	6	5	12	18	18	19	21
Total Metals								
Aluminum	0.0382	0.0973	0.04	0.036	0.0332	0.0312	0.0326	0.029
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00011	0.00011	<0.00010	0.00015	<0.00010	<0.00010	0.00011	<0.00010
Barium	0.0012	0.0017	0.0014	0.0014	0.0015	0.0017	0.0015	0.0018
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cadmium	0.000017	0.000013	<0.000010	<0.000010	0.000026	0.000008	0.000013	0.00001
Calcium	3.62	3.37	3.8	4.08	4.11	4.01	4.17	5.19
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper	0.00035	0.00046	0.00052	0.00028	0.00025	0.00027	0.00035	0.00027
Iron	0.0122	0.056	0.0127	0.0173	0.0108	0.0103	0.0149	0.009
Hardness	12.3	11.6	13.2	13.8	14.1	13.8	14.3	17.3
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	0.8	0.779	0.89	0.863	0.937	0.926	0.937	1.06
Manganese	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	0.0000105	0.0000039	0.0000038	0.0000036
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus	-	-	-	-	-	-	-	-
Potassium	0.117	0.129	0.135	0.146	0.131	0.138	0.134	0.134
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	4.02	3.87	3.99	3.9	3.9	3.68	3.71	4.08
Silver	<0.000020	<0.000020	<0.000020	<0.000020	0.000027	<0.000020	<0.000020	<0.000020
Sodium	1.48	1.48	1.63	2.11	1.64	1.64	1.65	1.71
Strontium	0.0139	0.0141	0.0155	0.0164	0.0171	0.017	0.0173	0.0197
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals								
Aluminum	0.0313	0.0545	0.0343	0.0289	0.0297	0.0234	0.0211	0.0262
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	<0.00010	0.00014	<0.00010	0.00015	0.00012	0.00011	0.00012	0.0001
Barium	0.0012	0.0014	0.0013	0.0015	0.0014	0.0016	0.0014	0.0018
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	0.000005	0.000008	<0.0000050	<0.0000050
Calcium	3.72	3.24	3.56	3.93	3.9	4.07	4.08	5.54
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper	0.00035	0.00041	0.0003	0.0003	0.0003	0.00025	0.00025	0.00026
Iron	0.0067	0.0278	0.0066	0.0074	0.0051	<0.0050	<0.0050	0.0061
Hardness	12.9	11.1	12.4	13.6	-	-	14.1	18.7
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	0.877	0.74	0.851	0.93	0.893	0.939	0.951	1.19
Manganese	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	0.0000069	0.0000036	0.00002	<0.000020
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus	<0.0050	-	-	-	-	-	-	-
Potassium	0.119	0.135	0.126	0.139	0.116	0.119	0.11	0.141
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	4.57	3.56	3.57	3.71	3.73	3.72	3.66	4.08
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	1.6	1.44	1.54	1.69	1.62	1.64	1.66	1.92
Strontium	0.0147	0.0135	0.015	0.0166	0.016	0.0169	0.0171	0.0212
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.
^ Dry, no flow.
* Field replicate sample.

TABLE 41
7 SOUTH QUINSAM RIVER WATER QUALITY
2012/2013 EMS ID: E292113
COMPANY IDENTITY- 7SQR

Parameter / Sample Date	April 3	May 1	June 5	July 3	August 1	August 20	September 4	Site Descripiton
								GPS (m)
Conductivity (umhos/cm)	129	125	70.1	74.9	89.8	103	88.2	Minegrid
Hardness CaCO3	32.7	30.4	22.7	25.8	28.7	-	29.3	Northing / Easting
pH	7.58	7.59	7.58	7.64	7.64	7.63	7.58	100966 / 102233
Total suspended solids	4	<4.0	<4.0	<4.0	50.5	<4.0	<4.0	UTM ZONE 10
Total dissolved solids	-	-	-	-	-	-	-	Northing / Easting
Acidity (to pH 8.3)	0.6	0.6	<0.50	0.8	0.82	<0.50	<0.50	5534805 / 325400
Alkalinity - Total CaCO3	27.9	32.9	23.4	24.4	26.4	31.4	26.7	
Ammonia Nitrogen	0.016	0.0096	0.026	0.015	0.017	-	0.015	
Nitrate and Nitrite as N	0.164	0.158	0.166	0.157	0.104	-	0.115	
Kjeldahl Nitrogen	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	Downstream of 7 South
Dissolved Phosphate	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	
Total Phosphate	29.5	25.8	9.07	10.3	12.6	16.9	12.9	
Sulphate	0.031	<0.020	<0.020	0.023	<0.020	-	<0.020	

Parameter / Sample Date	October 9	November 5	December 12	Site Descripiton
				GPS (m)
Conductivity (umhos/cm)	90.2	113	124	Minegrid
Hardness CaCO3	26.4	34.9	29.9	Northing / Easting
pH	7.61	7.64	7.5	100966 / 102233
Total suspended solids	<4.0	<4.0	4	UTM ZONE 10
Total dissolved solids	-	-	-	Northing / Easting
Acidity (to pH 8.3)	<0.50	<0.50	<0.50	5534805 / 325400
Alkalinity - Total CaCO3	26.7	27.9	31.6	
Ammonia Nitrogen	0.011	0.0069	-	
Nitrate and Nitrite as N	<0.020	0.022	-	
Kjeldahl Nitrogen	0.128	0.16	-	Downstream of 7 South
Dissolved Phosphate	<0.0050	<0.0050	<0.0050	
Total Phosphate	<0.0050	<0.0050	-	
Sulphate	14	27.1	25.4	

Results are expressed in milligrams per litre except where noted.

TABLE 42
7 SOUTH QUINSAM RIVER METALS ANALYSIS
2012/2013 EMS ID: E292113
COMPANY IDENTITY - 7SQR

Parameter	April	May	June	July	August	September	Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Sample Date	3	1	5	3	1	4	Max	30-Day Mean[1]
Total Metals								
Aluminum	0.142	0.0254	0.0345	0.0397	0.0712	0.0182	-	-
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0003	0.00022	0.00011	0.00021	0.0003	0.00023	**0.005^**	-
Barium	0.003	0.0025	0.0014	0.0017	0.0022	0.0019	-	-
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	<0.00001	<0.000010	0.000018	<0.000010	<0.000010	<0.0000050	[2]	-
Calcium	10.7	10	7.65	8.6	9.54	9.73	-	-
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0007	0.00062	0.00063	0.00078	0.0011	0.0006	-	**≤0.002**
Iron	0.198	0.0704	0.096	0.114	0.183	0.0771	-	**≤ 0.3**
Hardness	32.7	30.4	22.7	25.8	28.7	29.3	-	-
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.0050**	**≤0.003**
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.48	1.3	0.875	1.04	1.18	1.22	-	-
Manganese	0.007	0.0049	0.0057	0.0086	0.0115	0.0074	-	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	**≤0.0001**	-
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.0250**	-
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	**≤0.007**
Potassium	0.235	0.206	0.188	0.155	0.15	0.155	-	-
Selenium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.7	1.74	1.7	1.84	1.82	1.85	-	-
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	11.7	11.7	3.65	4.18	6.34	6.94	-	-
Strontium	0.064	0.0502	0.0232	0.0313	0.0376	0.0365	-	-
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	0.008	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.0300**	-
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**	-
Dissolved Metals								
Aluminum	0.0489	0.0153	0.0141	0.0164	0.0119	0.0093	**0.1000**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0002	0.00017	0.00023	0.0002	0.00026	0.0002	-	-
Barium	0.003	0.0024	0.0016	0.0017	0.0019	0.0016	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	0.000014	0.000013	<0.000010	<0.000010	<0.000010	<0.000005	-	-
Calcium	10.4	10.4	8.12	8.35	9.69	9.41	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00072	0.00064	0.00085	0.00084	0.00056	0.00064	-	-
Iron	0.0619	0.0422	0.0458	0.068	0.0684	0.0394	-	-
Hardness	32.7	30.4	22.7	25.8	28.7	29.3	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.51	1.29	0.912	0.998	1.21	1.17	-	-
Manganese	0.0035	0.0043	0.0045	0.0065	0.004	0.0022	-	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.265	0.226	0.244	0.157	0.146	0.142	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.69	1.81	1.69	1.86	1.88	1.72	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	12	11.6	3.78	4.13	6.46	6.95	-	-
Strontium	0.063	0.0544	0.027	0.0282	0.0377	0.0363	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	0.0068	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-

130-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes only.
^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
¤ Results were collected on June 4th, ¤¤ results were collected on June 28th.
Results from June 4th are meant to represent the conditions during the month of May

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results are expressed in milligrams per litre except where noted.

TABLE 42
7 SOUTH QUINSAM RIVER METALS ANALYSIS
2012/2013 EMS ID: E292113
COMPANY IDENTITY - 7SQR

Parameter	October	November	December	Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Sample Date	9	5	12	**Max**	**30-Day Mean[1]**
Total Metals					
Aluminum	0.0113	0.0601	0.139	-	-
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0002	0.00029	0.00025	**0.005^**	-
Barium	0.0017	0.0029	0.0029	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	-	-
Cadmium	<0.0000050	<0.0000050	<0.000010	[2]	-
Calcium	9.28	11	9.33	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00069	0.00094	0.00103	-	**≤0.002**
Iron	0.0701	0.173	0.282	-	**≤ 0.3**
Hardness	26.4	34.9	29.9	-	-
Lead	<0.00020	<0.00020	<0.00020	**0.0050**	**≤0.003**
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.08	1.5	1.26	-	-
Manganese	0.0051	0.007	0.0081	-	-
Mercury	<0.000020	<0.000020	<0.000010	**≤0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	**0.0250**	-
Phosphorus	<0.0050	<0.0050		-	**≤0.007**
Potassium	0.135	0.215	0.243	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.64	2.27	2.33	-	-
Silver	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	6.7	8.53	12.3	-	-
Strontium	0.0344	0.0593	0.0463	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	0.0081	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	0.0107	**0.0300**	-
Zirconium	<0.00050	<0.00050	<0.00050	**-**	-
Dissolved Metals					
Aluminum	0.0052	0.0163	0.0221	**0.1000**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00017	0.00023	0.00023	-	-
Barium	0.0015	0.0026	0.0025	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	-	-
Cadmium	<0.0000050	<0.0000050	<0.000010	-	-
Calcium	8.8	11.5	9.84	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00039	0.00068	0.00062	-	-
Iron	0.04	0.0595	0.0519	-	-
Hardness	26.4	34.9	29.9	-	-
Lead	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.07	1.47	1.3	-	-
Manganese	0.0023	0.0017	0.0018	-	-
Mercury	<0.000020	<0.000020	<0.000010	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	-	-
Phosphorus	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.133	0.208	0.227	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.61	2.2	2.26	-	-
Silver	<0.000020	<0.000020	<0.000020	-	-
Sodium	6.24	8.29	12.3	-	-
Strontium	0.0323	0.056	0.0524	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	0.0081	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	-	-

[1] 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes only.
^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
¤ Results were collected on June 4th, ¤¤ results were collected on June 28th.
Results from June 4th are meant to represent the conditions during the month of May

[2] Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results are expressed in milligrams per litre except where noted.

TABLE 43
Quinsam River Downstream Site 1 Water Quality
2012/2013 EMS ID: E286930
COMPANY IDENTITY-QRDS1

Parameter	April				May						June					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton
Sample Date	3	10	17	24	1	8	15	22	29*	29	6	12	19*	19	26	Max	30-Day Mean[1]	GPS (m)
Conductivity (umhos/cm)	145	172	197	164	127	110	94.5	78.6	69.6	69.2	66.8	64.6	57.4	58.8	67.9	-	-	Minegrid
Hardness CaCO3	37.6	-	-	-	31	-	-	-	-	-	23.9	-	-	-	-	-	-	Northing Easting
pH	7.6	7.79	7.83	7.81	7.59	7.65	7.57	7.55	7.55	7.69	7.37	7.49	7.49	7.6	7.7	N/A	≥ (6.5)[2] or (6.9)[3]	102635 101895
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	≤ 5	UTM ZONE 10
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	<0.5	<0.5	<0.5	0.52	0.68	0.88	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	-	5535534 323861
Alkalinity - Total CaCO3	31.3	39.1	42.1	38.1	32.5	29.4	27.6	24.7	24.7	25.8	22.4	23.9	21.4	23.1	23.5	-	-	Downstream of 5 South and Barrier Pillar Influences. Upstream 7 South mining operation
Ammonia Nitrogen	0.031	-	-	-	<0.0050	-	-	-	-	-	0.011	-	-	-	-			
Nitrate and Nitrite as N	0.03	-	-	-	<0.020	-	-	-	-	-	<0.020	-	-	-	-	-	-	
Dissolved Phosphorus	<0.0050	-	-	-	<0.0050	-	-	-	-	-	<0.0050	-	-	-	-	-	-	
Total Phosphorus	<0.0050	-	-	-	<0.0050	-	-	-	-	-	<0.0050	-	-	-	-	-	-	
Sulphate	33.3	37.3	47.5	32.5	26.9	21	14.8	10.8	8.67	9.25	8.73	8.04	6.5	5.49	9.09	100^	N/A	

Parameter	July					August				September				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton
Sample Date	4	10	17	23	31	7	14	20	28	5	11	18	25	Max	30-Day Mean[1]	GPS (m)
Conductivity (umhos/cm)	79	78.1	76.4	87.5	88.9	92.6	96	102	99.4	87	85	84.6	80.2	-	-	Minegrid
Hardness CaCO3	27.4	-	-	-	29.1		-	-	-	28.2	-	-	-	-	-	Northing Easting
pH	7.64	7.61	7.52	7.5	7.56	7.67	7.54	7.61	7.7	7.68	7.69	7.6	7.5	N/A	≥ (6.5)[2] or (6.9)[3]	102635 101895
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	≤ 5	UTM ZONE 10
Total Dissolved Solids		-	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	0.56	0.52	<0.50	<0.50	0.62	0.91	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.79	-	-	5535534 323861
Alkalinity - Total CaCO3	23.1	25.2	25.4	25.5	26.6	27.3	28.5	29.8	29.9	27	29.1	27.9	25.3	-	-	Downstream of 5 South and Barrier Pillar Influences. Upstream 7 South mining operation
Ammonia Nitrogen	0.0076	-	-	-	0.0082	-	-	-	-	0.0082	-	-	-			
Nitrate and Nitrite as N	<0.020	-	-	-	<0.020	-	-	-	-	<0.020	-	-	-	-	-	
Dissolved Phosphorus	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-	
Total Phosphorus	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-	
Sulphate	10.7	12.1	11.8	13	13.2	13.9	15	17	15	12.5	12	11.8	11	100^	N/A	

Parameter	October					November				December		Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton
Sample Date	2	10	16	23	30	6	13	20	27	4	11	Max	30-Day Mean[1]	GPS (m)
Conductivity (umhos/cm)	85.5	92.6	108	131	130	116	146	129	139	150	138	-	-	Minegrid
Hardness CaCO3	-	27.2	-	-	-	35	-	-	-	-	60	-	-	Northing Easting
pH	7.6	7.64	7.7	7.79	7.65	7.65	7.78	7.47	7.64	7.69	7.72	N/A	≥ (6.5)[2] or (6.9)[3]	102635 101895
Total Suspended Solids	<4.0	-	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	≤ 5	UTM ZONE 10
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	<0.50	0.98	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	-	5535534 323861
Alkalinity - Total CaCO3	27.6	27.2	29.6	30.1	29.9	27.4	33.1	28.2	32.2	33.1	32.3	-	-	Downstream of 5 South and Barrier Pillar Influences. Upstream 7 South mining operation
Ammonia Nitrogen	-	0.026	-	-	-	-	-	-	-	-	-			
Nitrate and Nitrite as N	-	<0.020	-	-	-	-	-	-	-	-	-	-	-	
Dissolved Phosphorus	-	<0.0050	-	-	-	-	-	-	-	-	-	-	-	
Total Phosphorus	-	<0.0050	-	-	-	-	-	-	-	-	-	-	-	
Sulphate	12.7	14.2	22.2	30.1	28.2	23.5	33.1	27.8	27.5	31	27.8	100^	N/A	

Parameter	February	March			Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton
Sample Date	6	19	26*	26	Max	30-Day Mean[1]	GPS (m)
Conductivity (umhos/cm)	-	-	-	-	-	-	Minegrid
Field Conductivity (uS/cm)	-	-	-	107	-	-	Northing Easting
Hardness CaCO3	-	-	-	-			102635 101895
pH	-	-	-	-	N/A	≥ (6.5)[2] or (6.9)[3]	UTM ZONE 10
Field pH	-	-	-	7.53	-	-	Northing Easting
Total Suspended Solids	-	-	-	-	25	≤ 5	5535534 323861
Total Dissolved Solids	-	-	-	-	-	-	Downstream of 5 South and Barrier Pillar Influences. Upstream 7 South mining operation
Acidity (to pH 8.3)	-	-	-	-			
Alkalinity - Total CaCO3	-	-	-	-	-	-	
Ammonia Nitrogen	-	-	-	-	-	-	
Nitrate and Nitrite as N	-	-	-	-	-	-	
Dissolved Phosphorus	-	-	-	-			
Total Phosphorus	-	-	-	-			
Sulphate	5.69	21.9	24.1	24.8	100^	N/A	

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
[2] 30-day 90th percentile
[3]Running 30-day median
^The sulphate limit is a guideline rather than a site-specific objective

Results are expressed in milligrams per litre except where noted.
* Field replicate sample

TABLE 44
QUINSAM RIVER DOWNSTREAM SITE 1 METALS ANALYSIS
2012/2013 EMS ID: E286930
COMPANY IDENTITY- QRDS1

Parameter	April	May	June	July		September	Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Sample Date	3	1	6	4	31	5	Max	30-Day Mean[1]
Total Metals								
Aluminum	0.077	0.0218	0.0246	0.0182	0.0164	0.0274	-	-
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0004	0.00016	0.00017	0.00018	0.00022	0.0002	**0.005^**	-
Barium	0.003	0.0021	0.0012	0.0015	0.0018	0.0017	-	-
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	0.000007	[2]	-
Calcium	12.3	10.3	8.06	9.19	9.76	9.41	-	-
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0006	0.00052	0.00078	0.00084	0.00066	0.00101	-	**≤0.002**
Iron	0.109	0.0391	0.0343	0.0488	0.0401	0.0679	-	**≤ 0.3**
Hardness	37.6	31	23.9	27.4	29.1	28.2	-	-
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.0050**	**≤0.003**
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.69	1.31	0.922	1.09	1.14	1.13	-	-
Manganese	0.005	0.0037	0.0035	0.0041	0.0024	0.008	**0.0500**	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	**≤0.0001**	-
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.0250**	-
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	**≤0.007**
Potassium	0.243	0.196	0.142	0.112	0.154	0.155	-	-
Selenium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.8	1.85	1.79	1.78	1.71	1.77	-	-
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	13.9	11.6	3.66	4.4	6.25	6.58	-	-
Strontium	0.075	0.0507	0.0259	0.034	0.0373	0.0349	-	-
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.0300**	-
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**	-
Dissolved Metals								
Aluminum	0.0391	0.0196	0.0138	0.0133	0.0147	0.0098	**0.1000**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00027	0.00018	0.00011	0.00018	0.00022	0.00019	-	-
Barium	0.0032	0.0021	0.0012	0.0014	0.0017	0.0015	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	0.053	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000005	-	-
Calcium	12.3	10.6	8.51	8.76	9.51	9.02	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0009	0.0007	0.00068	0.00058	0.0006	0.00075	-	-
Iron	0.0453	0.0182	0.0209	0.0288	0.0271	0.0169	-	-
Hardness	37.6	31	23.9	27.4	29.1	28.2	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.77	1.35	0.957	1.04	1.19	1.1	-	-
Manganese	0.0026	0.0019	0.0026	0.0028	0.0012	<0.0010	-	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorus	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Potassium	0.298	0.219	0.164	0.11	0.157	0.135	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.5	1.85	1.75	1.78	1.73	1.6	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	14.6	12.1	3.8	4.46	6.44	6.59	-	-
Strontium	0.0724	0.055	0.027	0.0345	0.0377	0.0346	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes only.

^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

¤ Results were collected on June 4th, ¤¤ results were collected on June 28th. Results from June 4th are meant to represent the conditions during the month of May

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results are expressed in milligrams per litre except where noted.
WQO= Water Quality Objective.
WQG= Watet Quality Guideline.

TABLE 44
QUINSAM RIVER DOWNSTREAM SITE 1 METALS ANALYSIS
2012/2013 EMS ID: E286930
COMPANY IDENTITY- QRDS1

Parameter	October	November	December	Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Sample Date	10	6	11	Max	30-Day Mean[1]
Total Metals					
Aluminum	0.0161	0.0568	0.156	-	-
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00018	0.00045	0.00027	**0.005^**	-
Barium	0.0016	0.0031	0.0176	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	-	-
Cadmium	**0.000016 (WQG)**	<0.0000050	<0.000010	[2]	-
Calcium	9.1	11.5	16.3	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00102	0.0012	0.00113	-	**≤0.002**
Iron	0.0423	0.0964	0.222	-	**≤ 0.3**
Hardness	27.2	35	60	-	-
Lead	<0.00020	<0.00020	<0.00020	**0.0050**	**≤0.003**
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.08	1.56	4.71	-	-
Manganese	0.0038	0.0059	0.0098	**0.0500**	-
Mercury	<0.000020	<0.000020	<0.000010	**≤0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	**0.0250**	-
Phosphorus	<0.0050	-	-	-	**≤0.007**
Potassium	0.168	0.211	5.15	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.59	2.06	6.1	-	-
Silver	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	6.91	8.88	24.6	-	-
Strontium	0.0351	0.0733	0.116	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	0.0066	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	0.0053	0.0057	**0.0300**	-
Zirconium	<0.00050	<0.00050	<0.00050	**-**	-
Dissolved Metals					
Aluminum	0.0097	0.0103	0.0191	**0.1000**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00016	0.00022	0.00022	-	-
Barium	0.0014	0.0027	0.0024	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	-	-
Cadmium	<0.0000050	<0.0000050	<0.000010	-	-
Calcium	8.72	12.5	10.6	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00046	0.00053	0.00061	-	-
Iron	0.0193	0.0279	0.0297	-	-
Hardness	27.2	35	60	-	-
Lead	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.11	1.6	1.39	-	-
Manganese	<0.0010	<0.0010	0.0013	-	-
Mercury	<0.000020	<0.000020	<0.000010	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	-	-
Phosphorus	<0.0050	-	-	-	-
Potassium	0.137	0.229	0.247	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.67	2.26	2.28	-	-
Silver	<0.000020	<0.000020	<0.000020	-	-
Sodium	6.78	9.18	14.5	-	-
Strontium	0.0326	0.0579	0.0552	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	0.0066	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes only.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
¤ Results were collected on June 4th, ¤¤ results were collected on June 28th.
Results from June 4th are meant to represent the conditions during the month of May

Results are expressed in milligrams per litre except where noted.
WQO= Water Quality Objective.
WQG= Watet Quality Guideline.

TABLE 45

SOUTH DYKE SUMP WATER QUALITY

2012/2013 EMS ID: E292126

COMPANY IDENTITY - SDS

Parameter	April				May					June				Site Description	
														GPS (m)	
														Minegrid	
Sample Date	3	10	17	24	2	8	15	22	29	6	12	19	26	Northing	Easting
Conductivity (umhos/cm)	2650	3160	3160	3140	3100	3160	3110	3170	3140	3070	2940	2960	2980	102553	99305
Hardness CaCO3	1050	-	-	-	1270	-	-	-	-	1230	-	-	-	UTM ZONE 10	
pH	7.98	8.06	7.98	8	8.02	7.95	7.97	8.05	8.15	8.02	7.99	8.02	8.01	Northing	Easting
Acidity (to pH 8.3)	8.9	11.9	9.4	8.81	7.89	9.36	11.4	4.88	5.52	11.4	3.95	4.61	8.7	5533411	322376
Alkalinity - Total $CaCO_3$	244	306	275	285	283	300	274	293	306	288	247	283	293	Extreme South	
Sulphate	1350	1650	1630	1530	1530	1630	1610	1630	1550	1500	1480	1440	1380	End of 2 North Pit	

Parameter	July					August				September				Site Description	
														GPS (m)	
														Minegrid	
Sample Date	4	10	17	23	31	7	14	20	28	4	11	18	25	Northing	Easting
Conductivity (umhos/cm)	3000	3080	3160	3150	3130	3160	3250	3340	3240	3190	3290	3330	3270	102553	99305
Hardness CaCO3	1190	-	-	-	1250	-	-	-	-	1400	-	-	-	UTM ZONE 10	
pH	8.02	8.13	8.01	7.97	7.99	7.98	7.91	8.04	8.04	8.17	8.13	8.11	8.15	Northing	Easting
Acidity (to pH 8.3)	9.25	13.9	11.8	13.5	9.64	17.1	8.2	3.6	9.6	4.17	8.2	4.17	7.45	5533411	322376
Alkalinity - Total $CaCO_3$	271	318	317	305	274	276	230	234	249	293	292	282	296	Collection Sump at South Side of the Tailings Dam	
Sulphate	1330	1550	1660	1540	1490	1610	1590	1680	1640	1550	1590	1680	1720		

Parameter	October					November				December			Site Description	
													GPS (m)	
													Minegrid	
Sample Date	2	10	16	23	30	6	13	20	27	4	11	28	Northing	Easting
Conductivity (umhos/cm)	3290	3350	3250	3090	3160	3030	3310	2810	3300	2930	3280	3180	102553	99305
Hardness CaCO3	-	1190	-	-	-	1220	-	-	-	-	1440	-	UTM ZONE 10	
pH	8.05	8.09	8.06	8.09	7.99	8.02	8.04	7.94	7.99	8	8.01	8.1	Northing	Easting
Acidity (to pH 8.3)	7.8	7.34	5.01	8.36	4.09	7.4	10.4	11.8	10.8	8.68	7.23	13	6E+06	322376
Alkalinity - Total $CaCO_3$	291	282	299	306	291	283	286	260	297	270	291	319	Collection Sump at South Side of the Tailings Dam	
Sulphate	1720	1630	1650	1560	1600	1490	1690	1420	1760	1470	1620	1530		

Parameter	January					February				March				Site Description	
														GPS (m)	
														Minegrid	
Sample Date	2	8	16	21	24	4	14	19	25	4	11	19	26	Northing	Easting
Conductivity (umhos/cm) Field	-	-	-	-	-	3108	2107	2005	-	-	3064	2626	3072	102553	99305
Conductivity (umhos/cm)	3200	2870	3190	3150	3041	-	-	-	-	-	-	-	-		
Hardness CaCO3	1250	-	-	-	-	-	-	-	-	-	-	-	-	UTM ZONE 10	
pH-F	-	-	-	7.86	7.91	7.95	7.87	7.93	*	*	7.46	7.66	8.02		
pH-L	8.09	7.94	7.95	7.96	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	8.90	12.3	13.2	12.3	-	-	-	-	-	-	-	-	-	5533411	322376
Alkalinity - Total $CaCO_3$	322	291	298	298	-	-	-	-	-	-	-	-	-	Collection Sump at South Side of the Tailings Dam	
Sulphate	1550	1380	1550	1560	-	-	-	-	-	-	-	-	-		

Results expressed in milligrams per litre except where noted.

* Field replicate sample.

TABLE 46
SOUTH DYKE SUMP METALS ANALYSIS
2012/2013 EMS ID: E292126
COMPANY IDENTITY - SDS

Parameter	April	May	June	July		September
Sample Date	3	2	6	4	31	4
Total Metals						
Aluminum	4.59	0.024	0.0143	0.0434	0.0184	0.0122
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010
Arsenic	0.004	0.00021	0.00021	0.00061	0.00035	<0.00020
Barium	0.049	0.0149	0.0133	0.0199	0.0135	0.0135
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020
Boron	0.63	0.924	0.891	0.979	0.971	1.09
Cadmium	0.00009	<0.000010	<0.000010	0.000016	<0.000010	<0.000025
Calcium	340	411	401	389	404	456
Chromium	0.008	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020
Cobalt	0.0091	0.00201	0.00099	0.00193	<0.00050	<0.0010
Copper	0.0239	0.00124	0.00056	0.00128	0.00084	0.00064
Iron	6.41	0.104	0.0614	0.148	0.0521	0.04
Hardness	-	-	-	-	-	-
Lead	0.0008	<0.00020	<0.00020	<0.00020	<0.00020	<0.00040
Lithium	0.01	0.0073	0.0062	0.0072	0.008	0.01
Magnesium	48.2	59.5	55.4	53.2	59.2	63.6
Manganese	0.67	0.429	0.285	0.403	0.149	0.2
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020
Nickel	0.019	0.0102	0.0052	0.0064	0.0042	0.0091
Phosphorus	-	-	-	-	-	-
Potassium	4.74	4.94	4.71	4.8	4.98	5.45
Selenium	0.0009	0.00012	0.00031	0.00037	0.00019	<0.00020
Silicon	10.9	4.04	3.99	4.01	3.94	4.79
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000040
Sodium	216	304	296	298	326	332
Strontium	2.33	2.79	2.65	2.63	2.77	2.92
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.010
Titanium	0.299	<0.0050	<0.0050	<0.0050	<0.0050	<0.010
Uranium	0.0002	0.00018	0.00017	0.00015	0.00016	0.00021
Vanadium	0.018	<0.0050	<0.0050	<0.0050	<0.0050	<0.010
Zinc	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.010
Zirconium	0.0018	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010
Dissolved Metals						
Aluminum	0.0261	0.014	0.0126	0.0141	0.0096	0.0083
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00016	0.00016	0.00038	0.00029	0.00038	0.00021
Barium	0.0285	0.0143	0.0143	0.0189	0.0141	0.012
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.709	0.807	0.84	0.835	0.874	0.946
Cadmium	0.000023	0.000032	0.000017	0.000034	<0.000010	<0.000025
Calcium	370	394	417	375	392	413
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.0053	0.00182	0.00118	0.00187	<0.00050	0.00069
Copper	0.00095	0.00134	0.0021	0.00225	0.00192	0.0005
Iron	0.0089	0.0204	0.0336	0.0296	<0.0050	0.0105
Hardness	-	-	-	-	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0074	0.0078	0.0072	0.0067	0.0072	0.0086
Magnesium	49.2	58.8	57.7	51.9	58.9	62.8
Manganese	0.625	0.438	0.3	0.378	0.158	0.198
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.012	0.0064	0.0052	0.0065	0.0047	0.0084
Phosphorus	-	-	-	-	-	-
Potassium	4.58	4.95	5.06	4.42	5.17	5.15
Selenium	0.00116	0.00022	0.00042	0.00024	0.00012	0.00014
Silicon	3.68	3.65	3.97	3.81	4.06	4.3
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	224	301	311	287	327	334
Strontium	2.36	2.81	2.83	2.44	2.75	2.9
Thallium	<0.000050	0.000064	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	0.00014	0.00018	0.00017	0.00014	0.00017	0.00016
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 46
SOUTH DYKE SUMP METALS ANALYSIS
2012/2013 EMS ID: E292126
COMPANY IDENTITY - SDS

Parameter / Sample Date	October 10	November 6	December 11	January 13
Total Metals				
Aluminum	0.0273	0.316	0.194	0.0308
Antimony	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	<0.00010	0.00052	0.00028	0.00012
Barium	0.0121	0.0311	0.0205	0.0156
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.948	1.12	0.929	0.925
Cadmium	<0.000010	<0.000025	0.000029	<0.000010
Calcium	418	408	452	409
Chromium	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	0.00463	0.00564	0.00303
Copper	0.0008	0.00212	0.00206	0.00072
Iron	0.0758	0.411	0.393	0.0886
Hardness	-	-	-	1250
Lead	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0082	0.0108	0.0101	0.0088
Magnesium	63.9	56.6	58.3	55.1
Manganese	0.103	0.642	0.706	0.566
Mercury	<0.000020	<0.000020	<0.000010	<0.010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0035	0.0127	0.0151	0.0094
Phosphorus	-	-	-	-
Potassium	5.48	5.75	5.26	5.23
Selenium	<0.00010	0.00031	0.00051	0.00036
Silicon	4.54	5.02	5.3	4.56
Silver	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	332	319	347	314
Strontium	3.03	2.73	2.9	2.75
Thallium	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	0.0179	0.0088	<0.0050
Uranium	0.00018	0.0002	0.00019	0.00018
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	0.0062	0.0116	0.0075
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals				
Aluminum	<0.0030	0.0162	0.0335	0.0179
Antimony	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	<0.00010	0.00034	0.00043	0.00023
Barium	0.0112	0.0273	0.0193	0.0158
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.867	1.02	0.978	0.846
Cadmium	<0.000025	<0.000025	0.000011	0.000011
Calcium	376	398	483	413
Chromium	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	0.00397	0.00508	0.00294
Copper	0.00054	0.00107	0.00044	0.00046
Iron	0.0064	0.0948	0.0051	0.0077
Hardness	-	-	-	1250
Lead	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	0.0097	0.0107	0.0082
Magnesium	62	54	56.7	53.2
Manganese	0.0975	0.489	0.572	0.52
Mercury	<0.000020	<0.000020	<0.000010	<0.00010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.004	0.0118	0.0127	0.0085
Phosphorus	-	-	-	-
Potassium	5.37	5.65	5.68	5.00
Selenium	<0.00010	0.00049	0.00061	0.00034
Silicon	4.05	4.07	5.02	4.50
Silver	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	320	308	346	306
Strontium	3.02	2.56	2.93	2.72
Thallium	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	0.0179	0.0088	<0.0050
Uranium	0.00018	0.00017	0.00019	0.00017
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 47
LLE-0649 WATER QUALITY
2012/2013 EMS ID: E292130
COMPANY IDENTITY- LLE

Parameter	April					May				June				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	2	10	17	24	30	8	15	22	29	5	12	19	26	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	242	255	326	356	346	325	497	674	479	283	295	265	228	-	-	Minegrid	
Hardness CaCO3	110	-	-	-	149	-	-	-	-	115	-	-	-	-	-	Northing	Easting
pH	7.35	7.43	7.46	7.45	7.18	7.47	7.19	7.38	7.5	7.19	7.6	7.61	7.61	N/A	≥ (6.5)[2] or (6.9)[3]	101389	99552
Total Suspended Solids	6	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	≤ 5	UTM ZONE 10	
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	1.5	0.8	1.8	3.86	5.24	2.67	4.87	2.37	2.14	1.49	2.03	1.66	0.79	-	-	5532912	323456
Alkalinity - Total CaCO3	23.5	25.2	27.6	**26.2**	29.8	28.3	33.3	37.5	36.6	28.4	31.5	32.7	30.1	-	-	South Mine Area, Last Sampling Point Above Long Lake	
Ammonia Nitrogen	0.025	-	-	-	0.025	-	-	-	-	0.041	-	-	-				
Nitrate and Nitrite as N	0.024	-	-	-	0.035	-	-	-	-	0.027	-	-	-	-	-		
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	<0.0050	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-		
Total Phosphorus	0.0084	-	-	-	0.0055	-	-	-	-	0.009	-	-	-	-	-		
Sulphate	90.2	98.5	**128**	**131**	**130**	**125**	**226**	**314**	98	**110**	-	-	**121**	**100^**	N/A		

Parameter	July					August				September				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	3	10	17	23	31	7	14	20	28	4	18	25*	25	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	276	320	608	932	1050	1210	1290	1400	1450	1580	1740	1760	1740	-	-	Minegrid	
Hardness CaCO3	110	-	-	-	527	-	-	-	-	828	-	-	-	-	-	Northing	Easting
pH	7.62	7.65	7.17	7.52	7.71	7.76	7.93	7.95	8.1	7.9	7.8	7.67	7.78	N/A	≥ (6.5)[2] or (6.9)[3]	101389	99552
Total Suspended Solids	<4.0	<4.0	4	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	≤ 5	UTM ZONE 10	
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	2.51	2.68	13.6	4.57	12	5.48	1.95	3.61	2.48	2.55	4.3	4.11	9.42	-	-	5532912	323456
Alkalinity - Total CaCO3	34	38.9	60.4	69.9	83.4	84.4	85.6	91.7	91.5	92.8	90.8	93.7	93.1	-	-	South Mine Area, Last Sampling Point Above Long Lake	
Ammonia Nitrogen	0.017	-	-	-	0.01	-	-	-	-	0.022	-	-	-				
Nitrate and Nitrite as N	0.025	-	-	-	<0.020	-	-	-	-	<0.020	-	-	-	-	-		
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	0.0057	-	-	-	0.0057	-	-	-	-	<0.0050	-	-	-	-	-		
Total Phosphorus	0.0078	-	-	-	<0.0050	-	-	-	-	0.0093	-	-	-	-	-		
Sulphate	91.3	**118**	**268**	**374**	**508**	**579**	**586**	**674**	**730**	**804**	**919**	**941**	**1000**	**100^**	N/A		

Parameter	October					November				December				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	2	9	16	23	30	5	13	20	27	4	11	18	28	Max	30-Day Mean[1]	GPS (m)	
pH	7.65	7.69	7.65	7.3	7.22	7.33	7.52	7.3	7.5	7.44	7.58	7.51	7.35	N/A	≥ (6.5)[2] or (6.9)[3]	Minegrid	
Hardness CaCO3	-	892	-	-	-	74.3	-	73.2	105	121	169	156	86.3	-	-	Northing	Easting
Conductivity (umhos/cm	1720	1780	997	248	135	179	171	174	249	300	388	364	233	-	-	101389	99552
Total Suspended Solids	<4.0	<4.0	14	<4.0	9.5	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	≤ 5	UTM ZONE 10	
Total Dissolved Solids	-	1510	-	-	-	106	-	120	164	200	288	246	160	-	-	Northing	Easting
Acidity (to pH 8.3)	3.18	3.08	7.9	<0.50	1.53	1.09	1.09	1.39	1.95	0.87	1.43	2.01	1.7	-	-	5532912	323456
Alkalinity - Total CaCO3	88.4	85.7	50	24.1	15.6	23.6	21.6	17.5	22.3	26.1	36.8	37	27.4	-	-	South Mine Area, Last Sampling Point Above Long Lake	
Ammonia Nitrogen	-	<0.0050	-	-	-	0.0062	-	0.0086	0.021	0.03	0.038	0.066	0.0187				
Nitrate and Nitrite as N	-	<0.020	-	-	-	0.038	-	0.03	0.036	<0.020	0.032	0.062	0.071	-	-		
Kjeldahl Nitrogen	-	-	-	-	-	-	-	0.253	0.267	0.216	-	0.279	0.215	-	-		
Dissolved Phosphorus	-	<0.0050	-	-	-	0.0051	-	0.0051	<0.0050	<0.0050	0.0053	0.0052	-	-	-		
Total Phosphorus	-	0.0066	-	-	-	0.0118	-	0.0066	<0.0050	0.0052	0.0107	0.0074	0.0051				
Sulphate	**955**	**942**	**463**	**104**	41	56.7	53.8	60.7	63.7	**111**	**153**	**131**	77.4	**100^**	N/A		

Parameter	January					February						March				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	2	8	16	22	29	4	7	12	19	20	25	5	11	19	26	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	254	273	294	379	-	-	144	-	-	403	-	293	-	-	-			Minegrid	
Field Conductivity (uS/cm	-	-	-	-	**PNC**	195	-	381	283	-	217	-	324	374	279	-	-	Northing	Easting
Hardness CaCO3	102	-	115	150	-	76.6	54.6	-	-	155	-	119	-	-	-	-	-		
pH	7.41	7.51	7.38	7.63	-	-	7.42	7.51	-	7.47	-	7.51	-	-	-	N/A	≥ (6.5)[2] or (6.9)[3]	101389	99552
Field pH	-	-	-	-	**PNC**	6.8	-	6.83	7.14	-	7.4	-	7.5	7.08	7.3	-	-	UTM ZONE 10	
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	-	<4.0	-	-	-	<4.0	-	<4.0	-	-	-	25	≤ 5	Northing	Easting
Total Dissolved Solids	192	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Acidity (to pH 8.3)	0.6	1.24	2.78	5.01	-	-	-	-	-	-	-	-	-	-	-	-	-	5532912	323456
Alkalinity - Total CaCO3	30.1	36.2	37	43.5	-	39.9	22.2	-	-	44.6	-	36.8	-	-	-	-	-	South Mine Area, Last Sampling Point Above Long Lake	
Ammonia Nitrogen	0.032	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Nitrate and Nitrite as N	0.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	<0.0050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total Phosphorus	0.0058	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	91.4	94.4	96.8	**134**	79.5	59.1	42.3	**159**	**143**	**144**	**104**	**103**	**113**	**100**	**105**	**100^**	N/A		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
[2] 30-day 90th percentile
[3]Running 30-day median
^The sulphate limit is a guideline rather than a site-specific objective

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

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TABLE 48
LLE-0649 METALS ANALYSIS
2012/2013 EMS ID: E292130
COMPANY INDENTITY - LLE

Parameter	April		June	July		September	Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Sample Date	2	30	5	3	31	4	Max	30-Day Mean[1]
Total Metals								
Aluminum	0.307	0.0471	0.0637	0.0582	0.0165	0.0301	-	-
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0011	0.00137	0.00108	0.00149	0.00189	0.00092	**0.005^**	-
Barium	0.013	0.0203	0.0146	0.0163	0.0457	0.0548	-	-
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.05	0.057	0.051	0.057	0.21	0.341	-	-
Cadmium	<0.00001	<0.000010	**0.000018**	<0.000010	<0.000010	**<0.000025**	[2]	-
Calcium	35.8	46.8	36.7	35	165	259	-	-
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0011	0.00038	0.00048	0.00061	0.00073	0.0007	-	**≤0.002**
Iron	**0.677**	**1.78**	**0.581**	**0.653**	**0.754**	0.182	-	**≤ 0.3**
Hardness	110	-	149	115		110	-	-
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.0050**	**≤0.003**
Lithium	<0.005	<0.0050	<0.0050	<0.0050	0.0113	0.0177	-	-
Magnesium	4.92	7.92	5.8	5.53	27.8	44	-	-
Manganese	0.045	**0.249**	**0.093**	**0.114**	**0.616**	0.0385	**0.0500**	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	**≤0.0001**	-
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.0250**	-
Phosphorus	0.0084	0.0055	0.009	0.0078	<0.005	0.0093	-	**-**
Potassium	0.378	0.494	0.309	0.246	0.582	0.863	-	-
Selenium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	3	2.53	2.23	2.52	5.42	5.99	-	-
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	3.52	7.34	5.86	6.07	30.3	46.5	-	-
Strontium	0.182	0.284	0.209	0.213	1.05	1.66	-	-
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	0.022	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.0300**	-
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**	-
Dissolved Metals								
Aluminum	0.0282	0.0199	0.0319	0.03	0.0066	<0.0030	**0.1000**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00065	0.00107	0.00103	0.00135	0.00168	0.00087	-	-
Barium	0.0105	0.0196	0.0165	0.0157	0.0457	0.0576	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	0.054	0.053	<0.050	0.222	0.352	-	-
Cadmium	<0.000010	0.000011	<0.000010	0.000011	<0.000010	<0.000025	-	-
Calcium	34	46.5	38.9	36.4	159	269	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00125	0.0004	0.00062	0.00058	0.00064	0.00052	-	-
Iron	0.235	1.3	0.33	0.357	0.0701	0.0248	-	-
Hardness	-	-	-	-	-	-	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	0.0106	0.0177	-	-
Magnesium	4.83	7.17	6.24	5.76	28.2	46.3	-	-
Manganese	0.0403	0.245	0.098	0.112	0.61	0.028	-	-
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorus	<0.0050	<0.0050	<0.0050	0.0057	0.0057	<0.0050	-	-
Potassium	0.388	0.463	0.369	0.28	0.606	0.885	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.3	2.36	2.3	2.77	5.37	5.97	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	3.49	6.64	6.43	5.99	30.7	49.8	-	-
Strontium	0.183	0.282	0.231	0.212	1.04	1.73	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes only.

^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

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TABLE 48
LLE-0649 METALS ANALYSIS
2012/2013 EMS ID: E292130
COMPANY INDENTITY - LLE

Parameter	October	November			December				Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Sample Date	9	5	20	27	4	11	18	28	Max	30-Day Mean[1]
Total Metals										
Aluminum	0.0035	0.266	0.168	0.0993	0.0925	0.205	0.0769	0.119	-	-
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00077	0.00099	0.00091	0.0021	0.00078	0.00226	0.00177	0.00147	**0.005^**	-
Barium	0.0656	0.0142	0.01	0.0123	0.0104	0.021	0.0177	0.0112	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	0.328	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	**<0.000025**	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.000005	0.000006	**0.000035**	[2]	-
Calcium	276	23.7	23.6	34.2	39.7	55.3	50	27.7	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00049	0.00153	0.00095	0.00073	0.00104	0.00089	0.00083	0.00151	-	**≤0.002**
Iron	0.174	**0.557**	**0.343**	**0.338**	**0.417**	**1.79**	**2.27**	**1.06**	-	**≤ 0.3**
Hardness	892	74.3	73.2	105	121	121	169	156	-	-
Lead	<0.00020	0.0004	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.0050**	**≤0.003**
Lithium	0.0175	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	49.3	3.65	3.46	4.82	5.21	7.58	7.45	4.12	-	-
Manganese	0.0218	**0.0706**	0.0377	0.0333	0.0332	**0.139**	**0.166**	**0.0652**	**0.0500**	-
Mercury	<0.0000020	<0.0000020	<0.0000020	<0.0000020	0.0000021	0.0000026	0.0000022	<0.0000020	**≤0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	**0.0250**	-
Phosphorus	0.0066	0.0118	0.0066	<0.005	0.0052	0.0107	0.0074	0.0051	-	**-**
Potassium	1.16	0.479	0.472	0.516	1.05	1.89	2.05	1.46	-	-
Selenium	<0.00010	0.0001	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	5.36	3.87	3.23	3.2	2.98	3.95	3.5	3.41	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	52.7	3.76	3.86	5.26	6.46	8.83	9.63	6.94	-	-
Strontium	1.91	0.14	0.145	0.198	0.221	0.312	0.291	0.162	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	0.0154	0.0139	<0.0050	<0.0050	0.0116	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	0.006	<0.0050	<0.0050	0.0052	0.0091	<0.0050	0.0057	**0.0300**	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**	-
Dissolved Metals										
Aluminum	<0.0030	0.0491	0.0584	0.0448	0.0404	0.0364	0.0388	0.0503	**0.1000**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00075	0.00092	0.0007	0.00187	0.00069	0.00154	0.00142	0.00137	-	-
Barium	0.062	0.0129	0.0087	0.0122	0.0107	0.0179	0.0163	0.0111	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	0.34	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Cadmium	<0.000025	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	-
Calcium	288	22.3	23.4	34.6	39.7	49.7	46.8	29.8	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00031	0.00093	0.00058	0.00047	0.0006	0.00051	0.00043	0.00049	-	-
Iron	0.0268	0.2	0.179	0.225	0.273	1.01	1.54	0.858	-	-
Hardness	-	-	-	-	-	-	-	-	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	0.0185	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	47.5	3.74	3.53	4.81	5.36	7.3	6.97	4.53	-	-
Manganese	0.0186	0.0594	0.0321	0.0316	0.031	0.13	0.153	0.068	-	-
Mercury	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	-	-
Phosphorus	<0.0050	0.0051	0.0051	<0.0050	<0.0050	0.0053	0.0052		-	-
Potassium	1.17	0.459	0.462	0.514	1.01	1.59	1.91	1.55	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	5.44	3.14	3.33	3.17	3.05	3.25	3.42	3.39	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	50.7	3.82	<0.000010	4.98	6.3	8.85	9.24	6.19	-	-
Strontium	1.8	0.136	0.131	0.193	0.228	0.297	0.267	0.17	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	0.0154	0.0139	<0.0050	<0.0050	0.0116	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes only.

^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

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TABLE 48
LLE-0649 METALS ANALYSIS
2012/2013 EMS ID: E292130
COMPANY INDENTITY - LLE

Parameter	January			February			March	Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Sample Date	2	16	22	4	7	20	5	Max	30-Day Mean[1]
Total Metals									
Aluminum	0.148	0.112	0.0687	0.0796	0.133	0.0662	0.0712	-	-
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00154	0.00153	0.0016	0.00102	0.00094	0.00113	0.00123	**0.005^**	-
Barium	0.0121	0.0126	0.0179	0.0094	0.007	0.016	0.0128	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	0.053	<0.050	<0.050	0.05	<0.050	-	-
Cadmium	**0.00003**	<0.000010	<0.000010	<0.000005	<0.000010	<0.000010	<0.000010	[2]	-
Calcium	31.9	35.1	47.8	24.8	17.7	52.5	34.9	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	**0.00204**	0.00056	0.00057	0.00052	0.00064	0.00063	0.00058	-	**≤0.002**
Iron	**1.28**	**1.88**	**3.14**	**0.757**	**0.353**	**0.963**	**0.447**	-	**≤ 0.3**
Hardness	86.3	111	151	76.6	55.3	162	108	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**0.0050**	**≤0.003**
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	4.82	5.58	7.67	3.59	2.69	7.49	5.13	-	-
Manganese	**0.0847**	**0.12**	**0.215**	**0.0514**	0.0238	**0.0787**	**0.0503**	**0.0500**	-
Mercury	<0.0000020	<0.000010	<0.000010	<0.0000020	<0.000010	<0.000010	<0.000010	**≤0.0001**	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	**0.0250**	-
Phosphorus	0.0058	-	-	-	-	-	-	-	-
Potassium	1.43	2.14	2.68	2.17	1	1.87	1.43	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	3.33	3.48	4.18	3.56	3.01	3.01	2.8	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**0.0001**	-
Sodium	6.74	8.59	12	8.56	4.81	13.4	9.64	-	-
Strontium	0.187	0.203	0.277	0.139	0.0977	0.306	0.215	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	0.0054	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	0.0051	<0.0050	<0.0050	<0.0050	<0.0050	**0.0300**	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Dissolved Metals									
Aluminum	0.0465	0.0409	0.0377	0.0375	0.0482	0.0254	0.0275	**0.1000**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00135	0.00137	0.00133	0.00085	0.00085	0.00104	0.00108	-	-
Barium	0.0123	0.0126	0.0172	0.0093	0.0069	0.0166	0.0121	-	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	<0.050	<0.050	0.051	<0.050	-	-
Cadmium	<0.0000050	0.000013	<0.000010	<0.000005	<0.000010	<0.000010	<0.000010	-	-
Calcium	32.4	36.4	48.1	24.4	17.6	50.4	38.8	-	-
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00051	0.00054	0.00049	0.00039	0.00045	0.00035	0.00032	-	-
Iron	1.02	1.53	2.61	0.606	0.175	0.709	0.302	-	-
Hardness	102	115	150	76.6	54.6	155	119	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium	5	5.88	7.23	3.78	2.59	7.13	5.3	-	-
Manganese	0.0873	0.123	0.205	0.051	0.0179	0.0765	0.0499	-	-
Mercury	<0.0000020	<0.000010	<0.000010	<0.0000020	<0.000010	<0.000010	<0.000010	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorus	<0.0050	-	-	-	-	-	-	-	-
Potassium	1.51	2.24	2.86	2.25	0.975	1.76	1.57	-	-
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon	3.39	3.54	3.94	3.34	3.04	2.95	2.92	-	-
Silver	<0.000020	<0.000020	0.000038	<0.000020	<0.000020	<0.000020	<0.000020	-	-
Sodium	6.72	9.04	11.1	8.21	4.47	12.8	10.1	-	-
Strontium	0.184	0.216	0.268	0.142	0.0992	0.305	0.196	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes only.

^: The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 49
3 SOUTH-77 WATER QUALITY
2012/2013 EMS ID: E292128
COMPANY IDENTITY - 3S77

Parameter / Sample Date	April					May				June				Site Description
	2	10	17	24	30	8	15	22	29	5	12	19	26	
Conductivity (umhos/cm)	519	487	571	600	622	606	622	627	622	617	588	584	597	Minegrid
Hardness CaCO3	241	-	-	-	289	-	-	-	-	293	-	-	-	Northing Easting
pH	7.62	7.6	7.71	7.74	7.54	7.46	7.62	7.75	7.73	7.69	7.86	7.65	7.66	101060 98505
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	UTM ZONE 10
Total Suspended Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	2.7	0.9	3.6	3.75	4.6	4.85	3.41	0.59	1.33	<0.50	1.75	5.06	12.6	5531876 323093
Alkalinity - Total CaCO3	48.3	50.7	55.1	55.7	54.5	59.6	63.3	64.5	64.4	64.2	65.8	65.1	72.5	
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nitrate - Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	20 tonne Bulk
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	Sample Pit in 3 Seam
Dissolved Phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	above 4 South Mine
Total Phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sulphate	200	188	218	212	215	242	279	282	255	212	230	199	189	

Parameter / Sample Date	July					August				September				Site Description
	3	10	17	23	31	7	14	20	28	4	18	18*	25	
Conductivity (umhos/cm)	556	535	536	534	542	556	568	561	567	563	575	589	580	Minegrid
Hardness CaCO3	240	-	-	-	256	-	-	-	-	272	-	-	-	Northing Easting
pH	7.96	7.83	7.48	7.63	7.83	7.97	7.98	7.93	7.98	7.77	7.89	7.8	7.7	101060 98505
Total Suspended Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	UTM ZONE 10
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	2.39	4.67	8.71	3.46	7.02	1.49	1	1.96	3.51	2.05	2.94	3.04	2.98	5531876 323093
Alkalinity - Total CaCO3	72.8	74.2	74.9	77.8	78.5	81.8	83.5	84.3	86.2	87.4	89.7	92.3	92.5	
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nitrate - Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	20 tonne Bulk
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	Sample Pit in 3 Seam
Dissolved Phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	above 4 South Mine
Total Phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sulphate	175	188	196	176	196	180	180	183	185	189	190	194	174	

Parameter / Sample Date	October				November			Site Description
	2	16	23	30	5	13	20	
pH	7.57	7.84	7.35	7.82	7.64	7.8	7.67	Minegrid
Hardness CaCO3	-	-	-	-	210	-	-	Northing Easting
Conductivity (umhos/cm)	585	512	521	529	459	408	398	101060 98505
Total Suspended Solids	-	-	-	-	-	-	-	UTM ZONE 10
Total Dissolved Solids	-	-	-	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	2.47	3.17	4.12	1.36	1.44	2.33	2.15	5531876 323093
Alkalinity - Total CaCO3	92.2	81.4	81.5	66.5	55.2	52.6	50.7	
Ammonia Nitrogen	-	-	-	-	-	-	-	
Nitrate - Nitrite as N	-	-	-	-	-	-	-	20 tonne Bulk
Kjeldahl Nitrogen	-	-	-	-	-	-	-	Sample Pit in 3
Dissolved Phosphate	-	-	-	-	-	-	-	Seam above 4
Total Phosphate	-	-	-	-	-	-	-	South Mine
Sulphate	191	169	191	190	168	146	140	

Parameter / Sample Date	February				March			Site Description
	4	12	19	25	11	19	26	
Conductivity (umhos/cm)	PNC	-	-	-	-	-	-	Minegrid
Field Conductivity (uS/cm)	480	382.3	440	467	647	671	645	Northing Easting
Hardness CaCO3	257	-	-	-	-	-	-	101060 98505
pH	PNC	-	-	-	-	-	-	UTM ZONE 10
Field pH	7.54	6.7	7.34	7.75	7.17	7.08	7.45	Northing Easting
Acidity (to pH 8.3)	-	-	-	-	-	-	-	5531876 323093
Alkalinity - Total CaCO3	94.5	-	-	-	-	-	-	20 tonne Bulk
Dissolved Phosphate	-	-	-	-	-	-	-	Sample Pit in 3
Total Phosphate	-	-	-	-	-	-	-	Seam above 4
Sulphate	189	-	-	-	-	-	-	South Mine

Results expressed in milligrams per litre except where noted.
* Field Replicate Sample.

TABLE 50

3 SOUTH-77 METALS ANALYSIS

2012/2013 EMS ID: E292128

COMPANY IDENTITY - 3S77

Parameter	April		June	July	
Sample Date	2	30	5	3	31
Total Metals					
Aluminum	0.004	0.0033	0.0063	0.0389	0.0394
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0003	0.00048	0.00072	0.0006	0.00103
Barium	0.013	0.0175	0.017	0.0159	0.0172
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.08	0.097	0.108	0.122	0.116
Cadmium	<0.00001	<0.000010	0.000024	<0.000010	<0.000010
Calcium	79.4	94.4	96.1	78.9	83.6
Chromium	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Copper	0.0004	0.00036	0.00034	0.00066	0.00071
Iron	0.018	0.0234	0.0424	0.262	0.145
Hardness	-	-	-	-	-
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	10.3	13	12.9	10.4	11.6
Manganese	0.004	0.0081	0.0114	0.009	0.0367
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.001	<0.0010	<0.0010	<0.0010	0.0014
Phosphorus	-	-	-	-	-
Potassium	0.632	0.742	0.788	0.667	0.727
Selenium	<0.0001	<0.00010	0.00015	<0.00010	<0.00010
Silicon	2.6	2.93	3.08	2.89	3.32
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	6.29	7.4	8.04	7.43	8.44
Strontium	0.436	0.551	0.526	0.459	0.484
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.0050	<0.0050	<0.0050	0.0056
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals					
Aluminum	0.0059	0.0035	<0.0030	0.007	<0.0030
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00035	0.00046	0.00062	0.00053	0.00114
Barium	0.013	0.0171	0.0186	0.0156	0.0178
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.085	0.097	0.109	0.111	0.138
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium	79	94.6	96.7	81.8	87.5
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper	0.00045	0.00045	0.0005	0.00233	0.00048
Iron	0.0121	0.0188	0.0176	0.0179	0.0231
Hardness	-	-	-	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	10	12.7	12.9	11.2	11.7
Manganese	0.004	0.0095	0.0111	0.0055	0.029
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus	-	-	-	-	-
Potassium	0.602	0.745	0.819	0.693	0.785
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	2.51	2.95	3.09	3.25	3.52
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	6.04	7.34	8.31	7.97	8.96
Strontium	0.445	0.556	0.567	0.456	0.509
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre except where noted.

* Filed replicate sample.

TABLE 50

3 SOUTH-77 METALS ANALYSIS

2012/2013 EMS ID: E292128

COMPANY IDENTITY - 3S77

Parameter / Sample Date	September 4	November 5	February 4
Total Metals			
Aluminum	0.0111	0.0042	0.0196
Antimony	<0.00050	<0.00050	<0.00050
Arsenic	0.00253	0.00054	0.00055
Barium	0.019	0.0146	0.0176
Beryllium	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010
Boron	0.117	0.117	0.098
Cadmium	-	<0.000010	0.000014
Calcium	89.5	68.3	81.6
Chromium	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	<0.00050
Copper	0.00047	0.00062	0.00057
Iron	0.213	0.0108	0.0689
Hardness	-	-	253
Lead	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050
Magnesium	11.8	9.55	11.9
Manganese	0.119	0.0085	0.0028
Mercury	<0.000010	<0.000010	<0.00002
Molybdenum	<0.0010	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	<0.0010
Phosphorus	-	-	-
Potassium	0.885	0.803	0.864
Selenium	<0.00010	<0.00010	<0.00010
Silicon	4.14	2.97	2.93
Silver	<0.000020	<0.000020	<0.000020
Sodium	8.78	7.41	18.9
Strontium	0.5	0.402	0.493
Thallium	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050
Dissolved Metals			
Aluminum	<0.0030	0.0037	0.0038
Antimony	<0.00050	<0.00050	<0.00050
Arsenic	0.00271	0.00051	0.00052
Barium	0.0188	0.0146	0.0185
Beryllium	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010
Boron	0.131	0.107	0.089
Cadmium	-	<0.000010	0.000017
Calcium	92	68.6	82.9
Chromium	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	<0.00050
Copper	0.00055	0.00099	0.00053
Iron	0.0785	<0.0050	0.0103
Hardness	-	-	257
Lead	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050
Magnesium	12	9.26	12.1
Manganese	0.111	0.0081	0.0018
Mercury	<0.000010	<0.000010	<0.00002
Molybdenum	<0.0010	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	<0.0010
Phosphorus	-	-	-
Potassium	0.921	0.753	0.947
Selenium	<0.00010	<0.00010	<0.00010
Silicon	4.15	2.94	2.81
Silver	<0.000020	<0.000020	<0.000020
Sodium	9.02	7.2	19.8
Strontium	0.528	0.401	0.525
Thallium	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre except where noted.

* Filed replicate sample.

TABLE 51
MIDDLE POINT TERMINAL EFFLUENT QUALITY
2012/2013 EMS ID: E243081
COMPANY IDENTITY-MP

Parameters Date	T.S.S (mg/L)	PH (mg/L)	Oil&Grease Total - (mg/L)	Estimated Flow m3/h
2-Apr-12	<4	7.64	<1	2
09-Apr-12	<4	7.84	<1	2
16-Apr-12	<4	7.66	<1	2
23-Apr-12	<4	7.85	<1	2
30-Apr-12	<4	7.68	<1	2
07-May-12	<4	7.83	<1	2
14-May-12	<4	7.72	<1	2
22-May-12	<4	7.82	<1	2
28-May-12	<4	7.94	<1	2
04-Jun-12	<4	7.89	<1	2
11-Jun-12	<4	7.89	<1	2
26-Jun-12	9	7.90	<1	2
Note: Permitted for 50mg/L TSS, 10mg/L O&G, and 6.5-8.5 pH				

Parameter Date	T.S.S (mg/L)	PH (mg/L)	Oil&Grease Total - (mg/L)	Estimated Flow m3/h
3-Jul-12	<4	7.95	<1	2
09-Jul-12	<4	7.86	<1	2
16-Jul-12	<4	7.74	<1	2
24-Jul-12	9.8	7.92	<1	2
13-Aug-12	<4	7.92	1	2
28-Aug-12	<4	7.97	<1	2
04-Sep-12	<4	7.80	<1	2
11-Sep-12	<4	7.94	1	2
17-Sep-12	<4	7.90	<1	2
24-Sep-12	<4	7.82	<1	2
Note: Permitted for 50mg/L TSS, 10mg/L O&G, and 6.5-8.5 pH				

TABLE 51
MIDDLE POINT TERMINAL EFFLUENT QUALITY
2012/2013 EMS ID: E243081
COMPANY IDENTITY-MP

Parameter Date	T.S.S (mg/L)	PH (mg/L)	Oil&Grease Total - (mg/L)	Estimated Flow m3/h
1-Oct-12	<4	7.69	<1.0	2
8-Oct-12	<4	7.84	3.5	2
22-Oct-12	<4	7.96	1	2
29-Oct-12	<4	7.71	2.4	2
05-Nov-12	<4	7.95	<1.0	2
19-Nov-12	<4	7.76	<1.0	2
03-Dec-12	<4	7.96	<1.0	2
11-Dec-12	<4	7.96	<1.0	2
18-Dec-12	<4	7.72	<1.0	2
28-Dec-12	<4	7.77	<1.0	2
Note: Permitted for 50mg/L TSS, 10mg/L O&G, and 6.5-8.5 pH				

Parameter Date	T.S.S (mg/L)	PH (mg/L)	Oil&Grease Total - (mg/L)	Estimated Flow m3/h
3-Jan-13	<1.0	7.47	<1.0	2
8-Jan-13	<4.0	7.68	<1.0	2
14-Jan-13	<4.0	7.70	<1.0	2
21-Jan-13	<4.0	7.66	<1.0	2
28-Jan-13	<4.0	7.78	<1.0	2
04-Feb-13	<4.0	8.02	<1.0	2
11-Feb-13	<4.0	8.30	<1.0	2
17-Feb-13	<4.0	7.67	1.00	2
25-Feb-13	<4.0	7.77	<1.0	2
05-Mar-13	<4.0	7.80	<1.0	2
10-Mar-13	<4.0	7.68	<1.0	2
18-Mar-13	<4.0	7.69	<1.0	2
25-Mar-13	<4.0	7.75	<1.0	2
Note: Permitted for 50mg/L TSS, 10mg/L O&G, and 6.5-8.5 pH				

TABLE 52
UNDERGROUND 3 MAINS WATER QUALITY
2012/2013
COMPANY IDENTITY- UG3M

Stations	UG3M				
Parameters	**April**	**June**	**July**	**October**	**January**
Sample Date	**9**	**6**	**23**	**29**	**21**
Conductivity (umhos/cm)	2350	2750	2790	3030	2680
Hardness CaCO3	390	452	571	597	484
pH	7.98	8.22	8.02	8.07	8.07
Total suspended solids	-	<4.0	-	-	<4.0
Total dissolved solids	-	-	-	-	-
Acidity (to pH 8.3)	7.1	4.58	15.5	11.7	12.6
Alkalinity - Total CaCO3	393	385	382	373	383
Ammonia Nitrogen	-	-	-	-	0.0905
Nitrate and Nitrite as N	-	-	-	-	-
Dissolved Phosphate	-	-	-	-	-
Total Phosphate	-	-	-	-	-
Sulphate	885	1060	1090	1260	1050

Results are expressed in milligrams per litre except where noted.

TABLE 53
UNDERGROUND 3 MAINS METALS ANALYSIS
2012/2013
COMPANY IDENTITY-UG3M

Stations	UG3M				
Parameters	**April**	**June**	**July**	**October**	**January**
Sample Date	9	6	23	29	21
Total Metals					
Aluminum	0.036	0.0118	0.0114	0.0438	0.0252
Antimony	<0.0005	<0.00050	<0.00050	<0.0010	<0.00050
Arsenic	0.0001	0.00016	0.00027	0.00039	0.00016
Barium	0.012	0.0111	0.0139	0.0139	0.0117
Beryllium	<0.0001	<0.00010	<0.00010	<0.00020	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.0020	<0.0010
Boron	0.86	0.889	1.06	0.94	1.03
Cadmium	0.00002	<0.000010	<0.000010	<0.000025	<0.000010
Calcium	125	147	186	193	160
Chromium	<0.001	<0.0010	<0.0010	<0.0020	<0.0010
Cobalt	0.0008	0.00064	0.00052	<0.0010	0.00094
Copper	0.001	0.00277	<0.00020	0.00076	0.00038
Hardness (as CaCO3)	-	-	-	597	493
Iron	0.364	0.758	0.977	1.02	0.571
Lead	<0.0002	<0.00020	<0.00020	<0.00040	<0.00020
Lithium	0.018	0.0164	0.0206	0.02	0.0194
Magnesium	18.7	20.7	26.1	28.1	22.9
Manganese	0.153	0.224	0.229	0.223	0.16
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	<0.001	<0.0010	<0.0010	<0.0020	<0.0010
Nickel	0.002	0.0016	0.0014	<0.0020	0.0024
Phosphorus	-	-	-	-	-
Potassium	3.51	3.42	4.22	4.4	4.07
Selenium	<0.0001	<0.00010	<0.00010	<0.00020	<0.00010
Silicon	3.3	3.04	3.45	3.02	3.32
Silver	<0.00002	<0.000020	<0.000020	<0.000040	<0.000020
Sodium	391	392	489	483	443
Strontium	1.21	1.34	1.78	1.86	1.5
Thallium	<0.00005	<0.000050	<0.000050	<0.00010	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.010	<0.0050
Titanium	<0.005	<0.0050	<0.0050	<0.010	<0.0050
Uranium	<0.0001	<0.00010	<0.00010	<0.00020	<0.00010
Vanadium	<0.005	<0.0050	<0.0050	<0.010	<0.0050
Zinc	<0.005	<0.0050	<0.0050	<0.010	<0.0050
Zirconium	<0.0005	<0.00050	<0.00050	<0.0010	<0.00050
Dissolved Metals					
Aluminum	0.0074	0.0052	0.0073	0.0079	0.0093
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00019	0.00021	0.00032	0.00022	0.00015
Barium	0.0135	0.0134	0.0137	0.0128	0.0113
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.907	0.92	1.01	-	0.919
Cadmium	<0.000010	<0.000010	0.000018	<0.000010	<0.000010
Calcium	123	160	156	195	157
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00096	0.00072	0.00101	0.00061	0.00093
Copper	0.00048	0.00021	0.00044	0.0004	0.00045
Hardness (as CaCO3)	-	-	-	597	484
Iron	0.0321	0.257	0.0768	<0.0050	0.062
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0176	0.0185	0.019	0.0191	0.0208
Magnesium	18.6	23.1	23.6	27	22.7
Manganese	0.157	0.258	0.212	0.224	0.157
Mercury	<0.000010	<0.000010	<0.000010	-	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0025	0.0015	0.002	0.0016	0.0025
Phosphorus	-	-	-	-	-
Potassium	3.52	3.87	3.75	3.82	4.47
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	3.14	3.14	3.02	3.13	3.08
Silver	<0.000020	<0.000020	<0.000020	<0.000020	0.000023
Sodium	385	452	431	483	430
Strontium	1.16	1.55	1.58	1.88	1.47
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.

TABLE 54

87 PANEL WATER QUALITY

2012/2013

COMPANY IDENTITY-87 PANEL

Parameter	April				May					June
Sample Date	4	9	17	23	1	7	15	22	28	27
Conductivity (umhos/cm)	1210	1260	1330	4480	1250	1230	1270	1310	1310	2880
Hardness CaCO3	40.1	44.9	73.5	792	44.9	37.4	45.3	53.4	48.3	449
pH	8.47	8.46	8.42	8.13	8.44	8.25	8.22	8.38	8.44	8.09
Total Suspended Solids	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	716	728	788	3440	726	732	760	790	770	-
Acidity (to pH 8.3)	<0.5	<0.5	<0.5	12.6	<0.50	<0.50	<0.50	<0.50	<0.50	5.38
Alkalinity - Total CaCO3	350	355	342	313	340	343	342	337	343	209
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-
Nitrate - Nitrite as N	-	-	-	-	-	-	-	-	-	-
Sulphate	121	134	180	1860	174	158	176	202	185	1220

Parameter	July					August		September
Sample Date	3	9	16	23	30	7	13	24
Conductivity (umhos/cm)	3080	2420	3600	3330	3620	3750	3630	5050
Hardness CaCO3	470	763	393	449	218	375	345	1200
pH	7.95	7.93	7.78	7.92	8.06	8.1	8.1	7.84
Total Suspended Solids	-	-	-	-	-	-	-	39.3
Total Dissolved Solids	-	-	-	-	-	-	-	-
Acidity (to pH 8.3)	1.16	24.3	16.8	9.32	16.5	2.55	4.16	16.9
Alkalinity - Total CaCO3	241	313	405	267	406	341	353	248
Ammonia Nitrogen	-	-	-	-	-	-	-	-
Nitrate - Nitrite as N	-	-	-	-	-	-	-	-
Sulphate	1270	1070	1350	1360	1220	1360	1250	2780

Parameter	October				November			December		
Sample Date	2	16	22	29	5	19	27	3	11	19
Conductivity (umhos/cm)	5840	5940	2540	2520	2530	2520	2570	1330	1550	1580
Hardness CaCO3	1400	986	841	771	782	765	769	227	290	250
pH	7.84	7.89	7.67	7.9	7.89	7.99	8.09	8.17	8.17	8.11
Total Suspended Solids	238	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-
Acidity (to pH 8.3)	8.75	5.63	11.1	10.8	9.33	11.9	10.3	0.9	2.02	2.7
Alkalinity - Total CaCO3	266	250	270	273	275	271	238	230	226	236
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-
Nitrate - Nitrite as N	-	-	-	-	-	-	-	-	-	-
Sulphate	3580	3360	1200	1170	1150	1170	1300	416	523	523

Parameter	January			February	March
Sample Date	3	7	14	4	7
Conductivity (umhos/cm)	1650	1670	1750	1900	2030
Hardness CaCO3	268	269	281	301	333
pH	8.23	8.05	8.19	8.07	8.07
Total Suspended Solids	-	4.3	5.7	<4.0	4
Total Dissolved Solids	-	-	-	-	-
Acidity (to pH 8.3)	1.46	2.27	3.27	-	-
Alkalinity - Total CaCO3	231	225	241	236	230
Ammonia Nitrogen	-	0.0922	0.105	-	-
Nitrate - Nitrite as N	-	-	-	-	-
Sulphate	570	563	609	721	789

Results expressed in milligrams per litre except where noted

TABLE 55
87 PANEL METALS ANALYSIS
2012/2013
COMPANY IDENTITY-87 PANEL

Stations	87 Panel									
Parameters	April				May					June
Sample Date	4	9	17	23	1	7	15	22	28	27
Total Metals										
Aluminum	1.12	0.13	0.128	0.171	0.343	0.134	0.23	0.249	0.934	0.126
Antimony	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00162
Arsenic	0.0133	0.016	0.0117	0.0039	0.0156	0.0151	0.0142	0.0152	0.0139	0.0107
Barium	0.042	0.042	0.0421	0.0349	0.0361	0.035	0.0325	0.0329	0.044	0.0383
Beryllium	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	1.58	1.62	1.54	2.11	1.53	1.38	1.3	1.5	1.44	1.03
Cadmium	0.00001	0.00001	0.000037	0.000046	<0.000010	0.000013	<0.000010	<0.000010	0.00001	0.000021
Calcium	12.6	16.4	25.9	276	15	12.4	14.2	16.8	15.9	142
Chromium	0.002	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0023	<0.0010
Cobalt	0.002	0.0067	0.0171	0.0154	0.00055	<0.00050	0.00059	0.00059	0.00093	0.00211
Copper	0.0028	0.0021	0.00175	0.0084	0.00103	0.00078	0.00127	0.0012	0.00234	0.00256
Iron	0.576	0.262	0.331	0.647	0.277	0.182	0.246	0.302	0.516	0.278
Lead	<0.0002	<0.0002	<0.00020	0.00045	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00049
Lithium	0.006	0.006	0.0067	0.0169	0.0068	0.006	0.0056	0.0058	0.007	0.0123
Magnesium	0.937	1.09	1.72	19.6	1.41	1.2	1.25	1.52	1.42	8.53
Manganese	0.007	0.007	0.0145	0.115	0.0057	0.0054	0.007	0.009	0.0079	0.0253
Mercury	<0.000010	<0.000010	<0.000010	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	0.005	0.006	0.0056	0.0127	0.0028	0.0026	0.0027	0.0031	0.0035	0.0198
Nickel	0.004	0.01	0.0243	0.0419	0.0014	0.0011	0.0019	0.0021	0.0029	0.0106
Phosphorus	-	-	-	-	-	-	-	-	-	-
Potassium	2.45	2.52	2.77	9.34	2.71	2.42	2.6	2.68	2.64	4.28
Selenium	0.0009	0.0013	0.0014	0.00041	<0.00010	<0.00010	<0.00010	<0.00010	0.00037	0.00643
Silicon	3.9	3.2	3.46	2.65	3.73	2.95	3.15	3.16	3.88	2.48
Silver	<0.00002	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	248	265	272	754	270	252	244	255	264	455
Strontium	0.173	0.218	0.324	3.56	0.204	0.183	0.208	0.233	0.228	1.44
Thallium	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	0.04	<0.005	<0.0050	0.0079	<0.0050	<0.0050	0.0287	<0.0050	0.0407	<0.0050
Uranium	<0.0001	<0.0001	<0.00010	0.00065	0.00012	0.0001	0.00011	0.00014	0.00015	0.00039
Vanadium	0.006	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.005	0.0062	0.006	0.0055	<0.0050	<0.0050	<0.0050	<0.0050	0.0067
Zirconium	0.0006	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals										
Aluminum	0.029	0.0112	0.0123	0.0076	0.0134	0.0105	0.0109	0.0159	0.0165	0.0179
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	0.00178
Arsenic	0.0147	0.0154	0.0102	0.00331	0.0172	0.0154	0.0154	0.0178	0.0146	0.0122
Barium	0.0405	0.039	0.0414	0.0374	0.037	0.0327	0.0323	0.0366	0.0438	0.0427
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010
Boron	1.72	1.68	1.63	2.25	1.68	1.46	1.48	1.66	1.47	1.2
Cadmium	<0.000010	0.00001	0.000026	0.000037	<0.000010	<0.000010	<0.000010	<0.000025	<0.000010	<0.000010
Calcium	14.7	16.2	26.6	285	15.6	13	15.7	18.8	17.1	163
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010
Cobalt	0.00118	0.00606	0.016	0.0153	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	0.0021
Copper	0.00165	0.00156	0.00083	0.00275	0.00054	0.00061	0.00068	0.00073	0.00139	0.00069
Iron	0.0124	<0.0050	<0.0050	0.0089	0.0096	0.0097	0.071	0.013	0.0071	<0.0050
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00040	<0.00020	<0.00020
Lithium	0.0062	0.0056	0.0065	0.0176	0.0069	0.006	0.006	<0.010	0.0062	0.0132
Magnesium	0.851	1.05	1.73	19.5	1.44	1.18	1.46	1.57	1.39	10
Manganese	0.0046	0.0058	0.0135	0.114	0.0013	<0.0010	<0.0010	<0.0020	0.0028	0.0262
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	0.005	0.0052	0.0055	0.0131	0.0029	0.0025	0.0029	0.0032	0.0034	0.0242
Nickel	0.0032	0.0092	0.0233	0.0413	0.0011	<0.0010	<0.0010	<0.0020	0.0017	0.0115
Phosphorus	-	-	-	-	-	-	-	-	-	-
Potassium	2.47	2.47	2.76	9.1	2.78	2.48	2.78	3.17	3.01	5.33
Selenium	0.00111	0.00138	0.00166	0.00042	<0.00010	<0.00010	<0.00010	<0.00020	0.00023	0.00573
Silicon	2.84	2.88	2.94	2.83	3.21	3.05	3.12	3.6	3.12	2.86
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000040	<0.000020	<0.000020
Sodium	251	261	276	757	284	259	260	278	287	556
Strontium	0.179	0.211	0.327	3.75	0.231	0.188	0.218	0.261	0.235	1.65
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	0.0001	0.00078	0.00012	<0.00010	0.00014	<0.00020	0.00011	0.00044
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.

TABLE 55
87 PANEL METALS ANALYSIS
2012/2013
COMPANY IDENTITY-87 PANEL

Stations	87 Panel							
Parameters	July					August		September
Sample Date	3	9	16	23	30	7	13	24
Total Metals								
Aluminum	0.0098	-	0.351	3.39	0.327	0.46	0.776	0.0517
Antimony	0.00125	-	0.00021	0.00079	0.00138	<0.00063	<0.00050	<0.0010
Arsenic	0.015	-	0.00767	0.00719	0.012	0.039	0.0314	0.00484
Barium	0.0351	-	0.0462	0.0482	0.0304	0.113	0.0915	0.0277
Beryllium	<0.00010	-	<0.000050	<0.00010	<0.00010	<0.00013	<0.00010	<0.00020
Bismuth	<0.0010	-	<0.000025	<0.0010	<0.0010	<0.0013	<0.0010	<0.0020
Boron	1.32	-	0.98	2.03	0.517	1.19	0.929	1.83
Cadmium	0.000018	-	0.000049	0.000056	0.000014	0.000015	<0.000010	0.000144
Calcium	165	277	147	180	89.9	139	120	398
Chromium	<0.0010	-	0.00109	0.0063	<0.0010	<0.0013	0.0023	<0.0020
Cobalt	0.00271	-	0.00277	0.00645	0.00303	0.0028	0.00296	0.0246
Copper	0.00058	-	0.00116	0.0126	0.00672	0.00388	0.00577	0.005
Iron	0.0723	-	0.282	1.56	0.735	0.355	0.58	0.318
Lead	<0.00020	-	0.000134	0.00143	0.00302	0.0003	0.00032	<0.00040
Lithium	0.0141	-	0.0075	0.0258	<0.0050	0.0108	0.0076	0.012
Magnesium	9.62	28	10.3	9.58	6.35	9.33	9.03	27.9
Manganese	0.0362	-	0.116	0.0789	0.126	0.0436	0.0602	0.386
Mercury	<0.000010	-	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	
Molybdenum	0.0231	-	0.0164	0.0429	0.0047	0.0207	0.0129	0.008
Nickel	0.0121	-	0.012	0.0212	0.0087	0.0148	0.0128	0.0705
Phosphorus	-	-	-	-	-	-	-	-
Potassium	4.73	-	6.86	5.83	3.34	6.54	5.95	9.3
Selenium	0.00371	-	0.00134	0.0052	0.00027	0.00177	0.00101	0.0271
Silicon	2.49	-	3.68	7.98	1.56	3.53	4.12	2.46
Silver	<0.000020	-	<0.000025	<0.000020	<0.000020	<0.000025	<0.000020	<0.000040
Sodium	533	-	633	608	356	747	639	869
Strontium	1.78	-	1.71	1.96	1.1	1.9	1.64	4.26
Thallium	<0.000050	-	<0.000010	<0.000050	<0.000050	<0.000063	<0.000050	<0.00010
Tin	<0.0050	-	<0.0010	<0.0050	<0.0050	<0.0063	<0.0050	<0.010
Titanium	<0.0050	-	0.0274	0.231	<0.0050	0.0104	0.0506	<0.010
Uranium	0.00045	-	0.000264	0.0008	<0.00010	0.00031	0.00017	0.00087
Vanadium	<0.0050	-	0.0042	0.0153	<0.0050	0.0072	0.0077	<0.010
Zinc	<0.0050	-	0.00125	0.0239	0.0347	<0.0063	0.0061	<0.010
Zirconium	<0.00050	-	<0.00050	0.00135	<0.00050	<0.00063	<0.00050	<0.0010
Dissolved Metals								
Aluminum	0.0038	0.0046	0.0111	0.0071	0.0066	0.0107	0.0161	0.0072
Antimony	0.00156	<0.00050	0.00022	0.00065	<0.00050	<0.00050	<0.00050	<0.0010
Arsenic	0.0126	0.0025	0.00669	0.00442	0.00707	0.04	0.0317	0.00271
Barium	0.0383	0.0324	0.0474	0.0365	0.0243	0.111	0.0935	0.0262
Beryllium	<0.00010	<0.00010	<0.000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020
Bismuth	<0.0010	<0.0010	<0.000025	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020
Boron	1.15	1.15	1	1.93	0.484	1.2	0.994	1.93
Cadmium	<0.000020	0.000027	0.000115	0.000036	<0.000010	<0.000010	<0.000010	0.000204
Calcium	172	261	140	166	77.9	135	121	428
Chromium	<0.0010	<0.0010	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020
Cobalt	0.00324	0.00673	0.00332	0.00435	0.00139	0.00184	0.00281	0.0292
Copper	0.00092	0.00164	0.00185	0.00206	0.00059	0.00122	0.00093	0.0033
Iron	<0.0050	0.0115	0.0122	0.008	0.0132	0.0081	<0.0050	0.016
Lead	<0.00020	<0.00020	0.000084	0.00038	<0.00020	<0.00020	<0.00020	<0.00040
Lithium	0.0149	0.0105	0.0075	0.0223	<0.0050	0.0087	0.0075	0.014
Magnesium	10	27	10.2	8.45	5.7	9.1	10.1	31.7
Manganese	0.0375	0.0901	0.113	0.052	0.0542	0.039	0.0584	0.447
Mercury	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	
Molybdenum	0.0209	0.0011	0.0171	0.041	0.004	0.0192	0.014	0.0073
Nickel	0.0134	0.0161	0.0125	0.0157	0.0049	0.0125	0.0125	0.0937
Phosphorus	-	-	-	-	-	-	-	-
Potassium	5.02	4.3	6.68	4.97	3.07	6.29	6.29	9.41
Selenium	0.00279	0.00077	0.00128	0.00451	0.00023	0.002	0.00111	0.0512
Silicon	2.65	2.98	3.13	3.09	1.56	3.25	2.89	2.29
Silver	<0.000020	<0.000020	<0.000025	<0.000020	<0.000020	<0.000020	<0.000020	<0.000040
Sodium	517	291	631	562	395	718	703	1040
Strontium	1.62	2.05	1.81	1.78	0.996	1.77	1.74	4.64
Thallium	<0.000050	<0.000050	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010
Tin	<0.0050	<0.0050	<0.0010	<0.0050	<0.0050	<0.0050	<0.0050	<0.010
Titanium	<0.0050	<0.0050	0.0037	<0.0050	<0.0050	<0.0050	<0.0050	<0.010
Uranium	0.00061	0.00019	0.000299	0.00065	<0.00010	0.00028	0.00019	0.00083
Vanadium	<0.0050	<0.0050	0.0015	<0.0050	<0.0050	<0.0050	<0.0050	<0.010
Zinc	<0.0050	<0.0050	0.00247	0.0126	<0.0050	<0.0050	<0.0050	0.019
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010

Results are expressed in milligrams per litre except where noted.

TABLE 55
87 PANEL METALS ANALYSIS
2012/2013
COMPANY IDENTITY-87 PANEL

Stations	87 Panel									
Parameters	October				November			December		
Sample Date	2	16	22	29	5	19	27	3	11	19
Total Metals										
Aluminum	0.904	0.0202	0.0953	0.48	0.064	0.286	0.116	5.02	2.58	0.325
Antimony	0.001	<0.0010	<0.00050	<0.00050	<0.00050	0.00093	0.00131	0.00102	0.00141	0.00082
Arsenic	0.00472	0.00451	0.00092	0.00131	0.00035	0.00094	0.00079	0.0126	0.00599	0.00479
Barium	0.0231	0.0215	0.0235	0.0186	0.0177	0.0203	0.0201	0.0566	0.042	0.041
Beryllium	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	2.11	2.15	0.974	1.04	1.22	0.999	0.983	1.11	1.19	1.24
Cadmium	0.000212	0.000106	0.000242	0.000033	0.000077	0.000131	0.000137	0.000096	0.000129	0.000071
Calcium	481	422	306	263	253	267	262	75.4	96.8	93.3
Chromium	0.004	<0.0020	<0.0010	0.0013	<0.0010	<0.0010	<0.0010	0.0103	0.0035	<0.0010
Cobalt	0.0476	0.0276	0.0603	0.00538	0.0278	0.0642	0.0576	0.038	0.0526	0.0308
Copper	0.0185	0.00529	0.00294	0.00428	0.00188	0.00363	0.00225	0.0358	0.0254	0.00941
Iron	2.56	0.115	0.311	0.919	0.266	0.576	0.311	4.82	1.43	0.696
Lead	0.00162	<0.00040	<0.00020	0.0005	0.00034	0.00088	0.0012	0.00163	0.00135	0.00026
Lithium	<0.010	0.014	0.0109	0.0109	0.0121	0.0111	0.0107	0.0206	0.0198	0.0191
Magnesium	58.5	29.4	32.7	27.7	28.8	28.4	28.5	8.7	9.75	9.84
Manganese	2.03	0.563	0.223	0.0568	0.0555	0.0785	0.0677	0.319	0.368	0.265
Mercury	<0.000010	<0.000010	<0.000010		<0.000020	<0.000020	<0.000020	0.000043	<0.000010	<0.000010
Molybdenum	0.0034	0.0097	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0053	0.0055	0.0069
Nickel	0.114	0.0696	0.0772	0.0084	0.031	0.0727	0.0694	0.0754	0.0887	0.0607
Phosphorus	-	-	-	-	-	-	-	-	-	-
Potassium	9.08	8.39	6.29	4.16	4.68	4.91	5.19	5.14	5.29	5.67
Selenium	0.00501	0.00237	0.00083	0.00053	0.00099	0.00185	0.00217	0.00253	0.00316	0.00302
Silicon	3.82	2.03	3.39	3.71	3.33	3.31	3.42	7.92	6.57	3.16
Silver	0.000119	<0.000040	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	0.000026	<0.000020	<0.000020
Sodium	958	1090	318	301	315	317	326	214	257	269
Strontium	4.08	5.4	2.22	1.99	1.93	2.1	2.03	0.887	0.97	1.05
Thallium	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.010	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	0.023	<0.010	<0.0050	0.0143	<0.0050	0.0102	<0.0050	0.179	0.119	0.0071
Uranium	0.00075	0.00069	0.00028	0.0002	0.00019	0.00027	0.00025	0.00029	0.00023	0.00025
Vanadium	0.01	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0199	0.0068	<0.0050
Zinc	0.023	<0.010	0.0309	0.0104	0.0147	0.0235	0.0207	0.0356	0.042	0.0182
Zirconium	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00256	0.00118	<0.00050
Dissolved Metals										
Aluminum	<0.0060	0.0039	0.0201	0.0722	0.0063	0.0764	0.009	0.0514	0.0458	0.026
Antimony	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	0.00062	0.00058	0.00059	0.00053	0.00071
Arsenic	0.0016	0.00386	0.00063	0.00034	0.00037	0.00063	0.00069	0.00285	0.00267	0.00256
Barium	0.0166	0.0165	0.02	0.017	0.0186	0.0189	0.0191	0.0369	0.0375	0.0352
Beryllium	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	2.03	1.59	0.953	1.04	1.04	0.975	0.986	1.06	1.1	1.04
Cadmium	0.000086	0.000068	0.000367	0.000024	0.000056	0.000109	0.000139	0.000041	0.000107	0.000049
Calcium	462	354	288	262	269	259	261	77.9	100	85.6
Chromium	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.0477	0.0207	0.0934	0.00445	0.0255	0.0555	0.0547	0.0281	0.0442	0.0232
Copper	0.00186	0.00223	0.00262	0.00136	0.00118	0.00292	0.00141	0.00791	0.00887	0.0042
Iron	0.011	0.0125	0.0074	<0.0050	0.0085	0.133	0.0053	0.0352	0.0188	0.0191
Lead	<0.00040	<0.00020	<0.00020	<0.00020	<0.00020	0.00031	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.010	0.0107	0.0093	0.011	0.0101	0.0107	0.0108	0.0178	0.0187	0.0154
Magnesium	59.7	24.6	29.7	28.1	26.9	28.5	28.7	7.99	9.61	8.8
Manganese	1.92	0.429	0.213	0.0452	0.0563	0.126	0.0583	0.27	0.323	0.212
Mercury	<0.000010	<0.000010	<0.000010	-	<0.000020	<0.000020	<0.000020	<0.000020	<0.000010	<0.000010
Molybdenum	0.0032	0.0079	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0046	0.005	0.0055
Nickel	0.121	0.0524	0.114	0.0066	0.0288	0.0645	0.067	0.0533	0.0744	0.0464
Phosphorus	-	-	-	-	-	-	-	-	-	-
Potassium	9.53	6.82	4.79	4.17	4.76	5.01	5.29	4.77	5.56	5.03
Selenium	0.00503	0.00152	0.00109	0.0006	0.00113	0.00206	0.00225	0.00231	0.00291	0.00272
Silicon	2.76	2.07	3.09	3.05	3.15	3.6	3.39	2.99	3.15	2.81
Silver	<0.000040	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	974	813	287	307	294	320	325	209	250	246
Strontium	4.3	3.77	1.97	1.99	1.86	1.98	2.05	0.799	0.988	0.91
Thallium	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	0.023	<0.010	<0.0050	0.0143	<0.0050	0.0102	<0.0050	0.179	0.119	0.0071
Uranium	0.0006	0.00057	0.00019	0.00024	0.00019	0.00019	0.00022	0.00016	0.00021	0.0002
Vanadium	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.012	0.0067	0.049	0.0055	0.0132	0.0215	0.0169	0.01	0.0234	0.0058
Zirconium	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.

TABLE 55
87 PANEL METALS ANALYSIS
2012/2013
COMPANY IDENTITY-87 PANEL

Stations	87 Panel				
Parameters	January			February	March
Sample Date	3	7	14	4	7
Total Metals					
Aluminum	0.234	0.248	0.213	0.123	0.111
Antimony	0.00101	0.00127	<0.00050	0.00053	0.0008
Arsenic	0.00362	0.003	0.00428	0.00431	0.00514
Barium	0.0358	0.0296	0.0324	0.033	0.034
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.997	0.932	1.01	1.05	1.09
Cadmium	0.000047	0.000061	0.000062	0.000079	0.000104
Calcium	90.7	86.6	91.5	110	127
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.0245	0.0231	0.0295	0.0418	0.0479
Copper	0.00691	0.00533	0.0052	0.00496	0.00511
Hardness	263	254	267	318	364
Iron	0.347	0.337	0.361	0.403	0.668
Lead	0.00025	<0.00020	0.00021	<0.00020	<0.00020
Lithium	0.0162	0.014	0.0169	0.0144	0.0141
Magnesium	8.78	9.13	9.26	10.7	11.2
Manganese	0.162	0.162	0.164	0.185	0.193
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	0.0063	0.0063	0.007	0.0079	0.0096
Nickel	0.0511	0.0496	0.0547	0.0691	0.0734
Phosphorus	-	-	-	-	-
Potassium	5.66	4.76	5.28	5.18	5.89
Selenium	0.00271	0.0023	0.00211	0.00235	0.00201
Silicon	3.22	2.73	2.85	2.81	2.94
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	247	247	259	304	327
Strontium	0.968	0.933	1.01	1.16	1.27
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	0.0057	<0.0050	0.0064	0.0059	<0.0050
Uranium	0.0002	0.00021	0.00021	0.00023	0.00029
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.0131	0.0124	0.013	0.0161	0.017
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals					
Aluminum	0.0243	0.0174	0.0193	0.0127	0.0103
Antimony	0.00101	0.00115	<0.00050	0.00059	0.00076
Arsenic	0.00227	0.00216	0.00323	0.00229	0.00159
Barium	0.0334	0.0312	0.0337	0.0348	0.0316
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	1.14	1.02	1.1	0.96	1.06
Cadmium	0.00006	0.000038	0.000058	0.00008	0.000095
Calcium	91.6	92.2	96.2	104	115
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.0247	0.0229	0.0297	0.0389	0.047
Copper	0.00454	0.0035	0.00293	0.00255	0.00269
Hardness	268	269	281	301	333
Iron	0.0589	0.0246	0.0197	0.0132	<0.0050
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0175	0.0145	0.0161	0.0159	0.0129
Magnesium	9.44	9.38	9.89	10.2	11.3
Manganese	0.17	0.15	0.167	0.178	0.186
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.0065	0.0062	0.0077	0.0091	0.0094
Nickel	0.0519	0.0492	0.0546	0.0639	0.072
Phosphorus	-	-	-	-	-
Potassium	5.52	5.08	5.6	5.44	5.52
Selenium	0.00278	0.00276	0.00255	0.00256	0.00198
Silicon	2.63	2.77	2.77	2.78	2.7
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	253	259	279	297	330
Strontium	0.986	0.953	1.04	1.23	1.21
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	0.00023	0.00021	0.00024	0.00023	0.00026
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.0122	0.0095	0.0077	0.0105	0.0141
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.

TABLE 56
101 PANEL METALS ANALYSIS
2012/2013
COMPANY IDENTITY-101 PANEL

Parameter / Sample Date	June 6	July 23	October 29	January 21
Conductivity (umhos/cm)	1380	1410	1560	1250
Hardness CaCO3	122	119	131	124
pH	8.27	8.01	8.28	8.28
Total Suspended Solids	-	-	-	11.3
Total Dissolved Solids	-	882	-	-
Acidity (to pH 8.3)	33.5	8.26	3.63	8.13
Alkalinity - Total CaCO3	474	485	513	437
Ammonia Nitrogen	-	-	-	-
Nitrate - Nitrite as N	-	-	-	-
Sulphate	180	187	231	184

Results are expressed in milligrams per litre except where noted.

TABLE 57
101 PANEL METALS ANALYSIS
2012/2013
COMPANY IDENTITY-101 PANEL

Stations / Parameters / Sample Date	June 6	July 23	October 29	January 21
Total Metals				
Aluminum	0.0292	0.183	0.12	0.078
Antimony	<0.00050	<0.00050	<0.0020	<0.00050
Arsenic	0.0078	0.00797	0.0042	0.00748
Barium	0.0261	0.0273	0.0247	0.0273
Beryllium	<0.00010	<0.00010	<0.00040	<0.00010
Bismuth	<0.0010	<0.0010	<0.0040	<0.0010
Boron	1.34	1.44	1.14	1.46
Cadmium	0.000027	0.000016	<0.000050	<0.000010
Calcium	40.2	42	43.8	39.6
Chromium	<0.0010	<0.0010	<0.0040	<0.0010
Cobalt	0.00109	0.00607	0.0028	0.00949
Copper	0.00091	0.00408	0.0028	0.00429
Hardness (as CaCO3)	-	-	131	121
Iron	5.78	6.06	4.25	6.14
Lead	<0.00020	<0.00020	<0.00080	<0.00020
Lithium	0.009	0.0105	<0.020	0.0104
Magnesium	4.72	5.26	5.18	5.46
Manganese	0.176	0.207	0.172	0.24
Mercury	<0.000010	<0.010		<0.000010
Molybdenum	0.0014	0.0013	<0.0040	<0.0010
Nickel	0.0017	0.0103	<0.0040	0.0161
Phosphorus	-	-	-	-
Potassium	4.83	5.33	5.51	4.8
Selenium	<0.00010	<0.00010	<0.00040	<0.00010
Silicon	3.3	3.58	3.07	3.46
Silver	<0.000020	<0.000020	<0.000080	<0.000020
Sodium	259	290	277	241
Strontium	0.498	0.542	0.558	0.448
Thallium	<0.000050	<0.000050	<0.00020	<0.000050
Tin	<0.0050	<0.0050	<0.020	<0.0050
Titanium	<0.0050	<0.0050	<0.020	<0.0050
Uranium	<0.00010	<0.00010	<0.00040	<0.00010
Vanadium	<0.0050	<0.0050	<0.020	<0.0050
Zinc	<0.0050	0.0079	<0.020	0.0089
Zirconium	<0.00050	<0.00050	<0.0020	<0.00050
Dissolved Metals				
Aluminum	0.0069	0.018	0.145	0.0038
Antimony	<0.0010	<0.00050	<0.00050	<0.00050
Arsenic	0.00236	0.00283	0.0009	0.0015
Barium	0.0216	0.0198	0.0205	0.0201
Beryllium	<0.00020	<0.00010	<0.00010	<0.00010
Bismuth	<0.0020	<0.0010	<0.0010	<0.0010
Boron	1.38	1.37	1.44	1.49
Cadmium	<0.000025	<0.000010	0.000011	<0.000010
Calcium	40.9	39.3	45.4	40.8
Chromium	<0.0020	<0.0010	<0.0010	<0.0010
Cobalt	0.001	0.00581	0.00212	0.00856
Copper	0.00095	0.00036	0.00082	0.0003
Hardness (as CaCO3)	-	-	134	124
Iron	0.058	0.408	0.0371	0.0264
Lead	0.00045	<0.00020	<0.00020	<0.00020
Lithium	<0.010	0.0095	0.0095	0.0104
Magnesium	4.75	4.98	5.08	5.37
Manganese	0.175	0.19	0.17	0.223
Mercury	<0.000010	<0.000010		<0.000010
Molybdenum	<0.0020	0.0012	0.0017	<0.0010
Nickel	<0.0020	0.0097	0.0042	0.0148
Phosphorus	-	-	-	-
Potassium	5.02	5.03	5	4.69
Selenium	<0.00020	<0.00010	<0.00010	<0.00010
Silicon	3.17	3.1	3.21	3.4
Silver	<0.000040	<0.000020	<0.000020	<0.000020
Sodium	271	275	305	237
Strontium	0.506	0.501	0.581	0.439
Thallium	<0.00010	<0.000050	<0.000050	<0.000050
Tin	<0.010	<0.0050	<0.0050	<0.0050
Titanium	<0.010	<0.0050	<0.0050	<0.0050
Uranium	<0.00020	<0.00010	<0.00010	<0.00010
Vanadium	<0.010	<0.0050	<0.0050	<0.0050
Zinc	<0.010	<0.0050	<0.0050	<0.0050
Zirconium	<0.0010	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.

TABLE 58
PLANT DITCH SEEP WATER QUALITY
2012/2013
COMPANY IDENTITY - PDS

Parameter / Sample Date	April	May	June	July	Site Description GPS (m)	
					Minegrid	
					Northing	Easting
	4	1	6	4	103442	99182
Conductivity (umhos/cm)	825	1680	1800	1380	UTM ZONE 10	
Hardness CaCO3	319	696	729	531	Northing	Easting
pH	8.1	7.93	7.9	7.91	5533844	321591
Acidity (to pH 8.3)	2	13	17.8	3.29	Lowest Elevation Below CPP Collection Ditch	
Alkalinity - Total CaCO3	133	220	241	176		
Sulphate	276	682	720	527		

Parameter / Sample Date	August	September	November	December	March	Site Description GPS (m)	
						Minegrid	
						Northing	Easting
	1	5		5	7	103442	99182
Conductivity (umhos/cm)	1910	2160	2530	-	2380	UTM ZONE 10	
Hardness CaCO3	778	912	782	1170	1180	Northing	Easting
pH	7.76	8.14	7.47	7.66	7.72	5533844	321591
Acidity (to pH 8.3)	39	13.9	30.9	24.8	-	Lowest Elevation Below CPP Collection Ditch	
Alkalinity - Total CaCO3	316	357	380	329	345		
Sulphate	720	807	1170	850	1060		

Results are expressed in milligrams per litre.
^Dry No Sample.

TABLE 59
PLANT DITCH SEEP METALS ANALYSIS
2012/2013
COMPANY IDENTITY-PDS

Parameter / Sample Date	April 4	May 1	June 6	July 4	August 1
Total Metals					
Aluminum	0.106	0.2	0.837	0.119	0.325
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0004	0.00069	0.00173	0.00063	0.001
Barium	0.008	0.0266	0.0424	0.016	0.0422
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.11	0.197	0.204	0.244	0.214
Cadmium	<0.00001	0.000011	0.000033	<0.000010	0.000033
Calcium	101	210	222	159	241
Chromium	<0.001	<0.0010	0.002	<0.0010	<0.0010
Cobalt	<0.0005	0.00064	0.00215	<0.00050	0.0011
Copper	0.0016	0.00224	0.00563	0.00232	0.00315
Iron	0.166	1.83	6.89	0.495	2.46
Hardness	-	-	-	-	-
Lead	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	16.5	41.6	42.3	32.4	42.8
Manganese	0.085	0.5	1.93	0.269	2.78
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.001	0.001	0.0022	<0.0010	0.0034
Phosphorus	-	-	-	-	-
Potassium	1.14	2.83	2.88	1.47	3.28
Selenium	<0.0001	<0.00010	0.00011	<0.00010	<0.00010
Silicon	4.1	3.82	4.42	2.37	3.81
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	45.6	130	131	97.1	168
Strontium	0.52	1.31	1.32	1.02	1.48
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	0.008	0.0115	0.0447	<0.0050	0.0171
Uranium	0.0003	0.00058	0.00048	0.00028	0.00067
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.008	<0.0050	0.0062	<0.0050	0.0085
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals					
Aluminum	0.0065	0.0046	0.0086	0.0065	0.0085
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00036	0.0004	0.00046	0.00062	0.00067
Barium	0.008	0.0239	0.0327	0.016	0.034
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.116	0.202	0.225	0.194	0.223
Cadmium	<0.000010	0.00002	<0.000010	0.000011	<0.000010
Calcium	99.4	198	222	161	239
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	0.00084	<0.00050	0.00059
Copper	0.00155	0.00248	0.00194	0.00208	0.00145
Iron	0.0289	0.0776	0.464	0.0567	0.0904
Hardness	-	-	-	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	18.3	39.9	42.2	31.3	42.3
Manganese	0.0944	0.409	1.86	0.289	2.5
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus	-	-	-	-	-
Potassium	1.33	2.68	2.86	1.57	3.3
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	3.95	2.98	3.15	2.42	3.31
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	52.3	121	131	93.9	167
Strontium	0.564	1.25	1.3	0.94	1.46
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	0.00029	0.00055	0.00046	0.0003	0.00066
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.0079	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.
^ = Dry, no sample

TABLE 59
PLANT DITCH SEEP METALS ANALYSIS
2012/2013
COMPANY IDENTITY-PDS

Parameter / Sample Date	September 5	November 6	December 11	March 7
Total Metals				
Aluminum	0.0182	0.0116	-	0.0179
Antimony	<0.00050	<0.00050	-	<0.00050
Arsenic	0.00038	0.00059	-	0.00041
Barium	0.0354	0.0262	-	0.0216
Beryllium	<0.00010	<0.00010	-	<0.00010
Bismuth	<0.0010	<0.0010	-	<0.0010
Boron	0.216	0.533	-	0.45
Cadmium	0.000013	<0.000025	-	<0.000013
Calcium	285	421	-	399
Chromium	<0.0010	<0.0010	-	<0.0010
Cobalt	0.00082	0.00069	-	0.00051
Copper	0.00102	0.00034	-	0.00307
Iron	0.797	3.44	-	3.81
Hardness	-	-	-	1250
Lead	<0.00020	<0.00020	-	<0.00020
Lithium	<0.0050	<0.0050	-	<0.0050
Magnesium	48.6	66.6	-	62
Manganese	1.67	2.58	-	1.49
Mercury	<0.000020	<0.000020	-	<0.000010
Molybdenum	<0.0010	<0.0010	-	<0.0010
Nickel	0.0015	<0.0010	-	<0.0010
Phosphorus	-	-	-	-
Potassium	3.62	4.24	-	3.31
Selenium	0.00013	<0.00010	-	<0.00010
Silicon	6.29	5.06	-	4.84
Silver	<0.000020	<0.000020	-	<0.000020
Sodium	181	132	-	105
Strontium	1.72	3.01	-	2.78
Thallium	<0.000050	<0.000050	-	<0.000050
Tin	<0.0050	<0.0050	-	<0.0050
Titanium	<0.0050	<0.0050	-	<0.0050
Uranium	0.00092	0.00023	-	0.00018
Vanadium	<0.0050	<0.0050	-	<0.0050
Zinc	<0.0050	<0.0050	-	<0.0050
Zirconium	<0.00050	<0.00050	-	<0.00050
Dissolved Metals				
Aluminum	<0.0030	<0.0030	0.0062	<0.0030
Antimony	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00037	0.00028	0.00058	0.00029
Barium	0.0316	0.0153	0.0205	0.0183
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.22	0.334	0.51	0.444
Cadmium	<0.000010	<0.000025	<0.000010	<0.000010
Calcium	266	247	378	376
Chromium	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	0.00054	<0.00050
Copper	0.00089	0.00045	<0.00020	0.00085
Iron	0.0221	0.0531	0.362	0.0669
Hardness	-	-	-	1180
Lead	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	47.5	40.1	55.2	58.2
Manganese	1.42	1.51	1.51	0.772
Mercury	<0.000020	<0.000020	<0.000010	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0014	<0.0010	<0.0010	<0.0010
Phosphorus	-	-	-	-
Potassium	3.45	2.49	3.28	2.88
Selenium	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	5.65	2.78	5.34	4.81
Silver	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	177	78.4	104	98.6
Strontium	1.63	1.7	2.33	2.51
Thallium	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	-	<0.0050
Uranium	0.00086	0.00012	0.00018	0.00016
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.
^ = Dry, no sample

TABLE 60
PLANT DITCH SEEP_ROAD WATER QUALITY
2012/2013
COMPANY IDENTITY- PDSR

Parameter / Sample Date	April 3	May 1	July 4	November 6	December 11	January 1	Site Description	
							GPS (m)	
							Minegrid	
							Northing	Easting
Conductivity (umhos/cm)	977	1890	1760	1700	-	-	103655	99061
Hardness CaCO3	419	897	837	804	662	600	UTM ZONE 10	
pH	8.1	8.11	8.32	8.07	7.84	8.01	Northing	Easting
Acidity (to pH 8.3)	1.8	8.55	0.95	7.26	2.04	1.03	5533875	321348
Alkalinity - Total CaCO3	126	231	244	227	162	164	In Old Natural Drainage Below Clean Coal Stockpile	
Phosphorous-Dissolved	-	-	-	-	-	-		
Phosphorous-Total	-	-	-	-	-	-		
Sulphate	366	851	740	726	550	531		

Results are expressed in milligrams per litre.
^ = Dry, no sample

TABLE 61
PLANT DITCH SEEP ROAD METALS ANALYSIS
2012/2013
COMPANY IDENTITY-PDSR

Parameters	April	May	July	November	December	January
Sample Date	3	1	4	6	11	2
Total Metals						
Aluminum	0.037	0.0106	0.0157	0.0121	-	0.0152
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	-	<0.00050
Arsenic	<0.0001	0.00013	0.00024	<0.00010	-	<0.00010
Barium	0.013	0.0275	0.0286	0.0292	-	0.0176
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	-	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	-	<0.0010
Boron	0.15	0.372	0.441	0.371	-	0.208
Cadmium	<0.00001	<0.000010	0.000017	<0.000025	-	<0.000010
Calcium	131	281	264	254	-	184
Chromium	<0.001	<0.0010	<0.0010	<0.0010	-	<0.0010
Cobalt	<0.0005	<0.00050	<0.00050	<0.00050	-	<0.00050
Copper	0.0006	0.0004	0.00079	0.00066	-	0.00053
Hardness	-	-	-	-	-	594
Iron	0.036	0.0056	0.0137	0.0111	-	0.0282
Lead	<0.0002	<0.00020	<0.00020	<0.00020	-	<0.00020
Lithium	<0.005	<0.0050	<0.0050	<0.0050	-	<0.0050
Magnesium	22.7	47.4	43.2	41.5	-	32.8
Manganese	<0.001	<0.0010	<0.0010	<0.0010	-	0.0012
Mercury	<0.000010	<0.000010	<0.000010	<0.000020	-	<0.000010
Molybdenum	<0.001	<0.0010	<0.0010	<0.0010	-	<0.0010
Nickel	<0.001	<0.0010	<0.0010	0.0015	-	<0.0010
Phosphorus	-	-	-	-	-	-
Potassium	1.26	2.53	2.29	2.37	-	1.63
Selenium	<0.0001	<0.00010	0.00015	<0.00010	-	<0.00010
Silicon	3	3.59	4.03	3.93	-	3.13
Silver	<0.00002	<0.000020	<0.000020	<0.000020	-	<0.000020
Sodium	46.5	89.6	87.7	88.4	-	63.3
Strontium	0.786	1.97	1.75	1.67	-	1.15
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	-	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.0050	-	<0.0050
Titanium	<0.005	<0.0050	<0.0050	<0.0050	-	<0.0050
Uranium	0.0002	0.00083	0.00071	0.00079	-	0.00045
Vanadium	<0.005	<0.0050	<0.0050	<0.0050	-	<0.0050
Zinc	<0.005	<0.0050	<0.0050	<0.0050	-	<0.0050
Zirconium	<0.0005	<0.00050	<0.00050	<0.00050	-	<0.00050
Dissolved Metals						
Aluminum	0.0128	0.0105	0.0093	0.0074	0.0146	0.0074
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0002	<0.00010	0.00017	0.00012	0.00023	0.00013
Barium	0.0133	0.0287	0.027	0.0287	0.0195	0.0176
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.161	0.369	0.393	0.395	0.295	0.198
Cadmium	<0.000010	0.000025	0.000015	<0.000025	<0.000010	<0.000010
Calcium	127	277	254	255	212	187
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper	0.0006	0.00064	0.00153	0.00075	0.0005	0.00124
Hardness	-	-	-	-	-	600
Iron	0.0074	0.0105	0.0113	0.0054	<0.0050	0.0058
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	22.6	47.1	41.3	40.9	32.4	32.1
Manganese	<0.0010	0.0014	<0.0010	<0.0010	0.0041	<0.0010
Mercury	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010	<0.000010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	0.002	<0.0010
Phosphorus	-	-	-	-	-	-
Potassium	1.31	2.45	2.15	2.4	1.96	1.61
Selenium	0.0001	0.0001	<0.00010	<0.00010	0.0001	<0.00010
Silicon	3.24	3.38	3.98	3.75	3.66	3.34
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	46.3	86.9	83.9	89.1	75.3	63
Strontium	0.794	2.01	1.63	1.65	1.25	1.14
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050
Uranium	0.00023	0.00076	0.0007	0.00071	0.00045	0.00037
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.
^ = Dry, no sample

TABLE 62
2 SOUTH PIT WATER QUALITY
2012/2013 EMS ID: E292127
COMPANY IDENTITY-2S

Parameter	2SW			2SC			2SE		
Sample Date	02-Apr	30-Apr	05-Jun	02-Apr	30-Apr	05-Jun	02-Apr	30-Apr	05-Jun
Conductivity (umhos/cm)	1300	1310	651	1220	1320	1040	1340	1210	1380
Hardness (as CaCO3)	767	681	336	705	715	493	784	623	702
pH	7.53	7.18	6.35	7.47	7.63	7.55	5.07	7.72	7.87
Acidity(pH=8.3)	4.2	7.38	3.85	9.8	7.67	3.31	17.2	7.23	2.04
Alkalinity-Total CaCO3	45.3	25.5	2.23	69.8	81.3	36.8	<0.50	76.8	76.9
Sulphate	694	695	274	603	647	539	787	575	673

Parameter	2S				
	November		December		
Sample Date	20	27	4	11	18
pH	7.74	7.94	7.83	7.88	7.8
Hardness (as CaCO3)	476	533	348	619	
Conductivity (umhos/cm)	1030	1280	819	2100	1550
Total Suspended Solids	39.2	<4.0	13.3	-	-
Total Dissolved Solids	760	952	576	-	-
Acidity(pH=8.3)	2.45	2.29	0.65	3.85	4.85
Alkalinity-Total CaCO3	62.1	88.4	57.7	176	144
Nitrate + Nitrite	0.071	-	0.038	-	-
N-TKN	0.07	-	0.101	-	-
Dissolved Phosphorous	<0.0050	<0.0050	<0.0050	<0.0050	-
Total Phosphorous	0.0262	<0.0050	0.0124	-	-
Sulphate	472	664	335	979	693

Parameter	2S										
	January			February				March			
Sample Date	8	16	22	4	12	19	25	5	11	19	26
Conductivity (umhos/cm)	918	1670	1890	-	-	-	-	702	-	-	-
Field Conductivity (uS/cm)	-	-	-	668	735	814	478	-	1293	1281	1446
Hardness (as CaCO3)	-	-	-	320	-	-	-	306	-	-	-
pH	7.85	7.90	8.13	-	-	-	-	7.91	-	-	-
Field pH	-	-	-	7.65	7.47	7.64	7.75	-	7.21	7.18	7.8
Total Suspended Solids	48.5	4	<4.0	-	-	-	-	-	-	-	-
Alkalinity-Total CaCO3	84	148	179	65.5	-	-	-	73.6	-	-	-
Total Phosphorous	-	-	-	<0.00020	-	-	-	<0.00020	-	-	-
Sulphate	362	742	802	280	-	-	-	272	-	-	-

2SW = 2 South West
2SC = 2 South Center
2SE = 2 South East
2S = 2 South Pag Disposal
Results expressed as milligram per litre

TABLE 63
2 SOUTH PIT METALS ANALYSIS
2012/2013 EMS ID: E292127
COMPNAY IDENTITY-2SW/2SC/2SE

Sample Site	2SW			2SC			2SE		
Parameter	**02-Apr**	**30-Apr**	**05-Jun**	**02-Apr**	**30-Apr**	**05-Jun**	**02-Apr**	**30-Apr**	**05-Jun**
Total Metals									
Aluminum	0.091	3.12	0.057	0.024	0.0294	0.106	4.9	0.411	0.196
Antimony	<0.0005	<0.00050	<0.00050	<0.0005	<0.00050	<0.00050	<0.0005	<0.00050	<0.00050
Arsenic	0.0001	0.00281	<0.00010	<0.0001	0.00013	0.00034	0.0004	0.00159	0.00174
Barium	0.011	0.0324	0.0212	0.01	0.0124	0.0205	0.011	0.013	0.0153
Beryllium	<0.0001	<0.00010	<0.00010	<0.0001	<0.00010	<0.00010	0.0004	<0.00010	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.001	<0.0010	<0.0010	<0.001	<0.0010	<0.0010
Boron	0.17	0.173	0.063	0.16	0.217	0.124	0.16	0.218	0.292
Cadmium	0.00013	0.000264	0.000119	0.00008	0.000095	0.000071	0.00045	0.000102	0.000069
Calcium	273	238	121	249	252	176	274	218	248
Chromium	<0.001	0.0073	<0.0010	<0.001	<0.0010	<0.0010	<0.001	<0.0010	<0.0010
Cobalt	0.0073	0.015	0.011	<0.0005	<0.00050	0.00252	0.0456	0.0123	0.0106
Copper	0.0027	0.0182	0.00398	0.0005	0.00048	0.00177	0.0558	0.00347	0.00321
Iron	1.15	6.93	1.61	0.03	0.0599	0.248	0.162	0.0803	0.121
Lead	<0.0002	0.0013	<0.00020	<0.0002	<0.00020	<0.00020	<0.0002	<0.00020	<0.00020
Lithium	0.007	0.0091	<0.0050	0.009	0.0097	<0.0050	0.031	0.0099	0.0071
Magnesium	20.7	21.3	8.33	20	20.9	12.7	24	19.5	20.1
Manganese	0.209	1.04	0.289	0.019	0.0563	0.198	1.26	0.553	0.686
Mercury	<0.000010	<0.000010	<0.010	<0.000010	<0.000010	<0.010	<0.000010	<0.000010	<0.010
Molybdenum	<0.001	<0.0010	<0.0010	<0.001	<0.0010	<0.0010	<0.001	0.001	<0.0010
Nickel	0.019	0.0369	0.0153	0.012	0.0118	0.0104	0.082	0.0212	0.0187
Phosphorous	-	-	-	-	-	-	-	-	-
Potassium	1.37	2.16	1.51	1.03	1.19	1.74	0.964	1.16	1.55
Selenium	0.0005	0.00045	0.0015	0.0002	0.00012	0.00044	0.0003	0.00027	0.00039
Silicon	3.6	8.34	1.74	4	4.42	2.79	9.2	4.19	3.53
Silver	<0.00002	0.000042	<0.000020	<0.00002	<0.000020	0.000022	<0.00002	<0.000020	<0.000020
Sodium	10.3	13.3	2.01	9.05	12.5	9.65	11.3	16.1	19.1
Strontium	0.996	0.924	0.355	0.893	0.994	0.615	1.03	1	1.24
Thallium	<0.00005	0.000057	<0.000050	<0.00005	<0.000050	<0.000050	<0.00005	<0.000050	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.005	<0.0050	<0.0050	<0.005	<0.0050	<0.0050
Titanium	<0.005	0.129	<0.0050	<0.005	<0.0050	<0.0050	<0.005	<0.0050	<0.0050
Uranium	<0.0001	<0.00010	<0.00010	<0.0001	<0.00010	<0.00010	0.0001	<0.00010	<0.00010
Vanadium	<0.005	0.013	<0.0050	<0.005	<0.0050	<0.0050	<0.005	<0.0050	<0.0050
Zinc	0.075	0.0444	0.0601	0.015	0.0164	0.0144	0.14	0.0263	0.0185
Zirconium	<0.0005	0.00066	<0.00050	<0.0005	<0.00050	<0.00050	<0.0005	<0.00050	<0.00050
Dissolved Metals									
Aluminum	0.0054	0.0098	0.0098	0.0156	0.0128	0.0187	2.66	0.0587	0.0295
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	<0.00010	<0.00010	<0.00010	0.0003	0.00014	<0.00010	0.00044	0.00139	0.00168
Barium	0.0119	0.0215	0.0223	0.0098	0.0121	0.0229	0.0103	0.0138	0.0155
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00029	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.179	0.174	0.062	0.152	0.196	0.143	0.144	0.198	0.278
Cadmium	0.000135	0.000282	0.000128	0.000058	0.000091	0.000063	0.00047	0.00012	0.000072
Calcium	256	236	111	230	250	177	250	216	235
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00728	0.0108	0.0113	<0.00050	<0.00050	0.00253	0.0448	0.0122	0.0104
Copper	0.00086	0.00159	0.00311	0.00033	0.00045	0.00107	0.0513	0.00176	0.00217
Iron	0.224	0.0454	1.25	0.0096	0.0133	0.0051	0.0405	0.0244	0.0091
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0066	0.0052	<0.0050	0.0085	0.0097	<0.0050	0.0288	0.011	0.007
Magnesium	20.7	20.6	8.66	19.4	21.4	13.3	23.4	19.8	19.2
Manganese	0.218	0.971	0.303	0.0205	0.0591	0.206	1.27	0.571	0.725
Mercury	<0.000010	<0.000010	<0.010	<0.000010	<0.000010	<0.010	<0.000010	<0.000010	<0.010
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.001	<0.0010
Nickel	0.0194	0.032	0.0153	0.012	0.0123	0.0104	0.0785	0.0224	0.018
Phosphorous	-	-	-	-	-	-	-	-	-
Potassium	1.34	1.92	1.64	1.08	1.18	1.91	0.996	1.16	1.55
Selenium	0.00058	0.00045	0.00183	0.00024	<0.00010	0.00041	0.00036	0.00028	0.0004
Silicon	3.1	3.5	1.5	3.97	4.13	2.84	8.51	3.97	3.31
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	10.7	13.3	2.17	9.03	12	10.4	11.3	16.3	19.4
Strontium	0.964	0.931	0.37	0.861	0.982	0.673	0.949	1.03	1.24
Thallium	<0.000050	0.000051	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.0713	0.0287	0.0686	0.016	0.0193	0.013	0.139	0.0293	0.0157
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed as milligrams per litre

TABLE 63
2 SOUTH PIT METALS ANALYSIS
2012/2013 EMS ID: E292127
COMPNAY IDENTITY-2SW/2SC/2SE

	2S						
Parameter	**November**		**December**		**January**	**February**	**March**
Sample Date	20	27	4	11	2	4	5
Total Metals							
Aluminum	2.63	0.0306	1.32	1.71	0.215	0.077	0.154
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00179	0.00133	0.00112	0.00359	0.00194	0.00084	0.00057
Barium	0.033	0.0268	0.0231	0.036	0.0374	0.0246	0.0182
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.12	0.165	0.096	0.594	0.311	0.096	0.054
Cadmium	0.000093	0.000075	0.000055	0.000032	0.000035	0.000049	0.000072
Calcium	166	186	121	201	167	107	111
Chromium	0.0046	<0.0010	0.0025	0.0028	<0.0010	<0.0010	<0.0010
Cobalt	0.00486	0.00344	0.00275	0.00998	0.00736	0.00145	0.00086
Copper	0.00822	0.00118	0.00427	0.00411	0.00212	0.00112	0.00218
Hardness	-	-	-	-	489	311	330
Iron	2.2	0.0436	1.13	1.13	0.391	0.114	0.182
Lead	0.00034	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	0.0066	<0.0050	<0.0050	<0.0050
Magnesium	15	16.4	11.1	28.3	17.4	10.7	13.1
Manganese	0.209	0.171	0.153	0.498	0.253	0.051	0.0187
Mercury	<0.000020	<0.000010	<0.000020	<0.000010	<0.000010	<0.000020	<0.000010
Molybdenum	0.0017	0.0024	0.0014	0.0043	0.0036	0.0018	<0.0010
Nickel	0.0122	0.0112	0.0089	0.0287	0.0198	0.0057	0.0043
Phosphorous	0.0262	<0.0050	0.0124	-		-	-
Potassium	1.86	2.37	1.55	4.58	2.97	1.52	1.14
Selenium	0.00141	0.00143	0.00086	0.00051	0.00173	0.00104	0.00065
Silicon	6.1	3.27	4.28	4.65	2.09	2.61	3.72
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	36	68.3	33.4	261	123	22.2	7.72
Strontium	0.714	0.889	0.562	1.54	1.13	0.468	0.426
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	0.114	<0.0050	0.102	0.0826	0.0073	0.0051	0.0074
Uranium	0.00016	0.00016	0.00011	0.00051	0.00033	<0.00010	<0.00010
Vanadium	0.0078	<0.0050	<0.0050	0.0053	<0.0050	<0.0050	<0.0050
Zinc	0.0137	0.0067	0.0075	0.0063	<0.0050	0.0076	0.0088
Zirconium	0.00212	<0.00050	0.00065	0.00058	<0.00050	<0.00050	<0.00050
Dissolved Metals							
Aluminum	0.0061	0.0049	0.0096	0.0112	<0.0030	<0.0030	0.0037
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0006	0.00118	0.00053	0.00204	0.00129	0.00068	0.00042
Barium	0.0268	0.0267	0.0197	0.0321	0.0346	0.0243	0.0177
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.11	0.16	0.102	0.595	0.265	0.103	0.057
Cadmium	0.000076	0.000068	0.000041	0.000024	0.000073	0.000045	0.000067
Calcium	181	184	122	215	156	110	102
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00314	0.00329	0.00185	0.00808	0.00593	0.00133	0.00067
Copper	0.00125	0.00104	0.0035	0.0005	0.00087	0.00023	0.00114
Hardness	-	-	-	-	456	320	306
Iron	<0.0050	<0.0050	0.0053	<0.0050	0.0078	<0.0050	0.0057
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00055
Lithium	<0.0050	<0.0050	<0.0050	0.0052	<0.0050	<0.0050	<0.0050
Magnesium	15.4	15.8	10.7	25.8	15.9	11	12.3
Manganese	0.186	0.164	0.13	0.435	0.232	0.0516	0.0169
Mercury	<0.000020	<0.000010	<0.000020	<0.000010	<0.000010	<0.000020	<0.000010
Molybdenum	0.0016	0.0023	0.0014	0.004	0.0033	0.0015	<0.0010
Nickel	0.0088	0.0113	0.0062	0.0223	0.0171	0.006	0.0036
Phosphorous	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Potassium	1.85	2.37	1.41	4.54	2.84	1.59	1.08
Selenium	0.00161	0.00142	0.0006	0.00041	0.00164	0.00103	0.00066
Silicon	3.35	3.2	2.75	1.97	1.89	2.62	3.58
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	37.1	65.9	32.5	241	113	22.8	7.46
Strontium	0.716	0.871	0.516	1.53	1.03	0.465	0.413
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	0.114	<0.0050	0.102	0.0826	<0.0050	<0.0050	<0.0050
Uranium	0.0001	0.00014	<0.00010	0.00047	0.00029	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.0061	0.0053	0.0078	<0.0050	<0.0050	0.0082	0.0229
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed as milligrams per litre

TABLE 64
5 SOUTH PORTAL SUMP
2012/2013
COMPANY IDENTITY-5SP

Parameters	April				May					June			
Sample Date	2	10	17	24	1	8	15	22	29	5	12	19	26
Conductivity(UMHOS/CM)	852	1370	1080	580	436	380	376	373	351	381	372	412	438
Hardness as CaCO3	224	-	-	-	137	-	-	-	-	114	-	-	-
pH	7.99	8.18	8.22	8.05	7.9	7.97	7.96	7.93	7.97	7.84	7.73	7.79	7.79
TSS	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (pH=8.3)	2.2	<0.5	<0.5	1.24	0.85	<0.50	0.66	<0.50	<0.50	<0.50	<0.50	0.68	0.72
Alkalinity (as CaCO3)	101	166	131	81.5	70.1	60.8	63.8	61.1	50.1	46.3	41.2	40	38.2
Ammonia as Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorous-Dissolved	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorous-Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphate	297	514	379	184	126	97.1	95.9	98.9	89.9	97.4	97.1	108	123

Parameters	July					August				September			
Sample Date	3	10	17	23	31	7	14	20	28	4	11	18	25
Conductivity(UMHOS/CM)	458	505	523	547	573	623	688	717	729	730	751	796	800
Hardness as CaCO3	158	-	-	-	238	-	-	-	-	287	-	-	-
pH	7.84	7.71	7.8	7.83	7.66	7.92	8.06	8.05	8.13	8.06	8.11	7.99	7.94
TSS	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (pH=8.3)	2.64	<0.50	0.64	1.19	3.2	4.65	0.91	0.6	1.1	0.6	1.97	<0.50	1.92
Alkalinity (as CaCO3)	40	40.6	43.7	49.1	61.8	83.1	101	110	109	105	103	102	102
Ammonia as Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorous-Dissolved	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorous-Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphate	144	168	174	181	187	185	226	193	187	230	215	246	257

Parameters	October					November				December			January	
Sample Date	2	9	16	23	30	5	13	20	27	4	11	18	2	8
Conductivity(UMHOS/CM)	817	871	921	700	495	584	278	193	146	138	71.8	158	136	80.0
Hardness as CaCO3	-	354	-	-	-	243	-	-	-	-	24.7	-		
pH	7.89	7.98	3.58	4.17	5.35	5.14	6.73	6.89	7.24	7.29	7.22	7.21	6.92	6.85
TSS	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (pH=8.3)	0.89	0.86	88.9	49.1	7.54	12.6	1.21	1.64	1.72	<0.50	1.21	1	-	-
Alkalinity (as CaCO3)	101	106	<0.50	<0.50	0.73	<0.50	7.04	6.78	12.3	13.4	15	12.6	-	-
Ammonia as Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorous-Dissolved	-	-	-	-	-	-	-	-	-	-	<0.0050	-	-	-
Phosphorous-Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphate	241	262	382	285	200	233	108	74.1	15.9	41.4	13.7	51.3	-	-

Results expressed as milligram per litre except where noted

TABLE 65
5 South Protal Sump METALS ANALYSIS
2012/2013
COMPANY IDENTITY-5SP

Parameter / Sample Date	April	May	June	July		September	Parameter / Sample Date	October	November	December
	2	1	5	3	31	4		9	5	11
Total Metals							**Total Metals**			
Aluminum	0.875	0.105	0.699	3.66	0.914	0.223	Aluminum	0.559	2.24	0.601
Antimony	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	Antimony	<0.00050	<0.00050	<0.00050
Arsenic	0.0004	0.00026	0.00072	0.00198	0.00124	0.00062	Arsenic	0.00077	0.00027	0.00023
Barium	0.024	0.0216	0.0297	0.0622	0.0679	0.0807	Barium	0.106	0.0525	0.0096
Beryllium	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	Beryllium	<0.00010	0.00031	<0.00010
Bismuth	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	Bismuth	<0.0010	<0.0010	<0.0010
Boron	0.25	0.141	0.087	0.086	0.123	0.19	Boron	0.214	0.055	<0.050
Cadmium	0.00002	<0.000010	0.000024	0.000051	0.000015	-	Cadmium	0.000013	0.000821	0.000026
Calcium	75.4	45.3	37.9	52.2	78.9	95	Calcium	115	79.3	7.58
Chromium	0.001	<0.0010	<0.0010	0.0043	<0.0010	<0.0010	Chromium	<0.0010	<0.0010	<0.0010
Cobalt	0.0007	<0.00050	0.00052	0.00255	<0.00050	<0.00050	Cobalt	<0.00050	0.0563	0.00061
Copper	0.0029	0.00112	0.00269	0.0131	0.00473	0.00405	Copper	0.00579	0.093	0.00112
Iron	1.03	0.113	0.788	4.35	0.833	0.199	Iron	0.709	0.431	0.232
Lead	<0.0002	<0.00020	<0.00020	0.00068	0.0002	<0.00020	Lead	<0.00020	<0.00020	0.00056
Lithium	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	Lithium	<0.0050	0.0069	<0.0050
Magnesium	8.62	5.78	4.79	6.73	9.88	12.2	Magnesium	16.6	10.4	1.39
Manganese	0.031	0.0112	0.0221	0.0946	0.0263	0.0083	Manganese	0.0209	1.22	0.0186
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	Mercury	-	<0.000010	<0.000010
Molybdenum	<0.001	0.0014	0.0021	0.0019	0.0029	0.0029	Molybdenum	0.0031	<0.0010	<0.0010
Nickel	0.002	<0.0010	<0.0010	0.004	0.0018	<0.0010	Nickel	0.0011	0.103	0.0021
Phosphorous	-	-	-	-	-	-	Phosphorous	-	-	-
Potassium	1.49	1.34	2.64	2.65	3.26	3.88	Potassium	4.51	1.54	0.287
Selenium	0.0003	0.00017	0.00037	0.00037	0.00028	0.00021	Selenium	0.00031	0.00067	<0.00010
Silicon	4.5	4.11	2.4	6.62	2.14	0.69	Silicon	0.8	7.33	5.62
Silver	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	Silver	<0.000020	<0.000020	<0.000020
Sodium	83.5	32.8	23	20.5	23.7	28.7	Sodium	37.7	9.9	2.23
Strontium	0.508	0.258	0.169	0.236	0.366	0.455	Strontium	0.595	0.293	0.0354
Thallium	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	Thallium	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	Tin	<0.0050	<0.0050	<0.0050
Titanium	0.068	0.0057	0.0373	0.278	0.0667	0.0114	Titanium	0.0341	0.0076	0.0112
Uranium	<0.0001	<0.00010	0.0001	0.00015	0.00013	0.00023	Uranium	0.00032	0.00026	<0.00010
Vanadium	<0.005	<0.0050	<0.0050	0.0134	<0.0050	<0.0050	Vanadium	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.0050	<0.0050	0.0098	<0.0050	<0.0050	Zinc	<0.0050	0.139	<0.0050
Zirconium	<0.0005	<0.00050	<0.00050	0.00077	<0.00050	<0.00050	Zirconium	<0.00050	<0.00050	0.0006
Dissolved Metals							**Dissolved Metals**			
Aluminum	0.0126	0.0115	0.0751	0.0759	0.0324	0.0395	Aluminum	0.0198	1.73	0.0074
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	Antimony	<0.00050	<0.00050	<0.00050
Arsenic	0.00012	0.00017	0.00047	0.00054	0.00097	0.00087	Arsenic	0.00052	0.00018	<0.00010
Barium	0.0203	0.0209	0.0267	0.035	0.0624	0.0849	Barium	0.0973	0.0509	0.0043
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	Beryllium	<0.00010	0.00027	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	Bismuth	<0.0010	<0.0010	<0.0010
Boron	0.278	0.136	0.097	0.088	0.143	0.172	Boron	0.187	0.05	<0.050
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	Cadmium	<0.000010	0.000843	0.00001
Calcium	85.1	45.6	39.4	50.4	80.5	103	Calcium	116	80.8	7.62
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	Chromium	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	Cobalt	<0.00050	0.0543	0.00059
Copper	0.00038	0.00072	0.00096	0.00159	0.00198	0.00316	Copper	0.00328	0.0897	0.00035
Iron	0.0081	0.0053	<0.0050	0.008	0.0064	0.0126	Iron	0.0068	0.273	0.0125
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	Lead	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	Lithium	<0.0050	0.0069	<0.0050
Magnesium	8.51	5.69	4.65	5.74	9.23	13.5	Magnesium	15.5	10.1	1.38
Manganese	0.0154	0.0073	0.0033	0.0136	0.0019	0.0016	Manganese	<0.0010	1.17	0.0178
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	Mercury	-	<0.000010	<0.000010
Molybdenum	<0.0010	0.0014	0.0025	0.0021	0.0029	0.0033	Molybdenum	0.0027	<0.0010	<0.0010
Nickel	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	Nickel	0.0013	0.101	0.0016
Phosphorous	-	-	-	-	-	-	Phosphorous	-	-	<0.0050
Potassium	1.51	1.3	2.79	2.3	3.25	4.06	Potassium	4.49	1.55	0.245
Selenium	0.00027	0.00019	0.00044	0.0004	0.00026	0.00019	Selenium	<0.00010	0.00063	<0.00010
Silicon	3.61	3.94	1.56	1.74	0.91	0.41	Silicon	0.13	7.41	5.01
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	Silver	<0.000020	<0.000020	<0.000020
Sodium	87.2	32.1	24.2	19.6	23.4	30.8	Sodium	35.3	9.08	2.5
Strontium	0.555	0.266	0.188	0.225	0.368	0.488	Strontium	0.558	0.282	0.0313
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	Thallium	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	Tin	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	Titanium	0.0341	0.0076	0.0112
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	0.00023	Uranium	0.00027	0.00024	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	Vanadium	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	0.0222	<0.0050	<0.0050	Zinc	<0.0050	0.138	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	Zirconium	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.

TABLE 66
7 SOUTH SETTLING POND WATER QUALITY
2012/2013 EMS ID: E292069
COMPANY IDENTITY - 7SSD

Parameter / Sample Date	February			March				PERMIT	Site Description / GPS (m)	
	4	19	22	5/7	12	18	26			
Conductivity (umhos/cm)	-	-	353	310	-	407	377	**-**	**Minegrid**	
Field Conductivity (uS/cm)	860.9	185	-	-	-	360	347	**-**		
Hardness CaCO3	-	-	174	140	156	181	183	**-**	**Northing**	**Easting**
pH	-	-	7.96	7.91	-	7.80	7.98	**6 to 8**	**101360**	**101389**
Field pH	7.17	7.43	-	**-**	-	6.88	7.87	**6 to 8**	**UTM**	
Total Suspended Solids	-	-	8.00	4.30	9.80	<4.0	<4.0	**25**		
Acidity (to pH 8.3)	-	-	2.99	-	-	-	-	**-**	**5534365**	**324580**
Alkalinity - Total CaCO3	-	-	171.0	80.5	90.5	85.4	-	**-**		
Dissolved Organic Carbon	-	-	-	2.16	2.53	3.32	3.24		**7 South Surface Decant**	
Sulphate	-	-	14.5	73.7	87	112	104	**500**	**Pond Permitted Site**	
Bio Assays (%)	-	-	-	-	-	-	-	**100%**		

Results expressed in milligrams per litre except where noted.
Bold = Exceedence of permit limit.
* Field replicate sample.

TABLE 67
7 SOUTH SETTLING POND METALS ANALYSIS
2012/2013 EMS ID: E292069
COMPANY IDENTITY - 7SSD

Parameter	February	March				
Sample Date	22	5	12	18	26	**Permit**
Total Metals						
Aluminum	0.954	0.263	0.685	0.399	0.318	-
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-
Arsenic	0.00052	0.00046	0.00063	0.00069	0.00046	-
Barium	0.0165	0.0136	0.0198	0.0245	0.0181	-
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Boron	<0.050	<0.050	<0.050	<0.050	<0.050	-
Cadmium	0.000008	<0.000010	0.000036	0.000077	0.000057	-
Calcium	48.7	40.5	45.6	54.6	46.1	-
Chromium	0.0016	<0.0010	<0.0010	<0.0010	<0.0010	-
Cobalt	<0.00050	0.00078	0.001	0.00129	0.00057	-
Copper	0.00321	0.00153	0.00256	0.00368	0.00269	-
Hardness	179	146	156	185	160	-
Iron	1.2	0.33	0.991	1.17	0.362	-
Lead	<0.00020	<0.00020	0.00039	0.00036	<0.00020	-
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Magnesium	14	11	10.3	11.9	10.8	-
Manganese	0.0973	0.251	0.418	0.541	0.276	-
Mercury	<0.000020	<0.000010	<0.000010	<0.000020	0.000027	-
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Nickel	0.0012	0.0018	0.0015	0.0021	0.0014	-
Phosphorus	-	-	-	-	-	-
Potassium	0.62	0.877	1.09	1.42	1.13	-
Selenium	0.00031	0.00021	0.00026	0.00022	0.0002	-
Silicon	6.54	3.55	4.59	5.08	3.96	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	0.000023	-
Sodium	7.64	7.04	7.64	8.67	7.72	-
Strontium	0.185	0.159	0.179	0.209	0.179	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Titanium	0.0693	0.0126	0.0308	0.0195	0.018	-
Uranium	0.00037	0.00032	0.00039	0.00047	0.0004	-
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Zinc	0.0058	<0.0050	<0.0050	0.0127	<0.0050	-
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-
Dissolved Metals						
Aluminum	0.0071	0.0099	0.0127	0.0063	0.0133	**0.1**
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**
Arsenic	0.0003	0.00032	0.00037	0.00039	0.00039	**-**
Barium	0.014	0.0119	0.0166	0.0218	0.0191	**-**
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**-**
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**-**
Boron	<0.050	<0.050	<0.050	<0.050	<0.050	**-**
Cadmium	<0.0000050	<0.000010	0.000011	**0.000069 (P)**	0.000044	**0.000045**
Calcium	45.4	39.1	45.3	53.5	53	**-**
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**-**
Cobalt	<0.00050	0.00058	0.00067	0.00097	<0.00050	**-**
Copper	0.00076	0.00061	0.00063	0.00075	0.00082	**0.014**
Hardness	174	140	156	181	183	**-**
Iron	<0.0050	0.0056	0.0062	0.0453	0.0078	**0.35**
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**-**
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Magnesium	14.8	10.3	10.4	11.6	12.2	**-**
Manganese	0.079	0.234	0.424	0.525	0.31	**-**
Mercury	<0.000020	<0.000010	<0.000010	0.000044	<0.000020	**-**
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**-**
Nickel	<0.0010	0.0015	<0.0010	0.0016	0.001	**-**
Phosphorus	-	-	-	-	-	**-**
Potassium	0.61	0.853	1.06	1.39	1.32	**-**
Selenium	0.00032	0.0003	0.00024	0.00021	0.00025	**0.016**
Silicon	4.35	3.13	4.02	4.34	3.78	**-**
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	**-**
Sodium	8.17	6.73	7.73	8.56	8.88	**-**
Strontium	0.182	0.15	0.173	0.208	0.202	**-**
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	**-**
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Uranium	0.00035	0.00028	0.00037	0.00043	0.0004	**-**
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**-**
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**-**

Results expressed in milligrams per litre.
* Indicates replicate sample.

TABLE 68
WATER QUANTITY FOR 7 SOUTH SETTLING POND
2012/2013 EMS ID: E292069
COMPANY IDENTITY 7SSD

Date March	7SSD Average Daily Flow Rate (L/S)	7S *Staff Guage Reading (m)*	Allowable Dischagre Rate at 7SSD corresponding to the 7S Staff Gauge
1	**0.00000**	**-**	**-**
2	**0.00000**	**-**	**-**
3	**0.00000**	**-**	**-**
4	**0.00000**	**-**	**-**
5	**0.00000**	**-**	**-**
6	**0.00000**	**-**	**-**
7	**0.00000**	**-**	**-**
8	**0.00000**	**-**	**-**
9	**0.00000**	**-**	**-**
10	**0.00000**	**-**	**-**
11	**0.00000**	**-**	**-**
12	**0.00000**	**-**	**-**
13	**0.00000**	**-**	**-**
14	**0.00000**	**-**	**-**
15	**0.00000**	**-**	**-**
16	**0.00000**	**-**	**-**
17	**0.00000**	**-**	**-**
18	***0.371**	**0.21000**	**0.52198**
19	***0.371**	**0.20000**	**0.37173**
20	***0.521**	**0.22500**	**0.84359**
21	**0.46586**	**0.22500**	**0.84359**
22	**0.21586**	**0.21500**	**0.61484**
23	**0.17708**	**0.20000**	**0.37173**
24	**0.17245**	**0.19500**	**0.31169**
25	**0.16609**	**0.19500**	**0.31169**
26	**0.16030**	**0.20000**	**0.37173**
27	**0.06308**	**0.20000**	**0.37173**
28	**0.00000**	**-**	**-**
29	**0.00000**	**-**	**-**
30	**0.00000**	**-**	**-**
31	**0.00000**	**-**	**-**
Monthly Max.			
Monthly Avg.			

* Taken from Field note book

March 27, 2013 value was closed at 7SSD

TABLE 69
7 SOUTH SETTLING POND TSS
2012/2013 EMS ID: E292069
COMPANY IDENTITY 7SSD

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Jan-13	-	1-Feb-13	-	1-Mar-13	-
2-Jan-13	-	2-Feb-13	-	2-Mar-13	-
3-Jan-13	-	3-Feb-13	-	3-Mar-13	-
4-Jan-13	-	4-Feb-13	-	4-Mar-13	-
5-Jan-13	-	5-Feb-13	-	5-Mar-13	4.3*
6-Jan-13	-	6-Feb-13	-	6-Mar-13	-
7-Jan-13	-	7-Feb-13	-	7-Mar-13	-
8-Jan-13	-	8-Feb-13	-	8-Mar-13	-
9-Jan-13	-	9-Feb-13	-	9-Mar-13	-
10-Jan-13	-	10-Feb-13	-	10-Mar-13	-
11-Jan-13	-	11-Feb-13	-	11-Mar-13	-
12-Jan-13	-	12-Feb-13	-	12-Mar-13	9.8*
13-Jan-13	-	13-Feb-13	-	13-Mar-13	-
14-Jan-13	-	14-Feb-13	-	14-Mar-13	-
15-Jan-13	-	15-Feb-13	-	15-Mar-13	-
16-Jan-13	-	16-Feb-13	-	16-Mar-13	-
17-Jan-13	-	17-Feb-13	-	17-Mar-13	-
18-Jan-13	-	18-Feb-13	-	18-Mar-13	5.2
19-Jan-13	-	19-Feb-13	-	19-Mar-13	<4.0
20-Jan-13	-	20-Feb-13	-	20-Mar-13	20.00
21-Jan-13	-	21-Feb-13	-	21-Mar-13	<4.0
22-Jan-13	-	22-Feb-13	-	22-Mar-13	<4.0
23-Jan-13	-	23-Feb-13	-	23-Mar-13	<4.0
24-Jan-13	-	24-Feb-13	-	24-Mar-13	<4.0
25-Jan-13	-	25-Feb-13	-	25-Mar-13	<4.0
26-Jan-13	-	26-Feb-13	-	26-Mar-13	4.00
27-Jan-13	-	27-Feb-13	-	27-Mar-13	4.00
28-Jan-13	-	28-Feb-13	-	28-Mar-13	-
29-Jan-13	-		-	29-Mar-13	-
30-Jan-13	-		-	30-Mar-13	-
31-Jan-13	-		-	31-Mar-13	-
	-		-		-
Permit Limit: 25mg/L					

Note: All TSS results were from composite samples except samples marked with *

* = Grab samples.

Results are expressed in milligrams per litre.

^ = missing sample

P = Permit exceedance

TABLE 70
SULPHATE CONCENTRATIONS IN MINESITE WATER
2012/2013

Monitoring Station	April						May						June					
Sample Date	3	10	17	24	25	26	1	8	15	22	29	30	6	12	19	26	27	29
Catchment Ditch #1	342.0	-	-	-	-	-	863.0	-	-	-	-	-	889.0	-	-	-	-	-
Catchment Ditch #2	161.0	-	-	-	-	-	161.0	-	-	-	-	-	467.0	-	-	-	-	-
Quinsam Lake #1	-	-	-	-	24.0	-	-	-	-	-	-	6.7	-	-	-	-	11.6	-
Quinsam Lake #2	-	-	-	-	35.0	-	-	-	-	-	-	6.7	-	-	-	-	6.2	-
Quinsam Lake #3	-	-	-	-	27.0	-	-	-	-	-	-	7.0	-	-	-	-	5.5	-
Quinsam Lake #4	-	-	-	-	36.5	-	-	-	-	-	-	7.2	-	-	-	-	5.8	-
Quinsam Lake #5	-	-	-	-	36.9	-	-	-	-	-	-	7.3	-	-	-	-	5.7	-
Quinsam Lake #6	-	-	-	-	37.0	-	-	-	-	-	-	7.6	-	-	-	-	6.9	-
Long Lake #1	-	-	-	-	-	18.5	-	-	-	-	-	52.6	-	-	-	-	-	52.5
Long Lake #2	-	-	-	-	-	36.8	-	-	-	-	-	57.6	-	-	-	-	-	56.0
Long Lake #3	-	-	-	-	-	33.4	-	-	-	-	-	56.0	-	-	-	-	-	57.8
No Name Lake # 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.0
No Name Lake # 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.6
No Name Lake # 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.5
No Name Lake # 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.4
Long Lake Seep (LLSM)	358.0	-	-	-	-	-	489.0	-	-	-	-	-	457.0	-	-	-	-	-
SPD	210.0	235.0	278.0	250.0	-	-	232.0	258.0	284.0	266.0	262.0	-	214.0	233.0	197.0	169.0	-	-
3 South Pit	664.0	546.0	617.0	590.0	-	-	621.0	628.0	678.0	671.0	656.0	-	638.0	645.0	678.0	624.0	-	-
NNO	4.8	4.3	2.9	4.4	-	-	4.4	4.2	4.3	5.3	4.3	-	4.0	4.7	3.1	3.4	-	-
3S77	200.0	188.0	218.0	212.0	-	-	215.0	242.0	279.0	282.0	255.0	-	212.0	230.0	199.0	189.0	-	-
4S Lower	116.0	262.0	242.0	213.0	-	-	176.0	208.0	234.0	199.0	193.0	-	194.0	183.0	204.0	195.0	-	-
SPC	101.0	123.0	87.5	75.8	-	-	81.8	65.6	68.9	69.8	53.5	-	38.8	41.1	46.3	48.4	-	-
LLE	90.2	98.5	128.0	131.0	-	-	130.0	125.0	226.0	314.0	187.0	-	98.0	116.0	93.3	75.1	-	-
LLO	78.6	20.7	26.8	30.4	-	-	38.0	43.2	49.2	55.0	58.5	-	56.8	59.8	59.5	60.9	-	-
WB	49.5	49.0	48.7	35.5	-	-	21.6	19.0	15.0	10.8	8.3	-	9.1	9.0	5.9	7.3	-	-
South Dyke Pond	1350.0	1650.0	1630.0	1530.0	-	-	1530.0	1630.0	1610.0	1630.0	1550.0	-	1500.0	1480.0	1440.0	1380.0	-	-
2N-Portal Sump	811.0	900.0	955.0	880.0	-	-	867.0	985.0	964.0	1030.0	1000.0	-	1040.0	1020.0	988.0	940.0	-	-
WP	396.0	605.0	604.0	574.0	-	-	565.0	588.0	636.0	631.0	601.0	-	412.0	512.0	492.0	555.0	-	-
WD	370.0	460.0	527.0	525.0	-	-	542.0	594.0	630.0	644.0	631.0	-	635.0	711.0	647.0	670.0	-	-
WC	345.0	409.0	457.0	504.0	-	-	525.0	558.0	592.0	628.0	619.0	-	637.0	583.0	620.0	605.0	-	-
WA	<0.50	<0.50	1.4	1.3	-	-	1.2	1.5	1.6	4.0	2.2	-	1.1	1.4	0.7	0.7	-	-
QRSD1	33.3	37.3	47.5	32.5	-	-	26.9	21.0	14.8	10.8	8.7	-	8.7	8.0	6.5	9.1	-	-
7S	<0.50	0.7	1.1	0.7	-	-	0.9	0.7	0.9	-	-	-	-	-	-	<0.50	-	-
7SQR	29.5	-	-	-	-	-	25.8	-	-	-	-	-	9.1	-	-	-	-	-

Results expressed in milligrams per litre.
^ = Dry, no sample

TABLE 70
SULPHATE CONCENTRATIONS IN MINESITE WATER
2012/2013

Monitoring Station	July						August							September			
Sample Date	4	10	17	23	24	25	1	7	14	20	22	23	28	5	11	18	25
Catchment Ditch #1	756.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Catchment Ditch #2	395.0	-	-	-	-	-	912.0	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #1	-	-	-	-	-	12.5	-	-	-	-	16.1	-	-	-	-	-	-
Quinsam Lake #2	-	-	-	-	-	11.6	-	-	-	-	14.6	-	-	-	-	-	-
Quinsam Lake #3	-	-	-	-	-	11.6	-	-	-	-	15.2	-	-	-	-	-	-
Quinsam Lake #4	-	-	-	-	-	11.5	-	-	-	-	15.4	-	-	-	-	-	-
Quinsam Lake #5	-	-	-	-	-	12.1	-	-	-	-	15.5	-	-	-	-	-	-
Quinsam Lake #6	-	-	-	-	-	14.2	-	-	-	-	15.8	-	-	-	-	-	-
Long Lake #1	-	-	-	-	58.8	-	-	-	-	-	-	74.4	-	-	-	-	-
Long Lake #2	-	-	-	-	58.0	-	-	-	-	-	-	72.6	-	-	-	-	-
Long Lake #3	-	-	-	-	57.1	-	-	-	-	-	-	80.8	-	-	-	-	-
No Name Lake # 1	-	-	-	-	-	3.1	-	-	-	-	2.8	-	-	-	-	-	-
No Name Lake # 2	-	-	-	-	-	3.1	-	-	-	-	3.0	-	-	-	-	-	-
No Name Lake # 3	-	-	-	-	-	3.6	-	-	-	-	2.8	-	-	-	-	-	-
No Name Lake # 4	-	-	-	-	-	3.3	-	-	-	-	-	-	-	-	-	-	-
Long Lake Seep (LLSM)	324.0	-	-	-	-	-	523.0	-	-	-	-	-	-	503.0	-	-	-
SPD	151.0	149.0	152.0	151.0	-	-	141.0	139.0	1.2	140.0	-	-	144.0	138.0	142	154	149
3 South Pit	583	633.0	706.0	656.0	-	-	667.0	715.0	698.0	738.0	-	-	757.0	757.0	616	657	
NNO	4.4	4.0	4.6	3.6	-	-	2.9	2.7	3.3	3.1	-	-	2.9	3.7	3.28	4.51	4.16
3S77	175.0	188.0	196.0	176.0	-	-	196.0	180.0	180.0	183.0	-	-	185.0	189.0	190	194	174
4S Lower	191.0	190.0	169.0	174.0	-	-	141.0	155.0	-	-	-	-	-	-	-	-	-
SPC	36.4	57.7	54.2	43.6	-	-	-	-	-	-	-	-	-	-	-	-	-
LLE	91.3	118.0	268.0	374.0	-	-	508.0	579.0	586.0	674.0	-	-	730.0	804.0	919	941	1000
LLO	57.1	53.1	54.4	55.7	-	-	58.7	68.8	70.6	73.1	-	-	77.6	83.9	80.2	-	-
WB	10.8	9.8	10.7	13.4	-	-	19.0	14.4	14.8	15.5	-	-	14.8	12.7	12.1	11.3	12.7
South Dyke Pond	1330.0	1550.0	1660.0	1540.0	-	-	1490.0	1610.0	1590.0	1680.0	-	-	1640.0	1550.0	1590	1680	1720
2N-Portal Sump	941.0	1030.0	1140.0	1060.0	-	-	1070.0	1110.0	1110.0	1130.0	-	-	1140.0	1130.0	1110	1100	1130
WP	588.0	725.0	774.0	715.0	-	-	726.0	763.0	780.0	859.0	-	-	861.0	869.0	843	881	799
WD	635.0	694.0	682.0	643.0	-	-	696.0	656.0	689.0	712.0	-	-	736.0	732.0	733	794	835
WC	585.0	610.0	738.0	597.0	-	-	634.0	689.0	657.0	680.0	-	-	708.0	710.0	733	770	
WA	<0.50	1.5	1.8	0.8	-	-	1.4	2.2	1.5	<0.50	-	-	0.9	0.7	1.06	1.65	1.11
QRSD1	10.7	12.1	11.8	13.0	-	-	13.2	13.9	15.0	17.0	-	-	15.0	12.5	12	11.8	11
7S	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7SQR	10.3	-	-	-	-	-	12.6	-	-	16.9	-	-	-	12.9	-	-	-

Results expressed in milligrams per litre.
^ = Dry, no sample

TABLE 70
SULPHATE CONCENTRATIONS IN MINESITE WATER
2012/2013

Monitoring Station	October						November					December						
Sample Date	2	9	10	16	23	30	5	6	13	20	27	4	6	11	12	18	19	28
Catchment Ditch #1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Catchment Ditch #2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake #1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake #2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake #3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Name Lake # 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Name Lake # 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Name Lake # 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Name Lake # 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake Seep (LLSM)	-		451.0	-	-	-	-	392.0	-	-	-	-	-	-	611	-	-	-
SPD	150.0	146.0	-	142.0	144.0	110.0		136.0	39.6	122.0	33.7	252.0	-	26.9	-	46	-	28.3
3 South Pit	667	675.0	-	626.0	593.0	587.0	605.0	-	609.0	768.0	725.0	620.0	-	681	-	648	-	470
NNO	3.9	4.5	-	5.8	5.9	6.2	6.3	-	6.6	5.8	5.1	1.7	-	0.81	-	1.2	-	-
3S77	191.0	-	-	169.0	191.0	190.0	168.0	-	146.0	140.0	-	-	-	-	-	-	-	-
4S Lower	-	-	-	-	244.0	198.0	188.0	-	212.0	197.0	266.0	121.0	-	136	-	156	-	-
SPC	-	-	-	-	-	21.0	50.1	-	48.7	66.9	101.0	81.4	-	143	-	116	-	71.9
LLE	955.0	942.0	-	463.0	104.0	41.0	56.7	-	53.8	60.7	63.7	111.0	-	153	-	131	-	77.4
LLO	-	-	-	96.3	108.0	76.2	41.6	-	55.1	38.2	21.5	14.3	-	13.2	-	26.2	-	31.8
WB	12.1	14.2	-	20.4	29.1	28.3	27.7	-	32.1	29.2	29.4	35.7	-	27.4	-	37.5	-	26.2
South Dyke Sump	1720.0	-	1630.0	1650.0	1560.0	1600.0	-	1490.0	1690.0	-	1760.0	1470.0	-	1620	-	-	-	1530
2N-Portal Sump	1180.0	-	1170.0	1190.0	1200.0	1180.0	-	1170.0	1160.0	1160.0	1420.0	1120.0	-	1120	-	-	1160	987
WP	-	-	-	711.0	800.0	769.0	-	670.0	755.0	681.0	762.0	640.0	-	631	-	-	672	168
WD	849.0	-	977.0	769.0	883.0	801.0	-	441.0	431.0	536.0	580.0	487.0	538	481	-	672	-	673
WC	812.0	-	817.0	736.0	754.0	715.0	-	460.0	428.0	418.0	557.0	403.0	-	458	-	-	611	-
WA	1.1	-	23.1	1.5	1.2	1.5	-	1.2	2.3	0.5	1.2	1.3	-	2.14	-	-	2.81	-
QRSD1	12.7	-	14.2	22.2	30.1	28.2	-	23.5	33.1	27.8	27.5	31.0	-	27.8	-	-	-	-
7S	-	-	-	-	-	-	0.9	-	0.9	0.8	1.7	0.6	-		0.57	-	-	-
7SQR	-	14.0	-	-	-	-	27.1	-	-	-	-	-	-	-	25.4	-	-	-

Results expressed in milligrams per litre.
^ = Dry, no sample

TABLE 70
SULPHATE CONCENTRATIONS IN MINESITE WATER
2012/2013

Monitoring Station	January					February										March					
Sample Date	2/3	8/9	16	21/22	29	4	5	6/7/8	12	13/14	18	19	20	22/25	27	4/5/7	11	12	18/19	21	26
Catchment Ditch #1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Catchment Ditch #2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake #1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake #2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake #3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Name Lake # 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Name Lake # 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Name Lake # 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Name Lake # 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake Seep (LLSM)	543.0	-	-	-	-	464.0	-	-	-	-	-	-	-	-	-	476.0	-	-	-	-	-
SPD	17.8	18.6	16.9	22.5	12.6	10.2	7.5	10.2	5.7	12.6	3.6	-	9.9	191.0	177.0	179.0	242	-	312	-	300
3 South Pit	584	576.0	-	612.0	-	213.0	-	-	-	-	-	-	-	-	-	715.0	-	-	-	-	-
NNO	0.9	2.2	0.8	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3S77	-	-	-	-	-	189.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4S Lower	170.0	161.0	154.0	156.0	-	170.0	-	-	-	-	-	142.0	-	149.0	-	165.0	-	-	-	-	-
SPC	74.4	95.8	70.1	79.3	-	43.8	-	-	-	-	-	-	-	-	-	104.0	-	-	-	-	24.3
LLE	91.4	94.4	96.8	134.0	79.5	59.1	-	42.3	159.0	-	-	143.0	144.0	104.0	-	103.0	113	-	100	-	105
LLO	32.1	42.8	22.8	25.2	33.2	29.2	-	-	28.9	-	-	27.0	-	31.0	-	22.3	51.9	-	38.4	-	38.8
WB	35.4	28.8	28.9	29.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South Dyke Sump	1550.0	1380.0	1550.0	1560.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2N-Portal Sump	1030.0	1030.0	1060.0	1030.0	-	-	-	-	-	-	-	-	-	-	-	1050.0	-	-	-	-	-
WP	468.0	493.0	683.0	721.0	-	-	848.0	-	-	838.0	-	790.0	-	867.0	-	843.0	927	-	877	-	833
WD	682.0	642.0	641.0	651.0	699.0	-	529.0	-	478.0	-	474.0	-	-	520.0	-	591.0	668	-	672	-	488
WC	586.0	473.0	525.0	612.0	-	-	456.0	-	-	-	-	-	-	-	-	502.0	-	-	-	-	-
WA	1.8	-	2.3	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QRSD1	-	-	-	-	-	-	-	5.7	-	-	-	-	-	-	-	-	-	-	21.9	-	24.8
7S	1.1	1.6	1.1	2.5	-	-	-	1.4	-	-	-	-	-	-	-	0.9	-	1.27	3.85	6.75	-
7SSD	-	-	-	-	-	-	-	-	-	-	-	-	-	14.5	-	73.7	-	87	112	-	104
7SQR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Results expressed in milligrams per litre.
^ = Dry, no sample

TABLE 71
RAINFALL PRECIPITATION
2012/2013

DATE	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN*	FEB*	MAR*
1	1.00	2.50	0.50	0.50	0.00	5.10	0.00	0.30	3.80	0.00	0.00	2.80
2	32.00	0.50	0.50	13.50	0.00	1.30	0.30	2.00	1.30	0.00	0.00	1.80
3	9.10	2.50	0.00	7.90	0.00	0.30	2.30	2.80	0.00	1.60	2.80	0.00
4	0.80	10.90	0.50	0.30	0.00	0.00	6.90	6.30	0.00	6.80	0.80	0.00
5	1.80	0.00	0.50	0.30	0.00	0.00	33.30	0.30	0.50	7.40	5.60	1.20
6	1.30	0.00	1.00	0.00	0.00	0.00	18.50	0.00	2.80	24.10	28.80	0.00
7	0.30	0.00	5.10	0.00	0.00	0.00	6.10	0.00	0.80	3.80	0.00	2.20
8	0.30	0.00	2.00	0.00	0.00	0.00	0.00	30.00	4.30	6.80	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	3.00	13.70	7.10	1.60	1.00	0.00
10	0.00	0.50	4.10	0.00	0.00	0.00	26.40	13.00	0.00	0.00	1.20	0.00
11	1.00	0.00	3.00	0.00	0.00	0.00	0.80	7.90	3.60	0.00	1.60	16.60
12	0.00	0.00	11.20	0.00	0.00	0.00	0.50	3.60	5.60	0.00	1.80	10.00
13	0.30	0.00	0.00	0.00	0.00	0.00	6.10	1.50	0.50	1.80	6.80	7.40
14	0.30	0.00	7.40	0.00	0.00	1.50	2.00	8.60	9.90	4.20	8.20	1.20
15	0.00	0.00	1.50	0.00	0.00	0.30	11.90	0.30	13.50	0.00	0.40	0.00
16	6.10	0.00	2.00	0.00	0.00	0.30	3.80	0.30	4.10	1.00	1.40	4.40
17	0.30	0*	3.30	0.00	0.00	0.30	1.50	0.00	5.80	0.40	0.00	0.00
18	2.00	0*	1.50	0.00	0.00	0.00	4.10	0.30	4.60	0.00	10.40	0.00
19	1.00	0*	3.00	0.00	0.00	0.30	9.70	8.10	10.90	0.00	0.00	25.20
20	0.00	0*	0.00	0.50	0.30	2.50	7.40	20.60	5.30	0.00	2.00	5.00
21	2.50	5.30	0.00	0.00	0.00	0.30	4.80	15.50	1.50	0.00	1.80	2.00
22	0.80	0*	9.90	3.00	1.80	0.30	9.10	11.40	3.80	4.30	4.30	0.00
23	1.30	3.00	18.50	0.00	0.50	0.00	6.10	6.30	1.00	12.90	0.00	0.00
24	1.30	5.10	6.90	0.00	0.00	0.00	0.80	5.80	0.50	9.70	22.30	2.60
25	3.30	0.00	0.50	0.00	0.00	0.00	0.30	10.40	0.00	8.40	0.20	0.00
26	0.00	0.00	12.70	0.00	0.00	0.00	0.30	0.30	2.50	5.60	13.40	0.00
27	1.50	3.00	0.00	0.30	0.00	0.00	0.00	0.30	2.80	1.00	1.60	0.00
28	2.50	10.20	1.30	0.80	0.00	0.00	11.90	0.30	5.30	2.30	16.20	0.00
29	2.00	3.00	0.00	0.30	0.00	0.00	2.00	0.30	0.50	5.80	-	0.00
30	1.00	4.30	2.30	0.00	0.00	0.00	3.00	1.00	12.20	0.10	-	0.00
31	-	0.50	-	0.00	0.00	-	0.30	-	2.30	1.00	-	0.00
Monthly Total	**73.80**	**51.30**	**99.20**	**27.40**	**2.60**	**12.50**	**183.20**	**171.20**	**116.80**	**110.60**	**132.60**	**82.40**
Quarterly Total		**224.30**			**42.50**			**471.20**			**325.60**	

Results expressed in millimeters.
Results from April - September are augmented with data from Environment Canada at Campbell River Airport
* Results are from Environment Canada at Campbell River Airport.

TABLE 72
WATER LEVELS AND FLOWS
2012/2013

Date	LLO (old) (m)	LLO (new) (m)	LLE (mm)	7S (m)
02-Apr-12	0.35	-	150	-
10-Apr-12	0.26	-	90	-
17-Apr-12	0.20	-	60	-
24-Apr-12	0.18	-	60	-
30-Apr-12	0.17	-	50	-
08-May-12	0.15	-	40	-
15-May-12	0.10	-	30	-
22-May-12	0.06	-	30	-
29-May-12	0.09	-	30	-
05-Jun-12	0.10	-	30	-
12-Jun-12	0.10	-	30	-
19-Jun-12	0.11	-	50	-
26-Jun-12	0.16	-	50	-
03-Jul-12	0.15	-	60	-
10-Jul-12	0.14	-	40	-
17-Jul-12	0.05	-	20	-
23-Jul-12	0.02	-	10	-
31-Jul-12	0.02	-	7	-
07-Aug-12	^	-	5	-
14-Aug-12	^	-	5	-
20-Aug-12	^	-	5	-
28-Aug-12	^	-	3	-
04-Sep-12	^	-	3	-
11-Sep-12	^	-	^	-
18-Sep-12	^	-	3	-
25-Sep-12	^	-	1	-
02-Oct-12	^	-	2	-
09-Oct-12	^	-	2	-
16-Oct-12	0.1	-	10	-
23-Oct-12	0.1	-	10	-
30-Oct-12	0.23	-	95	-
05-Nov-12	0.24	-	85	-
13-Nov-12	-	-	100	-
19-Nov-12	0.45	-	200	-
27-Nov-12	0.33	-	100	0.20
04-Dec-12	0.45	-	100*	0.25
11-Dec-12	0.3	-	100	0.19
18-Dec-12	0.25	-	-	-
28-Dec-12	0.25	-	175	
02-Jan-13	0.21	-	100	0.20
08-Jan-13	0.24	165	-	-
15-Jan-13	0.22	0.26	110	0.20
21-Jan-13	0.18	0.2	90	0.20
24-Jan-13	0.21	-	85	-
04-Feb-13	0.49	-	160	-
06-Feb-13	-	-	-	0.26
12-Feb-13	0.295	0.35	155	-
25-Feb-13	0.265	0.335	142	-
04-Mar-13	0.28	-	125	0.21
11-Mar-13	0.21	0.25	70	0.22
18-Mar-13				0.21
19-Mar-13	0.245	0.31	90	0.20
21-Mar-13	-	-	-	0.22
26-Mar-13	0.21	0.26	90	0.20

^ = No Flow
* = visual assessment

TABLE 73
Quinsam River at Argonaut Bridge Flow Data
2012/2013
COMPANY IDENTITY-WA

Date	Flow(m3/s)*	Date	Flow(m3/s)*	Date	Flow(m3/s)*
1-Apr-11	1.251	**1-May-11**	3.188	**1-Jun-11**	4.366
2-Apr-11	1.374	**2-May-11**	2.981	**2-Jun-11**	4.964
3-Apr-11	2.375	**3-May-11**	2.649	**3-Jun-11**	4.658
4-Apr-11	1.707	**4-May-11**	2.441	**4-Jun-11**	4.273
5-Apr-11	1.467	**5-May-11**	2.248	**5-Jun-11**	3.860
6-Apr-11	1.410	**6-May-11**	1.980	**6-Jun-11**	3.508
7-Apr-11	1.342	**7-May-11**	1.895	**7-Jun-11**	3.287
8-Apr-11	1.287	**8-May-11**	2.326	**8-Jun-11**	3.247
9-Apr-11	1.257	**9-May-11**	2.678	**9-Jun-11**	3.065
10-Apr-11	1.244	**10-May-11**	2.833	**10-Jun-11**	3.149
11-Apr-11	1.262	**11-May-11**	2.696	**11-Jun-11**	3.273
12-Apr-11	1.502	**12-May-11**	2.800	**12-Jun-11**	3.593
13-Apr-11	1.835	**13-May-11**	3.274	**13-Jun-11**	4.491
14-Apr-11	2.044	**14-May-11**	4.188	**14-Jun-11**	4.692
15-Apr-11	2.238	**15-May-11**	5.320	**15-Jun-11**	4.395
16-Apr-11	2.625	**16-May-11**	5.872	**16-Jun-11**	4.436
17-Apr-11	3.048	**17-May-11**	5.628	**17-Jun-11**	5.146
18-Apr-11	2.904	**18-May-11**	5.188	**18-Jun-11**	4.963
19-Apr-11	2.523	**19-May-11**	4.776	**19-Jun-11**	4.469
20-Apr-11	2.199	**20-May-11**	4.482	**20-Jun-11**	4.046
21-Apr-11	1.917	**21-May-11**	4.581	**21-Jun-11**	3.751
22-Apr-11	1.938	**22-May-11**	4.979	**22-Jun-11**	3.726
23-Apr-11	2.514	**23-May-11**	4.782	**23-Jun-11**	4.669
24-Apr-11	3.714	**24-May-11**	4.537	**24-Jun-11**	5.344
25-Apr-11	4.449	**25-May-11**	4.245	**25-Jun-11**	5.287
26-Apr-11	5.104	**26-May-11**	4.320	**26-Jun-11**	4.908
27-Apr-11	4.782	**27-May-11**	4.646	**27-Jun-11**	4.363
28-Apr-11	4.091	**28-May-11**	4.694	**28-Jun-11**	3.797
29-Apr-11	3.527	**29-May-11**	4.364	**29-Jun-11**	3.357
30-Apr-11	3.223	**30-May-11**	3.991	**30-Jun-11**	3.209
		31-May-11	3.761		

Measured in flow (m3/s).
* = data from Environment Canada

TABLE 73
Quinsam River at Argonaut Bridge Flow Data
2012/2013
COMPANY IDENTITY-WA

Date	Flow(m3/s)*	Date	Flow(m3/s)*	Date	Flow(m3/s)*
1-Jul-11	2.976	**1-Aug-11**	1.165	**1-Sep-11**	1.824
2-Jul-11	2.882	**2-Aug-11**	1.154	**2-Sep-11**	1.814
3-Jul-11	3.088	**3-Aug-11**	1.150	**3-Sep-11**	1.807
4-Jul-11	3.268	**4-Aug-11**	1.152	**4-Sep-11**	1.619
5-Jul-11	3.128	**5-Aug-11**	1.147	**5-Sep-11**	1.431
6-Jul-11	2.919	**6-Aug-11**	1.146	**6-Sep-11**	1.428
7-Jul-11	2.755	**7-Aug-11**	1.147	**7-Sep-11**	1.423
8-Jul-11	2.632	**8-Aug-11**	1.149	**8-Sep-11**	1.421
9-Jul-11	2.586	**9-Aug-11**	1.071	**9-Sep-11**	1.424
10-Jul-11	2.475	**10-Aug-11**	0.952	**10-Sep-11**	1.417
11-Jul-11	2.365	**11-Aug-11**	0.936	**11-Sep-11**	1.416
12-Jul-11	2.263	**12-Aug-11**	0.935	**12-Sep-11**	1.412
13-Jul-11	2.168	**13-Aug-11**	0.935	**13-Sep-11**	1.406
14-Jul-11	2.037	**14-Aug-11**	0.935	**14-Sep-11**	1.399
15-Jul-11	1.933	**15-Aug-11**	0.913	**15-Sep-11**	1.396
16-Jul-11	1.821	**16-Aug-11**	0.910	**16-Sep-11**	1.394
17-Jul-11	1.729	**17-Aug-11**	0.899	**17-Sep-11**	1.392
18-Jul-11	1.635	**18-Aug-11**	0.891	**18-Sep-11**	1.389
19-Jul-11	1.536	**19-Aug-11**	0.890	**19-Sep-11**	1.390
20-Jul-11	1.464	**20-Aug-11**	0.881	**20-Sep-11**	1.505
21-Jul-11	1.390	**21-Aug-11**	0.886	**21-Sep-11**	1.631
22-Jul-11	1.378	**22-Aug-11**	0.883	**22-Sep-11**	1.623
23-Jul-11	1.347	**23-Aug-11**	0.876	**23-Sep-11**	1.612
24-Jul-11	1.325	**24-Aug-11**	1.238	**24-Sep-11**	1.556
25-Jul-11	1.319	**25-Aug-11**	1.561	**25-Sep-11**	1.519
26-Jul-11	1.245	**26-Aug-11**	1.560	**26-Sep-11**	1.514
27-Jul-11	1.168	**27-Aug-11**	1.557	**27-Sep-11**	1.507
28-Jul-11	1.168	**28-Aug-11**	1.693	**28-Sep-11**	1.507
29-Jul-11	1.168	**29-Aug-11**	1.857	**29-Sep-11**	1.492
30-Jul-11	1.167	**30-Aug-11**	1.843	**30-Sep-11**	1.486
31-Jul-11	1.165	**31-Aug-11**	1.834		

Measured in flow (m3/s).
* = data from Environment Canada

TABLE 73
Quinsam River at Argonaut Bridge Flow Data
2012/2013
COMPANY IDENTITY-WA

Date	Flow(m3/s)*	Date	Flow(m3/s)*	Date	Flow(m3/s)*
1-Oct-12	1.480	**1-Nov-12**	1.970	**1-Dec-12**	5.840
2-Oct-12	1.490	**2-Nov-12**	1.880	**2-Dec-12**	6.720
3-Oct-12	1.490	**3-Nov-12**	1.830	**3-Dec-12**	6.040
4-Oct-12	1.480	**4-Nov-12**	1.820	**4-Dec-12**	5.820
5-Oct-12	1.280	**5-Nov-12**	1.840	**5-Dec-12**	5.670
6-Oct-12	1.130	**6-Nov-12**	1.890	**6-Dec-12**	4.540
7-Oct-12	1.130	**7-Nov-12**	1.950	**7-Dec-12**	4.320
8-Oct-12	1.120	**8-Nov-12**	1.930	**8-Dec-12**	3.810
9-Oct-12	1.120	**9-Nov-12**	1.890	**9-Dec-12**	3.460
10-Oct-12	1.120	**10-Nov-12**	1.860	**10-Dec-12**	3.290
11-Oct-12	1.110	**11-Nov-12**	1.840	**11-Dec-12**	2.520
12-Oct-12	1.130	**12-Nov-12**	1.820	**12-Dec-12**	1.220
13-Oct-12	1.020	**13-Nov-12**	1.830	**13-Dec-12**	1.150
14-Oct-12	1.110	**14-Nov-12**	1.830	**14-Dec-12**	1.120
15-Oct-12	1.210	**15-Nov-12**	1.540	**15-Dec-12**	1.090
16-Oct-12	1.380	**16-Nov-12**	1.100	**16-Dec-12**	1.070
17-Oct-12	1.370	**17-Nov-12**	1.520	**17-Dec-12**	1.080
18-Oct-12	1.420	**18-Nov-12**	1.870	**18-Dec-12**	1.100
19-Oct-12	1.550	**19-Nov-12**	1.850	**19-Dec-12**	1.080
20-Oct-12	1.510	**20-Nov-12**	1.840	**20-Dec-12**	1.980
21-Oct-12	1.490	**21-Nov-12**	1.520	**21-Dec-12**	2.420
22-Oct-12	1.560	**22-Nov-12**	1.450	**22-Dec-12**	2.420
23-Oct-12	1.560	**23-Nov-12**	1.540	**23-Dec-12**	2.420
24-Oct-12	1.580	**24-Nov-12**	1.460	**24-Dec-12**	2.380
25-Oct-12	1.570	**25-Nov-12**	1.380	**25-Dec-12**	2.370
26-Oct-12	1.570	**26-Nov-12**	1.310	**26-Dec-12**	2.370
27-Oct-12	1.590	**27-Nov-12**	1.260	**27-Dec-12**	2.350
28-Oct-12	1.620	**28-Nov-12**	1.250	**28-Dec-12**	2.340
29-Oct-12	1.700	**29-Nov-12**	1.920	**29-Dec-12**	2.330
30-Oct-12	1.780	**30-Nov-12**	2.900	**30-Dec-12**	2.320
31-Oct-12	1.960			**31-Dec-12**	2.31

Measured in flow (m3/s).
* = data from Environment Canada

TABLE 73
Quinsam River at Argonaut Bridge Flow Data
2012/2013
COMPANY IDENTITY-WA

Date	Flow(m3/s)*	Date	Flow(m3/s)*	Date	Flow(m3/s)*
1-Jan-13	2.135	**1-Feb-13**	0.703	**1-Mar-13**	2.953
2-Jan-13	2.101	**2-Feb-13**	0.731	**2-Mar-13**	2.913
3-Jan-13	2.087	**3-Feb-13**	0.746	**3-Mar-13**	3.156
4-Jan-13	2.077	**4-Feb-13**	0.786	**4-Mar-13**	3.435
5-Jan-13	2.072	**5-Feb-13**	1.117	**5-Mar-13**	3.413
6-Jan-13	2.091	**6-Feb-13**	1.517	**6-Mar-13**	3.250
7-Jan-13	2.151	**7-Feb-13**	1.247	**7-Mar-13**	2.983
8-Jan-13	2.195	**8-Feb-13**	1.046	**8-Mar-13**	2.791
9-Jan-13	2.314	**9-Feb-13**	0.914	**9-Mar-13**	2.617
10-Jan-13	2.256	**10-Feb-13**	0.846	**10-Mar-13**	2.504
11-Jan-13	1.672	**11-Feb-13**	0.823	**11-Mar-13**	2.453
12-Jan-13	0.930	**12-Feb-13**	0.823	**12-Mar-13**	2.535
13-Jan-13	0.894	**13-Feb-13**	0.825	**13-Mar-13**	2.815
14-Jan-13	0.873	**14-Feb-13**	0.885	**14-Mar-13**	4.331
15-Jan-13	0.859	**15-Feb-13**	0.903	**15-Mar-13**	5.653
16-Jan-13	0.849	**16-Feb-13**	0.883	**16-Mar-13**	5.842
17-Jan-13	0.844	**17-Feb-13**	0.849	**17-Mar-13**	5.536
18-Jan-13	0.748	**18-Feb-13**	0.807	**18-Mar-13**	5.043
19-Jan-13	0.619	**19-Feb-13**	0.781	**19-Mar-13**	4.482
20-Jan-13	0.612	**20-Feb-13**	0.759	**20-Mar-13**	4.320
21-Jan-13	0.606	**21-Feb-13**	0.746	**21-Mar-13**	4.054
22-Jan-13	0.603	**22-Feb-13**	0.776	**22-Mar-13**	3.714
23-Jan-13	0.608	**23-Feb-13**	0.799	**23-Mar-13**	3.325
24-Jan-13	0.605	**24-Feb-13**	0.806	**24-Mar-13**	2.985
25-Jan-13	0.612	**25-Feb-13**	0.954	**25-Mar-13**	2.739
26-Jan-13	0.645	**26-Feb-13**	0.906	**26-Mar-13**	2.531
27-Jan-13	0.657	**27-Feb-13**	0.841	**27-Mar-13**	2.428
28-Jan-13	0.655	**28-Feb-13**	1.453	**28-Mar-13**	2.401
29-Jan-13	0.651	**-**	-	**29-Mar-13**	2.423
30-Jan-13	0.656	**-**	-	**30-Mar-13**	2.526
31-Jan-13	0.674	**-**	-	**31-Mar-13**	2.801

Measured in flow (m3/s).
* = data from Environment Canada

TABLE 74
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
WATER QUALITY
2012/2013

Parameter / Sample ID	WD		RPD (%)	WD		RPD (%)	WD		RPD (%)	WC		RPD (%)	WP		RPD (%)
Sample Date	17-Apr	17-Apr*		15-May	15-May*		17-Jul	17-Jul*		10-Jul	10-Jul*		7-Aug	7-Aug*	
Conductivity (umhos/cm)	1730	1740	-0.6	1850	1880	-1.6	1940	1960	-1.0	1810	1810	0.0	2050	2040	0.5
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	8.12	8.08	0.5	8.08	8.08	0.0	8.03	8.07	-0.5	8.41	8.38	0.4	8.15	8.15	0.0
Total Suspended Solids	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	4.8	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	2	2.5	[-0.5]	4.72	5.35	-12.5	10.1	7.62	**28.0**	<0.50	<0.50	NC	2.43	3.02	[-0.59]
Alkalinity-Total as CaCO3	329	330	-0.3	325	356	-9.1	370	367	0.8	284	283	0.4	275	273	0.7
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulfate	527	521	1.1	630	618	1.9	682	658	3.6	610	609	0.2	763	780	-2.2

Parameter / Sample ID	WA		RPD (%)	WB		RPD (%)	WB		RPD (%)	SPD		RPD (%)	SPD		RPD (%)
Sample Date	26-Jun	26-Jun*		2-May	2-May*		22-May	22-May*		10-Apr	10-Apr*		11-Sep	11-Sep*	
Conductivity (umhos/cm)	41.5	44.7	-7.4	117	117	0.0	76.3	77.6	-1.7	634	633	0.2	445	448	-0.7
Hardness CaCO3	-	-	-	30	30.4	-1.3	-	-	-	-	-	-	-	-	-
pH	7.42	7.66	-3.2	7.49	7.48	0.1	7.5	7.57	-0.9	7.78	7.8	-0.3	8.05	8.02	0.4
Total Suspended Solids	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	<0.50	<0.50	NC	0.66	0.81	[-0.15]	<0.50	<0.50	NC	1.1	1.1	[0]	<0.50	1.07	NC
Alkalinity-Total as CaCO3	17	17.8	-4.6	30.5	32.2	-5.4	24.9	24.9	0.0	55	55.5	-0.9	79.3	79.2	0.1
Ammonia Nitrogen	-	-	-	0.0059	<0.0050	NC	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	<0.020	<0.020	NC	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen	-	-	-	0.2	0.221	[-0.021]	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	<0.0050	<0.0050	NC	-	-	-	-	-	-	-	-	-
Total Phosphorous	-	-	-	<0.0050	<0.0050	NC	-	-	-	-	-	-	-	-	-
Sulfate	0.7	1.54	[-0.84]	20.6	21.6	-5.4	10.8	10.9	-0.9	235	229	2.6	153	142	7.5

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 74
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
WATER QUALITY
2012/2013

Parameter / Sample ID	3S		RPD (%)	2NPS		RPD (%)	2NPS		RPD (%)	NNO		RPD (%)	7S		RPD (%)
Sample Date	12-Jun	12-Jun*		8-May	8-May*		14-Aug	14-Aug*		20-Aug	20-Aug*		3-Apr	3-Apr*	
Conductivity (umhos/cm)	1300	1310	-0.8	2260	2260	0.0	2590	2580	0.4	43.9	43.3	1.4	29	29.5	-1.7
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	13.1	12.6	3.9
pH	7.88	7.93	-0.6	7.79	7.74	0.6	8.12	8.12	0.0	7.38	7.36	0.3	7.23	7.22	0.1
Total Suspended Solids	-	-	-	-	-	-	-	-	-	<4.0	<4.0	NC	<4.0	<4.0	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	1	1.21	[-0.21]	9.03	10.2	-12.2	8.69	8.58	1.3	<0.50	<0.50	NC	1.1	<0.5	NC
Alkalinity-Total as CaCO3	69.9	71.3	-2.0				315	316	-0.3	17.3	16.6	4.1	12.5	10.2	20.3
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	0.017	0.041	[-0.024]
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	0.252	0.332	[-0.08]
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	0.0063	0.0087	[-0.0024]
Dissolved Phosporous	-	-	-	-	-	-	-	-	-	-	-	-	0.021	0.0219	[-0.0009]
Total Phosphorous	-	-	-	-	-	-	-	-	-	3.09	3.07	0.6	<0.50	<0.50	NC
Sulfate	645	634	1.7	975	985	-1.0	1110	1110	0.0	-	-	-	0.084	0.084	[0]

Parameter / Sample ID	7S		RPD (%)	QRDS1		RPD (%)	QRDS1		RPD (%)	LLE		RPD (%)	3S77		RPD (%)
Sample Date	24-Apr	24-Apr*		29-May	29-May*		19-Jun	19-Jun*		25-Sep	25-Sep*		18-Sep	18-Sep*	
Conductivity (umhos/cm)	38.4	38.3	0.3	69.2	69.6	-0.6	58.8	57.4	2.4	1740	1760	-1.1	575	589	-2.4
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	7.48	7.47	0.1	7.69	7.55	1.8	7.6	7.49	1.5	7.78	7.67	1.4	7.89	7.8	1.1
Total Suspended Solids	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	-	-	-
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	0.71	0.55		<0.50	<0.50	NC	<0.50	<0.50	NC	9.42	4.11	**78.5**	2.94	3.04	-3.3
Alkalinity-Total as CaCO3	16.9	16.4	3.0	25.8	24.7	4.4	23.1	21.4	7.6	93.1	93.7	-0.6	89.7	92.3	-2.9
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphorous	0.72	<0.50	NC	-	-	-	-	-	-	-	-	-	-	-	-
Sulfate	-	-	-	9.25	8.67	6.5	5.49	6.5	-16.8	1000	941	6.1	190	194	-2.1

Results expressed in mg/L except where noted.
* Replicate Sample.
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Bolded = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 74
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
WATER QUALITY
2012/2013

Parameter / Sample ID	MQL 1m		RPD (%)	MQL 4m		RPD (%)	MQL 9m		RPD (%)	MQL B		RPD (%)	MQL 1m		RPD (%)
Sample Date	25-Apr	25-Apr*		4-Jun	4-Jun*		28-Jul	28-Jul*		25-Jul	25-Jul*		22-Aug	22-Aug*	
Conductivity (umhos/cm)	161	161	0.0	71	69.9	1.6	198	197	0.5	232	234	-0.9	99.8	99.7	0.1
Hardness CaCO3	35.1	35.1	0.0	22.8	-	NC	44	43.6	0.9	59.6	55.9	6.4	29.4	29.5	-0.3
pH	7.64	7.88	-3.1	7.52	7.5	0.3	7.82	7.66	2.1	7.52	7.24	3.8	7.84	7.84	0.0
Total Suspended Solids	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity-Total as CaCO3	39.1	37.8	3.4	24.3	25	-2.8	43	41.9	2.6	44.6	37.2	18.1	28.7	30.8	-7.1
Ammonia Nitrogen	<0.0050	-	NC	0.074	-	NC	0.01	-	NC	0.036	-	NC	0.039	-	NC
Nitrate/Nitrite as N	<0.020	-	NC	<0.020	-	NC	<0.020	-	NC	<0.020	-	NC	0.022	-	NC
Total Kjeldahl Nitrogen	0.123	-	NC	0.103	-	NC	0.097	-	NC	0.139	-	NC	0.154	-	NC
Dissolved Phosporous	<0.0050	-	NC	<0.0050	-	NC	<0.0050	-	NC	<0.0050	-	NC	<0.0050	-	NC
Total Phosphorous	0.0117	-	NC	<0.0050	-	NC	<0.0050	-	NC	<0.0050	-	NC	<0.0050	-	NC
Sulfate	30.2	33.7	-11.0	8.27	7.57	8.8	46.1	48.2	-4.5	54.4	25	**74.1**	16.2	15.4	5.1

Parameter / Sample ID	LLM 1m		RPD (%)	LLM 4m		RPD (%)	LLM 9m		RPD (%)	LLM B		RPD (%)	LLM 1m		RPD (%)
Sample Date	26-Apr	26-Apr*		4-Jun	4-Jun*		29-Jul	29-Jul*		24-Jul	24-Jul*		23-Aug	23-Aug*	
Conductivity (umhos/cm)	132	132	0.0	297	300	-1.0	404	404	0.0	402	401	0.2	236	241	-2.1
Hardness CaCO3	45.8		NC	99		NC	146		NC	137	143	-4.3	67.6	90.1	**-28.5**
pH	7.48	7.46	0.3	7.76	7.76	0.0	7.64	7.58	0.8	7.62	7.64	-0.3	7.7	7.79	-1.2
Total Suspended Solids	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	0.78	0.62	[0.16]	1.14	1.79	[-0.65]	2.74	2.97	-8.1	3.96	3.54	11.2	<0.50	0.59	NC
Alkalinity-Total as CaCO3	22.3	21.2	5.1	41.4	42	-1.4	51.6	51.1	1.0	52.9	52.2	1.3	39.6	39.6	0.0
Ammonia Nitrogen	0.017	-	NC	0.011	-	NC	0.031	-	NC	0.012	-	NC	0.017	-	NC
Nitrate/Nitrite as N	<0.020	-	NC	<0.020	-	NC	0.068	-	NC	0.078	-	NC	<0.020	-	NC
Total Kjeldahl Nitrogen	0.104	-	NC	0.128	-	NC	0.244	-	NC	0.128	-	NC	0.207	-	NC
Dissolved Phosporous	<0.0050	-	NC	<0.0050	-	NC	<0.0050	-	NC	<0.0050	-	NC	<0.0050	-	NC
Total Phosphorous	<0.0050	-	NC	<0.0050	-	NC	0.0354	-	NC	<0.0050	-	NC	<0.0050	-	NC
Sulfate	34.4	34.7	-0.9	90.5	93	-2.7	139	131	5.9	135	133	1.5	76.8	78.1	-1.7

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 74
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
WATER QUALITY
2012/2013

Parameter / Sample ID	WD		RPD (%)	WD		RPD (%)	WC		RPD (%)	WC		RPD (%)
Sample Date	27-Nov	27-Nov*		28-Dec	28-Dec*		20-Nov	20-Nov*		4-Dec	4-Dec*	
Conductivity (umhos/cm)	1810	1820	-0.6	1970	1980	-0.5	1640	1640	0.0	1490	1480	0.7
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-
pH	8.02	8.04	-0.2	8.01	8.09	-1.0	8.42	8.41	0.1	8.41	8.38	0.4
Total Suspended Solids	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	3.54	4.63	-26.7	3.55	3.77	-6.0	<0.50	1.28	NC	<0.50	<0.50	NC
Alkalinity-Total as CaCO3	370	374	-1.1	316	325	-2.8	346	347	-0.3	311	304	2.3
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-	0.047	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	<0.0050	-	<0.0050	-	-
Total Phosphorous	-	-	-	-	-	-	-		-	-	-	-
Sulfate	580	547	5.9	673	667	0.9	418	413	1.2	403	393	2.5

Parameter / Sample ID	WB		RPD (%)	WB		RPD (%)	2NPS		RPD (%)	WP		RPD (%)
Sample Date	9-Oct	9-Oct*		11-Dec	11-Dec*		23-Oct	23-Oct*		30-Oct	30-Oct*	
Conductivity (umhos/cm)	90.6	89.5	1.2	140	140	0.0	2580	2570	0.4	1940	1940	0.0
Hardness CaCO3	28.5	-	-	33.6	-	-	-	-	-	-	-	-
pH	7.62	7.64	-0.3	7.7	7.72	-0.3	7.77	7.76	0.3	8.09	8.13	-0.5
Total Suspended Solids	<4.0	<4.0	NC	<4.0	<4.0	NC	-	-	-	<4.0	<4.0	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	<0.50	0.79	NC	<0.50	<0.50	NC	11.9	12.9	-8.1	<0.50	<0.50	NC
Alkalinity-Total as CaCO3	26.2	27.2	-3.7	34.8	33.1	5.0	307	307	0.0	247	246	0.4
Ammonia Nitrogen	0.0081	-	-	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	<0.020	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	<0.0050	-	-	<0.0050	-	-	-	-	-	-	-	-
Total Phosphorous	<0.0050	-	-	-	-	-	-	-	-	-	-	-
Sulfate	14.2	14.1	0.7	27.4	27.8	-1.4	1200	1190	0.8	769	732	4.9

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 74
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
WATER QUALITY
2012/2013

Parameter / Sample ID	WB		RPD (%)	SPD		RPD (%)	2NPS		RPD (%)
Sample Date	16-Jan	16-Jan*		29-Jan	29-Jan*		22-Jan	22-Jan*	
Conductivity (umhos/cm)	152	153	-0.7	-	-	-	2400	2390	0.4
Hardness CaCO3	-	-	-	-	-	-	-	-	-
pH	7.57	7.59	-0.3	7.22	-	N/A	7.91	7.9	0.1
Total Suspended Solids	4	4	0.0	10.5	9.5	10.0	-	-	-
Total Dissolved Solids	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	-	-	-	-	-	-	-	-	-
Alkalinity-Total as CaCO3	34.3	34.3	0.0	-	-	-	291	288	1.0
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-
Total Phosphorous	-	-	-	-	-	-	-	-	-
Sulfate	28.9	31	-7.0	12.6	12.4	1.6	1020	1030	-1.0

Parameter / Sample ID	SPC		RPD (%)	NNO		RPD (%)	QRDS1		RPD (%)
Sample Date	5-Mar	5-Mar*		8-Jan	8-Jan*		26-Mar	26-Mar*	
Conductivity (umhos/cm)	314	315	-0.3	29.7	29.5	0.7	-	-	-
Hardness CaCO3	115	117	-1.7	-	-	-	-	-	-
pH	7.69	7.76	-0.9	7.08	7.09	-0.1	-	-	-
Total Suspended Solids	-	-	-	4	4	0.0	-	-	-
Total Dissolved Solids	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	-	-	-	-	-	-	-	-	-
Alkalinity-Total as CaCO3	45.3	44.3	2.2	10.8	11.3	-4.5	-	-	-
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-
Total Phosphorous	-	-	-	-	-	-	-	-	-
Sulfate	104	111	-6.5	1.21	1.48	[0.27]	24.8	24.1	2.9

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 75
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
METALS ANALYSIS
2012/2013

Sample ID	WB		RPD	7S		RPD	MQL 1m		RPD	MQL 9m		RPD
Parameter												
Sample Date	02-May	2-May*		03-Apr	3-Apr*		25-Apr	25-Apr*		28-Jul	28-Jul*	
Total Metals												
Aluminum	0.0231	0.0234	-1.2903	1.0100	0.9760	3.4240	0.0223	-	-	0.0136	-	-
Antimony	<0.00050	<0.00050	NC	<0.0005	<0.0005	NC	<0.00050	-	-	<0.00050	-	-
Arsenic	0.00012	0.00014	[-0.00002]	0.0006	0.0006	0	0.00015	-	-	0.00016	-	-
Barium	0.0019	0.0020	[-0.001]	0.0040	0.0040	[0]	0.0024	-	-	0.0027	-	-
Beryllium	<0.00010	<0.00010	NC	<0.0001	<0.0001	NC	<0.00010	-	-	<0.00010	-	-
Bismuth	<0.0010	<0.0010	NC	<0.001	<0.001	NC	<0.0010	-	-	<0.0010	-	-
Boron	<0.050	<0.050	NC	<0.05	<0.05	NC	<0.050	-	-	0.065	-	-
Cadmium	<0.000010	<0.000010	NC	<0.00001	<0.00001	NC	0.000017	-	-	<0.000010	-	-
Calcium	9.91	9.72	1.94	3.97	3.79	4.6	11.7	11.6	0.8584	14.7	14.3	2.7586
Chromium	<0.0010	<0.0010	NC	0.001	0.001	NC	<0.0010	-	-	<0.0010	-	-
Cobalt	<0.00050	<0.00050	NC	<0.0005	<0.0005	NC	<0.00050	-	-	<0.00050	-	-
Copper	0.00072	0.00068	[0.00004]	0.00220	0.00200	9.52381	0.00211	-	-	0.00124	-	-
Iron	0.04	0.04	6.20	1.03	1.01	2.0	0.0401	-	-	0.0168	-	-
Hardness	-	-	-	-	-	-	35.1	35.1	0.0000	44	43.6	0.9132
Lead	<0.00020	<0.00020	NC	<0.0002	<0.0002	NC	<0.00020	-	-	<0.00020	-	-
Lithium	<0.0050	<0.0050	NC	<0.005	<0.005	NC	<0.0050	-	-	<0.0050	-	-
Magnesium	1.24	1.28	-3.17	0.776	0.756	2.6	1.44	1.48	-2.7397	1.8	1.89	-4.8780
Manganese	0.004	0.004	[0]	0.006	0.005	[0.001]	0.004	-	-	0.003	-	-
Mercury	<0.000010	<0.000010	NC	<0.000010	<0.000010	NC	<0.0000010	-	-	<0.00000020	-	-
Molybdenum	<0.0010	<0.0010	NC	<0.001	<0.001	NC	<0.0010	-	-	<0.0010	-	-
Nickel	<0.0010	<0.0010	NC	<0.001	<0.001	NC	<0.0010	-	-	<0.0010	-	-
Phosphorus	<0.0050	<0.0050	NC	0.021	0.0219	[-0.0009]	0.0117	-	-	<0.0050	-	-
Potassium	0.24	0.25	[-0.01]	0.245	0.239	[0.006]	0.256	-	-	0.292	-	-
Selenium	<0.00010	<0.00010	NC	<0.0001	<0.0001	NC	<0.00010	-	-	<0.00010	-	-
Silicon	1.81	1.76	2.80	4.3	4.2	2.4	1.84	-	-	1.61	-	-
Silver	<0.000020	<0.000020	NC	<0.00002	<0.00002	NC	<0.000020	-	-	<0.000020	-	-
Sodium	10.80	11.20	-3.64	1.28	1.24	3.2	16.7	-	-	21.3	-	-
Strontium	0.04	0.05	-1.99	0.014	0.014	0.0	0.0651	-	-	0.0785	-	-
Thallium	<0.000050	<0.000050	NC	<0.00005	<0.00005	NC	<0.000050	-	-	<0.000050	-	-
Tin	<0.0050	<0.0050	NC	<0.005	<0.005	NC	<0.0050	-	-	<0.0050	-	-
Titanium	<0.0050	<0.0050	NC	0.108	0.101	6.698565	<0.0050	-	-	<0.0050	-	-
Uranium	<0.00010	<0.00010	NC	<0.0001	<0.0001	NC	<0.00010	-	-	<0.00010	-	-
Vanadium	<0.0050	<0.0050	NC	<0.005	<0.005	NC	<0.0050	-	-	<0.0050	-	-
Zinc	<0.0050	<0.0050	NC	<0.005	<0.005	NC	0.0099	-	-	<0.0050	-	-
Zirconium	<0.00050	<0.00050	NC	<0.0005	<0.0005	NC	<0.00050	-	-	<0.00050	-	-
Dissolved Metals												
Aluminum	0.02	0.02	1.87	0.238	0.25	-4.918033	0.0172	-	-	0.0105	-	-
Antimony	<0.00050	<0.00050	NC	<0.00050	<0.00050	NC	<0.00050	-	-	<0.00050	-	-
Arsenic	0.00012	0.00012	[0]	0.00020	0.00022	[-0.00002]	0.00014	-	-	0.00013	-	-
Barium	0.0019	0.0019	0.0000	0.0018	0.0018	[0]	0.0024	-	-	0.0027	-	-
Beryllium	<0.00010	<0.00010	NC	<0.00010	<0.00010	NC	<0.00010	-	-	<0.00010	-	-
Bismuth	<0.0010	<0.0010	NC	<0.0010	<0.0010	NC	<0.0010	-	-	<0.0010	-	-
Boron	<0.050	<0.050	NC	<0.050	<0.050	NC	0.052	-	-	0.073	-	-
Cadmium	<0.000010	<0.000010	NC	<0.000010	<0.000010	NC	0.00001	-	-	<0.000010	-	-
Calcium	10.10	9.95	1.50	4.06	3.85	5.3	12.1	12.2	-0.8230	14.4	15.7	-8.6379
Chromium	<0.0010	<0.0010	NC	<0.0010	<0.0010	NC	<0.0010	-	-	<0.0010	-	-
Cobalt	<0.00050	<0.00050	NC	<0.00050	<0.00050	NC	<0.00050	-	-	<0.00050	-	-
Copper	0.00075	0.00068	[0.00007]	0.00155	0.00164	-5.64263	0.00094	-	-	0.00034	-	-
Iron	0.0177	0.0171	[0.0006]	0.3900	0.2310	**51.2077**	36.6000	36.9000	-0.8163	43.5000	47.9000	-9.6280
Hardness	-	-	-	-	-	-	0.0169	-	-	0.0085	-	-
Lead	<0.00020	<0.00020	NC	<0.00020	<0.00020	NC	<0.00020	-	-	<0.00020	-	-
Lithium	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC	<0.0050	-	-	<0.0050	-	-
Magnesium	1.25	1.25	0.00	0.721	0.719	0.3	1.56	1.57	-0.6390	1.85	2.1	-12.6582
Manganese	0.0027	0.0028	[-0.0001]	0.0032	0.0018	[0.0014]	0.0019	-	-	0.0023	-	-
Mercury	<0.000010	<0.000010	NC	<0.000010	<0.000010	NC		-	-	<0.00000020	-	-
Molybdenum	<0.0010	<0.0010	NC	<0.0010	<0.0010	NC	<0.0010	-	-	<0.0010	-	-
Nickel	<0.0010	<0.0010	NC	<0.0010	<0.0010	NC	<0.0010	-	-	<0.0010	-	-
Phosphorus	<0.0050	<0.0050	NC	0.0063	0.0087	[-0.0024]	<0.0050	-	-	<0.0050	-	-
Potassium	0.24	0.25	-4.03	0.32	0.346	-7.8	0.273	-	-	0.294	-	-
Selenium	<0.00010	<0.00010	NC	<0.00010	<0.00010	NC	<0.00010	-	-	<0.00010	-	-
Silicon	1.78	1.80	-1.12	3.4	3.36	1.2	1.91	-	-	1.59	-	-
Silver	<0.000020	<0.000020	NC	<0.000020	<0.000020	NC	<0.000020	-	-	<0.000020	-	-
Sodium	11.10	11.20	-0.90	1.45	1.42	2.1	18.1	-	-	21.2	-	-
Strontium	0.05	0.05	0.20	0.0138	0.0135	2.2	0.0666	-	-	0.0778	-	-
Thallium	<0.000050	<0.000050	NC	<0.000050	<0.000050	NC	<0.000050	-	-	<0.000050	-	-
Tin	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC	<0.0050	-	-	<0.0050	-	-
Titanium	<0.0050	<0.0050	NC	0.0247	0.0252	[0.0005]	<0.0050	-	-	<0.0050	-	-
Uranium	<0.00010	<0.00010	NC	<0.00010	<0.00010	NC	<0.00010	-	-	<0.00010	-	-
Vanadium	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC	<0.0050	-	-	<0.0050	-	-
Zinc	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC	0.0091	-	-	<0.0050	-	-
Zinconium	<0.00050	<0.00050	NC	<0.00050	<0.00050	NC	<0.00050	-	-	<0.00050	-	-

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded= RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 75
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
METALS ANALYSIS
2012/2013

Sample ID	MQL B		RPD	MQL 1m		RPD	LLM B		RPD	LLM 1m		RPD	SPC		RPD	Field Blank	Detection Limit	Field Blank	Detection Limit	Field Blank	Detection Limit
Parameter																					
Sample Date	25-Jul	25-Jul*		22-Aug	22-Aug*		23-Jul	24-Jul*		23-Aug	23-Aug*		05-Mar	5-Mar*		29-Jun					
Total Metals																					
Aluminum	0.0137	-	-	0.0180	-	-	0.0094	-	-	0.0068	-	-	0.0450	0.0441	2.0202	<0.0030	0.0030	-	0.0030	<0.0030	0.0030
Antimony	<0.000020	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	<0.00050	NC	<0.00050	0.00050	-	0.00050	<0.00050	0.00050
Arsenic	0.000113	-	-	0.00018	-	-	0.00024	-	-	0.00053	-	-	0.0004	0.00042	-4.878049	<0.00010	0.00010	-	0.00010	<0.00010	0.00010
Barium	0.0036	-	-	0.0014	-	-	0.0077	-	-	0.0050	-	-	0.0102	0.0096	6.0606	<0.0010	0.0010	-	0.0010	<0.0010	0.0010
Beryllium	<0.000010	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	<0.00010	NC	<0.00010	0.00010	-	0.00010	<0.00010	0.00010
Bismuth	<0.0000050	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	<0.0010	NC	<0.0010	0.0010	-	0.0010	<0.0010	0.0010
Boron	0.093	-	-	<0.050	-	-	0.154	-	-	0.054	-	-	0.05	0.051	-2.0	<0.050	0.050	-	0.050	<0.050	0.050
Cadmium	<0.0000050	-	-	<0.0000050	-	-	<0.000010	-	-	0.000009	-	-	<0.000010	<0.000010	NC	<0.000010	0.000010	-	0.000010	<0.000010	0.000010
Calcium	19.2	18	6.4516	9.81	9.84	-0.3053	46.6	49	-5.0209	22.6	30.2	**-28.7879**	41.6	41.4	0.4819	-	-	-	-	<0.050	0.0500
Chromium	<0.00010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	<0.0010	NC	<0.0010	0.0010	-	0.0010	<0.0010	0.0010
Cobalt	0.0000353	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	<0.00050	NC	<0.00050	0.00050	-	0.00050	<0.00050	0.00050
Copper	0.00111	-	-	0.00058	-	-	0.00036	-	-	0.00030	-	-	0.00065	0.00042	[.00023]	<0.00020	0.00020	-	0.00020	<0.00020	0.00020
Iron	0.036	-	-	0.0466	-	-	0.0337	-	-	0.0429	-	-	0.082	0.0797	2.8	<0.0050	0.0050	-	0.0050	<0.50	0.0050
Hardness	59.6	55.9	6.4069	29.4	29.5	-0.3396	137	143	-4.2857	67.6	90.1	**-28.5352**	127	126	0.7905	<0.50	0.50	-	0.50	<0.0050	0.50
Lead	0.0000308	-	-	<0.00020	-	-	<0.00020	-	-	<0.00020		-	<0.00020	<0.00020	NC	<0.00020	0.00020	-	0.00020	<0.00020	0.00020
Lithium	0.00052	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050		-	<0.0050	<0.0050	NC	<0.0050	0.0050	-	0.0050	<0.0050	0.0050
Magnesium	2.85	2.67	6.5217	1.19	1.19	0.0000	4.91	4.94	-0.6091	2.69	3.54	**-27.2873**	5.65	5.51	2.5090	-	-	-	-	<0.050	-
Manganese	0.020	-	-	0.008	-	-	0.152	-	-	0.008	-	-	0.002	0.002	4.444	<0.0010	0.0010	-	0.0010	<0.0010	0.0010
Mercury	<0.0000010	-	-	<0.0000010	-	-	<0.0000010	-	-	<0.00000020	-	-	<0.000010	<0.000010	NC	<0.000010	0.000010	-	0.000010	<0.000010	0.000010
Molybdenum	0.000199	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	<0.0010	NC	<0.0010	0.0010	-	0.0010	<0.0010	0.0010
Nickel	0.000281	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	<0.0010	NC	<0.0010	0.0010	-	0.0010	<0.0010	0.0010
Phosphorus	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	-	-	NC	-	-	-	-	-	-
Potassium	0.301	-	-	0.158	-	-	0.617	-	-	0.256	-	-	1.98	1.95	1.5	-	-	-	-	<0.050	-
Selenium	0.00005	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	<0.00010	NC	<0.00010	0.00010	-	0.00010	<0.00010	0.00010
Silicon	1.67	-	-	1.69	-	-	3.69	-	-	2.21	-	-	2.98	2.95	1.0	<0.10	0.10	-	0.10	<0.10	0.10
Silver	<0.0000050	-	-	<0.000020	-	-	<0.000020	-	-	<0.000020	-	-	<0.000020	<0.000020	NC	<0.000020	0.000020	-	0.000020	<0.000020	0.000020
Sodium	24.6	-	-	7.92	-	-	23.4	-	-	9.01	-	-	12.1	11.6	4.2	-	-	-	-	<0.050	-
Strontium	0.0903	-	-	0.0384	-	-	0.411	-	-	0.166	-	-	0.246	0.243	1.2	<0.0010	0.0010	-	0.0010	<0.0010	0.0010
Thallium	<0.0000020	-	-	<0.000050	-	-	<0.000050	-	-	<0.000050	-	-	<0.000050	<0.000050	NC	<0.000050	0.000050	-	0.000050	<0.000050	0.000050
Tin	0.00049	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	<0.0050	NC	<0.0050	0.0050	-	0.0050	<0.0050	0.0050
Titanium	<0.00050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	<0.0050	NC	<0.0050	0.0050	-	0.0050	<0.0050	0.0050
Uranium	0.0000109	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	<0.00010	NC	<0.00010	0.00010	-	0.00010	<0.00010	0.00010
Vanadium	<0.00020	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	<0.0050	NC	<0.0050	0.0050	-	0.0050	<0.0050	0.0050
Zinc	0.00166	-	-	<0.0050	-	-	<0.0050	-	-	0.0211	-	-	<0.0050	<0.0050	NC	<0.0050	0.0050	-	0.0050	<0.0050	0.0050
Zirconium	<0.00010	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	<0.00050	NC	<0.00050	0.00050	-	0.00050	<0.00050	0.00050
Dissolved Metals																					
Aluminum	0.00905	-	-	0.0258	-	-	0.0053	-	-	0.0093	-	-	0.0322	0.0322	0	<0.0030	0.0030	<0.0030	0.0030	<0.0030	0.0030
Antimony	0.000021	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	<0.00050	NC	<0.00050	0.00050	<0.00050	0.00050	<0.00050	0.00050
Arsenic	0.00014	-	-	0.00016	-	-	0.00021	-	-	0.00069	-	-	0.00037	0.00037	0.00000	<0.00010	0.00010	<0.00010	0.00010	<0.00010	0.00010
Barium	0.0036	-	-	0.0013	-	-	0.0069	-	-	0.0064	-	-	0.0093	0.0096	-3.1746	<0.0010	0.0010	<0.0010	0.0010	<0.0010	0.0010
Beryllium	<0.000010	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	<0.00010	NC	<0.00010	0.00010	<0.00010	0.00010	<0.00010	0.00010
Bismuth	<0.0000050	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	<0.0010	NC	<0.0010	0.0010	<0.0010	0.0010	<0.0010	0.0010
Boron	0.071	-	-	<0.050	-	-	0.139	-	-	0.079	-	-	<0.050	<0.050	NC	<0.050	0.050	<0.050	0.050	<0.050	0.050
Cadmium	<0.0000050	-	-	<0.0000050	-	-	<0.000010	-	-	<0.0000050	-	-	<0.000010	<0.000010	NC	<0.000010	0.000010	<0.000010	0.000010	<0.000010	0.000010
Calcium	17.8	19.4	-8.6022	9.6	9.56	0.4175	46	-	-	29.3	29.5	-0.6803	37.7	38.1	-1.0554	-	-	<0.050	-	<0.050	-
Chromium	<0.00010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	<0.0010	NC	<0.0010	0.0010	<0.0010	0.0010	<0.0010	0.0010
Cobalt	0.000015	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	<0.00050	NC	<0.00050	0.00050	<0.00050	0.00050	<0.00050	0.00050
Copper	0.00048	-	-	0.00073	-	-	0.00040	-	-	0.00088	-	-	0.00034	0.00031	9.23077	<0.00020	0.00020	<0.00020	0.00020	<0.00020	0.00020
Iron	54.9000	60.1000	-9.0435	28.7000	28.6000	0.3490	135.0000	-	-	86.8000	88.5000	-1.9395	0.0435	0.0425	2.3256	<0.0050	0.0050	<0.50	0.0050	<0.50	0.0050
Hardness	0.0128	-	-	0.0278	-	-	0.0063	-	-	0.0287	-	-	115	117	-1.7	<0.50	0.50	**0.005**	0.50	<0.0050	0.50
Lead	<0.0000050	-	-	<0.00020	-	-	<0.00020	-	-	<0.00020	-	-	<0.00020	<0.00020	NC	<0.00020	0.00020	<0.00020	0.00020	<0.00020	0.00020
Lithium	<0.00050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	<0.0050	NC	<0.0050	0.0050	<0.0050	0.0050	<0.0050	0.0050
Magnesium	2.55	2.85	-11.1111	1.14	1.14	0.0000	4.88	-	-	3.28	3.62	-9.8551	5.09	5.2	-2.1380	-	-	<0.050	-	<0.050	-
Manganese	0.0168	-	-	<0.0010	-	-	0.0033	-	-	<0.0010	-	-	0.0012	0.0012	0.0000	<0.0010	0.0010	<0.0010	0.0010	<0.0010	0.0010
Mercury	<0.0000010	-	-	<0.0000010	-	-	<0.0000010	-	-	<0.00000020	-	-	<0.010	<0.010	NC	<0.010	0.000010	<0.010	0.000010	<0.010	0.000010
Molybdenum	0.000208	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	<0.0010	NC	<0.0010	0.0010	<0.0010	0.0010	<0.0010	0.0010
Nickel	0.000075	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	<0.0010	NC	<0.0010	0.0010	<0.0010	0.0010	<0.0010	0.0010
Phosphorus	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	-	-	-	-	-	-	-	-	-
Potassium	0.277	-	-	0.148	-	-	0.623	-	-	0.327	-	-	1.76	1.85	-5.0	-	-	<0.050	-	<0.050	0.05
Selenium	<0.000040	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	<0.00010	NC	<0.00010	0.00010	<0.00010	0.00010	<0.00010	0.00010
Silicon	1.55	-	-	1.64	-	-	3.72	-	-	2.73	-	-	2.84	2.84	0.0	<0.10	0.10	<0.10	0.10	<0.10	0.10
Silver	<0.0000050	-	-	<0.000020	-	-	<0.000020	-	-	<0.000020	-	-	<0.000020	<0.000020	NC	<0.000020	0.000020	**0.00003**	0.000020	<0.000020	0.000020
Sodium	23.3	-	-	7.78	-	-	23.5	-	-	11.3	-	-	10.9	11.3	-3.6	-	-	<0.050	-	<0.050	-
Strontium	0.0911	-	-	0.0392	-	-	0.409	-	-	0.214	-	-	0.228	0.231	-1.3	<0.0010	0.0010	<0.0010	0.0010	<0.0010	0.0010
Thallium	<0.0000020	-	-	<0.000050	-	-	<0.000050	-	-	<0.000050	-	-	<0.000050	<0.000050	NC	<0.000050	0.000050	<0.000050	0.000050	<0.000050	0.000050
Tin	<0.00020	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	<0.0050	NC	<0.0050	0.0050	<0.0050	0.0050	<0.0050	0.0050
Titanium	<0.00050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	<0.0050	NC	<0.0050	0.0050	<0.0050	0.0050	<0.0050	0.0050
Uranium	0.00001	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	<0.00010	NC	<0.00010	0.00010	<0.00010	0.00010	<0.00010	0.00010
Vanadium	<0.00020	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	<0.0050	NC	<0.0050	0.0050	<0.0050	0.0050	<0.0050	0.0050
Zinc	0.00042	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	<0.0050	NC	<0.0050	0.0050	<0.0050	0.0050	<0.0050	0.0050
Zirconium	<0.00010	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	<0.00050	NC	<0.00050	0.00050	<0.00050	0.00050	<0.00050	0.00050

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 76

7SSD and 7S Data Comparison

EMS ID:

E292069 E292109

STATION NAME		7S	7SSD	Permit
Period		March	March	
Permit EMS No.		E292109	E292068	Limit 7SSD
Parameter	**Unit**			(P)
pH-L	**pH Units**	7.243333	7.890000	6.00-8.00
pH Field	**pH Units**	5.950000	7.375000	
Cond-L	**uS/cm**	40.300000	392.000000	-
Cond Field	**uS/cm**	51.000000	353.500000	-
Alk-T	**mg/L**	13.933333	85.400000	-
TSS	**mg/L**	4.000000	4.000000	25
Dissolved Organic Carbon ©	**mg/L**	1.900000	3.280000	-
SO4-D	**mg/L**	4.556667	108.000000	500
Al-D	**mg/L**	0.023567	0.009800	0.1
Cd-D	**mg/L**	0.000006	**0.000057**	0.000045
Hard-D	**mg/L**	15.600000	182.000000	-
Hardness (as CaCO3)	**mg/L**	15.133333	172.500000	-
Cu-D	**mg/L**	0.000253	0.000785	0.014
Fe-D	**mg/L**	0.005367	0.026550	0.35
Se-D	**mg/L**	0.000100	0.000230	0.016

March 18, 2013 Started discharging at 7SSD.

Results represent an average of samples obtained throughout the discharge period in March

Bold values indicate permit exceedance

Table 77
Field Discharge Table for 7S and 7SSD

Field Table - Staff Gauge Measurements and Corresponding Flow Values at 7SSD		
7S Staff Gauge (m)	**Discharge at 7S (L/s)**	**Set Discharge Rate at 7SSD**
0.140	0.2486	0.0311
0.145	0.3174	0.0397
0.150	0.4018	0.0502
0.155	0.5048	0.0631
0.160	0.6296	0.0787
0.165	0.7799	0.0975
0.170	0.9599	0.1200
0.175	1.1744	0.1468
0.180	1.4287	0.1786
0.185	1.7288	0.2161
0.190	2.0813	0.2602
0.195	2.4936	0.3117
0.200	2.9739	0.3717
0.205	3.5313	0.4414
0.210	4.1759	0.5220
0.215	4.9187	0.6148
0.220	5.7719	0.7215
0.225	6.7488	0.8436
0.230	7.8639	0.9830
0.235	9.1332	1.1417
0.240	10.5741	1.3218
0.245	12.2052	1.5257
0.250	14.0473	1.7559
0.255	16.1224	2.0153
0.260	18.4547	2.3068
0.265	21.0700	2.6337
0.270	23.9964	2.9995
0.275	27.2641	3.4080
0.280	30.9056	3.8632
0.285	34.9558	4.3695
0.290	39.4523	4.9315

TABLE 78
5 YEAR ANNUAL AVERAGES
NORTH AND SOUTH WATER MANAGEMENT SYSTEMS
WATER QUALITY
2012/2013

	Station Name	WQO	WQO-Av	WWQG	Mid Quinsam Lake Outlet					Mid Quinsam Lake Inlet					Mid Quinsam Lake 1M				
Parameter		-	-	-	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Cond-L	**uS/cm**	-	-	-	114.96	139.02	131.94	108.43	114.60	42.33	45.35	41.91	41.09	41.50	-	-	-	96.86	101.80
pH-L	**pH Units**	-	**6.90**	**6.0-8.5**	7.62	7.72	7.63	7.54	7.61	7.65	7.96	7.53	7.42	7.49	7.52	7.87	7.89	7.50	7.65
TSS	**mg/L**	-	**25**	**25**	4	3	3	4	4.0	3	5	3	4	5.5	3	3	3	4	4
Alk-T	**mg/L**	-	-	-	25.933	30.425	30.484	28.151	29.9	18.948	19.610	24.641	18.620	18.7	25.014	31.800	30.483	25.625	29.500
N-NH3	**mg/L**	-	-	**2.50**	0.0132	0.0071	0.0149	0.0269	0.009	0.0093	0.0053	0.0212	0.0207	0.0096	0.0227	0.0180	0.0052	0.0150	0.0285
N-TKN	**mg/L**	-	-	-	0.0999	0.1179	0.1199	0.1598	0.146	0.0691	0.0941	0.1214	0.1363	0.119	0.0857	0.1102	0.0697	0.1250	0.1230
NO2+NO3	**mg/L**	-	-	-	0.0227	0.0140	0.0185	0.0200	0.02	0.0237	0.0176	0.0201	0.0200	0.021	0.0066	0.0063	0.0072	0.0200	0.0200
P-PO4-D	**mg/L**	-	-	-	0.0024	0.0020	0.1731	-	0.005	0.0023	0.0020	0.0024	-	0.005	0.0044	0.0025	0.0036	-	0.0050
P-PO4-T	**mg/L**	-	-	-	0.0046	0.0028	0.0033	-	0.005	0.0028	0.0025	0.0029	-	0.005	0.0054	0.0070	0.0046	-	0.0061
SO4-D	**mg/L**	**100.00**	-	**100.00**	25.36	31.07	28.44	21.37	21.59	0.56	0.68	1.22	2.21	1.92	16.93	32.68	24.43	14.82	16.44

	Station Name	WQO	WQO-Av	WWQG	Mid Quinsam Lake 4M					Mid Quinsam Lake 9M					Mid Quinsam Lake 1M from B				
Parameter		-	-	-	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**		**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Cond-L	**uS/cm**	-	-	-	-	-	-	111.20	87.90	-	-	-	189.00	206.00	-	-	-	287.50	228.00
pH-L	**pH Units**	-	**6.90**	**6.0-8.5**	7.54	7.88	7.90	7.51	7.58	7.63	7.80	7.73	7.49	7.76	7.62	7.76	7.73	7.29	7.64
TSS	**mg/L**	**25**	**25**	**25**	3	3	3	4	4	3	3	3	4	4.0	3	3	3	4	4
Alk-T	**mg/L**	-	-	-	25.283	32.617	30.550	26.625	27.400	28.443	46.133	31.000	31.857	44.7	33.350	44.483	32.300	36.500	44.200
N-NH3	**mg/L**	-	-	**2.50**	0.0216	0.0175	0.0051	0.0133	0.0550	0.0141	0.0175	0.0079	0.0187	0.0368	0.0247	0.0182	0.0248	0.0388	0.0310
N-TKN	**mg/L**	-	-	-	0.0873	0.1155	0.0960	0.1271	0.1570	0.0801	0.1023	0.1150	0.1533	0.14	0.0892	0.1183	0.1183	0.1467	0.1370
NO2+NO3	**mg/L**	-	-	-	0.0064	0.0065	0.0072	0.0200	0.0200	0.0087	0.0105	0.0097	0.0214	0.02	0.0114	0.0147	0.0136	0.0300	0.0200
P-PO4-D	**mg/L**	-	-	-	0.0031	0.0029	0.0023	-	0.0050	0.0030	0.0024	0.0023	-	0.005	0.0026	0.0025	0.0023	-	0.0050
P-PO4-T	**mg/L**	-	-	-	0.0045	0.0042	0.0032	-	0.0050	0.0041	0.0027	0.0037	-	0.0056	0.0037	0.0031	0.0039	-	0.0050
SO4-D	**mg/L**	**100.00**	-	**100.00**	17.97	34.63	24.70	16.04	12.64	33.00	106.07	28.53	42.43	47.2	61.45	132.95	26.90	115.67	50.30

	Station Name	WQO	WQO-Av	WWQG	South Pit Culvert					Long Lake Outlet					Long Lake Seep				
Parameter		-	-	-	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Cond-L	**uS/cm**	-	-	-	273.07	264.19	215.92	188.47	222.00	226.96	219.01	187.68	165.07	177.10	1598.70	1600.77	1380.00	1237.50	1384.00
pH-L	**pH Units**	-	**6.90**	**6.0-8.5**	7.65	7.62	7.35	7.46	7.57	7.68	7.66	7.44	7.46	7.54	7.79	7.59	7.82	7.87	8.01
TSS	**mg/L**	**25**	**25**	**25**	3	3	4	4	4	3	3	3	4	5	8	5	4	4	9
Alk-T	**mg/L**	-	-	-	34.990	32.575	20.061	26.318	31.000	35.967	32.008	21.867	26.514	28.500	254.522	253.692	218.250	199.000	221.000
N-NH3	**mg/L**	-	-	**2.50**	0.0076	0.0066	0.0228			0.0110	0.0070	0.0248	0.0291	0.0169	-	0.0707	0.0417	-	
N-TKN	**mg/L**	-	-	-	-	-	0.2303			0.1148	0.1293	0.1425	0.2712	0.2040	0.1471	0.0763	0.0930	-	
NO2+NO3	**mg/L**	-	-	-	0.0997	0.1011	0.0894	0.0947	0.0940	0.0339	0.0193	0.0849	0.0214	0.0210	-	0.0582	0.0283	-	
P-PO4-D	**mg/L**	-	-	-	0.0033	0.0030	0.0040		0.0061	0.0026	0.0021	0.0023		0.0050	-	0.0020	-	-	
P-PO4-T	**mg/L**	-	-	-	0.0055	0.0065	0.0073			0.0044	0.0031	0.0063		0.0054	-	0.0053	-	-	
SO4-D	**mg/L**	**100.00**	-	**100.00**	94.05	90.70	74.22	60.82	70.50	69.53	66.06	56.46	47.53	48.30	633.22	633.08	527.42	465.08	547.00

Results expressed in mg/L except where noted.

TABLE 78
5 YEAR ANNUAL AVERAGES
NORTH AND SOUTH WATER MANAGEMENT SYSTEMS
WATER QUALITY
2012/2013

	Station Name	WQO	WQO-Av	WWQG	Settling Pond #4					North Pit Culvert					Settling Pond # 1				
Parameter		-	-	-	2008-09	2009-10	2010-11	2011-12	2012-13	2008-09	2009-10	2010-11	2011-12	2012-13	2008-09	2009-10	2010-11	2011-12	2012-13
Cond-L	uS/cm	-	-	-	2189.44	2137.50	1950.32	2011.61	1948.00	1973.52	1959.03	1819.23	1862.41	1811.00	670.48	633.36	697.74	591.62	379.60
pH-L	pH Units	-	6.90	6.0-8.5	8.13	8.08	8.12	8.06	8.08	8.25	8.25	8.29	8.27	8.30	7.65	7.75	7.61	7.76	7.57
TSS	mg/L	25	25	25	4	5	5	4	4	3	3	4	4	4	4	4	4	4	5
Alk-T	mg/L	-	-	-	301.17	336.00	361.55	328.73	343.00	265.86	277.26	283.63	299.55	307.00	57.89	63.78	51.03	66.72	50.75
N-NH3	mg/L	-	-	2.50	0.0165	0.0239	0.0189	0.0422	0.0406	0.0093	0.0097	0.0147	-	0.1400	0.0151	0.0097	0.0172	0.0278	0.0177
N-TKN	mg/L	-	-	-	0.0745	0.0928	0.1143	0.1200		-	-	0.0950	-	0.1760	0.2252	0.2143	0.2102	0.2450	0.3070
NO2+NO3	mg/L	-	-	-	0.2691	0.2192	0.0727	0.0478	0.0380	0.0659	0.0794	0.0937	0.0477	0.0610	0.0127	0.0110	0.0307	0.0200	0.0200
P-PO4-D	mg/L	-	-	-	0.0025	0.0021	0.0020	-	0.0050	0.0036	0.0030	0.0032	-	0.0050	0.0038	0.0024	0.0028	-	0.0052
P-PO4-T	mg/L	-	-	-	0.0046	0.0040	0.0039	-	0.0056	0.0058	0.0050	0.0060	-	0.0051	0.0096	0.0071	0.0070	-	0.0076
SO4-D	mg/L	100.00	-	100.00	862.02	796.19	708.58	688.39	633.00	754.33	742.72	662.29	631.24	590.00	276.82	264.32	284.02	214.63	133.84

	Station Name	WQO	WQO-Av	WWQG	Long Lake Middle 1M					Long Lake Middle 4M					Long Lake Middle 9M				
Parameter		-	-	-	2008-09	2009-10	2010-11	2011-12	2012-13	2008-09	2009-10	2010-11	2011-12	2012-13	2008-09	2009-10	2010-11	2011-12	2012-13
Cond-L	uS/cm	-	-	-	-	-	-	216.57	201.00	-	-	-	336.60	267.00	-	-	-	436.00	401.00
pH-L	pH Units	-	6.90	6.0-8.5	7.69	7.80	7.79	7.44	7.64	7.72	7.69	7.83	7.57	7.69	7.72	7.67	7.66	7.51	7.65
TSS	mg/L	25	25	25	3	3	3	4	4	3	3	4	4	4	3	3	4	4	4
Alk-T	mg/L	-	-	-	40.471	38.100	33.867	31.889	32.300	51.450	51.450	40.367	45.778	39.600	57.014	59.950	55.517	53.333	51.900
N-NH3	mg/L	-	-	2.50	0.0119	0.0203	0.0050	0.0298	0.0180	0.0112	0.0152	0.0068	0.0193	0.0146	0.0095	0.0200	0.0052	0.0238	0.0160
N-TKN	mg/L	-	-	-	0.1055	0.1190	0.1738	0.1833	0.1730	0.1043	0.1092	0.1310	0.1743	0.1260	0.1044	0.0780	0.1303	0.1250	0.1360
NO2+NO3	mg/L	-	-	-	0.0172	0.0102	0.0069	0.0200	0.0200	0.0190	0.0164	0.0083	0.0225	0.2630	0.0509	0.0677	0.0507	0.0467	0.0550
P-PO4-D	mg/L	-	-	-	0.0082	0.0028	0.0056	-	0.0050	0.0039	0.0031	0.0030	-	0.0050	0.0040	0.0020	0.0030	-	0.0050
P-PO4-T	mg/L	-	-	-	0.0118	0.0058	0.0078	-	0.0050	0.0054	0.0044	0.0041	-	0.0059	0.0056	0.0046	0.0039	-	0.0101
SO4-D	mg/L	100.00	-	100.00	89.76	75.85	68.25	58.56	59.70	128.50	122.88	87.38	110.00	84.20	140.71	148.00	137.67	146.67	135.00

	Station Name	WQO	WQO-Av	WWQG	Long Lake Middle 1M From B					3 South					4S-Lower					LLE			
Parameter		-	-	-	2008-09	2009-10	2010-11	2011-12	2012-13	2008-09	2009-10	2010-11	2011-12	2012-13	2008-09	2009-10	2010-11	2011-12	2012-13	2009-10	2010-11	2011-12	2012-13
Cond-L	uS/cm	-	-	-	-	-	-	442.50	407.00	1322.05	1607.26	1523.27	1022.29	1304.00	627.02	607.05	478.26	421.14	483.00	255.77	370.38	377.11	628.00
pH-L	pH Units	-	6.90	6.0-8.5	7.63	7.49	7.58	7.55	7.65	7.96	7.92	7.84	7.80	7.88	7.70	7.52	7.41	7.49	7.48	7.49	7.35	7.34	7.53
TSS	mg/L	25	25	25	3	3	3	4	4	4	4	7	4		3	3	18	4	4	5	5	4	4
Alk-T	mg/L	-	-	-	56.152	61.636	56.933	54.167	52.900	125.062	124.999	94.667	68.731	80.800	54.979	44.763	38.164	42.127	45.200	35.207	39.387	40.742	46.100
N-NH3	mg/L	-	-	2.50	0.0128	0.0193	0.0058	0.0162	0.0153	0.0129	0.0131	0.0268	0.0420	0.0153	0.0081	0.0190	0.0133	-		0.0308	0.0465	0.0550	0.0244
N-TKN	mg/L	-	-	-	0.0935	0.0976	0.0975	0.1217	0.1180	-	-	0.1000	-		-	-	0.5933	-		0.2534	0.2655	0.1600	0.2460
NO2+NO3	mg/L	-	-	-	0.0895	0.1027	0.0824	0.0783	0.0810	0.0199	0.0403	0.0344	0.0202	0.0350	-	-	0.0211	-		0.0353	0.0426	0.0259	0.0350
P-PO4-D	mg/L	-	-	-	0.0024	0.0021	0.0050	-	0.0050	0.0022	0.0021	0.0021	-	0.0052	-	-	-	-		0.0047	0.0050	-	0.0052
P-PO4-T	mg/L	-	-	-	0.0043	0.0029	0.0061	-	0.0050	0.0043	0.0035	0.0046	-	0.0056	-	-	-	-		0.0092	0.0088	-	0.0073
SO4-D	mg/L	100.00	-	100.00	146.58	148.94	139.17	151.67	136.00	816.53	850.74	717.29	470.46	640.00	259.43	258.22	213.28	155.75	184.00	84.15	112.21	137.50	262.70

Results expressed in mg/L except where noted.

TABLE 79

5 YEAR ANNUAL AVERAGES NORTH AND SOUTH MANAGEMENT SYSTEM

METALS ANALYSIS

2012/2013

	Station Name	WQO	WQO-Av	WWQG	Settling Pond # 1					South Pit Culvert					Long Lake Outlet				
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
As-T	**mg/L**	**0.05000**		**0.005**	0.00134	0.00099	0.00113	0.00081	0.00097	0.18005	0.13915	0.00046	0.00051	0.00048	0.03383	0.00058	0.00054	0.00043	0.00048
Cd-T	**mg/L**	*			0.00004542	0.00004158	0.00003094	0.00002500	0.00006280	0.00900170	0.00695519	0.00001483	0.00001167	0.00001180	0.00169508	0.00001725	0.00002036	0.00001000	0.00000780
Cr-T	**mg/L**				0.00242	0.00158	0.00133	0.00100	0.00100	0.00910	0.00726	0.00100	0.00100	0.00100	0.00250	0.00100	0.00059	0.00100	0.00100
Co-T	**mg/L**	**0.0500**		**0.11**	0.0036	0.0006	0.0049	0.0006	0.0006	0.0090	0.0070	0.0004	0.0005	0.0005	0.0019	0.0003	0.0003	0.0005	0.0005
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0029	0.0243	0.0021	0.0011	0.0008	0.0091	0.0073	0.0008	0.0006	0.0007	0.0025	0.0011	0.0006	0.0008	0.0008
Fe-T	**mg/L**		**0.3000**	**1.0000**	0.4005	0.1910	1.3399	0.3473	0.2820	0.1248	0.1898	0.1706	0.1809	0.1750	0.1257	0.0736	0.1128	0.0966	0.1480
Hardness	**mg/L**				348.4	282.9	362.4	298.2	132.8	119.9	117.5	106.3	77.7	97.5	82.7	77.3	72.0	56.3	68.4
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0012	0.0008	0.0005	0.0002	0.0003	0.0451	0.0349	0.0003	0.0002	0.0002	0.0088	0.0005	0.0002	0.0002	0.0002
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.2517	0.0600	0.5297	0.0785	0.0709	0.0082	0.0112	0.0090	0.0078	0.0047	0.0551	0.0218	0.0250	0.0153	0.0202
Hg-T	mg/L	**0.0001**		**0.001**	0.0000214	0.0000192	0.0000239	0.0000175	0.0000081	0.0000200	0.0000186	0.0000167	0.0000175	0.0000084	0.0000200	0.0000192	0.0000171	0.0000175	0.0000073
Ni-T	**mg/L**	**0.025**			0.009	0.002	0.007	0.002	0.002	0.045	0.035	0.001	0.001	0.002	0.009	0.001	0.001	0.001	0.001
Ag-T	**mg/L**	**0.0001**			0.00005	0.00003	0.00003	0.00002	0.00002	0.00900	0.00696	0.00002	0.00002	0.00002	0.00168	0.00002	0.00001	0.00002	0.00002
Zn-T	**mg/L**	**0.03**			0.012	0.015	0.010	0.005	0.013	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.003	0.005	0.005
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.02005	0.02219	0.03228	0.01771	0.02780	0.03462	0.03467	0.05782	0.05986	0.04390	0.01745	0.02023	0.01884	0.02418	0.01840
As-D	**mg/L**				0.00129	0.00095	0.00119	0.00060	0.00073	0.00052	0.00052	0.00036	0.00044	0.00042	0.00059	0.00057	0.00048	0.00041	0.00045
B-D	**mg/L**				0.186	0.153	0.147	0.096	0.070	0.100	0.100	0.068	0.050	0.050	0.117	0.112	0.091	0.058	0.063
Ca-D	**mg/L**				114.82	93.38	117.63	97.25	41.81	38.97	39.36	33.35	24.97	31.00	28.18	26.31	27.42	18.63	21.48
Cd-D	**mg/L**				0.00006	0.00003	0.00007	0.00002	0.00003	0.00012	0.00008	0.00005	0.00001	0.00001	0.00006	0.00002	0.00002	0.00001	0.00001
Cu-D	**mg/L**				0.00264	0.00167	0.00161	0.00109	0.00059	0.00153	0.00129	0.00163	0.00100	0.00051	0.00103	0.00100	0.00117	0.00087	0.00062
Fe-D	**mg/L**				0.115	0.069	0.640	0.061	0.085	0.061	0.050	0.077	0.104	0.081	0.050	0.043	0.049	0.051	0.072
Pb-D	**mg/L**				0.00121	0.00079	0.00044	0.00023	0.00020	0.00050	0.00050	0.00029	0.00020	0.00020	0.00050	0.00050	0.00018	0.00020	0.00020
Hg-D	**mg/L**			**0.0001**	0.0000200	0.0000192	0.0000167	0.0000175	0.0000082	0.0000200	0.0000195	0.0000169	0.0000175	0.0000078	0.0000200	0.0000192	0.0000158	0.0000175	0.0000073
Ni-D	**mg/L**				0.00782	0.00214	0.00711	0.00201	0.00140	0.00101	0.00101	0.00123	0.00100	0.00100	0.00100	0.00100	0.00069	0.00100	0.00100
Na-D	**mg/L**				17.98	15.26	28.46	8.32	4.16	6.83	6.49	6.54	3.20	6.10	13.64	12.36	9.74	7.07	8.36
K-D	**mg/L**				2.00	2.00	1.53	0.87	0.39	2.00	2.00	0.91	0.30	1.19	2.00	2.00	1.02	0.30	0.32
Zn-D	**mg/L**				0.0105	0.0050	0.0088	0.0050	0.0107	0.0050	0.0050	0.0052	0.0050	0.0050	0.0052	0.0050	0.0031	0.0050	0.0050

	Station Name	WQO	WQO-Av	WWQG	Long Lake Seep					Settling Pond #4					North Pit Culvert				
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
As-T	**mg/L**	**0.05000**		**0.005**	0.00745	0.00496	0.00277	0.00235	0.00573	0.00243	0.00250	0.00198	0.00138	0.00220	0.18354	0.19144	0.05094	0.00075	0.00107
Cd-T	**mg/L**	*			0.00008726	0.00007192	0.00003892	0.00001417	0.00001230	0.00010117	0.00009317	0.00007717	0.00002750	0.00001800	0.00917375	0.00957035	0.00255042	0.00002583	0.00001300
Cr-T	**mg/L**				0.00500	0.00423	0.00225	0.00100	0.00100	0.00475	0.00500	0.00300	0.00133	0.00100	0.00958	0.00978	0.00425	0.00100	0.00100
Co-T	**mg/L**	**0.0500**		**0.11**	0.0026	0.0019	0.0022	0.0008	0.0011	0.0014	0.0015	0.0013	0.0011	0.0011	0.0093	0.0096	0.0031	0.0005	0.0005
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0050	0.0042	0.0029	0.0005	0.0005	0.0052	0.0050	0.0033	0.0016	0.0014	0.0096	0.0098	0.0042	0.0011	0.0006
Fe-T	**mg/L**		**0.3000**	**1.0000**	3.3443	2.7256	1.5721	0.9818	1.7280	0.1758	0.1580	0.2367	0.2604	0.3800	0.0505	0.0661	0.1084	0.1122	0.1218
Hardness	**mg/L**				651.9	661.2	564.8	479.6	552.0	539.5	469.8	449.8	411.3	382.0	477.3	491.0	410.1	362.4	325.0
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0025	0.0021	0.0010	0.0002	0.0002	0.0024	0.0025	0.0014	0.0002	0.0002	0.0460	0.0479	0.0132	0.0002	0.0002
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.4784	0.4050	0.3328	0.2710	0.3770	0.0542	0.0544	0.0634	0.0598	0.0669	0.0212	0.0292	0.0454	0.0280	0.0249
Hg-T	**mg/L**	**0.0001**		**0.001**	0.00002000	0.0000192	0.0000158	0.0000175	0.0000068	0.0000200	0.0000192	0.0000150	0.0000175	0.0055030	0.0000200	0.0000200	0.0000167	0.0000175	0.0000078
Ni-T	**mg/L**	**0.025**			0.006	0.005	0.005	0.002	0.002	0.005	0.005	0.004	0.004	0.003	0.046	0.048	0.015	0.002	0.001
Ag-T	**mg/L**	**0.0001**			0.00010	0.00008	0.00005	0.00002	0.00002	0.00010	0.00014	0.00006	0.00002	0.00002	0.00918	0.00957	0.00258	0.00002	0.00002
Zn-T	**mg/L**	**0.03**			0.012	0.005	0.007	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.02500	0.02362	0.02250	0.01119	0.00710	0.02525	0.02500	0.01808	0.01312	0.00960	0.02758	0.02554	0.02000	0.01454	0.00840
As-D	**mg/L**				0.00583	0.00418	0.00209	0.00184	0.00302	0.00242	0.00250	0.00178	0.00093	0.00145	0.00250	0.00242	0.00152	0.00060	0.00092
B-D	**mg/L**				0.770	0.782	0.651	0.539	0.618	0.884	0.921	0.938	0.925	0.924	0.818	0.824	0.843	0.858	0.868
Ca-D	**mg/L**				231.39	235.38	198.42	168.67	189.00	181.09	157.44	149.61	138.38	125.50	161.23	163.90	135.52	120.68	106.20
Cd-D	**mg/L**				0.00009	0.00007	0.00010	0.00002	0.00001	0.00018	0.00009	0.00015	0.00002	0.00002	0.00011	0.00009	0.00016	0.00002	0.00001
Cu-D	**mg/L**				0.00500	0.00423	0.00316	0.00135	0.00103	0.00517	0.00500	0.00336	0.00086	0.00090	0.00542	0.00506	0.00300	0.00133	0.00058
Fe-D	**mg/L**				2.757	1.978	1.115	0.571	0.494	0.030	0.030	0.022	0.033	0.010	0.030	0.030	0.025	0.015	0.023
Pb-D	**mg/L**				0.00250	0.00212	0.00098	0.00020	0.00021	0.00238	0.00250	0.00135	0.00020	0.00020	0.00250	0.00242	0.00135	0.00020	0.00020
Hg-D	**mg/L**			**0.0001**	0.0000207	0.0000192	0.0000150	0.0000175	0.0000068	0.0000200	0.0000192	0.0000150	0.0000175	0.0058480	0.0000200	0.0000196	0.0000150	0.0000167	0.0000078
Ni-D	**mg/L**				0.00573	0.00489	0.00540	0.00235	0.00260	0.00475	0.00500	0.00417	0.00351	0.00330	0.00500	0.00490	0.00342	0.00153	0.00120
Na-D	**mg/L**				138.17	143.85	108.78	95.08	100.30	330.50	336.08	312.58	323.75	302.00	304.25	308.97	287.08	304.83	281.00
K-D	**mg/L**				2.73	2.73	2.44	2.26	2.22	3.35	3.22	3.37	3.66	3.43	3.07	3.07	3.15	3.41	3.12
Zn-D	**mg/L**				0.0120	0.0052	0.0071	0.0582	0.0056	0.0053	0.0050	0.0051	0.0050	0.0050	0.0052	0.0051	0.0050	0.0050	0.0063

*Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3

0.00002 at 60 mg/L CaCO3

0.00003 at 90 mg/L CaCO3

0.00004 at 120 mg/L CaCO3

0.00005 at 150 mg/L CaCO3

0.00006 at 210 mg/L CaCO3

TABLE 79

5 YEAR ANNUAL AVERAGES NORTH AND SOUTH MANAGEMENT SYSTEM

METALS ANALYSIS

2012/2013

	Station Name	WQO	WQO-Av	WWQG	Mid Quinsam Lake Outlet					Mid Quinsam Lake Inlet					Mid Quinsam Lake 1M				
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
As-T	**mg/L**	**0.05000**		**0.005**	0.00050	0.00050	0.00035	0.00011	0.00017	0.00050	0.03375	0.03348	0.00011	0.00011	0.00050	0.00050	0.00050	0.00010	0.00014
Cd-T	**mg/L**	*			0.00001700	0.00001700	0.00001512	0.00001250	0.00000770	0.00001700	0.00168175	0.00167472	0.00001000	0.00000750	0.00001700	0.00004000	0.00001700	0.00001000	0.00000870
Cr-T	**mg/L**				0.00100	0.00100	0.00075	0.00100	0.00100	0.00108	0.00250	0.00210	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00085
Co-T	**mg/L**	**0.0500**		**0.11**	0.0003	0.0003	0.0003	0.0005	0.0005	0.0003	0.0019	0.0018	0.0005	0.0005	0.0003	0.0003	0.0003	0.0005	0.0004
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0010	0.0010	0.0008	0.0007	0.0006	0.0010	0.0025	0.0023	0.0007	0.0009	0.0010	0.0010	0.0010	0.0011	0.0009
Fe-T	**mg/L**		**0.3000**	**1.0000**	0.0514	0.0446	0.0495	0.0512	0.0488	0.0300	0.0331	0.0238	0.0325	0.0245	0.0343	0.0352	0.0443	0.0455	0.0469
Hardness	**mg/L**				37.4	39.8	36.8	33.5	31.9	21.1	21.1	19.6	21.2	19.2	30.0	40.3	34.6	27.2	28.7
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0005	0.0005	0.0003	0.0002	0.0002	0.0005	0.0088	0.0085	0.0002	0.0002	0.0005	0.0005	0.0005	0.0002	0.0002
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.0083	0.0073	0.0093	0.0076	0.0066	0.0014	0.0027	0.0023	0.0021	0.0016	0.0052	0.0057	0.0083	0.0082	0.0069
Hg-T	mg/L	0.0001000		0.0010000	0.0000200	0.0000192	0.0000160	0.0000175	0.0000071	0.0000200	0.0000200	0.0000167	0.0000177	0.0000060	0.0004798	0.0006512	0.0007672	0.0013833	0.0000014
Ni-T	**mg/L**	**0.025**			0.001	0.001	0.001	0.001	0.001	0.001	0.009	0.009	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Ag-T	**mg/L**	**0.0001**			0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00168	0.00168	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Zn-T	**mg/L**	**0.03**			0.005	0.005	0.004	0.005	0.005	0.005	0.005	0.003	0.005	0.005	0.005	0.005	0.005	0.005	0.007
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.01674	0.01650	0.01726	0.01862	0.01440	0.02022	0.02143	0.02285	0.02295	0.01960	0.04099	0.01238	0.01515	0.02260	0.01730
As-D	**mg/L**				0.00050	0.00050	0.00035	0.00013	0.00015	0.00050	0.00050	0.00023	0.00010	0.00010	0.02900	0.00050	0.00050	0.00010	0.00014
B-D	**mg/L**				0.100	0.100	0.077	0.050	0.053	0.100	0.100	0.064	0.050	0.050	0.100	0.100	0.100	0.050	0.050
Ca-D	**mg/L**				12.42	13.22	11.86	10.50	10.58	7.13	7.12	6.44	6.38	6.41	9.89	13.37	11.52	9.10	9.65
Cd-D	**mg/L**				0.00009	0.00002	0.00002	0.00001	0.00001	0.00005	0.00002	0.00001	0.00001	0.00001	0.00144	0.00002	0.00002	0.00003	0.00001
Cu-D	**mg/L**				0.00109	0.00100	0.00106	0.00082	0.00071	0.00111	0.00114	0.00084	0.00103	0.00073	0.00229	0.00100	0.00103	0.00090	0.00138
Fe-D	**mg/L**				0.037	0.032	0.034	0.028	0.025	0.030	0.030	0.021	0.015	0.012	0.030	0.030	0.030	0.026	0.023
Pb-D	**mg/L**				0.00050	0.00050	0.00031	0.00020	0.00020	0.00050	0.00050	0.00020	0.00020	0.00020	0.00757	0.00050	0.00050	0.00024	0.00018
Hg-D	mg/L			0.0001000	0.0000200	0.0000192	0.0000168	0.0000167	0.0000071	0.0000200	0.0000192	0.0000150	0.0000169	0.0000060	0.0002467	0.0004620	0.0005140	0.0013260	0.0000014
Ni-D	**mg/L**				0.00100	0.00100	0.00075	0.00100	0.00100	0.00102	0.00100	0.00058	0.00100	0.00100	0.00800	0.00100	0.00100	0.00100	0.00085
Na-D	**mg/L**				9.38	12.14	11.05	8.44	10.07	2.24	2.00	1.33	0.69	0.67	6.57	13.42	11.05	7.21	7.40
K-D	**mg/L**				2.00	2.00	1.55	0.21	0.20	2.00	2.00	1.05	0.11	0.08	2.00	2.00	2.00	0.15	0.14
Zn-D	**mg/L**				0.0050	0.0050	0.0037	0.0050	0.0050	0.0050	0.0050	0.0030	0.0050	0.0056	0.0050	0.0050	0.0050	0.0060	0.0064

	Station Name	WQO	WQO-Av	WWQG	Mid Quinsam Lake 4M					Mid Quinsam Lake 9M					Mid Quinsam Lake 1M from B				
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
As-T	**mg/L**	**0.05000**		**0.005**	0.00050	0.00050	0.00050	0.00011	0.00015	0.00050	0.00050	0.00050	0.00010	0.00015	0.00050	0.00050	0.00050	0.00010	0.00013
Cd-T	**mg/L**	*			0.00001700	0.00002233	0.00001700	0.00001286	0.00000870	0.00001700	0.00001700	0.00001700	0.00001000	0.00000870	0.00001700	0.00001700	0.00001700	0.00001000	0.00000750
Cr-T	**mg/L**				0.00100	0.00100	0.00100	0.00100	0.00087	0.00100	0.00100	0.00100	0.00100	0.00085	0.00100	0.00100	0.00100	0.00100	0.00085
Co-T	**mg/L**	**0.0500**		**0.11**	0.0003	0.0003	0.0003	0.0005	0.0004	0.0003	0.0003	0.0003	0.0005	0.0004	0.0003	0.0003	0.0003	0.0005	0.0004
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0010	0.0010	0.0010	0.0013	0.0007	0.0010	0.0010	0.0010	0.0010	0.0012	0.0010	0.0012	0.0010	0.0006	0.0008
Fe-T	**mg/L**		**0.3000**	**1.0000**	0.0353	0.0347	0.0395	0.0400	0.0394	0.0316	0.0367	0.0300	0.0247	0.0323	0.0302	0.0448	0.0563	0.0910	0.0317
Hardness	**mg/L**				29.9	41.6	34.8	28.9	27.0	40.3	95.3	35.8	46.2	46.2	64.6	128.4	36.5	117.5	53.4
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0005	0.0005	0.0005	0.0002	0.0002	0.0005	0.0005	0.0005	0.0002	0.0002	0.0005	0.0005	0.0005	0.0002	0.0002
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.0050	0.0056	0.0087	0.0067	0.0068	0.0046	0.0118	0.0077	0.0085	0.0052	0.0114	0.0376	0.1080	0.1173	0.0076
Hg-T	**mg/L**	**0.0001**		**0.001**	0.0003107	0.0004187	0.0003427	0.0006014	0.0000069	0.0002434	0.0002077	0.0000863	0.0003867	0.0000073	0.0000720	0.0000767	0.0002162	0.0001817	0.0000073
Ni-T	**mg/L**	**0.025**			0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Ag-T	**mg/L**	**0.0001**			0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Zn-T	**mg/L**	**0.03**			0.005	0.005	0.005	0.005	0.004	0.005	0.005	0.005	0.005	0.004	0.005	0.005	0.005	0.005	0.004
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.01380	0.01443	0.01647	0.02217	0.02130	0.01110	0.00798	0.01365	0.01800	0.01660	0.00818	0.00740	0.01468	0.00880	0.01324
As-D	**mg/L**				0.00050	0.00050	0.00050	0.00010	0.00014	0.00050	0.00050	0.00050	0.00010	0.00015	0.00050	0.00050	0.00050	0.00010	0.00013
B-D	**mg/L**				0.100	0.100	0.100	0.050	0.050	0.100	0.100	0.100	0.052	0.073	0.100	0.100	0.100	0.052	0.076
Ca-D	**mg/L**				9.90	13.77	11.57	9.66	9.30	13.18	31.18	11.90	14.88	15.20	20.73	41.37	12.07	36.36	17.40
Cd-D	**mg/L**				0.00002	0.00002	0.00002	0.00002	0.00001	0.00002	0.00002	0.00002	0.00004	0.00001	0.00002	0.00002	0.00002	0.00001	0.00001
Cu-D	**mg/L**				0.00100	0.00195	0.00100	0.00087	0.00070	0.00100	0.00105	0.00102	0.00082	0.00052	0.00100	0.00122	0.00120	0.00054	0.00050
Fe-D	**mg/L**				0.030	0.030	0.031	0.028	0.021	0.030	0.030	0.030	0.019	0.010	0.030	0.030	0.031	0.017	0.010
Pb-D	**mg/L**				0.00050	0.00050	0.00050	0.00020	0.00017	0.00050	0.00050	0.00050	0.00026	0.00017	0.00050	0.00050	0.00050	0.00020	0.00017
Hg-D	**mg/L**			**0.00010**	0.00017	0.0003015	0.0002113	0.0004750	0.0000069	0.0001410	0.0001428	0.0000503	0.0003880	0.0000068	0.0000385	0.0000460	0.0001227	0.0001120	0.0000068
Ni-D	**mg/L**				0.00100	0.00100	0.00100	0.00100	0.00084	0.00100	0.00100	0.00100	0.00100	0.00085	0.00100	0.00100	0.00103	0.00100	0.00085
Na-D	**mg/L**				6.95	14.22	11.18	8.34	7.54	11.57	33.12	13.55	14.40	23.60	16.97	32.92	12.83	21.14	24.80
K-D	**mg/L**				2.00	2.00	2.00	0.17	0.14	2.00	2.00	2.00	0.23	0.31	2.00	2.00	2.00	0.29	0.32
Zn-D	**mg/L**				0.0050	0.0050	0.0050	0.0065	0.0043	0.0050	0.0050	0.0050	0.0062	0.0043	0.0050	0.0050	0.0050	0.0054	0.0042

2Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3

0.00002 at 60 mg/L CaCO3

0.00003 at 90 mg/L CaCO3

0.00004 at 120 mg/L CaCO3

0.00005 at 150 mg/L CaCO3

0.00006 at 210 mg/L CaCO3

TABLE 79

5 YEAR ANNUAL AVERAGES NORTH AND SOUTH MANAGEMENT SYSTEM

METALS ANALYSIS

2012/2013

	Station Name	WQO	WQO-Av	WWQG	Long Lake Middle 1M					Long Lake Middle 4M					Long Lake Middle 9M				
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
As-T	**mg/L**	**0.05000**		**0.005**	0.00063	0.00062	0.00056	0.00047	0.00055	0.00058	0.00059	0.00054	0.00031	0.00052	0.00057	0.00050	0.00050	0.00020	0.00025
Cd-T	**mg/L**	*			0.00001700	0.00001767	0.00001700	0.00001833	0.00001820	0.00001700	0.00001700	0.00001700	0.00001429	0.00057850	0.00001700	0.00001983	0.00001700	0.00001000	0.00001080
Cr-T	**mg/L**				0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100
Co-T	**mg/L**	**0.0500**		**0.11**	0.0003	0.0003	0.0003	0.0005	0.0005	0.0003	0.0003	0.0003	0.0005	0.0005	0.0003	0.0003	0.0003	0.0005	0.0005
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0010	0.0010	0.0010	0.0008	0.0004	0.0010	0.0010	0.0012	0.0008	0.0004	0.0010	0.0010	0.0012	0.0010	0.0004
Fe-T	**mg/L**		**0.3000**	**1.0000**	0.0712	0.0577	0.0552	0.0653	0.0627	0.0740	0.0718	0.0570	0.0440	0.0617	0.0964	0.0535	0.0578	0.0460	0.0413
Hardness	**mg/L**				97.2	89.6	87.8	66.2	73.8	137.8	135.4	110.5	119.8	93.1	149.1	163.5	156.7	156.0	140.0
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0005	0.0005	0.0005	0.0002	0.0002	0.0005	0.0005	0.0005	0.0007	0.0002	0.0005	0.0005	0.0008	0.0002	0.0002
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.0165	0.0082	0.0108	0.0162	0.0141	0.0399	0.0304	0.0177	0.0310	0.0131	0.2159	0.2675	0.0868	0.0840	0.0322
Hg-T	mg/L	0.0001000		0.0010000	0.0008103	0.0002685	0.0011537	0.0012417	0.0000073	0.0003795	0.0002470	0.0005035	0.0004917	0.0000084	0.0004067	0.0000763	0.0001160	0.0001500	0.0000077
Ni-T	**mg/L**	**0.025**			0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Ag-T	**mg/L**	**0.0001**			0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Zn-T	**mg/L**	**0.03**			0.005	0.005	0.005	0.005	0.008	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.03544	0.01043	0.01330	0.01750	0.01130	0.00602	0.00663	0.01272	0.01383	0.01090	0.00629	0.00618	0.01160	0.01600	0.00710
As-D	**mg/L**				0.02909	0.00060	0.00056	0.00043	0.00056	0.00057	0.00058	0.00055	0.00025	0.00050	0.00056	0.00050	0.00050	0.00020	0.00022
B-D	**mg/L**				0.117	0.117	0.107	0.063	0.066	0.147	0.144	0.103	0.120	0.086	0.156	0.163	0.150	0.150	0.137
Ca-D	**mg/L**				34.61	30.57	29.98	23.86	25.30	47.98	47.01	38.17	41.13	31.00	52.04	56.85	54.60	52.80	47.90
Cd-D	**mg/L**				0.00144	0.00002	0.00002	0.00002	0.00001	0.00002	0.00002	0.00002	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00001
Cu-D	**mg/L**				0.00233	0.00105	0.00270	0.00070	0.00050	0.00100	0.00100	0.00220	0.00075	0.00039	0.00100	0.00100	0.00228	0.00070	0.00035
Fe-D	**mg/L**				0.034	0.038	0.032	0.035	0.042	0.035	0.039	0.031	0.018	0.038	0.041	0.033	0.030	0.015	0.015
Pb-D	**mg/L**				0.00757	0.00050	0.00050	0.00020	0.00020	0.00050	0.00050	0.00050	0.00020	0.00020	0.00050	0.00050	0.00050	0.00020	0.00020
Hg-D	mg/L			0.0001000	0.0004268	0.0001670	0.0007298	0.0010714	0.0000073	0.0001633	0.0001155	0.0003607	0.0003214	0.0000073	0.0001633	0.0000345	0.0000705	0.0000900	0.0000073
Ni-D	**mg/L**				0.00800	0.00100	0.00100	0.00100	0.00100	0.00105	0.00103	0.00100	0.00100	0.00100	0.00100	0.00100	0.00103	0.00100	0.00100
Na-D	**mg/L**				17.10	15.58	12.63	9.54	9.69	24.13	23.96	16.50	20.13	12.80	26.46	28.32	25.87	25.30	22.50
K-D	**mg/L**				2.00	2.00	2.00	0.30	0.30	2.00	2.00	2.00	0.53	0.38	2.00	2.00	2.00	0.67	0.62
Zn-D	**mg/L**				0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050

	Station Name	WQO	WQO-Av	WWQG	Long Lake Middle 1M From B					3 South					4S-Lower					LLE			
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
As-T	**mg/L**	**0.05000**		**0.005**	0.00050	0.00050	0.00052	0.00025	0.00024	0.18481	0.12340	0.00113	0.00024	0.00032	0.20000	0.17783	0.03155	0.00015	0.00023	0.06153	0.00243	0.00156	0.00133
Cd-T	**mg/L**	*			0.00001637	0.00001591	0.00001700	0.00001167	0.00001130	0.00923731	0.00615540	0.00006181	0.00002500	0.00002940	0.01000000	0.00889078	0.00156123	0.00001364	0.00001750	0.00301270	0.00003147	0.00001385	0.00001230
Cr-T	**mg/L**				0.00100	0.00100	0.00100	0.00100	0.00100	0.00962	0.00795	0.00238	0.00100	0.00100	0.01000	0.00900	0.00481	0.00100	0.00100	0.00370	0.00127	0.00100	0.00100
Co-T	**mg/L**	**0.0500**		**0.11**	0.0003	0.0003	0.0003	0.0005	0.0005	0.0093	0.0072	0.0024	0.0012	0.0012	0.0100	0.0091	0.0035	0.0007	0.0036	0.0033	0.0010	0.0006	0.0005
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0010	0.0010	0.0012	0.0011	0.0004	0.0096	0.0080	0.0039	0.0020	0.0020	0.0100	0.0090	0.0068	0.0004	0.0004	0.0039	0.0019	0.0009	0.0008
Fe-T	**mg/L**		**0.3000**	**1.0000**	0.1137	0.0647	0.1443	0.0602	0.0447	0.1392	0.1452	0.3212	0.2532	0.2935	0.7000	1.8779	2.7717	0.7768	3.2700	0.7653	2.3161	2.0803	0.9710
Hardness	**mg/L**				160.1	163.4	159.7	152.0	142.0	880.7	902.2	731.1	486.6	638.0	-	301.20	239.9	184.7	193.0	117.2	179.9	165.2	203.8
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0005	0.0005	0.0005	0.0002	0.0002	0.0463	0.0315	0.0010	0.0002	0.0002	0.0500	0.0445	0.0081	0.0002	0.0002	0.0154	0.0004	0.0002	0.0002
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.6295	1.0881	0.6015	0.2762	0.2693	0.1467	0.1512	0.1492	0.0401	0.0351	0.1860	1.7128	0.2912	0.5201	2.6940	0.0916	0.2016	0.2205	0.1117
Hg-T	**mg/L**	**0.0001**		**0.001**	0.0000591	0.0000520	0.0000612	0.0001150	0.0000073	0.0000200	0.0000191	0.0000200	0.0000170	0.0000115	-	0.0000200	0.0000255	0.0000156	0.0000092	0.0000186	0.0000180	0.0000177	0.0000081
Ni-T	**mg/L**	**0.025**			0.001	0.001	0.001	0.001	0.001	0.047	0.034	0.006	0.003	0.003	0.050	0.045	0.011	0.001	0.004	0.016	0.002	0.001	0.001
Ag-T	**mg/L**	**0.0001**			0.00002	0.00002	0.00002	0.00002	0.00002	0.00924	0.00616	0.00005	0.00002	0.00002	0.01000	0.00889	0.00156	0.00002	0.00002	0.00301	0.00002	0.00002	0.00002
Zn-T	**mg/L**	**0.03**			0.005	0.005	0.005	0.005	0.007	0.005	0.005	0.006	0.008	0.007	0.014	0.105	0.024	0.009	0.094	0.005	0.006	0.005	0.005
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.02070	0.00803	0.01012	0.01133	0.00580	0.02738	0.02682	0.01975	0.03756	0.04430	-	0.02620	0.01902	0.02514	0.00820	0.04047	0.04211	0.03514	0.03350
As-D	**mg/L**				0.01475	0.00254	0.00050	0.00020	0.00022	0.00223	0.00230	0.00103	0.00020	0.00026	-	0.00061	0.00026	0.00015	0.00015	0.00212	0.00195	0.00130	0.00113
B-D	**mg/L**				0.160	0.164	0.150	0.150	0.138	0.349	0.357	0.332	0.170	0.219	-	0.128	0.102	0.080	0.075	0.102	0.075	0.071	0.087
Ca-D	**mg/L**				54.89	56.61	55.75	52.47	48.60	299.66	306.84	247.74	161.58	190.62	-	99.65	76.35	60.75	63.30	38.55	57.86	52.67	65.10
Cd-D	**mg/L**				0.00073	0.00012	0.00002	0.00001	0.00001	0.00011	0.00010	0.00015	0.00003	0.00002	-	0.00003	0.00014	0.00001	0.00002	0.00002	0.00005	0.00001	0.00001
Cu-D	**mg/L**				0.00164	0.00109	0.00217	0.00092	0.00034	0.00446	0.00464	0.00399	0.00146	0.00144	-	0.00122	0.00106	0.00057	0.00046	0.00154	0.00153	0.00092	0.00054
Fe-D	**mg/L**				0.030	0.030	0.031	0.017	0.009	0.030	0.033	0.025	0.014	0.016	-	1.550	0.279	0.681	2.134	0.578	1.620	1.500	0.647
Pb-D	**mg/L**				0.00404	0.00101	0.00050	0.00020	0.00020	0.00223	0.00230	0.00097	0.00020	0.00020	-	0.00061	0.00029	0.00020	0.00021	0.00050	0.00032	0.00022	0.00020
Hg-D	**mg/L**			**0.0001**	0.0000297	0.0000228	0.0000353	0.0000767	0.0000073	0.0000200	0.0000205	0.0000163	0.0000173	0.0002105	-	0.0000189	0.0000169	0.0000147	0.0000092	0.0000190	0.0000160	0.0000171	0.0000081
Ni-D	**mg/L**				0.00453	0.00150	0.00113	0.00100	0.00100	0.00527	0.00602	0.00599	0.00256	0.00290	-	0.00291	0.00123	0.00124	0.00330	0.00100	0.00102	0.00111	0.00100
Na-D	**mg/L**				27.67	28.45	26.77	25.57	22.60	73.32	73.03	91.29	19.79	26.72	-	12.66	14.25	7.35	6.11	6.25	9.03	7.32	12.35
K-D	**mg/L**				2.00	2.00	2.00	0.68	0.63	3.46	3.49	3.33	1.91	2.00	-	2.00	1.16	0.56	0.73	2.00	1.13	0.47	1.18
Zn-D	**mg/L**				0.0050	0.0050	0.0050	0.0050	0.0050	0.0052	0.0053	0.0061	0.0054	0.0057	-	0.1026	0.0178	0.0097	0.0880	0.0050	0.0051	0.0056	0.0050

*Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

TABLE 80: SUMMARY OF EXCEEDANCES, PERMIT NON-COMPLIANCE, UNMET WATER QUALITY OBJECTIVES & GUIDELINES

	Site	Parameter	Permit requirement	Measured data	Date	Comments
Permit Exceedance	**WD**	TSS	< 25 mg/L	28.3 mg/L	15-Sep-12	
		TSS	< 25 mg/L	26.0 mg/L	22 Mar-13	Replaced Suction Line
	7SSD	Cadmium (d)	<0.000045	0.000069 mg/L	Mar 18-13	
Permit Non-Compliance	**WD**	TSS	Daily Composite For TSS	No sample taken	15-Apr-12,Jan 9,27 & Feb 24	Equipment malfunction/Power failure
		Flow data	Continuous data	No data	Dec 12-31,Jan 1-3, 5-9, 25-29, Feb 5	Equipment malfunction
		Daily Composite For TSS	Daily Composite For TSS	Grab sample was taken	Jan 21, March 11, 13,1,24, 15,20	Equipment malfunction
	WC	Nitrate/Nitrite	Bi-weekly sample req.	No sample taken	Apr-Sep 4 x Oct-Dec	Sampler error
		Dissolved Phosphorous	Bi-weekly sample req.	Monthly sample taken	Jul-Sep 1 X Oct	Sampler error
	2NPS	Ammonia	Bi-monthly sample req.	No sample taken	Apr-Sep 1x Oct	Sampler error
		Nitrate/Nitrite	Bi-monthly sample req.	No sample taken	Apr-Sep 1x Oct	Sampler error
	SPC	TSS	Bi-weekly sample req	No sample taken	3x Oct-Dec	Sampler error
		Nitrate/Nitrite	Bi-monthly sample req.	No sample taken	Apr-Jul , Nov (2x Oct-Dec)	Sampler error
	3S	Ammonia	Bi-monthly sample req.	No sample taken	Apr-Sep	Sampler error
		Nitrate/Nitrite	Bi-monthly sample req.	No sample taken	Apr-Sep	Sampler error
		Dissolved Phosphorous	Bi-monthly sample req.	No sample taken	Apr-Sep 1 X Oct	Sampler error
		Total Phosphorous	Bi-monthly sample req.	No sample taken	1 X Oct	Sampler error
		Field pH/uS	Field pH/uS	Lab pH and Conductivity	Mar 5	Sampler error
	WB	Flow data	Daily max and avg.	No data	Apr-Sep	Sampler error
	MQL	Secchi disc	Measurement req.	No data	May	Sampler error
	MQL	Chlorophyll "A" & Pheopigement	Sample Apr-Sep	No data	Sep	Laboratory error
	LLM	Secchi disc	Measurement req.	No data	Aug	Sampler error
		Taxonomy	Sample Apr-Sep	No data	Sep	Arrived unpreserved Sampler Error

TABLE 80: SUMMARY OF EXCEEDANCES, PERMIT NON-COMPLIANCE, UNMET WATER QUALITY OBJECTIVES & GUIDELINES

Permit Non-Compliance	Site	Parameter	Permit requirement	Measured data	Date	Comments
Permit Non-Compliance	WP	T + D Metals	Monthly sample req.	No sample taken	1x Oct	Due to PAG removal
		Field pH	Field pH/uS	Lab pH	Jan 29 Feb 25	Sampler error
	WA	Cond, pH, TSS	Monthly sample req.	No sample taken	1x Dec	Due to weather
	4S-Lo	Field pH	Data required	No data	Mar 19	Sampler error
	SDS	Field pH	Data required	No data	Feb 25, Mar 4	Sampler error
	LLE	Field pH/uS	Data required	No data	Jan 29	Sampler error

TABLE 80: SUMMARY OF EXCEEDANCES, PERMIT NON-COMPLIANCE, UNMET WATER QUALITY OBJECTIVES & GUIDELINES

	Site	Parameter	WQO	Measured data	Date	Comments
Unmet Water Quality Objectives & Guidelines	MQL	Cadmium (T)	Based on hardness	0.00001 mg/L, 0.00001 mg/L	Jul	4m depth, 9m depth
	LLM	Sulphate (D)	< 100 mg/L	136 mg/L, 139 mg/L	Apr	9m depth, Bottom
				131 mg/L, 137 mg/L	May	9m depth, Bottom
				139, 131, 133 mg/L	June	9m, 9m*, Bottom
				135, 133 mg/L	July	9m, Bottom, Bottom*
				138 mg/L, 142 mg/L	Aug	9m depth, Bottom
				132 mg/L, 131 mg/L	Sept	9m depth, Bottom
		Manganese (T)	< 0.05 mg/L	0.0688 mg/L	Apr	Bottom
				0.0647 mg/L	May	Bottom
				0.127 mg/L	Jun	Bottom
				0.152 mg/L	Jul	Bottom
				0.0632 mg/L	Aug	Bottom
				1.14 mg/L	Sep	Bottom
		Cadmium (T)	Based on hardness (30 mg/L) <0.00001 mg/L	>0.00001mg/L	Jun	All Depths
				>0.00001 mg/L	July	1 and 9 m Depths
				>0.00001 mg/L	Aug	4m Depths
	LLO	TSS	25 mg/L	52 mg/L	13-Nov	**One Max value**. Average over 30 days is below Objective.
		Sulphate (D)	100 mg/L	108 mg/L	23-Oct	
		Manganese (T)	< 0.05 mg/L	0.0514 mg/L	5-Jun-12	
	NNO	Cadmium	≤ 0.00001 mg/L	0.00012 mg/L	9 Oct,11 Dec	
		Manganese (T)	< 0.05 mg/L	0.0912 mg/L	30-Apr-12	
	WA	TSS	< 25mg/L	67.3 mg/L	1-Apr-12	**One Max value**. Average over 30 days is below Objective.
	LLE	Sulphate (D)	<100 mg/L	>100 mg/L	27/41 events	67 % of samples
		Iron (T)	≤ 0.3 mg/L	≥0.3 mg/L	18/21 events	86% of samples
		Cadmium (T)	<0.00001 mg/L	>0.00001 mg/L	5/21 events	24% of samples
		Manganese (T)	0.05 mg/L	>0.05 mg/L	14/21 events	67 % of samples
		Copper(T)	≤0.002 mg/L	>0.002 mg/L	1/ 21 events	5 % of samples

List of Graphs

Graph 1	Hardness Settling Pond 4
Graph 2	pH Settling Pond 4
Graph 3	Total Suspended Solids Pond 4
Graph 4	Alkalinity Settling Pond 4
Graph 5	Sulphate Settling Pond 4
Graph 6	Ammonia Nitrogen Settling Pond 4
Graph 7	Nitrate Nitrogen Settling Pond 4
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Graph 9	Dissolved Aluminum Settling Pond 4
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Graph 11	Dissolved Copper Settling Pond 4
Graph 12	Dissolved Iron Settling Pond 4
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Graph 21	Alkalinity Settling Pond 1
Graph 22	Sulphate Settling Pond 1
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Graph 24	Nitrate Nitrogen Settling Pond 1
Graph 25	Dissolved Phosphate Settling Pond 1
Graph 26	Dissolved Aluminum Settling Pond 1
Graph 27	Dissolved Arsenic Settling Pond 1
Graph 28	Dissolved Copper Settling Pond 1
Graph 29	Dissolved Iron Settling Pond 1
Graph 30	Dissolved Lead Settling Pond 1
Graph 31	Dissolved Selenium Settling Pond 1
Graph 32	Dissolved Zinc Settling Pond 1

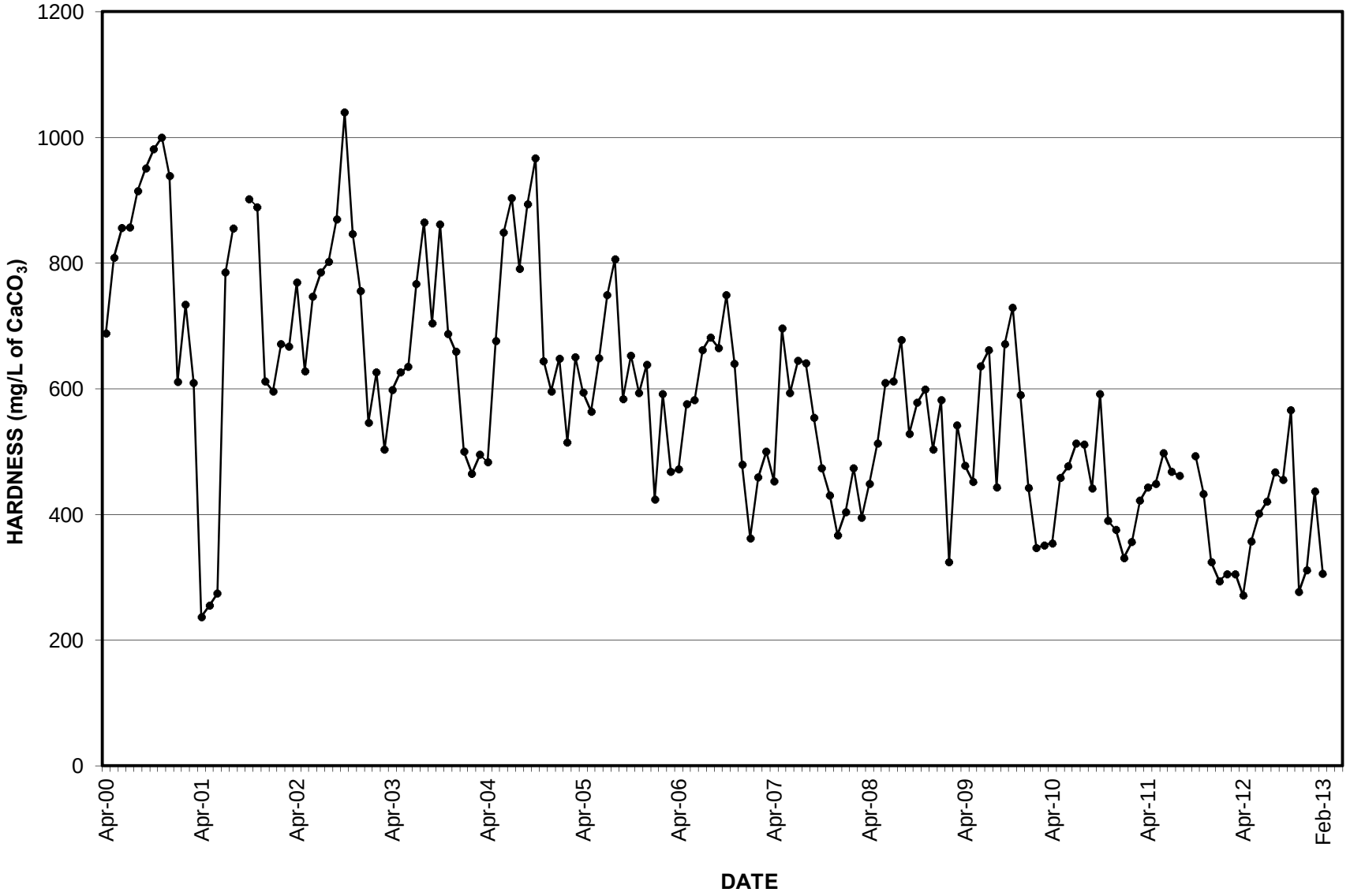
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GRAPH 37	SULPHATE NORTH PIT SUMP (WP)
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GRAPH 43	MIDDLE QUINSAM LAKE PH
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GRAPH 48	LONG LAKE PH
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GRAPH 52	LONG LAKE OUTLET PH
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GRAPH 54	SEEP INTO LONG LAKE (LLS) PH
GRAPH 55	SEEP INTO LONG LAKE (LLS) ALKALINITY
GRAPH 56	SEEP INTO LONG LAKE (LLS) SULPHATE
GRAPH 57	NO NAME LAKE PH
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GRAPH 66 DISSOLVED IRON SETTLING POND 7SSD VS 7S
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GRAPH 69 FIELD PH SETTLING POND 7SSD SOLIDS VS 7S
GRAPH 70 LABORATORY PH SETTLING POND 7SSD VS 7S

GRAPH 1

HARDNESS

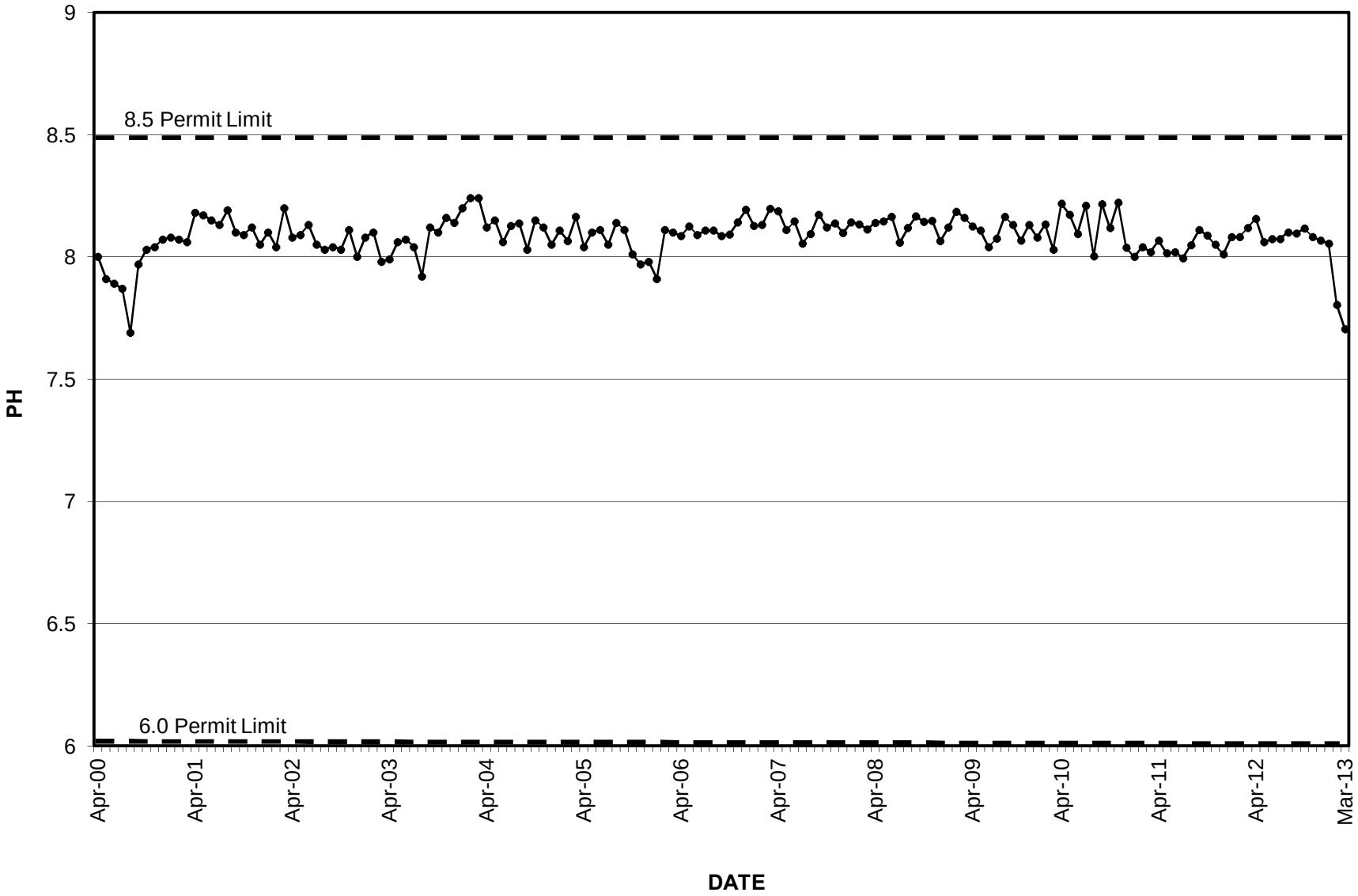
SETTLING POND 4



GRAPH 2

PH

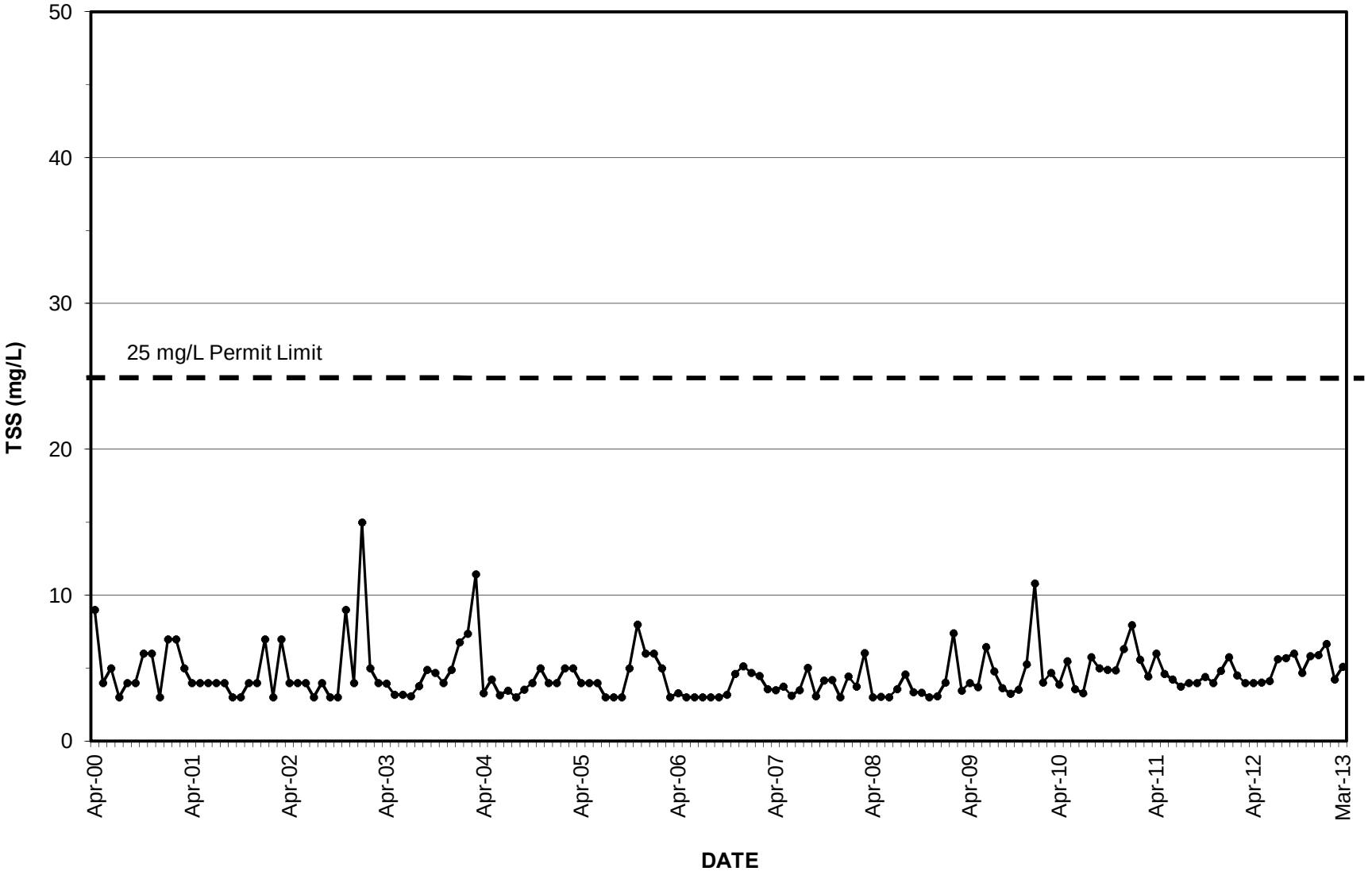
SETTLING POND 4



GRAPH 3

TOTAL SUSPENDED SOLIDS

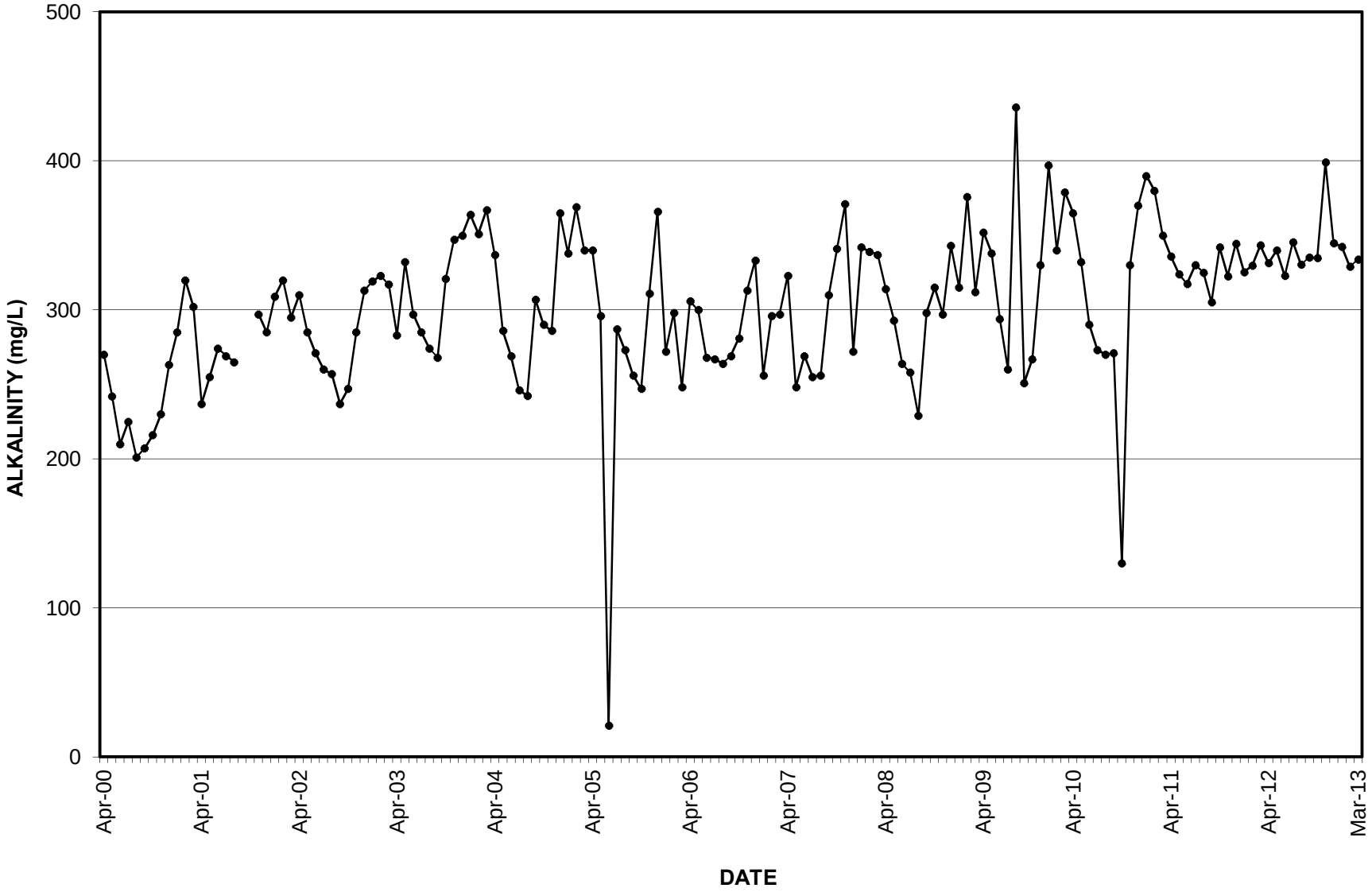
SETTLING POND 4



GRAPH 4

ALKALINITY

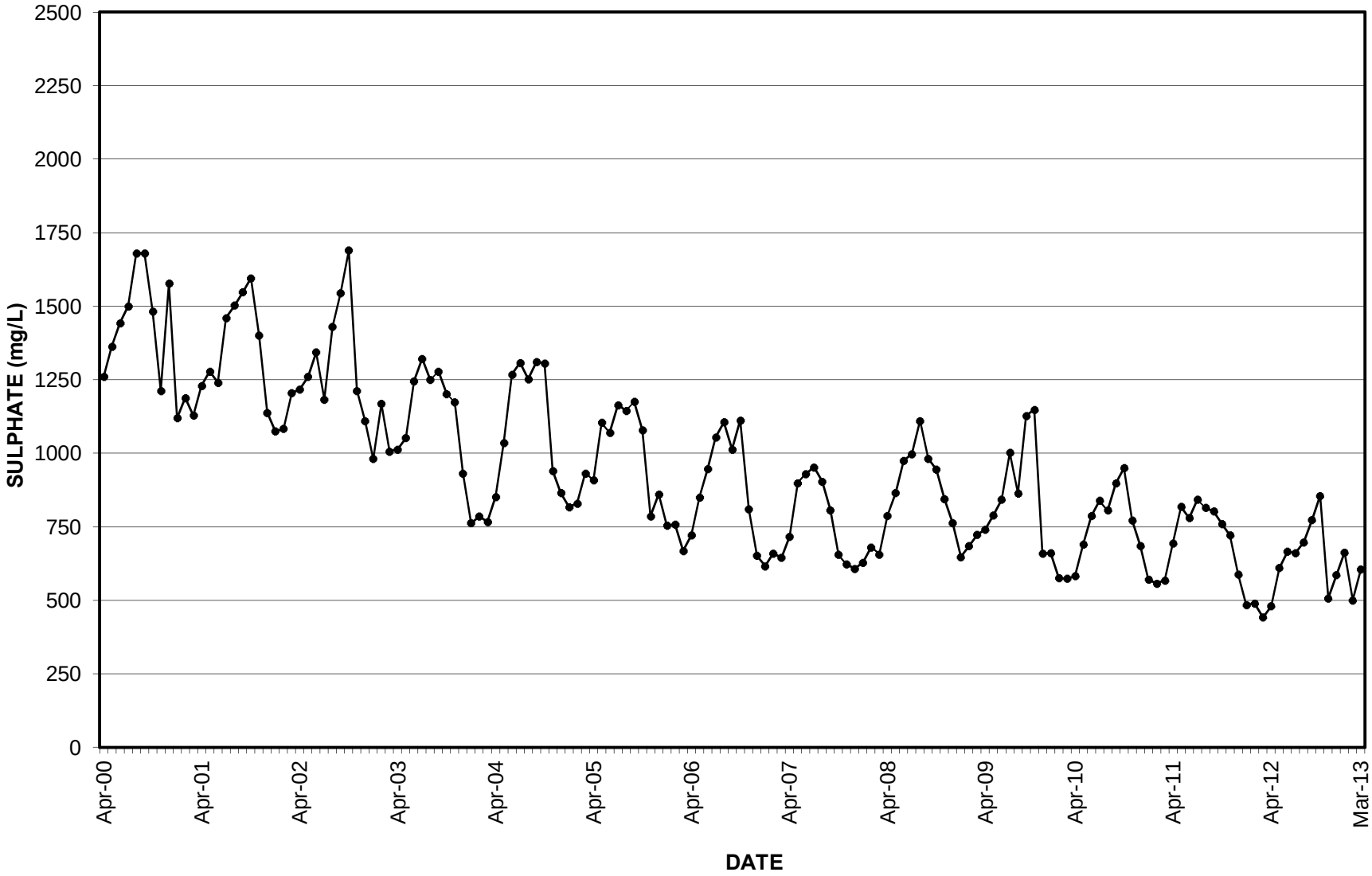
SETTLING POND 4



GRAPH 5

SULPHATE

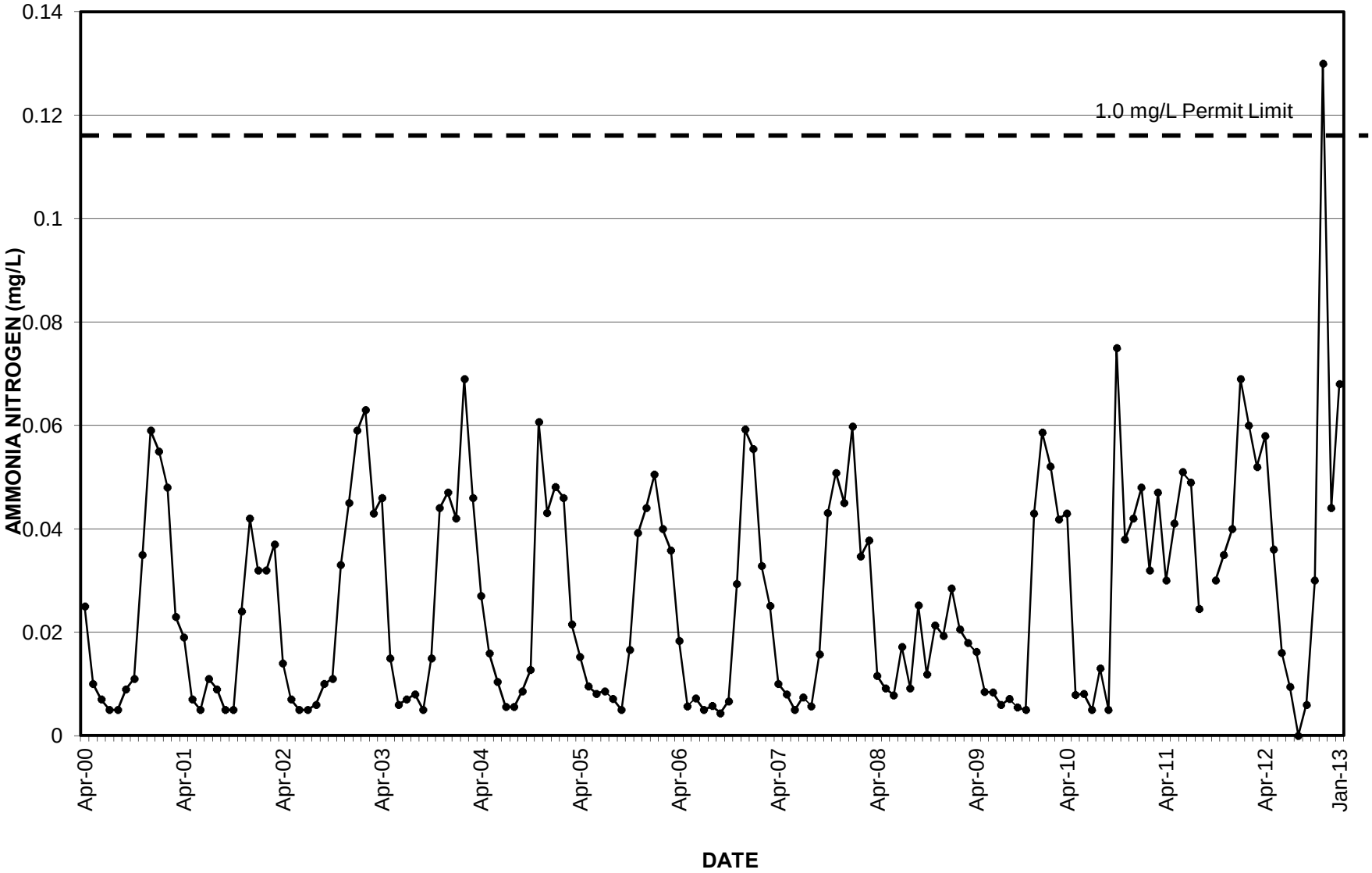
SETTLING POND 4



GRAPH 6

AMMONIA NITROGEN

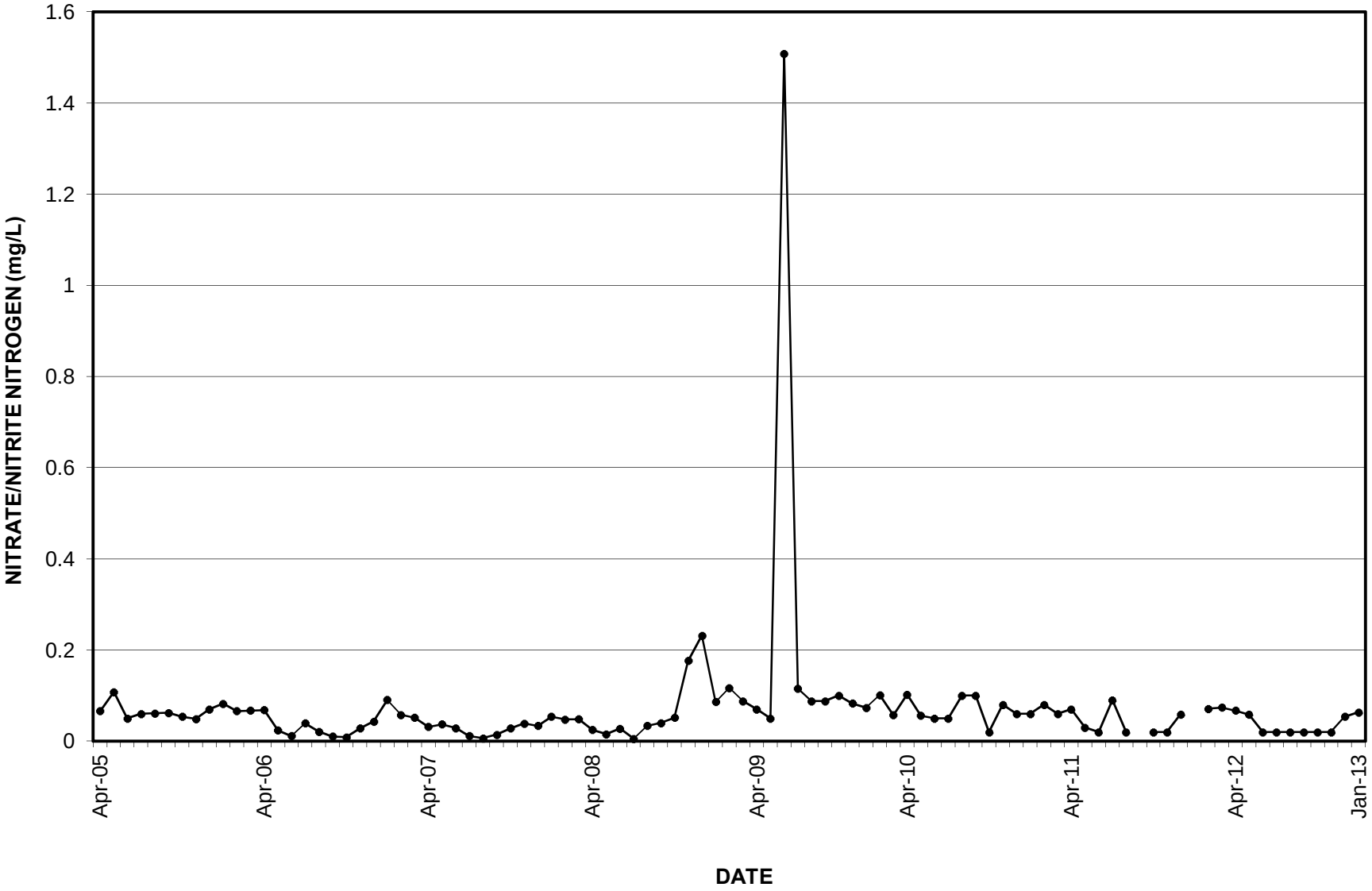
SETTLING POND 4



GRAPH 7

NITRATE/NITRITE NITROGEN

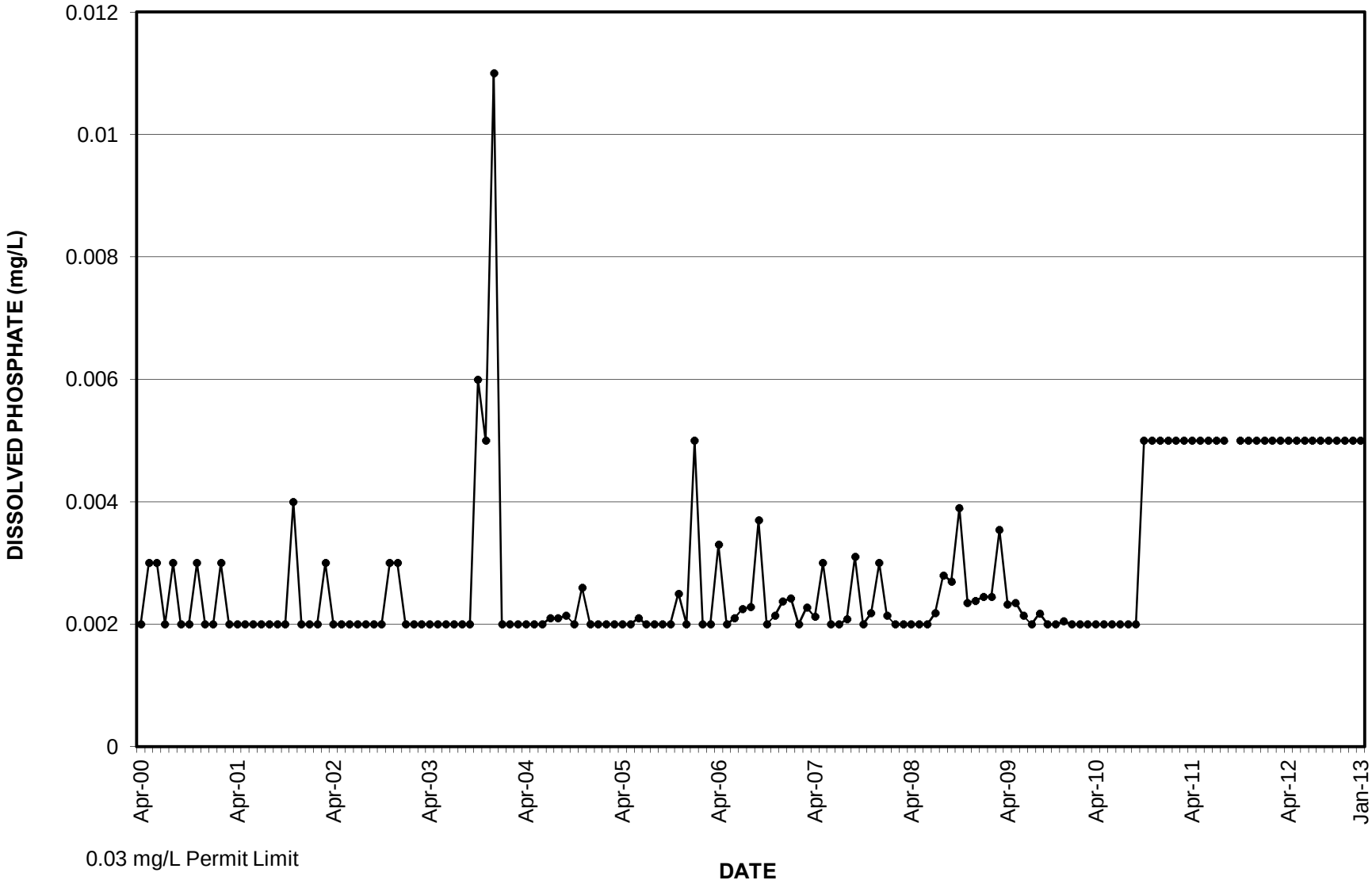
SETTLING POND 4



GRAPH 8

DISSOLVED PHOSPHOROUS

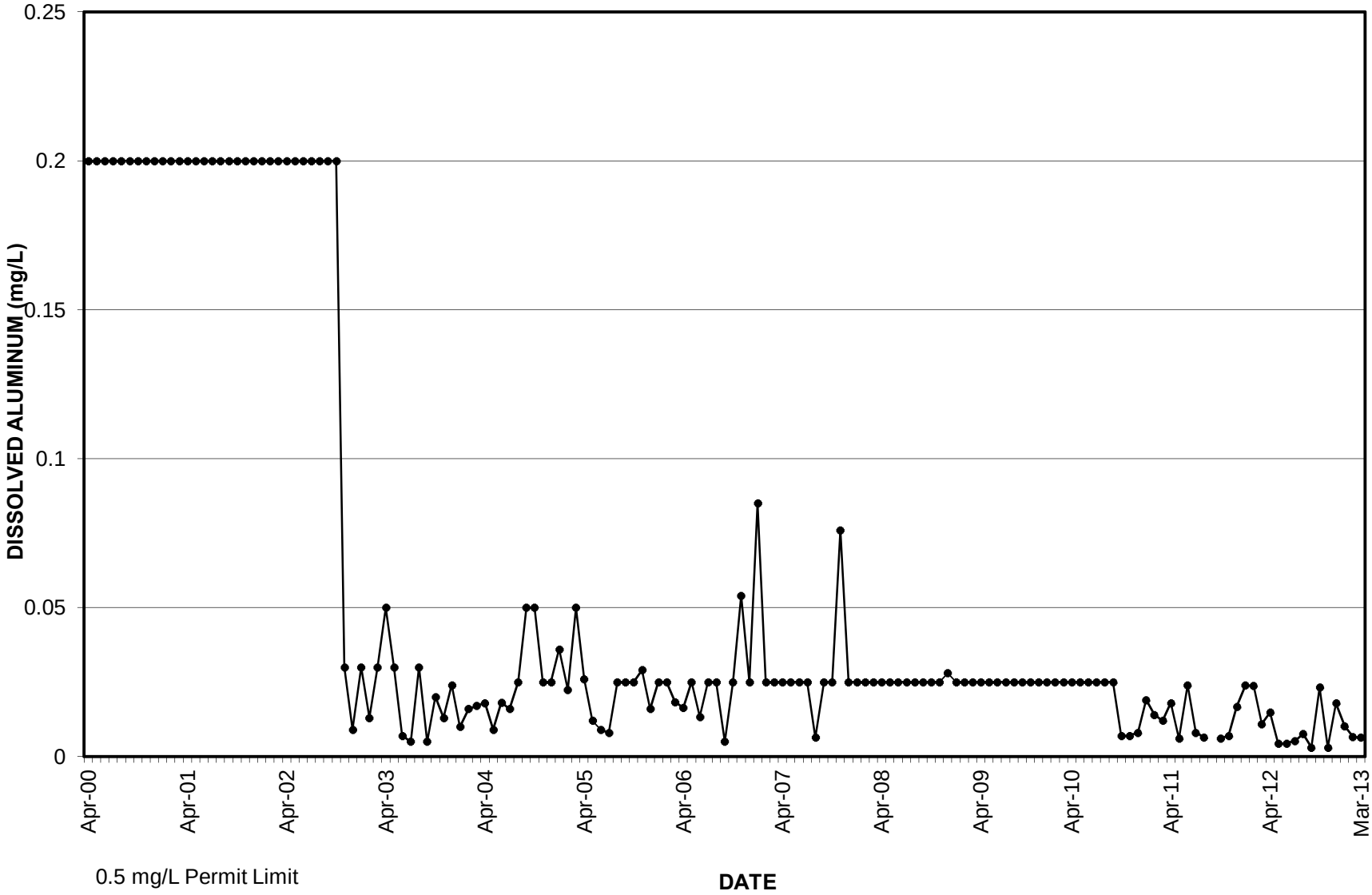
SETTLING POND 4



GRAPH 9

DISSOLVED ALUMINUM

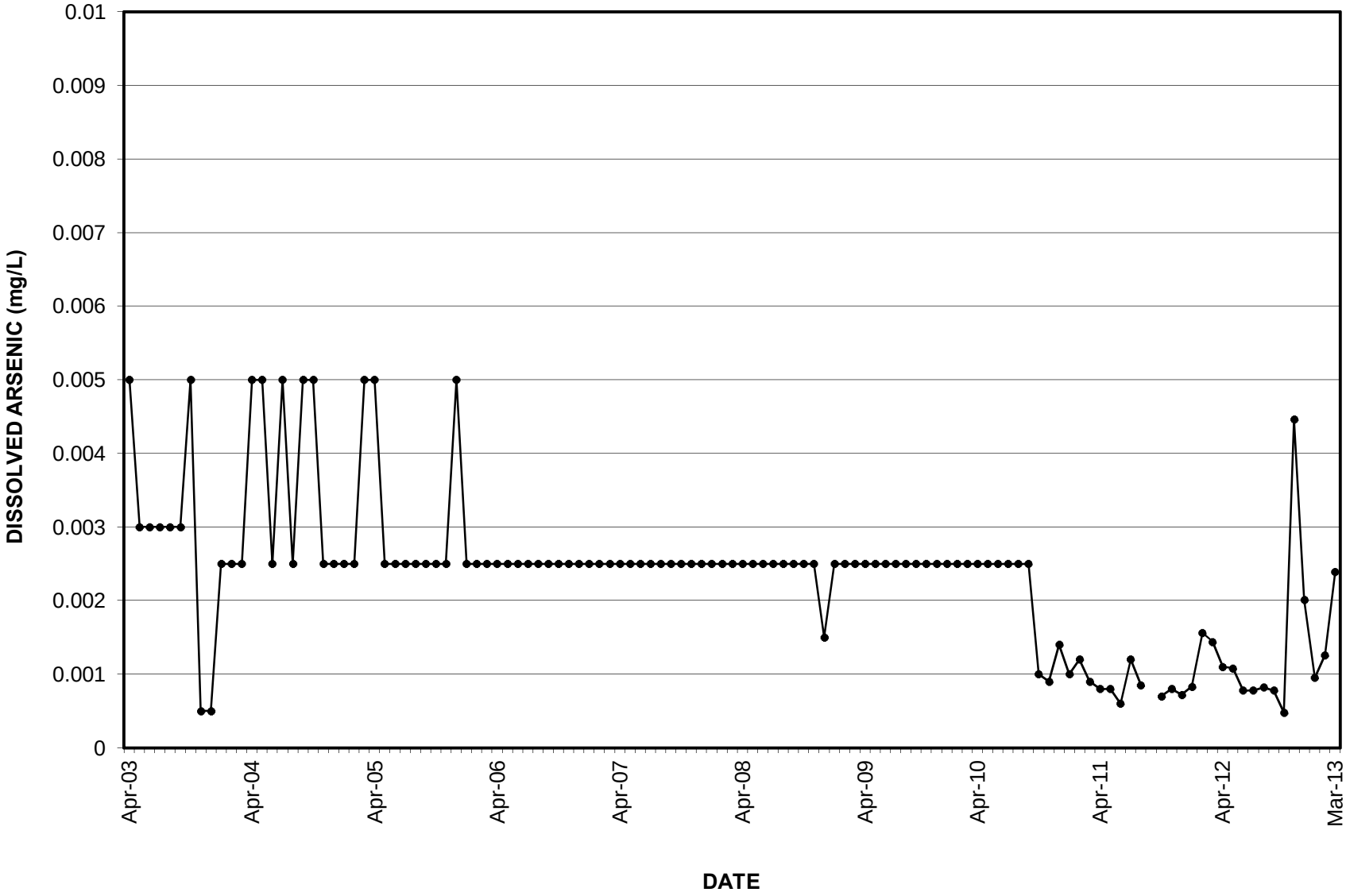
SETTLING POND 4



GRAPH 10

DISSOLVED ARSENIC

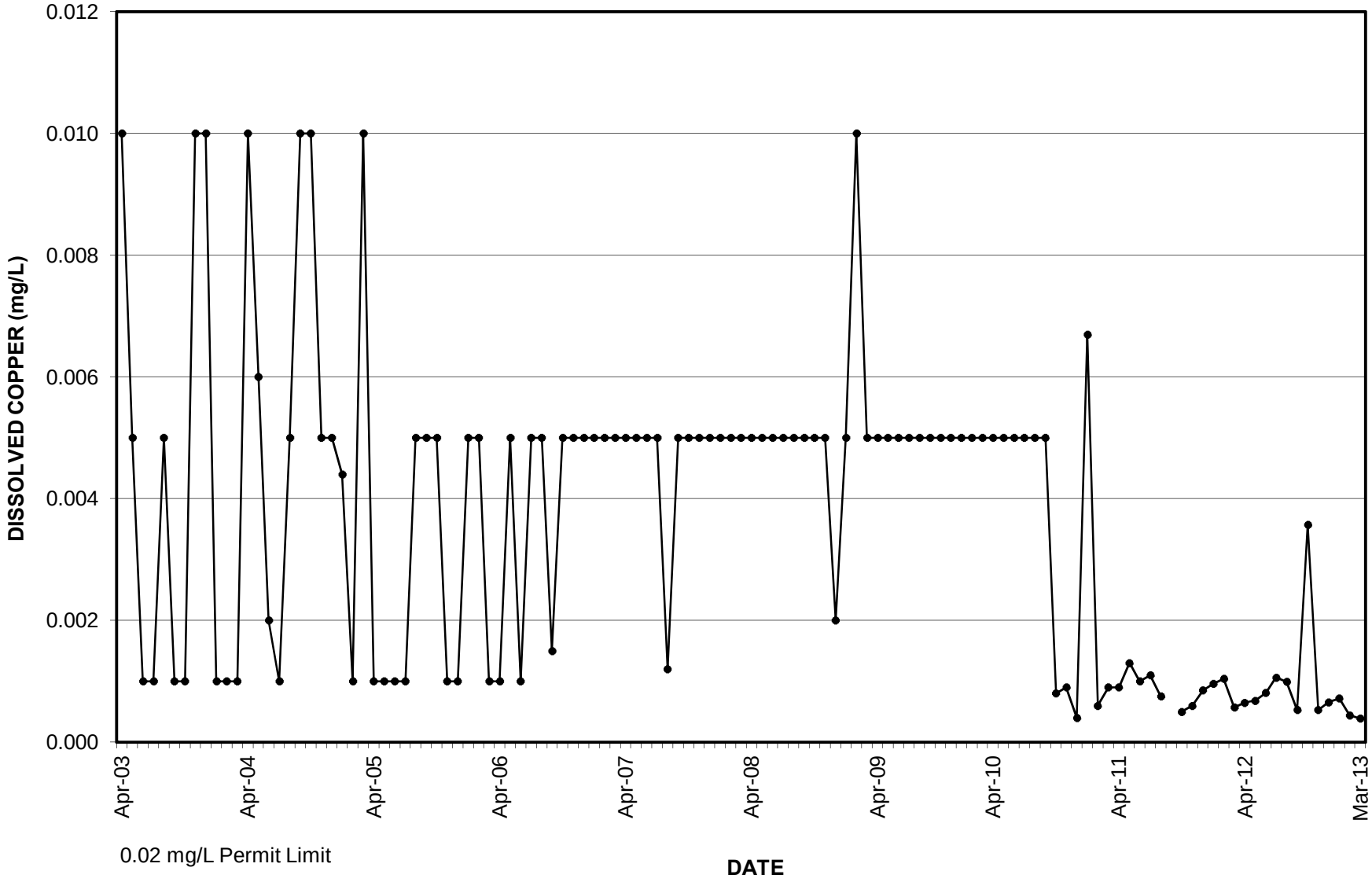
SETTLING POND 4



GRAPH 11

DISSOLVED COPPER

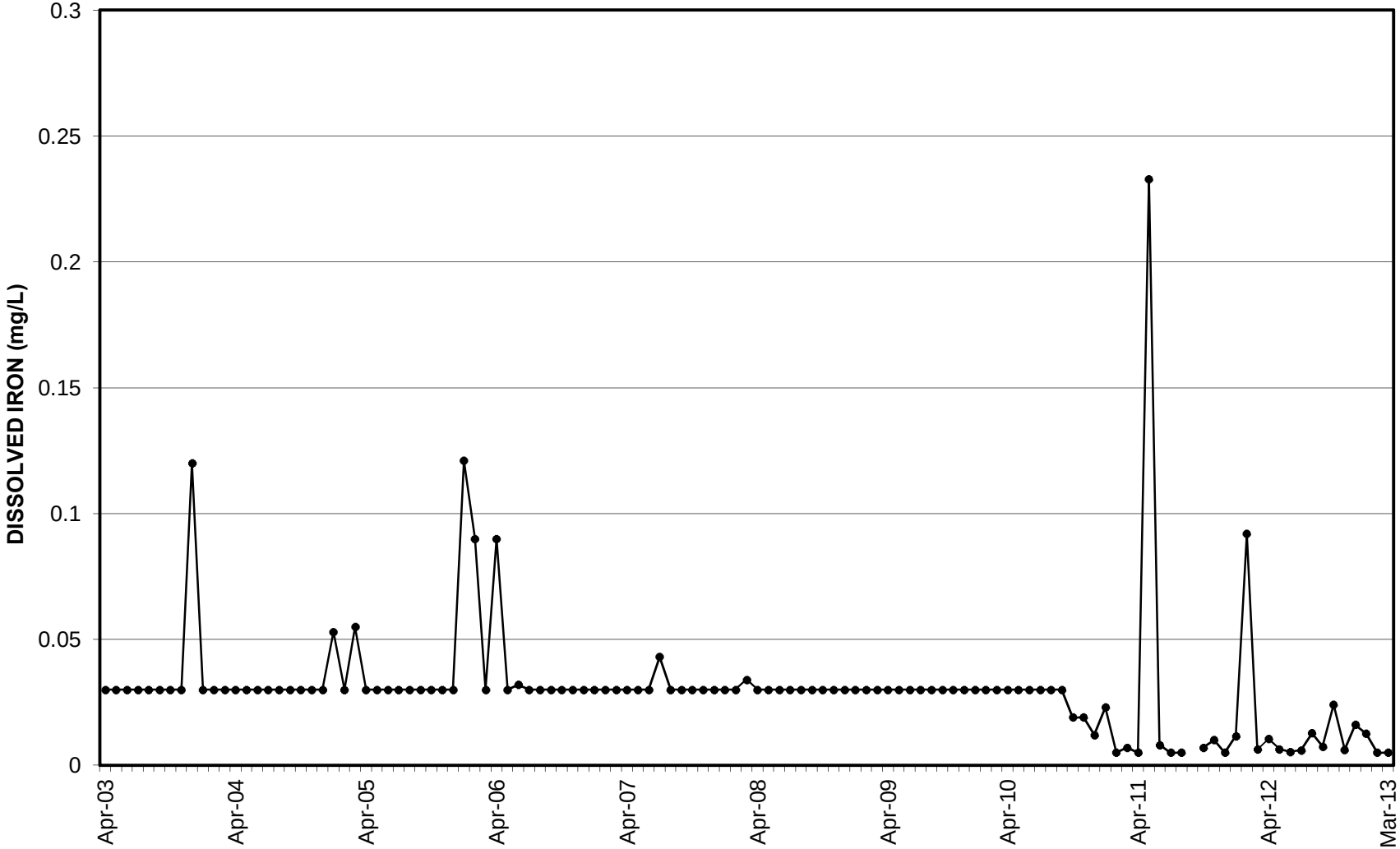
SETTLING POND 4



GRAPH 12

DISSOLVED IRON

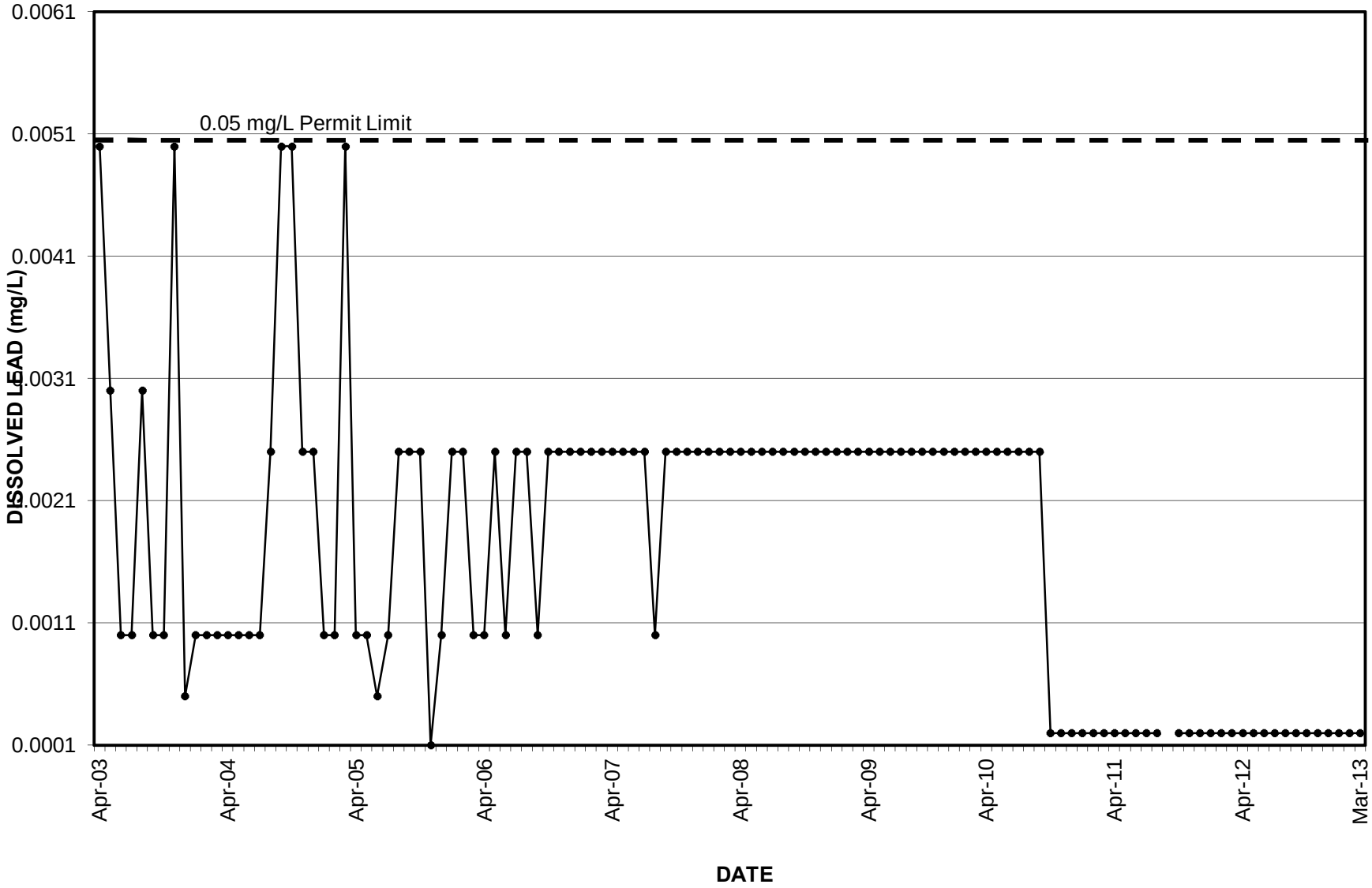
SETTLING POND 4



GRAPH 13

DISSOLVED LEAD

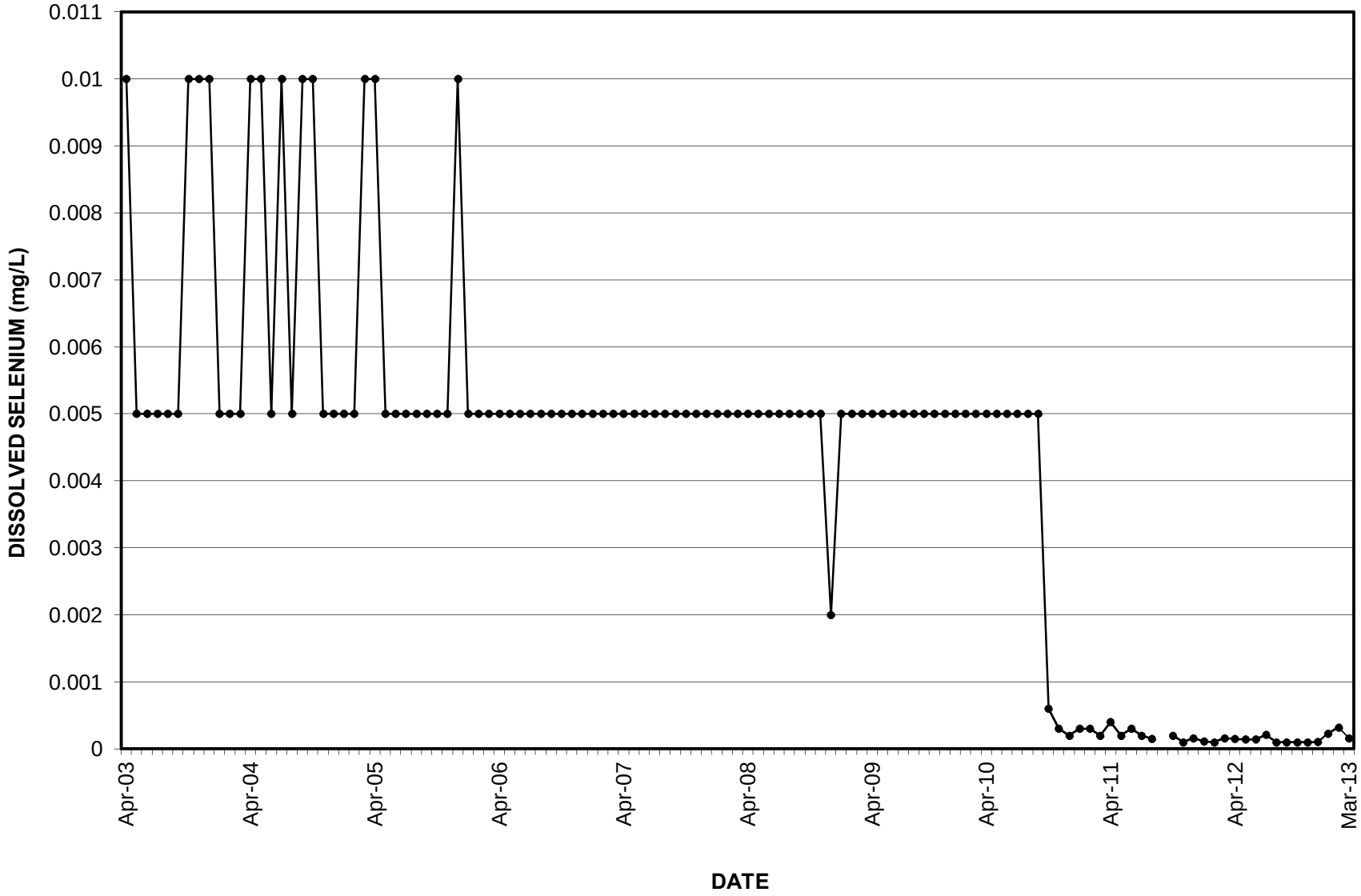
SETTLING POND 4



GRAPH 14

DISSOLVED SELENIUM

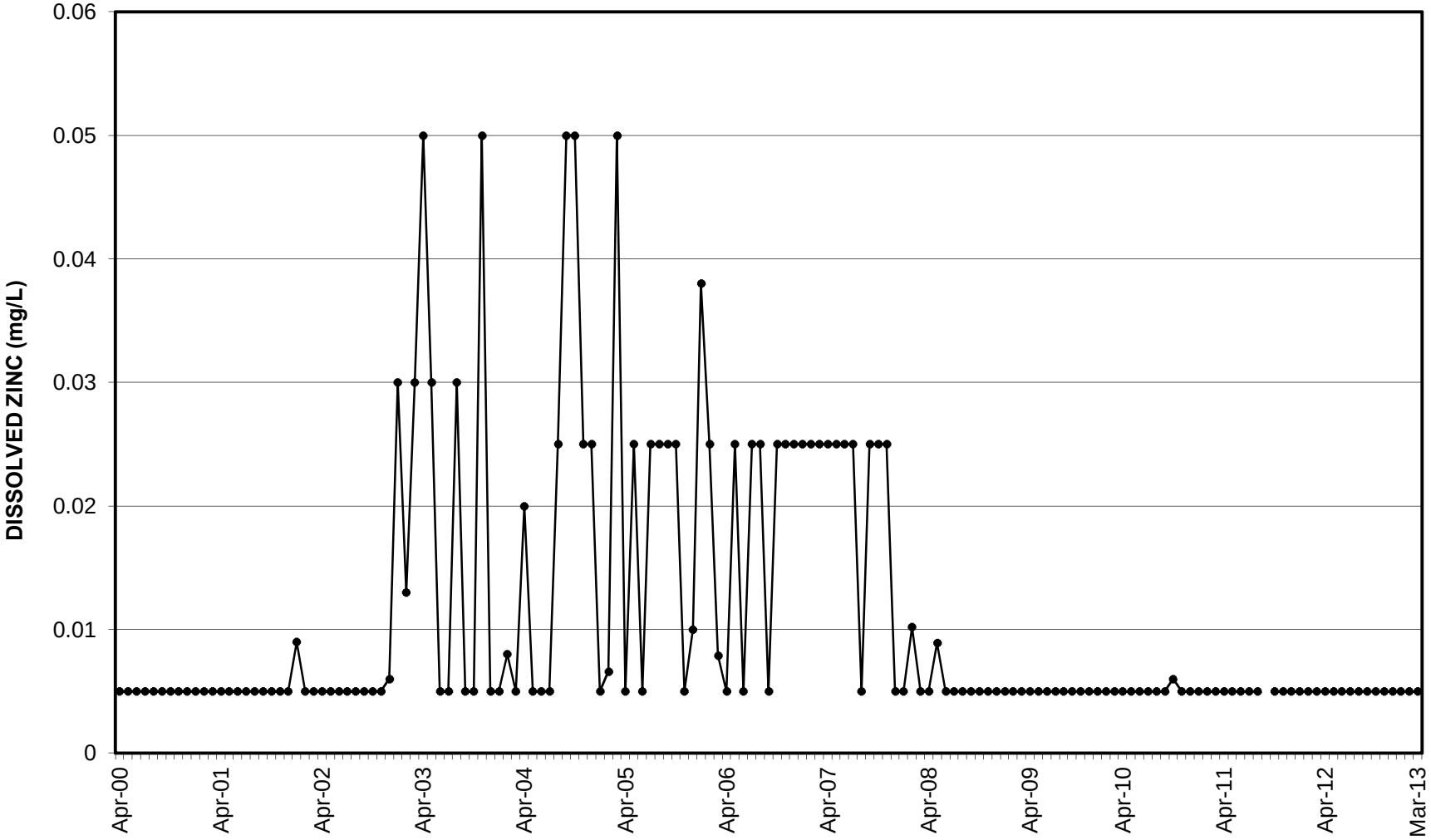
SETTLING POND 4



Graph 15

DISSOLVED ZINC

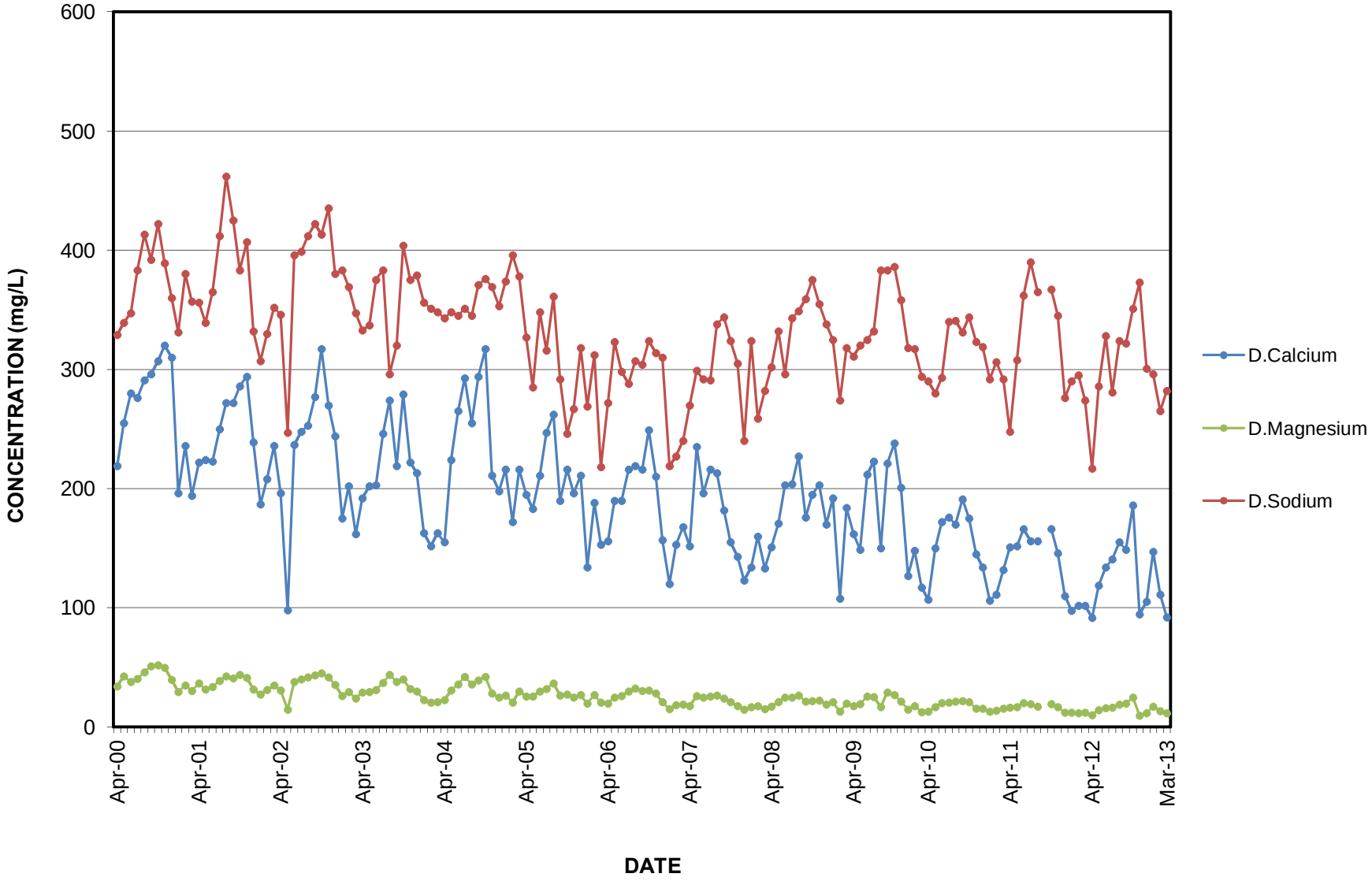
Settling Pond 4



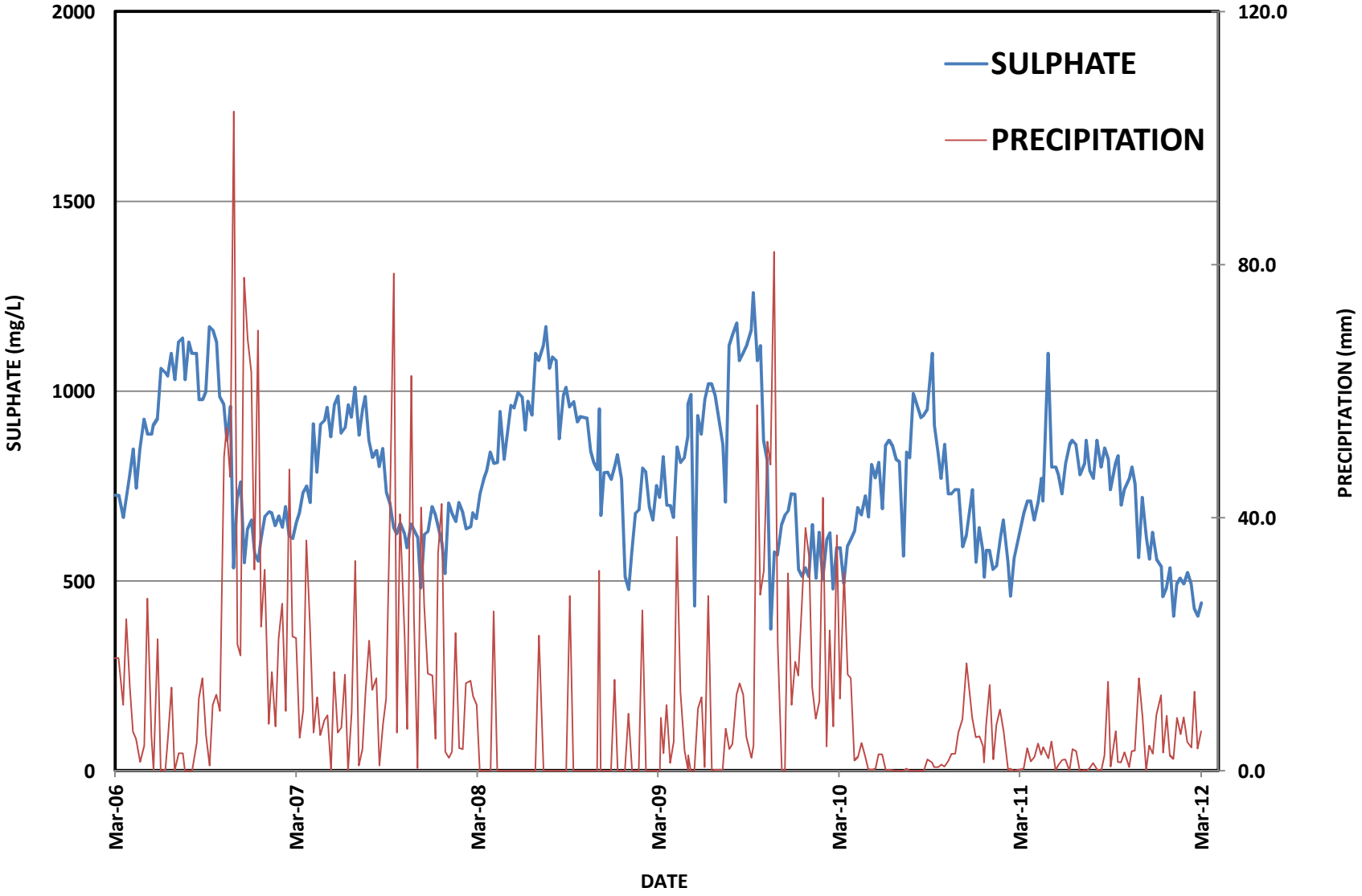
GRAPH 16

DISSOLVED CALCIUM/MAGNESIUM/SODIUM

SETTLING POND 4



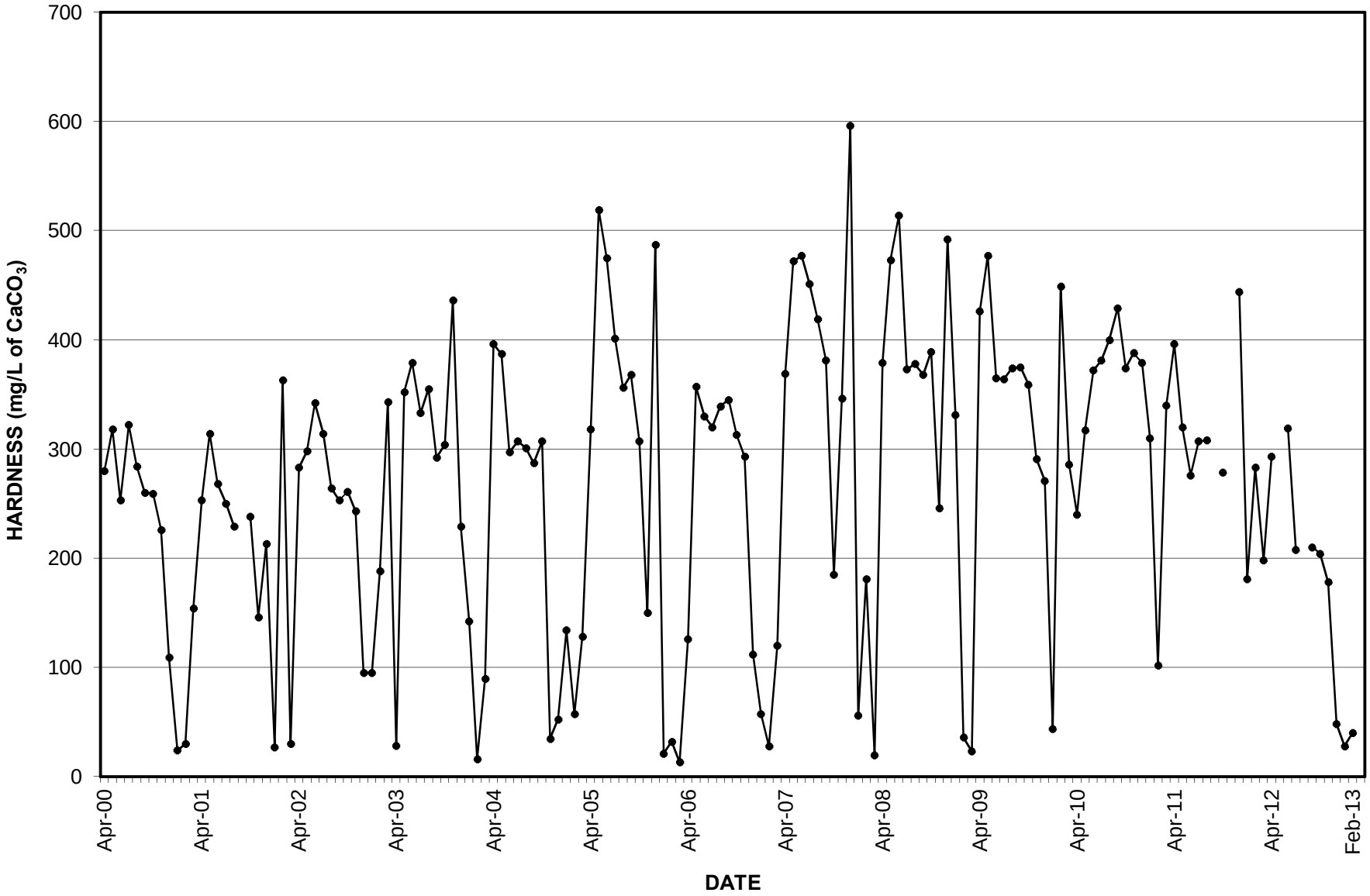
GRAPH 17
PRECIPITATION/SULPHATE
SETTLING POND 4



GRAPH 18

HARDNESS

SETTLING POND 1

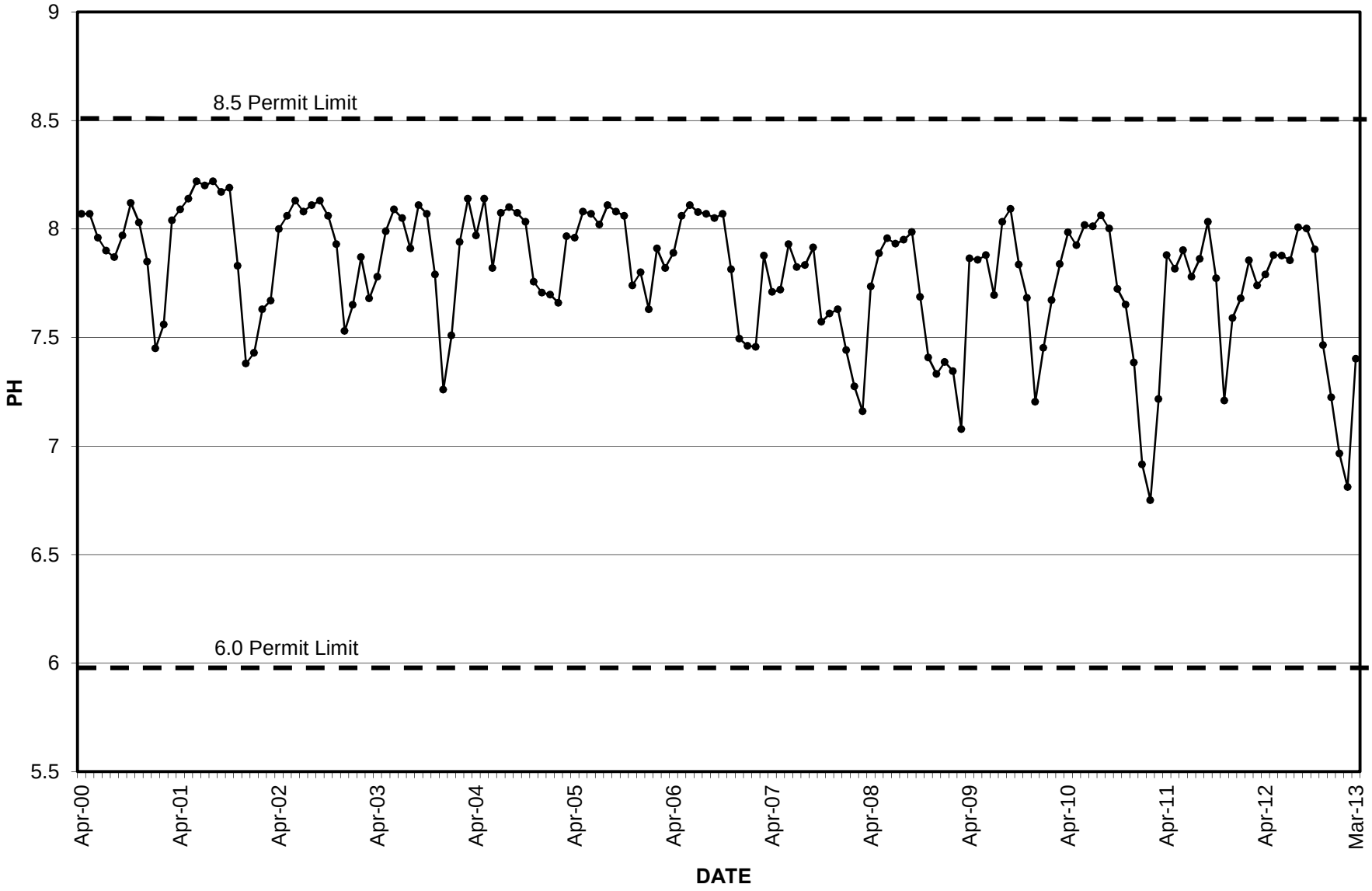


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 19

PH

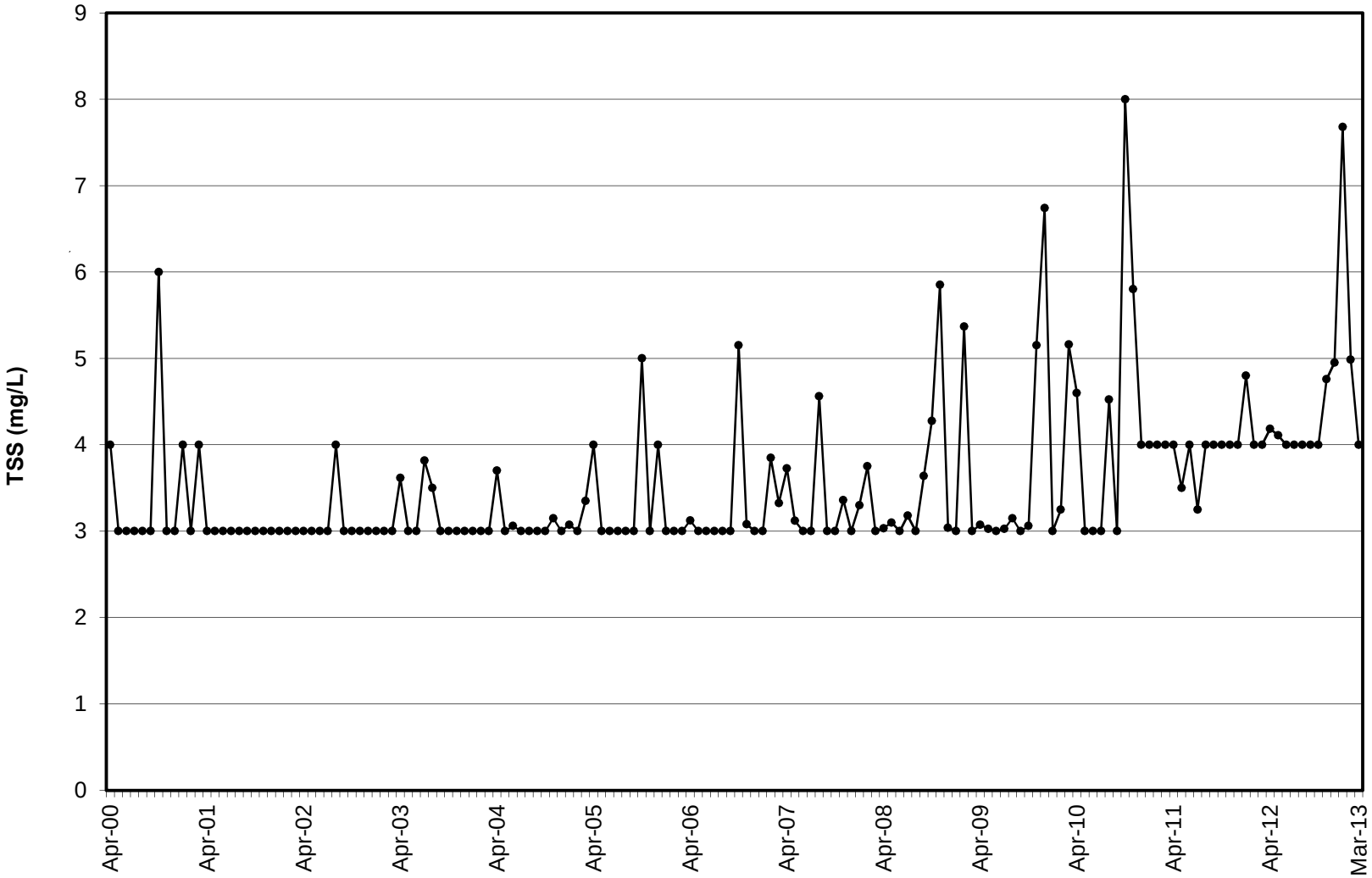
SETTLING POND 1



GRAPH 20

TOTAL SUSPENDED SOLIDS

SETTLING POND 1

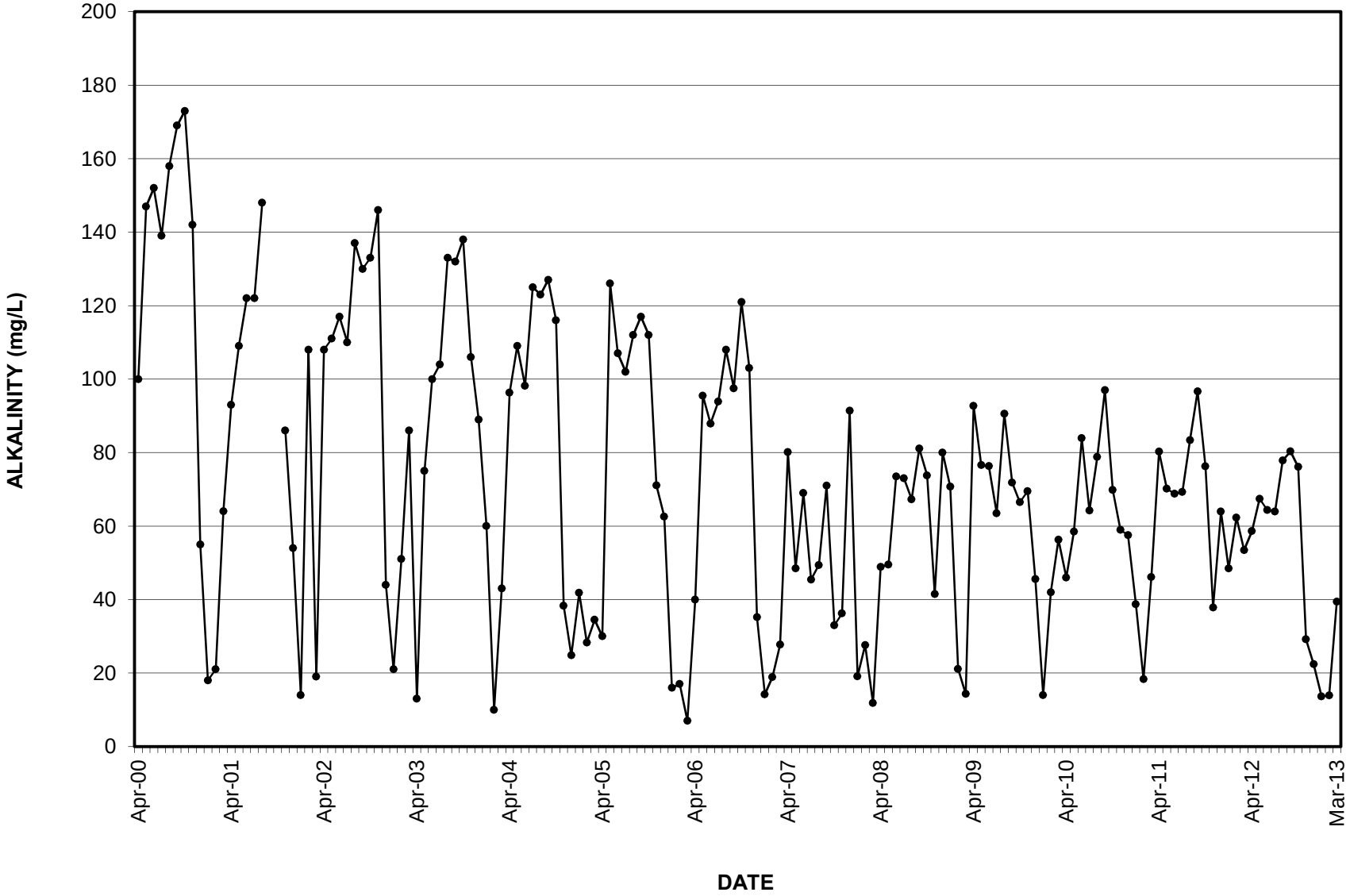


25 mg/L Permit Limit

GRAPH 21

ALKALINITY

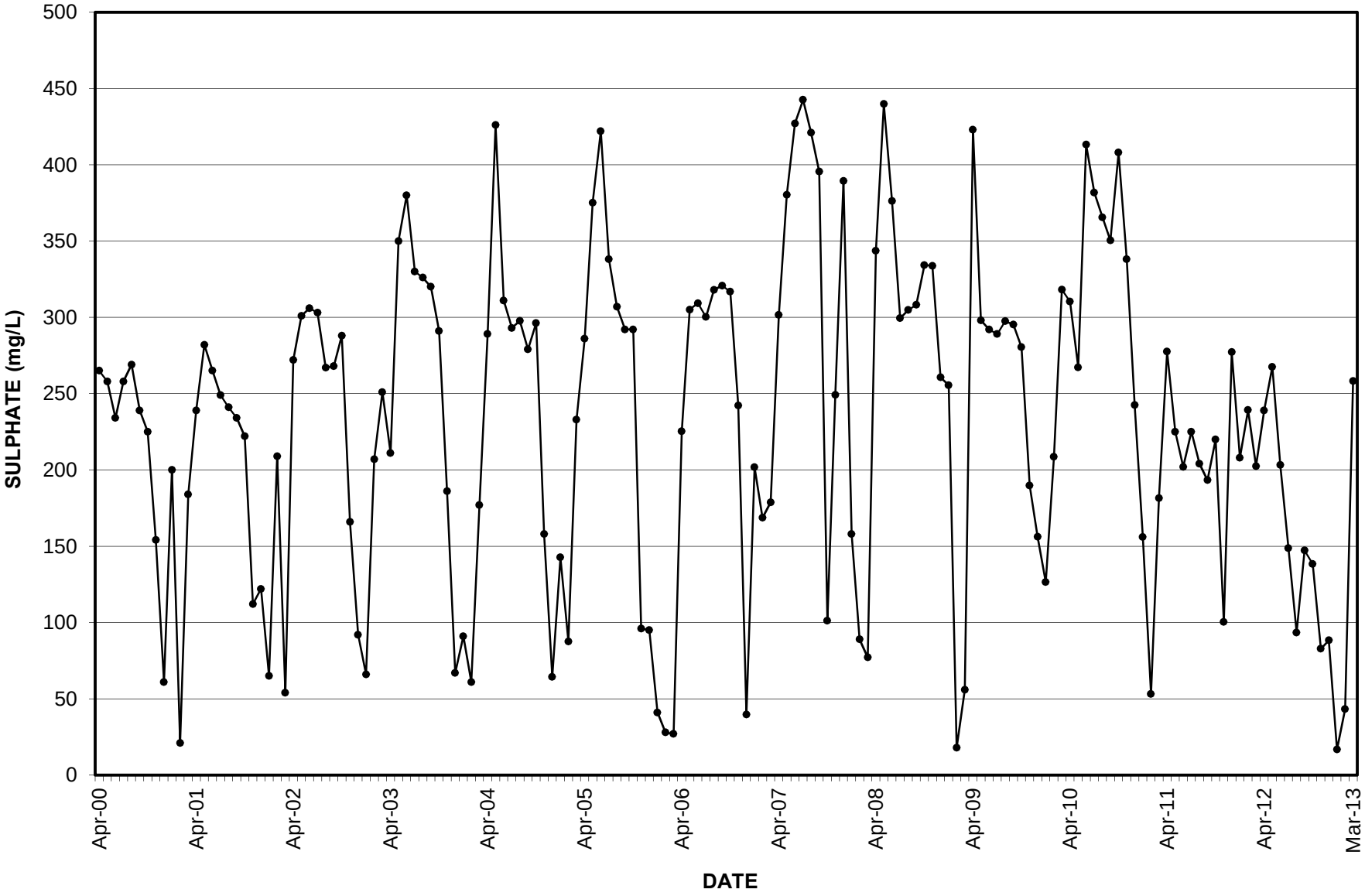
SETTLING POND 1



GRAPH 22

SULPHATE

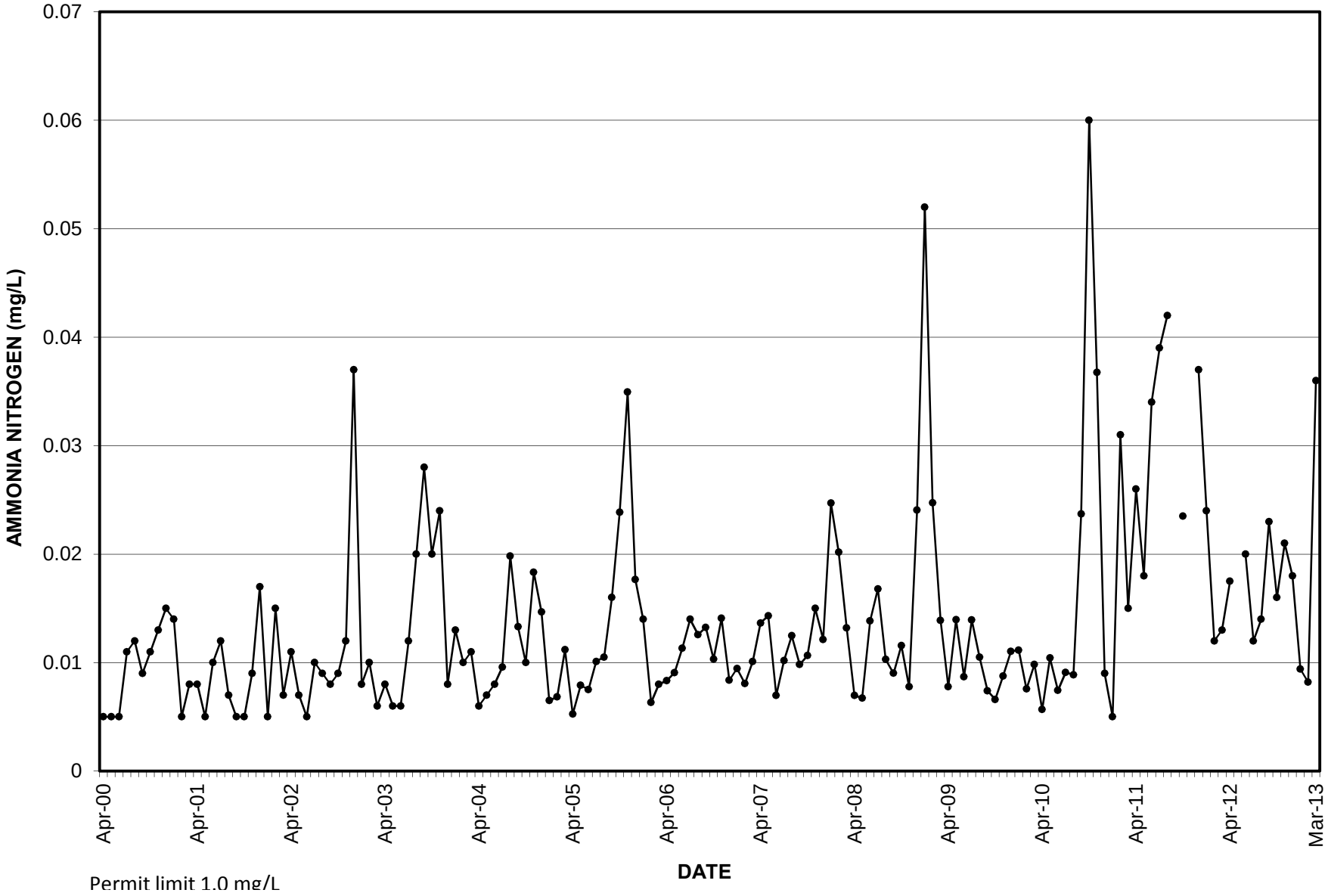
SETTLING POND 1



GRAPH 23

AMMONIA NITROGEN

SETTLING POND 1

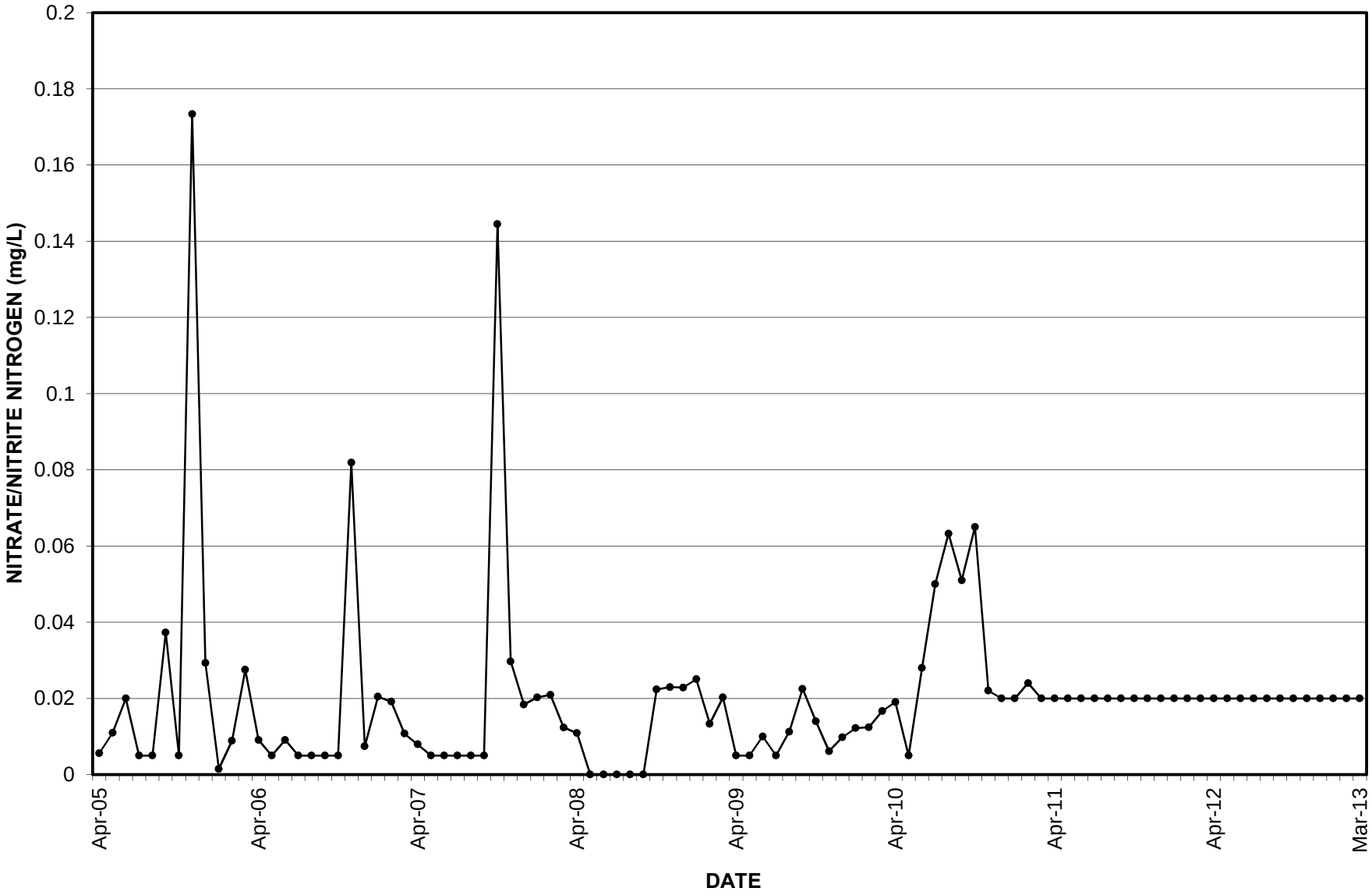


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 24

NITRATE/NITRITE NITROGEN

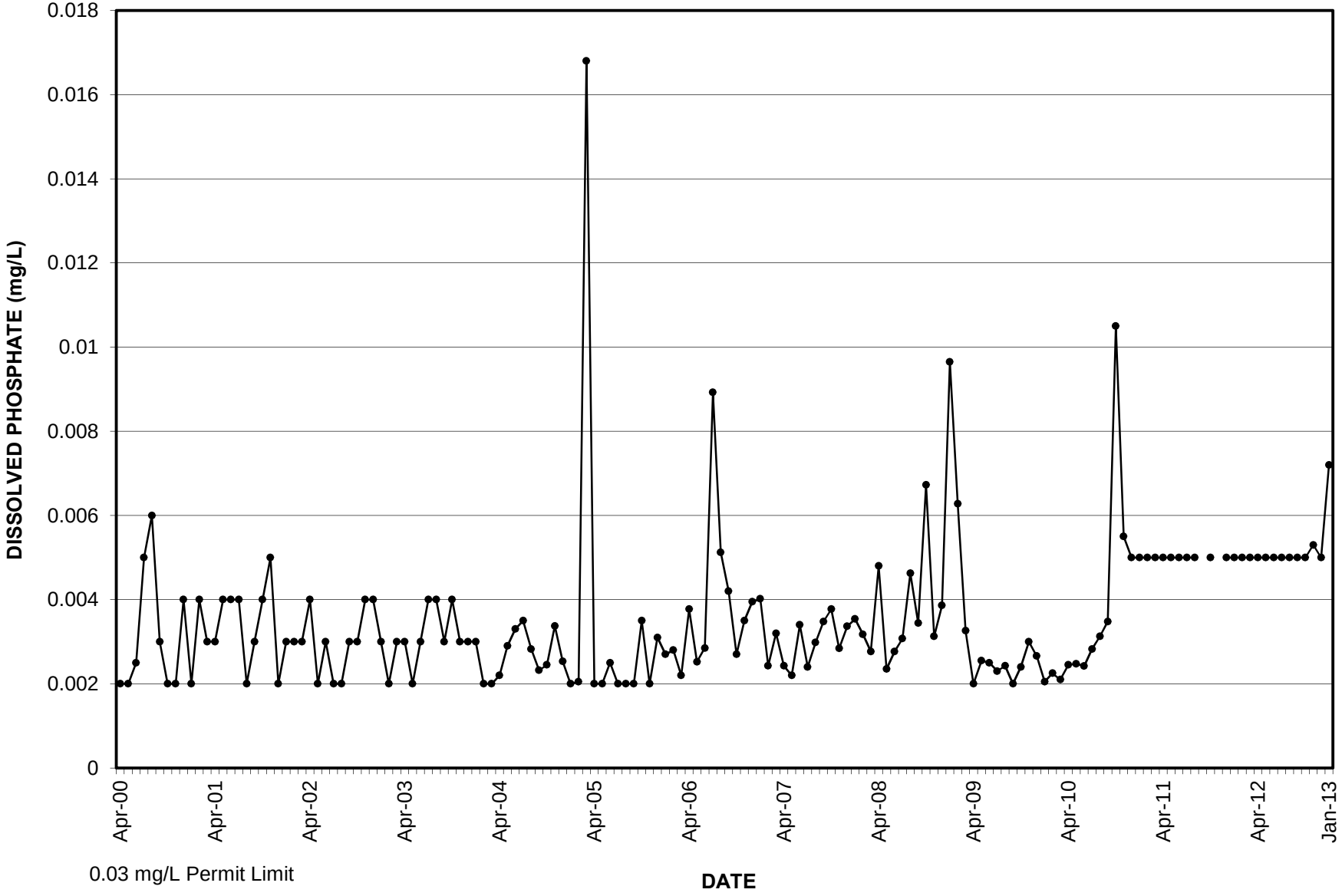
SETTLING POND 1



GRAPH 25

DISSOLVED PHOSPHOROUS

SETTLING POND 1

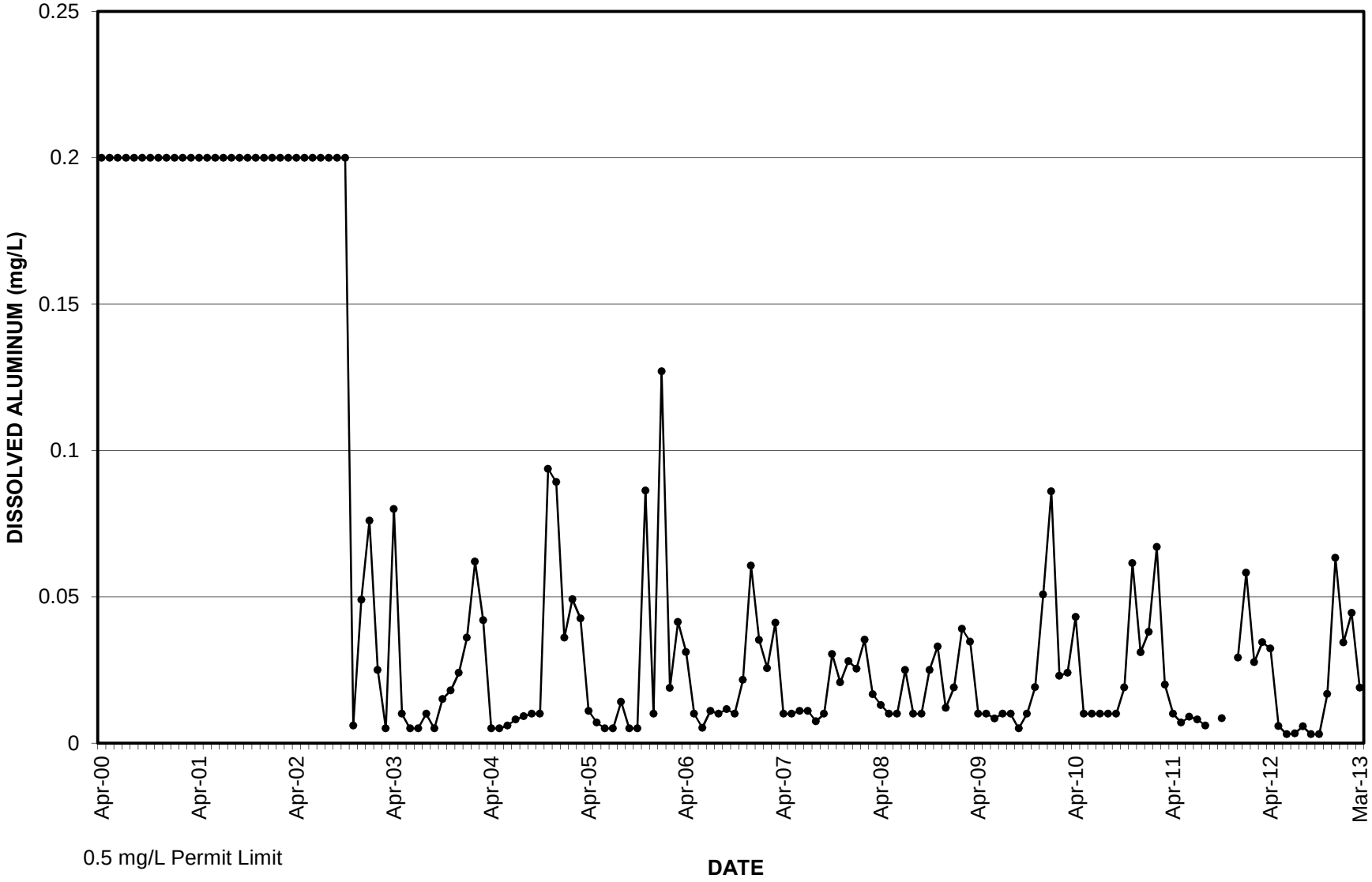


The detection limit decreased in late 2002.

GRAPH 26

DISSOLVED ALUMINUM

SETTLING POND 1

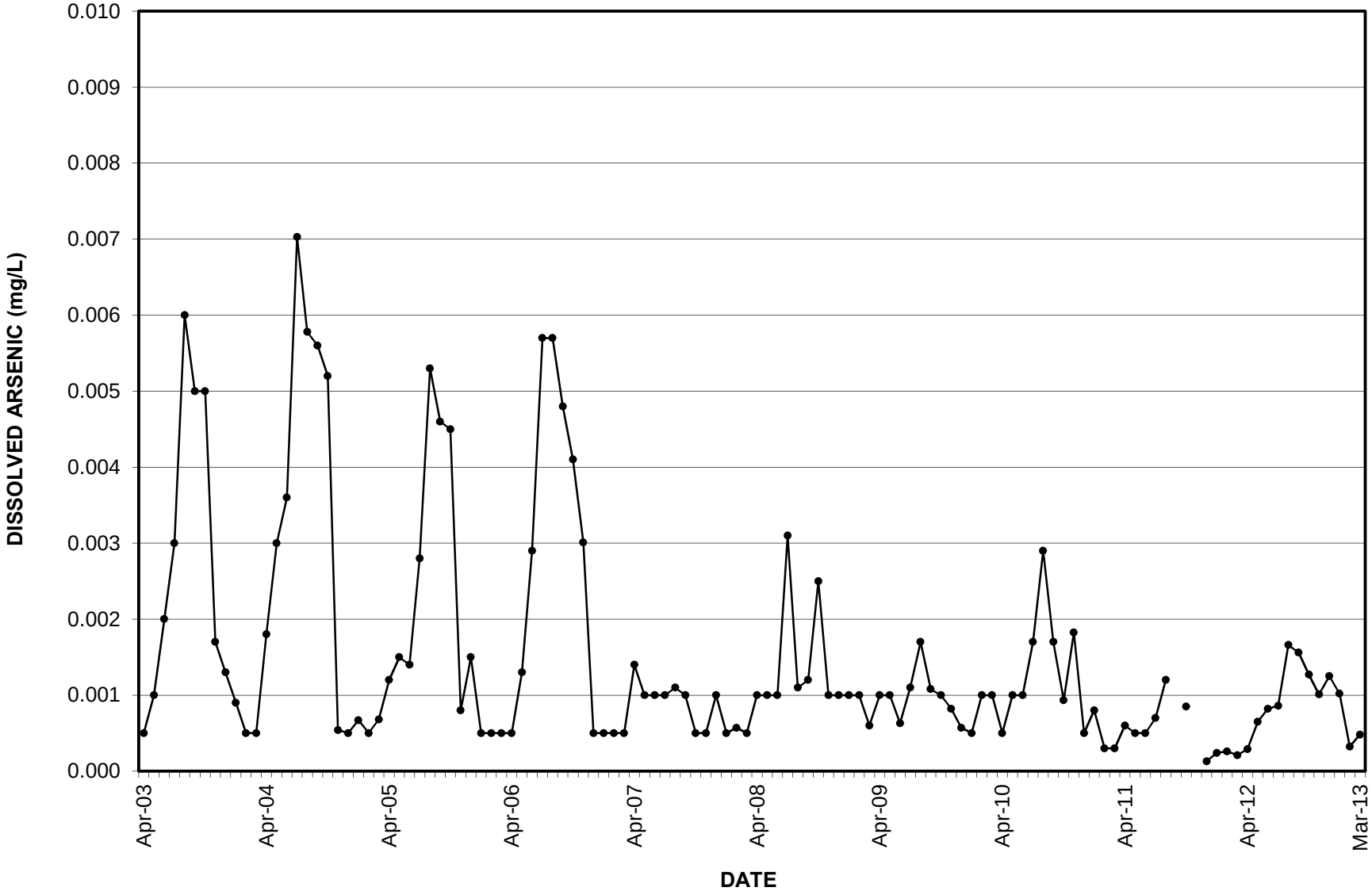


The detection limit decreased in late 2002.

GRAPH 27

DISSOLVED ARSENIC

SETTLING POND 1

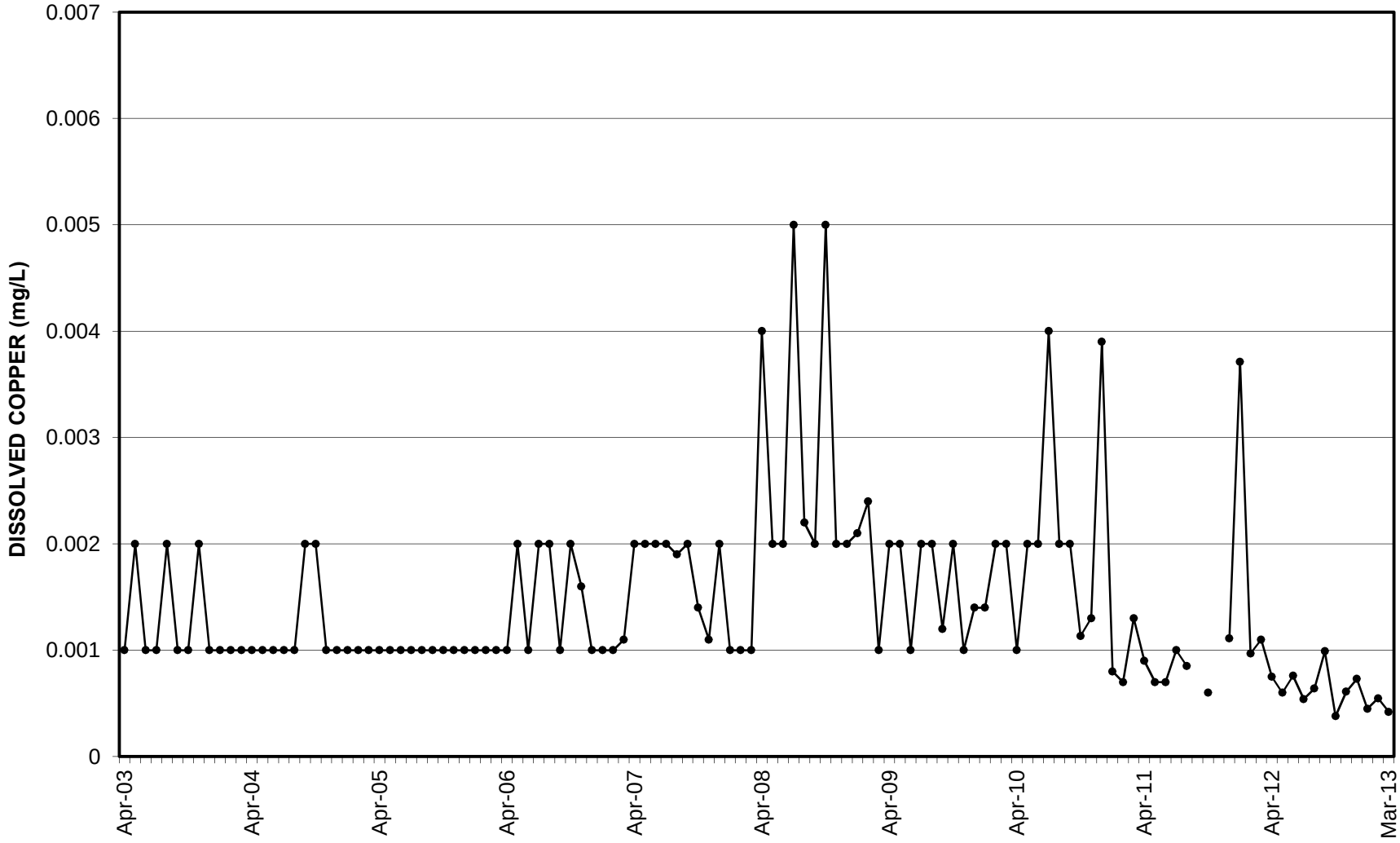


The detection limit decreased in late 2002.

GRAPH 28

DISSOLVED COPPER

SETTLING POND 1

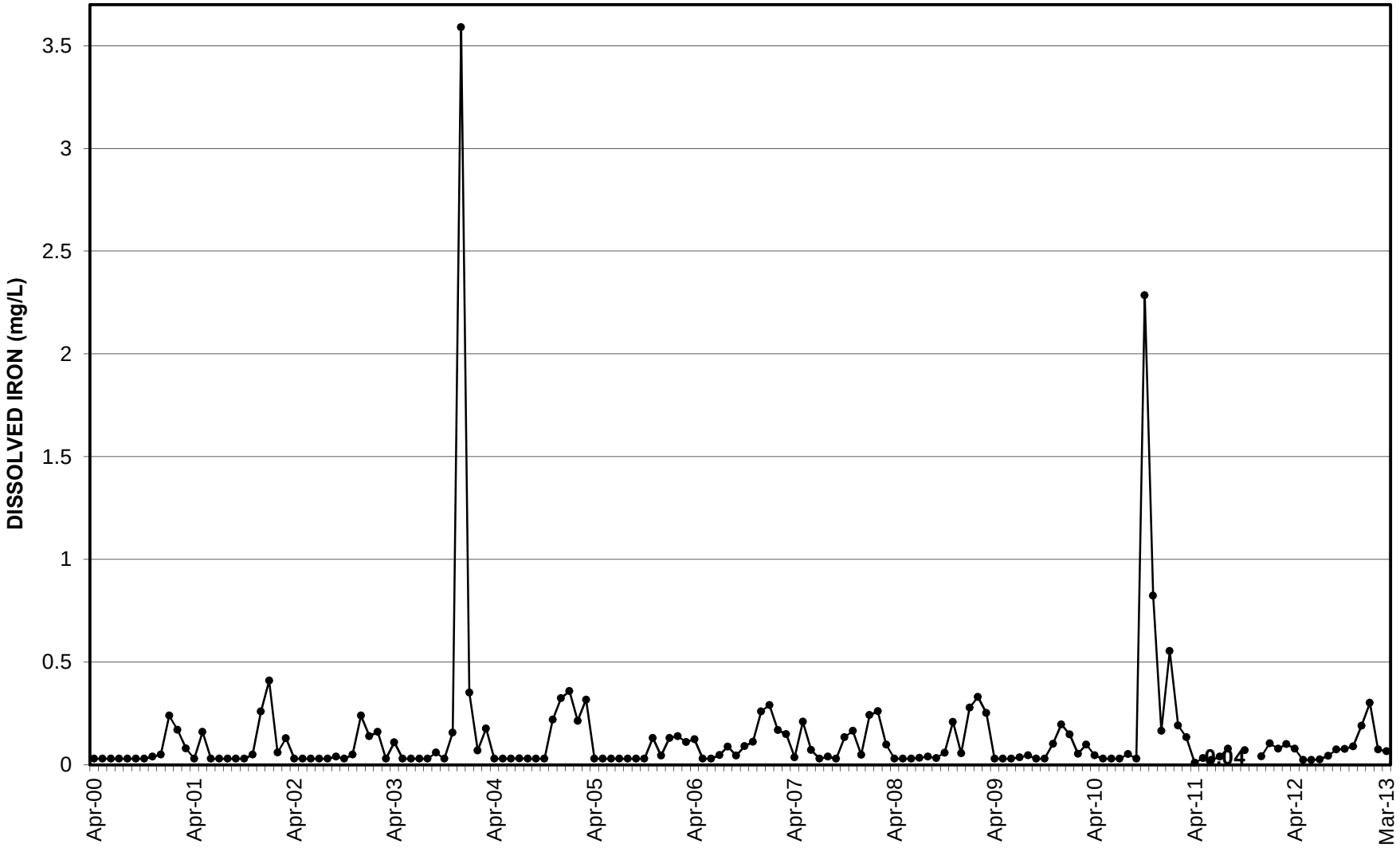


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 29

DISSOLVED IRON

SETTLING POND 1

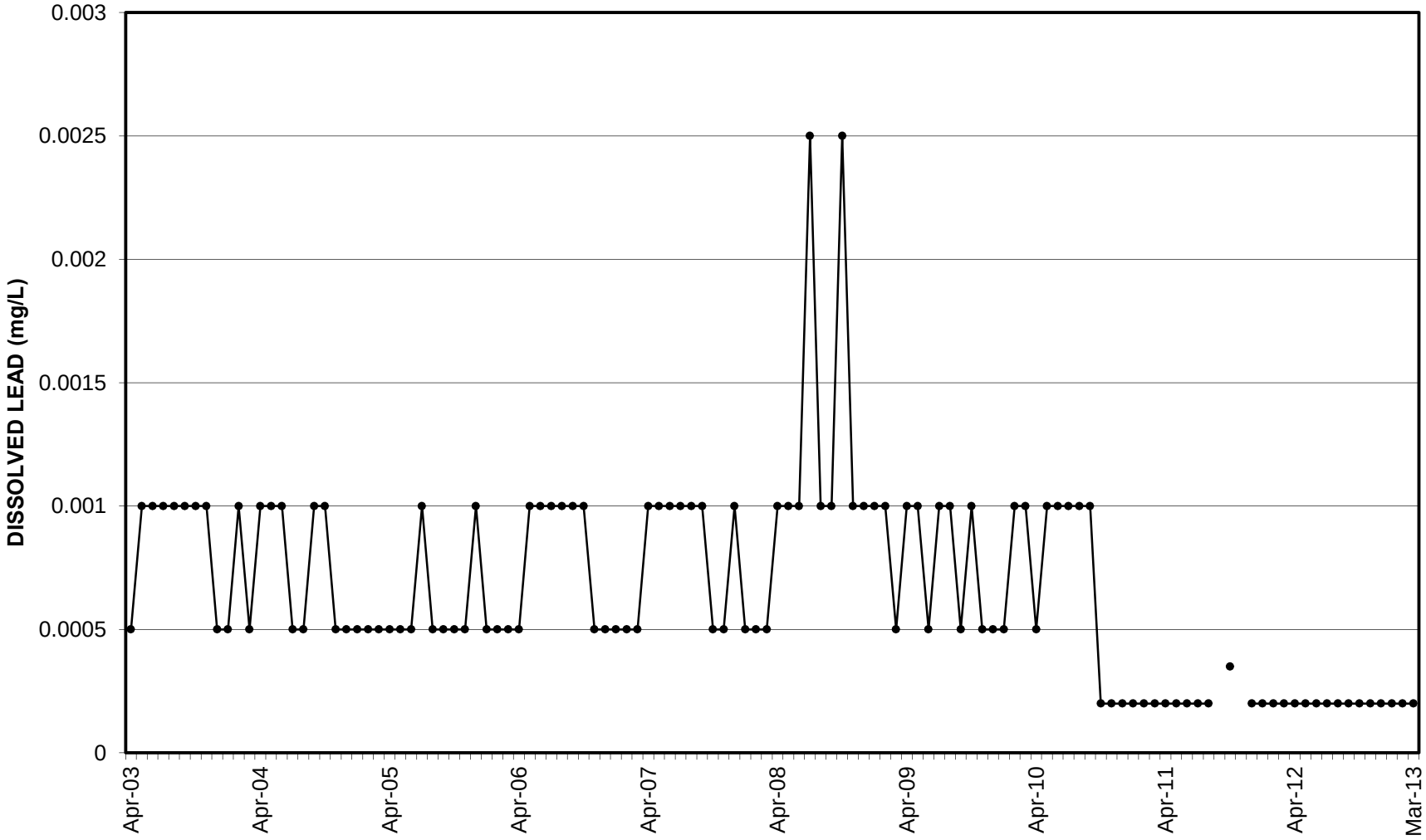


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 30

DISSOLVED LEAD

SETTLING POND 1

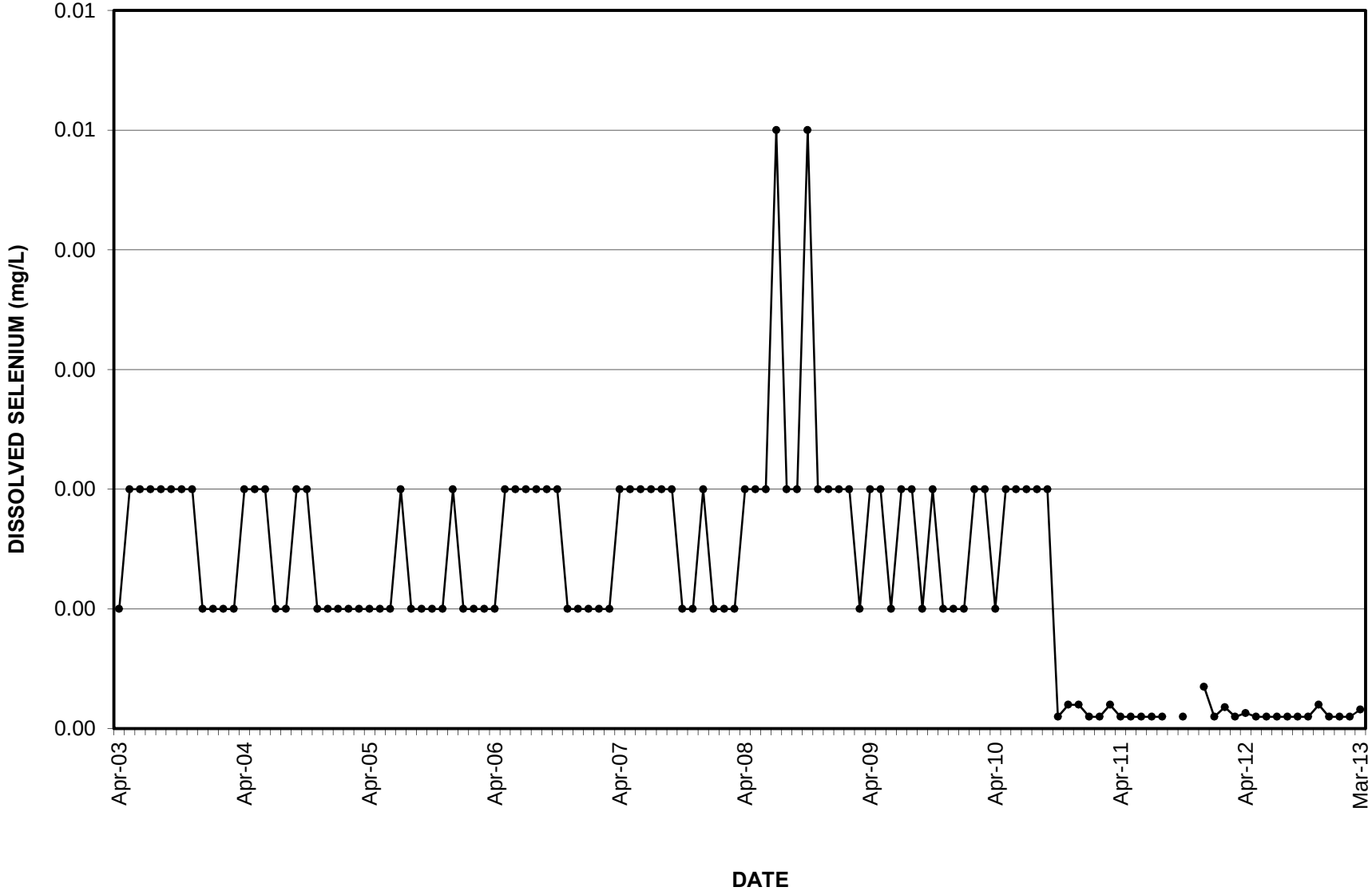


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 31

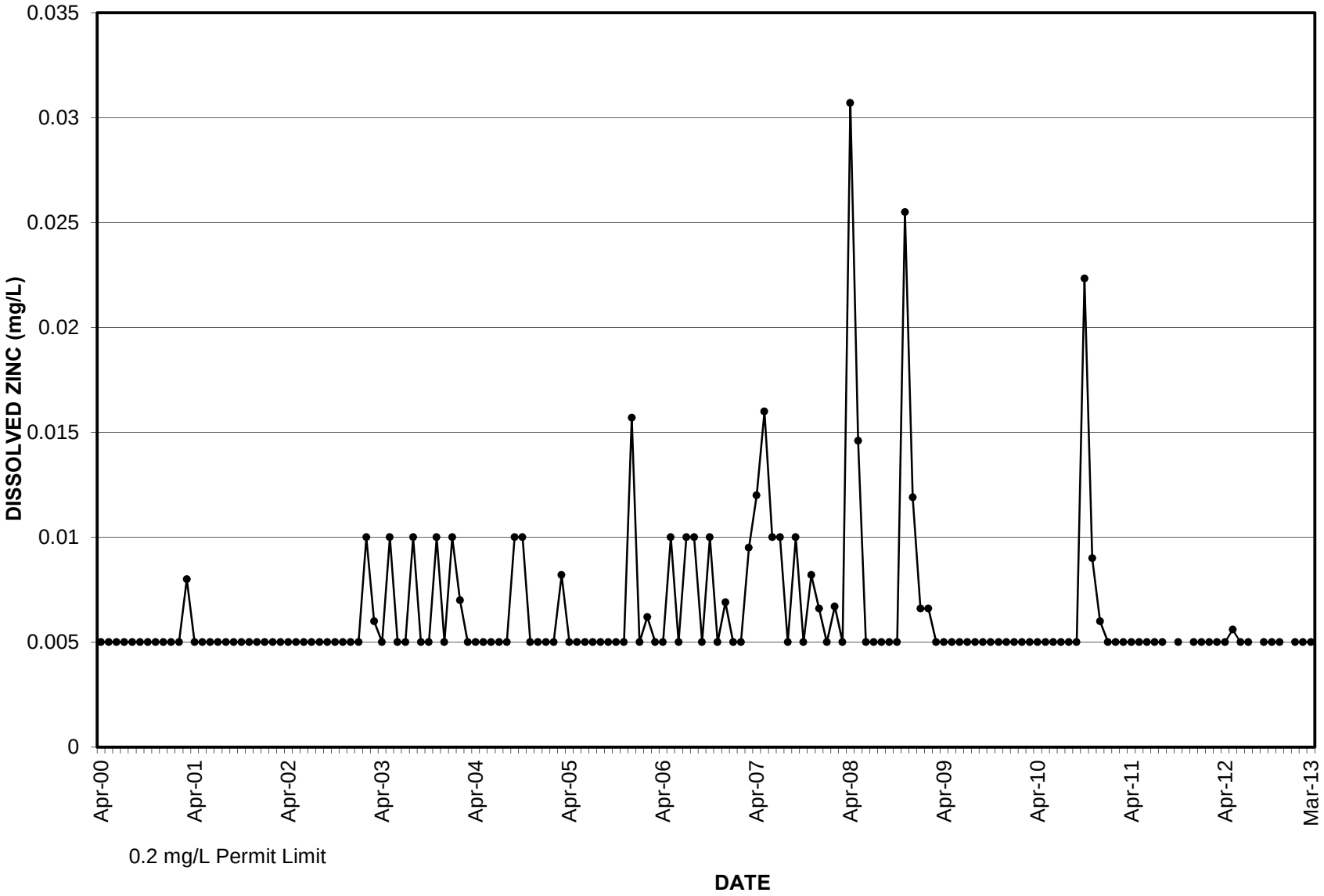
DISSOLVED SELENIUM

SETTLING POND 1



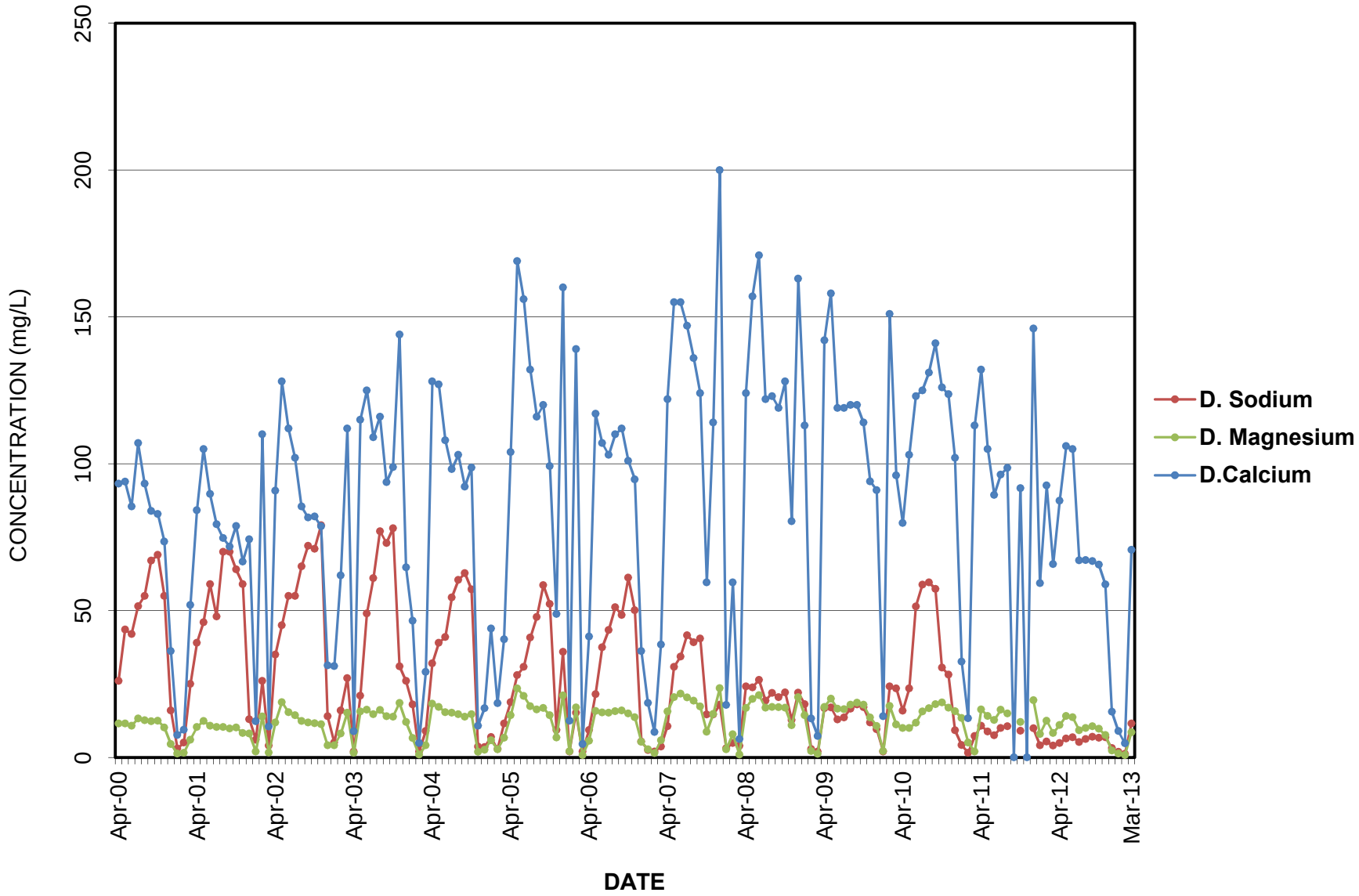
Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 32
DISSOLVED ZINC
SETTLING POND 1



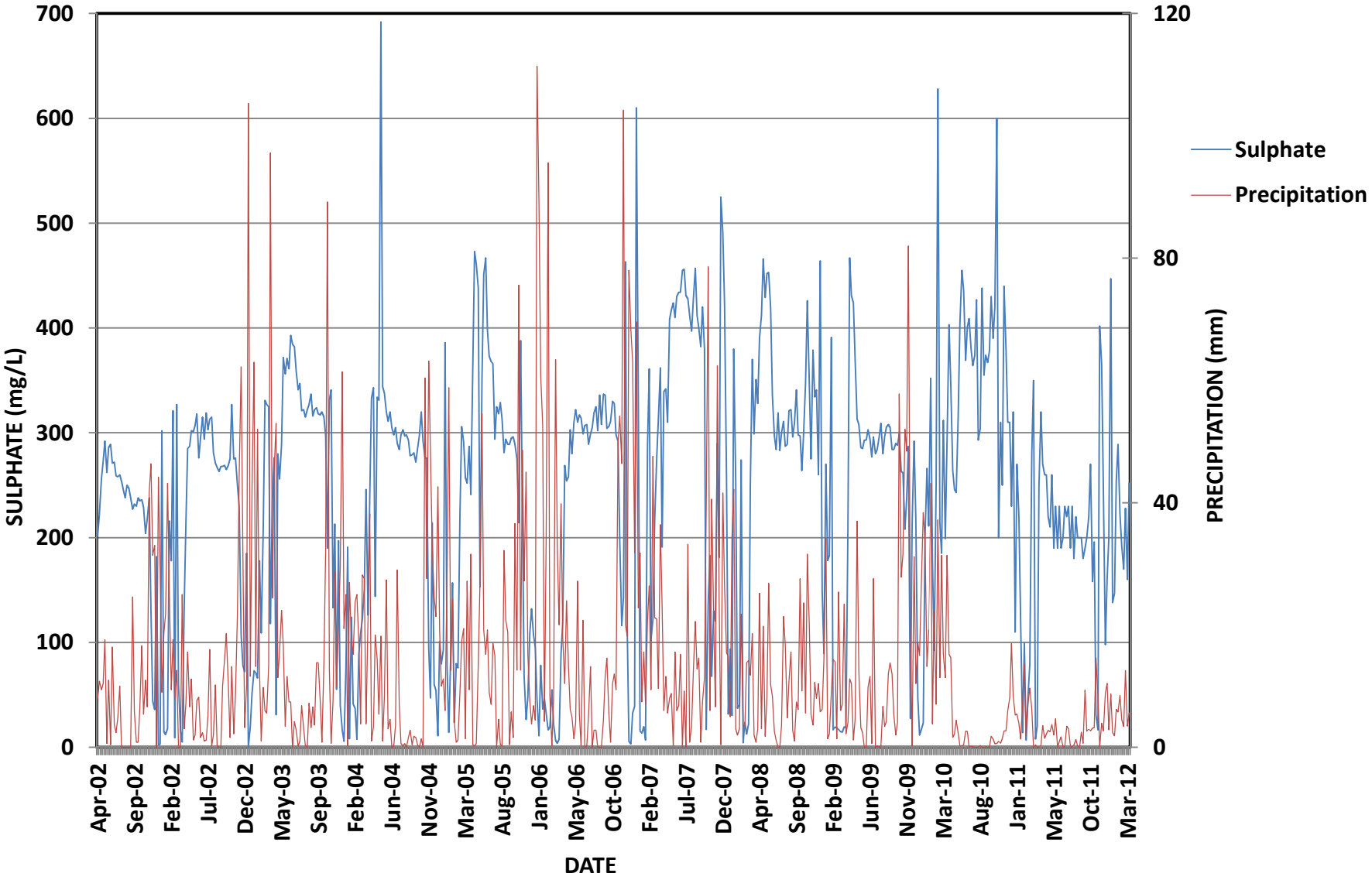
Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 33
DISSOLVED CALCIUM/MAGNESIUM/SODIUM
SETTLING POND 1



Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

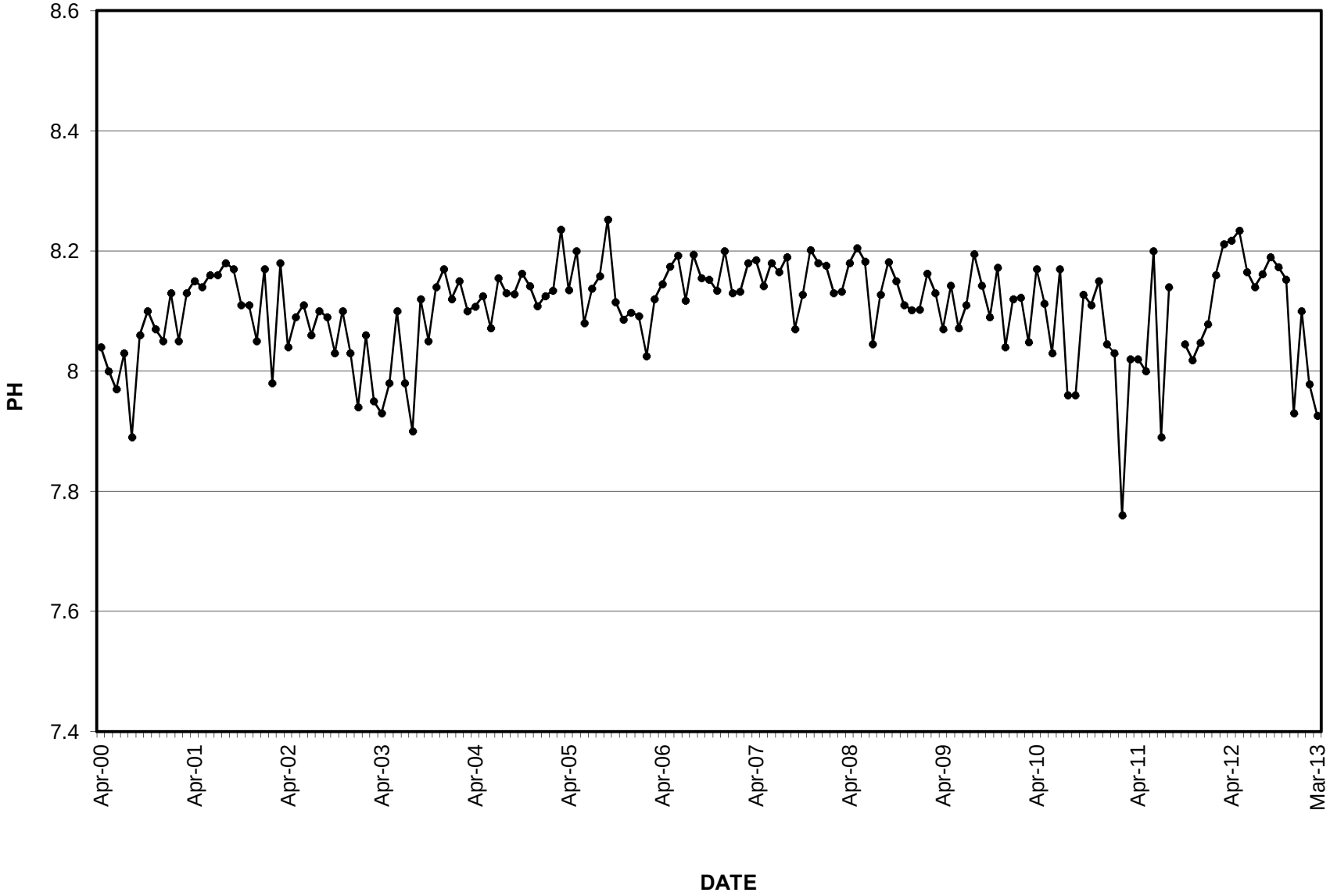
GRAPH 34
PRECIPITATION/SULPHATE
SETTLING POND 1



GRAPH 35

PH

NORTH PIT SUMP (WP)

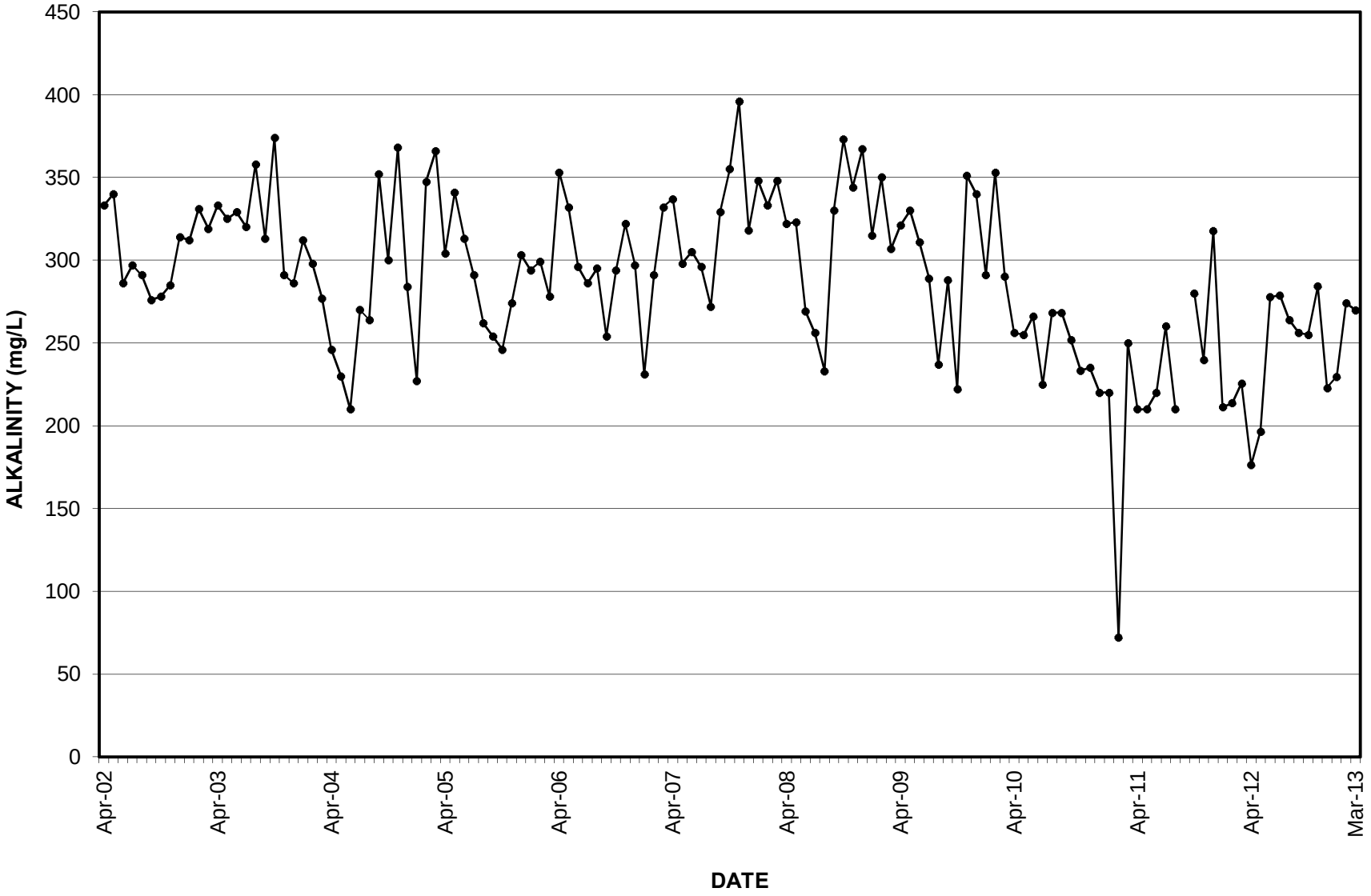


Data points are monthly averages.

GRAPH 36

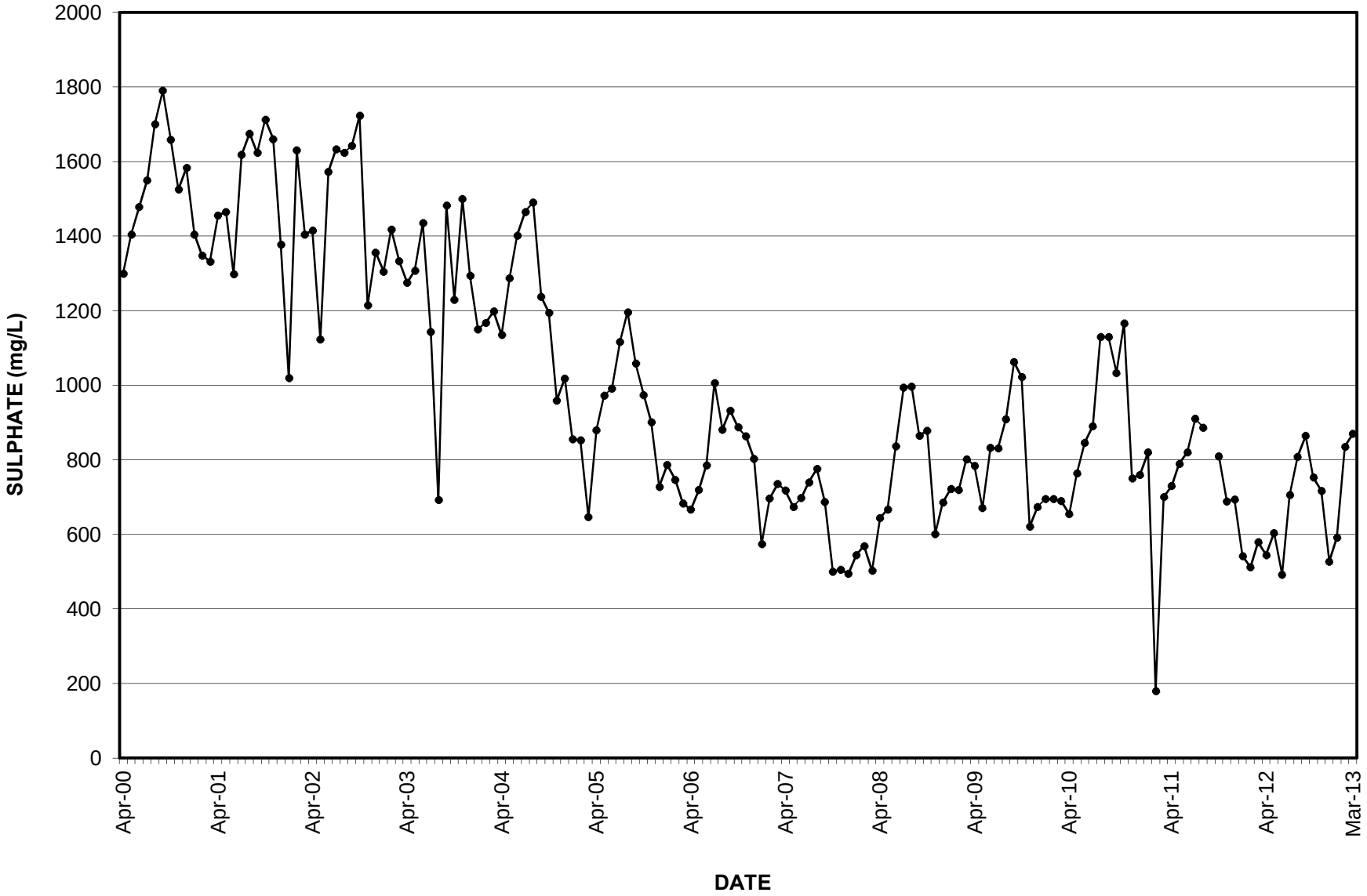
ALKALINITY

NORTH PIT SUMP (WP)



Data points are monthly averages.

GRAPH 37
SULPHATE
NORTH PIT SUMP (WP)

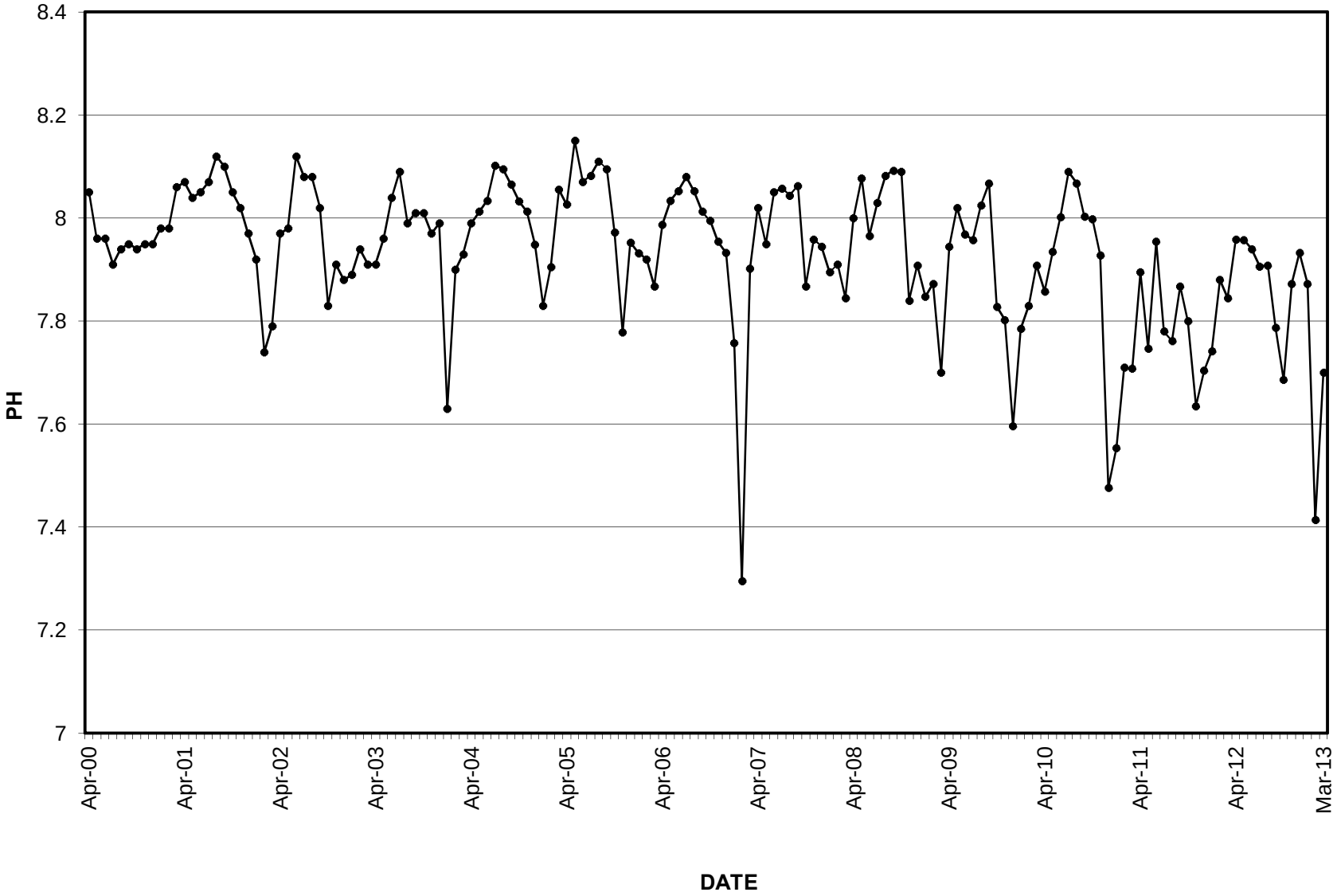


Data points are monthly averages.

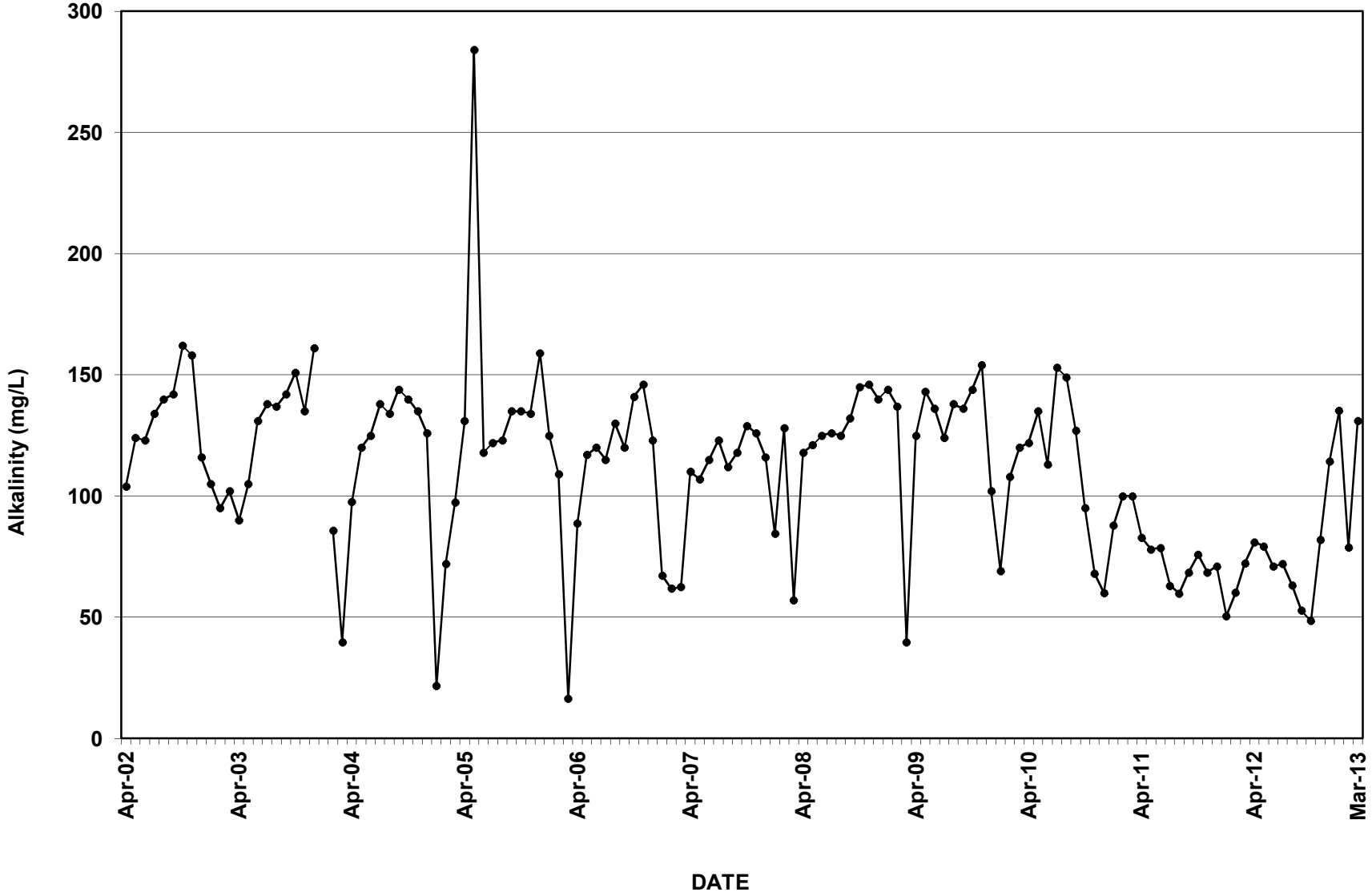
GRAPH 38

PH

3 SOUTH PIT



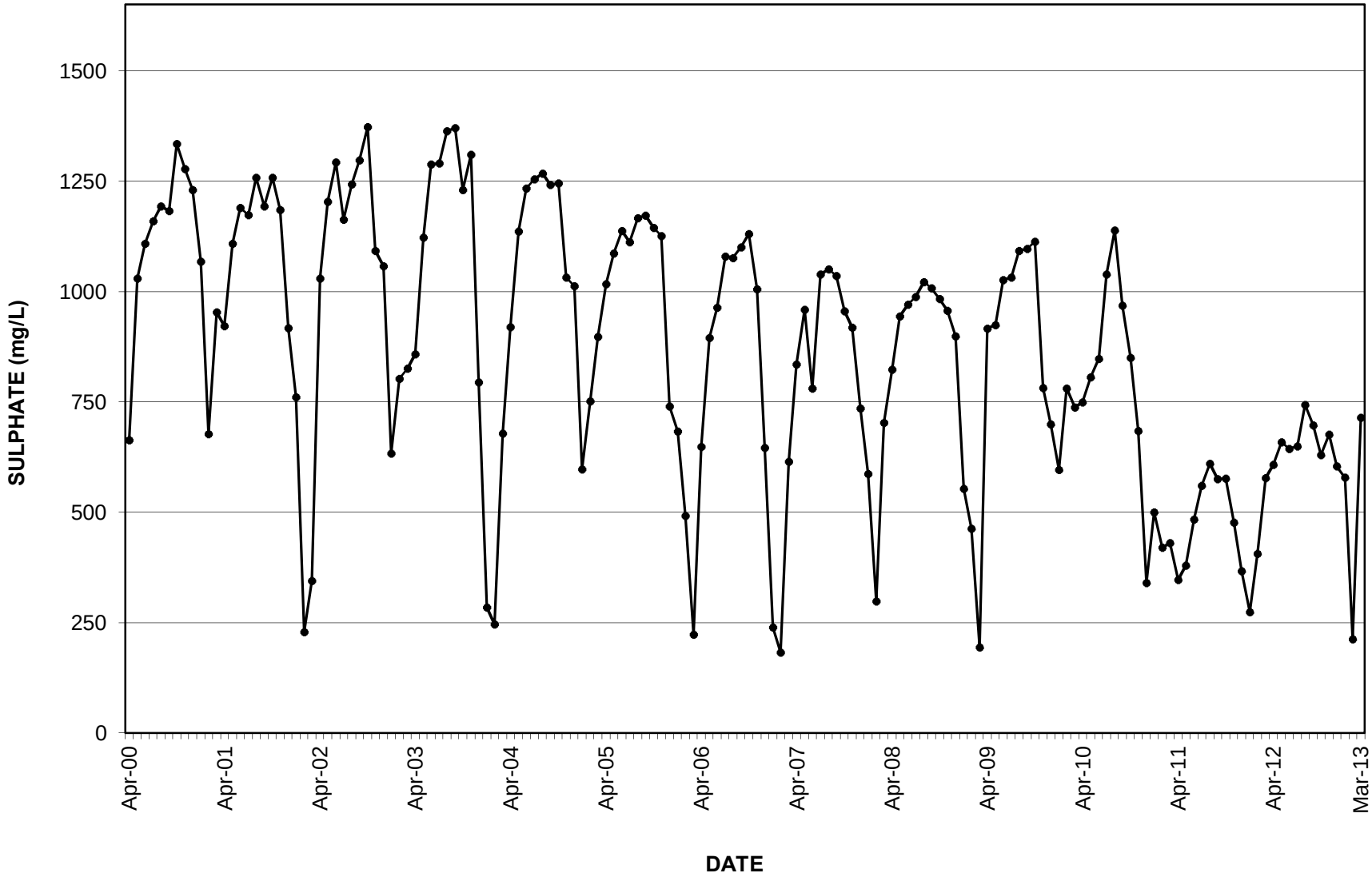
GRAPH 39
Alkalinity
3 SOUTH PIT



GRAPH 40

SULPHATE

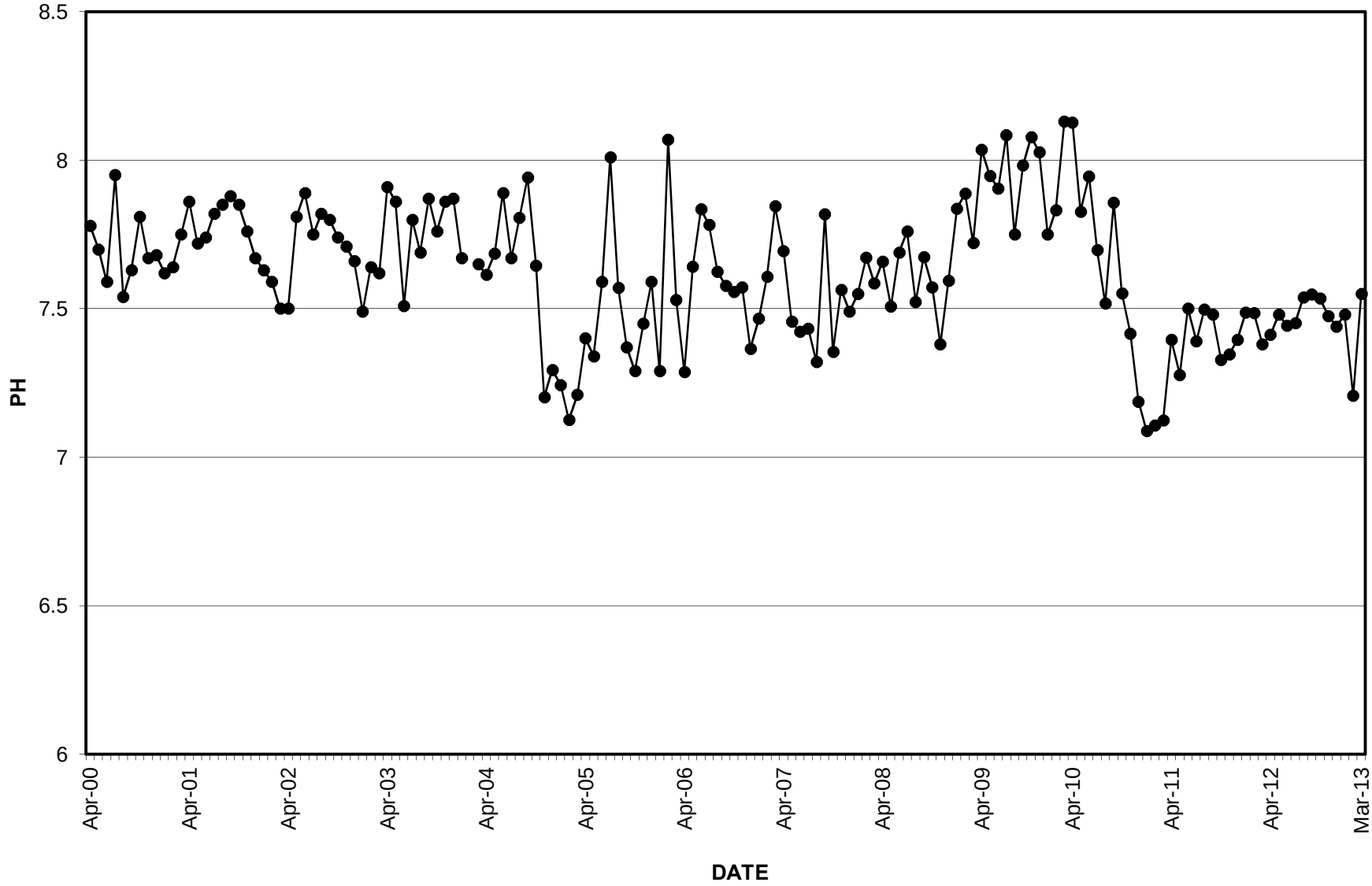
3 SOUTH PIT



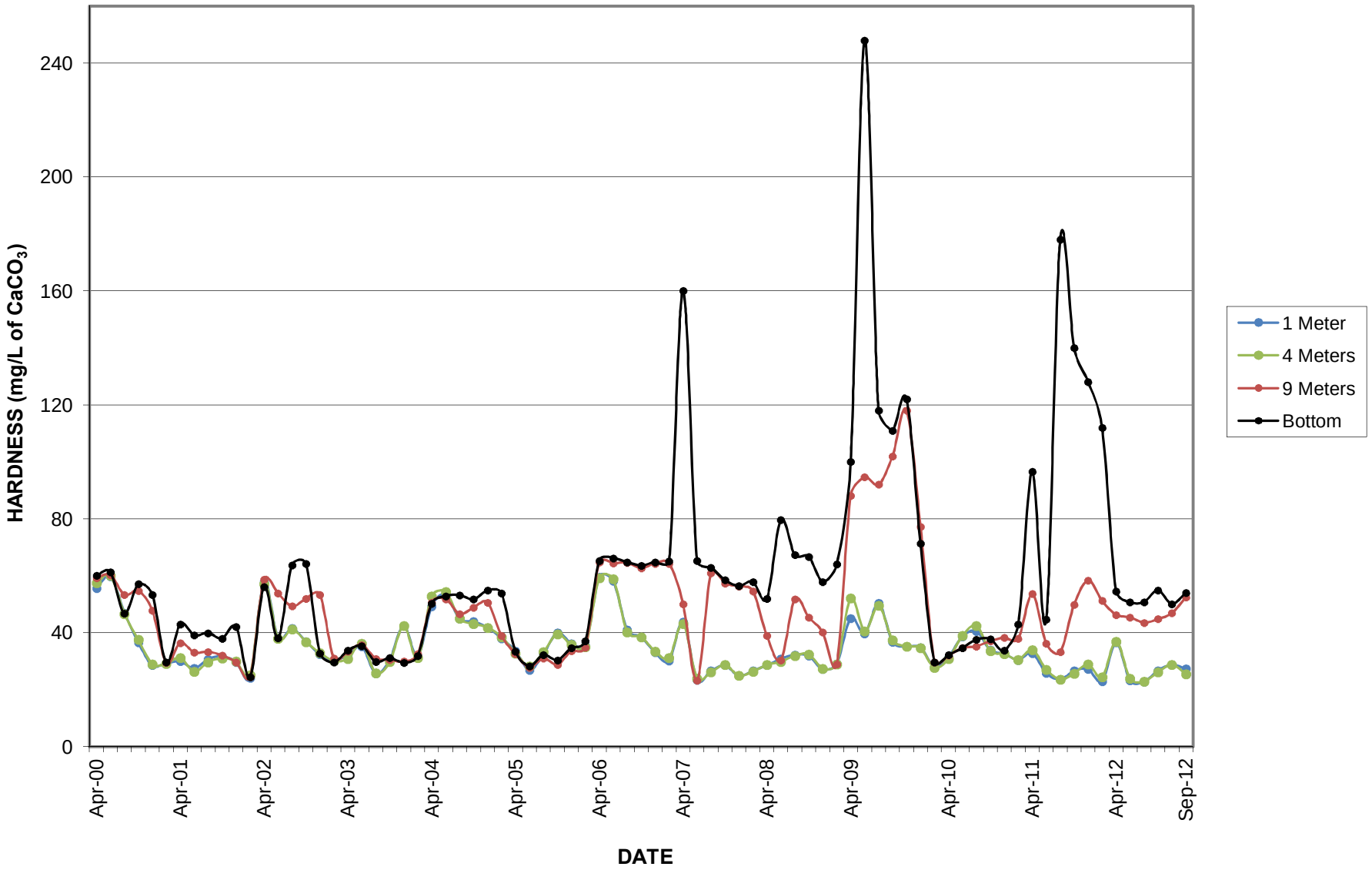
GRAPH 41

pH

MIDDLE QUINSAM LAKE INLET (WA)



GRAPH 42
MIDDLE QUINSAM LAKE
HARDNESS

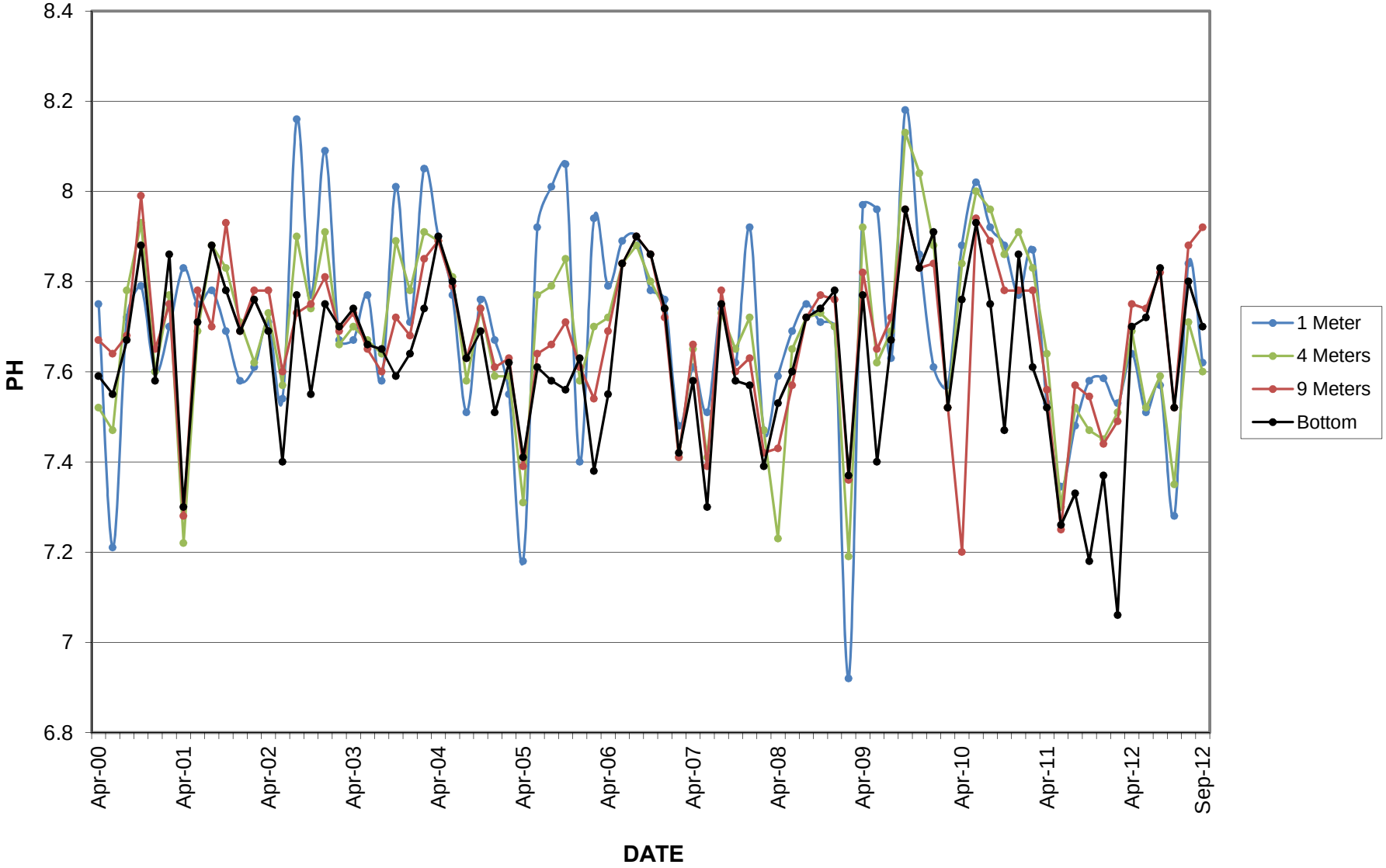


Note: The data for 1 meter depth closely mimics the data for 4 meters.
The line representing the data for 1 meter is mostly obscured
by the line representing the data for 4 meters.

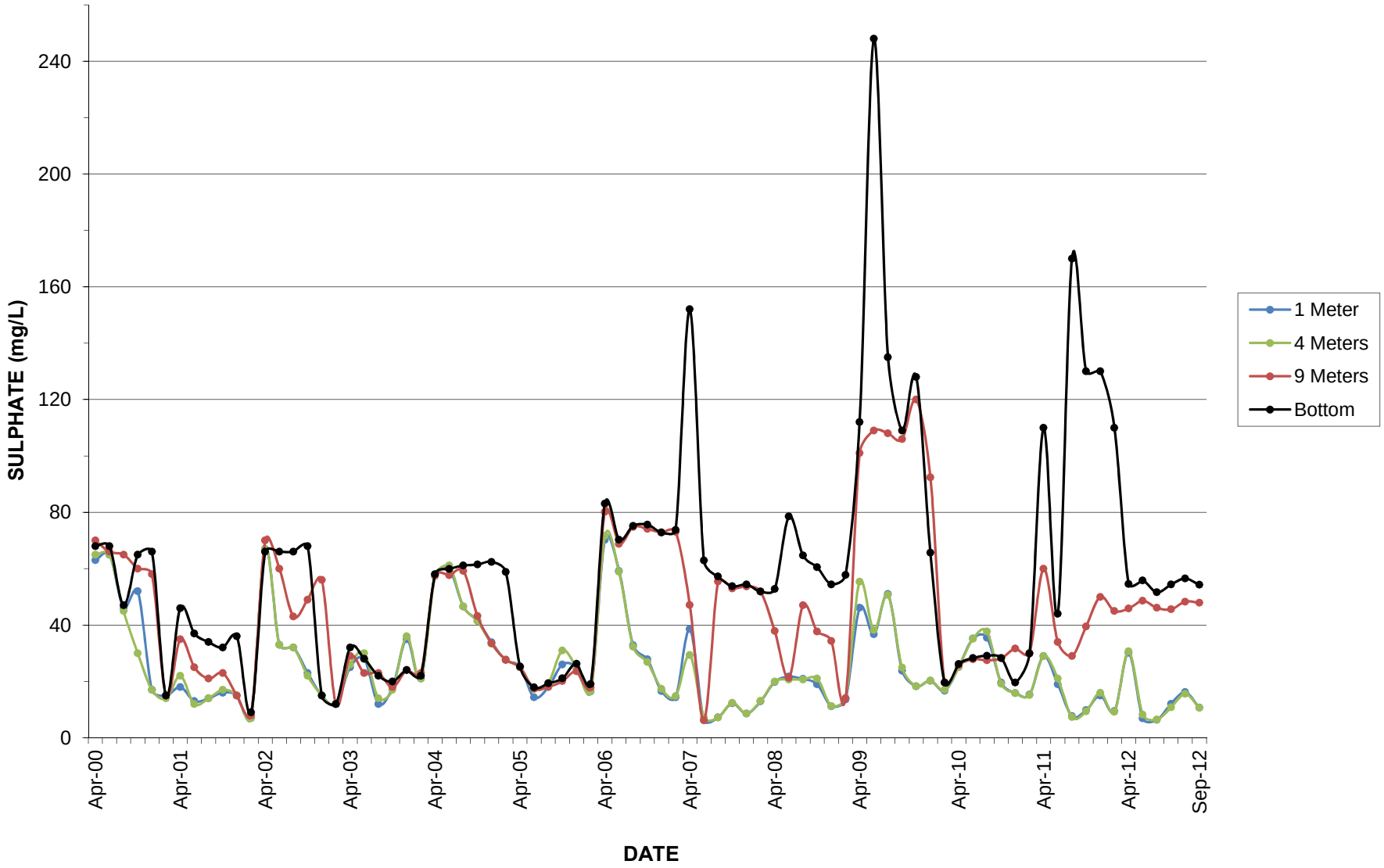
GRAPH 43

MIDDLE QUINSAM LAKE

pH



GRAPH 44
MIDDLE QUINSAM LAKE
SULPHATE

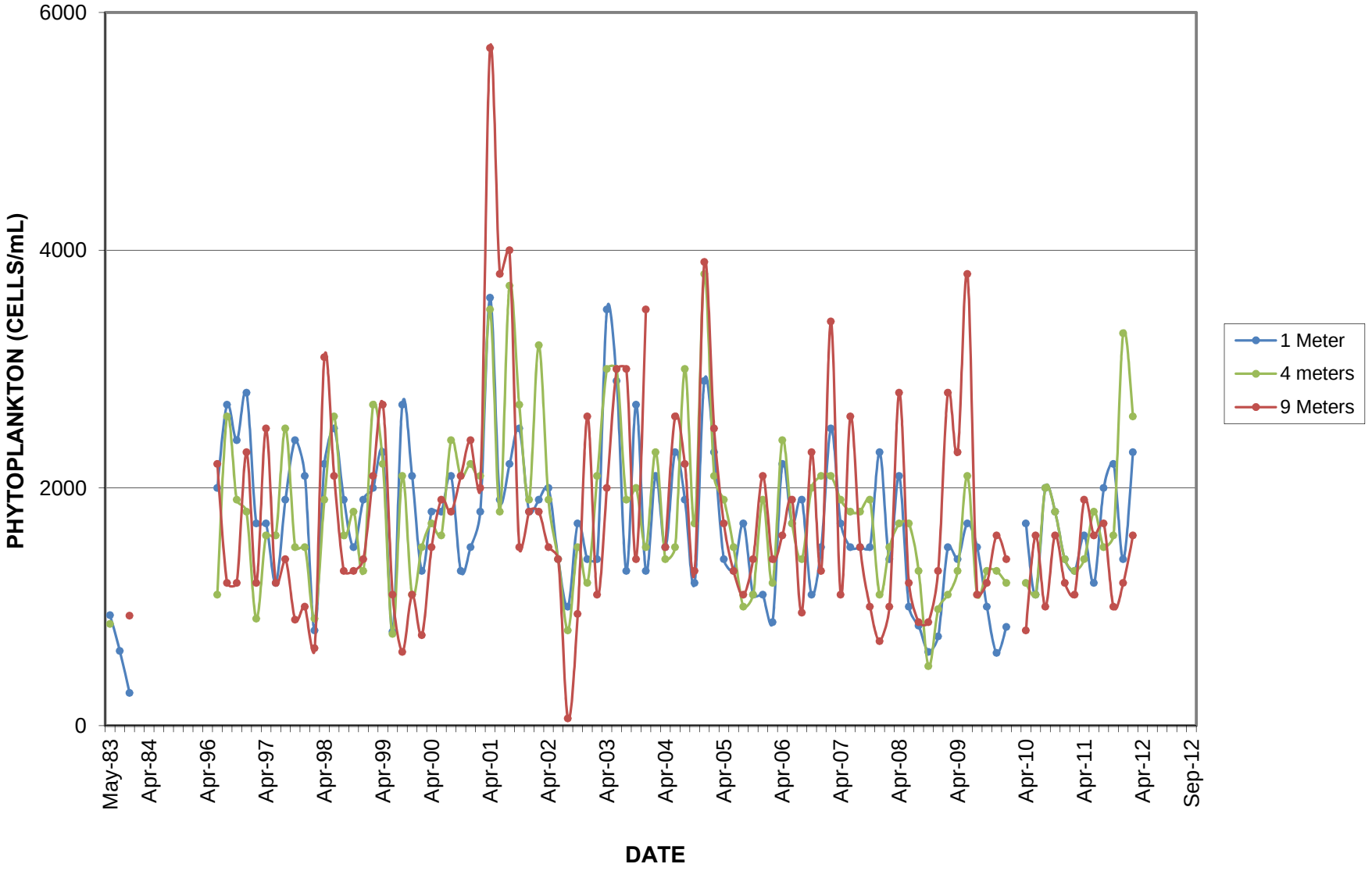


Note: The data for 1 meter depth closely mimics the data for 4 meters.
The line representing the data for 1 meter is mostly obscured
by the line representing the data for 4 meters.

GRAPH 45

MIDDLE QUINSAM LAKE

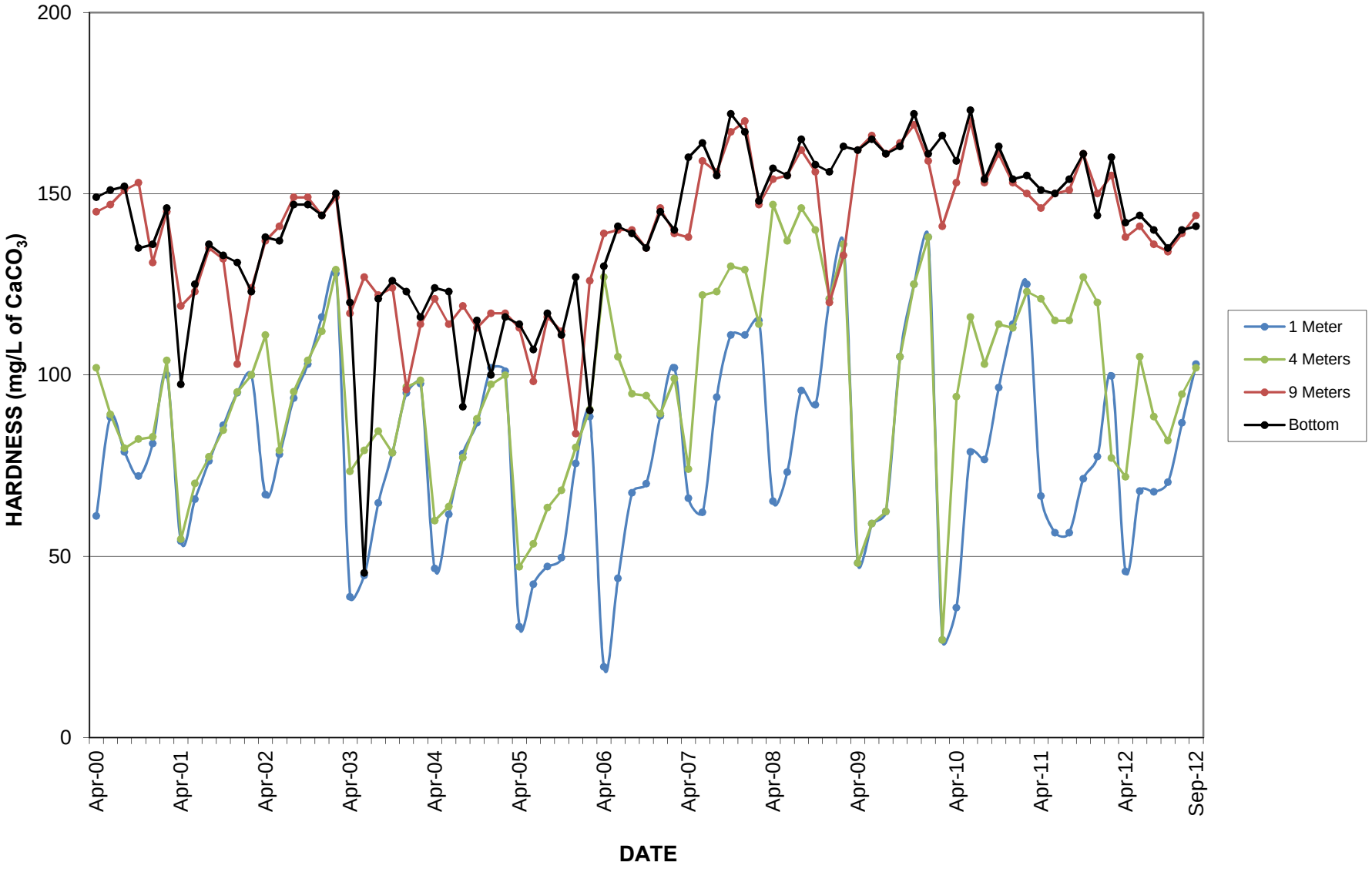
PHYTOPLANKTON ABUNDANCE



GRAPH 47

LONG LAKE

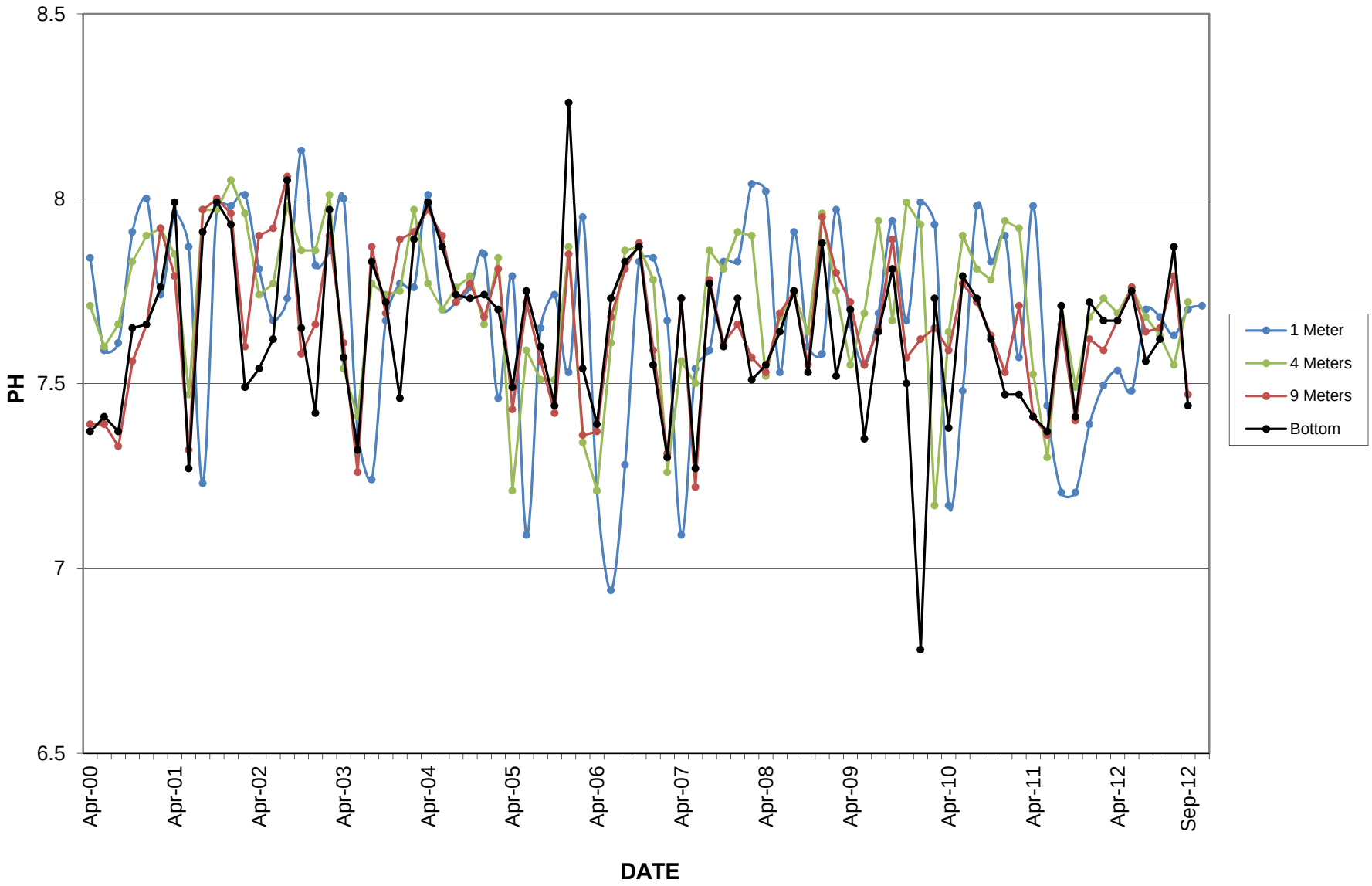
HARDNESS



GRAPH 48

LONG LAKE

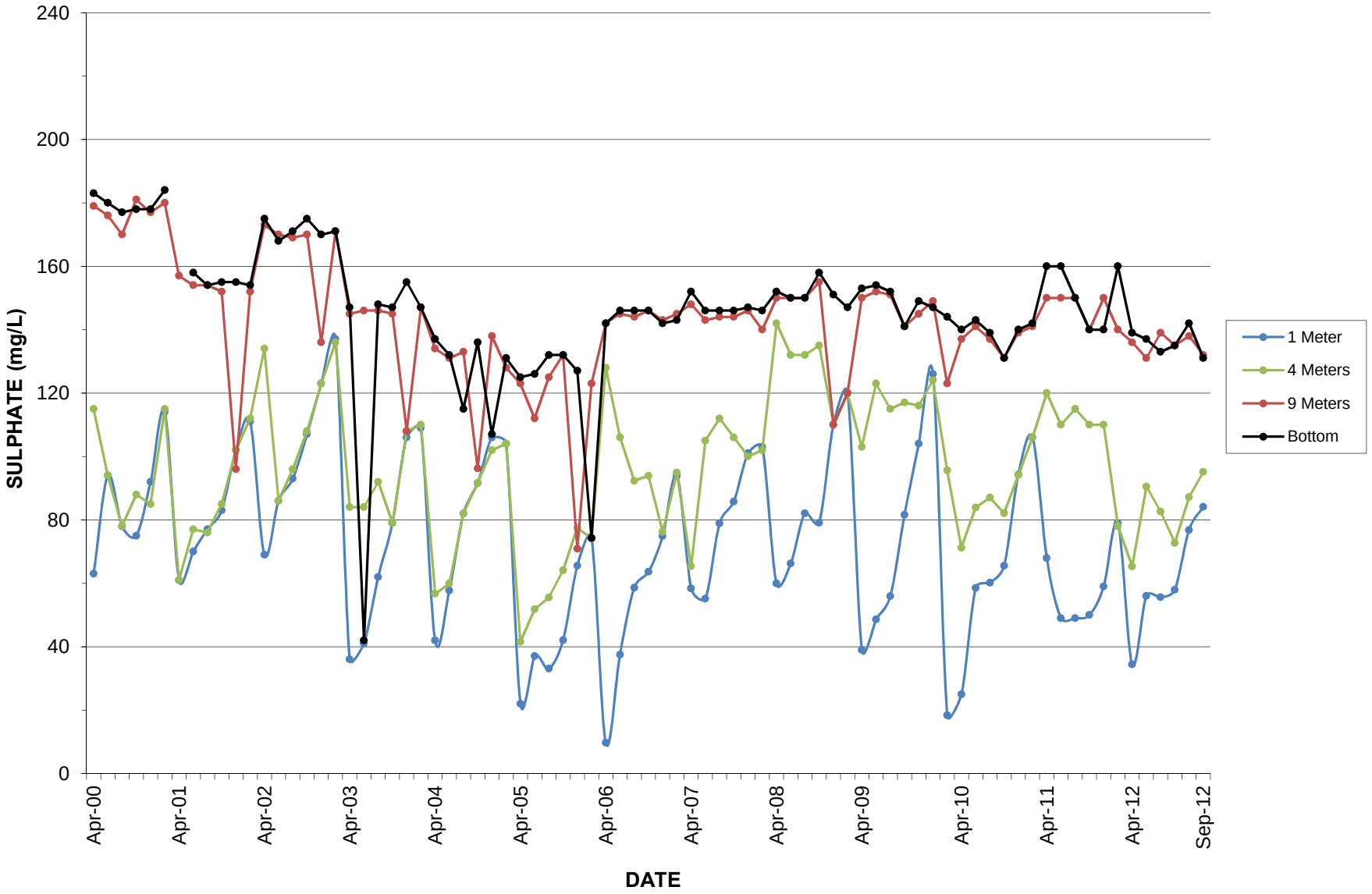
PH



GRAPH 49

LONG LAKE

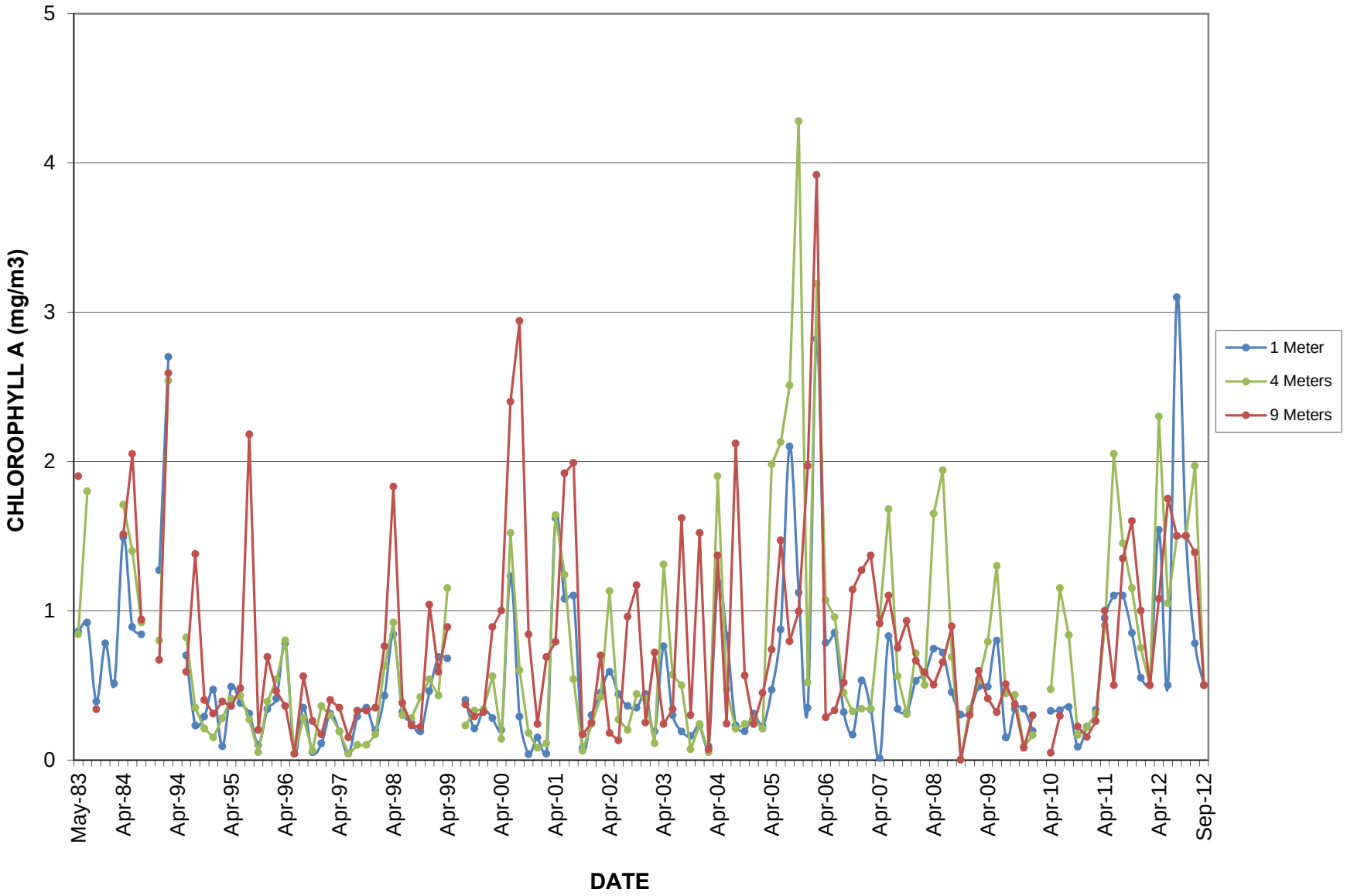
SULPHATE



GRAPH 50

LONG LAKE

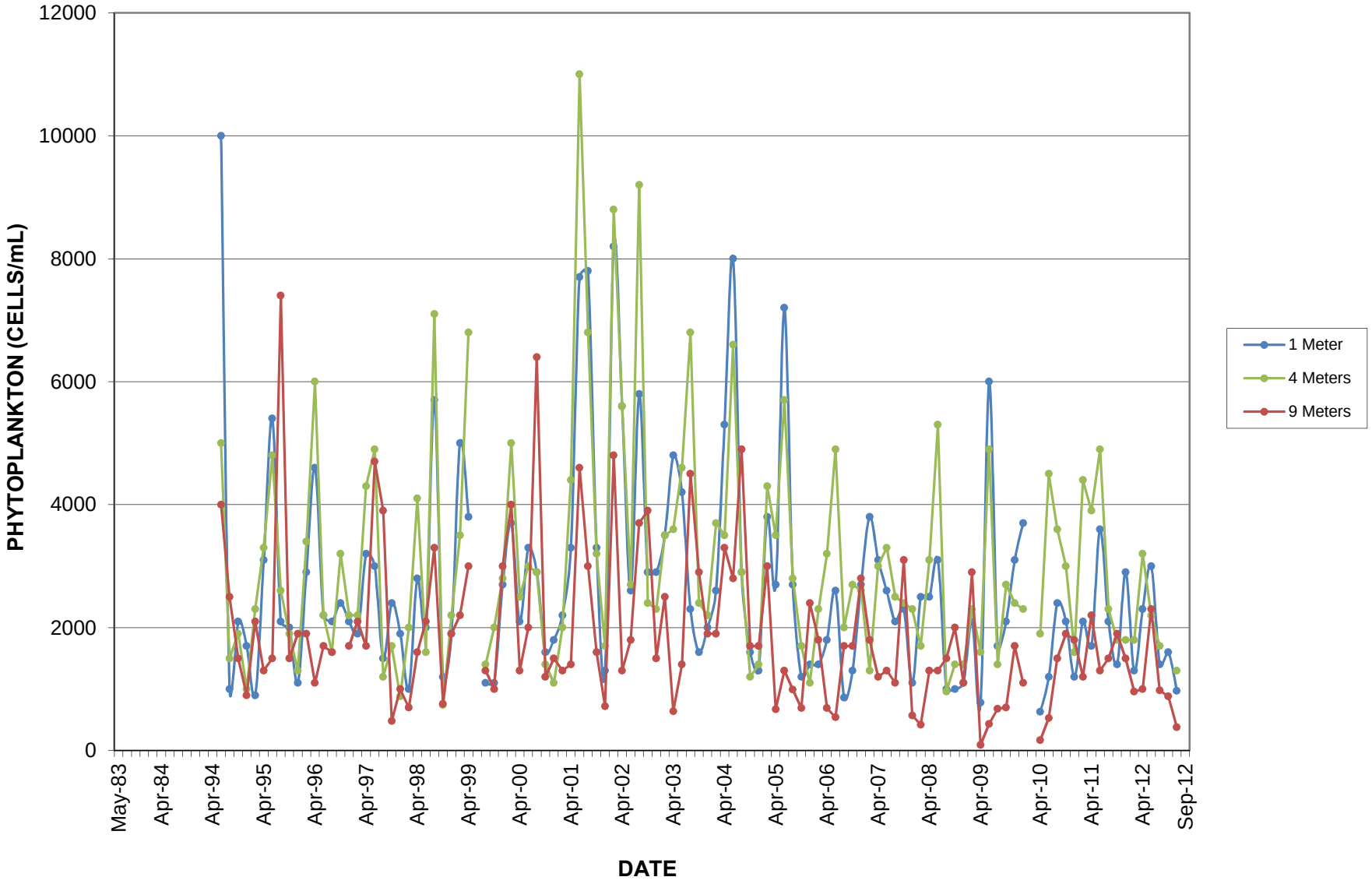
CHLOROPHYLL A



GRAPH 51

LONG LAKE

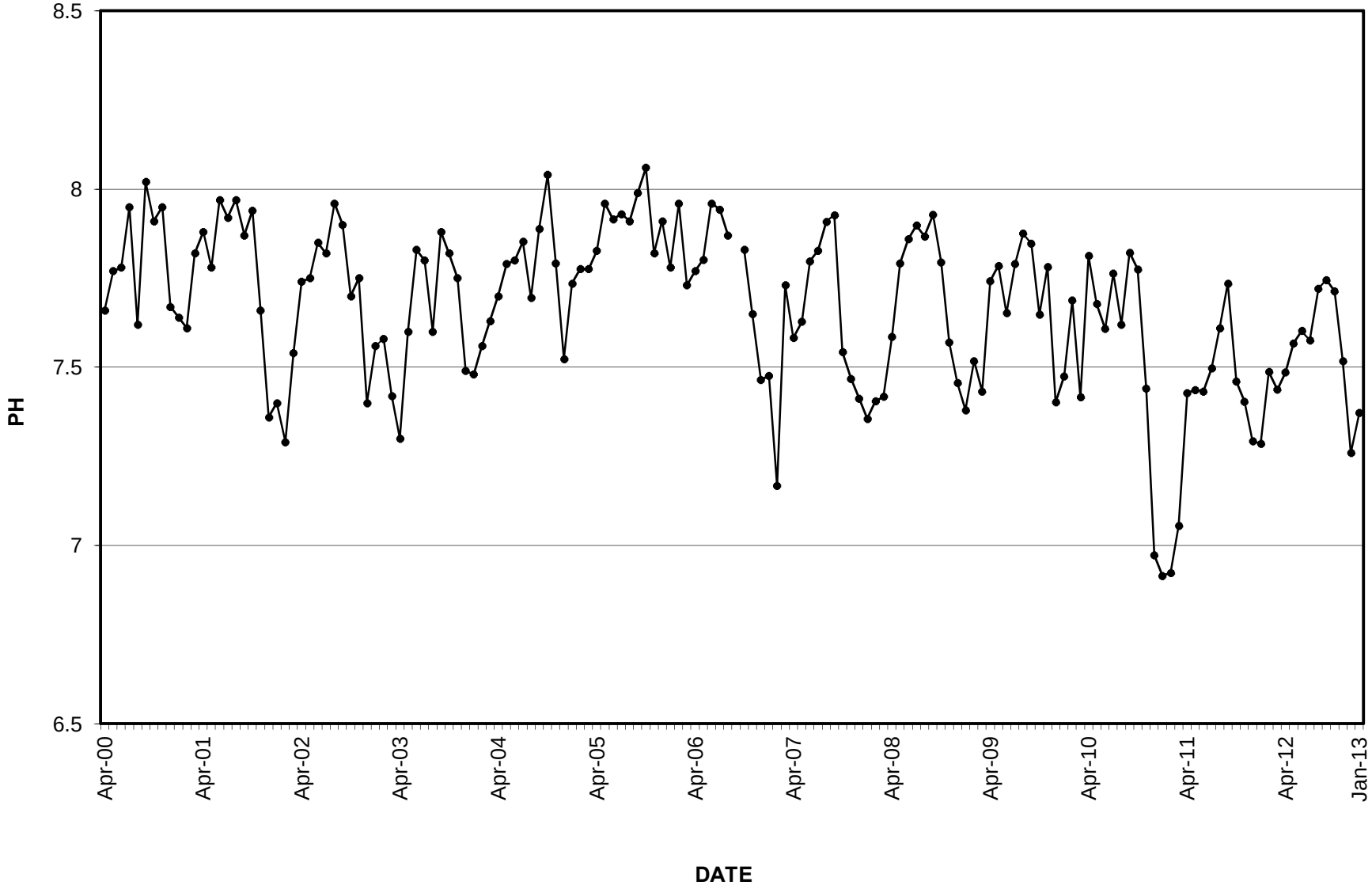
PHYTOPLANKTON ABUNDANCE



GRAPH 52

LONG LAKE OUTLET

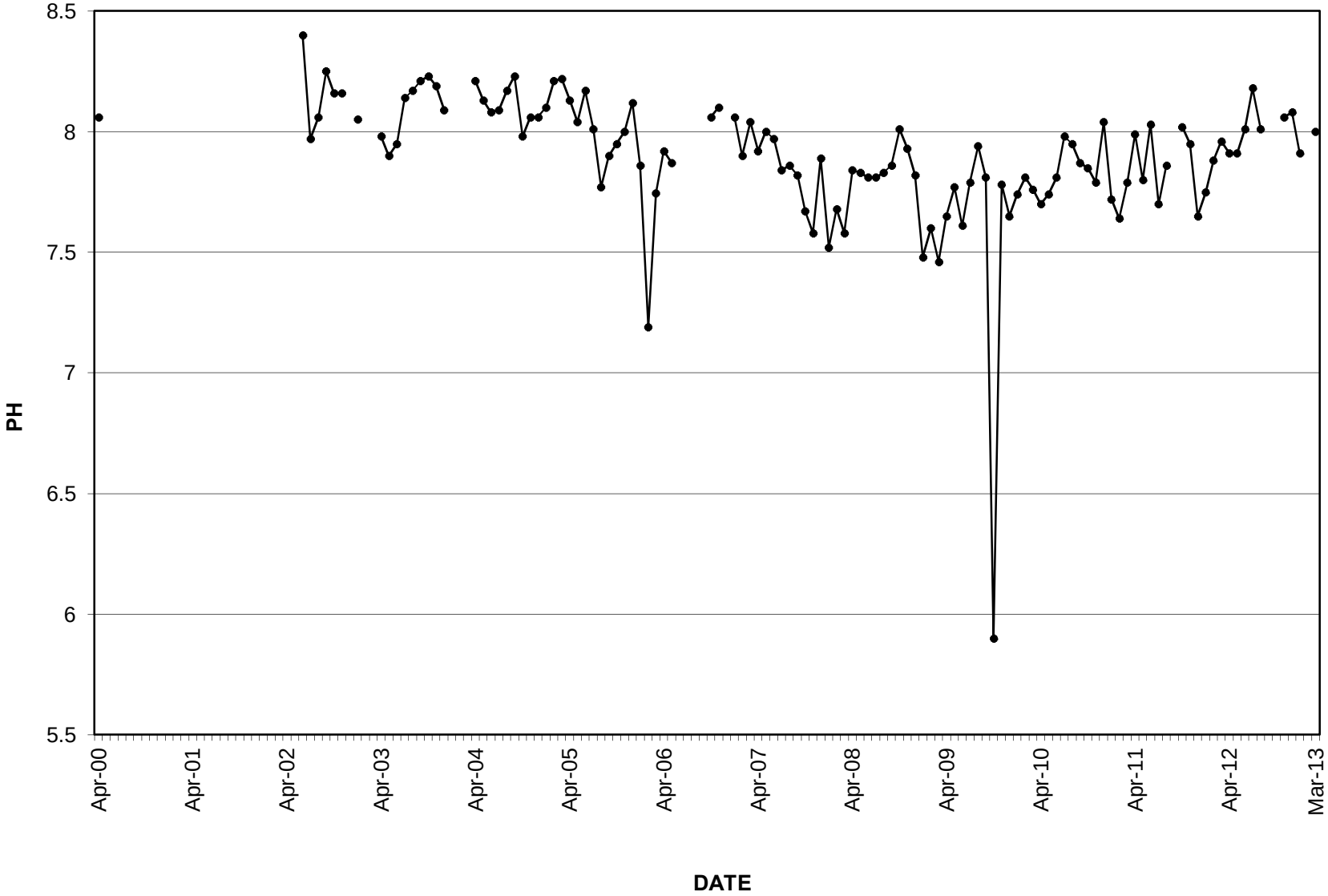
PH



GRAPH 54

pH

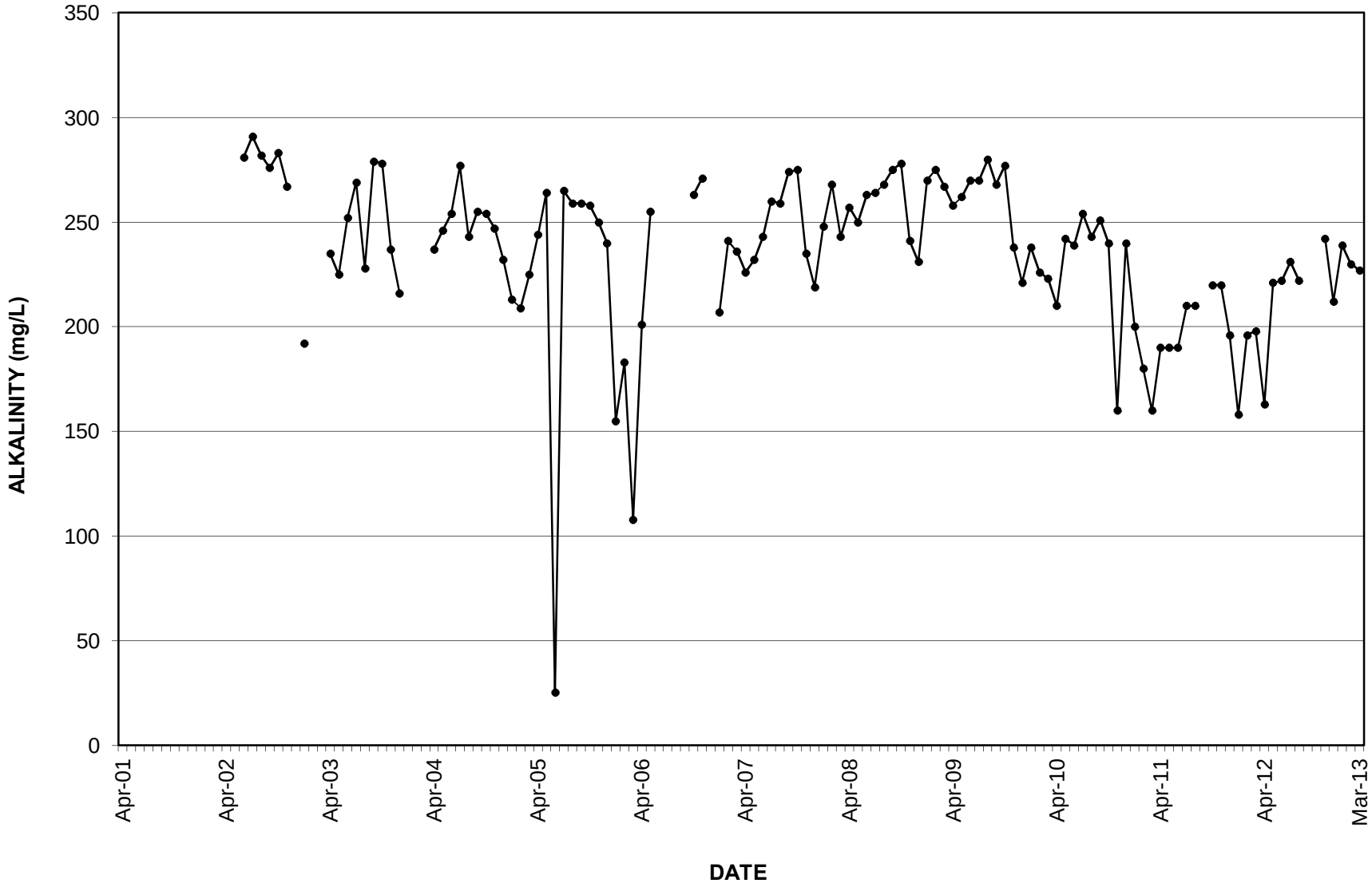
SEEP INTO LONG LAKE (LLS)



GRAPH 55

ALKALINITY

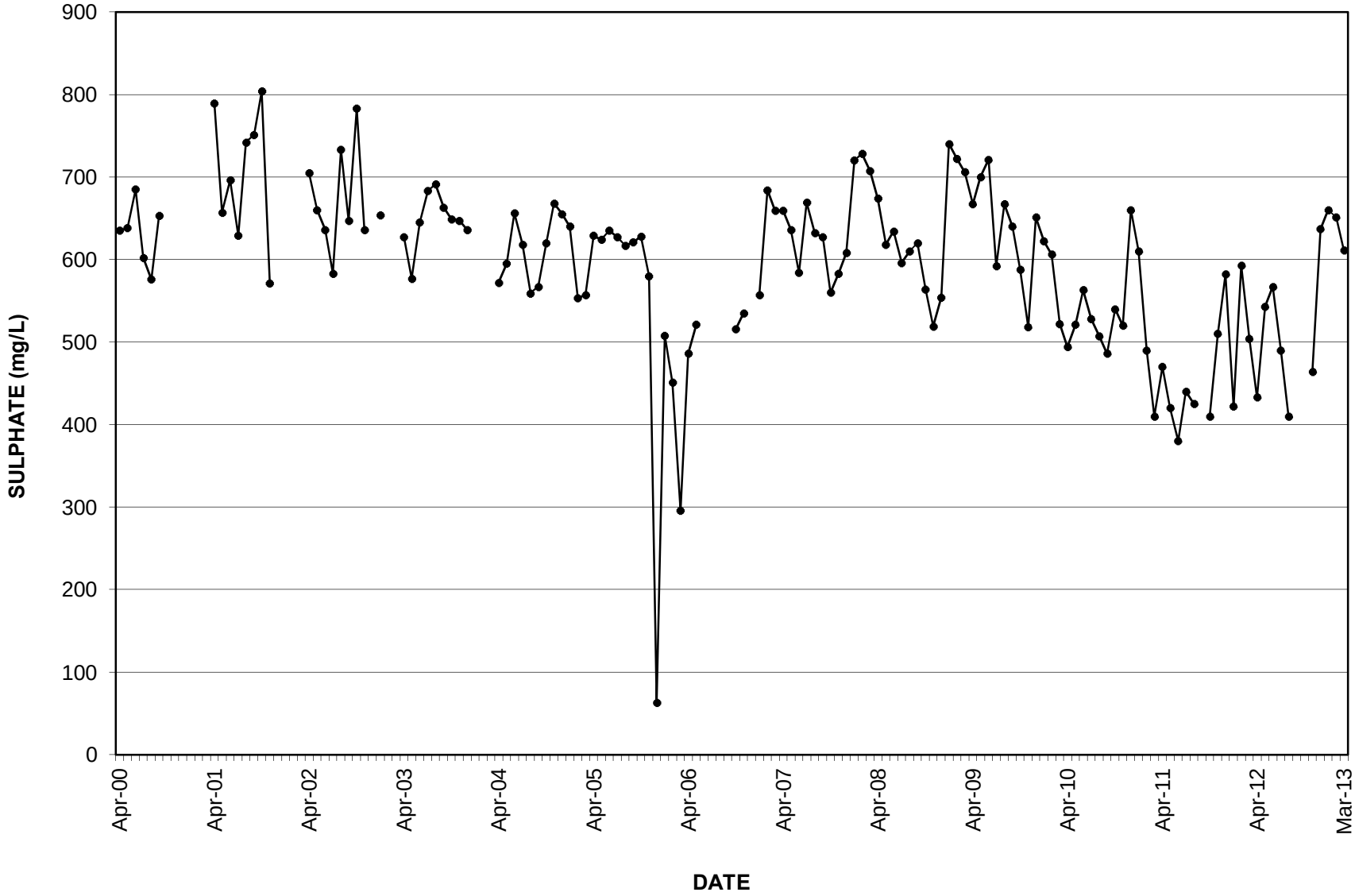
SEEP INTO LONG LAKE (LLS)



GRAPH 56

SULPHATE

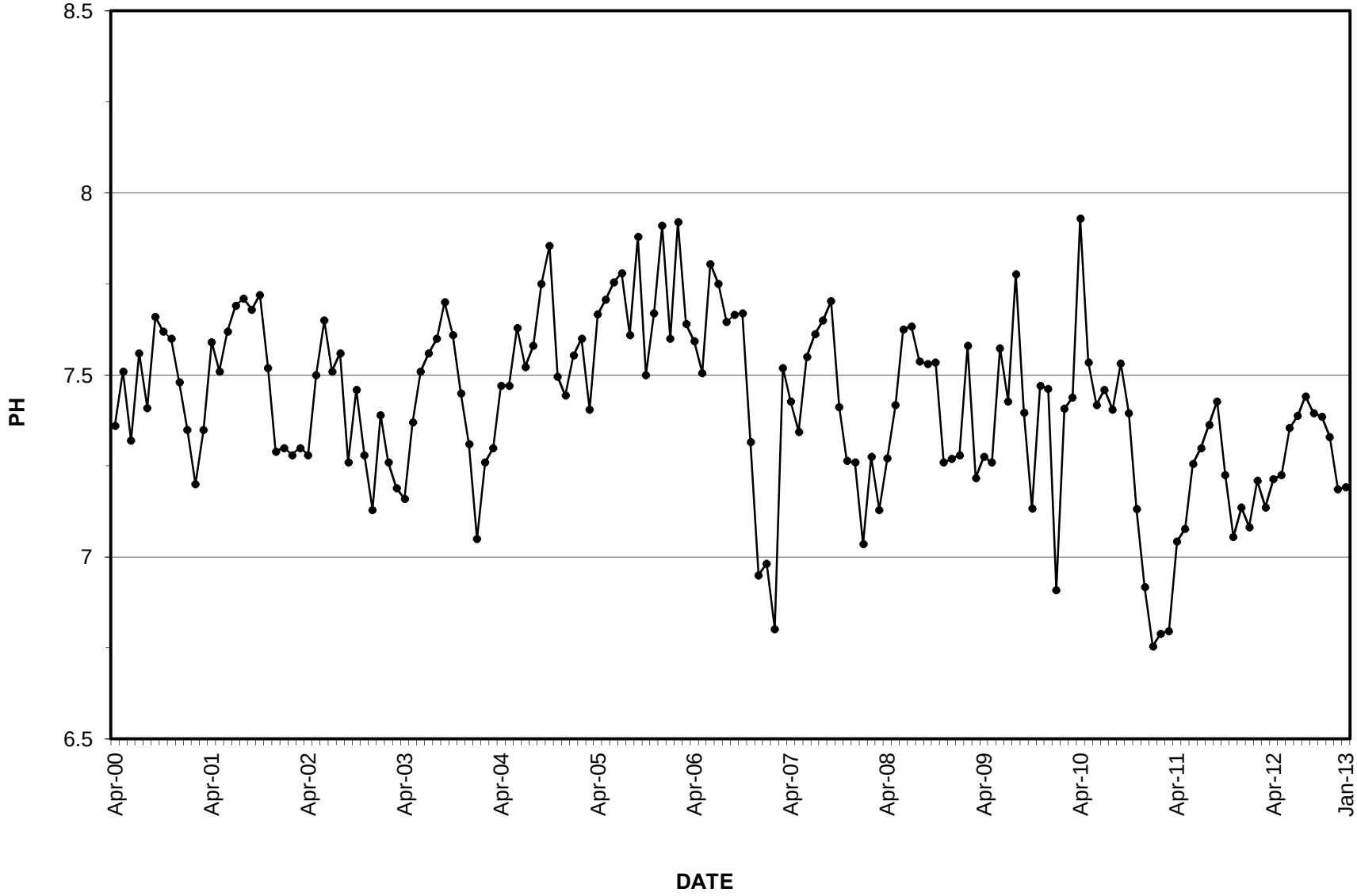
SEEP INTO LONG LAKE (LLS)



GRAPH 57

NO NAME LAKE OUTLET

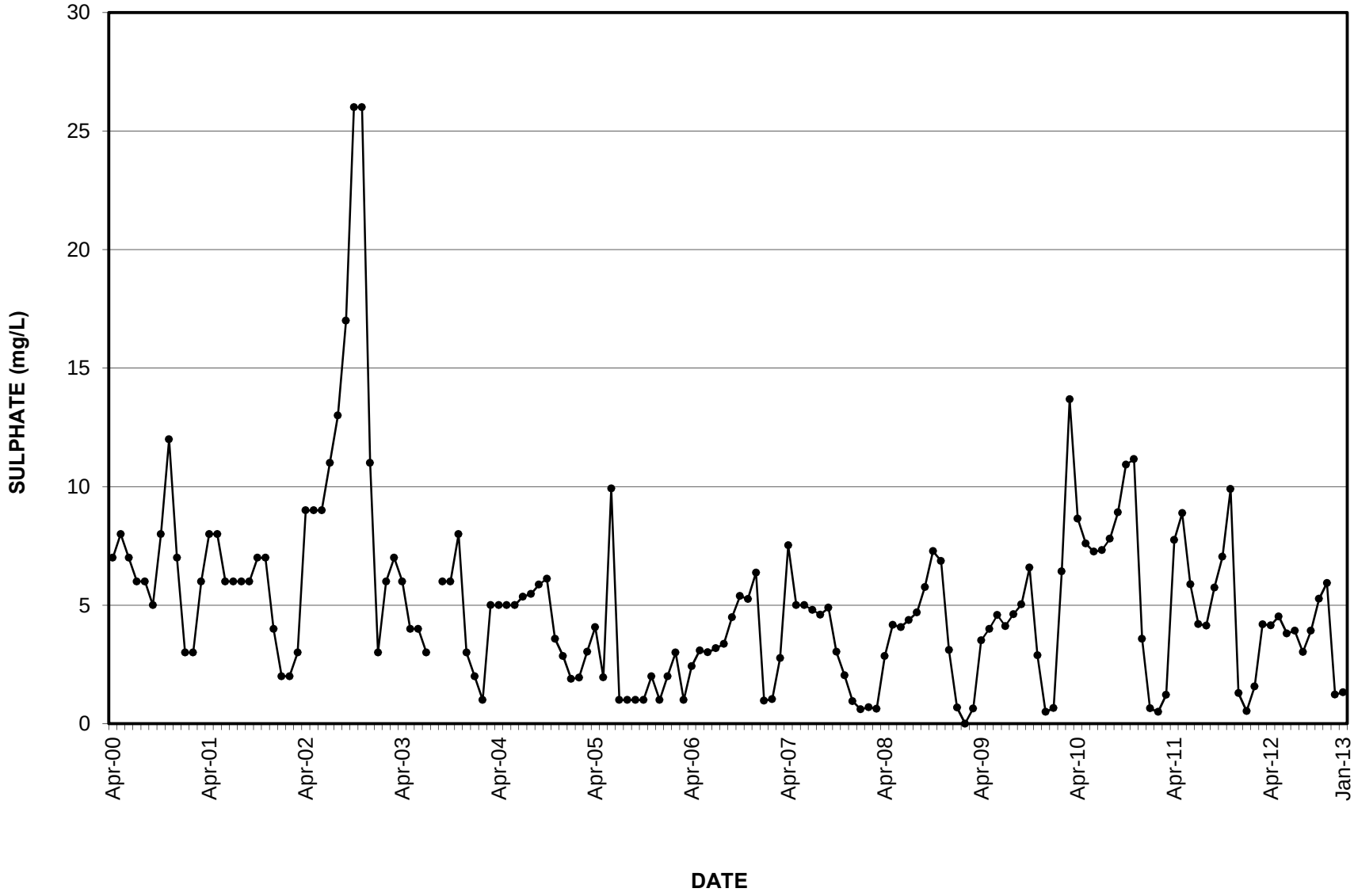
PH



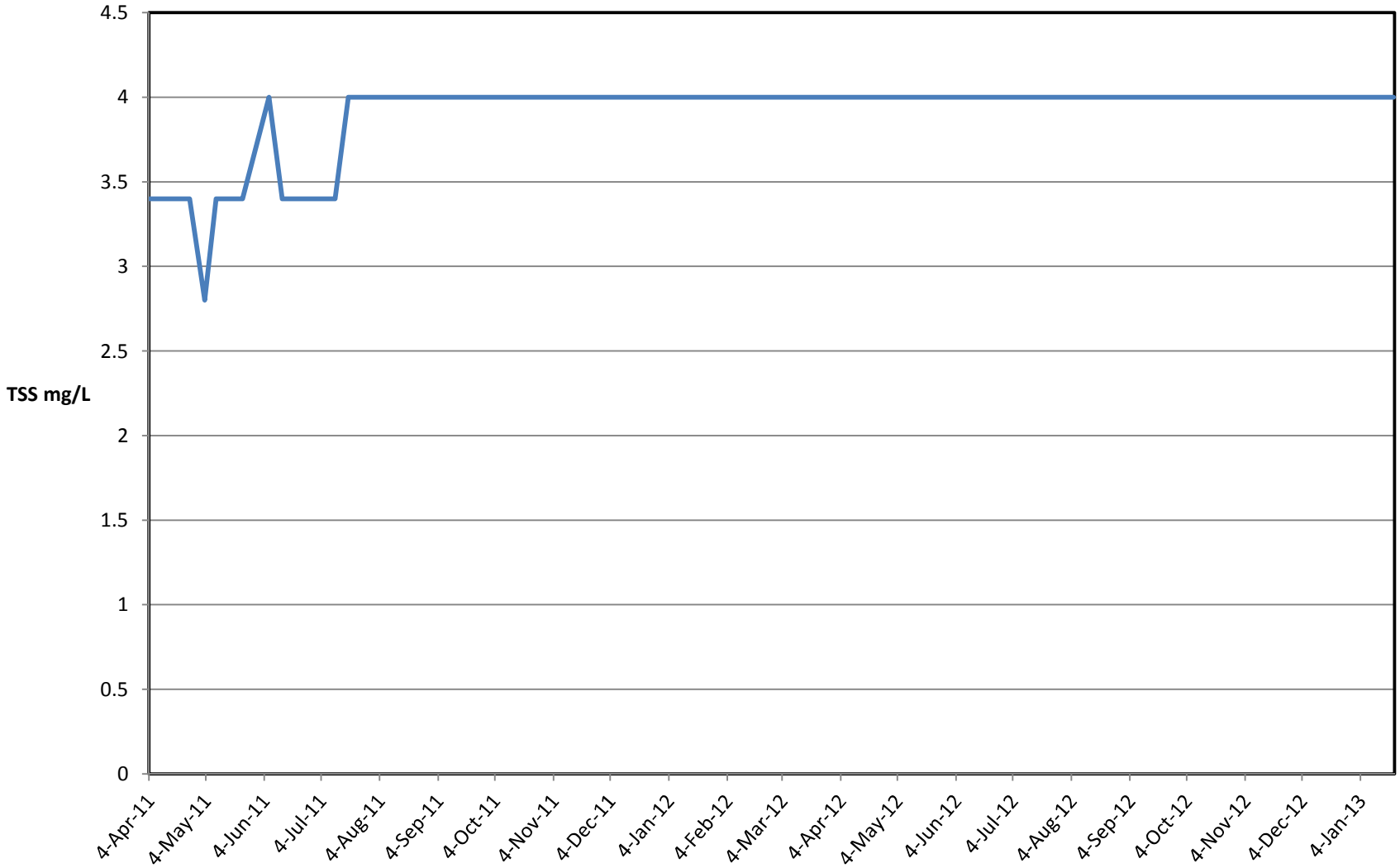
GRAPH 58

NO NAME LAKE OUTLET

SULPHATE

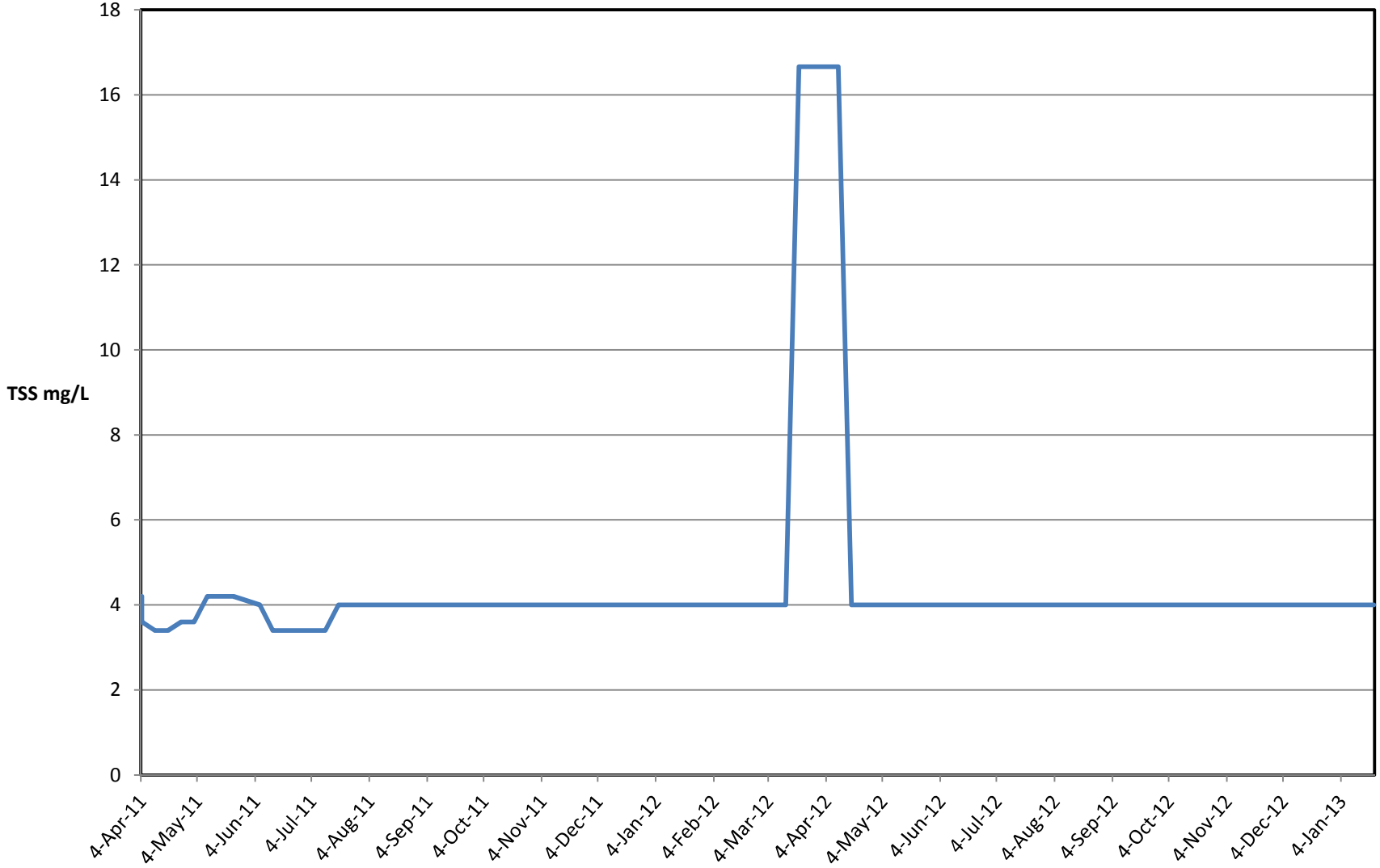


GRAPH 59
NNO
TSS (mg/L)



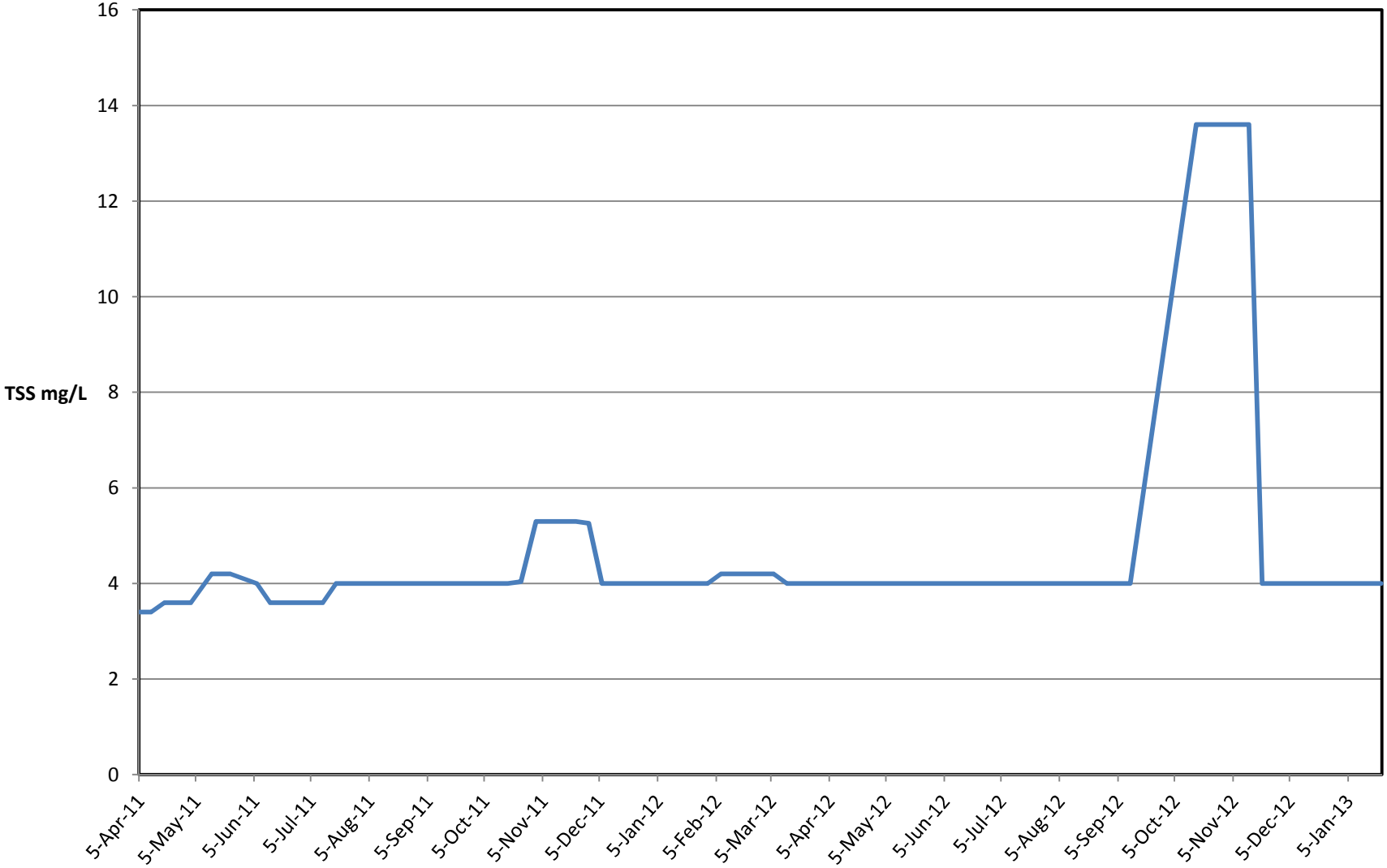
Concentrations of TSS are averaged using a running average of 5 weekly samples compared to the objective for the 30 day mean.

GRAPH 60
WA
TSS (mg/L)



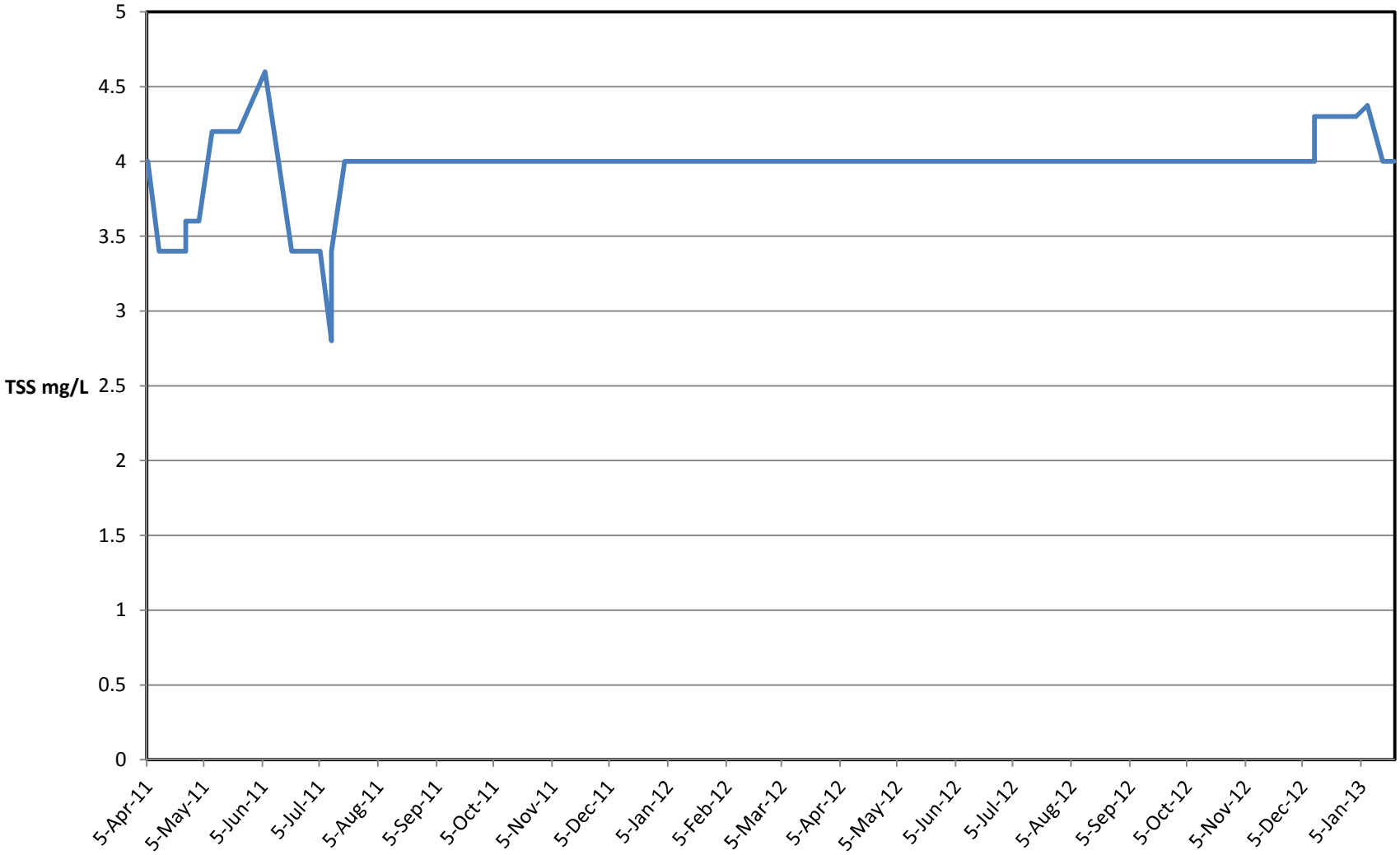
Concentrations of TSS are averaged using a running average of 5 weekly samples compared to the objective for the 30 day mean.

GRAPH 61
LLO
TSS (mg/L)



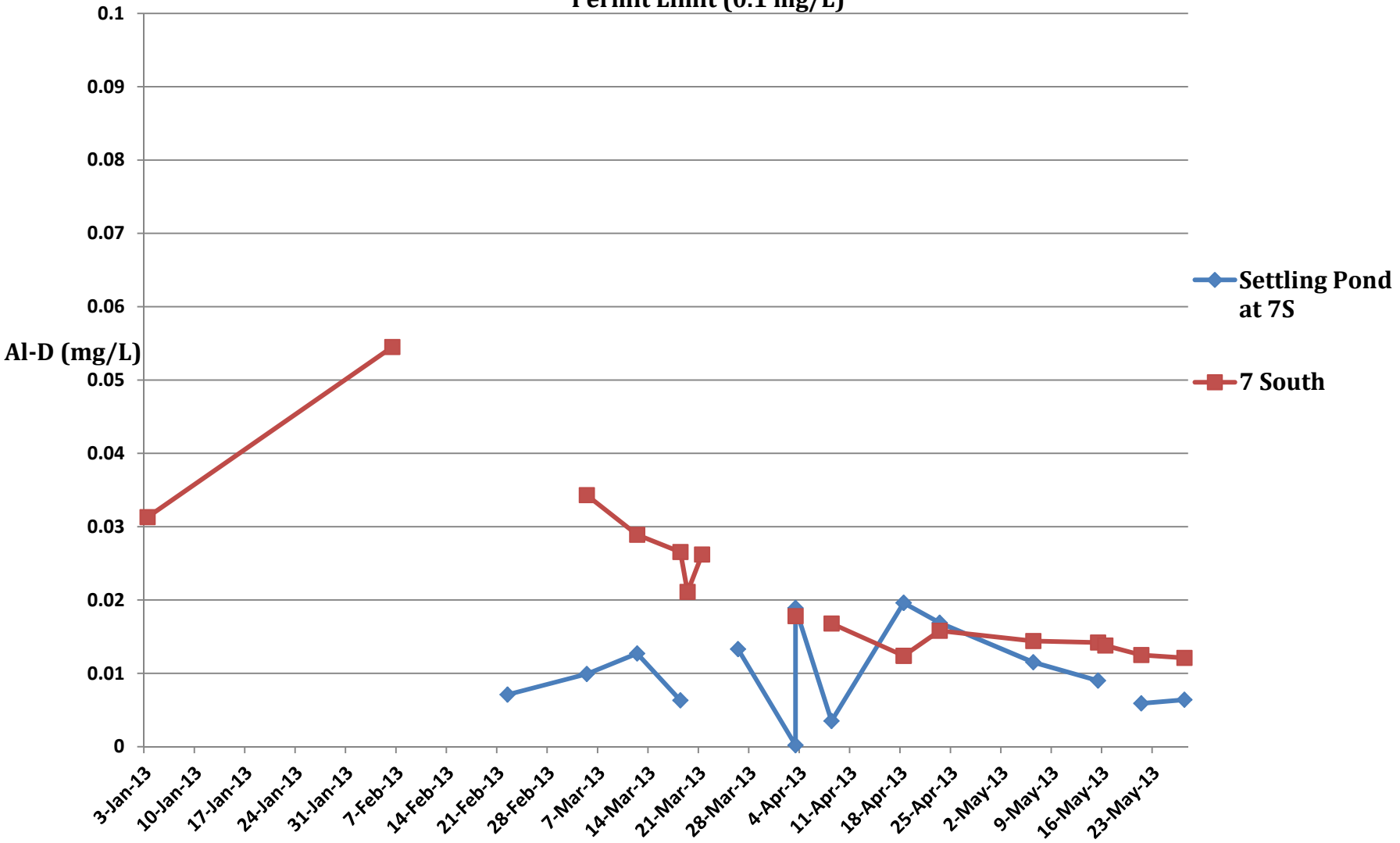
Concentrations of TSS are averaged using a running average of 5 weekly samples compared to the objective for the 30 day mean.

GRAPH 62
WB
TSS (mg/L)

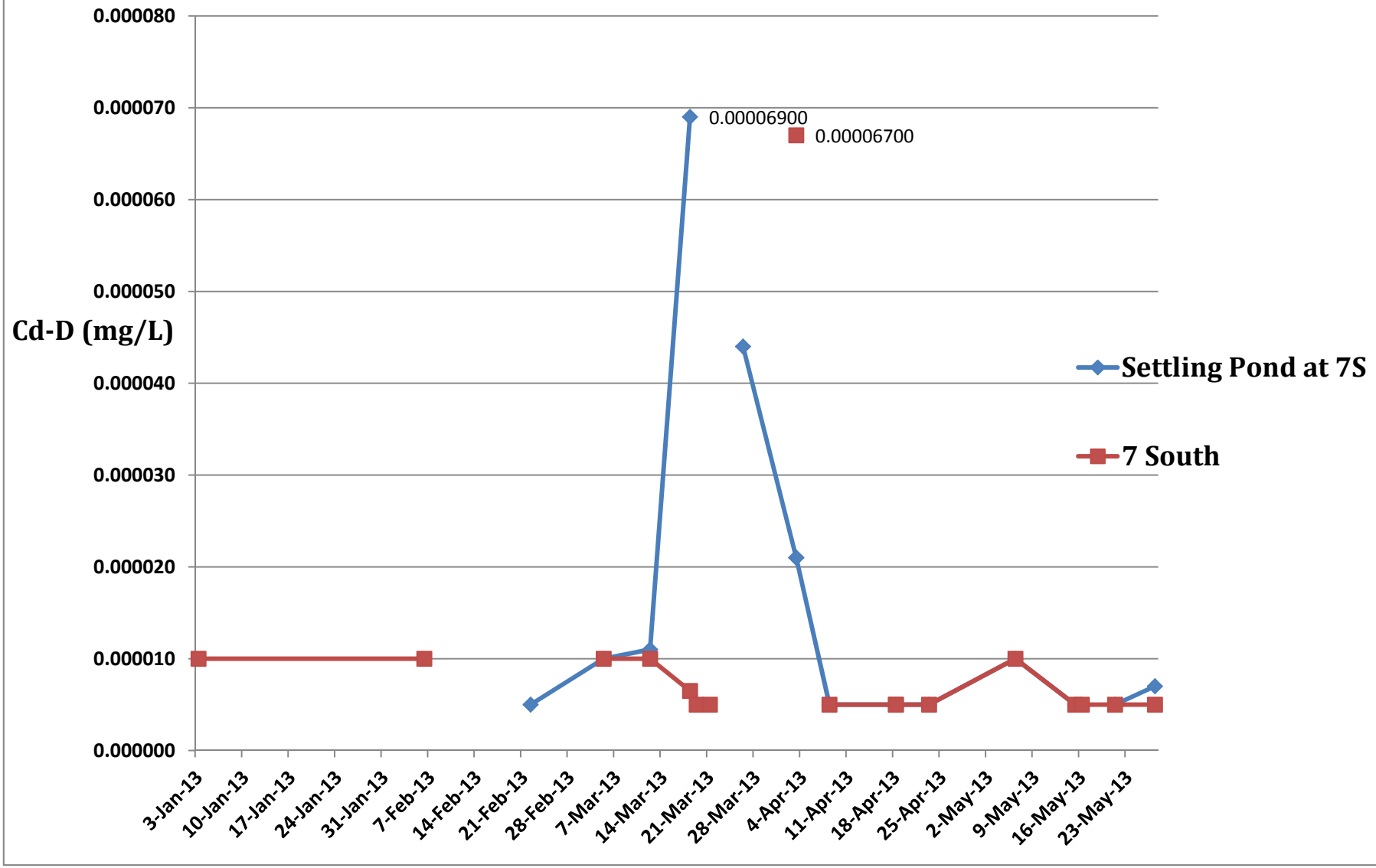


Concentrations of TSS are averaged using a running average of 5 weekly samples compared to the objective for the 30 day mean.

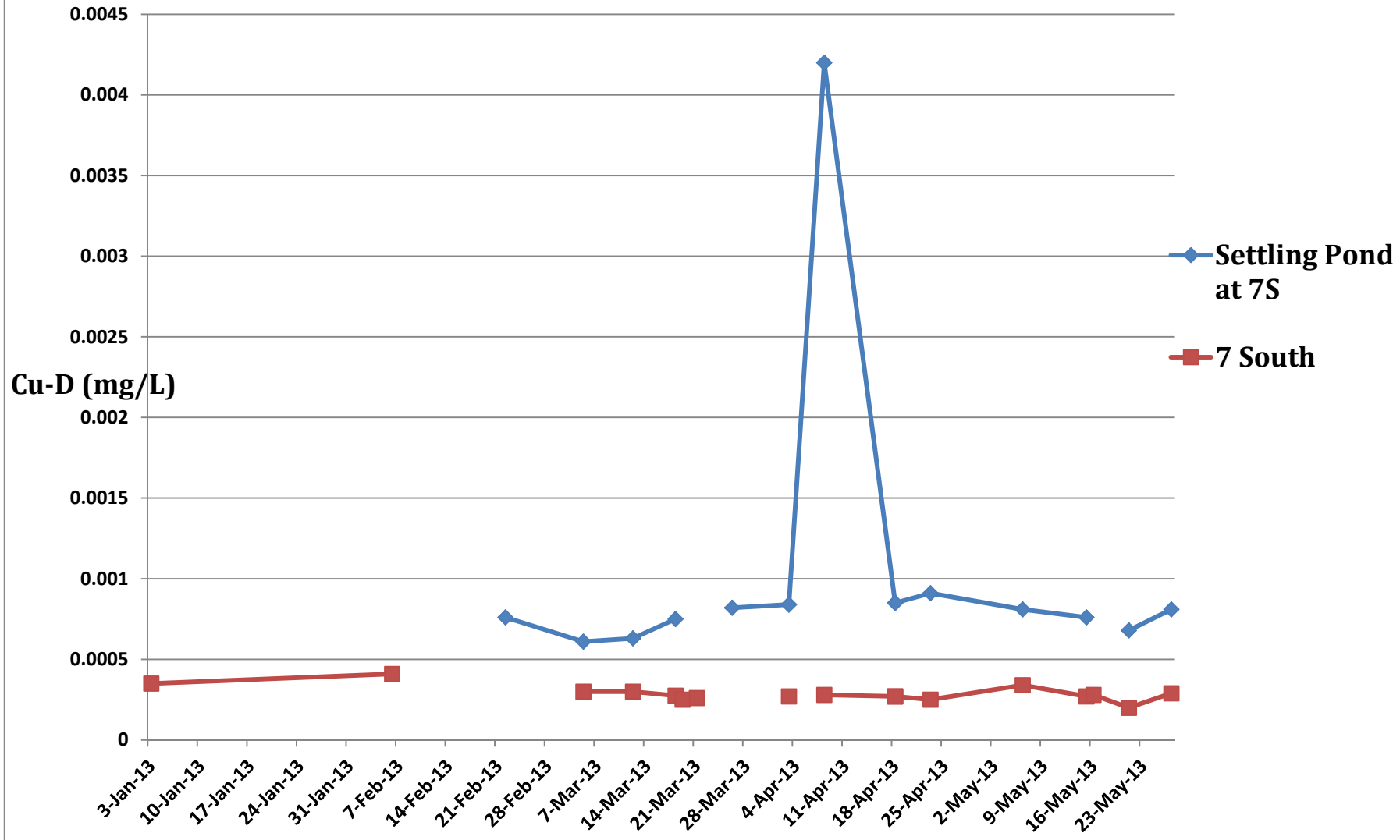
Graph 63
Dissolved Aluminum
Settling Pond 7SSD vs 7S
Permit Limit (0.1 mg/L)



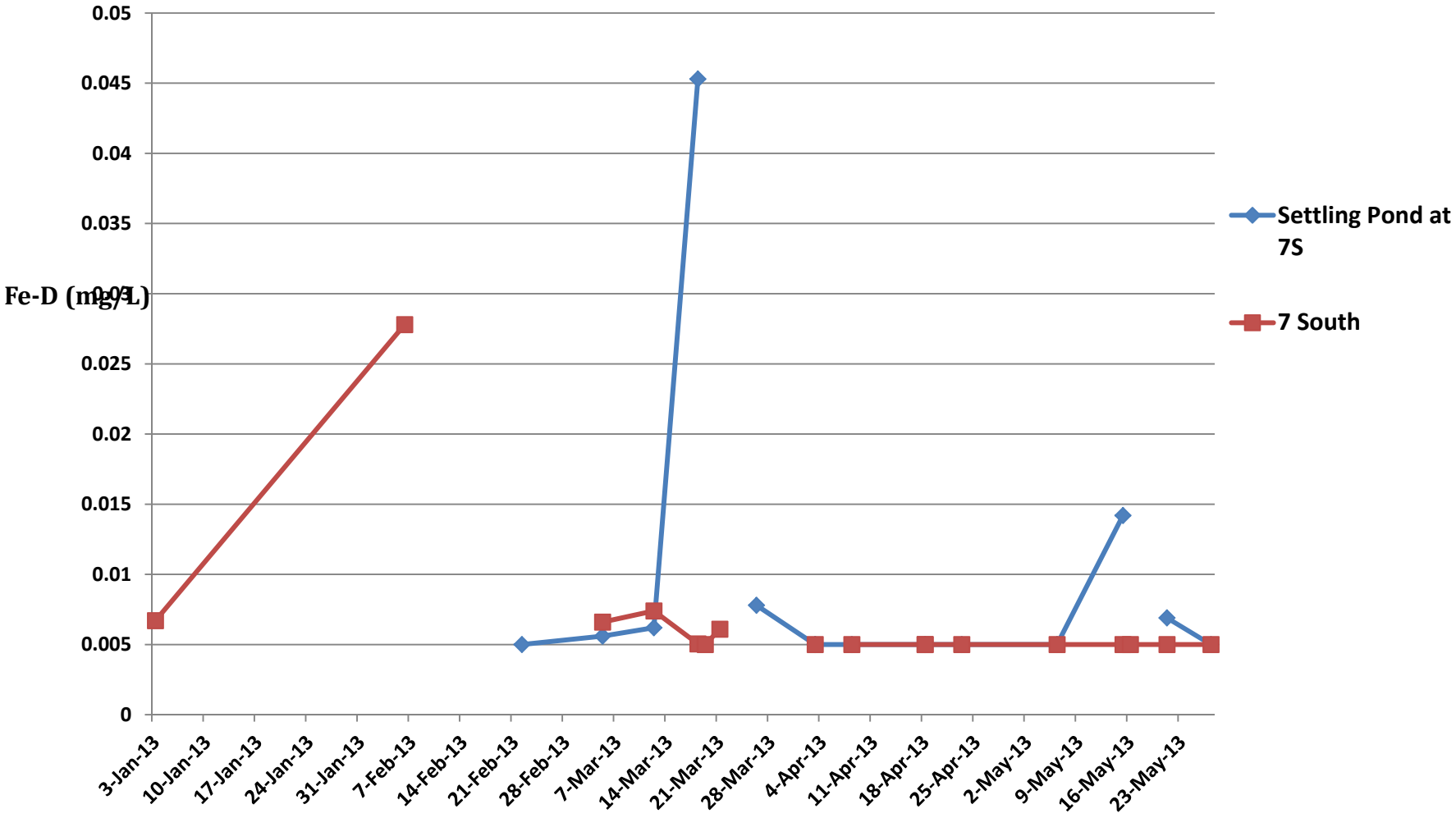
Graph 64
Dissolved Cadmium
Settling POnd 7SSD vs 7S
Permit Limit (0.000045 mg/L)



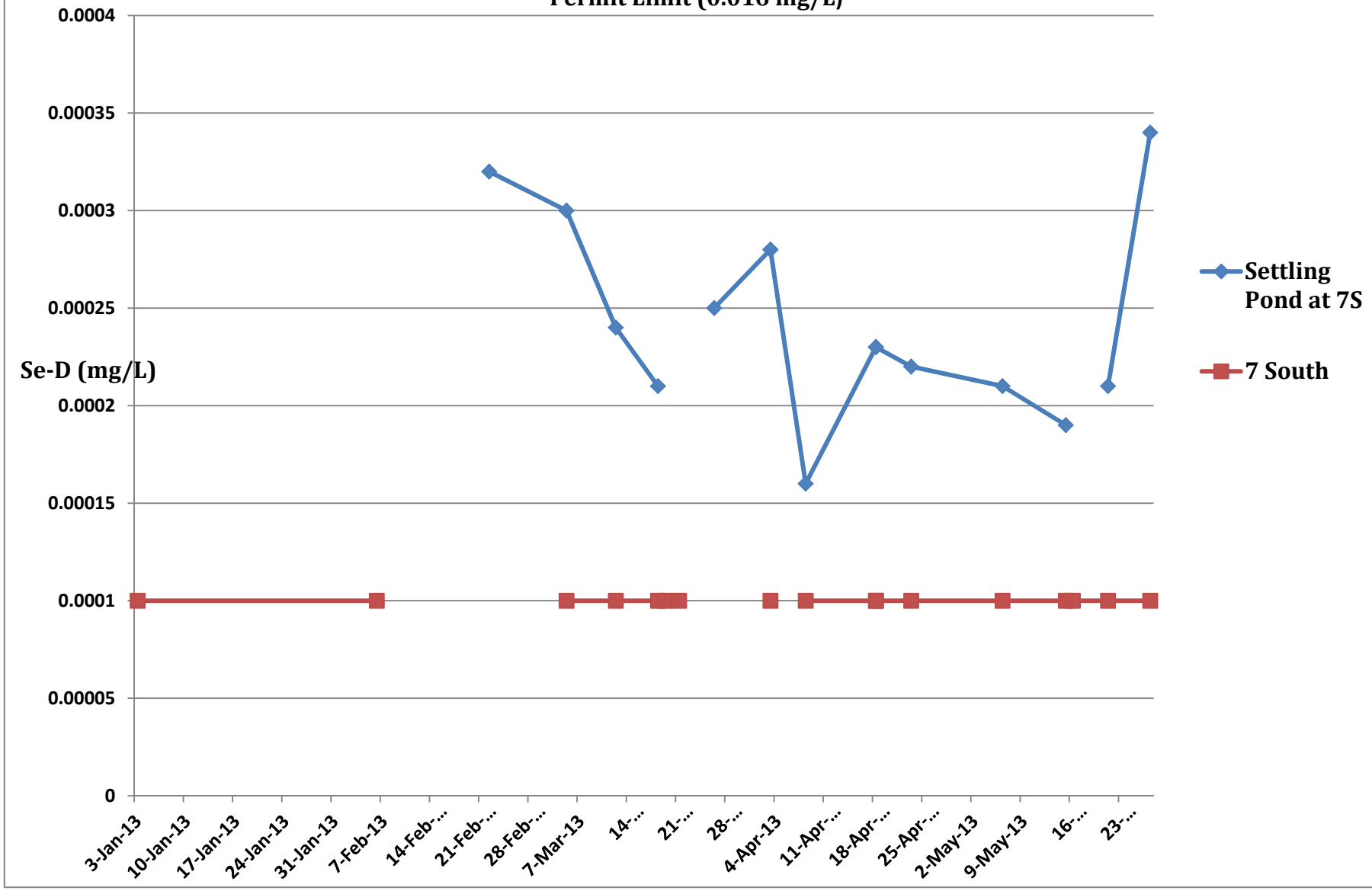
Graph 65
Dissolved Copper
Setttling Pond 7SSD vs 7S
Permit Limit (0.014 mg/L)



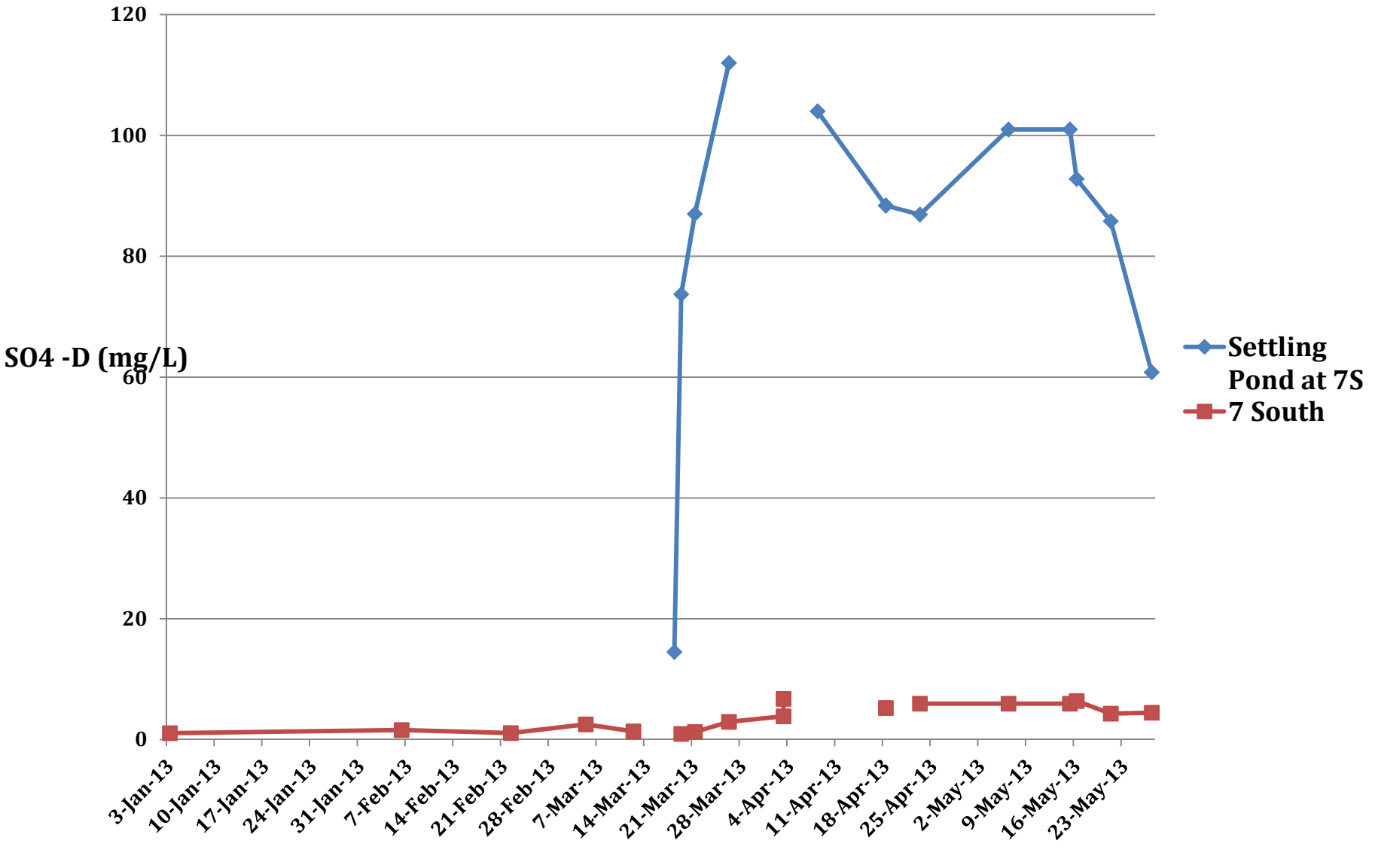
Graph 66
Dissolved Iron
Settling Pond 7SSD vs 7S
Permit Limit (0.35 mg/L)



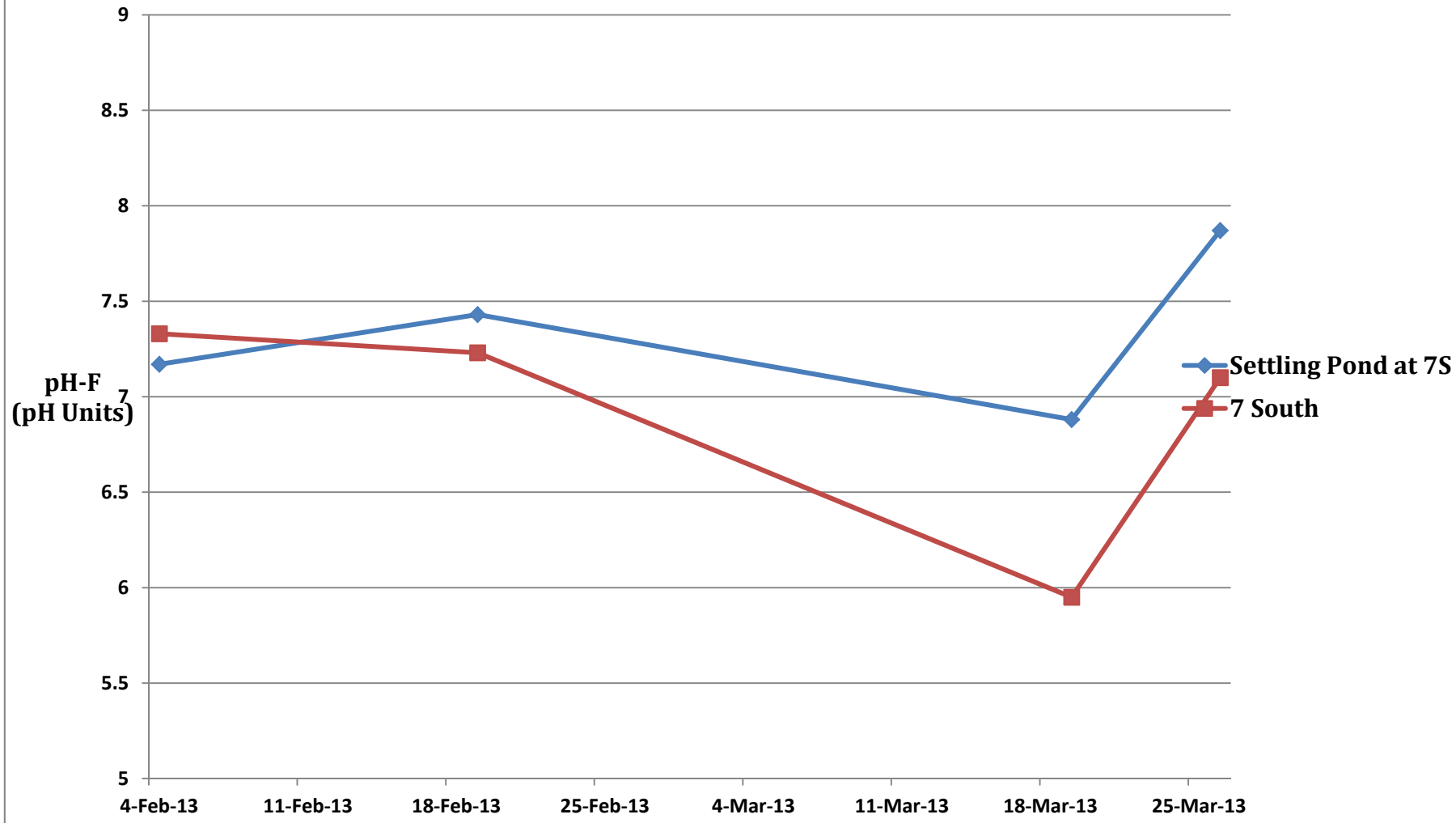
Graph 67
Dissolved Selenium
Settling Pond 7SSD vs 7S
Permit Limit (0.016 mg/L)



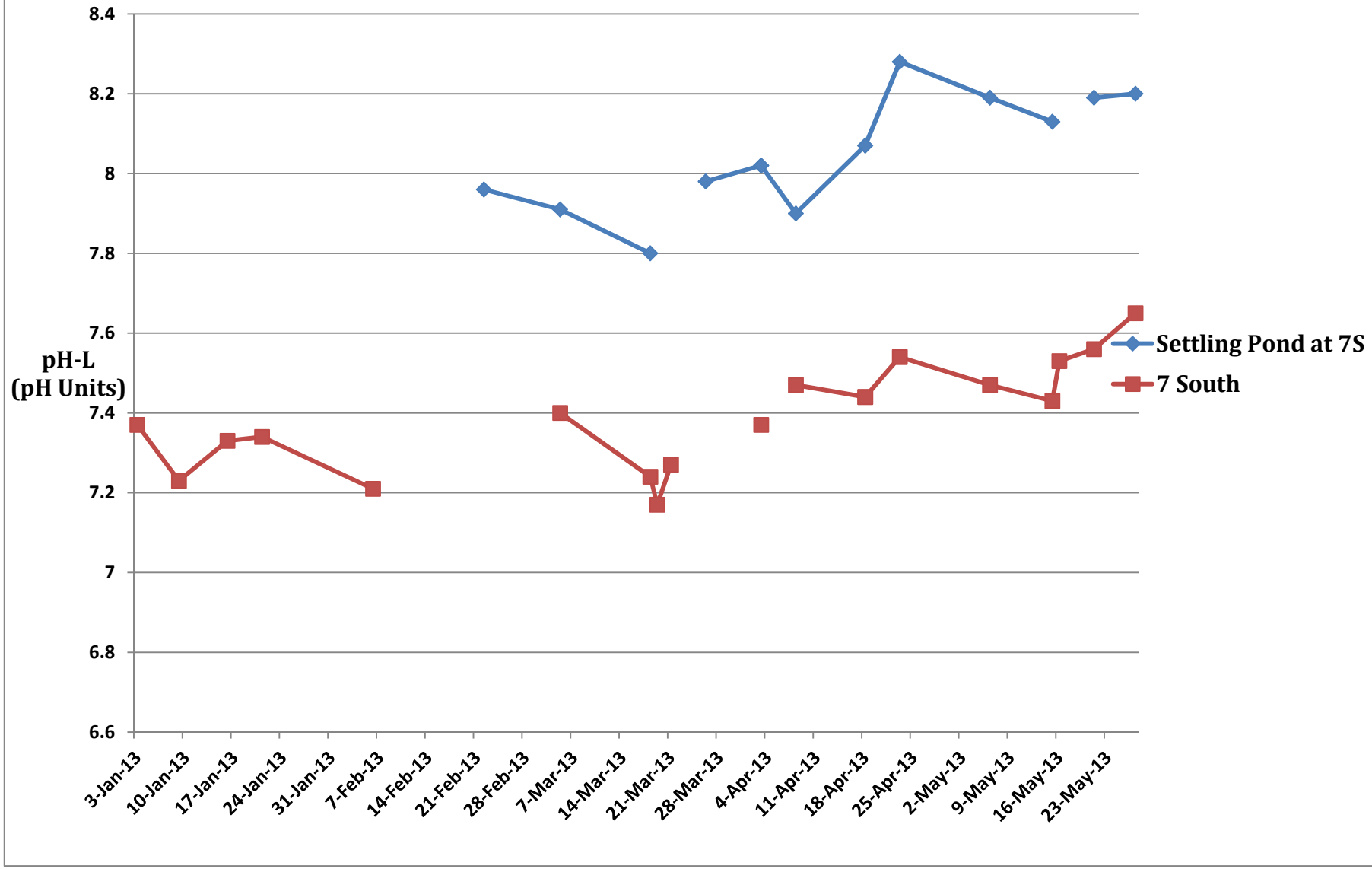
Graph 68
Dissolved Sulphate
Settling Pond 7SSD vs 7S
Permit Limit (500 mg/L)



Graph 69
Field pH Settling Pond
7SSD vs 7S
Permit Limit (6.0-8.0)



Graph 70
Lab pH
Settling Pond 7SSD vs 7S
Permit Limit (6.0-8.0)



List of Appendices

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Appendix II	Jacques Whitford “Phytoplankton, & Periphyton Analysis Protocols & QA/QC
Appendix III	Phytoplankton Analytical Results for Middle Quinsam & Long Lake
Appendix IV	Periphyton Analytical Results for Quinsam River and Long Lake Outlet
Appendix V	Ministry of Environment “Compliance Review Record”, Dated October 16, 2012
	ETRC and Public Meeting Minutes
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Appendix VII	Quinsam Baseline Hydrology Program 2012-13 Activities
Appendix VIII	Spills
Appendix IX	Long Lake Passive Treatment System
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APPENDIX I

BIOASSAYS

Quinsam Coal Corporation
Campbell River
SPD-04Dec12-P Grab

Rainbow Trout Bioassay
96-h LC50 %v/v: >100%

Maxxam Analytics
4606 Canada Way
Burnaby, BC
Canada V5G 1K5
tel: 604 734-7276
fax: 604 731-2386
web: http://maxxam.ca

Sample # : FE1556-01 / B2B0294 / 9239 — Report # : 2-11-200-317-12-005

Sample Taken:	Dec. 4, 2012 1:00 PM	Sample pH:	6.9
Sample Collected By:	N/A	Sample Dissolved Oxygen:	10.1 mg/L
Sample Received:	Dec. 5, 2012	Sample Temperature:	15.2 °C
Start Date/Time:	Dec. 6, 2012 12:30 PM	Sample Conductance:	667 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr	Number of Mortalities
0	43	15.1	15.2	7.3	7.6	10.2	9.6	0	0	0	0	0
10	125	15.1	15.3	7.2	7.4	10.3	9.5	0	0	0	0	0
18	185	15.1	15.4	7.2	7.4	10.3	9.6	0	0	0	0	0
32	260	15.1	15.4	7.2	7.4	10.3	9.8	0	0	0	0	0
56	429	15.1	15.4	7.1	7.4	10.3	9.9	0	0	0	0	0
100	667	15.2	15.3	7.1	7.7	10.3	9.8	0	0	0	0	0

Comments:
All fish appeared and behaved normally during the test. The cumulative fish culture mortality in previous 7 days was 0.11%. The acceptability criteria for fish culture mortality is <2%.

Test Conditions:

Organisms per Replicate:	10	Preaeration Time:	30 min.
Test Volume:	18 L	Rate of aeration:	6.5 ml/min/L
Loading Density:	0.34 g/L		

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (Mean + SD):	0.61 ± 0.19 g	Length (Mean + SD):	3.9 ± 0.3 cm
Weight (Range):	0.35– 1.02 g	Length (Range):	3.3– 4.6 cm

Reference Toxicant: Zinc
Test was conducted on: 28/11/2012
Test gave a 96-h LC50 of 0.08 (0.06, 0.12) mg/L
The historical mean LC50 and warning limits were 0.15 (0.06, 0.36) mg/L.

Dilution Water: Vancouver Tapwater hardened and dechlorinated
EDTA Hardness: 22 mg $CaCO_3$/L Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, Second Edition, December 2000 and May 2007 Amendments. Results contained in this report refer only to the testing of samples as submitted.

Analyst **Verified By**

2012Dec12

J. Pickard
DEC 12 2012

Quinsam Coal Corporation
Campbell River
WD-05Dec12-P Grab

Rainbow Trout Bioassay
96-h LC50 %v/v: >100%

Maxxam Analytics
4606 Canada Way
Burnaby, BC
Canada V5G 1K5
tel: 604 734-7276
fax: 604 731-2386
web: http://maxxam.ca

Sample # : FE3790-01 / B2B0725 / 9239 — Report # : 2-11-200-317-12-006

Sample Taken:	Dec. 5, 2012 1:00 PM	Sample pH:	7.8
Sample Collected By:	N/A	Sample Dissolved Oxygen:	9.9 mg/L
Sample Received:	Dec. 6, 2012	Sample Temperature:	15.5 °C
Start Date/Time:	Dec. 7, 2012 12:30 PM	Sample Conductance:	1746 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr	Number of Mortalities
0	44	15.2	15.4	7.1	7.0	10.3	9.7	0	0	0	0	0
10	223	15.2	15.0	7.1	7.8	10.3	9.6	0	0	0	0	0
18	389	15.3	15.2	7.3	7.8	10.3	9.6	0	0	0	0	0
32	609	15.3	15.3	7.5	8.1	10.3	9.7	0	0	0	0	0
56	1093	15.3	15.1	7.6	8.2	10.2	9.3	0	0	0	0	0
100	1747	15.4	15.3	7.7	8.3	10.0	9.5	0	0	0	0	0

Comments:
All fish appeared and behaved normally during the test. The cumulative fish culture mortality in previous 7 days was 0%. The acceptability criteria for fish culture mortality is <2%.

Test Conditions:

Organisms per Replicate:	10	Preaeration Time:	30 min.
Test Volume:	18 L	Rate of aeration:	6.5 ml/min/L
Loading Density:	0.36 g/L		

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (Mean + SD):	0.65 ± 0.13 g	Length (Mean + SD):	4.4 ± 0.2 cm
Weight (Range):	0.43– 0.96 g	Length (Range):	4– 4.7 cm

Reference Toxicant: Zinc
Test was conducted on: 28/11/2012
Test gave a 96-h LC50 of 0.08 (0.06, 0.12) mg/L
The historical mean LC50 and warning limits were 0.15 (0.06, 0.36) mg/L.

Dilution Water: Vancouver Tapwater hardened and dechlorinated
EDTA Hardness: 22 mg $CaCO_3$/L Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, Second Edition, December 2000 and May 2007 Amendments. Results contained in this report refer only to the testing of samples as submitted.

Analyst **Verified By**

2012 Dec 12

J. Rickard
DEC 12 2012

APPENDIX II

PHYTOPLANKTON & PERIPHYTON ANALYSIS PROTOCOLS & QA/QC

Jacques Whitford

Engineering,
Scientific,
Planning and
Management
Consultants

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Phytoplankton & Periphyton Analysis

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Phytoplankton and Periphyton Protocols and QA/QC

Last revised April 21, 2005

Jacques Whitford Limited
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Contact: Karen Munro, M.Sc., R.P.Bio
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Jacques Whitford

PHYTOPLANKTON AND PERIPHYTON ANALYSIS

1.0 QUALITY ASSURANCE/QUALITY CONTROL

Any supplied Chain of Custody forms are maintained. All samples are stored in the dark until they are prepared for examination. Standard protocols, listed below, are followed. Client requests for duplication are followed. Periodic checks of laboratory duplicates (two subsamples from the same container) are done. Taxonomic references are provided.

1.1 Equipment

Equipment includes a Zeiss IM inverted microscope with 10X oculars and 10X, 40X and 100X objectives and phase contrast optics. Field diameters, measured by a Zeiss technician, were used to calculate conversion factors.

1.2 Phytoplankton Samples

The method of phytoplankton analysis and guidelines for statistical reliability are discussed in Section 3. Glassware and sampling equipment are rinsed using sample water before settling the samples. Sample bottles are shaken well to distribute algae and 27 mL aliquots settled for a minimum of 16 hours. Subsamples are labeled or kept with the original sample bottles, to prevent confusion. Careful records of any dilutions are made. Any unusual or inconsistent results are checked by examining a new subsample. See Section 3.2 for additional comments on statistical reliability of the counts.

1.3 Periphyton Samples

The method of periphyton analysis and guidelines for statistical reliability are discussed in Section 4. Depending on the nature of the periphyton material, sample vials are shaken to distribute algae, or several subsamples of clumped material are removed. Material is examined on glass slides or in a 2 mL settling chamber. Subsamples are labeled or kept with the sample vials to prevent confusion.

1.4 Communicating Problems with the Client

The client is advised immediately if problems arise. This is seldom needed, but the most common reason is insufficient or no preservative in the sample.

2.0 SAMPLE PRESERVATION

Lugol's preservative is recommended. It can be ordered from a chemical supply house. Specify the concentrated form, not the dilute form used for gram staining of bacteria.

Lugol's is made by dissolving 5 g I_2 and 10 g KI in deionized water, then making it up to 200 mL including 20 mL glacial acetic acid. Store in a brown bottle away from light.

Use 1 mL per 100 mL Lugol's for phytoplankton samples. Use enough to turn the sample water the colour of tea for periphyton samples. Store preserved samples in the dark.

3.0 PHYTOPLANKTON ANALYSIS

3.1 Sampling Advice

Samples can be taken from the desired depth using a van Dorn or other type of discrete sampler. They also can be taken from just below the water surface, but these samples often do not reflect species composition in the lake. In thermally stratified lakes, samples should be taken at several depths (above, within and below the thermocline) to provide a good description of phytoplankton distribution.

Samples of 250 mL volume are adequate for analysis. They should be preserved immediately with Lugol's preservative (1 mL per 100 mL), and stored in the dark.

3.2 Counting Method

Samples are settled in 27 mL chambers then examined using a Zeiss inverted microscope. Very concentrated samples are settled in 2 mL chambers or diluted before analysis. Species are identified and enumerated at 100X, 400X, and 1000X magnifications. The use of three magnifications results in statistically reliable counts of both net plankton and nannoplankton. Results are presented as cells per mL or cells per L, as the client desires.

Samples from oligotrophic lakes usually require examination of the entire chamber bottom at 100X, two to four strips at 400X, and 50 to 200 fields at 1000X.

3.2.1 QA/QC Concerns

The reliability of the count depends on random distribution of organisms within the sample and a high enough count to be sure of the results. There are internal checks for accuracy of the analysis:

- Random distribution is checked when samples are examined at 100X magnification. Clumping is rarely a problem.
- Separate counts for individual strips and groups of fields are recorded. If numbers are inconsistent, more of the sample is counted or another subsample is examined.
- On the rare occasion when numbers seem inconsistent with other samples, another subsample is examined.

For a long series of samples, duplicate or blind samples can be submitted for analysis (10% replication recommended).

3.2.2 Statistical Reliability of Counts

At least 100 cells, filaments, or colonies of the predominant species are enumerated at each magnification. This provides an accuracy of $\pm$ 20% (0.95 confidence limits) for species counts (Lund *et al.*, 1958). Usually, at least 400 cells are counted at each magnification, providing $\pm$ 10% accuracy of total counts.

3.3 Cell Volume and Biomass Estimates

When requested, cell volumes are calculated for the most common species. This time-consuming step is recommended only for projects that involve several samples. A list of common species is established using two criteria: at least five observations in a sample to be considered common, and common in at least five samples. Subsamples of each sample are combined to create a composite sample. At least 20 cells per common species are measured. Cell volumes are calculated using geometric formulae, then mean values are calculated. Numerical abundance data are then converted to biovolume or biomass data (mg/m^3).

3.4 Biological Importance of the Counts

The method outlined in Section 3.2 ensures recognition of the very small phytoplankton, which often contribute much of the primary productivity of oligotrophic lakes. The numerical abundance data emphasize the importance of the nannoplankton, whereas the biomass data (Section 3.3) emphasize the importance of the netplankton.

4.0 PERIPHYTON ANALYSIS

4.1 Field Sampling Advice

4.1.1 Sampling Natural Substrates

In many cases, samples from natural substrates are preferable to those from artificial substrates (Aloi, 1990). This ensures that the algae collected reflect the natural community. Sampling natural substrates is quicker and requires little pre-planning, compared to sampling artificial substrates. However, when choosing individual rocks within a sampling location, natural patchiness of periphyton must be

considered. Several subsamples should be taken at each location, three to six depending on project needs and budget.
The RIC (1998) document *Freshwater Biological Sampling Manual* describes sampling procedures. Three or four rocks are selected randomly from the desired habitat (riffle, run, pool) at the site. Natural substrates are sampled quantitatively using a sampler with a known surface area (e.g., modified toilet plunger, template, a "Stockner sampler" - a modified wide barreled syringe fitted with a toothbrush). A known area (*ca.* 2.5 cm diameter) is sampled, removed to a vial, and preserved. Several "disks" can be composited in one sample (one or two disks per rock).

It is important to avoid contaminating the sample with river phytoplankton, so de-ionized water or filtered river water should be used to rinse a substrate surface or add liquid. When splitting the sample for both species identification and chlorophyll analysis, the samples are separated into two vials, as estimated by eye, and labeled. One sample is preserved for identification using Lugol's, then stored in the dark. The other sample is prepared for chlorophyll analysis following guidelines provided by the laboratory.

4.1.2 Sampling Artificial Substrates

Artificial substrates can be used to assess periphyton growth in streams and rivers. This avoids some of the problems associated with sampling natural substrates, such as heterogeneity of the natural environment, patchy periphyton distribution, and irregular sampling surfaces (Munro *et al.*, 1985). Various substrates have been used in the past, ranging in size from microscope slides to large plexiglass plates.

The substrates are removed after three or more weeks in the stream. The algae are removed with a scraper (e.g., plexiglass ice scraper for car windows) into a tray. The surface is rinsed with de-ionized water or filtered stream water, to prevent contamination of the sample by river phytoplankton. The contents are transferred to a labeled plastic vial using a wide mouth pipette or turkey baster.

When splitting the sample for both species identification and chlorophyll analysis, the samples are separated into two vials, as estimated by eye, and labeled. One sample is preserved for identification, using Lugol's, then stored in the dark. The sample for chlorophyll analysis is treated using guidelines provided by the laboratory (field filtration, stabilization with $MgCO_3$).

4.2 Periphyton Sample Analysis

Samples are examined qualitatively in the laboratory. Quantitative estimates are not made because they are not statistically reliable. The algae typically form mats, clumps, or are tangled among each other, rendering traditional counting techniques inaccurate.

Subsamples are examined in the microscope. Predominant and common organisms are identified to species or, occasionally, genus. Relative percent abundance of each non-diatom species (greens, blue-greens, reds, etc.) is estimated. The diatoms species are ranked as predominant, common, or present, as follows:

- predominant, more than 25% abundance;

- common, 5% to 25% abundance; and
- present, less than 5% abundance.

A quantitative estimate of diatom abundance can be obtained by boiling the sample in nitric acid to oxidize organic material. The clean silica shells of the diatoms are mounted permanently on microscope slides. Diatoms are identified and counted, then data are converted to numbers per cm^2. The procedure is time-consuming, expensive, and requires special laboratory arrangements to handle the chemicals and is not recommended in routine surveys.

4.2.1 Statistical Reliability

The greatest reliability is obtained through replicate sampling. The natural environment is highly variable, as are estimates of periphyton abundance. Using artificial substrates reduces the main source of variability. However, replication for species identification and especially for chlorophyll analysis is helpful.

For qualitative sample analysis, reliability is obtained by examining substantial portions of the sample. The samples are stored, so they can be re-examined at a later date. A species list, with scientific authorities, is included so that taxonomists can identify synonymous names for species.

Routine statistical analyses can be performed using data from the quantitative count of cleared diatoms described in section 4.2.

5.0 REFERENCES

Aloi, J. E. 1990. A critical review of recent freshwater periphyton field methods. *Can. J. Fish. Aquat. Sci.* 47. 656-670.

Lund, J. W. G., C. Kipling, and E. D. LeCren. 1958. The inverted microscope method of estimating algal numbers and the statistical basis of estimations by counting. *Hydrobiologia* 11: 143-170.

Munro, K.A., S.C. Samis, and M.D. Nassichuk. 1985. The effects of hatchery effluents on water chemistry, periphyton and benthic invertebrates of selected British Columbia streams. MS. Rep. Fish. Aquat. Sci. No. 1830; 203 pp.

Resource Inventory Committee (RIC, now RISC). 1998. Freshwater Biological Sampling Manual. Ministry of Sustainable Resource Management (formerly Ministry of Environment, Lands and Parks).

CLOSING

This information is provided for general project guidance. It is recommended that interested scientists contact the undersigned for more specific guidance on program design, sample handling procedures and reporting requirements.

Respectfully submitted,

JACQUES WHITFORD LIMITED

Original signed by:

Karen Munro, M.Sc., R.P.Bio.
Senior Biologist,
Environmental Planning and Permitting

[File Ref:P:\\BCV5047_\BCV50472 ALS\Methods and QAQC Manual – algae]

Jacques Whitford

APPENDIX III

PHYTOPLANKN ANALYTIAL RESULTS FOR MIDDLE QUINSAM LAKE AND LONG LAKE

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Fax: (604) 436-3752

VIA EMAIL: DLangill@maxxam.ca; LLuangkhamdeng@axxam.ca

June 18, 2012

Project No: 1231-10406

Maxxam Analytics Laboratory
4606 Canada Way
Burnaby, BC
V5G 1K5

Attention: Lanoy Luangkhamdeng

Dear Lanoy:

Reference: Quinsam Lakes Phytoplankton, April 2012
(Sample reference DG8932-DG8934 and DG7012, DI0237, DG7014)

1 INTRODUCTION

Quinsam Coal Ltd. collects six water samples from Long Lake and Middle Quinsam Lake monthly during the spring and summer growing season. Samples are submitted to Stantec Consulting Ltd. for phytoplankton taxonomic analysis, as part of ongoing monitoring requirements of the Ministry of Environment. Samples are taken at depths of 1 m, 4 m, and 9 m. Some months, an additional sample is taken as a field replicate for Quality Assurance/Quality Control (QA/QC). This brief report provides information about samples collected on April 5 and May 2, 2012. The sample collected on May 2, 2012 form part of the April data set.

2 METHODS

Sub-samples (27 mL) of preserved lake water were settled and examined at 100X, 400X and 1,000X magnifications using a Zeiss inverted microscope. Counting effort is defined as at least 100 organisms of the predominant species at 400X, up to 200 fields at 1,000X and a half or whole sub-sample at 100X.

3 RESULTS

3.1 Abundance

Abundance data for 1993 to 2011 are provided in Appendix A and detailed taxonomic results for April 2012 are presented in Appendix B.

Total abundance in the April 2012 samples for Long Lake ranged from 1,000 cells/mL (9 m sample depth) to 3,200 cells/mL (4 m sample depth), as summarized in Table 1, similar to results for previous years.

Table 1: Phytoplankton Abundance (cells/mL) in Long Lake, April 2012

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
April 2012	LL1	2,300	1,980	330	5
	LL4	3,200	2,570	590	6
	LL9	1,000	800	190	6

Total abundance in the April 2012 samples for Middle Quinsam Lake is summarized in Table 2. Total abundance ranged from 1,600 cells/mL (9 m sample depth) to 2,200 cells/mL (1 m sample depth), within the range reported for April since 1996 (Appendix A).

Table 2: Phytoplankton Abundance (cells/mL) in Middle Quinsam Lake, April 2012

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
April 2012	MQ1	2,200	2,010	200	3
	MQ4	1,700	1,440	220	3
	MQ9	1,600	1,420	180	5

3.2 Species Composition

Species composition data for April 2012 are contained in Appendix B. The most abundant phytoplankton in both Long Lake and Middle Quinsam Lake were the very small (<5 µm) chrysoflagellates (*Ochromonas* spp. and *Chromulina* spp.). Although these ultra-nanoplankton species were very abundant numerically, they usually contribute little to algal biomass.

In Long Lake, the most abundant larger species (>5 µm) at all three sample depths were the chrysophyte *Ochromonas* spp. and the cryptophyte *Rhodomonas minuta*. The diatom *Synedra radians* was also common at all three depths.

In Middle Quinsam Lake, *Ochromonas* spp. was the most abundant species at all three sample depths. At all three depths *Rhodomonas minuta* and *Synedra radians* were common.

4 SUMMARY

Temporal variations in phytoplankton abundance and composition are to be expected. These may result from changing lake conditions related to discharges from Quinsam Coal Ltd. (e.g., changes in sulphate or nutrient availability, shifts in pH) or to natural variation (e.g., timing of spring and autumn overturns).

Several features first observed in 2001 continue to be monitored: peak abundance in Long Lake samples in May and June of each year (a shift from pre-2001) and a second peak in abundance in Long Lake samples in September. Species composition and diversity continue to indicate oligotrophic conditions for both lakes, although some changes in recent years suggest shifts in nutrient dynamics of Long Lake, which would be useful to examine in greater detail.

5 CLOSURE

We trust this information meets your present requirements. Stantec would be pleased to organize a data review in support of the recent findings. Should you have any questions or require additional information, please contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Reviewed by:

Original signed by:

Laura Kennedy, M.Sc.
Aquatic Biologist
Environmental Services

Original signed by:

Karen Munro, M.Sc., R.P.Bio.
Senior Aquatic Biologist
Environmental Services

Appendix A: Historical Abundance Data: Quinsam Lakes System, 1993 – 2011
Appendix B: Species Composition Data, April 2012

LK/KM/nlb

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VIA EMAIL: DLangill@maxxam.ca; LLuangkhamdeng@maxxam.ca

July 3, 2012

Project No: 1231-10406

Maxxam Analytics Laboratory
4606 Canada Way
Burnaby, BC
V5G 1K5

Attention: Lanoy Luangkhamdeng

Dear Lanoy:

Reference: Quinsam Lakes Phytoplankton, May 2012
(Sample reference DN9785-DN9787, DO0274 and DO0276)
(Job Numbers B245027 and B245110)

1 INTRODUCTION

Quinsam Coal Ltd. collects six water samples from Long Lake and Middle Quinsam Lake monthly during the spring and summer growing season. Samples are submitted to Stantec Consulting Ltd. for phytoplankton taxonomic analysis, as part of ongoing monitoring requirements of the Ministry of Environment. Samples are taken at depths of 1 m, 4 m, and 9 m. Some months, an additional sample is taken as a field replicate for Quality Assurance/Quality Control (QA/QC). This brief report provides information about samples collected on May 30, 2012.

2 METHODS

Sub-samples (27 mL) of preserved lake water were settled and examined at 100X, 400X and 1,000X magnifications using a Zeiss inverted microscope. Counting effort is defined as at least 100 organisms of the predominant species at 400X, up to 200 fields at 1,000X and a half or whole sub-sample at 100X.

3 RESULTS

3.1 Abundance

Abundance data for 1993 to 2011 are provided in Appendix A and detailed taxonomic results for May 2012 are presented in Appendix B.

Total abundance in the May 2012 samples for Long Lake ranged from 2,200 cells/mL (4 m sample depth) to 3,000 cells/mL (1 m sample depth), as summarized in Table 1, similar to results for previous years.

Table 1: Phytoplankton Abundance (cells/mL) in Long Lake, 2012

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
April 2012	LL1	2,300	1,980	330	5
	LL4	3,200	2,570	590	6
	LL9	1,000	800	190	6
May 2012	LL1	3,000	2,470	470	15
	LL4	2,200	1,640	600	7
	LL9	2,300	2,050	280	7

Total abundance in the May 2012 samples for Middle Quinsam Lake is summarized in Table 2. Total abundance ranged from 830 cells/mL (4 m replicate sample depth) to 1,200 cells/mL (9 m sample depth), within the range reported for April since 1996 (Appendix A).

Table 2: Phytoplankton Abundance (cells/mL) in Middle Quinsam Lake, 2012

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
April 2012	MQ1	2,200	2,010	200	3
	MQ4	1,700	1,440	220	3
	MQ9	1,600	1,420	180	5
May 2012	MQ1	1,100	990	140	1
	MQ4	830	680	140	0.2
	MQ9	1,200	1000	150	0.2

3.2 Species Composition

Species composition data for May 2012 are contained in Appendix B. The most abundant phytoplankton in both Long Lake and Middle Quinsam Lake were the very small (<5 µm) chrysoflagellates (*Ochromonas* spp. and *Chromulina* spp.). Although these ultra-nanoplankton species were very abundant numerically, they usually contribute little to algal biomass.

In Long Lake, the most abundant larger species (>5 µm) at all three sample depths were the chrysophyte *Ochromonas* spp. At 1 m and 4 m depths the diatom *Cyclotella stelligera/ocellata* and the cryptophyte *Rhodomonas minuta* were common. In addition, the colonial chrysophyte *Dinobryon cylindricum* was common at 1 m and chrysophyte *Chrysococcus* sp. was common at 4 m and 9 m depths.

The same pattern was apparent in Middle Quinsam Lake; the most abundant larger species (>5 µm) at all three depths were the chrysophyte *Ochromonas* spp. At 4m and 9m depths, *Rhodomonas minuta* was common and at 9 m, *Cyclotella glomerata* was common.

4 SUMMARY

Temporal variations in phytoplankton abundance and composition are to be expected. These may result from changing lake conditions related to discharges from Quinsam Coal Ltd. (e.g., changes in sulphate or nutrient availability, shifts in pH) or to natural variation (e.g., timing of spring and autumn overturns).

Several features first observed in 2001 continue to be monitored: peak abundance in Long Lake samples in May and June of each year (a shift from pre-2001) and a second peak in abundance in Long Lake samples in September. Species composition and diversity continue to indicate oligotrophic conditions for both lakes, although some changes in recent years suggest shifts in nutrient dynamics of Long Lake, which would be useful to examine in greater detail.

5 CLOSURE

We trust this information meets your present requirements. Stantec would be pleased to organize a data review in support of the recent findings. Should you have any questions or require additional information, please contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Original signed by:

Laura Kennedy, M.Sc.
Aquatic Biologist
Environmental Services

Reviewed by:

Original signed by:

Karen Munro, M.Sc., R.P.Bio.
Senior Aquatic Biologist
Environmental Services

Appendix A: Historical Abundance Data: Quinsam Lakes System, 1993 – 2011
Appendix B: Species Composition Data May 2012

LK/KM/nlb

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Stantec Consulting Ltd.
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VIA EMAIL: DLangill@maxxam.ca; LLuangkhamdeng@maxxam.ca

August 2, 2012

Project No: 1231-10406

Maxxam Analytics Laboratory
4606 Canada Way
Burnaby, BC
V5G 1K5

Attention: Lanoy Luangkhamdeng

Dear Lanoy:

Reference: Quinsam Lakes Phytoplankton, June 2012
(Sample reference DU9750-DU9752, DU9756, DV2943-DV2945, DV2949, DV3397-DV3399, DV3403)
(Job Numbers B256138, B256529, and B256602)

1 INTRODUCTION

Quinsam Coal Ltd. collects water samples from Long Lake and Middle Quinsam Lake monthly during the spring and summer growing season. A third lake (No Name Lake) was added to the program in June 2012. Samples are submitted to Stantec Consulting Ltd. for phytoplankton taxonomic analysis, as part of ongoing monitoring requirements of the Ministry of Environment. Samples are taken at depths of 1 m, 4 m, and 9 m. Some months, an additional sample is taken as a field replicate for Quality Assurance/Quality Control (QA/QC). This brief report provides information about samples collected on June 29, 2012.

2 METHODS

Sub-samples (27 mL) of preserved lake water were settled and examined at 100X, 400X and 1,000X magnifications using a Zeiss inverted microscope. Counting effort is defined as at least 100 organisms of the predominant species at 400X, up to 200 fields at 1,000X and a half or whole sub-sample at 100X.

3 RESULTS

3.1 Abundance

Abundance data for 1993 to 2011 are provided in Appendix A and detailed taxonomic results for June 2012 are presented in Appendix B.

Total abundance in the June 2012 samples for Long Lake ranged from 980 cells/mL (9 m sample depth) to 1,700 cells/mL (4 m sample depth), as summarized in Table 1, similar to results for previous years.

Table 1: Phytoplankton Abundance (cells/mL) in Long Lake, 2012

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
April 2012	LL1	2,300	1,980	330	5
	LL4	3,200	2,570	590	6
	LL9	1,000	800	190	6
May 2012	LL1	3,000	2,470	470	15
	LL4	2,200	1,640	600	7
	LL9	2,300	2,050	280	7
June 2012	LL1	1,400	1,080	310	3
	LL4	1,700	1,400	320	2
	LL9	980	810	170	2
	LL9 (rep)	1,200	1,020	140	1

Total abundance in the June 2012 samples for Middle Quinsam Lake is summarized in Table 2. Total abundance ranged from 830 cells/mL (4 m replicate sample depth) to 2,100 cells/mL (1 m sample depth), within the range reported for June since 1996 (Appendix A).

Table 2: Phytoplankton Abundance (cells/mL) in Middle Quinsam Lake, 2012

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
April 2012	MQ1	2,200	2,010	200	3
	MQ4	1,700	1,440	220	3
	MQ9	1,600	1,420	180	5
May 2012	MQ1	1,100	990	140	1
	MQ4	830	680	140	0.2
	MQ9	1,200	1000	150	0.2
June 2012	MQ1	2,100	1,920	170	0.4

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
	MQ4	890	740	150	0.3
	MQ9	1,100	910	200	0.4
	MQ9 (rep)	1,100	920	200	0.5

Total abundance in the June 2012 samples for No Name Lake ranged from 840 cells/mL (9 m sample depth) to 1,600 cells/mL (1 m sample depth), as summarized in Table 3.

Table 3: Phytoplankton Abundance (cells/mL) in No Name Lake, 2012

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
June 2012	NNL1	1,600	1,240	320	0.5
	NNL4	1,000	670	370	0.2
	NNL9	840	700	140	1
	NNL9 (rep)	880	730	160	0.8

3.2 Species Composition

Species composition data for June 2012 are contained in Appendix B. The most abundant phytoplankton in Long Lake, Middle Quinsam Lake and No Name Lake were the very small (<5 µm) chrysoflagellates (*Ochromonas* spp. and *Chromulina* spp.). Although these ultra-nanoplankton species were very abundant numerically, they usually contribute little to algal biomass.

In Long Lake, the most abundant larger species (>5 µm) at all three sample depths were the chrysophyte *Ochromonas* spp., the cryptophyte *Rhodomonas minuta* common. At 1 m and 4 m depths the diatom *Cyclotella stelligera/ocellata* was also common and at 4 m and 9 m depths the chrysophyte *Chrysococcus* sp. was common.

A similar pattern was apparent in Middle Quinsam Lake; the most abundant larger species (>5 µm) at all three depths were the chrysophyte *Ochromonas* spp. At 1 m depth, the green alga *Dictyosphaerium* sp. was common and at 9 m depth *Rhodomonas minuta* was common.

In No Name Lake, the most abundant larger species (>5 µm) at 1 m, 4 m and 9 m sample depths were *Rhodomonas minuta* and *Ochromonas* spp. The green alga *Nephrocytium* sp. was also common at 1 m and 4 m depths, along with the green *Oocystis* sp. at 4 m and 9 m depths and the cryptophyte *Cryptomonas* spp. at 9 m depth.

3.3 Comparison of Replicate Samples

Two replicates were collected from 9 m in each of Long Lake, Middle Quinsam Lake and No Name Lake in June 2012. Percent difference in the duplicate samples was calculated. A difference of up to

10% can be expected for a total cell count of 400 organisms, for repeat sampling from the same bottle; higher percent difference can be expected when separate grabs are used for the replicates.

For Long Lake, total abundance was 980 cells/mL in one sample and 1,200 cells/mL in the other, a difference of ± 20%. Species composition and abundance were similar in the two samples. Sample reproducibility was approximately within that expected for replicate samples taken from separate grabs.

Two replicates were also collected from 9 m in Middle Quinsam. Total abundance was 1,100 cells/mL in both samples. Species composition and abundance were similar in the two samples. Sample reproducibility was within that expected for replicate samples.

For No Name Lake, total abundance was 840 cells/mL in one sample and 880 cells/mL in the other, a difference of ± 4%. Species composition and abundance were similar in the two samples. Sample reproducibility was approximately within that expected for replicate samples.

4 SUMMARY

Temporal variations in phytoplankton abundance and composition are to be expected. These may result from changing lake conditions related to discharges from Quinsam Coal Ltd. (e.g., changes in sulphate or nutrient availability, shifts in pH) or to natural variation (e.g., timing of spring and autumn overturns).

Several features first observed in 2001 continue to be monitored: peak abundance in Long Lake samples in May and June of each year (a shift from pre-2001) and a second peak in abundance in Long Lake samples in September. Species composition and diversity continue to indicate oligotrophic conditions for both lakes, although some changes in recent years suggest shifts in nutrient dynamics of Long Lake, which would be useful to examine in greater detail.

5 CLOSURE

We trust this information meets your present requirements. Stantec would be pleased to organize a data review in support of the recent findings. Should you have any questions or require additional information, please contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Original signed by:

Laura Kennedy, M.Sc.
Aquatic Biologist
Environmental Services

Reviewed by:

Original signed by:

Karen Munro, M.Sc., R.P.Bio.
Senior Aquatic Biologist
Environmental Services

Appendix A: Historical Abundance Data: Quinsam Lakes System, 1993 – 2011
Appendix B: Species Composition Data: June 2012

LK/KM/pf

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August 28, 2012

Project No: 1231-10406

Maxxam Analytics Laboratory
4606 Canada Way
Burnaby, BC
V5G 1K5

Attention: Lanoy Luangkhamdeng

Dear Lanoy:

Reference: Quinsam Lakes Phytoplankton, July 2012
(Sample reference EA3385, EA3387, EA6534, EA 6535, EA6536 EA7028, EA7029 and EA7030)

1 INTRODUCTION

Quinsam Coal Ltd. collects water samples from Long Lake and Middle Quinsam Lake monthly during the spring and summer growing season. A third lake (No Name Lake) was added to the program in June 2012. Samples are submitted to Stantec Consulting Ltd. for phytoplankton taxonomic analysis, as part of ongoing monitoring requirements of the Ministry of Environment. Samples are taken at depths of 1 m, 4 m, and 9 m. Some months, an additional sample is taken as a field replicate for Quality Assurance/Quality Control (QA/QC). This brief report provides information about samples collected on July 25, 2012. No sample was analyzed for LL 4 m, as the bottle was broken in transit from Quinsam Coal to Maxxam Laboratories.

2 METHODS

Sub-samples (27 mL) of preserved lake water were settled and examined at 100X, 400X and 1,000X magnifications using a Zeiss inverted microscope. Counting effort is defined as at least 100 organisms of the predominant species at 400X, up to 200 fields at 1,000X and a half or whole sub-sample at 100X.

3 RESULTS

3.1 Abundance

Abundance data for 1993 to 2011 are provided in Appendix A and detailed taxonomic results for July 2012 are presented in Appendix B.

Total abundance in the July 2012 samples for Long Lake ranged from 880 cells/mL (9 m sample depth) to 1,600 cells/mL (1 m sample depth), as summarized in Table 1, similar to results for previous years. No results were available from the 4 m sample depth due to loss of sample during shipment.

Table 1: Phytoplankton Abundance (cells/mL) in Long Lake, 2012

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
April 2012	LL1	2,300	1,980	330	5
	LL4	3,200	2,570	590	6
	LL9	1,000	800	190	6
May 2012	LL1	3,000	2,470	470	15
	LL4	2,200	1,640	600	7
	LL9	2,300	2,050	280	7
June 2012	LL1	1,400	1,080	310	3
	LL4	1,700	1,400	320	2
	LL9	980	810	170	2
	LL9 (rep)	1,200	1,020	140	1
July 2012	LL1	1,600	1,390	170	3
	LL4	Sample lost in transit (broken bottle)			
	LL9	880	730	150	2

Total abundance in the July 2012 samples for Middle Quinsam Lake is summarized in Table 2. Total abundance ranged from 740 cells/mL (9 m replicate sample depth) to 1,300 cells/mL (1 m sample depth), within the range reported for July since 1996 (Appendix A).

Table 2: Phytoplankton Abundance (cells/mL) in Middle Quinsam Lake, 2012

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
April 2012	MQ1	2,200	2,010	200	3
	MQ4	1,700	1,440	220	3
	MQ9	1,600	1,420	180	5

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
May 2012	MQ1	1,100	990	140	1
	MQ4	830	680	140	0.2
	MQ9	1,200	1000	150	0.2
June 2012	MQ1	2,100	1,920	170	0.4
	MQ4	890	740	150	0.3
	MQ9	1,100	910	200	0.4
	MQ9 (rep)	1,100	920	200	0.5
July 2012	MQ1	1,300	1,210	100	0.4
	MQ4	1,100	1,010	90	10
	MQ9	740	640	100	1.0

Total abundance in the July 2012 samples for No Name Lake ranged from 820 cells/mL (9 m sample depth) to 1,700 cells/mL (4 m sample depth), as summarized in Table 3.

Table 3: Phytoplankton Abundance (cells/mL) in No Name Lake, 2012

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
June 2012	NNL1	1,600	1,240	320	0.5
	NNL4	1,000	670	370	0.2
	NNL9	840	700	140	1
	NNL9 (rep)	880	730	160	0.8
July 2012	NNL1	1,300	1,000	260	1.2
	NNL4	1,700	1390	310	0.5
	NNL9	820	540	280	0.2

3.2 Species Composition

Species composition data for July 2012 are contained in Appendix B. The most abundant phytoplankton in Long Lake, Middle Quinsam Lake and No Name Lake were the very small (<5 µm) chrysoflagellates *(Ochromonas spp.* and *Chromulina spp.*). Although these ultra-nanoplankton species were very abundant numerically, they usually contribute little to algal biomass.

In Long Lake, the most abundant larger species (>5 µm) at both sample depths were the chrysophyte *Ochromonas spp.* At 9 m depth the cryptophyte *Rhodomonas minuta* was also common

A similar pattern was apparent in Middle Quinsam Lake; the most abundant larger species (>5 µm) at 1 m and 4 m sampling depths were the chrysophyte *Ochromonas spp*. At 9 m depth the most abundant larger species was *Rhodomonas minuta.*

In No Name Lake, the most abundant larger species (>5 µm) were the colonial blue-green *Merismopedia sp.* at 1 m depth, *Rhodomonas minuta a*nd the colonial green alga *Gloeocystis spp*. at 4 m depths and *Rhodomonas minuta* and the colonial green alga *Oocystis sp.* at 9 m depth. The chrysophyte *Ochromonas spp*. was also common at all three depths.

4 SUMMARY

Temporal variations in phytoplankton abundance and composition are to be expected. These may result from changing lake conditions related to discharges from Quinsam Coal Ltd. (e.g., changes in sulphate or nutrient availability, shifts in pH) or to natural variation (e.g., timing of spring and autumn overturns).

Several features first observed in 2001 continue to be monitored: peak abundance in Long Lake samples in May and June of each year (a shift from pre-2001) and a second peak in abundance in Long Lake samples in September. Species composition and diversity continue to indicate oligotrophic conditions for both lakes, although some changes in recent years suggest shifts in nutrient dynamics of Long Lake, which would be useful to examine in greater detail.

5 CLOSURE

We trust this information meets your present requirements. Stantec would be pleased to organize a data review in support of the recent findings. Should you have any questions or require additional information, please contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Original signed by:

Laura Kennedy, M.Sc.
Aquatic Biologist
Environmental Services

Reviewed by:

Original signed by:

Karen Munro, M.Sc., R.P.Bio.
Senior Aquatic Biologist
Environmental Services

Appendix A: Historical Abundance Data: Quinsam Lakes System, 1993 – 2011
Appendix B: Species Composition Data: July 2012

LK/KM/nlb

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September 6, 2012

Project No: 1231-10406

Maxxam Analytics Laboratory
4606 Canada Way
Burnaby, BC
V5G 1K5

Attention: Lanoy Luangkhamdeng

Dear Lanoy:

Reference: Quinsam Lakes Phytoplankton, August 2012
(Sample reference EH2379- EH2381, EH2383, EG9951-EG9953, EG9958, EH0018-EH0020, EH0025)
(Job Numbers B275303, B275640, and B275290)

1 INTRODUCTION

Quinsam Coal Ltd. collects water samples from Long Lake and Middle Quinsam Lake monthly during the spring and summer growing season. A third lake (No Name Lake) was added to the program in June 2012. Samples are submitted to Stantec Consulting Ltd. for phytoplankton taxonomic analysis, as part of ongoing monitoring requirements of the Ministry of Environment. Samples are taken at depths of 1 m, 4 m, and 9 m. Some months, an additional sample is taken as a field replicate for Quality Assurance/Quality Control (QA/QC). This brief report provides information about samples collected on August 22 and 23, 2012.

2 METHODS

Sub-samples (27 mL) of preserved lake water were settled and examined at 100X, 400X and 1,000X magnifications using a Zeiss inverted microscope. Counting effort is defined as at least 100 organisms of the predominant species at 400X, up to 200 fields at 1,000X and a half or whole sub-sample at 100X.

3 RESULTS

3.1 Abundance

Abundance data for 1993 to 2011 are provided in Appendix A and detailed taxonomic results for August 2012 are presented in Appendix B.

Total abundance in the August 2012 samples for Long Lake ranged from 940 cells/mL (1 m replicate sample depth) to 1,300 cells/mL (4 m sample depth), as summarized in Table 1, at the low end of the range noted since 1995 for August samples (also low in August 1995, 1997, 2000, 2001 and 2008), as summarized in Appendix A.

Table 1: Phytoplankton Abundance (cells/mL) in Long Lake, 2012

Date	Sampling Site	Total Abundance	< 5 µm (1000X)	5 to 25 µm (400X)	> 25 µm (100X)
April 2012	LL1	2,300	1,980	330	5
	LL4	3,200	2,570	590	6
	LL9	1,000	800	190	6
May 2012	LL1	3,000	2,470	470	15
	LL4	2,200	1,640	600	7
	LL9	2,300	2,050	280	7
June 2012	LL1	1,400	1,080	310	3
	LL4	1,700	1,400	320	2
	LL9	980	810	170	2
	LL9 (rep)	1,200	1,020	140	1
July 2012	LL1	1,600	1,390	170	3
	LL4	Sample lost in transit (broken bottle)			
	LL9	880	730	150	2
August 2012	LL1	970	740	210	19
	LL1 (rep)	940	760	170	14
	LL4	1,300	990	250	35
	LL9	380	250	130	0.5

Total abundance in the August 2012 samples for Middle Quinsam Lake is summarized in Table 2. Total abundance ranged from 430 cells/mL (9 m replicate sample depth) to 1,030 cells/mL (1 m sample depth), at the low end of the range noted since 1996 for August samples (also low in August 2008 and 2009), as noted in Appendix A.

Table 2: Phytoplankton Abundance (cells/mL) in Middle Quinsam Lake, 2012

Date	Sampling Site	Total Abundance	< 5 µm (1000X)	5 to 25 µm (400X)	> 25 µm (100X)
April 2012	MQ1	2,200	2,010	200	3
	MQ4	1,700	1,440	220	3
	MQ9	1,600	1,420	180	5
May 2012	MQ1	1,100	990	140	1
	MQ4	830	680	140	0.2
	MQ9	1,200	1000	150	0.2
June 2012	MQ1	2,100	1,920	170	0.4
	MQ4	890	740	150	0.3
	MQ9	1,100	910	200	0.4
	MQ9 (rep)	1,100	920	200	0.5
July 2012	MQ1	1,300	1,210	100	0.4
	MQ4	1,100	1,010	90	10
	MQ9	740	640	100	1.0
August 2012	MQ1	1,030	860	180	0.8
	MQ1 (rep)	920	720	200	0.2
	MQ4	810	660	140	10
	MQ9	430	340	90	1.6

Total abundance in the August 2012 samples for No Name Lake ranged from 730 cells/mL (9 m sample depth) to 1,800 cells/mL (4 m sample depth), as summarized in Table 3.

Table 3: Phytoplankton Abundance (cells/mL) in No Name Lake, 2012

Date	Sampling Site	Total Abundance	< 5 µm (1000X)	5 to 25 µm (400X)	> 25 µm (100X)
June 2012	NNL1	1,600	1,240	320	0.5
	NNL4	1,000	670	370	0.2
	NNL9	840	700	140	1
	NNL9 (rep)	880	730	160	0.8
July 2012	NNL1	1,300	1,000	260	1.2
	NNL4	1,700	1390	310	0.5
	NNL9	820	540	280	0.2
August 2012	NNL1	810	660	150	1.6
	NNL1 (rep)	790	590	200	1.0
	NNL4	1,800	1,350	440	0.8
	NNL9	730	530	195	0.04

3.2 Species Composition

Species composition data for August 2012 are contained in Appendix B. The most abundant phytoplankton in Long Lake, Middle Quinsam Lake and No Name Lake were the very small (<5 µm) chrysoflagellates (*Ochromonas* spp. and *Chromulina* spp.). Although these ultra-nanoplankton species were very abundant numerically, they usually contribute little to algal biomass.

In Long Lake, the most abundant larger species (>5 µm) at all three sample depths were the chrysophyte *Ochromonas* spp. At 1 m and 4 m depths the *Cryptomonas* spp. and chrysophyte *Dinobryon cylindricum* were common and at 9 m depths the cryptophyte *Rhodomonas minuta* was common.

In Middle Quinsam Lake, the most abundant larger species (>5 µm) at all three depths were *Ochromonas* spp. and green alga *Gloeocystis* sp., with *Cryptomonas* spp. common in the samples from 1 m and 4 m and *Rhodomonas minuta* common in the sample from 9 m.

In No Name Lake, the most abundant larger species (> 5 µm) at the 1 m sample depth were *Ochromonas* spp., with *Rhodomonas minuta* and *Cryptomonas spp.* common. At 4 m and 9 m depths *Rhodomonas minuta* was most abundant, with the chrysophyte *Mallomonas* spp. common at 4 m depth.

3.3 Comparison of Replicate Samples

Two replicates were collected from 1 m sampling depth in each of Long Lake, Middle Quinsam Lake and No Name Lake in August 2012. Percent difference in the duplicate samples was calculated. A difference of up to 10% can be expected for a total cell count of 400 organisms, for repeat sampling from the same bottle; higher percent difference can be expected when separate grabs are used for the replicates, as was done here.

For Long Lake, total abundance was 970 cells/mL in one sample and 940 cells/mL in the other, a difference of ± 3%. Species composition and abundance were similar in the two samples. Sample reproducibility was within that expected for replicate samples.

Two replicates were also collected from 1 m in Middle Quinsam. Total abundance was 1,030 cells/mL in one sample and 920 cells/mL in the other, a difference of ± 11%. Species composition and abundance were similar in the two samples. Sample reproducibility was within that expected for replicate samples taken from separate grabs.

For No Name Lake, total abundance was 810 cells/mL in one sample and 790 cells/mL in the other, a difference of ± 2.5%. Species composition and abundance were similar in the two samples. Sample reproducibility was approximately within that expected for replicate samples.

4 SUMMARY

Temporal variations in phytoplankton abundance and composition are to be expected. These may result from changing lake conditions related to discharges from Quinsam Coal Ltd. (e.g., changes in sulphate or nutrient availability, shifts in pH) or to natural variation (e.g., timing of spring and autumn overturns).

Several features first observed in 2001 continue to be monitored: peak abundance in Long Lake samples in May and June of each year (a shift from pre-2001) and a second peak in abundance in Long Lake samples in September. Species composition and diversity continue to indicate oligotrophic conditions for both lakes, although some changes in recent years suggest shifts in nutrient dynamics of Long Lake, which would be useful to examine in greater detail.

5 CLOSURE

We trust this information meets your present requirements. Stantec would be pleased to organize a data review in support of the recent findings. Should you have any questions or require additional information, please contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Original signed by:

Laura Kennedy, M.Sc.
Aquatic Biologist
Environmental Services

Reviewed by:

Original signed by:

Karen Munro, M.Sc., R.P.Bio.
Senior Aquatic Biologist
Environmental Services

Appendix A: Historical Abundance Data: Quinsam Lakes System, 1993—2011
Appendix B: Species Composition Data: August 2012

LK/KM/pf

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VIA EMAIL: DLangill@maxxam.ca; LLuangkhamdeng@maxxam.ca

November 5, 2012

Project No: 1231-10406

Maxxam Analytics Laboratory
4606 Canada Way
Burnaby, BC V5G 1K5

Attention: Lanoy Luangkhamdeng

Dear Lanoy:

Reference: Quinsam Lakes Phytoplankton, September 2012
(Sample reference EN2234 - EN2236, EN5336 - EN5338, EN5182)
(Job Numbers B284594, B285058, B285081)

1 INTRODUCTION

Quinsam Coal Ltd. collects water samples from Long Lake and Middle Quinsam Lake monthly during the spring and summer growing season. A third lake (No Name Lake) was added to the program in June 2012. Samples are submitted to Stantec Consulting Ltd. for phytoplankton taxonomic analysis, as part of ongoing monitoring requirements of the Ministry of Environment. Samples are taken at depths of 1 m, 4 m, and 9 m. Some months, an additional sample is taken as a field replicate for Quality Assurance/Quality Control (QA/QC). This brief report provides information about samples collected on September 19 and 20, 2012. Two samples from Long Lake arrived unpreserved, and were not analyzed.

2 METHODS

Sub-samples (27 mL) of preserved lake water were settled and examined at 100X, 400X and 1,000X magnifications using a Zeiss inverted microscope. Counting effort is defined as at least 100 organisms of the predominant species at 400X, up to 200 fields at 1,000X and a half or whole sub-sample at 100X.

3 RESULTS

3.1 Abundance

Abundance data for 1993 to 2012 are provided in Appendix A and detailed taxonomic results for September 2012 are presented in Appendix B.

Total abundance in the September 2012 sample for Long Lake was 2,800 cells/mL (4 m replicate sample depth), as summarized in Table 1, similar to results for previous years. No results were available from the 1 m and the 9 m sample depths due to the samples arriving unpreserved.

Table 1: Phytoplankton Abundance (cells/mL) in Long Lake, 2012

Date	Sampling Site	Total Abundance	< 5 µm (1000X)	5 to 25 µm (400X)	> 25 µm (100X)
April 2012	LL1	2,300	1,980	330	5
	LL4	3,200	2,570	590	6
	LL9	1,000	800	190	6
May 2012	LL1	3,000	2,470	470	15
	LL4	2,200	1,640	600	7
	LL9	2,300	2,050	280	7
June 2012	LL1	1,400	1,080	310	3
	LL4	1,700	1,400	320	2
	LL9	980	810	170	2
	LL9 (rep)	1,200	1,020	140	1
July 2012	LL1	1,600	1,390	170	3
	LL4	Sample lost in transit (broken bottle)			
	LL9	880	730	150	2
August 2012	LL1	970	740	210	19
	LL1 (rep)	940	760	170	14
	LL4	1,300	990	250	35
	LL9	380	250	130	0.5
September 2012	LL1	Sample unpreserved—no analysis done			
	LL4	2,800	2,350	480	1.4
	LL9	Sample unpreserved—no analysis done			

Total abundance in the September 2012 samples for Middle Quinsam Lake is summarized in Table 2. Total abundance ranged from 580 cells/mL (9 m replicate sample depth) to 900 cells/mL (1 m sample depth), at the low end of the range noted since 1996 for September samples (also low in September 1997), as noted in Appendix A.

Table 2: Phytoplankton Abundance (cells/mL) in Middle Quinsam Lake, 2012

Date	Sampling Site	Total Abundance	< 5 µm (1000X)	5 to 25 µm (400X)	> 25 µm (100X)
April 2012	MQ1	2,200	2,010	200	3
	MQ4	1,700	1,440	220	3
	MQ9	1,600	1,420	180	5
May 2012	MQ1	1,100	990	140	1
	MQ4	830	680	140	0.2
	MQ9	1,200	1000	150	0.2
June 2012	MQ1	2,100	1,920	170	0.4
	MQ4	890	740	150	0.3
	MQ9	1,100	910	200	0.4
	MQ9 (rep)	1,100	920	200	0.5
July 2012	MQ1	1,300	1,210	100	0.4
	MQ4	1,100	1,010	90	10
	MQ9	740	640	100	1.0
August 2012	MQ1	1,030	860	180	0.8
	MQ1 (rep)	920	720	200	0.2
	MQ4	810	660	140	10
	MQ9	430	340	90	1.6
September 2012	MQ1	900	730	170	0.5
	MQ4	760	650	115	1.5
	MQ9	580	430	160	0.5

Total abundance in the September 2012 samples for No Name Lake ranged from 1,300 cells/mL (4 m sample depth) to 1,700 cells/mL (9 m sample depth), as summarized in Table 3.

Table 3: Phytoplankton Abundance (cells/mL) in No Name Lake, 2012

Date	Sampling Site	Total Abundance	< 5 µm (1000X)	5 to 25 µm (400X)	> 25 µm (100X)
June 2012	NNL1	1,600	1,240	320	0.5
	NNL4	1,000	670	370	0.2
	NNL9	840	700	140	1
	NNL9 (rep)	880	730	160	0.8
July 2012	NNL1	1,300	1,000	260	1.2
	NNL4	1,700	1390	310	0.5
	NNL9	820	540	280	0.2
August 2012	NNL1	810	660	150	1.6
	NNL1 (rep)	790	590	200	1.0
	NNL4	1,800	1,350	440	0.8
	NNL9	730	530	195	0.04
September 2012	NNL1	1,500	1,200	370	1.2
	NNL4	1,300	970	290	1.8
	NNL9	1,700	1,500	220	0.2

3.2 Species Composition

Species composition data for September 2012 are contained in Appendix B. The most abundant phytoplankton in Long Lake, Middle Quinsam Lake and No Name Lake were the very small (<5 µm) chrysoflagellates (*Ochromonas spp.* and *Chromulina spp.*). Although these ultra-nanoplankton species were very abundant numerically, they usually contribute little to algal biomass.

In Long Lake, the most abundant larger species (>5 µm) at 4 m sample depth was the cryptophyte *Rhodomonas minuta*.

In Middle Quinsam Lake, the most abundant larger species (>5 µm) at all three depths were the chrysophyte *Ochromonas* spp. *Dinobryon cylindricum* was also common at 1 m sample depth, *Cryptomonas spp*. was common at 1 m and 4 m sample depths, *Rhodomonas minuta* was common at 4 m and 9 m sample depths, and *Mallomonas* spp. were common at 9 m depth.

In No Name Lake, the most abundant larger species (> 5 µm) at 1 m and 4 m sample depths were *Ochromonas spp.* with *Rhodomonas minuta* common. At 9 m depths *Rhodomonas minuta* was most abundant and the chrysophyte *Ochromonas spp.* was common.

4 SUMMARY

Temporal variations in phytoplankton abundance and composition are to be expected. These may result from changing lake conditions related to discharges from Quinsam Coal Ltd. (e.g., changes in sulphate or nutrient availability, shifts in pH) or to natural variation (e.g., timing of spring and autumn overturns).

Several features first observed in 2001 continue to be monitored: peak abundance in Long Lake samples in May and June of each year (a shift from pre-2001) and a second peak in abundance in Long Lake samples in September. Species composition and diversity continue to indicate oligotrophic conditions for both lakes, although some changes in recent years suggest shifts in nutrient dynamics of Long Lake, which would be useful to examine in greater detail.

5 CLOSURE

We trust this information meets your present requirements. Stantec would be pleased to organize a data review in support of the recent findings. Should you have any questions or require additional information, please contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Original signed by:

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Appendix A: Historical Abundance Data: Quinsam Lakes System, 1993—2012
Appendix B: Species Composition Data: September 2012

LK/KM/pf

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APPENDIX A

Historical Abundance Data: Quinsam Lakes System, 1993—2012

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Table A1-1 **Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1993 and 1994**

Date	Sampling Site	Total Abundance	< 5mm (1000X)	5 to 25 mm (400X)	> 25 μm (100X)
1993 October	LLM1	2,300	1,800	530	
	LLM3	3,000	2,400	550	
	LLMB	610	420	190	
1994 May	LL1R	10,000	8,800	1,200	
	LL3R	5,000	3,800	1,200	
	LL9R	4,000	3,200	800	
1994 June	LL0	1,400	1,200	250	
	LL1	1,000	790	220	
	LL4	1,500	1,200	320	
	LL9	2,500	1,900	580	
	LLB	830	440	390	
1994 July	LL1	2,100	1,900	180	
	LL4	1900	1700	250	
	LL9	1,500	1,100	400	
1994 August	LL1	1,700	1,400	290	
	LL4	1,000	850	200	
	LL9	900	780	150	
1994 September	LL1	900	620	250	
	LL4	2,300	2,000	260	
	LL9	2,100	1,700	350	

Table A1-2: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1995

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
1995 April	LL1	3,100	2,700	340	
	LL4	3,300	2,900	350	
	LL9	1,300	1,100	280	
1995 May	LL1	5,400	4,900	570	
	LL4	4,800	4,100	700	
	LL9	1,500	1,000	500	
1995 June	LL1	2,100	1,800	300	
	LL4	2,600	2,100	500	
	LL9	7,400	6,600	850	
1995 July	LL1	2,000	1,700	300	
	LL4	1,900	1,650	350	
	LL9	1,500	1,200	300	
1995 August	LL1	1,100	960	180	
	LL4	1,300	1,100	240	
	LL9	1,900	1,700	210	
1995 September	LL1	2,900	2,800	170	
	LL4	3,400	3,100	330	
	LL9	1,900	1,600	280	

Table A1-3: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1996

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
1996 April	LL1	4,600	4,200	340	
	LL4	6,000	5,600	380	
	LL9	1,100	960	160	
1996 May	LL1	2,200	1,600	600	31
	LL4	2,200	1,700	540	16
	LL9	1,700	1,400	290	26
1996 June	LL1	2,100	1,600	440	4
	LL4	1,600	1,300	340	2
	LL9	1,600	1,100	500	9
1996 July	LL1	2,400	2,300	140	1
	LL4	3,200	3,000	200	3
	LL9	No sample			
1996 August	LL1	2,100	1,900	160	1
	LL4	2,200	1,800	390	37
	LL9	1,700	1,500	200	10
1996 September	LL1	1,900	1,600	230	82
	LL4	2,200	1,800	300	145
	LL9	2,100	1,800	220	38
1996 April	MQ1	No sample			
	MQ4	No sample			
	MQ9	No sample			
1996 May	MQ1	2,000	1,700	230	11
	MQ4	1,100	930	180	7
	MQ9	2,200	1,800	430	1
1996 June	MQ1	2,700	2,500	150	3
	MQ4	2,600	2,400	210	7
	MQ9	1,200	1,000	190	1
1996 July	MQ1	2,400	2,100	335	24
	MQ4	1,900	1,400	380	130
	MQ9	1,200	860	320	29
1996 August	MQ1	2,800	2,500	280	17
	MQ4	1,800	1,500	310	18
	MQ9	2,300	1,900	390	21
1996 September	MQ1	1,700	1,300	270	5
	MQ4	900	560	350	0.6
	MQ9	1,200	1,100	190	0.7

Table A1-4: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1997

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
1997 early May	LL1	3,200	2,800	340	12
	LL4	4,300	4,000	300	32
	LL9	1,700	1,600	140	5
1997 late May[1]	LL1	3,000	2,600	370	61
	LL4	4,900	4,200	620	100
	LL9	4,700	4,000	730	44
1997 June[2]	LL1	1,500	1,100	340	2
	LL4	1,200	1,000	240	1
	LL9	3,900	2,700	1,200	50
1997 July	LL1	2,400	2,300	110	0
	LL4	1,700	1,500	170	0.1
	LL9	480	390	80	2
1997 August	LL1	1,900	1,700	230	0.2
	LL4	880	740	140	0.6
	LL9	1,000	870	93	1.4
1997 September	LL1	1,000	870	140	0.6
	LL4	2,000	1,800	270	0.3
	LL9	700	490	210	0.8
1997 early May	MQ1	1,700	1,400	270	2
	MQ4	1,600	1,400	240	2
	MQ9	2,500	2,300	240	2
1997 late May	MQ1	1,200	1,000	150	0.4
	MQ4	1,600	1,300	280	1
	MQ9	1,200	1,000	190	0.2
1997 June	MQ1	1,900	1,700	140	1
	MQ4	2,500	2,400	130	1
	MQ9	1,400	1,200	200	1
1997 July	MQ1	2,400	2,300	130	0.3
	MQ4	1,500	1,400	110	0.1
	MQ9	890	640	260	0.6
1997 August	MQ1	2,100	1,900	220	0.8
	MQ4	1,500	1,300	190	1.4
	MQ9	1,000	760	240	1.6
1997 September	MQ1	800	640	170	1.3
	MQ4	900	620	280	6.4
	MQ9	650	370	280	1.5

1. recalculated counting *Synedra radians* at 400X rather than 100X
2. recalculated counting *Synedra radians* at 400X rather than 100X & *Cyclotella glomerata* at 1000X rather th

Table A1-5: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1998

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
1998 April	LL1	2,800	2,600	210	12
	LL4	4,100	3,700	390	12
	LL9	1,600	1,100	500	10
1998 May[1]	LL1	2000	1500	430	76
	LL4	1600	1100	480	85
	LL9	2100	1500	630	20
1998 June	LL1	5,700	5,600	140	0.3
	LL4	7,100	6,900	210	0.3
	LL9	3,300	1,700	1600	4
1998 July	LL1	1,200	1,100	130	10
	LL4	740	560	170	8
	LL9	760	130	630	5
1998 August	LL1	1,900	1,700	190	2
	LL4	2,200	2,000	230	2
	LL9	1,900	1,600	220	5
1998 September	LL1	5,000	4,900	130	2
	LL4	3,500	3,300	150	2
	LL9	2,200	2,000	220	5
1998 April	MQ1	2,200	1,900	250	3
	MQ4	1,900	1,600	260	3
	MQ9	3,100	2,700	460	2
1998 May	MQ1	2,500	2,300	210	1
	MQ4	2,600	2,400	180	2
	MQ9	2,100	1,700	480	0.4
1998 June	MQ1	1,900	1,700	180	1
	MQ4	1,600	1,400	200	1
	MQ9	1,300	1,000	310	0.4
1998 July	MQ1	1,500	1,400	120	19
	MQ4	1,800	1,600	150	35
	MQ9	1,300	1,100	190	25
1998 August	MQ1	1,900	1,700	250	12
	MQ4	1,300	950	350	10
	MQ9	1,400	890	490	12
1998 September	MQ1	2,000	1,800	200	11
	MQ4	2,700	2,500	220	7
	MQ9	2,100	1,900	230	10

1. recalculated for counting *Synedra radians* at 400X rather than 100X

Table A1-6: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1999

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
1999	LL1	3,800	3,500	310	9
April	LL4	6,800	6,200	560	17
	LL9	3,000	2,600	410	10
1999	LL1	No sample			
May	LL4	No sample			
	LL9	No sample			
1999	LL1	1,100	910	150	2
early July	LL4	1,400	1,200	150	1
	LL9	1,300	1,200	100	1
1999	LL1	1,100	870	200	1
late July	LL4	2,000	1,800	280	1
	LL9	1,000	860	130	1
1999	LL1	2,700	2,500	180	2
August	LL4	2,800	2,600	170	6
	LL9	3,000	2,800	170	4
1999	LL1	3,700	3,500	230	12
September	LL4	5,000	4,700	290	17
	LL9	4,000	3,700	290	3
1999	MQ1	2,300	1,600	220	430
April	MQ4	2,200	1,800	200	230
	MQ9	2,700	1,900	600	190
1999	MQ1	No sample			
May	MQ4	No sample			
	MQ9	No sample			
1999	MQ1	790	700	90	0.4
early July	MQ4	770	620	150	0.5
	MQ9	1,100	1,000	130	0.3
1999	MQ1	2,700	2,600	110	0.2
late July	MQ4	2,100	1,900	220	0.8
	MQ9	620	420	190	0.3
1999	MQ1	2,100	2,000	140	6
August	MQ4	1,100	980	110	4
	MQ9	1,100	1,000	120	9
1999	MQ1	1,300	1,100	190	14
September	MQ4	1,500	1,300	190	9
	MQ9	760	540	210	10

Table A1-7: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2000

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
2000	LL1	2,100	1,600	450	33
April	LL4	2,500	1,800	700	68
	LL9	1,300	590	740	6.8
2000	LL1	3,300	2,800	530	17
May	LL4	3,000	2,600	320	15
	LL9	2,000	1,500	490	15
2000	LL1	2,900	2,500	390	9.1
June	LL4	2,900	2,400	400	19
	LL9	6,400	5,700	730	19
2000	LL1	1,600	1,400	130	2.1
July	LL4	1,400	1,200	250	1.6
	LL9	1,200	990	250	3.6
2000	LL1	1,800	1,600	170	12
August	LL4	1,100	940	190	8.2
	LL9	1,500	1,400	130	1.9
2000	LL1	2,200	1,900	360	11
September	LL4	2,000	1,800	200	9.2
	LL9	1,300	1,100	200	7.2
2000	MQ1	1,800	1,300	450	5.9
April	MQ4	1,700	1,300	420	1.6
	MQ9	1,500	1,200	280	1.7
2000	MQ1	1,800	1,500	290	3
May	MQ4	1,600	1,300	290	4.4
	MQ9	1,900	1,600	270	7.6
2000	MQ1	2,100	1,900	250	1.4
June	MQ4	2,400	2,200	200	2.1
	MQ9	1,800	1,500	380	1.1
2000	MQ1	1,300	1,100	210	7.4
July	MQ4	2,100	1,800	250	9.6
	MQ9	2,100	1,300	800	22
2000	MQ1	1,500	1,200	290	5.8
August	MQ4	2,200	1,900	310	7.2
	MQ9	2,400	1,900	500	7.5
2000	MQ1	1,800	1,600	200	14
September	MQ4	2,100	1,900	250	14
	MQ9	2,000	1,700	220	28

Table A1-8: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2001

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
2001 April	LL1	3,300	2,600	670	19
	LL4	4,400	3,900	830	13
	LL9	1,400	860	490	5
2001 May	LL1	7,700	6,200	1,100	310
	LL4	11,000	10,000	980	100
	LL9	4,600	3,600	670	22
2001 June	LL1	7,800	6,600	1,000	170
	LL4	6,800	5,100	1,500	210
	LL9	3,000	2,400	680	25
2001 July	LL1	3,300	3,100	170	1
	LL4	3,200	3,000	180	1
	LL9	1,600	1,400	160	2
2001 August	LL1	1,300	1,100	180	1
	LL4	1,700	1,500	200	2
	LL9	720	540	170	1
2001 September	LL1	8,200	8,000	270	13
	LL4	8,800	8,600	260	13
	LL9	4,800	4,600	190	1
2001 April	MQ1	3,600	3,200	400	10
	MQ4	3,500	3,200	310	11
	MQ9	5,700	4,900	830	24
2001 May	MQ1	1,900	1,500	360	17
	MQ4	1,800	1,400	370	14
	MQ9	3,800	3,200	600	13
2001 June	MQ1	2,200	1,900	240	2
	MQ4	3,700	3,400	310	2
	MQ9	4,000	3,600	390	4
2001 July	MQ1	2,500	2,300	230	8
	MQ4	2,700	2,400	260	6
	MQ9	1,500	1,200	240	8
2001 August	MQ1	1,800	1,600	190	17
	MQ4	1,900	1,700	180	15
	MQ9	1,800	1,600	160	16
2001 September	MQ1	1,900	1,700	180	24
	MQ4	3,200	2,900	230	37
	MQ9	1,800	1,600	190	43

Table A1-9: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2002

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
2002 April	LL1	5600	5100	460	57
	LL4	5600	5100	490	40
	LL9	1300	1100	220	12
2002 May	LL1	2600	1900	710	29
	LL4	2700	2000	690	41
	LL9	1800	1300	460	37
2002 June	LL1	5800	5300	340	140
	LL4	9200	8600	450	96
	LL9	3700	3000	620	27
2002 July	LL1	2900	2700	180	0.3
	LL4	2400	2200	160	0.6
	LL9	3900	3300	560	41.2
2002 August	LL1	2900	2800	140	7.2
	LL4	2300	2200	150	3.2
	LL9	1500	1400	130	0.6
2002 September	LL1	3900	3700	220	27
	LL4	3500	3200	260	31
	LL9	2500	2300	210	2.2
2002 April	MQ1	2000	1700	360	8.2
	MQ4	1900	1600	300	3.6
	MQ9	1500	1200	260	4
2002 May	MQ1	1400	1100	270	1.1
	MQ4	1400	1200	230	1.7
	MQ9	1400	1100	330	1.4
2002 June	MQ1	1000	940	110	1
	MQ4	800	680	120	0.3
	MQ9	60	50	7	0
2002 July	MQ1	1700	1300	330	50
	MQ4	1500	1100	360	34
	MQ9	940	700	240	5.5
2002 August[1]	MQ1	1400	1200	140	42
	MQ4	1200	940	180	76
	MQ9	2600	200	300	275
2002 September	MQ1	1400	1200	160	33
	MQ4	2100	1900	220	28
	MQ9	1100	920	160	28

1. recalculated for counting *Cyclotella bodanica* at 400X rather than 100X

Table A1-10: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2003

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
2003	LL1	4800	4200	560	36
April	LL4	3600	2900	640	8.6
	LL9	640	450	190	6.9
2003	LL1	4200	3500	620	25
May	LL4	4600	3800	800	23
	LL9	1400	1100	280	16
2003	LL1	2300	1600	630	37
June	LL4	6800	6100	600	43
	LL9	4500	3800	680	42
2003	LL1	1600	1400	240	1
July	LL4	2400	2100	270	0.5
	LL9	2900	2700	250	9.8
2003	LL1	2000	1800	240	0.8
August	LL4	2200	1900	250	0.5
	LL9	1900	1600	260	0.6
2003	LL1	2600	2400	290	0.2
September	LL4	3700	3400	340	1.8
	LL9	1900	1600	250	1.9
2003	MQ1	3500	2900	570	28
April	MQ4	3000	2400	510	17
	MQ9	2000	1600	310	17
2003	MQ1	2900	2400	350	99
May	MQ4	3000	2400	480	43
	MQ9	3000	2500	560	16
2003	MQ1	1300	1100	180	6
June	MQ4	1900	1500	420	21
	MQ9	3000	2700	350	16
2003	MQ1	2700	2600	170	0.5
July	MQ4	2000	1600	380	1.5
	MQ9	1400	1100	240	79
2003	MQ1	1300	1000	280	43
August	MQ4	1500	1200	240	44
	MQ9	3500	2500	620	338
2003	MQ1	2100	1900	260	6.5
September	MQ4	2300	2000	290	23
	MQ9	Not			

Table A1-11: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2004

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
2004	LL1	5300	4100	1200	20
April	LL4	3500	2600	860	13
	LL9	3300	2600	730	9.1
2004	LL1	8000	7100	860	34
May	LL4	6600	5300	1200	36
	LL9	2800	2000	770	22
2004	LL1	2900	2600	270	3.1
June	LL4	2900	2600	310	5
	LL9	4900	4100	730	39
2004	LL1	1600	1300	280	2.7
July	LL4	1200	1100	170	2.2
	LL9	1700	1400	270	1
2004	LL1	1300	960	350	18
August	LL4	1400	1000	300	38
	LL9	1700	1600	110	27
2004	LL1	3800	3400	370	27
September	LL4	4300	3900	350	25
	LL4 - duplicate	3100	2800	320	19
	LL9	3000	2700	280	12
2004	MQ1	1500	1120	400	2.2
April	MQ4	1400	1030	370	5.2
	MQ9	1500	1200	340	4.2
2004	MQ1	2300	2000	310	2.4
May	MQ4	1500	1200	300	3.6
	MQ9	2600	2100	470	2.4
2004	MQ1	1900	1700	190	34
June	MQ4	3000	2700	250	48
	MQ9	2200	1900	210	123
2004	MQ1	1200	960	260	6.2
July[1]	MQ4	1700	1400	260	9.9
	MQ9	1300	840	340	82
2004	MQ1	2900	2600	260	53
August[2]	MQ4	3800	3500	250	51
	MQ4 - duplicate	2500	2200	210	53
	MQ9	3900	3600	260	44
2004	MQ1	2300	1700	550	25
September	MQ4	2100	1600	420	26
	MQ9	2500	2000	520	19

1. MQ9 recalculated for counting *Cyclotella bodanica* at 400X rather than 100X
2. MQ1, MQ4, MQ9 recalculated for counting *Elakatothrix gelatinosa* colonies at 400X rather than 100X

Table A1-12: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2005

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
2005 April	LL1	2700	2100	550	24
	LL4	3500	2800	610	29
	LL9	670	460	200	8.5
2005 May	LL1	7200	6600	670	55
	LL4	5700	4900	850	20
	LL9	1300	850	440	20
2005 June	LL1	2700	2400	300	2.4*
	LL4	2800	2500	330	8.3*
	LL9	990	850	130	8.9
2005 July	LL1	1200	800	400	44*
	LL4	1700	1200	460	33*
	LL9	692	540	150	3.5*
2005 August	LL1	1400	1100	290	26
	LL4	1100	810	220	64
	LL9	2400	1900	360	73
2005 September	LL1	1400	1100	170	170
	LL4	2300	1900	220	170
	LL9	1800	1200	590	31*
2005 April	MQ1	1400	1100	370	8.8
	MQ4	1900	1500	400	3.6
	MQ9	1700	1300	400	6.6
2005 May	MQ1	1300	1000	300	3.4
	MQ4	1500	1200	330	3.2
	MQ9	1300	1000	340	3.7
2005 June	MQ1	1700	1600	150	4.6
	MQ4	1000	710	270	2.1
	MQ9	1100	900	200	1.1
2005 July[1]	MQ1	1100	860	220	14.6
	MQ4	1100	920	200	11.2
	MQ9	1400	700	170	489
2005 August[2]	MQ1	1100	950	170	0.5
	MQ4	1900	1600	250	7.1
	MQ9	2100	1700	330	89*
2005 September	MQ1	870	710	140	10.7
	MQ4	1200	1100	170	20.2
	MQ9	1400	1100	180	146

* = Cyclotella bodanica counted at 400X rather than 100X

Table A1-13: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2006

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	> 25 μm (100X)
2006 April	LL1	1800	1100	610	1.9*
	LL4	3200	2700	520	14.7
	LL9	690	550	135	2.2
2006 May	LL1	2600	2000	620	19.7
	LL4	4900	4200	640	12.9
	LL9	540	380	160	4.8
2006 June	LL1	860	610	200	39.5
	LL4	2000	1800	190	22.2
	LL4 (rep)	1100	940	190	23.2
	LL9	1700	1400	220	17.7
2006 July	LL1	1300	1100	160	54.8
	LL4	2700	2200	370	165
	LL9	1700	1300	350	19.1
2006 August	LL1	2700	2500	200	14.3
	LL4	2600	2300	220	34.6
	LL9	2800	2300	470	23.8
2006 September	LL1	3800	3600	160	0.4
	LL4	1300	1200	120	2
	LL9	1800	1700	130	3.6
2006 April	MQ1	2200	16,00	240	9.4
	MQ4	2400	1900	550	8.6
	MQ9	1600	1400	180	8.2
2006 May	MQ1	1700	1500	240	10.8
	MQ4	1700	1400	320	7.4
	MQ4 (rep)	2100	1800	310	11.8
	MQ9	1900	1600	280	4.1
2006 June	MQ1	1900	1800	130	0.9
	MQ4	1400	1200	200	4.4
	MQ9	950	840	110	0.6
2006 July	MQ1	1100	870	220	42.8
	MQ4	2000	1700	260	16.6
	MQ9	2300	2100	180	18.8*
2006 August	MQ1	1500	1200	280	6.5
	MQ4	2100	1800	290	13.3
	MQ9	1300	880	400	17.0*
2006 September	MQ1	2500	2300	200	1.9
	MQ4	2100	1800	260	11.8
	MQ9	3400	2400	970	1.8*

* *Cyclotella bodanica* (diatom) counted at 400X rather than 100X

Table A1-14: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2007

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)
2007 April	LL1	3100	2800	240
	LL4	3000	2200	620
	LL9	1200	910	240
2007 May	LL1	2600	2000	540
	LL4	3300	2600	670
	LL9	1300	890	430
2007 June	LL1	2100	1600	420
	LL4	2500	2000	520
	LL9	1100	750	300
2007 July	LL1	2300	2000	240
	LL4	2400	2100	270
	LL9	3100	3000	180
2007 August	LL1	1100	900	240
	LL4	2300	2100	150
	LL4 (rep)	2600	2400	150
	LL9	570	480	90
2007 September	LL1	2500	2200	280
	LL4	1700	1400	240
	LL9	420	350	68
2007 April	MQ1	1700	1500	230
	MQ4	1900	1602	300
	MQ9	1100	900	200
2007 May	MQ1	1500	1300	250
	MQ4	1800	1500	320
	MQ9	2600	2300	310
2007 June	MQ1	1500	1200	300
	MQ4	1800	1600	200
	MQ9	1500	1200	290
2007 July	MQ1	1500	1100	220
	MQ4	1900	1500	440*
	MQ9	1000	860	150
	MQ9 (rep)	1600	1400	150
2007 August	MQ1	2300	2100	200
	MQ4	1100	970	160
	MQ9	710	590	120
2007 September	MQ1	1400	1100	270
	MQ4	1500	1200	290
	MQ9	1000	690	300

Table A1-15: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2008

Date	Sampling Site	Total Abundance	< 5µm (1000X)	5 to 25 µm (400X)	> 25 µm (100X)
2008 April	LL1	2,500	2,070	360	30
	LL4	3,100	2,500	540	50
	LL9	1,300	1,030	240	20
2008 May	LL1	3,100	2,840	220	20
	LL4	5,300	4,820	430	25
	LL9	1,300	1,030	260	20
2008 June	LL1	1,000	880	110	1
	LL4	960	730	220	8
	LL9 (rep)	1,500	1,060	380*	16*
	LL9	1,200	780	380*	7*
2008 July	LL1	1,000	970	80	1
	LL4	1,400	1,300	110	17
	LL9	2,000	1,500	370	110
2008 August	LL1	1,100	1,000	50	1
	LL4	1,400	1,300	50	11
	LL9	1,100	1,060	40	9
2008 September	LL1	2,100	1,730	420**	2**
	LL4	2,300	1,780	490**	3**
	LL9	2,900	2,250	690**	6**
2008 April	MQ1	2,100	1,850	200	1
	MQ4	1,700	1,530	200	3
	MQ9	2,800	2410	400	4
2008 May	MQ1	1,000	870	130	1
	MQ4	1,700	1460	230	2
	MQ9	1,200	1,000	180	2
2008 June	MQ1	840	700	140	0.4
	MQ4	1,300	1,040	240	1
	MQ9	870	580	280	0.5
2008 July	MQ1	620	520	90	8
	MQ4	500	370	130	8
	MQ9	870	680	180	0.5
	MQ9 (rep)	1,000	760	260	9
2008 August	MQ1	750	660	100	1
	MQ4	980	860	110	6
	MQ9	1,300	990	290	5
2008 September	MQ1	1,500	1,310	160	14
	MQ4	1,100	980	150	3
	MQ9	2,800	2,680	130	10

* *Synedra radians* (diatom) counted at 400X rather than 100X, due to high numbers

** *Asterionella formosa* (diatom) counted at 400X rather than 100X, due to high numbers

Table A1-16: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2009

Date	Sampling Site	Total Abundance	< 5 µm (1000X)	5 to 25 µm (400X)	> 25 µm (100X)
2009 April	LL1	780	480	300	6
	LL4	1,600	1,220	340	4
	LL9	90	60	30	1
2009 May	LL1	6,000	5,150	820	19
	LL4	4,900	4,100	760	10
	LL9	430	290	140	5
2009 June	LL1	1,700	1,370	370	5
	LL4	1,400	1,030	360	12
	LL9	680	340	330	6
2009 July	LL1	2100	1900	270	3
	LL4	2700	2400	330	4
	LL9	700	340	350	4
2009 August	LL1	3100	2900	170	3
	LL4	2400	2200	190	15
	LL9	1700	1300	370	10
2009 September	LL1	3700	3500	220	5
	LL4	2300	2100	180	3
	LL9	1100	950	170	1
2009 April	MQ1	1400	1130	250	33
	MQ4	1300	1170	160	12
	MQ9	2300	2730	520	13
2009 May	MQ1	1700	1440	260	3
	MQ4	2100	1750	340	5
	MQ9	3800	3060	720	18
2009 June	MQ1	1500	1360	160	0.1
	MQ4	1100	990	150	0.2
	MQ9	1100	940	200	0.8
2009 July	MQ1	1000	790	190	4
	MQ4	1300	1100	220	8
	MQ9	1200	940	240	5
2009 August	MQ1	610	450	160	0.3
	MQ4	1300	1170	170	3
	MQ9	1600	1200	390	0.4
2009 September	MQ1	830	670	160	5
	MQ4	1200	970	170	6
	MQ9	1400	1200	240	1

Table A1-17: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2010

Date	Sampling Site	Total Abundance	< 5 µm (1,000X)	5 to 25 µm (400X)	> 25 µm (100X)
2010 April	LL1	630	490	140	1.6
	LL4	1,900	1,500	390	3
	LL9	170	100	70	0.4
2010 May	LL1	1200	940	270	13.4
	LL4	4,500	3,800	650	17
	LL9	530	390	140	0.9
2010 June	LL1	2400	1900	500	5.2
	LL4	3,600	3,000	610	11
	LL9	1500	1100	400	10.6
2010 July	LL1	2100	1900	170	8.7
	LL1 (rep)	1,900	1,700	180	5
	LL4	3,000	2,800	250	2
	LL9	1,900	1,700	210*	0
2010 August	LL1	1200	990	180	1.5
	LL4	1,600	1,400	190	1
	LL4 (rep)	1,600	1,400	180	2
	LL9	1,800	1,600	170	0
2010 September	LL1	2100	1800	260	15.1
	LL4	4,400	4,200	200	5
	LL9	1200	1100	130	0.4
2010 April	MQ1	1700	1600	100	0.4
	MQ4	1,200	1,100	120	1
	MQ9	800	710	90	2.4
2010 May	MQ1	1100	990	120	0.9
	MQ4	1,100	960	150	1
	MQ9	1600	1330	240	2.9
2010 June	MQ1	2000	1700	270	0.9
	MQ4	1,400	1,100	240	1
	MQ9	1000	850	200	1.1
2010 July	MQ1	1800	1500	250	8.7
	MQ1 (rep)	1,400	1,300	170	6
	MQ4	1,500	1,300	180	10
	MQ9	1,600	1,400	180	4
2010 August	MQ1	1400	1200	140	7.2
	MQ4	1,000	870	160	5
	MQ4 (rep)	1,100	900	150	5
	MQ9	1,200	1,000	150	8
2010 September	MQ1	1300	1000	260	1.3
	MQ4	1,300	1,040	220	3
	MQ9	1100	900	190	1.7

Table A1-18: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2011

Date	Sampling Site	Total Abundance	< 5 µm (1,000X)	5 to 25 µm (400X)	> 25 µm (100X)
2011 April	LL1	1700	1400	220	52
	LL4	3,900	3,260	540	80
	LL9	2200	1820	340	9
2011 May	LL1	3600	2880	720	6
	LL1 (rep)	3,500	2,790	690	6
	LL4	4,900	4,160	700	6
	LL9	1300	900	350	5
2011 June	LL1	2,100	1,750	330	36
	LL4	2,300	2,050	290	3
	LL9	1,500	1,060	450	4
2011 July	LL1	1,400	1,150	270	3
	LL4	1,800	1,440	350	1
	LL4 (rep)	1,900	1,600	300	0.1
	LL9	1,900	1,550	320	2
2011 August	LL1	2,900	2,500	360	15
	LL4	1,800	1,400	320	27
	LL9	1,500	1,200	280	0.9
2011 September	LL1	1,300	940	380	2.2
	LL4	1,800	1,500	380	0.4
	LL9	960	770	190	0.3
2011 April	MQ1	1,600	1,370	270	7
	MQ4	1,400	1,160	270	6
	MQ9	1,900	1,400	490	3
2011 May	MQ1	1,200	1,050	190	2
	MQ1 (rep)	1,200	1,040	170	3
	MQ4	1,800	1,370	410	4
	MQ9	1,600	670	920	4
2011 June	MQ1	2,000	1,840	150	1
	MQ4	1,500	1,300	200	1
	MQ9	1,700	1,200	520	10
2011 July	MQ1	2,200	2,100	110	0.4
	MQ4	1,600	1,330	230	3
	MQ9	1,000	770	200	1
	MQ9(rep)	1,100	860	200	1
2011 August	MQ1	1,400	1,200	210	4
	MQ4	3,300	3,000	280	0.6
	MQ9	1,200	1,000	200	0.1
2011 September	MQ1	2,300	2,100	190	17.2
	MQ4	2,600	2,400	190	0.2
	MQ9	1,600	1,400	240	9.6

Table A1-19: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2012

Date	Sampling Site	Total Abundance	< 5 µm (1,000X)	5 to 25 µm (400X)	> 25 µm (100X)
2012 April	LL1	2,300	1,980	330	5
	LL4	3,200	2,570	590	6
	LL9	1,000	800	190	6
2012 May	LL1	3,000	2,470	470	15
	LL4	2,200	1,640	600	7
	LL9	2,300	2,050	280	7
2012 June	LL1	1,400	1,080	310	3
	LL4	1,700	1,400	320	2
	LL9	980	810	170	2
	LL9 (rep)	1,200	1,020	140	1
2012 July	LL1	1,600	1,390	170	3
	LL4	Sample lost in transit (broken bottle)			
	LL9	880	730	150	2
2012 August	LL1	970	740	210	19
	LL1 (rep)	940	760	170	14
	LL4	1,300	990	250	35
	LL9	380	250	130	0.5
2012 September	LL1	Sample unpreserved – no analysis done			
	LL4	2,800	2,350	480	1
	LL9	Sample unpreserved – no analysis done			
2012 April	MQ1	2,200	2,010	200	3
	MQ4	1,700	1,440	220	3
	MQ9	1,600	1,420	180	5
2012 May	MQ1	1,100	990	140	1
	MQ4	830	680	140	0
	MQ9	1,200	1,000	150	0.2
2012 June	MQ1	2,100	1,920	170	0.4
	MQ4	890	740	150	0.3
	MQ9	1,100	910	200	0.4
	MQ9 (rep)	1,100	920	200	0.5
2012 July	MQ1	1,300	1,210	100	0.4
	MQ4	1,100	1,010	90	10
	MQ9	740	640	100	1
2012 August	MQ1	1,030	860	180	0.8
	MQ1 (rep)	920	720	200	0.2
	MQ4	810	660	140	10
	MQ9	430	340	90	1.6
2012 September	MQ1	900	730	170	0.5
	MQ4	760	650	115	2
	MQ9	580	430	160	0.5
2012 June	NNL1	1,600	1,240	320	0.5
	NNL4	1,000	670	370	0.2
	NNL9	840	700	140	1
	NNL9 (rep)	880	730	160	0.8
2012 July	NNL1	1,300	1,000	260	1.2
	NNL4	1,700	1,390	310	1
	NNL9	820	540	280	0.2
2012 August	NNL1	810	660	150	1.6
	NNL1 (rep)	790	590	200	1
	NNL4	1,800	1,350	440	0.8
	NNL9	730	530	195	0.04
2012 September	NNL1	1,530	1,170	360	1.2
	NNL4	1,260	970	290	2
	NNL9	1,740	1530	220	0.2

APPENDIX B

Species Composition Data: September 2012

One Team. Infinite Solutions.

Stantec

QUINSAM LAKE PHYTOPLANKTON - 20 September 2012
Long Lake 1 m (EN5181-02R)
27 ml sample settled

TOTAL CELLS COUNTED
TOTAL CELLS PER ML

sample not preserved, no analysis done

QUINSAM LAKE PHYTOPLANKTON - 20 September 2012
Long Lake 4 m (EN5182-02R)
27 ml sample settled

TOTAL CELLS COUNTED	**452**
TOTAL CELLS PER ML	**2,800**

	number counted	cells per mL
1000 magnification - 50 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	72	1296
Ochromonas/Chromulina spp. (4-5 um)	42	756
Ochromonas/Chromulina spp. (6-7 um)	7	126
Pseudokephyrion sp.	10	180
TOTAL	**131**	**2358**
400 magnification - 1 strip		
CHRYSOPHYCEAE		
Diceras chodatii	1	2
Mallomonas acrokomas	24	41
Mallomonas spp.	1	2
Ochromonas spp. (8-10 um)	44	75
BACILLARIOPHYCEAE		
Cyclotella glomerata (cells + cols)	1	2
Melosira italica (filaments)	33	56
CHLOROPHYCEAE		
Gloeocystis sp. (cells + cols)	4	7
Nephrocytium sp. (cells + cols)	8	14
Schroederia setigera	2	3
CRYPTOPHYCEAE		
Cryptomonas spp.	13	22
Rhodomonas minuta	116	197
CYANOPHYCEAE		
Anabaena flos-aquae (fils)	16	27
Aphanocapsa sp. (cols)	16	27
Merismopedia sp. (cols)	8	14
TOTAL	**287**	**488**
100 magnification - whole sample		
CHRYSOPHYCEAE		
Dinobryon cylindricum (4 col, 9 cells)	9	0.4
BACILLARIOPHYCEAE		
Gomphonema acuminatum	1	0.04
Hannaea arcus	1	0.04
Synedra radians	2	0.1
Tabellaria fenestrata (1 col, 14 cells)	14	0.6
CHLOROPHYCEAE		
Botryococcus braunii (cols)	4	0.2
Closteriopsis sp.	1	0.04
Quadrigula sp. (cols)	2	0.1
TOTAL	**34**	**1.4**

QUINSAM LAKE PHYTOPLANKTON - 20 September 2012
Long Lake 9 m (EN5183-02R)
27 ml sample settled

TOTAL CELLS COUNTED
TOTAL CELLS PER ML

sample not preserved, no analysis done

QUINSAM LAKE PHYTOPLANKTON - 19 September 2012
Middle Quinsam Lake 1 m (EN2234-02R)
27 ml sample settled

TOTAL CELLS COUNTED	**401**
TOTAL CELLS PER ML	**900**

	number counted	cells per mL
1000 magnification - 100 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	42	378
Ochromonas/Chromulina spp. (4-5 um)	31	279
Ochromonas/Chromulina spp. (6-7 um)	2	18
Pseudokephyrion sp.	4	36
CHLOROPHYCEAE		
Oocystis sp. (3 x 5 um)	3	27
TOTAL	**82**	**738**
400 magnification - 3 strips		
CHRYSOPHYCEAE		
Chrysocapsa paludosa (cols)	1	1
Diceras chodatii	1	1
Dinobryon cylindricum (62 cols, 78 cells)	78	44
Dinobryon sp. (cells)	1	1
Mallomonas spp.	9	5
Ochromonas spp. (8-10 um)	103	58
BACILLARIOPHYCEAE		0
Cyclotella glomerata	4	2
Cyclotella bodanica	3	2
CHLOROPHYCEAE		0
Crucigenia sp. (cols)	1	1
Gloeocystis sp. (cells+cols)	5	3
Nephrocytium sp. (cells)		0
Oocystis sp. (cells+cols)	1	1
Scenedesmus sp. (cols)	1	1
Schroederia setigera	2	1
CRYPTOPHYCEAE		0
Cryptomonas sp.	60	34
Chroomonas sp.	7	4
Rhodomonas minuta	28	16
CYANOPHYCEAE		0
Aphanocapsa sp. (cols)	1	1
TOTAL	**306**	**173**
100 magnification - whole sample		
CHRYSOPHYCEAE		
Dinobryon bavaricum (12 col, 12 cell)	12	0.5
CHLOROPHYCEAE		
Botryococcus braunii (cols)	1	0.04
TOTAL	**13**	**0.5**

QUINSAM LAKE PHYTOPLANKTON - 19 September 2012
Middle Quinsam Lake 4 m (EN2235-02R)
27 ml sample settled

TOTAL CELLS COUNTED	**383**
TOTAL CELLS PER ML	**760**

	number counted	cells per mL
1000 magnification - 100 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	40	360
Ochromonas/Chromulina spp. (4-5 um)	24	216
Ochromonas/Chromulina spp. (6-7 um)	1	9
Pseudokephyrion sp.	4	36
CHLOROPHYCEAE		
Oocystis sp. (3 x 5 um)	3	27
TOTAL	**72**	**648**
400 magnification - 4 strips		
CHRYSOPHYCEAE		
Chrysocapsa paludosa (cols)	2	1
Diceras chodatii	2	1
Mallomonas sp.	11	5
Ochromonas spp. (8-10 um)	87	37
BACILLARIOPHYCEAE		
Cyclotella bodanica	25	11
Melosira italica (fil)	1	0.4
CHLOROPHYCEAE		
Gloeocystis sp. (cells + cols)	2	1
Nephrocytium sp. (cells)	3	1
Schroderia setigera	2	1
Tetraedron minimum	1	0.4
CRYPTOPHYCEAE		
Cryptomonas spp.	74	31
Rhodomonas minuta	59	25
CYANOPHYCEAE		
Aphanocapsa sp. (cols)	2	1
Chroococcus cf. Prescottii	2	1
TOTAL	**273**	**116**
100 magnification - whole sample		
CHRYSOPHYCEAE		
Dinobryon bavaricum (7 cols, 10 cells)	10	0.4
CHLOROPHYCEAE		
Botryococcus braunii (cols)	3	0.1
UNIDENTIFIED FLAGELLATE	25	1.0
TOTAL	**38**	**1.5**

QUINSAM LAKE PHYTOPLANKTON - 19 September 2012
Middle Quinsam Lake 9 m (EN2236-02R)
27 ml sample settled

TOTAL CELLS COUNTED	**427**
TOTAL CELLS PER ML	**580**

	number counted	cells per mL
1000 magnification - 100 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	23	207
Ochromonas/Chromulina spp. (4-5 um)	18	162
Ochromonas/Chromulina spp. (6-7 um)	2	18
Pseudokephyrion sp.	3	27
CHLOROPHYCEAE		
Oocystis sp. (3 x 5 um)	2	18
TOTAL	**48**	**432**
400 magnification - 4 strips		
CHRYSOPHYCEAE		
Chrysocapsa paludosa (cols)	3	1
Dinobryon sp. (cells)	1	0.4
Mallomonas sp.	76	32
Mallomonas acrokomas	5	2
Ochromonas spp. (8-10 um)	102	43
BACILLARIOPHYCEAE		
Cyclotella glomerata (cells + cols)	6	3
Cyclotella bodanica	19	8
Melosira italica (cells + fils)	9	4
CHLOROPHYCEAE		
Gloeocystis sp. (cols)	11	5
Oocystis sp. (cols + cells)	2	1
Scenedesmus sp. (cols)	10	4
CRYPTOPHYCEAE		
Cryptomonas spp.	32	14
Rhodomonas minuta	82	35
DINOPHYCEAE		
Gymnodinium sp.	1	0.4
Peridinium sp.	1	0.4
CYANOPHYCEAE		
Anabaena flos-aquae (fils)	1	0.4
Aphanocapsa sp. (cols)	4	2
Aphanothece sp. (cols)	1	0.4
Chroococcus Prescotti (cols)	1	0.4
TOTAL	**367**	**156**
100 magnification - whole sample		
CHRYSOPHYCEAE		
Dinobryon cylindricum (5 cols, 5 cells)	5	0.2
BACILLARIOPHYCEAE		
Navicula sp. (50-100 um)	1	0.04
Synedra radians	3	0.1
CHLOROPHYCEAE		
Botryococcus braunii (cols)	1	0.04
Quadrigula sp. (cols)	2	0.08
TOTAL	**12**	**0.5**

QUINSAM LAKE PHYTOPLANKTON - 20 September 2012
No Name Lake 1 m (EN5336-02R)
27 ml sample settled

TOTAL CELLS COUNTED	**526**
TOTAL CELLS PER ML	**1,530**

	number counted	cells per mL
1000 magnification - 50 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	35	630
Ochromonas/Chromulina spp. (4-5 um)	16	288
Ochromonas/Chromulina spp. (6-7 um)	8	144
Pseudokephyrion sp.	6	108
TOTAL	**65**	**1170**
400 magnification - 2 strips		
CHRYSOPHYCEAE		
Diceras chodatii	5	4
Mallomonas acrokomas	18	15
Mallomonas spp.	3	3
Ochromonas spp. (8-10 um)	136	116
BACILLARIOPHYCEAE		
Melosira italica (cells + fils)	66	56
CHLOROPHYCEAE		
Gloeocystis sp. (cells + cols)	2	2
Oocystis sp. (cells + cols)	3	3
Nephrocytium sp. (cells + cols)	5	4
Quadrigula sp. (cols)	1	1
CRYPTOPHYCEAE		
Chroomonas sp.	4	3
Cryptomonas spp.	24	20
Kathablepharis ovalis	1	1
Rhodomonas minuta	115	98
DINOPHYCEAE		
Gymnodinium sp.	2	2
Peridinium sp.	1	1
CYANOPHYCEAE		
Anabaena flos-aquae (filaments)	5	4
Aphanocapsa sp. (cols)	14	12
Chroococcus sp.	9	8
Merismopedia sp. (cols)	17	14
TOTAL	**431**	**366**
100 magnification - whole sample		
CHRYSOPHYCEAE		
Dinobryon cylindricum (1 col, 18 cells)	18	0.7
CHLOROPHYCEAE		
Botryococcus braunii (cols)	4	0.2
Elakatothrix gelatinosa (cols)	3	0.1
UNIDENTIFIED Flagellate	5	0.2
TOTAL	**30**	**1.2**

QUINSAM LAKE PHYTOPLANKTON - 20 September 2012
No Name Lake 4 m (EN5337-02R)
27 ml sample settled

TOTAL CELLS COUNTED	**440**
TOTAL CELLS PER ML	**1,260**

	number counted	cells per mL
1000 magnification - 50 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	29	522
Ochromonas/Chromulina spp. (4-5 um)	14	252
Ochromonas/Chromulina spp. (6-7 um)	3	54
Pseudokephyrion sp.	8	144
TOTAL	**54**	**972**
400 magnification - 2 strips		
CHRYSOPHYCEAE		
Diceras chodatii	5	4
Mallomonas acrokomas	17	14
Ochromonas spp. (8-10 um)	97	82
BACILLARIOPHYCEAE		
Melosira italica (filaments)	45	38
CHLOROPHYCEAE		
Nephrocytium sp. (cells)	4	3
Gloeocystis sp. (cells + cols)	1	1
Quadrigula sp. (cols)	1	1
Schroederia setigera	1	1
CRYPTOPHYCEAE		
Chroomonas sp.	5	4
Cryptomonas spp.	9	8
Rhodomonas minuta	89	76
CYANOPHYCEAE		
Anabaena flos-aquae (filaments)	6	5
Aphanocapsa sp. (cols)	18	15
Merismopedia sp. (cols)	43	37
Rhabdoderma sp. (cols)	1	1
TOTAL	**342**	**291**
100 magnification - whole sample		
CHRYSOPHYCEAE		
Dinobryon cylindricum (2 col, 39 cells)	39	1.6
CHLOROPHYCEAE		
Botryococcus braunii (cols)	3	0.1
UNIDENTIFIED FLAGELLATE	2	0.1
TOTAL	**44**	**1.8**

QUINSAM LAKE PHYTOPLANKTON - 20 September 2012
No Name Lake 9 m (EN5338-02R)
27 ml sample settled

TOTAL CELLS COUNTED **345**
TOTAL CELLS PER ML **1,740**

	number counted	cells per mL
1000 magnification - 50 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	70	1260
Ochromonas/Chromulina spp. (4-5 um)	14	252
Ochromonas/Chromulina spp. (6-7 um)	1	18
TOTAL	**85**	**1530**
400 magnification - 2 strips		
CHRYSOPHYCEAE		
Mallomonas spp.	6	5
Ochromonas spp. (8-10 um)	39	33
BACILLARIOPHYCEAE		
Melosira italica (fil)	34	29
CHLOROPHYCEAE		
Gloeocystis sp. (cells + cols)	2	2
Schroederia setigera	1	1
CRYPTOPHYCEAE		
Chroomonas acuta	1	1
Cryptomonas spp.	11	9
Rhodomonas minuta	154	131
EUGLENOPHYCEAE		
Trachelomonas sp.	1	1
CYANOPHYCEAE		
Anabaena flos-aquae (filaments)	1	1
Aphanocapsa sp. (cols)	2	2
Merismopedia sp. (cols)	2	2
TOTAL	**254**	**216**
100 magnification - whole sample		
CHLOROPHYCEAE		
Botryococcus braunii (cols)	3	0.1
UNIDENTIFIED FLAGELLATE	3	0.1
TOTAL	**6**	**0.2**

APPENDIX IV

PERIPHYTON ANALYTICAL RESULTS FOR QUINSAM RIVER AND LONG LAKE OUTLET

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VIA EMAIL: DLangill@maxxam.ca; LLuangkhamdeng@maxxam.ca

October 16, 2012

Project No: 123110406

Maxxam Analytics Laboratory
4606 Canada Way
Burnaby, BC
V5G 1K5

Attention: Dave Langill and Lanoy Luangkhamdeng

Dear Dave and Lanoy:

Reference: Quinsam Lakes Periphyton, August 2012
(Job Reference B271570, samples EE6061-01R and 6062-01R)

Enclosed are results for analysis of two periphyton samples from two stream locations in the Quinsam Lakes system. The artificial substrates were in the water for 11.5 weeks (several weeks longer than usual) and samples were collected 13 August 2012. Because of the long exposure period, the substrates had moved in the streams. At site WB one of the tiles was half out of the water (low water levels) and the other tile was upside down, which could affect the amount of material collected.

1 METHODS

Several subsamples (up to 5% of each sample) were examined in a Zeiss inverted microscope at 100x and 400x magnification to obtain a reliable semi-quantitative assessment of species abundance. Sufficient volume was examined to yield a consistent estimate of relative abundance of organisms that are distributed either randomly or in clumps.

Presence of silt and detritus was noted, and relative abundance (%) of non-diatom species (green, bluegreen, chrysophyte and red) was assessed, based on relative contribution to the biomass. Relative abundance of diatom species was ranked as predominant, common or present (corresponding approximately to >25%, 5 to 25% or <5%, respectively).

Abundance of non-diatom and diatom species was estimated based on "visual weight" (i.e., how much of a microscope field the organism covered), so is more closely related to biomass than cell number estimates. This approach accounts for large cells, filaments and colonies, which have more biomass and 'visual weight', as well as small cells, which can be numerically predominant but contribute little to biomass. Species considered predominant were high in both number and overall biomass.

A semi-quantitative assessment avoids some problems associated with strictly numerical abundance estimates, which may emphasize predominance of very small cells such as *Achnanthes* spp. (common early colonizing species that contribute little to biomass) and de-emphasize larger cells, whose presence may reflect longer term environmental conditions. Given that many periphyton species do not display random distribution in the stream or in growth form (filaments, colonies, clumps or mats), this approach overcomes the requirement of quantitative methods for random distribution of organisms.

Organisms were identified to species wherever possible. Exceptions included uncommon species, green algae requiring sexual reproductive structures for identification and species of diatoms belonging to very large genera (e.g., *Nitzschia, Navicula*) or requiring clearing of organic matter from silica frustules to observe the distinctive marking patterns required for identification.

2 RESULTS

Samples were collected from sites WB and LLO, from artificial substrates. Samples from both locations contained visible amounts of fine sediment. The samples consisted of detritus, silt and algae, mainly of diatoms (>99%) with some green algae (Table 1).

In the WB sample collected in 2012, *Eunotia pectinalis* var. *minor* was predominant and *Achnanthes* spp., including *A. minutissima* were common. In 2011 (typical incubation period and undisturbed tiles), there were higher numbers of common and predominant species: *Synedra ulna* and *Achnanthes minutissima* were predominant and *Achnanthes* spp., *Eunotia* spp., *Eunotia pectinalis* var. *minor, Synedra radians,* and *Tabellaria fenestrata* were common.

In the LL0 sample collected in 2012, there was no clearly predominant species. The distribution was spread among several common species, including *Achnanthes* spp., *Achnanthes minutissima, Eunotia* spp., *Eunotia pectinalis* var. *minor, Gomphonema acuminatum*, *Gomphonema subclavatum,* and *Gomphonema angustatum*. Similar results were reported in 2011, when the incubation period was shorter.

Community composition has varied over the years. All the species reported for 2012 have been observed in previous years for these samples, although relative proportions vary somewhat from

year to year. These species are common in streams of coastal British Columbia and were found during the late 1970s in the lower section of the Quinsam River (Munro *et al.*, 1985)[1].

Table 1: Periphyton Abundance in Samples from the Quinsam System, August 13, 2012

(+++ = predominant, ++ = common, + = present)

	WB	LLO
BACILLARIOPHYCEAE (diatoms)	**>99%**	**90%**
Achnanthes spp.	++	++
Achnanthes minutissima	++	++
Amphora ovalis		+
Cocconeis placentula	+	+
Cymbella spp.	+	+
Cymatopleura solea		+
Epithemia turgida	+	+
Eunotia spp.		++
Eunotia pectinalis v. *minor*	+++	++
Gomphonema spp.		+
Gomphonema acuminatum	+	++
Gomphonema angustatum	+	++
Gomphonema subclavatum	+	+
G. truncatum	+	+
Melosira italica	+	++
Navicula spp.		++
Nitzschia spp.	+	+
Pinnularia sp.		+
Synedra radians		+
Synedra ulna		+
Tabellaria fenestrata	+	+
CHLOROPHYCEAE (green algae)		
Euastrum sp.		+
Mougeotia sp.		5%
Oedogonium sp.		5%
Spirogyra sp.	+	

[1] Munro, K.A., S.C. Samis and M.D. Nassichuk. 1985. The effects of hatchery effluents on water chemistry, periphyton and benthic invertebrates of selected British Columbia streams. Can. MS. Rep. Fish. Aquat. Sci. 1830. 203 pp. plus appendices

3 CLOSURE

We trust this information meets your present requirements. Should you have any questions or require additional information, please contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Original signed by:

Karen Munro, M.Sc., R.P.Bio.
Senior Aquatic Scientist
Environmental Management Group

KM/mp

File Name and Path: [v:\1231\active\em\123110406\report\2012 quinsam\rpt_123110406_quinsam_periphyton_2012.docx]

APPENDIX V

MINISTRY OF ENVIRONMENT
“COMPLIANCE REVIEW RECORD” & ETRC MEETING MINUTES

Environmental Technical Review Committee (ETRC) Meeting Minutes

December 7, 2012
9:00am – 2:00 pm
Coast Discovery Inn and Marina, Campbell River

Attendees:

Darren Cowen	Quinsam Coal Corporation (QCC), Campbell River (DC)
Gary Gould	Hillsborough Resources, Vancouver (GG)
Kathleen Russell	Quinsam Coal Corporation (QCC), Campbell River (KR)
Erin Webb	QCC, Campbell River (EW)
Terri Martin	City of Campbell River, Campbell River (TM)
Tania Demchuk	Ministry of Energy, Mines and Natural Gas (MEMNG), Victoria (TD)
Luc Lachance	Ministry of Environment (MoE), Nanaimo (LL)
Hubert Bunce	MoE, Nanaimo (HB)
Deb Epps	MoE, Nanaimo (DE)
Louise LeBoutillier	MoE, Nanaimo (LB)

Regrets:

Kim Bellefontaine	MEMNG, Victoria
Ed Taje	MEMNG, Victoria
Nick Leone	Department of Fisheries and Oceans
John Miller	Environment Canada
Andrea Miskelly	MoE, Nanaimo

Purpose: To review the Quinsam Coal Corporation 2011/12 Annual Monitoring Report for completeness, identify issues and potential changes to the monitoring program and agree on possible recommendations to be made to the Regional Manager of Environmental Protection

Overview of mine activity over the preceding year and plans for the coming year (QCC)

GG spoke to a PowerPoint presentation on the current status and future plans for the mine operation. Some highlights of the presentation are summarized below and the full presentation is attached.

Current Mining Operations:

Mining continues in the 2-North and 5-South areas. As a result of coal market price, the focus is on cost control and the current production level is on hold. GG mentioned that the 87 panel had been backfilled and fully flooded in November 2012. HB enquired about the groundwater monitoring in the area and GG indicated that a groundwater monitoring well had been installed in the middle of the backfilled area.

In 2013, QCC expects to progressively remove pillars in the 2-North area. Mining is also expected to be completed in the 5-South area by March/April of 2013. QCC plans to proceed with closure of the 5-South area and install plugs in between 2-North and 5-South (under the Quinsam River) before proceeding with depillaring. GG indicated that there was no groundwater monitoring as of yet in the 5-South area but that it would be done by converting the injection well, for water pumped from 7-South, to a

monitoring well once depillaring and flooding is completed. Water from 7S is currently being pumped to 5S. Two weeks ago, retreat pillaring began on 11 Mains in 5-South.

The new 7-South mining area is currently in operation, with one continuous miner operating, and the raw coal stockpile is planned to increase progressively in the next few weeks. Mining was reported to be slower than planned due to difficulty with roof support drilling.

PAG-CCR Material Management:

GG indicated that 2-South pit conversion into a PAG-CCR storage facility had progressed well in 2012. The construction has been put on hold for the wet season but a first raise was completed before the rain arrived. The work will continue in 2013. HB asked where the overflow will discharge to and GG mentioned that it was planned to discharge to 3-South pit, which will subsequently discharge to Long Lake through a connector stream. 2N-Sump was reported to be filled to capacity and completion of the new PAG-CCR storage area is needed. HB enquired about PAG-CCR disposal for the 7-South mining area and GG said that most of the material is planned to be disposed of in the underground workings. However, at the beginning of the operation, CCR will have to be brought to 2-South. GG indicated that underground tailing injection and depillaring was also occurring in the 2-North mining area. The area is currently being dewatered and is discharging through Settling Pond 4.

TD asked about how the tailings were conveyed in the underground workings. TD also asked about the risk of flooding active mining areas and, in consequence, asked about the risk to miners' safety. GG indicated that a pipe had been laid underground and that flow and pressure changes were monitored. TM asked how many employees are currently on Site and about the company safety record. GG responded - approximately 140 and that the mine was accident free over the past year.

Future Developments:

GG briefly talked about the 7-South Area 5, previously referred to as Block 242 mining area. Area 5 is located to the west of 7-South and is estimated to hold about 850,000 tonnes of coal. The initial plan presented in 2010 to mine this area required an additional discharge to the Iron River, but the revised plan proposes to discharge to the existing 7-South settling pond if the water quality is acceptable. The *Mines Act* permit C-172 amendment was not yet submitted, but will be shortly. LL and HB indicated that the effluent PE-7008 permit amendment may also be required. Continuing monitoring in the Iron River is required.

GG briefly talked about the redevelopment of the 4-South area. According to GG, dewatering of the existing mine pool will not be required and no additional surface development is needed. The preferred approach is to stay away from water issues.

Others:

GG mentioned that Wash Plant drainage overflow to the 2N-pit sump was occurring at times, including when the MoE was conducting its inspection on October 15, 2012. DC pointed out that the associated permit condition 2.1.4 was not practical as written and needed to be reworded or clarified. HB

mentioned that the intent of the clause was not necessarily to obtain the authorization to overflow, but to inform MoE of the overflow frequency and duration.

2. Long Lake Update

2.1. Update on Long Lake Seep Treatment (QCC)

GG presented the status of the Long Lake Seep Treatment (LLST) project, which was requested to deal with the seep to Long Lake originating from the mining activities in 2-South. The objective of the LLST is to collect and treat flow of effluent from 2-South workings, reduce iron levels to below permit limits for SP1, and reduce sulphate levels. A dewatering well exists to draw down the water level; water is then redirected to the treatment cells. GG presented a summary of the process and indicated that the LLST effluent was being discharged below the Settling Pond 1 point of discharge. He indicated that commissioning was challenging.

The LLST system is comprised of three parts: the BioChem Reactor Cell (BCR), where sulphate is reduced to sulphide; the Sulphide Polishing Cell (SPC), where sulphide is dewatered; and the Aerobic Lagoon (AL), with outflow to the wetland. The design flow rate for the entire system is approximately 4.5 L/sec. An option to bypass both the BCR and SPC exists. GG noted that the BCR substrate is currently floating; QCC hopes that it will sink over time. A leak was also noticed from the inflow pipe to the BCR and repairs were planned. LL asked about the retention time and GG mentioned that water would spend about 14 days in the initial BCR and 7 days in the SPC. The SPC is not yet commissioned; this is currently being reviewed by Golder Associates. Preliminary results for sulphate removal are very promising (around 99% removal efficiency). However, results also show that iron concentration increased while going through the BCR.

Sampling locations are as follows:

- Inflow at the pump
- In the BCR: effluent at water level
- at sampling ports with differing elevations
- SPC – grab sample at top
- AL – grab sample at the overflow to discharge

LL enquired about the discharge location and GG indicated that it had been changed to a location slightly lower than Settling Pond 1 because the LLST changed location in the design stage. It was initially supposed to be located higher and discharge into Settling Pond 1, but due to ground conditions, the LLST was built in a flatter area at a slightly lower elevation. HB indicated that a permit amendment may be required in this case as this represents a new, unmonitored discharge. HB mentioned that MoE was initially under the impression that LLST effluent would be discharging to Settling Pond 1 and therefore, would be monitored at the pond's outfall and indirectly regulated by the established permit limits. HB suggested to either actively pump the LLST effluent to Settling Pond 1, or to request an authorization for a third point of discharge, or to request a temporary authorization to bypass the treatment works.

<u>Action item</u>: As a result of discussions after the meeting, MoE requested QCC to submit a request to temporarily bypass the works.

2.2. Review/Summary of SLR Report (MoE)

DE presented her summary of the SLR report. DE indicated that MoE had concerns about the report and mentioned that the report had not been reviewed by her prior to being sent to the ETRC agency members. DE reiterated the objectives of the study, which were to determine sediment background concentrations for parameters of concern in Long Lake and to assess the toxicity and bioavailability of parameters at concentrations above Sediment Quality Guidelines (SQGs). She insisted that these objectives had not been entirely met and that many of her recommendations and the ones from AM had not been integrated into the final report. For instance, DE indicated that some important data provided by MoE and by the Ministry of Forests, Land and Natural Resource Operations (FLNRO) were not integrated in the report.

DE said that the report provided preliminary background concentrations for As, Cu, Fe, and Mn; however, she had concerns regarding the use of outliers (inclusion vs exclusion and justifications for either) and that a comparison of the pre- and post- mining sediment quality in just Long Lake should have been done to determine if the preliminary background concentrations were appropriate. DE also had concerns regarding the recommendation of additional coring, given the issue around As mobility in sediment, which had not been addressed in the report, and that Dr. Cullen's coring data/final report was not available for review.

DC and GG indicated that a memo had been sent on December 6, 2012, the day before the ETRC meeting, to share QCC's opinion of the SLR report. DE and LL had not seen it yet. GG had prepared a quick table to highlight some of the pre/post sediment data (as suggested by DE) and briefly presented it. The results presented did not show a difference between pre- and post-mining for most parameters.

DE then referred to important studies, such as the Nordin benthic community structure (2006) and Taekama's plankton report (2002), that were not considered in the SLR report. She also referred to the statement that SLR made in its report about the extent of the impact and advised that there was no data to support their statement. MoE was going to set up a meeting with SLR to discuss these issues and make arrangements for a final report to be completed that addresses these concerns and meets the intent of the original terms of reference in the contract. HB, TM and others suggested we need to have SLR qualify their statement regarding "unacceptable risks to benthic organisms". **<u>Action item</u>: MoE to meet with SLR to follow up on issue.**

HB noted that the report is too broad to be helpful. DC has asked Lorax to review the report's comments. MOE noted that memo should go out with the report when document is released to the public. DE noted that maybe the old Fisheries work should be summarized in a proper report.

3. Review of issues identified at the 2011 agency and public ETRC meetings (MoE)

A review of issues identified at the 2011 agency meeting (December 8, 2011) and public ETRC meeting (March 5, 2012) was presented in the annual report, section 7.1. Most recommended actions were completed as indicated in the annual report.

The requests from the public and actions taken are summarized below and labelled "Recommended actions 2, 3 and 4":

- References to commencement of mining made in the annual report. Public ETRC members requested that QCC clearly state the mine that is referred to. This was noted by QCC.
- Ensure that table font size is appropriate for the printed tables in the annual report. The 2011/2012 annual report has been formatted to ensure that tables and graphs would be appropriate and legible.
- CREC /CREPG asked about the Long Lake Seep Treatment (LLST) liner lifespan. QCC indicated that they had not yet prepared and delivered this information. **Action item: QCC to respond to CREC/CREPG about the LLST liner life expectancy.**

Recommended action 1 (Provide hard copies of the annual report to the ETRC agency members). As requested, QCC provided hard copies to all ETRC agency members and made an additional copy available at City Hall for sign out (after agency meetings are complete, the additional copy is made available at the Campbell River public library). QCC also accommodated CREC by providing the Committee president with an electronic copy (PDF) of the annual report.

Recommended action 5 (Report out on 4S/LLE iron investigation and address the issue. Ensure mine impacted water goes to treatment). This action was discussed briefly at the meeting and the 4S/LLE iron investigation report was sent to MoE shortly after the meeting (December 12, 2011) for review.

Recommended action 8 (Conduct an in-depth review of the trend analysis report, communicate with the report authors, and make edits as needed. Circulate the final version of the report to the ETRC). The report has been integrated to the annual report and therefore made available to the ETRC.

Recommended actions 9, 10 and 11 were actions assigned to MoE and are not summarized in the 2011/2012 annual report issued by QCC. A short update on each action is provided below.

Recommended action 9 (Check to see if low level sampling procedures for methyl mercury are applicable to samples collected for total mercury. Also check to see if methyl mercury samples should be collected by QCC for comparison to guidelines). Recent information provided by QCC indicated that mercury contamination was caused by sampling equipment. Therefore, MoE decided not to pursue this recommendation further. Additionally, MoE considers sampling for total mercury only to be sufficient.

Recommended action 10 (Request that Dr. Cullen provides information prior to the public ETRC meeting so it can be reviewed). MoE contacted Dr. Cullen prior to the agency ETRC meeting without success. **Action item: MoE to contact Dr. Cullen again prior to the public ETRC meeting**.

Recommended action 11 (Circulate Long Lake Preliminary Risk Assessment report to ETRC members, once finalized). The report prepared by SLR Consulting was sent by email to the ETRC members on November 15, 2012. Findings were discussed in details at this meeting (refer to section 1.3).**Action item: Review report with SLR to get clarification on a number of items in the report and report out on the status of that report at the next public ETRC meeting scheduled for February.**

4. **Report out on actions taken as a result of the 2011 meetings (MoE).** Discussed in Section 2.

5. Review of Annual Monitoring Report

5.1. Report format (MoE)

LL discussed the format of the 2011/2012 annual report, which was submitted electronically on November 8, 2012. The hard copy document was received shortly after. Hard copies were sent to all ETRC agency members and, as requested in 2011, an additional hard copy was made available at the Campbell River public library on the following Wednesday (November 14). CREC initially requested a hard copy for its members. QCC proposed to provide an electronic copy of the report (PDF) that would allow CREC to print the report should they need to. That being said, the annual report copy available at City Hall than eventually the library was purposely put in binders to allow members of the public to make photocopies. LL suggested that an electronic report be made available online but QCC indicated that their website was not designed to be used as such.

The annual report was again presented in two volumes. One volume was dedicated to text, tables and graphs and a second volume was dedicated to analytical results, reports, public ETRC meeting minutes, spills, etc. The second volume also included the report by Summit Environment which addressed the Recommended Action 8. All tables and graphs were found to be legible. However, Water Quality Guidelines (WQGs) were not always clear in the tables, due to formatting (eg. red symbols such as * did not show well). **Action item: MoE requested that QCC use formatting that would be as obvious in black and white as in colour for future reports.**

In some instances, the presentation of average concentration values did not allow for a good interpretation. This is particularly true for concentrations recorded at LLE, which vary greatly between dry and wet months. On some graphs (as at SP4 and SP1), the scale could have been adjusted to reflect changes in the data set and a note could have been added on the graph to explain the change, which in this case was due to change in detection limit. LL indicated that summaries of studies were not presented in the text and in some cases were left to be discussed at the ETRC meeting. **Action items: MoE requested that a summary of completed, in-progress activities or studies relevant to the permitted discharges, associated authorised works and the receiving environment for the reporting period, be included in the next annual reports. Additionally, MoE also requested that projected activities for the coming year, that may have an impact on the environment, be included.**
Be careful about using annual averages in the report when guidelines require 5 and 30 days.

TM asked QCC to be careful when using the term “sustainable” in its annual report. TM referred to a section of the report where other qualifiers should have been used to avoid

confusion. TM also asked that the report make a clear connection between Long Lake seep and the mine and show exploration drilling locations on a map.

TM mentioned that maps indicating where exploration has been conducted during the reporting year were not included. TD indicated that this information was expected to be included in the Reclamation report.

TM also mentioned that on page 37, the connection between Long Lake seep and the mine operations is not clear. It should be clarified that mine effluent feeds the seep.

5.2. Adherence to monitoring schedule (MoE)

Adherence to the monitoring schedule was very good overall considering the extensive monitoring program managed by QCC. However, in the case of Settling Pond 4 (WD), 44 samples in total were missed during the reporting year, which represents a little more than 10%. QCC commented on the situation and indicated that it was mainly due to staff changeover and gaps in the transition. KR also said that solar panels and trickle chargers were going to be installed to increase reliability of the composite samplers.

Additionally, flow data from Settling Pond 1 (SPD) was not available for the entire Q1-2012. KR noted that a new staff gauge has now been installed. Lastly, the WB staff gauge was washed away, which resulted in a data gap between August 25 and October 31. The sample site has now been replaced by a hydrometric station. LL reminded that communication of these events is also a condition of the permit.

5.3. Compliance with permit limits (MoE/QCC)

The 2011/2012 annual report indicated a total of five permit exceedances, all related to TSS levels at the settling pond 1 (SPD) and 4 (WD) discharges.

QCC suggested the following controls to address non-compliances, as presented in its annual report:

- Training of new and temporary staff
- Setup of rechargeable batteries (trickle and solar-powered)
- Collection of daily grab samples when necessary
- Repairs of sampling equipment and increased inventory of key replacement parts
- Use of additional sampling trays for the composite samples (to allow for cleaning)
- Informing MoE at the time of exceedance, and when situation is corrected (via email)
- Conducting flow measurement at WB by measuring elevation from the bridge (in case float gauge washes away again)

<u>Settling Pond 1 (SPD)</u>

One permit exceedance was recorded at SPD, below Settling Pond 1, on February 21, 2012 and TSS levels reached 65.6 mg/L. At the meeting, KR indicated that revised sampling procedures had been developed to avoid permit exceedances like the ones that occurred at SPD. The sampling procedure now requires that sampling bottle trays used for 24-hour composite

sample collection be changed on every collection day (typically every 2-3 days) with clean bottle trays.

Settling Pond 4 (WD)

Four permit exceedances were recorded at WD, below Settling Pond 4, three of which were attributed to sampling method error as no significant rainfalls were recorded during those days. The other permit exceedance occurred on January 20, 2012 and was due to heavy rainfall as approximately 60 mm was recorded on that day; TSS value reached 60.8 mg/L.

EW and KR presented at the meeting a summary sheet titled "Permit Exceedances, Permit Non-Compliances, and Water Quality Guidelines Observations" and proposed to include a similar summary in the next annual report. The summary covered the 2011/2012 reporting year and included permit exceedances, non-compliances and WQG observations. It is very thorough and efficient at assessing compliance and MoE is very supportive of this initiative. MoE was also pleased to see that their recommendation to better highlight non-compliances had been taken to this level. Similar summaries have already been included in the latest quarterly reports submitted by QCC. It is important to mention that the summary also provides a better assessment of QCC's adherence to the monitoring schedule.

LLE (Entry to Long Lake)

LLE monitoring results for the 2011/2012 reporting period still indicated high iron and sulphate values even after redirecting the flow to the fire pond. LLE is not currently a regulated discharge site but is considered to be at the edge of the initial dilution zone and compared to WQG. KR indicated that the study had been shared with MoE in the 2010/2011 annual report. This topic was further discussed with DE under Section 5.4.

Long Lake Seep

Long Lake Seep still flows to Long Lake without treatment. However, significant progress has been made to address the issue and is discussed in a Section 2.1 above.

Administrative requirements

LL discussed compliance with permit administrative requirements in general. LL indicated that QCC submitted its annual report six months after the April 30 deadline. However, the quarterly reports were all submitted for the 2011/2012 reporting period. LL noted also that the Environmental Procedures Manual (EPM) had not been reviewed, as per requirements, by March 31. Additionally, QCC did not comply with permit clause 3.9.2 following permit non-compliances.

That being said, QCC has been generally very good at reporting and following up on incidents such as spills and overflows.

5.4. Review of monitoring data (MoE/QCC)

DE noted to be careful between guideline and objectives. Draft WQO are more general while site specific objectives are for the watershed (Middle Quinsam Sub-basin). Receiving environment exceedances are mentioned in the permit but they only prompt additional study. DE spoke about the monitoring data presented in the annual report and indicated that the comparison to WQG was found very useful. DE indicated that some receiving environment sites

should also be compared to WQG. These sites are Long Lake Entry (LLE) and Long Lake Seep (LLS). Sulphate and iron results recorded at LLE during the reporting period and in the last two 2012 quarters indicate that the issue at 4S Lower site has not been addressed and that sources of iron and sulphate need to be discussed. KR suggested that some of the higher results were collected during low flows and that samples may be concentrated or contaminated with sediment, making metals appear higher.QCC stated that it is important to ensure monitoring station LLE is appropriately located if it is being considered a receiving environment. **Action item: Conduct a mass balance in the dry season and in the wet season to document iron and sulphate loading coming from the 4S and draining to LLE. The detailed scope of the study is to be prepared by QCC and agreed with MoE.**

DE also noted that mercury and cadmium levels recorded in Middle Quinsam Lake (MQL) were high. KR indicated that QCC had commissioned a report from Lorax titled "Analysis of Cadmium and Mercury Levels in Surface Water Near the Quinsam Coal Mine" which reviewed the status. The report, dated October 25, 2012 was sent to MoE on December 13, 2012, a few days after the ETRC agency meeting. QCC explained that the study concluded elevated concentrations of Hg in lake samples were almost exclusively attributable to equipment contamination and cadmium water quality results for WB and LLO indicate that there is no measurable effect of mine related drainage on the Quinsam River water quality at the outlet of Middle Quinsam Lake. Moreover, the study recommended that QCC employ a low detection level when analyzing Hg and Cd in the receiving environment; QCC has adopted this recommendation. **Action item: MoE suggests that a summary of the report be presented at the next ETRC public meeting.**

- DE advised that the Long Lake phosphorus WQ objective was wrong and should have read 0.007 instead of 0.006 mg/L. She also indicated that Long Lake hardness cannot be used to calculate WQG as the hardness is affected by mining activities and is not representative of the receiving environment. For example, the Cd WQG is based on hardness and the natural background levels should be used, not the current hardness in Long Lake. In some tables, total As levels are coloured red, meaning they exceed WQG, when in fact they do not. **Action item: QCC should review of WQG values used with MoE, to ensure they are correct and based on consistent receiving environment hardness values. Discuss with MoE to address QCC concerns with using natural background hardness, etc.**

6. Effluent permit amendment highlights (MoE/QCC)

LL briefly discussed that effluent permit PE-7008 was being amended to take into account the new 7-South effluent discharge and to include a number of improvements to the monitoring program. LL indicated that the amendment needed for the 7-South mining effluent discharge was considered a major permit amendment while the site-wide monitoring program was considered a minor permit amendment.

7-South mining effluent amendment

LL advised that a first permit draft had been shared with QCC and that further discussions were needed to finalise some details of the application and to complete the assessment.

Site-wide monitoring program review

LL presented a few points relevant to the site-wide monitoring program changes. LL indicated that no changes to the discharge limits were considered and that the permit was being updated to reflect the

monitoring activities conducted by QCC, which were largely unaccounted for in the current version of the permit.

7. Any additional issues of concern (all)

LL and HB asked QCC for additional clarification about the Long Lake Seep Treatment discharge. GG indicated that the discharge was below Settling Pond 1 (SPD). HB said that MoE's understanding was that the LLST discharge was entering Settling Pond 1 and was monitored and permitted through the current permit limits set at SPD. HB noted that, considering the current situation, the LLST discharge was unauthorized by MoE. HB offered to discuss further as to how this discharge could be regulated. HB suggested that it could be considered as a bypass of works.

LL thanked everyone for their contribution and presence and suggested a round table to close the meeting. KR indicated that she would send the 4S Iron Study and the Environmental Procedures Manual to MoE. TM briefly discussed the Canada Goose issue, mentioning that the population of introduced non-migratory birds is exploding and causing damage to estuary environment as noted during Canadian Wildlife Service surveys. Geese nesting at the mine near the surface water treatment systems maybe contributing to this issue. The development of a Canada Goose Management plan has been recommended by The Nature trust of BC and senior agencies – other East Coast Vancouver Island communities are facing similar challenges and are in various states of management. DC indicated that QCC was looking forward to receiving an update on the new sulphate WQG and that he would follow up and send a request to MoE to authorize the LLST discharge.

Adjourn: 3:00pm

Summary of Actions:

Actions for QCC in Subsequent Annual Reports:

- MoE requested that QCC use formatting that would be as obvious in black and white as in colour for future reports**.**
- MoE requested that a summary of completed, in-progress activities or studies relevant to the permitted discharges, associated authorized works and the receiving environment relevant to the reporting period, be included in the next annual reports.
- MoE also requested to include projected activities for the coming year that may have an impact on the environment.
- QCC should review WQG values used, to ensure they are correct and based on correct receiving environment hardness values when the guidelines are hardness dependant. Discuss with MoE to address QCC concerns with using natural background hardness, etc.

Actions for QCC:

- MoE requested QCC to submit a request to temporarily bypass the works.
- QCC to respond to CREC/CREPG about the Long Lake Seep Treatment liner life expectancy.
- Status of the outstanding actions is proposed to be discussed at the next public ETRC meeting scheduled for February/March.
- MoE suggests that a summary of the report, “Analysis of Cadmium and Mercury Levels in Surface Water Near the Quinsam Coal Mine”, be presented at the next ETRC public meeting.
- Conduct a mass balance in the dry season and in the wet season to document iron and sulphate loading coming from the 4S and draining to LLE. The detailed scope of the study is to be prepared by QCC and agreed with MoE.

Actions for MoE:

- Review report with SLR to get clarification on a number of items in the report and report out on the status of that report at the next public ETRC meeting scheduled for February/March.
- MoE to contact Dr. Cullen again prior to the public ETRC meeting.

Ministry of Environment

Inspection Record

Environmental Protection Division

EP System: AMS	Inspection Status: *FINAL*
System Number: 7008	**Inspection No:** *2024*
EP System Status: *Active*	Inspection Date: 2012-10-15
Region: West Coast	Office: Nanaimo
Trigger: Planned	**Incidents of Non-Compliance Observed: Yes**
Non-Compliance Decision Matrix Level: Level 3	Non-Compliance Decision Matrix Category: Category B
Inspector Name(s): Luc Lachance, EPO Louise LeBoutillier, EPO Technician	Risk Ranking: Over 2 = High
Audit: Luc Lachance	Total Non-Compliance(s): *1*

Regulated Party:
Quinsam Coal Corporation

Regulated Party Contact(s):
Gary Gould and Darren Cowan

Mailing Address:
PO Box 5000
Campbell River BC V9W 8A3

Phone No: 250 286-3224	Fax No:

Contact Email:
dmc@hillsboroughresources.com

Location Description or Site Address:
Effluent discharge, Quinsam Coal Mine

Latitude: 49.935081 N	Longitude: 125.490725 W

Receiving Environment(s): Surfacewater

Summary

MONITORING AND REPORTING REQUIREMENTS

Inspection Period:
From: 2011-09-27 **To:** 2012-10-15

Requirement Source:
Waste Discharge Regulation

Activity: On Site	Waste Type: Effluent

Inspection Summary:
The site inspection was planned in the fall to better observe stormwater runoff at

Response:
Notice

the site. On the day of inspection, it was raining slightly and the area was covered in a thick fog which cleared a later in the day. We were given an overview of the North and South mining areas to get more familiar with the operation. The inspection was conducted during the site tour. The areas visited are the 2N Pit Sump, processing plant area and associated ditches and culverts, the settling pond 4, sampling stations, 2 South mine area, settling pond 1, Long Lake and Long Lake Seep, 3S pit water and the new Long Lake Seep Treatment ponds.

We were able to meet with the operations manager to get a brief introduction of the management team and the organisational structure. We also met with the surface crew supervisor, Rick Harvey, to go over his inspection routes and scope. Back at the office in Nanaimo but as part of this inspection, we discussed with the Preparation Plant manager, about the landfill operation permitted under PR-15827 and the responsibilities of the Surface Crew.

The new 7-South mining area, the settling pond and the 7S monitoring site were also visited. There were no discharges from the settling pond at the time of the inspection as the works are not yet authorized under permit PE-7008.

Note: Refuse permit PR-15827 compliance was also assessed during the site visit and is subject to another inspection report. As the annual report was submitted later in the year and after the inspection, compliance with the monitoring and reporting clauses will be assessed in another inspection report.

Compliance Summary	In	Out	N/A	N/D
Monitoring	4	0	0	1
Discharge	2	0	0	0
Operations	5	1	0	1

Inspection Details

Requirement Type: **Discharge**

Requirement Description:

1.1.3 and 1.1.4 - Authorized works must be complete and in operation and are made up of surface runoff collection and diversion ditches, plant site runoff collection box, flocc facilities, Settling Pond 4, 2N pit sump, tailings storage facility, 2N portal sump, surface and u/g pumping facilities and related appurtenances.

Findings:

All equipment observed were in good working condition or running during the site inspection.

Compliance: In

Requirement Type: **Operations**

Requirement Description:

2.1.4 - Wash plant effluent shall not be conveyed to the 2N pit sump without prior approval.

Findings:

The newly installed sump and sump pump along the wash plant ditch was in place and running. However, the culvert downstream, leading to 2N pit sump, was open and the level maintained in the sump allowed some flow to go through the ditch (i.e. not pumped to the tailings facility.). Clause 2.1.4 stipulates that QCC shall obtain approval prior to discharging into the wash plant effluent ditch leading to the 2N pit sump. Because this ditch is typically used during heavy and/or sustained rainfalls, it is not always possible for QCC to obtain prior approval and MoE proposed a new wording for the clause which would better reflect the initial intent which was to be notified of any overflows to the wash plant ditch. Regardless, the permittee was in non-compliance with the current permit clause at the time of the inspection.

Compliance: Out

Requirement Type: **Operations**

Requirement Description:

2.1.5 - Settled solids from Settling Pond 4 shall be removed to maintain a minimum water depth below the pond decant of 1.0 m and a minimum water storage volume of 2300 m3. Removed solids shall be disposed of in an approved manner.

Findings:

No apparent sediment could be observed during the site inspection and this clause was assumed to be in compliance. However, additional evidences may be needed to support compliance such as review of records and trending analysis. Although not specifically required under this permit, inspection routines and records should be kept onsite and be made available to the Ministry during the site inspections.

It was mentioned that sediments are normally disposed of in the tailings management facility when the pond is dredged.

Compliance: In

Requirement Type: **Operations**

Requirement Description:

2.1.6 - Discharge routing from Settling Pond 4 shall be via conveyance to Middle Quinsam Lake in an acceptable manner.

Findings:

During the site inspection, the discharge form Settling Pond 4 was clear and was not causing any erosion or visual impact due to low flow velocity and the nature of the receiving environment (wetland). Although not specifically required under the current permit, the Settling Pond 4 emergency overflow channel was somewhat overgrown. QCC should consider clearing vegetation along the overflow channel and conduct a survey to confirm elevations.

Compliance: In

Requirement Type: **Discharge**

Requirement Description:

1.2.3 and 1.2.4 - Authorized works must be complete and in operation and are made up of surface runoff collection and diversion ditches, flocc facilities, Settling Pond 1, 3 pit sumps (1S, 2S, 3S pits), an adit sump (4S adit), pumping facilities and related appurtenances.

Findings:

All equipment observed during the site inspection were in good working order or were running.

Compliance: In

Requirement Type: Operations

Requirement Description:

2.2.4 - Discharge routing from Settling Pond 1 shall be via conveyance to Long Lake through the adjacent wetlands, as defined by the South Pit Water Management plan (1990).

Findings:

Ok as per observations made at the site.

Compliance: In

Requirement Type: Operations

Requirement Description:

3.6 - Chemical Storage Containment -Approved containment works shall be used to prevent spills to the environment, e.g. for petroleum products and flocc agents.

Findings:

The chemical storage area was not inspected during this site inspection but should be inspected during the next site inspection.

Compliance: Not Determined

Requirement Type: Operations

Requirement Description:

3.9 - Maintenance of Works and Emergency Procedures - The permittee shall regularly inspect the authorized works and maintain them in good working order. The RWM shall be notified of any condition preventing effective operation.

Findings:

Based on discussion with the Surface Crew supervisor, Mr. Rick Harvey, regular inspections are conducted across the site to ensure the authorized works are in good working order. He indicated that typical daily checks include pond levels, visual inspection of berms (looking for bulging, seeps,, etc), ditches and culverts. That being said, no formal checklists were used and inspection records were limited to 'exceptions' logged in the supervisor's log book. It is recommended that inspections be formalised and records be kept and made available during future inspections.

Maintenance of works was briefly discussed during the site inspection and should be looked at again at the next inspection.

Compliance: In

Requirement Type: Operations

Requirement Description:

3.10 - Bypasses -
The permittee shall ensure no effluent is discharge without being processed through the authorized works unless prior written approval is obtained from the RWM.

Findings:

There were no bypasses observed during the inspection.

Compliance: In

Requirement Type: Monitoring

Requirement Description:

4.4.1 - Composite Sampling -
TSS samples for effluent shall be obtained via 24 hour composite samples. Each daily composite shall consist of eight samples collected at three hour intervals.

Findings:

Continuous sampler was observed running during the site inspection.

Compliance: In

Requirement Type: Monitoring

Requirement Description:

4.4.2 - Continuous Flow Recording -
The permittee shall provide and maintain suitable flow measuring devices and maintain a continuous record of the rate to which the effluent is discharge from the settling ponds.

Findings:

Flow measurement orifice was observed at the Settling Pond 4. The orifice seemed to be levelled and in good condition. However, vegetation debris were covering some sections of the orifice. It is recommended that the orifice be cleaned regularly to avoid flow restriction.

Compliance: In

Requirement Type: Monitoring

Requirement Description:

4.4.4 - Monitoring of Seeps
In-pit, out-of-pit, coal and waste rock seeps shall be monitored. Location and frequency will be determined by the RWM. Analyses will be obtained for pH, dissolved sulphate and dissolved iron.

Findings:

Inspection of the Long Lake seep indicated that new seeps had formed in addition to the ones already measured and monitored at Weir 1 (new) and Weir 2 (old). QCC confirmed that its flow monitoring infrastructure allowed them to measure all seep flows.

Compliance: In

Requirement Type: Monitoring

Requirement Description:

4.4.6 - Monitoring of Drainage Ditches and Water Channels - Visual inspection of these structures will be carried out by MOE staff and the permittee may be required to minimize soil erosion based on the results.

Findings:

This clause was assessed to be in compliance. See recommendations above.

Compliance: In

Requirement Type: Monitoring

Requirement Description:

4.5.1 Sampling and Analytical Procedures
Sampling shall be conducted in accordance with the procedures described in the latest version of "British Columbia Field Sampling Manual fro Continuous and the Collection of Air, Air Emission, Water, Wastewater, Soil, Sediment and Biological Samples", or by suitable alternative procedures as authorised by the Director.

Findings:

The 24 hour composite samples collected by the auto samplers at the settling ponds' discharge may not be kept cold (less than 4 degree C) at all times.

Compliance: Not Determined

ACTIONS REQUIRED BY REGULATED PARTY and/or ADDITIONAL COMMENTS:

1. (Clause 2.1.4). Based on revised clause wording, the Permittee is reminded that wash plant effluent shall not be conveyed to the 2-North pit sump via the wash plant ditch. The Permittee shall keep records of the date, duration and estimated volume of any overflow of the wash plant effluent sump.

2. (Clause 2.1.5). Although not specifically required under this permit, inspection routines and records should be kept onsite and be made available to the Ministry during site inspections.

3. (Clause 2.1.6). Although not specifically required under the current permit, the Settling Pond 4 emergency overflow channel was somewhat overgrown. QCC should consider clearing vegetation along the overflow channel and conduct a survey to ensure adequate elevations are maintained.

4. (Clause 3.9). No formal checklists were used and inspection records were limited to 'exceptions' logged in the supervisor's log book. It is recommended that inspections be formalised and records be kept available for future inspections.

5. (Clause 4.4.2). The Settling Pond 4 orifice seemed to be levelled and in good condition. However, vegetation debris were covering some sections of the orifice. It is recommended that the orifice be cleaned regularly to avoid flow restriction.

6. (Clause 4.5.1). The 24 hour composite samples collected by the auto samplers at the settling ponds' discharge may not be kept cold (less than 4 degree C) at all times. Please present your plan to demonstrate compliance with this clause to the Ministry by March 31, 2013.

INSPECTION CONDUCTED BY:

Signature	*Date Signed*
Luc Lachance	2013-01-08

ENCLOSURE(S) TO REGULATED PARTY & DESCRIPTION:

Photos are attached:
Photo records sheet (inspection)
Photo records sheet (7S area)

CVIS Archives

REGULATORY CONSIDERATIONS:

Ministry of Environment	West Coast Region Environmental Protection Division	Mailing Address: 2080-A Labieux Rd Nanaimo, BC V9T 6J9	Phone: (250) 751-3100 Fax: (250) 751-3103 Website: http://www.gov.bc.ca/env

Meeting Minutes
2012/13 Public Meeting with the
Quinsam Coal Mine Environmental Technical Review Committee

March 15th, 2013
10:30am – 4:00pm
Campbell River Enterprise Centre, 900 Alder St, Campbell River

Attendees:	Luc Lachance	Ministry of Environment (MoE) (LL)
	Deb Epps	MoE, Nanaimo (DE)
	Hubert Bunce	MoE, Nanaimo (HB)
	Louise LeBoutillier	MoE, Nanaimo (LB)
	Ed Taje	Ministry of Energy and Mines (MEMNG) (ET)
	Darren Cowan	Quinsam Coal Corporation (QCC) (DC)
	Gary Gould	QCC (GG)
	Kathleen Russell	QCC (KR)
	Norm Johnson	QCC (NJ)
	Erin Webb	QCC (EW)
	Terri Martin	City of Campbell River (TM)
	Dr. Bill Cullen	UBC / Canadian Water Network (BC)
	Frank Jamieson	Campbell River Environmental Committee (CREC) (FJ)
	Leona Adams	CREC / Campbell River Estuary Protection Group (LA)
	Dietmar Setzer	CREC (DS)
	John Lewis	Haig-Brown Institute (JL)
	Barry Ross	Greenways Land Trust (BR)
	Peter Winter	CREC / Greenways Land Trust (PW)
	Stan Goodrich	CREC / Greenways Land Trust (SG)
	Shannan Brown	Coach Shannan Consulting Services (Facilitator) (SB)
Regrets:	Dale Desrochers	Department of Fisheries and Oceans
	John Miller	Environment Canada
	Kim Bellefontaine	MEMNG
	Tania Demchuk	MEMNG
	Lynne Stone	Office of Claire Travena, MLA
	Lynda Belter	CREC
	Don McIver	CREC
	Andrea Miskelly	MoE
	Leanne Brunt	First Dollar Alliance

Purpose: To review the Quinsam Coal Corporation 2011/12 Annual Monitoring Report for completeness, review other environmental monitoring and protection measures taken since the report, identify issues and potential changes to the monitoring program and agree on possible recommendations to be made to the Regional Manager of Environmental Protection.

Welcome to our facilitator, introductions and review of ETRC Terms of Reference

HB referred to the QCC ETRC agency annual meeting and the public annual meeting which normally takes place a few months after the agency meeting. HB introduced the MoE team, including LL, LB and DE and thanked LB for organizing the meeting and all attendees for being here. HB also introduced the facilitator, SB. HB briefly presented the new public ETRC Terms of Reference (TOR) and associated ground rules which were developed to improve the meeting. HB mentioned that the main objective of the ETRC remains as stated in the 1983 public enquiry. HB referred about the voice recorder to assist with the meeting minutes.

LL invited all attendees to provide comments in regards to the public ETRC TOR. Two comments were posted on the board and are presented below as received:

1. TOR Background: Possibly mention that ETRC is a condition of the mine effluent permit. Under the ETRC membership: What are the expectations for meeting attendance? Hard for non technical members without their (*assumed this referred to experts*) input at meetings. Although this is worthy goal, is 30-days turnaround time realistic?

2. Determine the timing of each presentation in advance – allowing time for questions. Tell speakers they will be given a 5 minute warning to the end of their presentation. At that point, they must start to wrap-up.

Action item 1*: MoE to review the public ETRC TOR document considering the comments stated above. MoE will send a revised version of the TOR once updated.*

1. Overview of mine activity over the preceding year and plans for the coming year (QCC)

GG presented a PowerPoint presentation (ETRC Public Meeting _ March 2013 (QCC)) on the current status and future plans for the mine operations. Highlights from the presentation and discussion are summarized below:

- No lost time accidents within the mine site last 15 to 16 months as a result of employees involvement;
- Current work force at the mine site remains stable at 148 workers;
- Between April 2012 and March 2013, 401,844 metric tonnes of clean coal was produced from a total of 614,917 tonnes of run of mine production, primarily from the 5 South (5S), 2-North (2N) and 7-South (7S) mine operations. 7S area 1, entered into production in April 2012. 7S was fully approved in January 2013. There is currently 1 continuous miner in operation. Extraction figures are slightly under planned mainly due delays getting 7S mining area into production;
- 5S mining area planned to be completed this spring (April 2013). QCC currently depillaring of 5S area up to the river barrier pillar area;
- Early April 2013, QCC plans to develop area 2 of the 7S mining area.
- Mine Permit amendment granted in 2011 for the extraction of coal within the river barrier panel, in an area called 87 panel which is part of 2N mine. Mining in the 87 panel is now completed and currently being backfilled with PAG CCR. 80000 tonnes was backfilled and the underground workings are now being flooded.
- Additional area developed and completed in 2N are panel s 24, 21 and 400.

- Tailing injection trial has now moved to a fully operating plan and tailings are now pumped in the 2N underground workings.
- Conversion of the 2S pit into a PAG CCR disposal area (construction in progress), following the installation of the 2S portal pit concrete plugs.
- Approval of the Long Lake Seep Treatment (LLST) in February 2012, going through monitoring phase
- Approval of the 88 panel in May 2012
- PAG-CCR elevation increase for the 2N pit sump in August 2012.

ET asked if the total extraction figure included the box cut and underground extraction figures. GG confirmed this was the case and specified that there was only 6 to 7000 tonnes of coal extracted from the 7-South portal pit preparation. GG presented an overview of the mine site and referred to north and south mining areas which are divided by the Quinsam River. GG presented a closer view of the 2N mine where mining is nearing completion. GG referred to area called 87 panel which is within the river barrier panel where mining activities will end. GG summarized recent and forecasted permitting activities (slide 7). GG presented an overview of the 7S mining area and 2S PAG CCR storage facility (slides 8-14). GG mentioned that the 7S settling pond had not yet discharged. DC confirmed but said it was anticipated to discharge the next week. Sand / bentonite liner was installed in 2012 at the 2S PAG CCR area. HB asked about permeability testing results on test pads 1 and 2. GG mentioned that test pad 1 results indicated that construction method had to be reviewed to obtain compaction needed. An area had to be rebuilt based on QA/QC results. JL asked what was the lifespan of the liner? GG mentioned that it would last forever and that it was there for perpetuity. LA asked if QCC had figured out if seepage would come out of the containment area. GG mentioned it needed to be assessed at the end of winter and once the PAG material will be completely deposited and flooded. Capacity is 160,000m^3. Currently PAG CCR is being stored in 7S underground workings while PAG CCR 2S storage construction is being completed. GG indicated that QCC was now transitioning from surface tailing disposal to underground tailings management plan. Key step is to dewater underground workings to allow underground disposal. 2N, main and east panels are the first area where tailing are being injected. HB if dewatering activities have posed any challenges. GG mentioned that dewatering water was discharged via settling pond 4 and that no water quality issues were noted to date. GG talked about 7S area 5 mining proposal.

LA asked where the seepage and effluent flow from that area will be? GG mentioned that seepage will be towards the Iron river and in part towards the Quinsam river, following the land contours. LA asked if there would be a different settling pond? GG said that dewatering water quantities needed to be confirmed. The hope is to use the 7S settling pond and infrastructures to minimize surface disturbance. Options considered also include sending water to 7S or 5S underground workings. DS asked if the coal from that new area would also be stockpiled at the 7S stockpile area. GG confirmed. LA asked why 7S dewatering water used for dust suppression and fire control. "Why is it good for roads and not for the 7S settling pond?". GG mentioned this water will only be used for underground dust suppression and fire control only? Mainly used for continuous miner dust suppression sprays. ET specified that the required amount of water needed for fire control was 100,000 L. HB clarified that dust suppression for surface roads was pumped from existing ponds. GG said that water used for road dust suppression was pumped from settling pond 4. ET asked GG to explain in greater details and for the benefit of all what was involved in mining the river barrier panel. GG specified that only roadways and cross cuts were extracted. All supporting pillars were left in place to avoid subsidence under the river. All roadways have now been backfilled.

2013-2014 operational plan:

- Retreating from 2N mining area later in 2013 and start depillaring over the next 1 – 2 year.
- Install plugs to isolate the 5S water from 2N floodwater. As soon as the plugs are in place, 5S area will be flooded.
- Increase from 1 to 3 continuous miner in the 7S mining by year end.
- QCC plans to apply for permitting of 7S area 5 mining expansion area.
- Continue and complete PAG CCR 2S storage area construction. Construction work should start again in June 2013.

LLST trial will be discussed later in the meeting.

2. Review of Annual Monitoring Report (MoE, QCC)

LL presented a short power point presentation (ETRC public meeting - MoE slides). LL indicated that DE would be speaking about water quality aspects later.

2.1 Report format

LA asked why only an electronic printable copy was available and asked whether CREC could have a printable copy for distribution. DC noted that QCC delivers the report to MoE and it is up to MoE to distribute the report. HB advised that MoE could provide the report to CREC.

Action item 2*: MoE to distribute a printable copy of the Annual Report to CREC when received by QCC.*

DC mentioned that there was no issue in providing a printable copy to CREC. HB confirmed that LA was the point of contact to distribute the hard copies of the annual report for other interest groups. LA confirmed this was the case.

LA then questioned whether there was a way to go back to having the meetings within the current year of the annual report. HB replied that scheduling was proving difficult, due to staff shortages, lateness of report submittal, etc. But that QCC was dedicated to delivering the annual report by the deadline from now on, and that the ideal would be to have the meetings on the originally recommended dates. LA also asked if the meeting minutes could be prepared quickly after the agency meeting to give time to CREC to review and specifically asked to provide the minutes within a month. HB mentioned this was challenging but the ultimate objective.

LA asked about the location of the drill holes 77-30 and 78-198C. KR mentioned these holes were old wells. LA also asked for 2003 and 2004 drill holes 93 10-12 and 93 29-02 location. DC said he would look into it.

Action item 3*: QCC to identify location of original drill holes with CREC.* This was resolved during the meeting.

LA then asked why the wash plant seep ditch levels were not identified as exceedances when they were over the water quality guidelines (WQGs). HB replied that the receiving environment is not directly impacted by the discharge. DC clarified that the toe seep discharges into a sump and is then re-pumped into a collection box and into the tailings facility. LA observed that this was not clear in the report tables.

KR advised that an explanation would be included in next year report. LL mentioned that the plant seep ditch was on the agenda, point 6.2 and could be discussed in greater details then.

Report Improvements:
LL mentioned that summaries of current studies should be included in the annual Report. All tables and graphs were found to be legible. However, WQGs were not always clear in the tables, due to formatting (eg. red symbols such as * did not show well).

Action item 4: MoE requested that QCC use formatting that would be as obvious in black and white as in colour for future reports.

LL noted that QCC had developed a new table to be attached to their annual and quarterly reports. The table summarizes any exceedance of permit limits and WQG's. LA asked to see the table in question and KR distributed a copy of the table to the audience.

Annual Report Submission:
LL noted that the date for the submission of the Annual Report had been changed to 90 days after the last date of data collection. This was done to allow QCC time to submit by the deadline and to align QCC permit requirements to other permits across the province. Quarterly reports were all submitted on time and the Environmental Procedures Manual has not been reviewed by MoE but is due for a revision by March 31st, 2013.

2.2 Adherence to monitoring schedule

LL advised that adherence to the monitoring schedule was very good overall considering the extensive monitoring program managed by QCC. However, 44 samples were missed during the reporting year and there were 5 exceedances for TSS at WD (Settling Pond 4) and SPD (Settling Pond 1). KR discussed improvements to the sampling facilities including the installation of solar panels. SP4 is running well but SP1 sampling facility is still problematic. KR mentioned that it was being looked at. LL also referred to gaps in flow measurements at SP4. KR said that new staff did not realize how important the flow reading was. LL referred to gaps in flow measurement at the WBL monitoring site. KR said this was typically happening every year due to high flows and debris carried down the river damaging the staff gauges. A hydrometric station equipped with pressure transducer was setup and is continuously reporting and hidden behind a rock so it may now be better protected at high flows.

2.3 Compliance with permit limits

LL indicated that there were minor non-compliance issues with the permit requirements. There were TSS exceedances at Settling Pond 1 (SPD) and Settling Pond 4 (WD). The WD exceedances were related to precipitation while the other exceedances at SPD were related to a dirty sampling line. KR referred to changes made to their sample collection frequency (from weekly to daily) and to the sampling bottle cleaning frequency which is now done weekly. The problem is expected to be resolved now.

LA mentioned the wash plant box runoff to the wash plant ditch, as well as the coal stock pile runoff, and asked whether either of these was out of compliance. HB mentioned that the collection box takes overflows to the 2N pit sump. GG confirmed that the majority of seepage goes to the lower sump and is pumped back to the system. LA asked whether the 2N pit sump had been re-purposed. LL advised that

only the overflow was noted during the site inspection. DC mentioned that the overflow should be put into context; the water discharge is captured by the 2N Pit sump and not discharged to the environment. Any overtopping is a result of excessive precipitation where the pump capacity is exceeded.

LA stated that the permit needs to be reworded. HB replied that QCC was required to minimize the quantity of flow and that was reflected in the latest permit amendment. Changes in wording include keeping MoE informed of events. This allows for a more accurate recording and follow-up if issues arise in the future. HB stated that overflow of the collection box is not typically related to process flows but to precipitation which was not initially reflected in the 2010 permit conditions. The amended permit now requires QCC to record all overflows from the collection box. Frequency of overflow will then be assessed.

2.4 Review of monitoring data

Review/Update on WQO and guidelines:

DE said that some receiving environment sites should be compared to WQGs, i.e. LLE and Long Lake seep prior to going to Long Lake. SO_4 and Fe results were higher at LLE indicating that 4S had not been addressed. DE asked if KR would be talking about the 4S high Fe and SO_4 results but KR said it was not on the agenda. DE stated that high results in the 2011 annual report could be due to very low flows. In low or no flow conditions, QCC should not be collecting samples as they could be contaminated with sediment particles and not representative of the discharge.

DE said that Hg and Cd levels were higher in Middle Quinsam Lake mainly tied to an equipment issues (Hg only). DC mentioned that it would be discussed later by QCC. DE mentioned that phosphorus WQG is 7 mg/L for Middle Quinsam Lake and 6 mg/lfor Long Lake – not as presented in the annual report. DE also mentioned that hardness dependant parameters should be calculated based on background hardness values. Wrong WQG arsenic values were also used in the tables.

3. Report out on actions taken as a result of the 2010 meetings (MoE)

LL mentioned that most actions were closed and that outstanding actions would be discussed here today and listed those. It was mentioned that 4S LLE high Fe and SO_4 results discussion was not on this meeting's agenda. Prior discussion between MoE and QCC are to occur before it is discussed at the ETRC meeting. QCC was not prepared to discuss this topic. GG mentioned that the action was for QCC to discuss with MoE to discuss the scope of a mass balance exercise.

Action item 5: *MoE to set a meeting to discuss mass balance scope with QCC to better assist in interpreting the results at LLE.*

LA mentioned the dewatering of 4S underground workings. GG said there was no intention to dewater 4S. LA asked about impacts. GG mentioned it was modelled as part of the 7S mining application and taken into account for water quality prediction. HB said that it was better to keep the water underground than to remove it. LA asked about the plans to treat water using reverse osmosis. GG said the plan is to abandon the area, leave the water there and approach the 4S from a different area. LA asked where the PAG CCR will go then? GG said the PAG CCR will go to 7S underground, area 2.

Additional area will be required over the long term. For example, 7S area 5 is a potential area. 4S is still seen as potential but not a preferred location for PAG CRR disposal site in the future.

LA reminded that life expectancy of the liner was not provided to her as requested at the last public meeting. GG will provide information.

Action item 6: *QCC to provide information on the liner life expectancy to CREC/LA*

LA asked about the presentation of the results from the sediment study. LL said this was not on the agenda. GG mentioned that sediment sampling was now part of the effluent permit and sediment study associated to the 7S permit amendment process. Long Lake hydrogeogical study (Lorax).

Action item 7: *QCC to send a copy of the sediment report to LA as requested.*

4. Long Lake (LL)

4.1 Long Lake Seep (LLS) mitigation update – GG presentation

GG continued with his Power Point presentation (slide 17) and provided an update on the Long Lake Seep treatment system (LLST). GG restated the objective of the system which is to collect and treat the effluent entering Long Lake along the seep, reduce Fe to levels permitted at SPD (Settling Pond 1), i.e. 0.5 mg/L , reduce sulphate levels to under 300 mg/L (seep is 500-600 mg/L) and manage precipitates. GG provided an overview of the treatment system location and reviewed the background information associated to the seep. GG also showed the locations of the drill holes requested earlier in the meeting by LA and provided information on groundwater monitoring coverage in the area. GG noted that water was extracted from a dewatering well and pumped to the LLST for treatment. It is not practical to extract water at the seep location.

GG provided an overview of the treatment system principles (slides 20 to 24) and treatment ponds constructed to date, i.e. the biochemical reactor cell (BCR), the sulphide polishing cell (SPC), the aeration lagoon (AL) and the settling pond. QCC is still commissioning the LLST and is bypassing the sulphide polishing cells. QCC hopes to commission the entire system soon. The initial intent was to discharge effluent to the existing settling pond 1. However, due to construction constraints and the objective to keep the system passive, the LLST effluent is discharging downstream of settling pond 1.

GG mentioned some of the operational challenges to date:

- substrate in the biochemical reactor tends to float (but has not settled);
- leak in the piping at the entrance to the BCR. The leak was stopped by lowering the pond level. GG mentioned that leak will be fixed early this spring.

LA asked about the 'plastic' liner and why bentonite is not used for the LLST. GG mentioned that a LLPE membrane was used due to cost and timeframe consideration. LA asked what the target sulphate levels were? GG mentioned that QCC objective was less than 300 mg/L at the effluent, considering the Long Lake Seep levels are at 500 to 600 mg/L. JL asked how efficient was the treatment system was? GG responded that the system is currently operating at 4L/sec inflow and presented the graphs (slides 25 to 38). SG mentioned that sulphate levels are too high and DS reminded that pre-mining sulphate levels were much lower in the watershed. GG confirmed that pre-mining levels were in the range of 15 mg/L in SO_4. GG pointed out that higher metal levels were observed during the commissioning period. This is

believed to be related to the flushing of the system and leaching of the raw material. Conductivity results support the hypothesis. BR asked if bacteria and substrate were self perpetuating or needs to be replenished. GG confirmed that the bacteria are self perpetuating but this is dependent on food source. The wood chips, which act as a food source, are depleted and need to be replaced. Temperature is key to sulphate reduction and the system efficiency is lower at low temperature. Ideal temperature is above 10 degree C. A rebound is anticipated in the spring and summer. HB suggested that a higher pond should help in stabilizing temperature. LA asked about the heating of the water. GG mentioned this is not a preferred approach as it is not aligned with the idea of a passive system. More importantly, QCC is looking at a permanent solution to control the seep and is looking at other means, including the installation of a curtain to address the issue. DS asked how long it would take to manage the water. GG said the information was not fully available but the seep flow tends to fluctuate seasonally. JL asked if this was a commitment to control Long Lake Seep in perpetuity and if the system would remain in place indefinitely. GG acknowledged and referred to the approved closure plan with the Ministry of Energy and Mines and Natural Gas. LA mentioned constant pumping will need to be maintained over time.

BR questioned whether there were any problems with wildlife. GG mentioned that H_2S emission was resulting from the reaction. It can be smelted easily, but no problems with animals are expected. There were ducks and geese on the pond last fall, and fencing may be required at some point, as the liner is slippery. GG is hoping to see the system stabilizing this summer. Metal concentration in the effluent may come up when the SPC is commissioned as it happened with the commissioning of the BCR. This will be monitored.

GG mentioned that data collected so far indicated that BOD showed a decreasing trend, Al leaching out of substrate is decreasing with the LLTS. As is similar to Al (decrease over time). The Fe objective (dissolved Fe less than the current limit for SP1). Total dissolved Fe levels are at or below current targets. However, it is still early in the game and GG would like to have at least one full year of data.

The focus for 2013 is commissioning of the SPC, ongoing monitoring, reports and maintenance of the system including the repair of the BCR influent liner boot.

BC asked if the monitoring of the seep was ongoing. GG confirmed that it was and said that flow measurement had actually been improved and hydrometric station had been installed. BC asked about the water in a nearby stream, running in the ravine east of 2S mining area. GG confirmed the creek was not influenced by mining activities (no exposed mining area and no runoff from mining disturbed area) and that metal levels were naturally high in the area. LL asked if the pumping of underground workings would affect the flow of that creek? GG said the creek is ephemeral and is only affected by surface water runoff, not groundwater. LA strongly suggested using a different type of liner (i.e. bentonite) in consideration for the long term. GG confirmed that they were looking for feedback on potentials.

4.2 Long Lake Seep (LLS) treatment discharge authorization status (MoE)

LL introduced the status of the discharge authorization. LA asked where the discharge was going. HB mentioned it is discharging below settling pond 1 and that water was not treated prior to the LLST trial. LA asked if the LLST discharge will be authorized to discharge downstream of settling pond 1 once the LLST system is complete or if it will be pumped back. HB mentioned that it will likely be maintained as it is in order to keep the LLST as a passive system and added that the point of compliance will be at the downstream confluence. MoE is still working with QC; currently the discharge point is temporary but may be authorized as this is a trial. DC gave a graphic representation of the discharge and the existing

LLST. HB reminded that the ultimate goal was to reduce the sulphate levels reaching Long Lake. DS asked if better sulphate reduction would have been achieved if LLST effluent had entered SPD as initially planned. GG noted that you are still getting the benefit of mixing prior to the SPD. DS said that sulphate levels should aim to be much lower than 300 mg/L in order to keep levels low at the receiving environment. LA stated that natural wetlands should not be used for treatment and WQG should be met prior to entering the natural wetland. HB noted that this is not the receiving environment and that no wetlands are involved, and that the LLST treats previously untreated sulphate. LA asked if sulphate and iron levels will be increasing at LLE. KR said it was not expected to be the case, and had not been so far. BC asked how the 300 mg/L limit was set. GG referred to Golder, who designed the system based on bench test results and their experience with sulphate reduction potential using this type of treatment system. JL asked if the system could be optimized somehow. GG said the system was a function of retention time and water temperature. The system could be modified; expanded and operational aspects could be changed to improve the overall results if needed. DE mentioned that there is the potential for 4 systems to operate.

JL said the receiving environment definition should be synonymous with fish habitat. HB said yes to a certain degree this was true for this system. However, there are culverts and wetlands within QCC.

4.3 Review of the SLR report (MoE)

DE presented a summary of the SLR report and went over a Power Point presentation (ETRC agency meeting - Long lake). DE mentioned that SLR essentially conducted a third party review of all available data. A draft report was produced in June 2012 and comments were sent back to SLR to finalize the report. The final report was submitted in October 2012 but it did not address all the concerns and comments raised by MoE. That said, the report was nonetheless sent to the ETRC agency members without a thorough review by MoE EQ section.

DE talked about the objectives of the SLR report which were to:

1. Identify and review background data available relevant to pre-mining conditions in relation to the parameters of concern.
2. Assess toxicity and bioavailability of parameters above Interim Sediment Quality Guidelines (ISQG) to the benthic community.

SLR determined there was impact on benthic community based on As, Cu, Fe and Mn concentrations. However, SLR did not specifically state whether the impacts were natural or induced.

Action item 8*: MoE to share presentation with public ETRC members*

SLR proposed background values for As, Cu, Fe and Mn but also made a list of observations and recommendations:

- Assess changes in detection limits over time;
- Use of raw data from federal fisheries report (unavailable at the time of writing the report);
- Collect additional sediment core data (including but not limited to BC sediment core data);
- Conduct quantitative ecological risk assessment.

MoE concerns remains:

- Comparison of post mining sediment results to proposed background values was not done;

- Assessment of mobility of As in sediments to assess reliability of As as a mining activity indicator not done but may have an impact on data interpretation and conclusions;
- Inclusion of missing data;
- Did not include benthic community data from Nordin report;
- Comparison of benthic community structure pre and post mining not provided;
- Review of Dr. Cullen's data when completed to determine if coring is an appropriate tool – BC noted he could provide the data;
- Review of 1983 data and analytical methodologies should have been included.

QCC also provided comments on the SLR report and provided pre- and post-mining data which did not indicate a difference.

MoE is currently working with SLR to complete the report to address concerns expressed above. A letter was sent to SLR.

JL asked if there has there been toxicological testing done over time on flesh (fish tissue). DE mentioned that metal analysis on liver has been conducted before by Environment Canada but nothing has been done since 2008. DE said that it would be good to have this done over time. That said, DE mentioned that DFO is using Long Lake as a rearing site which tends to suggest that the lake is safe for aquatic life. DC asked JL if he was interested in toxicology testing. JL responded that he was more interested in data over time. PW asked if the data from Environment Canada was critical. DE replies that it was important to establish background data.

LA asked if SLR considered the 3S-77 grab sample site and its potential impact on Long Lake. LA made references to previous discussion with Lorax at the last ETRC public meeting.

SG asked if the current version of the SLR report is available to CREC. HB said yes, but that MoE has major qualifications to it. SG said he would email MoE regarding the report.

SB said that the meeting is at risk of running behind. There are 20 minutes for Dr. Cullen's presentation.

***Action item 9**: MoE to provide the SLR report to CREC along with disclaimer*

4.4 Results of the sediment study and update on Canadian Water Network Studies (Dr Cullen)

BC introduced two papers he was working on. The first one titled "The nature, origin, and toxicity of arsenic in lake sediments" was recently submitted to Science to the Environment. BR was a contributing Author. The second one titled "Fresh water mussels as bioindicators: Arsenic concentrations and speciation in Margaritifera falcate and Anodonta kennerlyi from the Quinsam Watershed, Vancouver Island BC, Canada" is ready to be published.

Refer to the Power Presentation attached (Quinsam 2013 (Dr. Cullen))

- Introduced sampling locations (slide 3) and referred to high As concentration observed from grab samples (L2 sampling site) on Long Lake which confirmed that some sediments were high in As.
- Key message is that As in those sediments is soluble and therefore bioavailable based on As solubility measurements done using As X-ray absorption near edge structure (XANES) method.
- Introduced XANES work done (slide 5). Results found that As in the sediment was not of sulphide/mineral but rather bound to oxygen as commonly found in the environment. Solubility of the As-Oxygen compounds is quite variable and depends on the As/O ratio.
- Slide 6 shows the dated core results in Long Lake. BC referred to 1979 as the beginning of the mining activities and showed an increase in As in the sediments post mining. GG clarified when the operation began. LA mentioned that 1977 bulk sample collected could have contributed to the increase in As concentration in the sediments as well. Some discussion as to when actual mining began took place.

BC presented toxicity results using mud shrimp in Scottish estuaries:

- Determined sediment were toxic to mud shrimp even for lower As sediment concentrations. Mud shrimp live in estuaries and also known to take up inorganic As. Response/mortality highly depends on As concentrations.
- Porewater quality is key as it reflects how much As is dissolved in the sediments and how much is available to organisms. Pore water samples are useful in determining organism sensitivity to As.
- Slides 8, 9 and 10 suggest differences in organisms present in Long Lake (from west to east side) reflect As concentration in the sediments. It is unclear if this is a naturally occurring phenomenon or if this is caused by something else.

BC referred to ecological effect assessment of contaminated sediments using weight of evidence approach which is typically looking at sediment chemistry, toxicity testing and benthic community evaluation. (slide 11). BC referred to some organisms being very tolerant to As and in the case of Long Lake *Hyalella azteca (amphipod)*, which were found to be tolerant to As levels much higher than guidelines (reference to paper from Liber et al., 2011).

BC discussed the Liber et Al., 2011 paper (Toxicity of U, Mo, Ni, and As to *Hyalella azteca* and *Chironomous dilutis* in water only and spiked- sediment toxicity tests) in greater details (slides 12)

- *Hyalella azteca* and *Chironomous dilutes* are tolerant to As level that are much higher than ISQG (> 500 mg/L versus 17 mg/L).

- Result shows the difference between whole sediments As concentrations, on which ISQG are based, versus As pore water concentrations. Sediments with pore water spiked with As proved to be much more toxic (slide 14). Key finding is that sediment chemistry has to be combined with pore water chemistry for a more complete assessment.

BC discussed the paper titled "Development and evaluation of consensus-based sediment quality guidelines for fresh water ecosystems" by MacDonald et al. (slide 16). This study suggests sediment is toxic at levels above 33 ppm As.

BC then referred to the Golder sediment study (Golder 2011 Sediment Assessment Interpretive Report FINAL_2011Mar16) and summarized the weights assigned to each aspect used to support the ecological assessment:

- 10% assigned to pore water results;
- 30% assigned to toxicity results (using *Hyalella aztecaI*) which are considered tolerant to high As levels. Considered high;
- 55% assigned to benthic community structures. Considered high especially if the organism are not sensitive to As;
- 5% assigned to sediment chemistry. Considered too low considering the 33 ppm value reported in MacDonald et al. study.

BC introduced work done on mussels (slide 21 to 25), namely the paper to be published titled: "Fresh water mussels as bioindicators: Arsenic concentrations and speciation in Margaritifera falcate and Anodonta kennerlyi from the Quinsam Watershed, Vancouver Island BC, Canada".

- Organisms used as they are easy to handle and measure effects on. However, they do not necessarily reflect what is going on in the receiving environment and because SQG do not provide a complete picture of the "potential for bioaccumulation in aquatic organisms nor the associated hazards to the species that consume aquatic organisms (i.e., wildlife and humans)" as stated by MacDonald et al;
- Results indicate an increase in As over a 10 year period (1999 to today);
- Results from native mussels from Gooseneck Lake were presented.

BC discussed additional study by Martel and Lauzon-Guay on *Anodonta kennerlyi* life cycle (2005), slide 26), and results of caged mussels experiment conducted by BC.

- Glochedia (young mussels) *Anodonta kennerlyi* attach to some fish species and are carried around. Sculpins and cut throat are present in the Middle Quinsam Lake system but Glochedia or mussels *Anodonta kennerlyi* were not found. However, they were found at the main inlet of Lower Quinsam Lake and the outflow of Long Lake. None were found in Long Lake, Middle Quinsam and No Name Lake;
- Caged mussel experiment indicated an increase in As over a period of 3 to 6 months. (slide 29).
- Unfortunately, control cage was lost;
- Questioned the effect of keeping mussels in a cage. Experiment indicated that loss of body mass is important and likely has an impact on As (ww) concentration in an experiment;
- 2009 – 2010 caged experiment also showed an important loss of weight. Survival rate was lower in No Name Lake than in Long Lake, which indicates that other factors than As in the sediment affect the mussels. Loss of weight could not only be attributed to the mussels being caged. However, the control was lost during the experiment.

BC added that dialysis cannot account for the change in the As concentration in the sediment cores. HB asked how this conclusion could be made. BC said the rate of change (i.e. As concentration) was too great. Anaerobic systems are difficult to predict or model. LL asked when the papers will be made available. BC said the presentation and the Stroten paper would be left with MoE for the ETRC members.

KR asked where in No Name Lake the mussels were found. BR responded that they were left of the launch and down to the far end – half way to the outflow and right to the outflow. BC noted that the highest mass loss was in mussels in No Name Lake.

5. Review of issues raised by local environmental organizations

5.1 Quinsam Coal Water Quality Trend Analysis 2006-2011 final report summary (QCC)

DC spoke to a Power Point presentation (ETRC_March 15_QCC_WQTA) that presented a summary of the report above. The study was done by Summit Environmental and with lab analysis done by ALS Environmental.

- Trend analysis was performed on data set between 2006 and 2011. Pre 2006 data was found to be too variable in terms of sampling and analytical methods to be used in this analysis.
- Done for 8 parameters: pH, alkalinity, sulphate, iron, manganese, arsenic, mercury, cadmium
- The study considered the following sampling points:
    - Settling ponds 1 (SPD) and settling pond 4 (WD)
    - Outlets of wetlands downstream from the settling ponds 1 and 4 (SPC and WC respectively)
    - Receiving environment lake sites (Long Lake (LLM), Middle Quinsam Lake (MQL), Middle Quinsam Lake outlet (WB)
- DC went through the objectives (slide 4) and the statistical methods applied (slide 5)
- Many samples came back below detection limits (low) and could not be used for statistical analysis
- Seasonal Kendall test results are summarized on slide 7. Downward trend detected at WC for sulphate was limited to seasonal variability.
- Homogeneity test results are summarized on slide 8.
- Conclusions (slide 9):
    - many samples were below detection limits
    - SO_4 trends downward at SPC
    - SO_4 trend upward at MQL should be treated with caution as data is spaced evenly
    - Dissolved and total Hg showed upward trends at MQL (see slide for details) but change was minor
    - As and Cd showed no trends
- Recommendations (slide 10):
    - maintain the use of the low detection limits
    - maintain a regular sampling interval. DC mentioned the revised sampling program should address this situation. KR said that specific days in the months will be targeted for sampling.
    - flow measurement should be measured when collecting samples

SG asked why Hg was now showing a trend upward. DC mentioned it will be covered in the next topic. LA asked to have access to report. Action item: DC to provide report to LA / CREC

5.2 Summary of report, "Analysis of Cadmium and Mercury Levels in Surface Water Near the Quinsam Coal Mine" (QCC).

DC presented a Power Point presentation (ETRC_March 15_QCC_HGCD)

- Presented the rational for the sampling sites selection (slide 2).
- Samplings sites are:
    - No Name Lake
    - Long Lake
    - Middle Quinsam Lake
    - Quinsam River
    - Background/Reference (Gooseneck Lake)
- Data used spanned 1979 to 2012 but was variable between monitoring sites (lotic and lentic sites, slide 5 and 6). Limited set of data available between 1979 and 2004.
- Detection limits for Cd and Hg generally above WQG prior to 2010
- Data was evaluated for QA/QC. Some issues associated to sample preparation were noticed and may have resulted in higher Cd values.
- Results were summarized for Lotic (streams) and Lentic (Lakes) environments:
    - <u>Lotic sites</u>
      Hg – downstream stations concentrations similar to background sites. No measurement effects of north and south mining activities. More work may need to be done to better characterize Hg concentration Quinsam River variability.

      Cd – Limited conclusions could be made with data prior to 2010 due to high detection limits. 2010 to 2012 showed WQG exceedances.

    - <u>Lentic sites</u>
      Hg – Most high Hg results reported in 1984 and 2003 onwards were found to be related to sample contamination. Source of contamination related to alpha water sampler used between 2003 and 2011. Hg concentration

      Cd – Rare trends detected between 1981 and 2012.

- Recommendations:
    - Lower detection limits for both Cd and Hg
    - Continue analysing total and dissolved fractions (QA/QC)
    - Filter samples at the lab
    - Conduct lake profile at background lake (i.e. Gooseneck Lake)

LA asked about the alpha sampler. DC mentioned contamination issues have been well documented but are not discussed here. KR stated that the alpha sampler was purchased in approximately 2007. DE mentioned that Hg was not particularly a concern, but the change in detection limit was high. The new sampler used by QCC does not show the same Hg concentration.

Action item 10: DC to provide report to LA / CREC

5.3 Water quality objective guidelines (MoE)

DE presented a short summary of the new sulphate WQG which are about to be signed off.

Max sulphate is now a hardness-based sulphate value. To be compared to the 5 weekly samples in 30 days. Value at the time of the meeting, sulphate WQG for very soft water was 115 mg/L. Very soft water was defined as 0 to 17 mg/L. Refer to the Final technical document attached (sulphate_final_guideline_april_2013) now defines very soft water as having a hardness value between 0 to 30 mg/L and the associate SO4 WQG is 128 mg/L.

LL mentioned that WA hardness is typically below 20 mg/L based on the annual report. DE mentioned that a Canadian guideline was also being worked on for sulphate but BC had not yet decided if it would be using it or not.

DE referred to current WQO and the need to review and/or update those values with new WQG, over the last four years.

LA asked about settling pond effluent values higher than WQG. DE mentioned theses values were not receiving environment values. DS asked about the definition of the natural environment at Quinsam Coal and he raised the question about the dilution zone which he did not agree with and then continued on the 7S discharge. DS and LA both stated that a larger settling pond would be needed. LA asked about contingency measures should QCC not be able to meet the WQG at 7S sampling site. LL mentioned there was a set of contingency measures agreed between MoE and QCC. The contingency measures will be documented in the next review of the Environmental procedures Manual.

DS referred to words in WQG report for sulphate which said that the guidelines must not to be exceeded at any times. HB put this into context and mentioned that science evolved and that a new report is pending. BC referred to WQO specific to watershed. DE said this is exactly what is being worked on with QCC.

DS referred to the Appendix D of the effluent permit which was missing the EMS number. LL mentioned that this was not included to avoid overloading the map but that it would be considered in the next permit amendment.

LA referred to the appeal process for the 7S permit amendment decision. LA asked about the deadline and the appeal process. This was further discussed and it was offered to send additional information to CREC.

5.4 Others:

LA requested core samples to be collected in Middle Quinsam Lake at three locations (as a minimum) considering the high Cd and sulphate levels reported. Feels it is important to be done considering that high sulphate values were associated to high As levels in Long Lake. BC supported the approach in order to have a better idea of the extent of the problem. HB mentioned that MoE will consider the request and was interested in having more information regarding the sources identified by CREC. KR discussed connection between the toe of the tailing dam and the settling pond 4.

Action item 11: *MoE to follow up with CREC in regards to their request to conduct sediment sampling in Middle Quinsam Lake.*

Summary of recommended action items for QCC:

1. ***Action item 1****: MoE to review the public ETRC TOR document considering the comments stated above. MoE will send a revised version of the TOR once updated.*
2. ***Action item 2****: MoE to distribute a printable copy of the Annual Report to CREC when received by QCC in subsequent years.*
3. ***Action item 3****: QCC to identify location of original drill holes with CREC.* This was resolved during the meeting.
4. ***Action item 4:*** MoE requested that QCC use formatting that would be as obvious in black and white as in colour for future reports.
5. ***Action item 5:*** *MoE to set a meeting to discuss mass balance scope with QCC to better assist in interpreting the results at LLE.*
6. ***Action item 6:*** *QCC to provide information on the liner life expectancy to CREC/LA*
7. ***Action item 7:*** *QCC to send a copy of the sediment report (2010 Golder report) to LA as requested.*
8. ***Action item 8****: MoE to share SLR (Long Lake study) presentation with public ETRC members*
9. ***Action item 9*** *: MoE to provide the SLR report to CREC along with disclaimer*
10. ***Action item 10****: DC to provide "Analysis of Cadmium and Mercury Levels in Surface Water Near the Quinsam Coal Mine" report to LA / CREC*
11. ***Action item 11:*** *MoE to follow up with CREC in regards to their request to conduct sediment sampling in Middle Quinsam Lake.*

APPENDIX VI

2011/2012 ANNUAL GROUNDWATER MONITORING SUMMARY, 2 NORTH, 3 SOUTH AREAS QUINSAM COAL

Summary of Groundwater Monitoring Results at the Quinsam Mine

Annual Report – (2012-13)

Prepared by Kathleen Russell BSc.
Environmental Coordinator for Quinsam Coal Corporation

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Introduction

Quinsam Coal as a portion of the requirements of permit PE-07008 conducts quarterly ground water monitoring. This factual letter provides the results of the 2012-13 annual groundwater-monitoring program.

The scope of the groundwater monitoring has been developed by Golder Associates, Lorax Environmental and Quinsam Coal, and reviewed by the ETRC (Environmental Technical Review Committee). The ETRC is comprised by representatives from City of Campbell River, Quinsam Hatchery, Ministry of the Environment (MOE), Ministry of Energy Mines and Petroleum Resources (MEMPR), Ministries of Fisheries and Oceans (MOF), and Environment Canada.

1 Regulatory Considerations

Quinsam Coal is authorized under the effluent permit PE-07008 issued by the Ministry of the Environment.
The permit identifies three locations where effluent discharge is permitted; the North coal Mining Operations, the South Coal mining operations, and Block 242. The permit criteria are for both effluent quantity and quality with the latter defined by parameters of interest; i.e. sulphate, phosphate, dissolved copper, iron, lead and zinc.

The permit is not directly relevant to the measure of the groundwater quality. For comparison and a measure of groundwater quality, the analytical results from the monitoring events are compared with the effluent permit. Additionally the requirements are compared to the British Columbia, contaminated site regulations (CSR) (BC reg.37/96. O.C. 1480/96) including the amendments (343/2008, January 1, 2009) and the water quality standards for fresh water aquatic life (AW). The aquatic life standard assumes that a minimum 1:10 dilution is available for groundwater discharged to a freshwater system.

2 Methods

The quarterly groundwater program for the North and South operational areas includes monitoring of the following wells (Fig 1) and activities.

- Measure the groundwater levels in the monitoring wells;
  - South MW-002 to MW-005
  - North MW00-1S,MW00-1DMW,MW00-6S, and MW00-6D
- Purge the wells- approximately three well volumes
- Measure field water quality parameters : pH, conductivity, temperature, and redox,
- Collect samples for laboratory analysis including dissolved metals, dissolved anions, and hardness.

3 Quality Assurance Quality Control

The QA/QC program for the field sampling was conducted in accordance with *"The British Columbia Field Sampling Manual, For Continuous Monitoring and Collection of Air, Air-Emissions, Water, Wastewater, Soil, Sediment, and Biological Samples, 2003 Edition"* and the supplementary audit conducted by Golder in 2004*, "Quality Control for Surface Water Sampling at Quinsam Coal*", previously submitted to MOE. Replicate sampling was performed in accordance with the above stated documents and evaluated for significance using the criteria as stated in the MOE publication. Results for a Field replicates are deemed significant if the Relative Percent Difference (RPD) is greater than 20% for replicate samples that are >5 times the Mean Detection Limit (MDL). Replicate samples and relative percent difference are presented in tables (6 and 7).

4 Results and Discussion

4.1 Groundwater levels

A summary of the measured groundwater levels and elevations are presented in figure1.

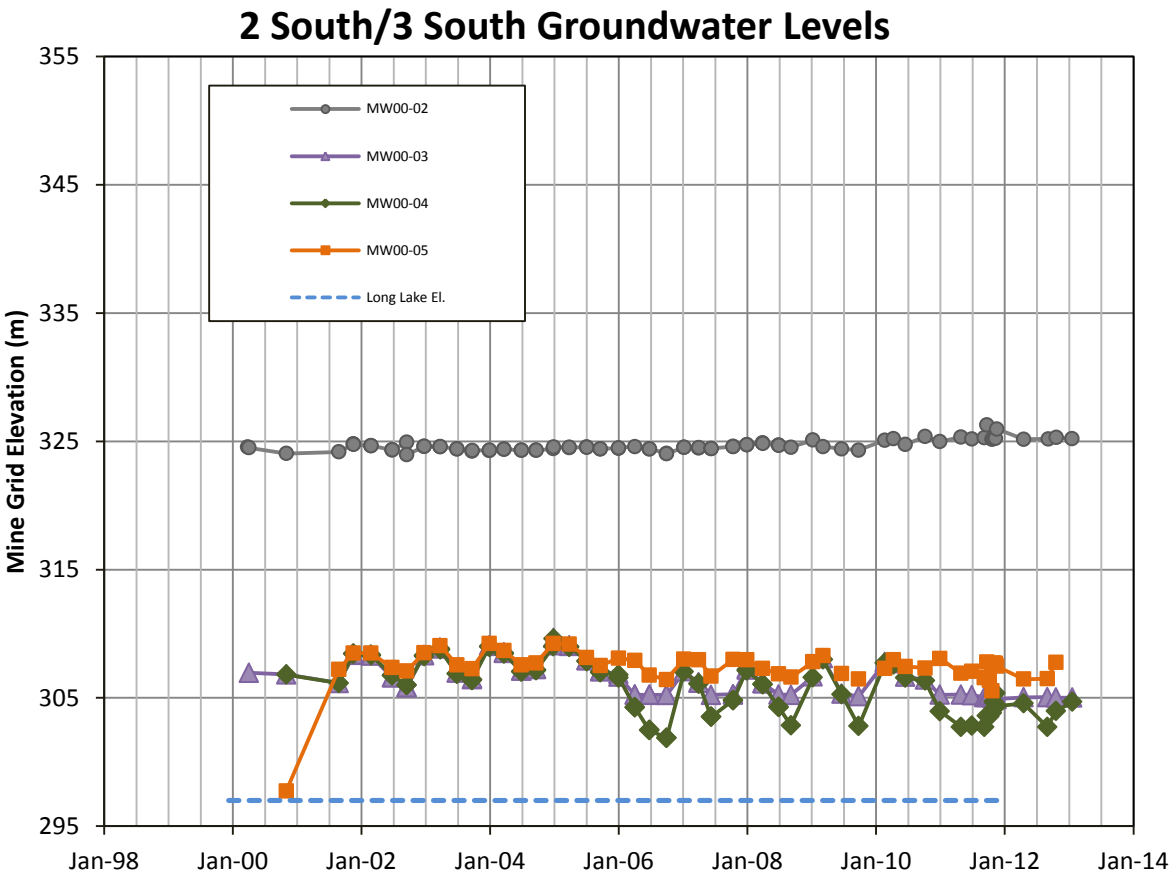


Figure 1: Summary of Groundwater levels and Elevations in 2/3 South

Figure 1 display that the static groundwater levels in the 2-3 south area have remained fairly stable and consistent with previous years.

5 Groundwater Quality

Eight groundwater monitoring wells were installed at the minesite by Golder Associates in 2000 for the purpose of groundwater quality monitoring and assessment of general hydrogeology conditions. Groundwater monitoring wells MW00-1 and MW00-6 are located in the 2 north mine area in the vicinity of the Wash Plant ditch. Groundwater monitoring wells MW00-2, MW00-3, MW00-4, and MW00-5 are located in the 2 South – 3 South area.

The details of the 2012/13 groundwater monitoring results are presented in the Appendix ( ). Golder Associates was contracted by QCC to initiate the first quarterly groundwater monitoring program and the report entitled "April 2012 Quarterly Groundwater Monitoring 2 North, 3 South Areas, Quinsam Mine Campbell River, B.C." was submitted to the MOE on July 16, 2012.
Lorax Environmental was contracted by QCC to monitor the groundwater for the subsequent two quarters and finally Quinsam Environmental Department assumed the full responsibility of the program. The tables and graphs for the groundwater program can be found in Tables 1-6 and Graphs 1-7.

Approximately three well volumes were purged from each well prior to sampling, between 33 and 200 liters of water. Groundwater sampling of MW00-1S, MW00-2, MW00-4, and MW00-5 was observed to be clear. Wells MW00-1D, MW00-6S, and MW00-6D demonstrated a grayish silty appearance. MW00-3 had insufficient water to obtain a sample on during the 4th quarter and MW00-4 was not sampled due to sampler error. A compilation of the groundwater analytical data is presented in Table 2.
Notable results in comparison to the Permit effluent and CSR regulations include the following observations:

- None of the parameters for the CSR for Aquatic Life were observed to be above the standards for nutrients reported for the 2 North and 3 South Monitoring wells during this period.
- Concentrations of dissolved iron reported for the groundwater sampled from wells MW00-2 (0.525 mg/L) and MW00-5 (2.03 mg/ L) in September and November (2.14 mg/L) exceeded the MOE mine effluent permit of 0.5 mg/l. All other dissolved metal analytical results were below the CSR standards.
- pH concentrations reported for the groundwater from wells MW00-1D (9.05) in April and (9.07) in September and MW00-6D in September (8.61) exceeded the MOE Mine effluent permit of 6.0-8.5 pH.
- Sulphate concentrations for the groundwater samples from wells MW00-1S (1040 mg/L) in September, MW00-2 (1260 mg/ l) in April and (1160 mg/L) in September, and MW00-5 (1910 mg/L) in April, (1880 mg/L) in September and (1780 mg/L) in November exceeded the CSR Aquatic Life standard of 1000 mg/L.

6 Quality Assurance/Quality Control

6.1 Results of Field Replicates

Samples were collected from MW00-1S, MW00-1D, MW00-2, MW00-4, MW00-5, MW00-6S, MW00-6D, and a replicates from MW00-5, MW00-2 and two field blanks were collected during this monitoring year. The relative percent difference (RPD) for all parameters was within the standards as described by BC Field sampling manual. Absolute difference of the replicates was within the laboratory analytical standards of less than two times the detection limit. The Analytical results of the field replicate are shown in Tables 6 and 7.

7 Discussion

The recommendations as stated in previous reports by Golder are replicated below;
Continue to conduct quarterly groundwater monitoring of the 2 North monitoring wells (MW00-1S, MW00-1D, MW00-6S, and MW00-6D) to assess groundwater quality in the area of the wash plant ditch.
Reduce the monitoring requirements by eliminating dissolved metals from the suite of groundwater monitoring parameters currently being analyzed in monitoring wells MW00-1D and MW00-6D. The long term groundwater quality trends suggest that the relatively deeper surficial groundwater system is not significantly influenced by effluent in the Wash Plant Ditch from the coal preparation pad. Now that the wash plant ditch has been rerouted the dissolved metals should be removed from the analytical request. However, laboratory analysis of dissolved anions (i.e. bromide, chloride, fluoride and sulphate) and field measurements of pH, conductivity and total alkalinity should be continued in the semi-annual monitoring program

Continue to conducts quarterly groundwater monitoring in the 3 South area to assess quality trends in the former underground workings and the 3 South pit.

8 References

April 2012 Quarterly Groundwater Monitoring 2 North, 3 South Areas, Quinsam Mine, Campbell River, B.C.
Golder Associates July 16, 2013

2011/2012 Annual Groundwater Monitoring Summary, 2North, 3South areas Quinsam Mine
Golder Associates June 13, 2013

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Table 1: 1st Quarter Groundwater Chemical Analyses - 2 North, 3 South Area, Quinsam Mine

Location	**BC MoE Permit**	CSR Standards Freshwater	CSR Notes	MW00-1S	MW00-1D	MW00-2	MW00-3	MW00-4	MW00-5	MW00-5	MW00-6S	MW00-6D
Date Sampled	**PE-07008**[1]	Aquatic Life (AW)[2]		27-Apr-12	27-Apr-12	27-Apr-12	27-Apr-12	27-Apr-12	27-Apr-12	27-Apr-12	27-Apr-12	27-Apr-12
Sample Control Number				0405-06	0405-05	0405-01		0405-04	0405-02	0405-03	0405-07	0405-08
QA/QC										field replicate		
							Insufficient water to sample					
Physical Tests												
Hardness $CaCO_3$				963	21.4	1,190	-	329	1,070	1,080	693	99.8
pH	**6.0-8.5**			6.20	**9.05**	6.49	-	6.98	6.73	6.73	7.25	8.22
Field Temperature (^{0}C)				7.37	8.54	8.71	-	7.54	9.61	9.61	8.64	8.74
Field Conductivity (µS/cm)				1,263	137	1,523	-	472	2,462	2,462	1,119	182
Field Oxidation-Reduction Potential (mV)				-93.1	-118.1	60.8	-	12.5	46.1	46.1	-122.4	-146.1
Field Alkalinity - Total $CaCO_3$				310.5	154.5	258	-	148.5	304.5	304.5	385.5	180
Dissolved Anions												
Bromide				<1.0	<0.050	<1.0	-	<0.050	<1.0	<1.0	<1.0	<0.050
Chloride		1,500		<10	0.65	<10	-	<0.50	<10	<10	13	0.74
Fluoride		2-3	P, H	<0.40	0.136	<0.40	-	0.082	<0.40	<0.40	<0.40	0.100
Sulfate		1,000		880	26.6	1,260	-	253	1,910	1,900	842	59.0
Nutrients												
Nitrate Nitrogen		400		<0.10	0.0092	<0.10	-	0.0569	<0.10	<0.10	0.35	0.0510
Nitrite Nitrogen		0.2-2	Cl	<0.020	<0.0010	<0.020	-	<0.0010	<0.020	<0.020	<0.020	0.0014
Dissolved Metals												
Aluminum	**0.5**			<0.025	0.0328	<0.025	-	<0.010	<0.025	<0.025	<0.025	0.0160
Antimony		0.2		<0.0025	<0.00050	<0.0025	-	<0.0010	<0.0025	<0.0025	<0.0025	<0.00050
Arsenic		0.05		<0.0025	0.0212	<0.0025	-	<0.0010	<0.0025	<0.0025	<0.0025	0.0243
Barium		10		0.023	<0.020	<0.020	-	0.031	<0.020	<0.020	0.037	0.020
Beryllium		0.053		<0.0050	<0.0010	<0.0050	-	<0.0020	<0.0050	<0.0050	<0.0050	<0.0010
Bismuth				<0.20	<0.20	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		0.42	<0.10	0.39	-	0.16	1.90	1.90	0.31	<0.10
Cadmium		0.0001-0.0013	H	<0.000085	<0.000017	<0.000085	-	<0.000034	<0.000085	<0.000085	<0.000085	<0.000017
Calcium				297	8.35	406	-	112	372	375	234	37.5
Chromium		0.01^{VI}, 0.09^{III}	V	<0.0050	<0.0010	<0.0050	-	<0.0020	<0.0050	<0.0050	<0.0050	<0.0010
Cobalt		0.04		<0.0015	<0.00030	0.0064	-	<0.00060	0.0015	0.0016	<0.0015	<0.00030
Copper	**0.02**	0.02-0.09	H	<0.0050	0.0029	<0.0050	-	<0.0020	<0.0050	<0.0050	<0.0050	0.0011
Iron	**0.3 / 0.5**			<0.030	<0.030	**0.525**	-	<0.030	<0.030	<0.030	<0.030	<0.030
Lead	**0.05**	0.04-0.16	H	<0.0025	<0.00050	<0.0025	-	<0.0010	<0.0025	<0.0025	<0.0025	<0.00050
Lithium				<0.025	<0.0050	<0.025	-	<0.010	0.026	0.025	<0.025	<0.0050
Magnesium				53.6	0.13	41.5	-	12.1	35.3	35.3	26.1	1.48
Manganese				0.369	0.00062	2.53	-	0.00335	0.194	0.195	0.185	0.00044
Mercury		0.001		<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum		10		<0.0050	0.0109	<0.0050	-	<0.0020	<0.0050	<0.0050	0.0255	0.0061
Nickel		0.25-1.5	H	<0.0050	<0.0010	<0.0050	-	<0.0020	0.0059	0.0060	<0.0050	<0.0010
Phosphorous	**0.03**			*<0.30*	*<0.30*	*<0.30*	-	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*
Potassium				2.2	<2.0	3.5	-	<2.0	4.8	4.8	3.0	<2.0
Selenium		0.01		<0.0050	<0.0010	<0.0050	-	<0.0020	<0.0050	<0.0050	<0.0050	<0.0010
Silicon				7.23	2.45	2.53	-	2.99	2.35	2.37	5.56	3.42
Silver		0.0005-0.015	H	<0.00010	<0.000020	<0.00010	-	<0.000040	<0.00010	<0.00010	<0.00010	<0.000020
Sodium				125	44.5	97.1	-	27.3	530	533	210	31.0
Strontium				1.54	0.0302	2.50	-	0.809	4.39	4.42	1.29	0.168
Thallium		0.003		<0.0010	<0.00020	<0.0010	-	<0.00040	<0.0010	<0.0010	<0.0010	<0.00020
Tin				<0.0025	<0.00050	<0.0025	-	<0.0010	<0.0025	0.0034	<0.0025	<0.00050
Titanium		1		<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium		3		0.0028	0.00076	<0.0010	-	<0.00040	<0.0010	<0.0010	0.0081	0.00103
Vanadium				<0.0050	0.0099	<0.0050	-	<0.0020	<0.0050	<0.0050	<0.0050	0.0050
Zinc	**0.1 / 0.2**	0.075-2.4	P, H	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.
2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011).

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Bold and boxed numbers exceed the most stringent permit (PE-07008) criteria for the North and South Coal mining operations.
Permit criterion for total iron and zinc is 0.3 mg/L and 0.1 mg/L in the North coal mining operation and 0.5 mg/L and 0.2 mg/L, respectively in the South coal mining operation.
Shaded and boxed numbers exceed the CSR Freshwater Aquatic Life (AW) Standard (2010).
Italics indicate the laboratory detection limit is set higher than the MoE permit requirement.
H = standard is hardness dependant.
V = standard is valence dependant.
Cl = guideline is chloride dependant.
P = Refers to Protocol 10; Contaminated Sites, Hardness Dependant Site Specific Water Quality Standards for Cadmium and Zinc.

Cl = guideline is chloride dependant.
P = Refers to Protocol 10; Contaminated Sites, Hardness Dependant Site Specific Water Quality Standards for Cadmium and Zinc.

Table 2: 2nd Quarter Groundwater Chemical Analyses - 2 North, 3 South Area, Quinsam Mine

Loaction **Date Sampled** **QA/QC** **ALS Sample ID**		**BC MoE Permit PE-07008**[1]	CSR Standards Freshwater Aquatic Life (AW) [2]	CSR Notes	MW00-3 1-Oct-12 L1219469-1	MW00-2 1-Oct-12 L1219469-2	/1(MW00-2 FI 1-Oct-12 field replicate L1219469-2	MW00-4 25-Sep-12 L1215987-1	MW00-5 28-Sep-12 L1216782-3	MW00-1D 26-Sep-12 L1215987-2	MW00-1S 27-Sep-12 L1216782-2	MW00-6S 2-Oct-12 L1219469-3	MW00-6D 27-Sep-12 L1216782-1
					Insufficient water to sample								
Physical Tests													
pH					-	6.59		7.1	6.82	**9.07**	6.53	6.81	**8.61**
Temp	oC				-	13.57		10.25	10.71	9.35	9.37	9.13	13.33
Specific Conductivity	uS/cm				-	2113		798	3579	0.227	2168	2054	200
DO	mg/L				-	0.24		0.29	0.24	0.73		362	0.63
DO	%				-						1.7	131.8	
ORP	mV				-	36.9		139.6	-22.3	144.7	141.5	258	107
Total Alkalinity	mg/L CaCO3				-	225		219	402	132	342		102
					-								
Physical Tests					-								
Conductivity	uS/cm				-	2040	2030	786	3370	247	2080	1830	198
Hardness (as CaCO3)	mg/L				-	1170	1190	358	1020	24.3	1120	695	56.4
pH	pH	**6.0 - 8.5**			-	7.92	7.92	8.17	7.61	**8.77**	7.86	8.06	7.66
Total Suspended Solids	mg/L	**25**			-	<3.0	<3.0	3.3	9.0	5.8	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L				-	1640	1710	549	2730	161	1850	1430	123
Turbidity	NTU				-	1.0	0.88	2.01	13.6	19.9	0.22	0.87	2.91
Anions and Nutrients					-								
Acidity (as CaCO3)	mg/L				-	9.5	10.1	4.6	19.5	<1.0	20.3	5.8	12.8
Alkalinity, Total (as CaCO3)	mg/L				-	211	211	174	318	91.9	379	251	87.2
Ammonia, Total (as N)	mg/L	**1.0**	11.3 [h]		-	0.0749	0.0563	0.0061	0.104	0.0125	0.0299	0.0260	0.0061
Bromide (Br)	mg/L				-	<1.0	<1.0	<0.50	<1.0	<0.050	<1.0	<1.0	<0.050
Chloride (Cl)	mg/L		1,500		-	<10	<10	<5.0	<10	0.73	11	<10	0.54
Fluoride (F)	mg/L		2 [i]	P, H	-	<0.40	<0.40	<0.20	<0.40	0.134	<0.40	<0.40	0.109
Nitrate (as N)	mg/L		400		-	0.10	<0.10	0.054	<0.10	<0.0050	<0.10	1.53	<0.0050
Nitrite (as N)	mg/L		0.2 [i]	Cl	-	0.030	0.021	0.018	0.025	<0.0010	0.026	0.035	<0.0010
Total Kjeldahl Nitrogen	mg/L				-			0.053		0.118			
Total Nitrogen	mg/L				-	0.140	0.130	0.125	0.110	0.118	0.050	1.79	0.070
Orthophosphate-Dissolved (as P)	mg/L				-	0.0017	<0.0010	<0.0010	<0.0010	0.125	0.0018	0.0384	0.131
Phosphorus (P)-Total Dissolved	mg/L	**0.03**			-	<0.020	<0.0020	<0.0020	<0.0020	**0.107**	0.0113	0.0421	**0.159**
Phosphorus (P)-Total	mg/L				-	<0.020	<0.0020	<0.0020	0.0131	0.128	0.0222	0.0458	0.147
Sulfate (SO4)	mg/L		1,000		-	1,160	1,170	267	1,880	38	1,040	856	20
Sulphide as S	mg/L		0.02		-	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Organic / Inorganic Carbon					-								
Dissolved Organic Carbon	mg/L				-	1.84	1.74	2.21	1.17	2.77	3.12	7.23	1.01
Total Organic Carbon	mg/L				-	1.76	1.70	2.77	0.98	3.13	2.88	2.76	1.18
Dissolved Metals					-								
Dissolved Metals Filtration Location	-				-	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	**0.5**			-	<0.0060	<0.0060	0.0047	<0.015	0.0350	<0.0060	<0.0060	0.0174
Antimony (Sb)-Dissolved	mg/L		0.2		-	<0.00020	<0.00020	<0.00010	<0.00050	<0.00010	<0.00020	<0.00020	<0.00010
Arsenic (As)-Dissolved	mg/L		0.1		-	0.00027	0.00037	0.00032	0.00053	0.0175	0.00028	0.00150	0.0285
Barium (Ba)-Dissolved	mg/L		10		-	0.0438	0.0525	0.0406	0.0164	0.00380	0.0148	0.0312	0.0120
Beryllium (Be)-Dissolved	mg/L		0.05		-	<0.00020	<0.00020	<0.00010	<0.00050	<0.00010	<0.00020	<0.00020	<0.00010
Bismuth (Bi)-Dissolved	mg/L				-	<0.0010	<0.0010	<0.00050	<0.0025	<0.00050	<0.0010	<0.0010	<0.00050
Boron (B)-Dissolved	mg/L		50		-	0.359	0.437	0.249	1.77	0.068	0.480	0.335	0.054
Cadmium (Cd)-Dissolved	mg/L		0.00030	H	-	*<0.00020*	*<0.00020*	<0.00010	*<0.00050*	<0.00010	0.00006	0.00005	<0.00010
Calcium (Ca)-Dissolved	mg/L				-	401	408	122	354	9.52	346	232	21.4
Chromium (Cr)-Dissolved	mg/L		0.010	V	-	<0.00020	<0.00020	<0.00010	<0.00050	<0.00010	<0.00020	<0.00020	<0.00010
Cobalt (Co)-Dissolved	mg/L		0.040		-	0.00548	0.00542	0.00011	0.00245	<0.00010	<0.00020	<0.00020	<0.00010
Copper (Cu)-Dissolved	mg/L	**0.02**	0.02 [i]	H	-	<0.0010	<0.0010	0.00090	*<0.0025*	0.00331	<0.0010	<0.0010	0.00092
Iron (Fe)-Dissolved	mg/L	**0.5**			-	0.426	0.438	<0.030	**2.03**	<0.030	<0.030	<0.030	<0.030
Lead (Pb)-Dissolved	mg/L	**0.05**	0.04 [i]	H	-	<0.00010	<0.00010	<0.000050	<0.00025	<0.000050	<0.00010	<0.00010	<0.000050
Lithium (Li)-Dissolved	mg/L				-	0.0080	0.0090	0.00942	0.0219	<0.00050	<0.0010	0.0021	<0.00050
Magnesium (Mg)-Dissolved	mg/L				-	41.2	42.6	12.9	32.8	0.12	62.5	28.2	0.74
Manganese (Mn)-Dissolved	mg/L				-	2.34	2.30	0.0330	0.212	0.000846	0.408	0.127	0.000138
Mercury (Hg)-Dissolved	mg/L		0.0010		-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L		10		-	0.00013	0.00011	0.000195	0.00035	0.0111	0.00019	0.0146	0.00415
Nickel (Ni)-Dissolved	mg/L		0.25 [i]	H	-	0.0044	0.0044	0.00088	0.0037	<0.00050	0.0013	0.0021	<0.00050
Phosphorus (P)-Dissolved	mg/L	**0.03**			-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L				-	3.8	4.0	<2.0	4.4	<2.0	2.4	3.2	<2.0
Selenium (Se)-Dissolved	mg/L		0.0100		-	<0.00020	<0.00020	<0.00010	<0.00050	<0.00010	<0.00020	0.00021	0.00011
Silicon (Si)-Dissolved	mg/L				-	2.73	2.86	2.70	2.57	2.54	7.58	5.77	3.43
Silver (Ag)-Dissolved	mg/L		0.0005 [i]	H	-	<0.000020	<0.000020	<0.000010	*<0.000050*	<0.000010	<0.000020	<0.000020	<0.000010
Sodium (Na)-Dissolved	mg/L				-	88.4	91.3	45.7	505	48.6	131	212	22.8
Strontium (Sr)-Dissolved	mg/L				-	2.65	2.42	0.942	4.31	0.0341	1.85	1.17	0.0955
Sulphur(S)-Dissolved					-						-	<0.000020	
Thallium (Tl)-Dissolved	mg/L		0.0030		-	<0.000020	<0.000020	<0.000010	<0.000050	<0.000010	<0.000020	<0.00020	<0.000010
Tin (Sn)-Dissolved	mg/L				-	<0.00020	<0.00020	<0.00010	<0.00050	<0.00010	<0.00020	<0.010	<0.00010
Titanium (Ti)-Dissolved	mg/L		1		-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.00664	<0.010
Uranium (U)-Dissolved	mg/L		3		-	0.000349	0.000331	0.000044	0.000207	0.000717	0.00398	<0.0020	0.000810
Vanadium (V)-Dissolved	mg/L				-	<0.0020	<0.0020	<0.0010	<0.0050	0.0114	<0.0020	<0.0060	0.0049
Zinc (Zn)-Dissolved	mg/L	**0.2**	0.075 [i]	P, H	-	<0.0060	<0.0060	<0.0030	*<0.015*	<0.0030	<0.0060		<0.0030
Total Metals					-								
Aluminum (Al)-Total	mg/L				-	<0.0060	<0.0060	0.0202	0.031	1.47	0.0065	0.0470	0.163
Antimony (Sb)-Total	mg/L				-	<0.00020	<0.00020	<0.00010	<0.00050	<0.00010	<0.00020	<0.00020	0.00010
Arsenic (As)-Total	mg/L				-	0.00044	0.00057	0.00040	0.00064	0.0185	0.00032	0.00177	0.0273
Barium (Ba)-Total	mg/L				-	0.0469	0.0533	0.0404	0.0165	0.0135	0.0151	0.0396	0.0131
Beryllium (Be)-Total	mg/L				-	<0.00020	<0.00020	<0.00010	<0.00050	<0.00010	<0.00020	<0.00020	<0.00010
Bismuth (Bi)-Total	mg/L				-	<0.0010	<0.0010	<0.00050	<0.0025	<0.00050	<0.0010	<0.0010	<0.00050
Boron (B)-Total	mg/L				-	0.429	0.449	0.251	1.83	0.071	0.501	0.392	0.060
Cadmium (Cd)-Total	mg/L				-	<0.000020	<0.000020	0.000010	<0.000050	0.000017	0.000057	0.000047	0.000019
Calcium (Ca)-Total	mg/L				-	388	386	124	329	9.64	347	226	21.2
Chromium (Cr)-Total	mg/L				-	<0.00020	<0.00020	0.00021	<0.00050	0.00116	<0.00020	<0.00020	0.00029
Cobalt (Co)-Total	mg/L				-	0.00562	0.00529	0.00012	0.00244	0.00084	<0.00020	0.00025	<0.00010
Copper (Cu)-Total	mg/L				-	<0.0010	<0.0010	0.00159	<0.0025	0.00886	<0.0010	0.0014	0.00151
Iron (Fe)-Total	mg/L				-	0.466	0.467	0.066	2.02	1.60	<0.030	0.044	0.145
Lead (Pb)-Total	mg/L				-	<0.00010	<0.00010	<0.000050	<0.00025	0.000229	<0.00010	<0.00010	0.000100
Lithium (Li)-Total	mg/L				-	0.0092	0.0089	0.00875	0.0218	<0.00050	<0.0010	0.0022	<0.00050
Magnesium (Mg)-Total	mg/L				-	40.5	41.2	13.3	31.1	0.73	59.9	28.1	0.78
Manganese (Mn)-Total	mg/L				-	2.37	2.29	0.0353	0.216	0.0321	0.439	0.143	0.00535
Mercury (Hg)-Total	mg/L				-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L				-	0.00013	0.00011	0.000189	0.00050	0.0104	0.00024	0.0154	0.00447
Nickel (Ni)-Total	mg/L				-	0.0046	0.0043	0.00096	0.0036	0.00158	0.0013	0.0023	<0.00050
Phosphorus (P)-Total	mg/L				-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Total	mg/L				-	3.7	3.9	<2.0	4.1	<2.0	2.4	3.2	<2.0
Selenium (Se)-Total	mg/L				-	<0.00020	<0.00020	<0.00010	<0.00050	<0.00010	<0.00020	0.00022	0.00011
Silicon (Si)-Total	mg/L				-	2.70	2.75	2.79	2.48	5.12	7.77	5.98	3.72
Silver (Ag)-Total	mg/L				-	<0.000020	<0.000020	<0.000010	0.000069	<0.000010	<0.000020	<0.000020	<0.000010
Sodium (Na)-Total	mg/L				-	86.3	88.0	47.4	472	45.3	134	215	22.8
Strontium (Sr)-Total	mg/L				-	2.57	2.43	0.929	4.29	0.0356	1.89	1.27	0.100
Sulphur (S)- Total	mg/L				-								
Thallium (Tl)-Total	mg/L				-	<0.000020	<0.000020	<0.000010	<0.000050	<0.000010	<0.000020	<0.000020	<0.000010
Tin (Sn)-Total	mg/L				-	<0.00020	<0.00020	0.00046	<0.00050	0.00016	<0.00020	<0.00020	0.00019
Titanium (Ti)-Total	mg/L				-	<0.010	<0.010	<0.010	<0.010	0.099	<0.010	<0.010	0.011
Uranium (U)-Total	mg/L				-	0.000343	0.000327	0.000041	0.000202	0.000765	0.00403	0.00776	0.000870
Vanadium (V)-Total	mg/L				-	<0.0020	<0.0020	<0.0010	<0.0050	0.0146	<0.0020	<0.0020	0.0052
Zinc (Zn)-Total	mg/L				-	<0.0060	<0.0060	<0.0030	<0.015	0.0062	<0.0060	<0.0060	0.0037

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.
2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011).

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.

< = Less than the detection limit indicated.

Bold and boxed numbers exceed the most stringent permit (PE-07008) criteria for the North and South Coal mining operations.

Permit criterion for total iron and zinc is 0.3 mg/L and 0.1 mg/L in the North coal mining operation and 0.5 mg/L and 0.2 mg/L, respectively in the South coal mining operation.

Shaded and boxed numbers exceed the CSR Freshwater Aquatic Life (AW) Standard (2010).

Italics indicate the laboratory detection limit is set higher than the MoE permit requirement.

H = standard is hardness dependant.

V = standard is valence dependant.

Cl = guideline is chloride dependant.

P = Refers to Protocol 10; Contaminated Sites, Hardness Dependant Site Specific Water Quality Standards for Cadmium and Zinc.

Cl = guideline is chloride dependant.

P = Refers to Protocol 10; Contaminated Sites, Hardness Dependant Site Specific Water Quality Standards for Cadmium and Zinc.

Table 3: 3rd Quarter Groundwater Chemical Analyses - 2 North, 3 South Area, Quinsam Mine

RESULTS OF ANALYSIS Sample ID Date Sampled ALS Sample ID		BC MoE Permit PE-07008[1]	CSR Standards Freshwater Aquatic Life (AW) [2]	CSR Notes	MW00-3 27-Apr-12	MW00-4 14-NOV-12 L1238665-1	MW00-5 14-NOV-12 L1238665-2	FB1 22-NOV-12 L1241592-3
Physical Tests					Insufficient water to sample			Field replicate
pH					-	6.64	6.81	
Temp	oC				-	7.82	9.21	
Specific Conductivity	uS/cm				-	0.761	3.417	
DO	mg/L				-	1.1	0.39	
DO	%							
ORP	mV				-	16.7	-11.4	
Total Alkalinity	mg/L CaCO3				-	117	294	
					-			
Physical Tests					-			
Conductivity	uS/cm					757	3370	<2.0
Hardness (as CaCO3)	mg/L				-	360	965	<0.50
pH	pH	**6.0 - 8.5**			-	7.89	7.92	**5.49**
Total Suspended Solids	mg/L	**25**				<3.0	16.2	<3.0
Total Dissolved Solids	mg/L				-	563	2870	<10
Turbidity	NTU				-	1.46	18.6	<0.10
Anions and Nutrients					-			
Acidity (as CaCO3)	mg/L				-	5.4	12.0	2.1
Alkalinity, Total (as CaCO3)	mg/L				-	115	321	<2.0
Ammonia, Total (as N)	mg/L	**1.0**	11.3 [h]		-	<0.0050	0.0954	<0.0050
Bromide (Br)	mg/L				-	<0.050	<1.0	<0.050
Chloride (Cl)	mg/L		1,500		-	0.90	<10	<0.50
Fluoride (F)	mg/L		2 [i]	P, H	-	0.071	<0.40	<0.020
Nitrate (as N)	mg/L		400		-	0.0543	<0.10	<0.0050
Nitrite (as N)	mg/L		0.2 [j]	Cl	-	<0.0010	<0.020	<0.0010
Total Kjeldahl Nitrogen	mg/L				-			<0.050
Total Nitrogen	mg/L				-	0.070	0.070	<0.050
Orthophosphate-Dissolved (as P)	mg/L				-			<0.0010
Phosphorus (P)-Total Dissolved	mg/L	**0.03**			-	<0.0020	<0.0020	<0.0020
Phosphorus (P)-Total	mg/L				-	<0.0020	0.0067	<0.0020
Sulfate (SO4)	mg/L		1,000		-	295	1,780	<0.50
Sulphide as S	mg/L		0.02		-	<0.0020	<0.0020	<0.0020
Organic / Inorganic Carbon					-			
Dissolved Organic Carbon	mg/L				-	2.07	0.89	<0.50
Total Organic Carbon	mg/L				-	2.25	1.38	<0.50
Dissolved Metals					-			
Dissolved Metals Filtration Location	-				-	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	**0.5**			-	0.0030	<0.0020	<0.0030
Antimony (Sb)-Dissolved	mg/L		0.2		-	<0.00010	<0.00020	<0.00010
Arsenic (As)-Dissolved	mg/L		0.1		-	0.00016	0.00073	<0.00010
Barium (Ba)-Dissolved	mg/L		10		-	0.0334	0.0171	<0.000050
Beryllium (Be)-Dissolved	mg/L		0.05		-	<0.00010	<0.00020	<0.00010
Bismuth (Bi)-Dissolved	mg/L				-	<0.00050	<0.0010	<0.00050
Boron (B)-Dissolved	mg/L		50		-	0.183	1.98	<0.010
Cadmium (Cd)-Dissolved	mg/L		0.00030	H	-	<0.000010	<0.000020	<0.000010
Calcium (Ca)-Dissolved	mg/L				-	123	333	<0.050
Chromium (Cr)-Dissolved	mg/L		0.010	V	-	<0.00010	<0.00020	<0.00010
Cobalt (Co)-Dissolved	mg/L		0.040		-	<0.00010	0.00200	<0.00010
Copper (Cu)-Dissolved	mg/L	**0.02**	0.02 [1]	H	-	0.00106	<0.00040	<0.00050
Iron (Fe)-Dissolved	mg/L	**0.5**			-	<0.010	**2.14**	<0.030
Lead (Pb)-Dissolved	mg/L	**0.05**	0.04 [1]	H	-	<0.000050	<0.00010	<0.000050
Lithium (Li)-Dissolved	mg/L				-	0.00857	0.0182	<0.00050
Magnesium (Mg)-Dissolved	mg/L				-	12.9	32.6	<0.10
Manganese (Mn)-Dissolved	mg/L				-	0.00249	0.199	<0.000050
Mercury (Hg)-Dissolved	mg/L		0.0010		-	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L		10		-	0.000060	0.00038	<0.000050
Nickel (Ni)-Dissolved	mg/L		0.25 [1]	H	-	0.00093	0.0035	<0.00050
Phosphorus (P)-Dissolved	mg/L	**0.03**			-	<0.050	<0.050	<0.30
Potassium (K)-Dissolved	mg/L				-	1.40	4.69	<2.0
Selenium (Se)-Dissolved	mg/L		0.0100		-	<0.00010	<0.00020	<0.00010
Silicon (Si)-Dissolved	mg/L				-	3.37	2.65	<0.050
Silver (Ag)-Dissolved	mg/L		0.0005 [1]	H	-	<0.000010	<0.000020	<0.000010
Sodium (Na)-Dissolved	mg/L				-	30.0	485	<2.0
Strontium (Sr)-Dissolved	mg/L				-	0.882	3.83	<0.00020
Sulphur(S)-Dissolved					-	96.6	548	
Thallium (Tl)-Dissolved	mg/L		0.0030		-	<0.000010	<0.000020	<0.000010
Tin (Sn)-Dissolved	mg/L				-	<0.00010	<0.00020	<0.00010
Titanium (Ti)-Dissolved	mg/L		1		-	<0.010	<0.020	<0.010
Uranium (U)-Dissolved	mg/L		3		-	0.000021	0.000197	<0.000010
Vanadium (V)-Dissolved	mg/L				-	<0.0010	<0.0020	<0.0010
Zinc (Zn)-Dissolved	mg/L	**0.2**	0.075 [1]	P, H	-	0.0013	0.0022	<0.0030
Total Metals					-			
Aluminum (Al)-Total	mg/L				-	0.0135	0.110	<0.0030
Antimony (Sb)-Total	mg/L				-	<0.00010	<0.00020	<0.00010
Arsenic (As)-Total	mg/L				-	0.00035	0.00077	<0.00010
Barium (Ba)-Total	mg/L				-	0.0338	0.0191	<0.000050
Beryllium (Be)-Total	mg/L				-	<0.00010	<0.00020	<0.00010
Bismuth (Bi)-Total	mg/L				-	<0.00050	<0.0010	<0.00050
Boron (B)-Total	mg/L				-	0.203	2.07	<0.010
Cadmium (Cd)-Total	mg/L				-	<0.000010	<0.000020	<0.000010
Calcium (Ca)-Total	mg/L				-	124	326	<0.050
Chromium (Cr)-Total	mg/L				-	0.00012	0.00032	<0.00010
Cobalt (Co)-Total	mg/L				-	<0.00010	0.00214	<0.00010
Copper (Cu)-Total	mg/L				-	0.00137	0.0013	<0.00050
Iron (Fe)-Total	mg/L				-	0.049	2.51	<0.030
Lead (Pb)-Total	mg/L				-	0.000063	0.00011	<0.000050
Lithium (Li)-Total	mg/L				-	0.00906	0.0189	<0.00050
Magnesium (Mg)-Total	mg/L				-	13.3	32.7	<0.10
Manganese (Mn)-Total	mg/L				-	0.00421	0.205	<0.000050
Mercury (Hg)-Total	mg/L				-	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L				-	0.000075	0.00038	<0.000050
Nickel (Ni)-Total	mg/L				-	0.00097	0.0038	<0.00050
Phosphorus (P)-Total	mg/L				-	<0.050	<0.050	<0.30
Potassium (K)-Total	mg/L				-	1.48	4.66	<2.0
Selenium (Se)-Total	mg/L				-	<0.00010	<0.00020	<0.00010
Silicon (Si)-Total	mg/L				-	3.48	2.87	<0.050
Silver (Ag)-Total	mg/L				-	<0.000010	<0.000020	<0.000010
Sodium (Na)-Total	mg/L				-	32.7	496	<2.0
Strontium (Sr)-Total	mg/L				-	0.908	3.88	<0.00020
Sulphur (S)- Total	mg/L				-	101	572	
Thallium (Tl)-Total	mg/L				-	<0.000010	<0.000020	<0.000010
Tin (Sn)-Total	mg/L				-	0.00019	<0.00020	<0.00010
Titanium (Ti)-Total	mg/L				-	<0.010	<0.020	<0.010
Uranium (U)-Total	mg/L				-	0.000022	0.000194	<0.000010
Vanadium (V)-Total	mg/L				-	<0.0010	<0.0020	<0.0010
Zinc (Zn)-Total	mg/L				-	<0.0030	<0.0060	<0.0030

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.
2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011).

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Bold and boxed numbers exceed the most stringent permit (PE-07008) criteria for the North and South Coal mining operations.
Permit criterion for total iron and zinc is 0.3 mg/L and 0.1 mg/L in the North coal mining operation and 0.5 mg/L and 0.2 mg/L, respectively in the South coal mining operation.
Shaded and boxed numbers exceed the CSR Freshwater Aquatic Life (AW) Standard (2010).
Italics indicate the laboratory detection limit is set higher than the MoE permit requirement.
H = standard is hardness dependant.
V = standard is valence dependant.
Cl = guideline is chloride dependant.
P = Refers to Protocol 10; Contaminated Sites, Hardness Dependant Site Specific Water Quality Standards for Cadmium and Zinc.
Cl = guideline is chloride dependant.
P = Refers to Protocol 10; Contaminated Sites, Hardness Dependant Site Specific Water Quality Standards for Cadmium and Zinc.

Table 4: 4th Quarter Groundwater Chemical Analyses - 2 North, 3 South Area, Quinsam Mine

RESULTS OF ANALYSIS Sample ID Date Sampled ALS Sample ID		BC MoE Permit PE-07008[1]	CSR Standards Freshwater Aquatic Life (AW) [2]	CSR Notes	MW00-3 13-Feb-13	MW00-2 13-Feb-13 L1269662-1	MW00-1 D 14-Feb-13 L1269662-4	MW00-1S 22-Feb-13 L1272006-1	MW00-6 S 1-Mar-13 L1274695-1	MW00-6 D 14-Feb-13 L1269662-3
Physical Tests					Insufficient water to sample					
pH					-	6.5	**9.47**	6.3	7.14	**8.73**
Temp	oC				-	9.66	6.87	7.16	8.73	7.55
Specific Conductivity	uS/cm				-	2250	0.262	1745	1712.3	172
DO	mg/L					0	-	0	-	-
DO	%				-	0	2.5	-	3.5	1.75
ORP	mV				-	-8.23	63.2	137.13	206.53	-0.9
Total Alkalinity	mg/L CaCO3				-	273	99	387	267	120
					-					
Physical Tests										
Conductivity	uS/cm				-	2220	232	1870	1830	0178
Hardness (as CaCO3)	mg/L				-	1240	021	0935	0656	0047
pH	pH	**6.0 - 8.5**				7.82	9.01 P	7.47	8.13	8.48
Total Suspended Solids	mg/L	**25**			-	<3.0	119 P	<3.0	5.2	<3.0
Total Dissolved Solids	mg/L				-	1980	262	1590	1440	0082
Turbidity	NTU				-	3.9	648.00	0.91	01.1	0.80
Anions and Nutrients					-					
Acidity (as CaCO3)	mg/L				-	11.0	<1.0	29.4	07.2	<1.0
Alkalinity, Total (as CaCO3)	mg/L				-	236	092	379	261	089
Ammonia, Total (as N)	mg/L	**1.0**	11.3 [h]		-	0.1020	0.0200	0.0271	0.006	0.0100
Bromide (Br)	mg/L				-	<1.0	<0.050	<1.0	<1.0	<0.050
Chloride (Cl)	mg/L		1,500		-	<10	0.67	<10	<10	<0.50
Fluoride (F)	mg/L		2 [i]	P, H	-	<0.40	0.14	<0.40	<0.40	0.111
Nitrate (as N)	mg/L		400		-	0.11	0.011	<0.10	0.72	<0.0050
Nitrite (as N)	mg/L		0.2 [j]	Cl	-	0.024	<0.0010	<0.020	<0.020	<0.0010
Total Kjeldahl Nitrogen	mg/L				-					
Total Nitrogen	mg/L				-	0.099	0.210	0.069	0.624	0.063
Orthophosphate-Dissolved (as P)	mg/L				-					
Phosphorus (P)-Total Dissolved	mg/L	**0.03**			-	<0.0020	0.128	<0.0020	0.051	0.164
Phosphorus (P)-Total	mg/L				-	<0.0020	0.619	<0.0020	0.0522	0.164
Sulfate (SO4)	mg/L		1,000		-	**1250 CSR**	28.8	838.0	842	13.1
Sulphide as S	mg/L		0.02		-	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
					-					
Organic / Inorganic Carbon					-					
Dissolved Organic Carbon	mg/L				-	1.38	2.76	3.45	2.1	1.2
Total Organic Carbon	mg/L				-	1.21	4.88	3.4	2.07	1.01
Dissolved Metals					-					
Dissolved Metals Filtration Location	-				-	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	**0.5**			-	<0.0020	0.0426	<0.0010	0.0014	0.0175
Antimony (Sb)-Dissolved	mg/L		0.2		-	<0.00020	<0.00020	<0.00010	0.00026	<0.00010
Arsenic (As)-Dissolved	mg/L		0.1		-	0.00022	0.019	0.00015	0.00121	0.0268
Barium (Ba)-Dissolved	mg/L		10		-	0.0218	0.0033	0.0147	0.0335	0.00986
Beryllium (Be)-Dissolved	mg/L		0.05		-	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L				-	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L		50		-	0.4480	0.0690	0.3740	0.2730	0.0520
Cadmium (Cd)-Dissolved	mg/L		0.00030	H	-	<0.000020	<0.000020	0.000025	0.000018	<0.000010
Calcium (Ca)-Dissolved	mg/L				-	426	8.34	289	222	18
Chromium (Cr)-Dissolved	mg/L		0.010	V	-	<0.00020	<0.00020	<0.00010	0.00	<0.00010
Cobalt (Co)-Dissolved	mg/L		0.040		-	0.00644	<0.00020	0.000980	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	**0.02**	0.02 [i]	H	-	<0.00040	000	000	000	000
Iron (Fe)-Dissolved	mg/L	**0.5**			-	0.881 (P)	<0.010	0.204	<0.010	<0.010
Lead (Pb)-Dissolved	mg/L	**0.05**	0.04 [i]	H	-	<0.00010	<0.00010	0.00005	0.00017	<0.000050
Lithium (Li)-Dissolved	mg/L				-	0.0095	<0.0010	<0.00050	<0.00050	<0.00050
Magnesium (Mg)-Dissolved	mg/L				-	43.900	0.12	51.9	24.70	0.610
Manganese (Mn)-Dissolved	mg/L				-	2.78	0.00021	0.926	0.0176	0.000338
Mercury (Hg)-Dissolved	mg/L		0.0010		-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L		10		-	00.0	00.0	00.0	00.0	00.0
Nickel (Ni)-Dissolved	mg/L		0.25 [i]	H	-	0.00	<0.0010	0.001	0.001	<0.00050
Phosphorus (P)-Dissolved	mg/L	**0.03**			-	<0.050	**0.145**	<0.050	0.05 (P)	0.153 (P)
Potassium (K)-Dissolved	mg/L				-	4.13000	0.620000	2.47000	2.89000	0.72000
Selenium (Se)-Dissolved	mg/L		0.0100		-	<0.00020	<0.00020	<0.00010	0.0004	<0.00010
Silicon (Si)-Dissolved	mg/L				-	2.82	2.41	7.88	5.47	3.25
Silver (Ag)-Dissolved	mg/L		0.0005 [i]	H	-	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L				-	105	45.2	108	188	20.4
Strontium (Sr)-Dissolved	mg/L				-	2.90	0.03	1.43	1.20	0.08
Sulphur(S)-Dissolved					-	386	9.16	244	262	4.37
Thallium (Tl)-Dissolved	mg/L		0.0030		-	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved	mg/L				-	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L		1		-	<0.020	<0.020	<0.010	<0.010	<0.010
Uranium (U)-Dissolved	mg/L		3		-	0.000419	0.000773	0.00285	0.00796	0.000782
Vanadium (V)-Dissolved	mg/L				-	<0.0020	0.0113	<0.0010	0.0011	0.0047
Zinc (Zn)-Dissolved	mg/L	**0.2**	0.075 [i]	P, H	-	<0.0020	<0.0020	<0.0010	0.0014	<0.0010
					-					
Total Metals					-					
Aluminum (Al)-Total	mg/L				-	<0.0060	37.60	<0.0030	0.04	0.05
Antimony (Sb)-Total	mg/L				-	<0.00020	<0.00020	<0.00010	0.00045	<0.00010
Arsenic (As)-Total	mg/L				-	0.00033	0.0294	0.00017	0.00127	0.0282
Barium (Ba)-Total	mg/L				-	0.0224	0.2290	0.0154	0.035	0.0108
Beryllium (Be)-Total	mg/L				-	<0.00020	0.00033	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L				-	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050
Boron (B)-Total	mg/L				-	0.4500	0.0750	0.3900	0.2990	0.0570
Cadmium (Cd)-Total	mg/L				-	<0.000020	0.000396	0.000025	0.000023	<0.000010
Calcium (Ca)-Total	mg/L				-	432	22.4	287	223	18.6
Chromium (Cr)-Total	mg/L				-	<0.00020	0.026	<0.00010	0.00	0.000
Cobalt (Co)-Total	mg/L				-	0.00669	0.020100	0.000990	0.00013	<0.00010
Copper (Cu)-Total	mg/L				-	<0.0010	000	000	000	000
Iron (Fe)-Total	mg/L				-	0.933	36.30000	0.203	0.051	0.043
Lead (Pb)-Total	mg/L				-	<0.00010	0.00490	<0.000050	0.00006	0.00006
Lithium (Li)-Total	mg/L				-	0.0098	0.00690	<0.00050	0.00056	<0.00050
Magnesium (Mg)-Total	mg/L				-	40.700	14.600	57.3	25.10	0.640
Manganese (Mn)-Total	mg/L				-	2.87	0.83	0.93	0.0226	0.00185
Mercury (Hg)-Total	mg/L				-	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L				-	00.0	00.0	00.0	00.0	00.0
Nickel (Ni)-Total	mg/L				-	0.00	0.0278	0.001	0.001	<0.00050
Phosphorus (P)-Total	mg/L				-	<0.050	0.491	<0.050	0.058	0.149
Potassium (K)-Total	mg/L				-	4.14000	3.000000	2.49000	3.06000	0.75000
Selenium (Se)-Total	mg/L				-	<0.00020	0.00034	<0.00010	0.0004	<0.00010
Silicon (Si)-Total	mg/L				-	2.91	52.2	7.99	5.71	3.41
Silver (Ag)-Total	mg/L				-	<0.000020	0.000096	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	mg/L				-	108	49.3	116	192	21.4
Strontium (Sr)-Total	mg/L				-	2.94	0.14	1.49	1.25	0.09
Sulphur (S)- Total	mg/L				-	377	9.42	269	266	4.46
Thallium (Tl)-Total	mg/L				-	<0.000020	00.0	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	mg/L				-	<0.00020	0.001	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L				-	<0.020	2.550	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L				-	0.000442	0.00129	0.00303	0.00833	0.00078
Vanadium (V)-Total	mg/L				-	<0.0020	0.11500	<0.0010	0.0015	0.0051
Zinc (Zn)-Total	mg/L					<0.0060	0.0876	<0.0030	<0.0030	0.0033

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.
2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011).

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.

< = Less than the detection limit indicated.

Bold and boxed numbers exceed the most stringent permit (PE-07008) criteria for the North and South Coal mining operations.

Permit criterion for total iron and zinc is 0.3 mg/L and 0.1 mg/L in the North coal mining operation and 0.5 mg/L and 0.2 mg/L, respectively in the South coal mining operation.

Shaded and boxed numbers exceed the CSR Freshwater Aquatic Life (AW) Standard (2010).

Italics indicate the laboratory detection limit is set higher than the MoE permit requirement.

H = standard is hardness dependant.

V = standard is valence dependant.

Cl = guideline is chloride dependant.

P = Refers to Protocol 10; Contaminated Sites, Hardness Dependant Site Specific Water Quality Standards for Cadmium and Zinc.

Cl = guideline is chloride dependant.

P = Refers to Protocol 10; Contaminated Sites, Hardness Dependant Site Specific Water Quality Standards for Cadmium and Zinc.

Table 5: 1st Quarter QA/QC Groundwater Chemical Analyses - 2 North, 3 South Area, Quinsam Mine

Location	**BC MoE Permit PE-07008**[1]	CSR Standards Freshwater Aquatic Life (AW) [2]	CSR Notes	MW00-5	MW00-5	RPD%
Date Sampled				27-Apr-12	27-Apr-12	[Absolute Difference]
Sample Control Number				0405-02	0405-03	
QA/QC					field replicate	
Physical Tests						
Hardness (mg/L as $CaCO_3$)				1,070	1,080	0.9%
Dissolved Anions						
Bromide				<1.0	<1.0	NC
Chloride		1,500		<10	<10	NC
Fluoride		2-3	H	<0.40	<0.40	NC
Sulphate		1,000		1,910	1,900	0.5%
Dissolved Metals						
Aluminum	**0.5**			<0.025	<0.025	NC
Antimony		0.2		<0.0025	<0.0025	NC
Arsenic		0.05		<0.0025	<0.0025	NC
Barium		10		<0.020	<0.020	NC
Beryllium		0.053		<0.0050	<0.0050	NC
Bismuth				<0.20	<0.20	NC
Boron		50		1.90	1.90	0.0%
Cadmium		0.0001-0.0013	P,H	<0.000085	<0.000085	NC
Calcium				372	375	0.8%
Chromium		0.01^{VI}, 0.09^{III}	V	<0.0050	<0.0050	NC
Cobalt		0.04		0.0015	0.0016	[0.0001]
Copper	**0.02**	0.02-0.09	H	<0.0050	<0.0050	NC
Iron	**0.3 / 0.5**			<0.030	<0.030	NC
Lead	**0.05**	0.04-0.16	H	<0.0025	<0.0025	NC
Lithium				0.026	0.025	[0.001]
Magnesium				35.3	35.3	0.0%
Manganese				0.194	0.195	0.5%
Mercury		0.001		<0.000010	<0.000010	NC
Molybdenum		10		<0.0050	<0.0050	NC
Nickel		0.25-1.5	H	0.0059	0.0060	[0.0001]
Phosphorous	**0.03**			*<0.30*	*<0.30*	NC
Potassium				4.8	4.8	0.0%
Selenium		0.01		<0.0050	<0.0050	NC
Silicon				2.35	2.37	0.8%
Silver		0.0005-0.015	H	<0.00010	<0.00010	NC
Sodium				530	533	0.6%
Strontium				4.39	4.42	0.7%
Thallium		0.003		<0.0010	<0.0010	NC
Tin				<0.0025	0.0034	NC
Titanium		1		<0.050	<0.050	NC
Uranium		3		<0.0010	<0.0010	NC
Vanadium				<0.0050	<0.0050	NC
Zinc	**0.1**	0.075-2.4	P,H	<0.0050	<0.0050	NC
Nutrients						
Nitrate Nitrogen		400		<0.10	<0.10	NC
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)		<0.020	<0.020	NC

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.
2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011).

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Bold and boxed numbers exceed the most stringent permit (PE-07008) criteria for the North and South Coal mining operations.
Permit criterion for total iron is 0.3 mg/L in the North coal mining operation and 0.5 mg/L in the South coal mining operation.
Shaded and boxed numbers exceed the CSR Freshwater Aquatic Life (AW) Standard (2010).
Italics indicate the laboratory detection limit is set higher than the MoE permit requirement.
H = standard is hardness dependant.
V = standard is valence dependant.
P = Refers to Protocol 10; Contaminated Sites, Hardness Dependant Site Specific Water Quality Standards for Cadmium and Zinc.
Bold relative percent difference (RPD) or [Absolute Difference] results indicate QA/QC limits were exceeded.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = For concentrations below five times the laboratory detection limit, the absolute difference calculation between duplicate samples should be less than two times the laboratory detection limit.

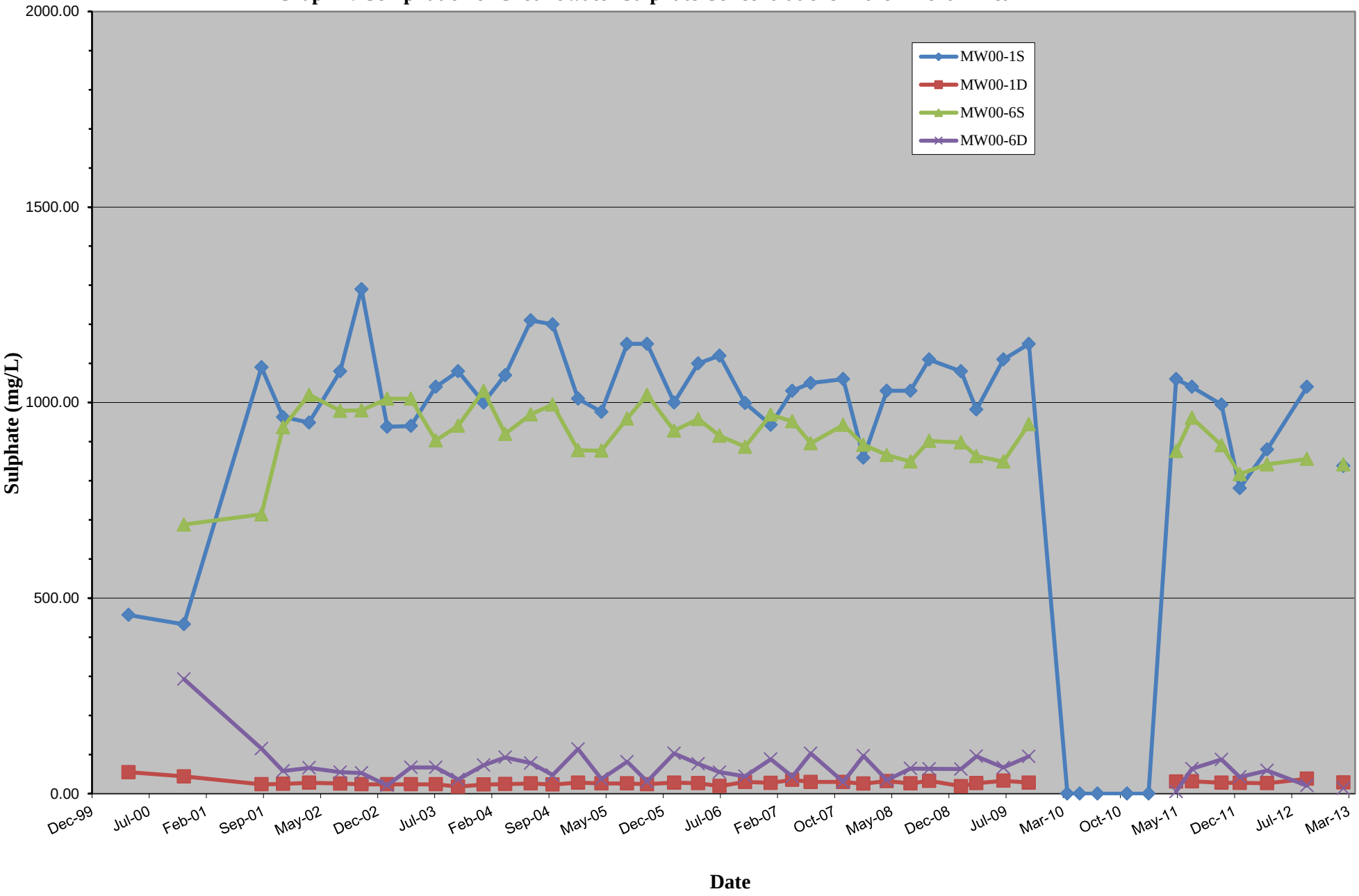
Table 6: 2nd Quarter QA/QC Groundwater Chemical Analyses - 2 North, 3 South Area, Quinsam Mine

RESULTS OF ANALYSIS Sample ID Date Sampled Time Sampled ALS Sample ID Matrix		Detection Limit	5xDL	2xDL	MW00-2 01-OCT-12 19:30 L1219469-1 Water	MW00-2-FD PW1 01-OCT-12 16:00 L1219469-2 Water	Results within 5xDL	Difference <2XDL	RPD %
Field Parameters	Units								
pH					6.59				
Temp	oC				13.57				
Specific Conductivity	uS/cm				2113				
DO	mg/L				0.24				
ORP	mV				36.9				
Total Alkalinity	mg/L CaCO3				225				
Physical Tests									
Conductivity	uS/cm	2	10	4	2040	2030			0.004914005
Hardness (as CaCO3)	mg/L	0.5	2.5	1	1170	1190			0.016949153
pH	pH	0.1	0.5	0.2	7.92	7.92			0
Total Suspended Solids	mg/L	3	15	6	<3.0	<3.0			
Total Dissolved Solids	mg/L	30	150	60	1640	1710			0.041791045
Turbidity	NTU	0.1	0.5	0.2	1	0.88			0.127659574
Anions and Nutrients									
Acidity (as CaCO3)	mg/L	1	5	2	9.5	10.1			0.06122449
Alkalinity, Total (as CaCO3)	mg/L	2	10	4	211	211			0
Ammonia, Total (as N)	mg/L	0.005	0.025	0.01	0.0749	0.0563			0.283536585
Bromide (Br)	mg/L	1	5	2	<1.0	<1.0			
Chloride (Cl)	mg/L	10	50	20	<10	<10			
Fluoride (F)	mg/L	0.4	2	0.8	<0.40	<0.40			
Nitrate (as N)	mg/L	0.1	0.5	0.2	0.1	<0.10	TRUE		
Nitrite (as N)	mg/L	0.02	0.1	0.04	0.03	0.021	TRUE	TRUE	
Total Kjeldahl Nitrogen	mg/L		0	0					
Total Nitrogen	mg/L	0.05	0.25	0.1	0.14	0.13	TRUE	TRUE	
Orthophosphate-Dissolved (as P)	mg/L	0.001	0.005	0.002	0.0017	<0.0010	TRUE		
Phosphorus (P)-Total Dissolved	mg/L	0.02	0.1	0.04	<0.020	<0.0020			
Phosphorus (P)-Total	mg/L	0.02	0.1	0.04	<0.020	<0.0020			
Sulfate (SO4)	mg/L	10	50	20	1160	1170			0.008583691
Sulphide as S	mg/L	0.002	0.01	0.004	<0.0020	<0.0020			
Organic / Inorganic Carbon									
Dissolved Organic Carbon	mg/L	0.5	2.5	1	1.84	1.74	TRUE	TRUE	
Total Organic Carbon	mg/L	0.5	2.5	1	1.76	1.7	TRUE	TRUE	
Total Metals									
Aluminum (Al)-Total	mg/L	0.006	0.03	0.012	<0.0060	<0.0060			
Antimony (Sb)-Total	mg/L	0.0002	0.001	0.0004	<0.00020	<0.00020			
Arsenic (As)-Total	mg/L	0.0002	0.001	0.0004	0.00044	0.00057	TRUE	TRUE	
Barium (Ba)-Total	mg/L	0.0001	0.0005	0.0002	0.0469	0.0533			0.127744511
Beryllium (Be)-Total	mg/L	0.0002	0.001	0.0004	<0.00020	<0.00020			
Bismuth (Bi)-Total	mg/L	0.001	0.005	0.002	<0.0010	<0.0010			
Boron (B)-Total	mg/L	0.02	0.1	0.04	0.429	0.449			0.045558087
Cadmium (Cd)-Total	mg/L	0.00002	0.0001	0.00004	<0.000020	<0.000020			
Calcium (Ca)-Total	mg/L	0.05	0.25	0.1	388	386			0.005167959
Chromium (Cr)-Total	mg/L	0.0002	0.001	0.0004	<0.00020	<0.00020			
Cobalt (Co)-Total	mg/L	0.0002	0.001	0.0004	0.00562	0.00529			0.060494959
Copper (Cu)-Total	mg/L	0.001	0.005	0.002	<0.0010	<0.0010			
Iron (Fe)-Total	mg/L	0.03	0.15	0.06	0.466	0.467			0.002143623
Lead (Pb)-Total	mg/L	0.0001	0.0005	0.0002	<0.00010	<0.00010			
Lithium (Li)-Total	mg/L	0.001	0.005	0.002	0.0092	0.0089			0.033149171
Magnesium (Mg)-Total	mg/L	0.1	0.5	0.2	40.5	41.2			0.017135863
Manganese (Mn)-Total	mg/L	0.0001	0.0005	0.0002	2.37	2.29			0.034334764
Mercury (Hg)-Total	mg/L	0.00001	0.00005	0.00002	<0.000010	<0.000010			
Molybdenum (Mo)-Total	mg/L	0.0001	0.0005	0.0002	0.00013	0.00011	TRUE	TRUE	
Nickel (Ni)-Total	mg/L	0.001	0.005	0.002	0.0046	0.0043	TRUE	TRUE	
Phosphorus (P)-Total	mg/L	0.3	1.5	0.6	<0.30	<0.30			
Potassium (K)-Total	mg/L	2	10	4	3.7	3.9	TRUE	TRUE	
Selenium (Se)-Total	mg/L	0.0002	0.001	0.0004	<0.00020	<0.00020			
Silicon (Si)-Total	mg/L	0.05	0.25	0.1	2.7	2.75			0.018348624
Silver (Ag)-Total	mg/L	0.00002	0.0001	0.00004	<0.000020	<0.000020			
Sodium (Na)-Total	mg/L	2	10	4	86.3	88			0.019506598
Strontium (Sr)-Total	mg/L	0.0004	0.002	0.0008	2.57	2.43			0.056
Thallium (Tl)-Total	mg/L	0.00002	0.0001	0.00004	<0.000020	<0.000020			
Tin (Sn)-Total	mg/L	0.0002	0.001	0.0004	<0.00020	<0.00020			
Titanium (Ti)-Total	mg/L	0.01	0.05	0.02	<0.010	<0.010			
Uranium (U)-Total	mg/L	0.00002	0.0001	0.00004	0.000343	0.000327			0.047761194
Vanadium (V)-Total	mg/L	0.002	0.01	0.004	<0.0020	<0.0020			
Zinc (Zn)-Total	mg/L	0.006	0.03	0.012	<0.0060	<0.0060			
Dissolved Metals									
Dissolved Metals Filtration Location	-	-			FIELD	FIELD			
Aluminum (Al)-Dissolved	mg/L	0.006	0.03	0.012	<0.0060	<0.0060			
Antimony (Sb)-Dissolved	mg/L	0.0002	0.001	0.0004	<0.00020	<0.00020			
Arsenic (As)-Dissolved	mg/L	0.0002	0.001	0.0004	0.00027	0.00037	TRUE	TRUE	
Barium (Ba)-Dissolved	mg/L	0.0001	0.0005	0.0002	0.0438	0.0525			0.180685358
Beryllium (Be)-Dissolved	mg/L	0.0002	0.001	0.0004	<0.00020	<0.00020			
Bismuth (Bi)-Dissolved	mg/L	0.001	0.005	0.002	<0.0010	<0.0010			
Boron (B)-Dissolved	mg/L	0.02	0.1	0.04	0.359	0.437			0.195979899
Cadmium (Cd)-Dissolved	mg/L	0.00002	0.0001	0.00004	<0.000020	<0.000020			
Calcium (Ca)-Dissolved	mg/L	0.05	0.25	0.1	401	408			0.017305315
Chromium (Cr)-Dissolved	mg/L	0.0002	0.001	0.0004	<0.00020	<0.00020			
Cobalt (Co)-Dissolved	mg/L	0.0002	0.001	0.0004	0.00548	0.00542			0.011009174
Copper (Cu)-Dissolved	mg/L	0.001	0.005	0.002	<0.0010	<0.0010			
Iron (Fe)-Dissolved	mg/L	0.03	0.15	0.06	0.426	0.438			0.027777778
Lead (Pb)-Dissolved	mg/L	0.0001	0.0005	0.0002	<0.00010	<0.00010			
Lithium (Li)-Dissolved	mg/L	0.001	0.005	0.002	0.008	0.009			0.117647059
Magnesium (Mg)-Dissolved	mg/L	0.1	0.5	0.2	41.2	42.6			0.033412888
Manganese (Mn)-Dissolved	mg/L	0.0001	0.0005	0.0002	2.34	2.3			0.017241379
Mercury (Hg)-Dissolved	mg/L	0.00001	0.00005	0.00002	<0.000010	<0.000010			
Molybdenum (Mo)-Dissolved	mg/L	0.0001	0.0005	0.0002	0.00013	0.00011	TRUE	TRUE	
Nickel (Ni)-Dissolved	mg/L	0.001	0.005	0.002	0.0044	0.0044	TRUE	TRUE	
Phosphorus (P)-Dissolved	mg/L	0.3	1.5	0.6	<0.30	<0.30			
Potassium (K)-Dissolved	mg/L	2	10	4	3.8	4	TRUE	TRUE	
Selenium (Se)-Dissolved	mg/L	0.0002	0.001	0.0004	<0.00020	<0.00020			
Silicon (Si)-Dissolved	mg/L	0.05	0.25	0.1	2.73	2.86			0.046511628
Silver (Ag)-Dissolved	mg/L	0.00002	0.0001	0.00004	<0.000020	<0.000020			
Sodium (Na)-Dissolved	mg/L	2	10	4	88.4	91.3			0.032276016
Strontium (Sr)-Dissolved	mg/L	0.0004	0.002	0.0008	2.65	2.42			0.090729783
Thallium (Tl)-Dissolved	mg/L	0.00002	0.0001	0.00004	<0.000020	<0.000020			
Tin (Sn)-Dissolved	mg/L	0.0002	0.001	0.0004	<0.00020	<0.00020			
Titanium (Ti)-Dissolved	mg/L	0.01	0.05	0.02	<0.010	<0.010			
Uranium (U)-Dissolved	mg/L	0.00002	0.0001	0.00004	0.000349	0.000331			0.052941176
Vanadium (V)-Dissolved	mg/L	0.002	0.01	0.004	<0.0020	<0.0020			
Zinc (Zn)-Dissolved	mg/L	0.006	0.03	0.012	<0.0060	<0.0060			

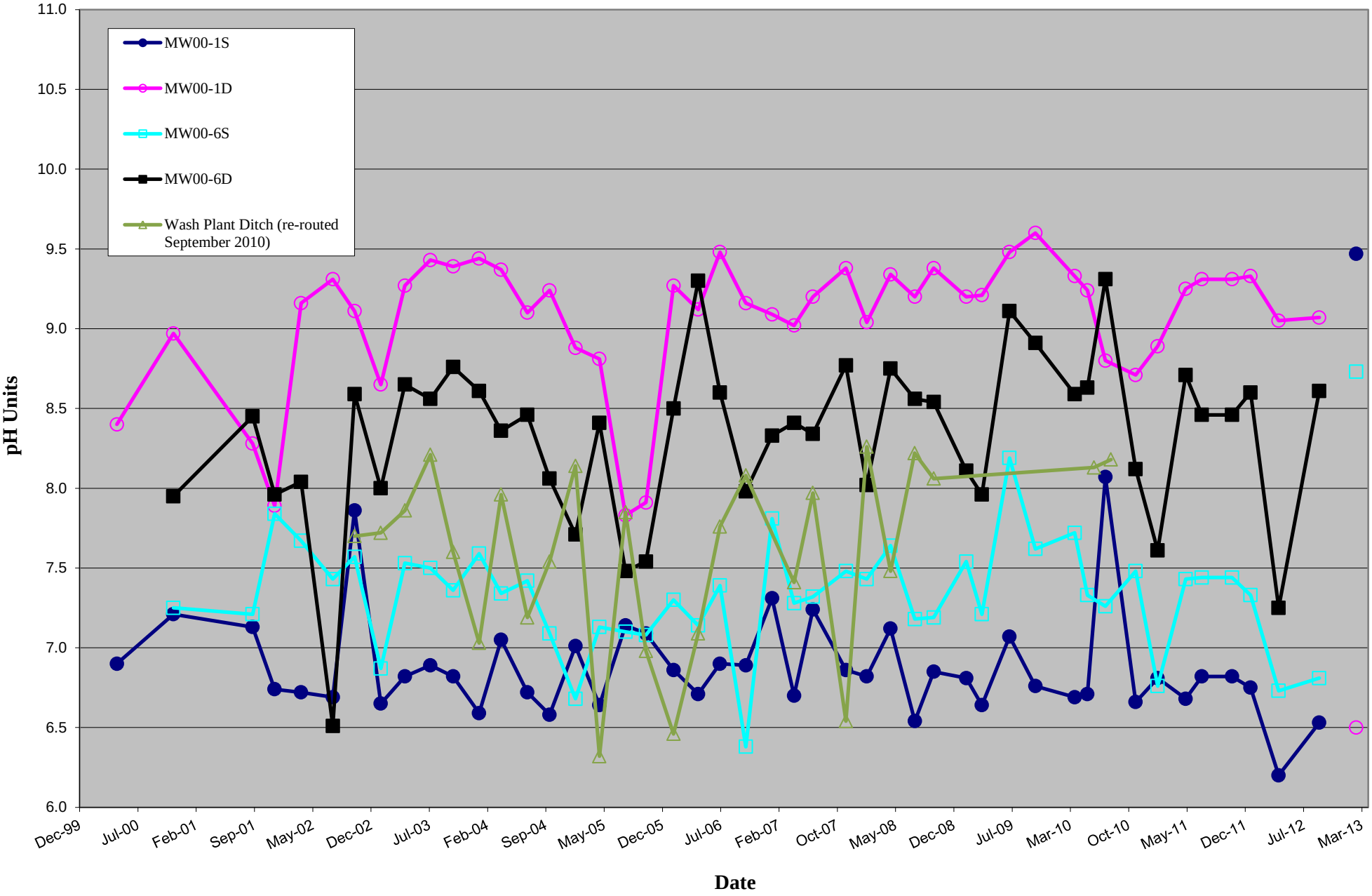
LIST OF GRAPHS

Graph 1	Compilation of Groundwater Sulphate Concentrations in the 2 North Area
Graph 2	Compilation of Field Measured pH in Groundwater in the 2 North Area
Graph 3	Compilation of Groundwater Chloride Concentrations in the 2 North Area
Graph 4	Compilation of Groundwater Sulphate Concentrations in the 3 South Pit
Graph 5	Compilation of Field Measured pH in Groundwater in the 3 South Area
Graph 6	Compilation of Groundwater Chloride Concentrations in the 3 South Area
Graph 7	Compilation of Groundwater Dissolved Iron Concentrations in the 3 South Pit Area

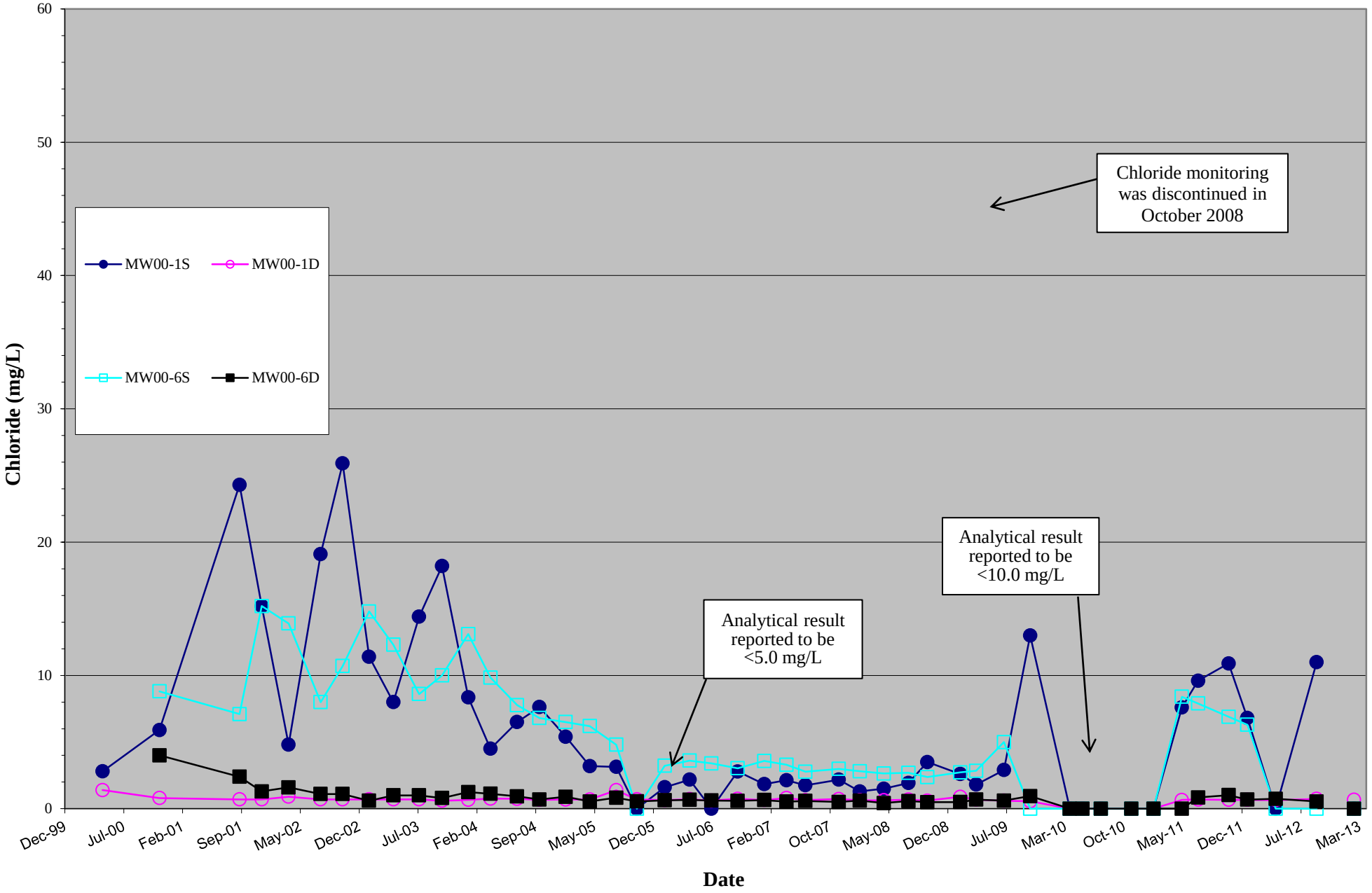
Graph 1: Compilation of Groundwater Sulphate Concentrations in the 2 North Area



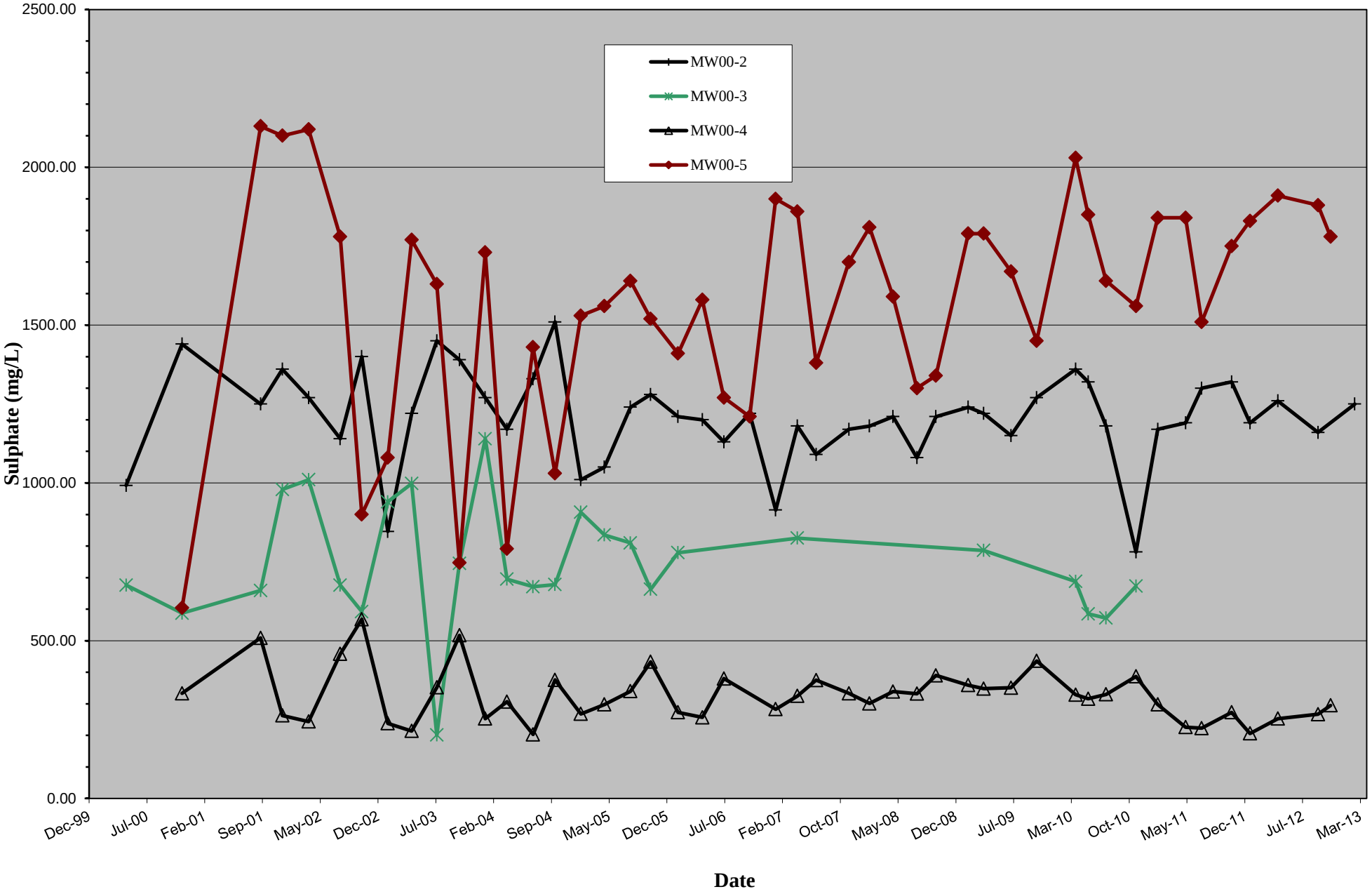
Graph 2: Compilation of Field Measured pH in Groundwater in the 2 North Area



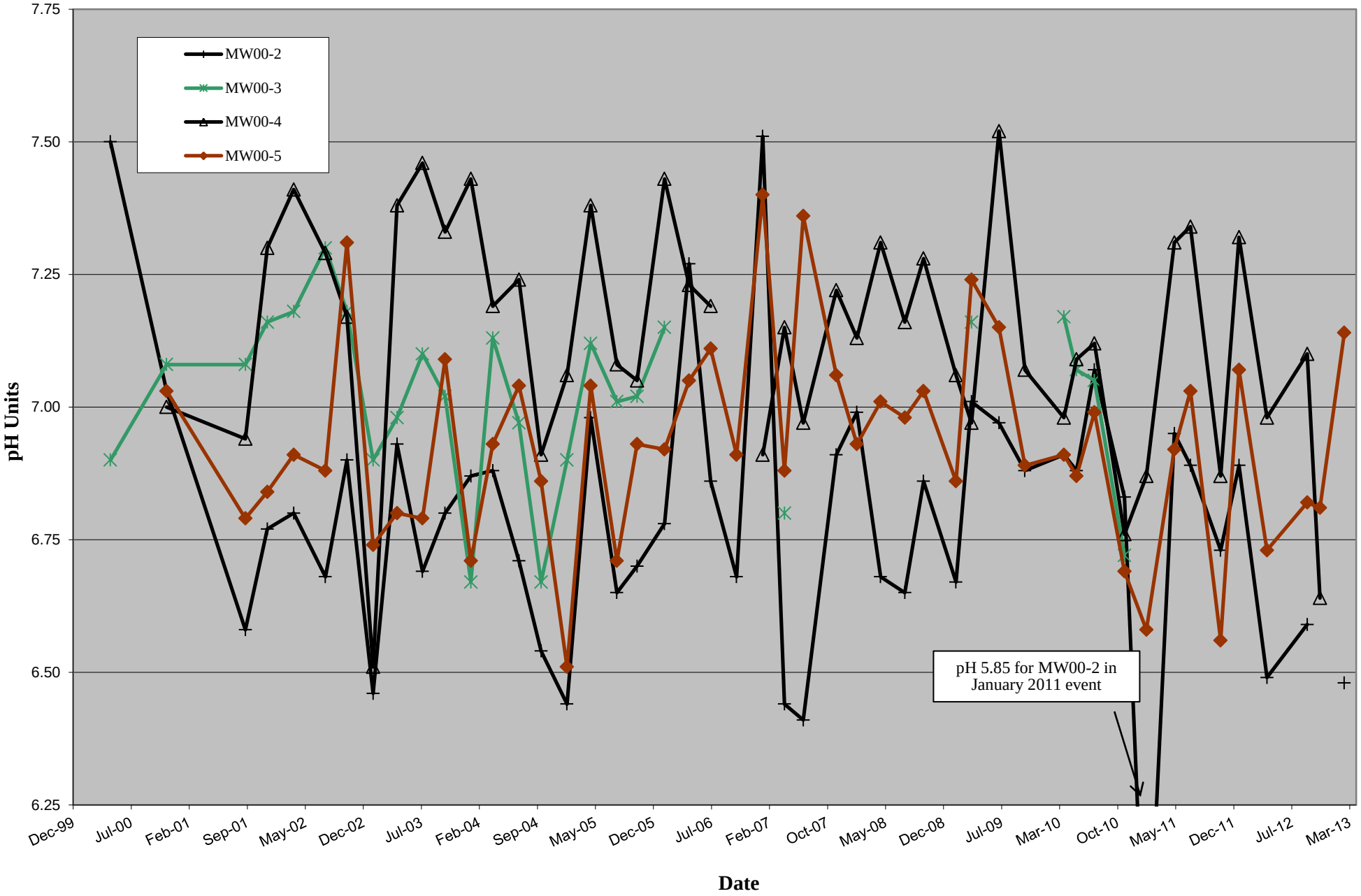
Graph 3: Compilation of Groundwater Chloride Concentrations in the 2 North Area



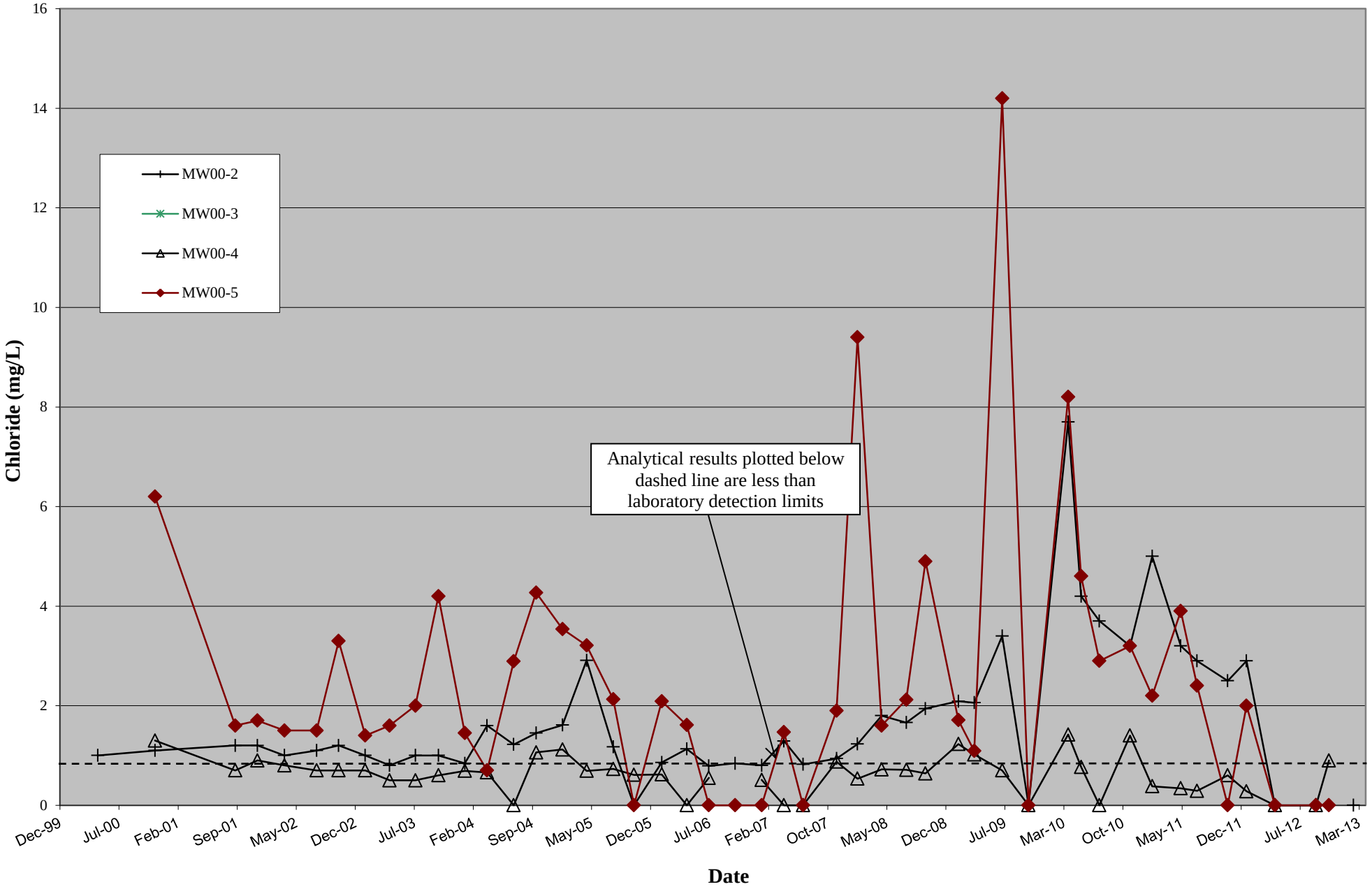
Graph 4: Compilation of Groundwater Sulphate Concentrations in the 3 South Pit Area



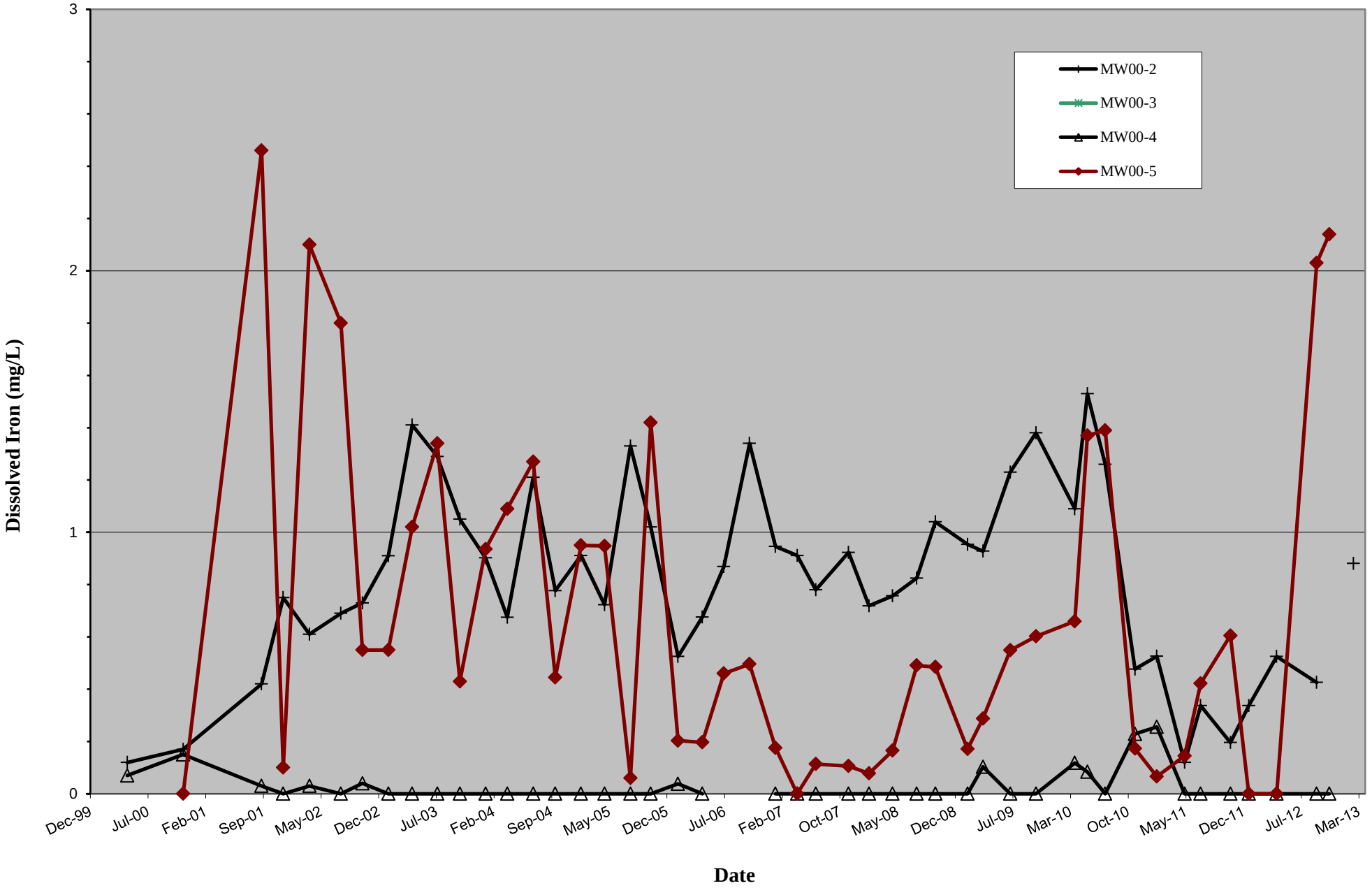
Graph 5: Compilation of Field Measured pH in Groundwater in the 3 South Area



Graph 6: Compilation of Groundwater Chloride Concentrations in the 3 South Area



Graph 7: Compilation of Groundwater Dissolved Iron Concentrations in the 3 South Pit Area



APPENDIX VII

Quinsam Baseline Hydrology Program

MEMORANDUM

To:	**Darren Cowan and Kathleen Russell**	**Date: June 27, 2013**
From:	**Colin Fraser, Lorax Environmental Services Ltd.**	**Project #: J885-8**
Subject:	**Quinsam Baseline Hydrology Program 2012-13**	

1. Introduction

1.1 Quinsam Baseline Hydrology Program: 2012-13 Activities

Lorax Environmental Services Ltd. (Lorax) was retained to maintain and expand the baseline hydrology monitoring program at the Quinsam Coal mine. The scope of work related to hydrology monitoring activities had several objectives, including:

To develop/validate rating curves (*i.e.*, stage-discharge relationships) for hydrometric stations. Rating curves at Quinsam Coal mine have not been validated for a number of years. High quality and recent stage-discharge relations are a necessary input to the computation of robust discharge rates.

To modify existing (and new) hydrometric stations to record stage continuously. Continuous water level recorders increase the resolution of hydrometric data. High discharge and short duration events can only be captured via a continuous water level recorder and these episodic flow events may play an important role in the water and chemical balances of lakes and watercourses near the mine site.

To establish additional hydrometric stations in support of permitting requirements and the long-term mine development plan.

In addition to activities at four existing hydrometric stations, two new hydrometric stations were established. New stations included a flow monitoring station established downstream of the 7S sediment pond, as well as a flow monitoring station established on the Iron River in support of the 7S Area 5 development and application to government.

1.2 Overview of the Technical Memo

This memo provides a summary of hydrology activities and findings since April 5th, 2012. The hydrometric stations are described in Section 2, whereas recent and long-term climate data are presented in Section 3. An understanding of these climate data is required to properly interpret hydrology findings presented in Section 4, Section 5 and Appendices A and B. Appendix A presents a station-by-station summary of rating curves, water level-staff gauge relationships and continuous discharge records estimated for hydrology stations. Appendix B summarizes relevant hydrometric data from a regional analysis of Eastern Vancouver Island (Obedkoff, 2003). Lastly, next steps and recommendations are provided in Section 6.

2. Station Descriptions

The hydrometric stations that formed the focus of this study are presented in Table 1.

Candidate locations for hydrometric stations were first scoped on an April 4-5, 2012 site visit, and site selection continued through to a second site visit which took place July 23-25, 2012. Following reconnaissance and station selection, efforts overall focused on the permanent installation of stilling wells and staff gauges, deploying instrumentation and developing rating curves for the hydrometric stations.

Hydrometric stations are described below briefly:

Long Lake Outlet (LLO) – On July 25th, 2012, a stilling well, pressure transducer and two staff gauges were installed a short distance downstream of the historic LLO hydrometric station. The rationale for locating the new station downstream from the old was several-fold: 1) the occurrence of bedrock outcrops well suited for attaching station instruments and hardware; 2) a deep and well defined channel at the location; and 3) easy access from the main haul road.

At LLO, discharge measurements are currently being inferred from continuous measurements of stage and a stage-discharge relationship (*i.e.*, rating curve). Continuous measurements of stage are being recorded with a Solinst 0-5 m pressure transducer and pressure transducer measurements are barometrically compensated by means of an atmospheric pressure record collected at the mine office. To minimize disturbance to the pressure transducer, it is housed in a perforated and well protected stilling well and accessed by a direct-read cable. Spot measurements of stage and flow were collected at LLO over the past year to develop the rating curve for the station. The rating curve is used to estimate discharge for the hydrometric station at half hour intervals.

Long Lake Seep (LLS) – A large rectangular weir was installed at LLS in 2010 and monthly measurements of stage have been recorded at this location for a number of years. To compliment these past efforts, a water level recorder, temperature sensor and pH sensor were installed at the main weir (LLSM) on April 5th, 2012. Data is presently being recorded at hourly interval with the most recent data download being current to February 7th, 2013.

Hourly data from the three sensors are recorded by a 7-Channel GlobalWater datalogger. At LLS, continuous measurements of stage from the water level recorder are used to estimate discharge using the Francis equation:

$$Q = 1.84 \cdot B \cdot H^{3/2}$$

Q = discharge in m^3/s

B = the length of weir in m (0.61 m) and

H = the head on the weir in m and measured upstream of the notch in the weir.

Long Lake Culvert (LLE) – Discharges from this culvert are a mix of waters from the south mine area including: Settling Pond # 1; 2 and 3 South Pits; more recently the Long Lake Seep Passive Treatment System and overland flow from the surrounding areas; and natural drainage including flows emanating from a meadow of interconnected wetlands. Stage measurements have been recorded at the downstream end of the LLE culvert since July 5, 2010. A pressure transducer was added to this station in July 2012 to measure stages continuously.

Estimates of discharge at the LLE hydrometric station were computed from first principles using the Manning equation:

$$Q = (1/n)\cdot(A\cdot R^{2/3}S^{1/2})$$

Q = discharge, m^3/s

n = Manning's roughness coefficient

A = cross-sectional area of flow, m

R = hydraulic radius, m

SO = slope, metre of vertical drop per metre of horizontal distance (dimensionless)

The culvert was assumed to have a diameter of 0.9144 m and a Manning n of 0.024 (*i.e.*, idealized value for a corrugated metal culvert). Measured discharges from the culvert equated well to idealized culvert flows which assumed a slope of 1.1% (*i.e.*, a fall of 0.18 m over 16.4 m length), therefore this slope value was carried forward in discharge calculations. This idealized rating curve was verified with field measurements over the past year.

Middle Quinsam Lake Outlet (WB) – A hydrometric station was installed at WB on September 14, 2012. The station setup is comprised of a stilling well, Solinst 0-5 m pressure transducer and two staff gauges. The overall approach to estimating discharge at WB is generally similar to that which is employed at LLO (*i.e.*, continuous measurements of stage; rating curve), noting though that discharges at WB are approximated by the arithmetic sum of corresponding discharge measurements at LLO (18.2 km^2 drainage) and the Water Survey of Canada hydrometric station operated upstream of Middle Quinsam Lake (84 km^2 drainage). Direct measurements of discharge were also made during three site visits, but flow conditions showed little variation across these dates.

7S Monitoring Station (7S) - A hydrometric station was installed at 7S on July 23, 2012. Like LLO and WB stations, half-hourly estimates of discharge are computed from a continuous record of stage and a rating curve. 7S instrumentation consist of a stilling well, staff gauge and Solinst 0-5 m pressure transducer.

Iron River below 7SArea 5 (IR) - A hydrometric station was installed at IR on July 25, 2012. Like LLO, WB and 7S, half-hourly estimates of discharge are computed from a

continuous record of stage and a rating curve. IR instrumentation consist of a stilling well, staff gauge and Solinst 0-5 m pressure transducer with a direct read cable.

It is notable that drainage areas reporting to these six hydrometric stations vary by more than three orders of magnitude (*i.e.*, 0.27 to 111 km^2). Precipitation depths near the mine vary with space and elevation (*e.g.*, more snow accumulation/storage with elevation). Therefore, noted differences in drainage areas and elevations are important to consider when interpreting the hydrology results for these stations (Sections 4 and 5). In general, variability in topography is least in drainages with smallest area (*i.e.*, LLS, LLE and 7S), compared to the three larger drainages (*i.e.*, IR, WB and LLO). By means of example, elevations within the 7S drainage vary between 210 and 320 m asl, whereas elevations in the IR (Iron River) drainage basin range from 200 m to more than 1,200 m asl.

Table 1:
Hydrometric Stations - Quinsam Baseline Hydrology Program 2012-13

Station Name and Symbol	Latitude/ Longitude	Estimated Drainage Area (km^2)
Long Lake Outlet (LLO)	49.921515°N -125.466333°W	18.2
Long Lake Seep (LLS)	49.912934°N -125.475906°W	<0.76
Long Lake Culvert (LLE)	49.918495°N -125.462922°W	2.4
Quinsam River below Middle Quinsam Lake (WB)	49.925807°N -125.467120°W	111
7S Monitoring Station (7S)	49.940348°N -125.443024°W	0.27
Iron River below 7S Area 5 (IR)	49.926789°N -125.431160°W	57

3. Climate Conditions near the Mine Site

Nearest sources of climate data include the weather stations at Campbell River Airport, Upper Campbell River and the mine (*i.e.*, Quinsam Weather Station) (see Table 2). Data for parameters such as precipitation, air temperature, relative humidity, wind speed and atmospheric pressure have been collected at these sites for considerable period of time. In addition to the climate data at these three locations, hourly precipitation data is also collected at the nearby Quinsam River at Argonaut Bridge hydrometric station. Station coordinates for this precipitation gauge are provided in Appendix B.

Table 2:
Weather Data Locations

	Campbell River Airport	Upper Campbell Lake	Quinsam Weather Station
Latitude	49° 57’ 00”	49° 54’ 00”	49° 55’ 51.32”
Longitude	125° 16’ 12”	125° 37’ 48”	125° 28’ 56.91”
Period (daily)	1965-2012	1980-1998	1999-2009
Elevation	106 m	549 m	324 m

Previously, Lorax undertook a study to define precipitation and evaporation for the Quinsam Mine (Lorax, 2009) whereby long-term synthetic time-series of daily temperature, rainfall and total precipitation were generated for Quinsam Mine using local weather station data and long-term data from the nearby Environment Canada weather stations (*i.e.*, Campbell River Airport and Upper Campbell Lake).

Quinsam Mine precipitation was reconstructed for the period of record and determined to be 1,034 mm per annum, a value that is roughly two-thirds of the depths recorded at Campbell River (see Table 3; 1,449 mm). On a monthly basis, precipitation depths are typically greatest in the autumn and winter (*i.e.*, November through April; 150-250 mm/month), but much lower in the summer (June through September; 25-100 mm/month).

Evaporation/evapotranspiration for free-water surfaces, forested and clear cut terrain were estimated to be 858, 466 and 326 mm annually, where highest monthly rates of evaporation coincide with lowest rates of monthly precipitation (Jun-Sep). A description of the methods and data inputs used to compute these estimates are included in Lorax (2009).

3.1 2012 and 2013 Climate Data

Patterns of precipitation for Campbell River and Quinsam River at Argonaut Bridge station are shown in Figure 1. In 2012, total precipitation at Campbell River was 1,644 mm – a value indicative of above average precipitation conditions. Of note, precipitation depths recorded during July, August and September 2012 were well below normal and coincided with warmer than normal temperatures during those months (Figure 2).

Inspection of 2013 precipitation data through to the end of May 2013 is suggestive that values for January, February and March were well below average, but approximately normal for the months of April and May 2013. Precipitation data for 2013 are shown in Figure 3 plotted against normal conditions for Campbell River.

Table 3:
Annual and Monthly Precipitation, Rainfall, and Snow Water Equivalent (SWE) at Quinsam Mine and Campbell River Airport (1965-2009) after Lorax (2009).

	Quinsam Mine Synthetic			Campbell River Airport		
Mon	**Precip. (mm)**	**Rainfall (mm)**	**SWE (mm)**	**Precip. (mm)**	**Rainfall (mm)**	**SWE (mm)**
Jan	143.3	108.2	35.1	202.0	166.4	35.6
Feb	108.1	81.5	26.6	142.2	125.4	16.8
Mar	110.3	83.2	27.1	139.3	127.9	11.4
Apr	54.9	52.8	2.1	82.4	81.2	1.3
May	40.2	40.2	0.0	61.7	61.7	0.0
Jun	35.6	35.6	0.0	54.7	54.7	0.0
Jul	25.1	25.1	0.0	38.6	38.6	0.0
Aug	29.4	29.4	0.0	45.6	44.7	0.9
Sep	38.5	38.5	0.0	59.2	59.2	0.0
Oct	104.8	103.9	0.9	158.5	157.7	0.8
Nov	161.6	137.1	24.5	228.2	214.6	13.6
Dec	182.5	134.0	48.5	236.8	206.1	30.6
Ann.	1,034	869	165	1,449	1,338	111

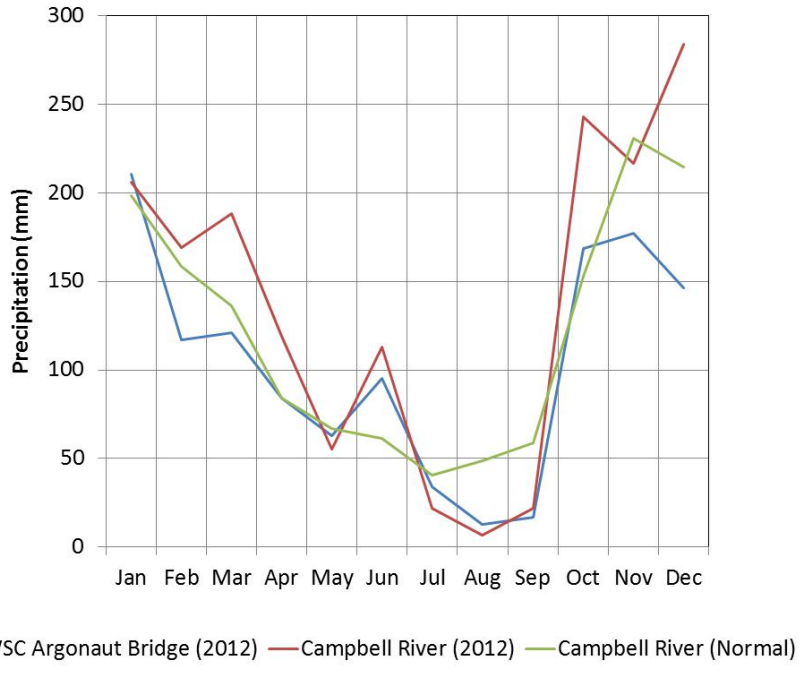


Figure 1: **Comparison of monthly precipitation depths at Campbell River and WSC Argonaut Bridge for 2012 to normal conditions at Campbell River (1971-2000).**

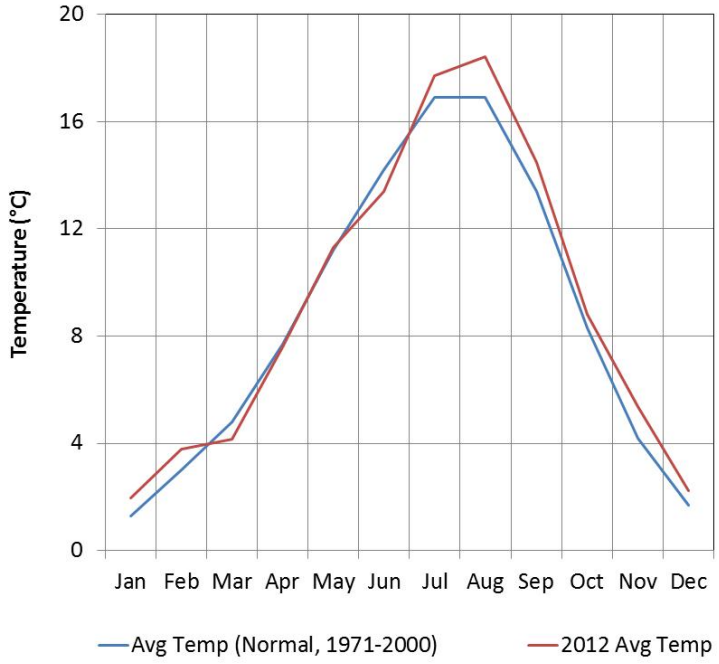


Figure 2: Comparison of monthly air temperature data for Campbell River. In the plot, 2012 data are compared to normal conditions for the station.

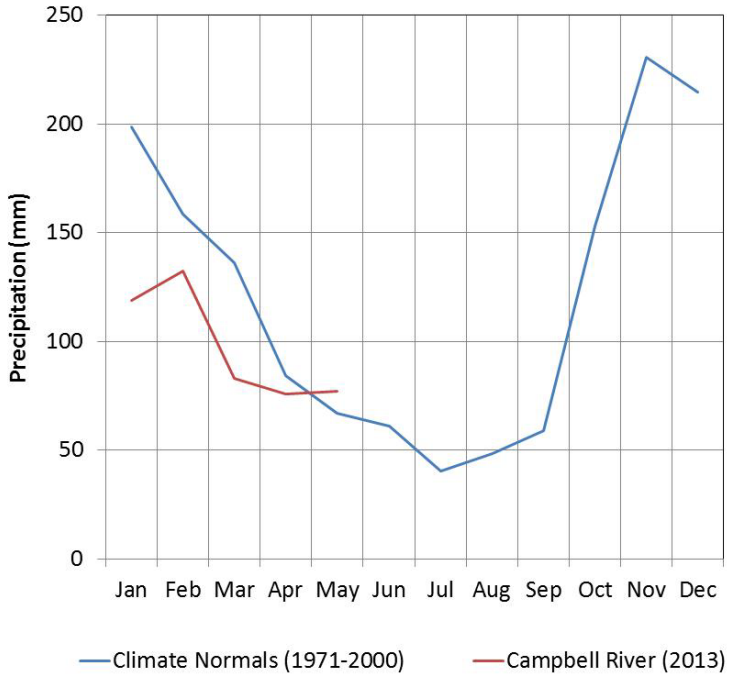


Figure 3: Comparison of monthly precipitation depths at Campbell River to normal conditions at Campbell River (1971-2000).

4. Regional Hydrology

Previous studies and regional hydrometric data are reviewed briefly in this section as they are useful to frame runoff depths and discharge patterns recently measured near the mine site.

A number of relevant hydrometric statistics are reported in Obedkoff (2003). This study aimed to characterize the variability of streamflow parameters through organization of hydrometric and drainage data into sub-regional hydrologic zones showing similarity. The Quinsam Coal Mine is situated in Zone 28 defined by Obedkoff, an elongated hydrological region that encompasses the east portion of Vancouver Island. Figure B1.1 (Appendix B) shows the general location of Water Survey of Canada stations nearest the Quinsam Coal mine and Table B1.1 summarizes pertinent location, drainage area, elevation and period of record data for these stations.

Figure B2.1 is reproduced from the Obedkoff study and shows the Zone 28 relationship between annual runoff and elevation. Mean drainage elevations for LLO and IR were estimated to be 423 and 683 m asl respectively (see Table B1.1), whereas the smaller drainages in the baseline hydrology program (*i.e.*, LLO, LLS and LLE) are positioned at much lower elevation (*i.e.*, 200 to 300 m asl) than these larger drainage basins. The Obedkoff study is suggestive that mean annual runoff depths should range from 500 mm (LLS, LLE, 7S) to ~1,200 mm (IR), with runoff depths for LLO intermediate to these two end points (*i.e.*, 800 mm for an average year).

Geographically, the Oyster River, Quinsam River, Tsolum at Murex are closest to the Quinsam Mine (*i.e.*, within 15 km of the Iron River hydrometric station) and may serve as useful proxies for site hydrology conditions (see Figure B1.1). For much of the year though, the Quinsam River is diverted to the Campbell River watershed for hydro-power purposes, therefore observed runoff depths and flow behaviour (*i.e.*, magnitude, frequency, duration and timing of flows) of the Quinsam River (*e.g.*, at Argonaut Bridge and WB below Middle Quinsam Lake) will differ from the natural flowing watercourses on an adjacent to the Quinsam Coal mine. Mean monthly flow patterns and statistics for Water Survey of Canada stations nearest to the mine are reported in Appendix B3.

5. Key Findings from 2012-13 Baseline Monitoring

Period of record summaries for the six hydrometric stations are presented in detail in Appendix A1 through A6. The general layout of figures and tables presented for each station is essentially the same and includes the following:

Figure An.1: A plot illustrating the correlation between continuous water level measurements and staff gauge observations recorded at the station.

Figure An.2: A plot illustrating the rating relation for the hydrometric station.

Table An.1: Monthly summary of discharge statistics measured at the hydrometric station (*i.e.*, average, maximum and minimum monthly discharges).

Table An.2: Monthly summary of runoff statistics estimated for the hydrometric station for the period of record.

Figure An.3: A plot illustrating patterns in estimated daily discharge for the period of record. Daily precipitation data is shown on the plot on the secondary y-axis.

5.1 LLO

Continuous measurements of stage for the period of record July 25, 2012 to June 6, 2013 correlated very well with spot measurements made at the LLO staff gauge (Figure A1.1).

As shown in Figure A1.2, four rating curve points were collected at LLO over the past year where field measurements of discharge ranged between 0 and 2.0 m^3/s. Average monthly discharges reported for LLO in Table A1.1 were several orders of magnitude higher in the autumn and winter (*e.g.*, 0.43-1.12 m^3/s; November 2012 through March 2013) compared to the summer (*e.g.*, 0-0.19 m^3/s between August and October 2012).

Using a drainage area of 18.2 km^2 for LLO, the discharge values (monthly average, maximum and minimum values) reported in Table A1.1 were converted to runoff depths in mm (see Table A1.2). For the period of record, runoff was estimated to be 698 mm. This runoff amount compared well to expected values based on regional analogues (Section 4; a rough estimate of 800 mm for mean elevation of 423 m asl), noting though that the precipitation for the period of record is below normal.

The LLO discharge record is shown as a time series in Figure A1.3. Careful inspection of this time series shows that for a 3-4 day period (November 29 to December 2, 2012) that coincided with appreciable rainfall, estimates of discharge exceeded those that were used to define the LLO rating curve. The upper/extreme portions of the rating curve may benefit from future field measurements and more validation.

5.2 LLS

Continuous measurements of stage for the period of record April 5, 2012 to February 7th, 2013 correlated very well with spot measurements made at the LLS staff gauge (Figure A2.1).

Like LLO, average monthly discharges reported for LLS (Table A2.1) were several orders of magnitude higher in the autumn and winter (*e.g.*, 0.007-0.019 m^3/s between November 2012 and March 2013) compared to summer 2012 (*e.g.*, observations of no and very low flow between August and October 2012). The highest discharge recorded over the past year was estimated to be 0.039 m^3/s and occurred in April 2012.

The surface drainage that reports to LLS is small (<0.76 km^2 and uncertain). Furthermore, there are several surface seeps near LLS main weir that report to Long Lake – and likely groundwater seepage that reports to the lake. Runoff depths therefore were not computed for this station. The LLS discharge record is shown as a time series in Figure A2.3.

5.3 LLE

Continuous measurements of stage for the period of record Sept 14, 2012 to June 6, 2013 correlated reasonably well with spot measurements of water depth made at the LLE culvert (Figure A3.1). A water level recorder was first deployed at this station in late July 2012. However, the deployed sensor did not function properly and was returned to Solinst for repair under warranty. LLE stages and discharges were very low or negligible during the period of repair.

As shown in Figure A3.2, an idealized rating curve is presented for LLE based on a Manning equation approach. Average monthly discharges reported for LLE are presented in Table A3.1 and these values are converted to runoff depths in mm in Table A3.2. Using a drainage area conservatively estimated to be 2.4 km^2, period of record discharge at LLE was 1,124 mm. This runoff depth was higher than regional analogues and nearby stations (*e.g.*, LLO, 7S discussed in Section 5.5 below), especially so considering below normal precipitation during the period of measurement. The discrepancy can be accounted for by 1) uncertainties in the drainage area estimate; and more importantly 2) the effects of site water management (*i.e.*, pumping and diverting of water) from outside the topographically defined watershed – into it.

The LLE discharge record is shown as a time series in Figure A3.3, and strongly resembles the pattern of discharge seen at LLO. Figure A3.4 shows the correspondence between idealized discharge assumed for LLE culvert and field measurements of discharge recorded since September 2012. To date, there is good agreement between these two approaches, however, it is recommended that the upper/extreme portions of the rating curve continue to be validated with future measurements of discharge (current meter or salt dilution gauging at the culvert or in the stream channel downstream). It is notable that 2012-13 baseline measurements at LLE were outside verified rates of discharge for only 3 or 4 days duration.

5.4 WB

Continuous measurements of stage for the period of record Sept 14, 2012 to June 6, 2013 correlated very well with spot measurements made at the WB staff gauge (Figure A4.1).

It is noted in Section 2 that discharges at WB were approximated by the arithmetic sum of discharges measurements at LLO (18.2 km^2 drainage) and the Water Survey of Canada hydrometric station operated upstream of Middle Quinsam Lake (84 km^2 drainage). As

shown in Figure A4.2, eight rating curve points were amassed during the baseline study with rating curve coverage between 1.0 and 8.0 m^3/s.

Average monthly discharges are reported for WB in Table A1.1, and were transformed to runoff depths in mm using a drainage area of 111 km^2 (see Table A1.2). For the period of record, runoff was estimated to be 492 mm. As expected, this runoff depth is less than those based on regional analogues (Section 4; a rough estimate of 1,200 mm for mean elevation of ~700 m asl), noting that the precipitation for the period of record appears to be below normal. A considerable proportion of flow that would naturally report to the lake is diverted by BC Hydro to the Campbell River.

The WB discharge record is shown as a time series in Figure A4.3. In the past, discharges on the order at 20-40 m^3/s have been observed at WB - albeit for short duration. Discharges of these magnitudes were not encountered during the baseline study, however, broadening of the rating curve over time will be necessary.

5.5 7S

Continuous measurements of stage for the period of record July 25, 2012 to June 6, 2013 correlated very well with spot measurements made at the 7S staff gauge (Figure A5.1).

As shown in Figure A5.2, six rating curve points were collected at 7S over the past year where field measurements of discharge ranged between 0 and 0.140 m^3/s. Like LLO, average monthly discharges reported for 7S (Table A5.1) were several orders of magnitude higher in the autumn and winter compared to the summer. Once converted to a runoff depth, a value of 711 mm was returned for the period of record. This runoff amount compared reasonably well to values based on regional analogues (Section 4; a rough estimate of 800 mm for mean elevation of 423 m asl), noting that the precipitation for the period of record appears to be below normal.

The 7S discharge record is shown as a daily time series in Figure A5.3. To date, the 7S rating curve provides adequate coverage for the stage conditions observed. However, these data should continue to be monitored closely and additional field measurements of discharge be carried out as warranted.

5.6 IR

Continuous measurements of stage for the period of record July 25, 2012 to June 6, 2013 correlated very well with spot measurements made at the IR staff gauge (Figure A6.1). As shown in Figure A6.2, five rating curve points were collected at 7S over the past year where field measurements of discharge ranged between 0 and 40 m^3/s.

Once converted to a runoff depth, observed IR flows equated to 672 mm for the period of record. This runoff amount was lower than expected based on regional analogues (Section 4; a rough estimate of 1,100 mm for mean elevation of 683 m asl). However, precipitation for the period of record appears to be below normal.

The IR discharge record is shown as a daily time series in Figure A6.3. To date, the IR rating curve provides adequate coverage for the stage conditions observed. However, the rating curve would benefit from further validation at the high discharge end of the curve (*e.g.*, 15-45 m^3/s). Measuring flows of that magnitude pose logistical and safety challenges.

6. Next Steps and Recommendations

To maintain the baseline hydrology program, Quinsam Mine staff may wish to consider and expand upon the following:

- Download water level recorders (including the barologger) with monthly frequency.
- Record staff gauge measurements (or equivalent – *e.g.*, depth in culvert) at monthly time step.
- Benchmark hydrometric stations in accordance with provincial guidelines for baseline monitoring and mining project, and verify station elevations are stable (to be done annually).
- Measure discharges (*e.g.*, current meter, salt dilution gauging, acoustic doppler current profiler) to verify the representativeness of existing rating curves. It is common practice to measure one or two verification measurements per station per year. For maximum benefit, these measurements should occur under different discharge conditions.

7. Closure

We trust this meets your current requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

Respectfully submitted,
Lorax Environmental Services Ltd.

PROFESSIONAL
PROVINCE OF
C. J. D. FRASER
36348
BRITISH COLUMBIA
GEOSCIENTIST
06/27/2013

Colin Fraser, M.Sc., P.Geo.
Senior Hydrologist

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Lorax, 2013. 7S Area5 Water Quality Effects Assessement. Submitted to Quinsam Coal Corporation on June 5, 2013. 437 pp.

Obedkoff. W. 2003. Streamflow in the Lower Mainland and Vancouver Island. Ministry of Sustainable Resource Management – Aquatic Information Branch. 186 pp.

Appendix A:
Quinsam Baseline Hydrology Program 2012-13

A1. Long Lake Outlet (LLO)

A2. Long Lake Seep (LLS)

A3. Long Lake Culvert (LLE)

A4. Quinsam River below Middle Quinsam Lake (WB)

A5. 7S Monitoring Station (7S)

A6. Iron River below 7S Area 5 (IR)

Appendix A1.

Long Lake Outlet (LLO)

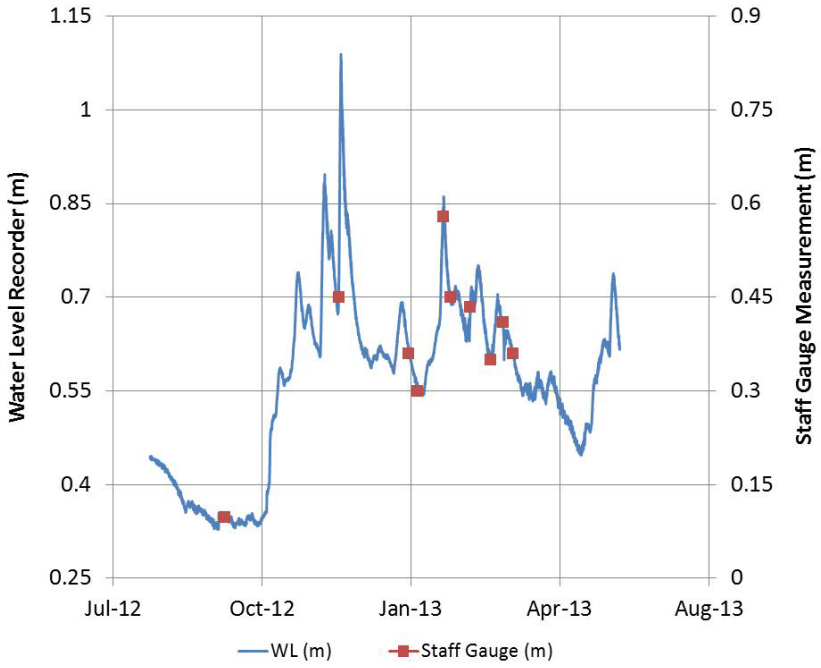
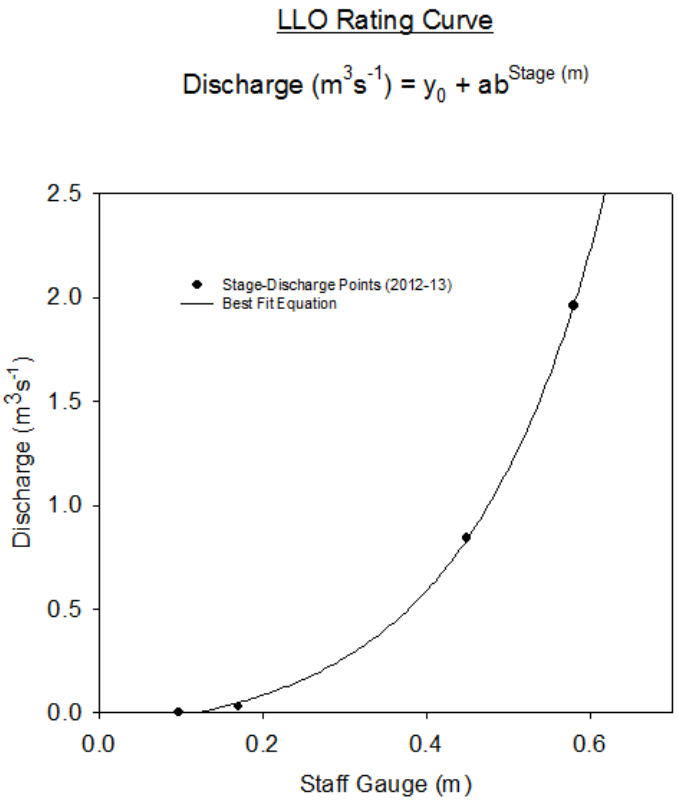


Figure A1.1: Relationship between continuous water level and spot measurements of stage at LLO staff gauges for the period of record.



FigureA1.2: Stage-discharge relationship for the LLO hydrometric station. Values for y0, a, and b were determined to be -0.1381, 0.0687 and 363.1808 respectively.

Table A1.1:
LLO discharge statistics for the period of record July 25, 2012 to June 6, 2012.

Month	Average Discharge (m^3/s)	Maximum Discharge (m^3/s)	Minimum Discharge (m^3/s)
Jul*	0.07	0.08	0.07
Aug	0.02	0.06	0.00
Sep	0.00	0.00	0.00
Oct	0.19	0.74	0.00
Nov	1.12	4.31	0.43
Dec	0.98	5.00	0.38
Jan	0.43	0.77	0.26
Feb	0.86	1.93	0.45
Mar	0.60	1.11	0.30
Apr	0.26	0.33	0.18
May	0.26	0.74	0.09
Jun*	0.75	1.00	0.48

*indicates statistics based on an incomplete month of data collection

Table A1.2:
LLO runoff statistics for the period of record July 25, 2012 to June 6, 2012.

Month	Average Runoff (mm/day)	Maximum Runoff (mm/day)	Minimum Runoff (mm/day)
Jul*	0.3	0.4	0.3
Aug	0.1	0.3	0.0
Sep	0.0	0.0	0.0
Oct	0.9	3.5	0.0
Nov	5.3	20.5	2.1
Dec	4.6	23.7	1.8
Jan	2.0	3.7	1.2
Feb	4.1	9.2	2.1
Mar	2.8	5.3	1.4
Apr	1.3	1.6	0.8
May	1.2	3.5	0.4
Jun*	3.6	4.8	2.3

*indicates statistics based on an incomplete month of data collection

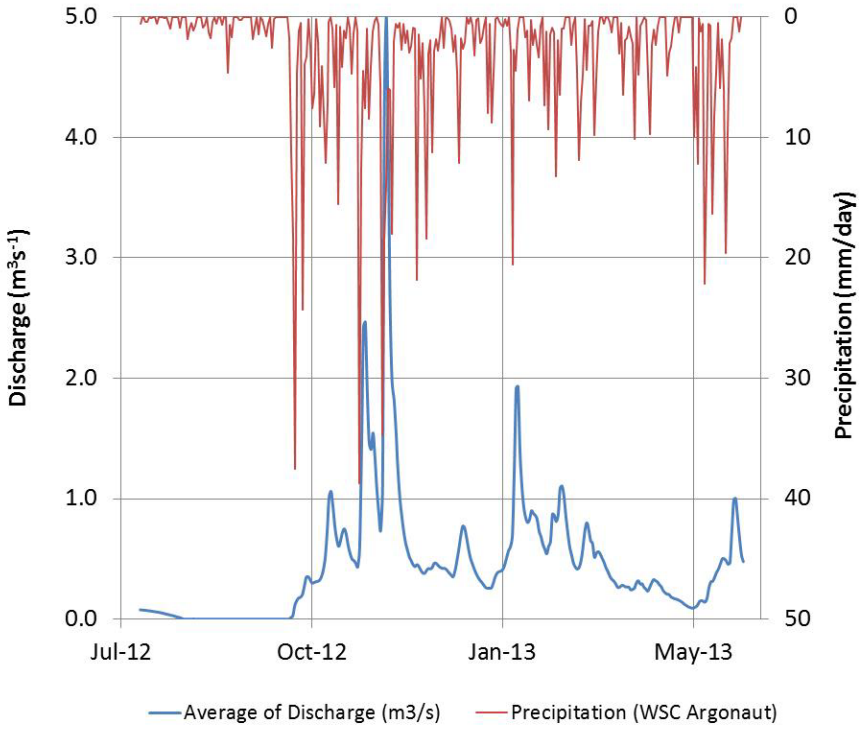


Figure A1.3: Daily discharge data for LLO hydrometric station. Precipitation data from the Water Survey of Canada rain gauge near Argonaut Bridge is shown on the secondary y-axis.

Appendix A2.

Long Lake Seep (LLS)



Figure A2.1: Relationship between continuous water level and spot measurements of stage at LLS staff gauge for the period of record. Water level values below the black dashed line equate to zero discharge (*i.e.*, below the weir notch elevation).

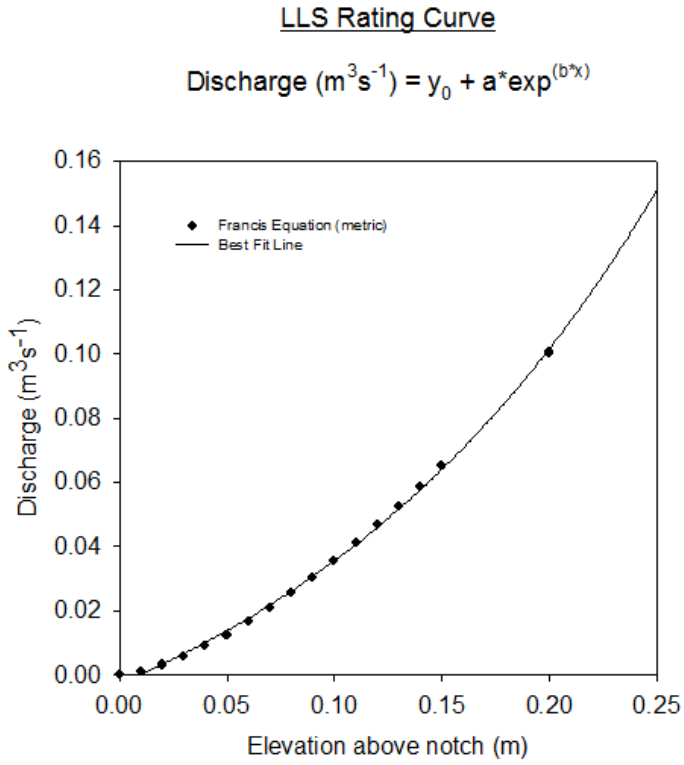


Figure A2.2: Stage-discharge relationship for the LLS hydrometric station. Values for y0, a, and b were determined to be -0.0547, 0.0520 and 5.5017 respectively.

Table A2.1:
LLS discharge statistics for the period of record April 5, 2012 to February 7, 2013.

Month	Average Discharge (m^3/s)	Maximum Discharge (m^3/s)	Minimum Discharge (m^3/s)
Apr	0.019	0.039	0.008
May	0.004	0.007	0.003
Jun	0.004	0.005	0.004
Jul	0.004	0.004	0.003
Aug	0.002	0.003	0.001
Sep	0.000	0.001	0.000
Oct	0.000	0.000	0.000
Nov	0.008	0.021	0.000
Dec	0.019	0.031	0.009
Jan	0.007	0.008	0.005
Feb*	0.007	0.013	0.005

* indicates statistics based on an incomplete month of data collection

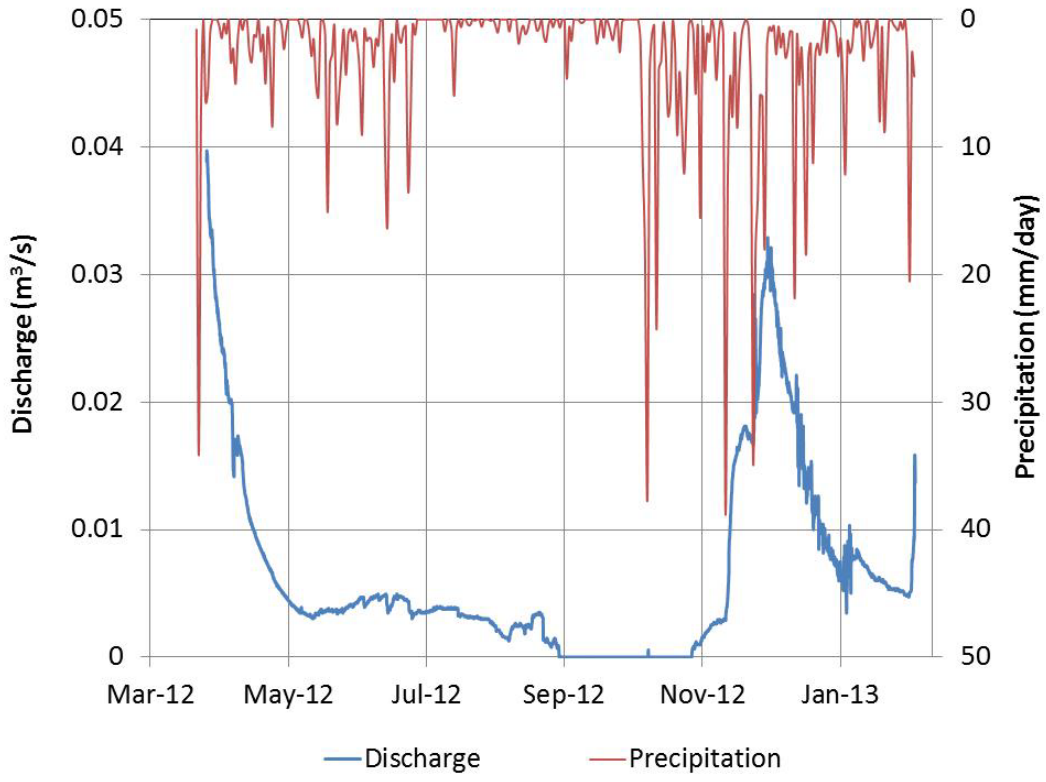


Figure A2.3: Daily discharge data for LLS hydrometric station. Precipitation data from the Water Survey of Canada rain gauge near Argonaut Bridge is shown on the secondary y-axis.



Photo A2.1: LLS Hydrometric station during moderate-high flow (April 2012).

Appendix A3.

Long Lake Culvert (LLE)

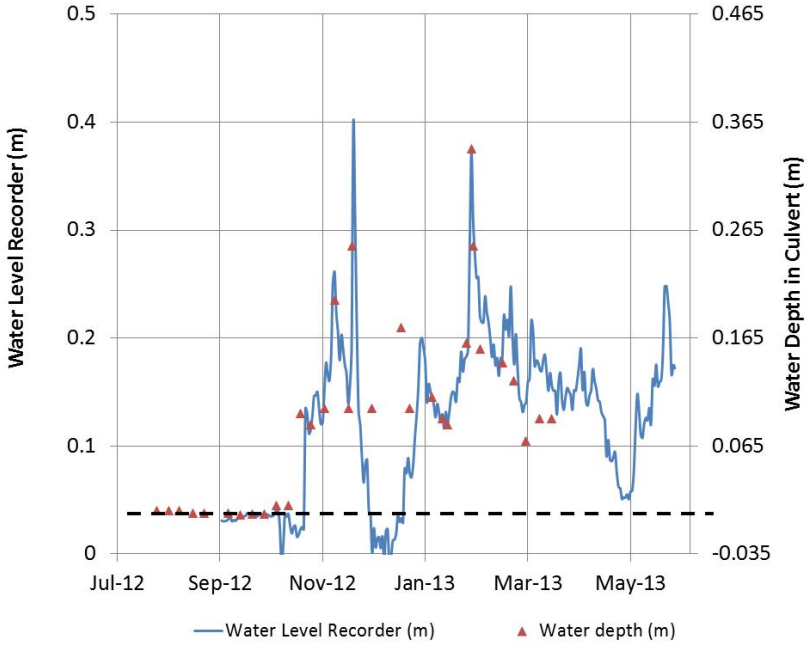


Figure A3.1: Relationship between continuous water level and spot measurements of water depth at LLE culvert for the period of record. The black dashed line indicates depth of zero discharge.

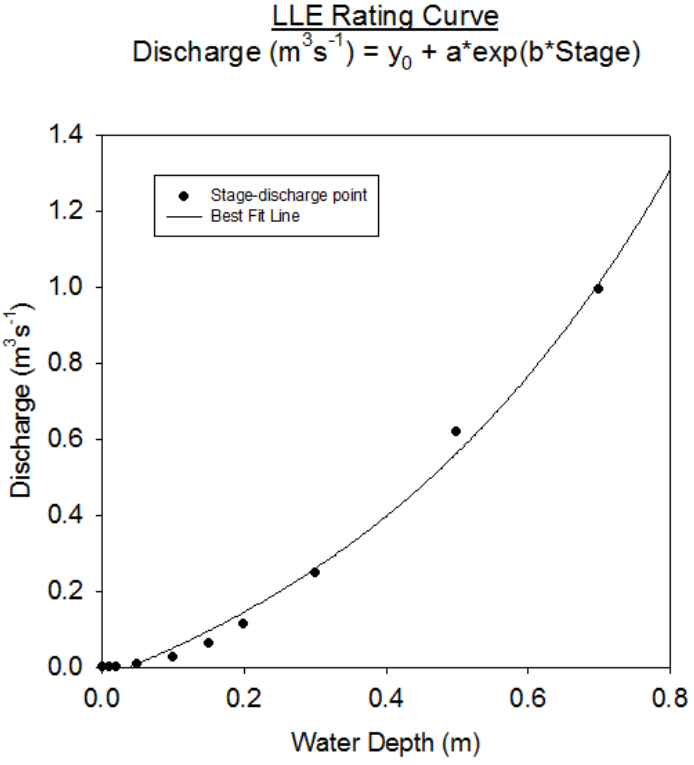


Figure A3.2: Stage-discharge relationship for the LLE hydrometric station. Values for y_0, a, and b were determined to be -0.398, 0.3698 and 1.9111 respectively.

Table A3.1:
LLE discharge statistics for the period of record Sept 14, 2012 to June 6, 2012.

Month	Average Discharge (m^3/s)	Maximum Discharge (m^3/s)	Minimum Discharge (m^3/s)
Sep*	0.000	0.000	0.000
Oct	0.000	0.000	0.000
Nov	0.159	0.716	0.073
Dec	0.075	0.467	0.007
Jan	0.132	0.227	0.075
Feb	0.243	0.512	0.163
Mar	0.173	0.264	0.108
Apr	0.125	0.170	0.054
May	0.090	0.306	0.000
Jun*	0.212	0.287	0.132

* indicates statistics based on an incomplete month of data collection

Table A3.2:
LLE runoff statistics for the period of record Sept 14, 2012 to June 6, 2012.

Month	Average Runoff (mm/day)	Maximum Runoff (mm/day)	Minimum Runoff (mm/day)
Sep*	0.00	0.00	0.00
Oct	0.00	0.00	0.00
Nov	5.72	25.76	2.63
Dec	2.72	16.80	0.25
Jan	4.76	8.16	2.69
Feb	8.76	18.44	5.86
Mar	6.23	9.51	3.89
Apr	4.51	6.11	1.93
May	3.25	11.03	0.00
Jun*	7.63	10.35	4.76

* indicates statistics based on an incomplete month of data collection

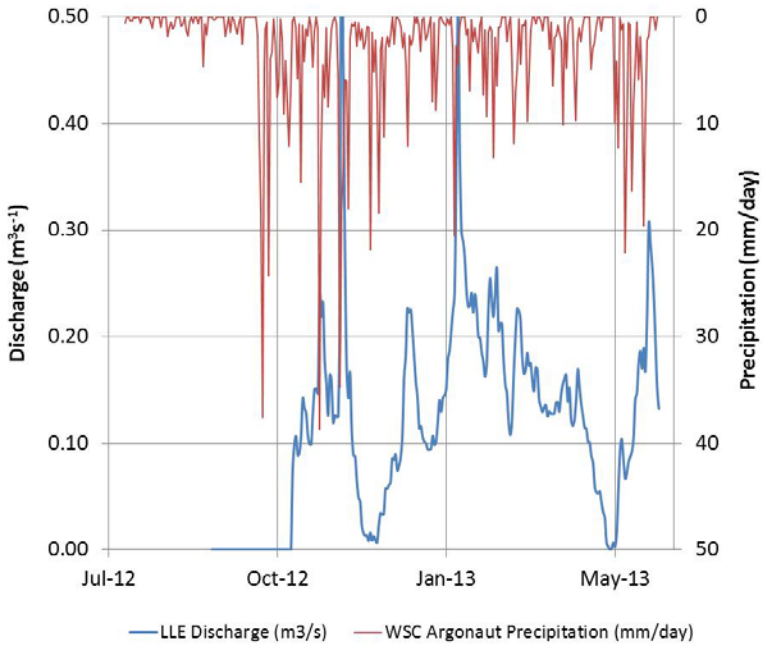


Figure A3.3: Daily discharge data for LLE hydrometric station. Precipitation data from the Water Survey of Canada rain gauge near Argonaut Bridge is shown on the secondary y-axis.

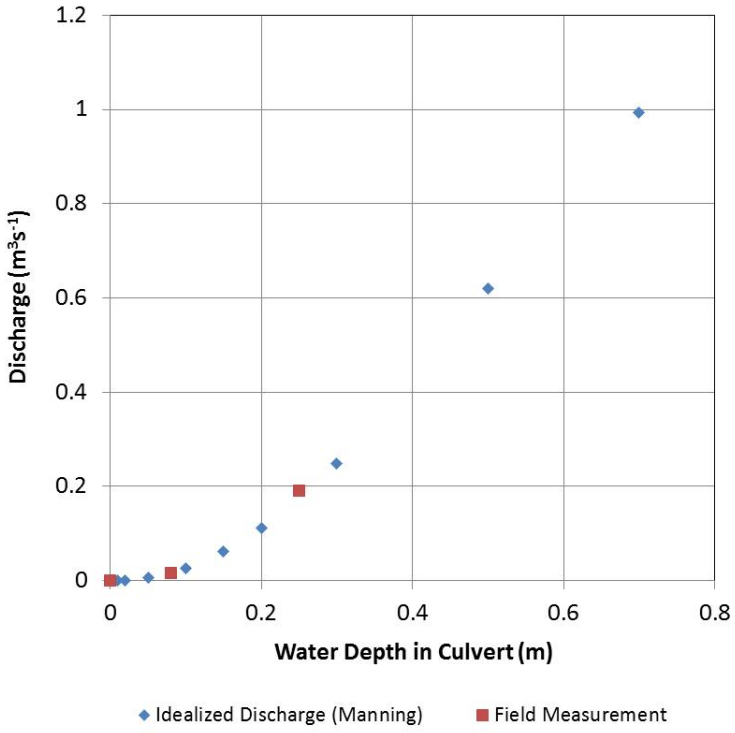


Figure A3.4: Comparison between idealized (Manning) estimates and field measurements of discharge at LLE culvert.

Appendix A4.

Quinsam River below Middle Quinsam Lake (WB)

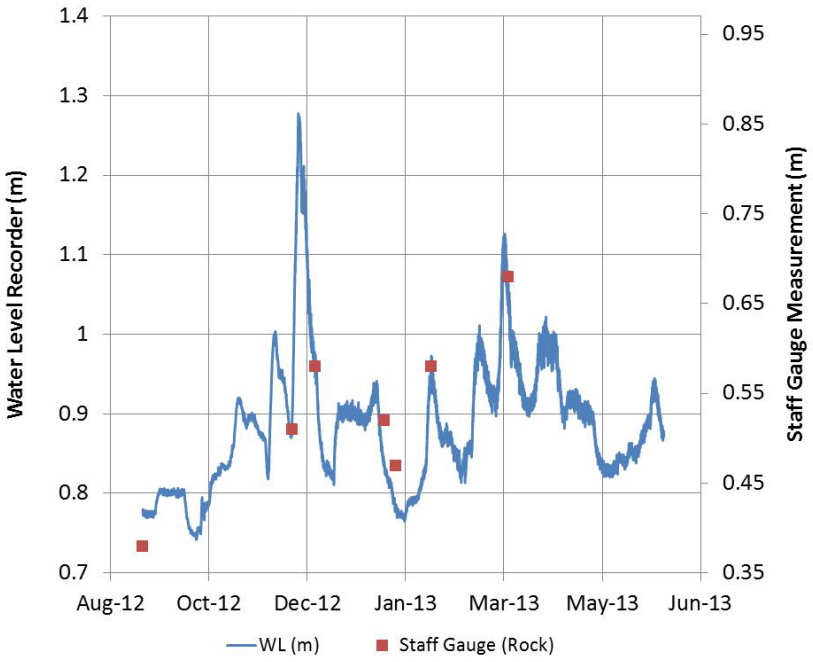


Figure A4.1: Relationship between continuous water level and spot measurements of stage at WB staff gauge for the period of record.

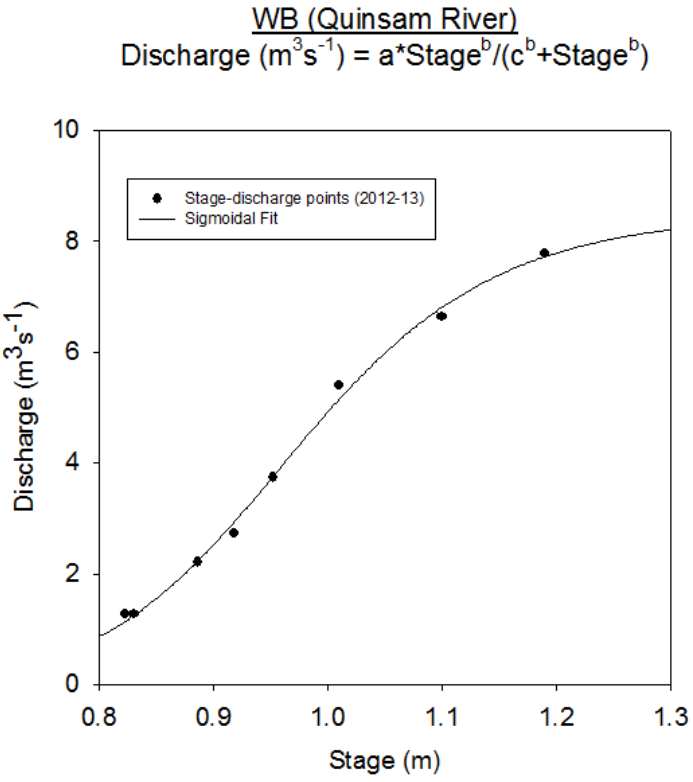


Figure A4.2: Stage-discharge relationship for the WB hydrometric station. Values for a, b, and c were determined to be 8.53, 11.15 and 0.97 respectively.

Table A4.1:
WB discharge statistics for the period of record Sept 14, 2012 to June 6, 2012.

Month	Average Discharge (m^3/s)	Maximum Discharge (m^3/s)	Minimum Discharge (m^3/s)
Sep*	0.8	0.9	0.6
Oct	1.0	2.3	0.4
Nov	2.8	5.7	1.3
Dec	3.6	8.0	1.1
Jan	1.6	3.2	0.6
Feb	1.9	3.7	0.8
Mar	4.0	6.9	2.7
Apr	3.4	4.9	2.4
May	1.6	3.1	1.2
Jun*	2.6	3.3	2.0

* indicates statistics based on an incomplete month of data collection

Table A4.2:
WB runoff statistics for the period of record Sept 14, 2012 to June 6, 2012.

Month	Average Runoff (mm/day)	Maximum Runoff (mm/day)	Minimum Runoff (mm/day)
Sep*	0.6	0.7	0.5
Oct	0.7	1.8	0.3
Nov	2.2	4.4	1.0
Dec	2.8	6.2	0.9
Jan	1.2	2.5	0.5
Feb	1.4	2.9	0.6
Mar	3.1	5.4	2.1
Apr	2.6	3.8	1.9
May	1.3	2.4	0.9
Jun*	2.0	2.5	1.6

* indicates statistics based on an incomplete month of data collection

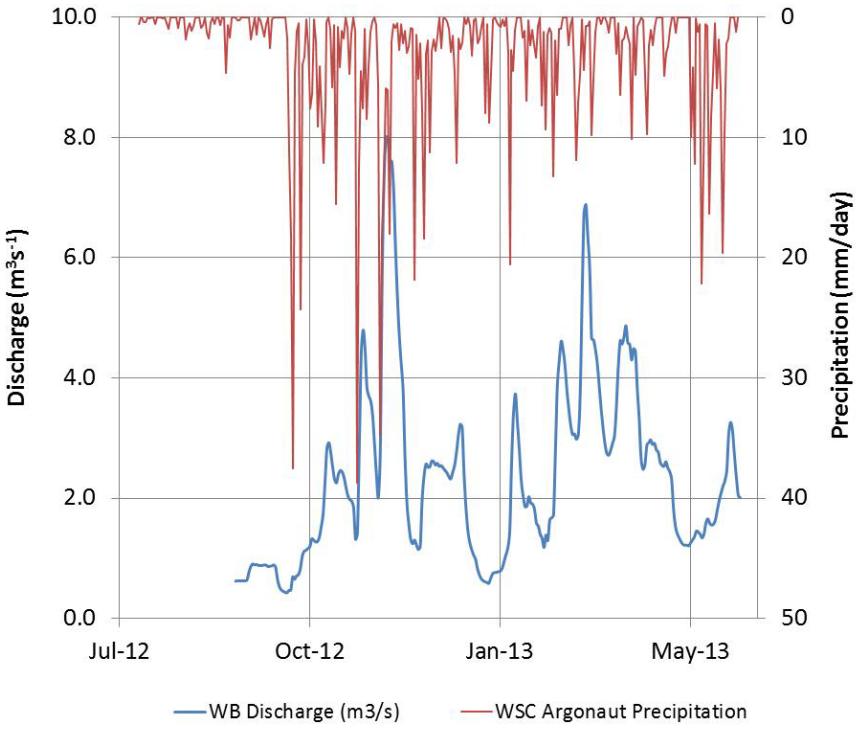


Figure A4.3: Daily discharge data for WB hydrometric station. Precipitation data from the Water Survey of Canada rain gauge near Argonaut Bridge is shown on the secondary y-axis.

Appendix A5.

7S Monitoring Station (7S)

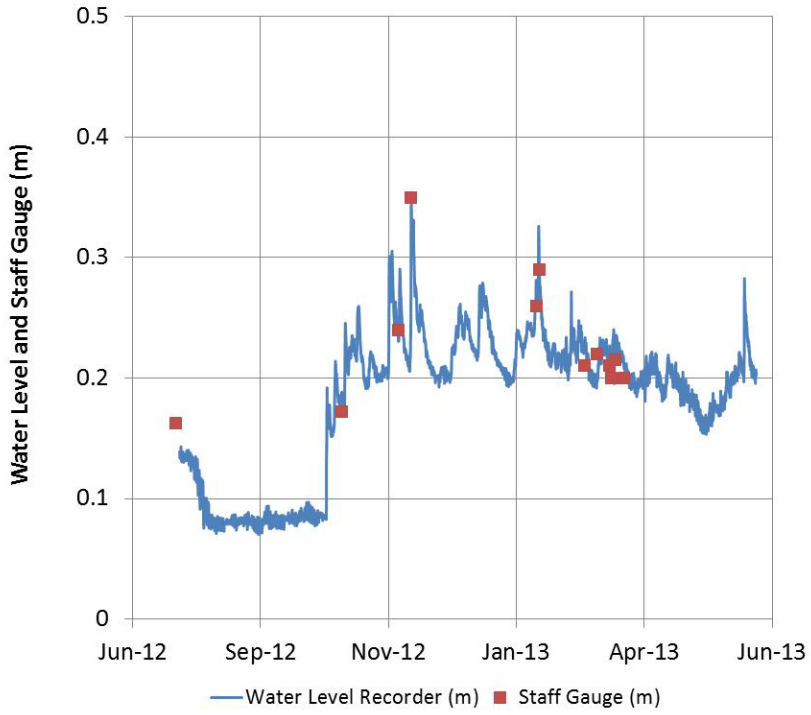


Figure A5.1: Relationship between continuous water level and spot measurements of stage at 7S staff gauge for the period of record.

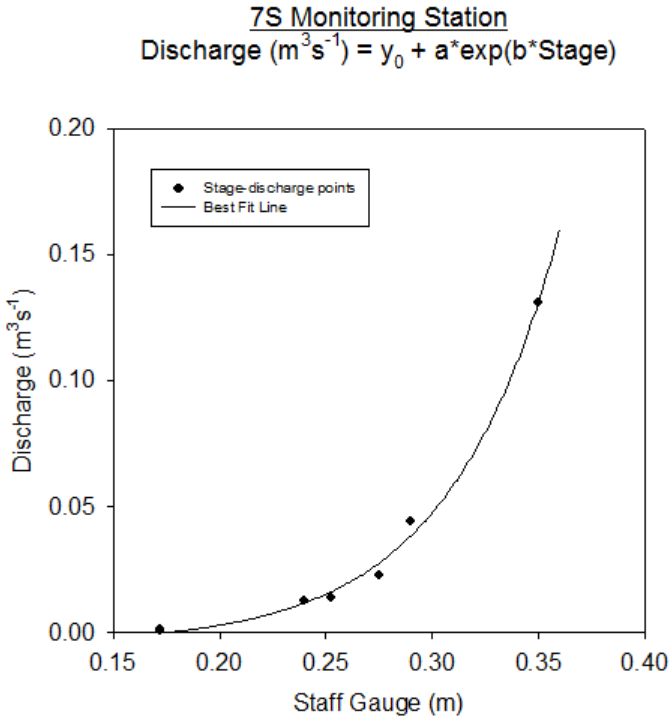


Figure A5.2: Stage-discharge relationship for the 7S hydrometric station. Values for y0, a, and b were determined to be -0.0048, 0.0002 and 19.1383 respectively.

Table A5.1:
7S discharge statistics for the period of record July 25, 2012 to June 6, 2012.

Month	Average Discharge (m^3/s)	Maximum Discharge (m^3/s)	Minimum Discharge (m^3/s)
Jul*	0.0000	0.0000	0.0000
Aug	0.0000	0.0000	0.0000
Sep	0.0000	0.0000	0.0000
Oct	0.0033	0.0221	0.0000
Nov	0.0164	0.0780	0.0037
Dec	0.0119	0.0360	0.0043
Jan	0.0118	0.0322	0.0041
Feb	0.0138	0.0564	0.0055
Mar	0.0078	0.0140	0.0039
Apr	0.0042	0.0075	0.0018
May	0.0031	0.0197	0.0000
Jun*	0.0073	0.0128	0.0047

* indicates statistics based on an incomplete month of data collection

Table A5.2:
7S runoff statistics for the period of record July 25, 2012 to June 6, 2012.

Month	Average Runoff (mm/day)	Maximum Runoff (mm/day)	Minimum Runoff (mm/day)
Jul*	0.0	0.0	0.0
Aug	0.0	0.0	0.0
Sep	0.0	0.0	0.0
Oct	1.0	7.1	0.0
Nov	5.2	25.0	1.2
Dec	3.8	11.5	1.4
Jan	3.8	10.3	1.3
Feb	4.4	18.1	1.8
Mar	2.5	4.5	1.2
Apr	1.4	2.4	0.6
May	1.0	6.3	0.0
Jun*	2.3	4.1	1.5

* indicates statistics based on an incomplete month of data collection

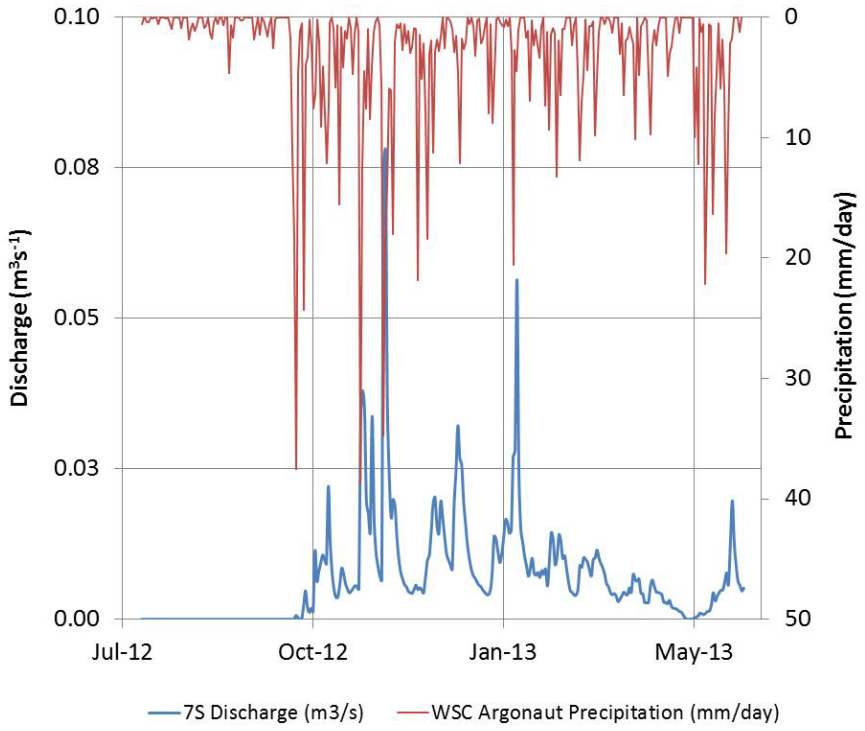


Figure A5.3: Daily discharge data for 7S hydrometric station. Precipitation data from the Water Survey of Canada rain gauge near Argonaut Bridge is shown on the secondary y-axis.

Appendix A6.

Iron River below 7S Area 5 (IR)

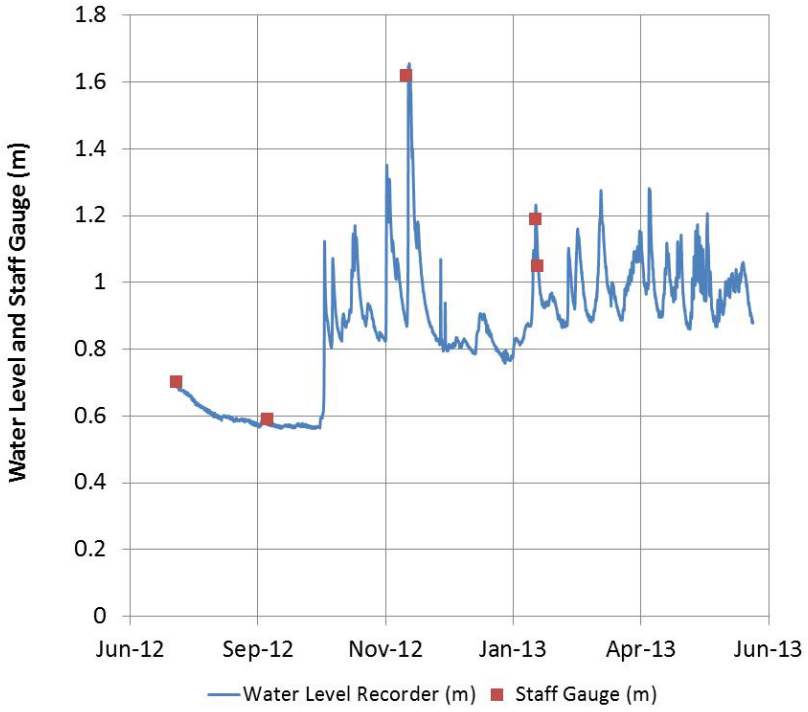


Figure A6.1: Relationship between continuous water level and spot measurements of stage at IR staff gauge for the period of record.

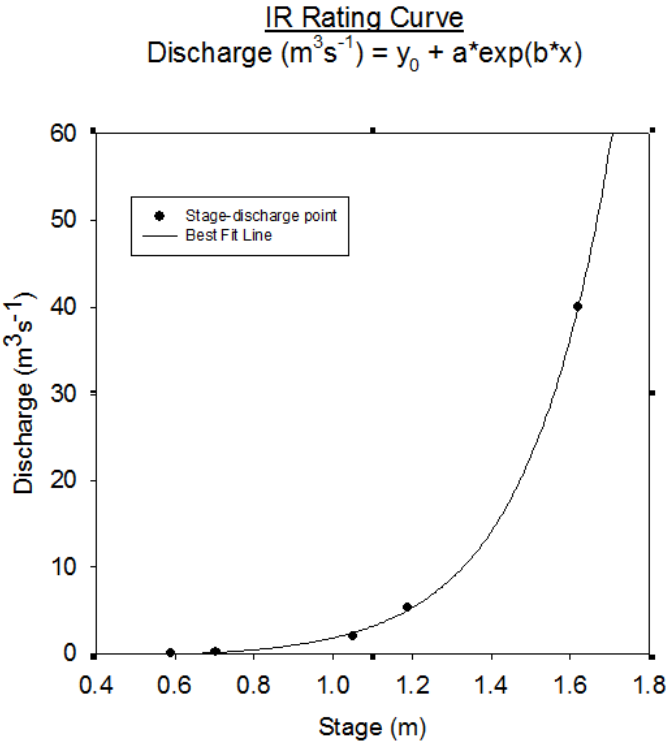


Figure A6.2: Stage-discharge relationship for the IR hydrometric station. Values for y_0, a, and b were determined to be -0.4084, 0.0214 and 4.6573 respectively.

Table A6.1:
IR discharge statistics for the period of record July 25, 2012 to June 6, 2012.

Month	Average Discharge (m^3/s)	Maximum Discharge (m^3/s)	Minimum Discharge (m^3/s)
Jul*	0.091	0.117	0.068
Aug	0.043	0.057	0.005
Sep	0.045	0.045	0.045
Oct	0.783	3.760	0.045
Nov	3.604	32.329	0.606
Dec	1.736	15.124	0.477
Jan	0.581	1.007	0.361
Feb	1.500	4.894	0.770
Mar	2.001	5.812	0.936
Apr	2.264	5.691	0.975
May	1.774	3.989	0.813
Jun*	1.461	2.301	0.900

* indicates statistics based on an incomplete month of data collection

Table A6.2:
IR runoff statistics for the period of record July 25, 2012 to June 6, 2012.

Month	Average Runoff (mm/day)	Maximum Runoff (mm/day)	Minimum Runoff (mm/day)
Jul*	0.14	0.18	0.10
Aug	0.06	0.09	0.01
Sep	0.07	0.07	0.07
Oct	1.19	5.70	0.07
Nov	5.46	49.00	0.92
Dec	2.63	22.93	0.72
Jan	0.88	1.53	0.55
Feb	2.27	7.42	1.17
Mar	3.03	8.81	1.42
Apr	3.43	8.63	1.48
May	2.69	6.05	1.23
Jun*	2.21	3.49	1.36

* indicates statistics based on an incomplete month of data collection

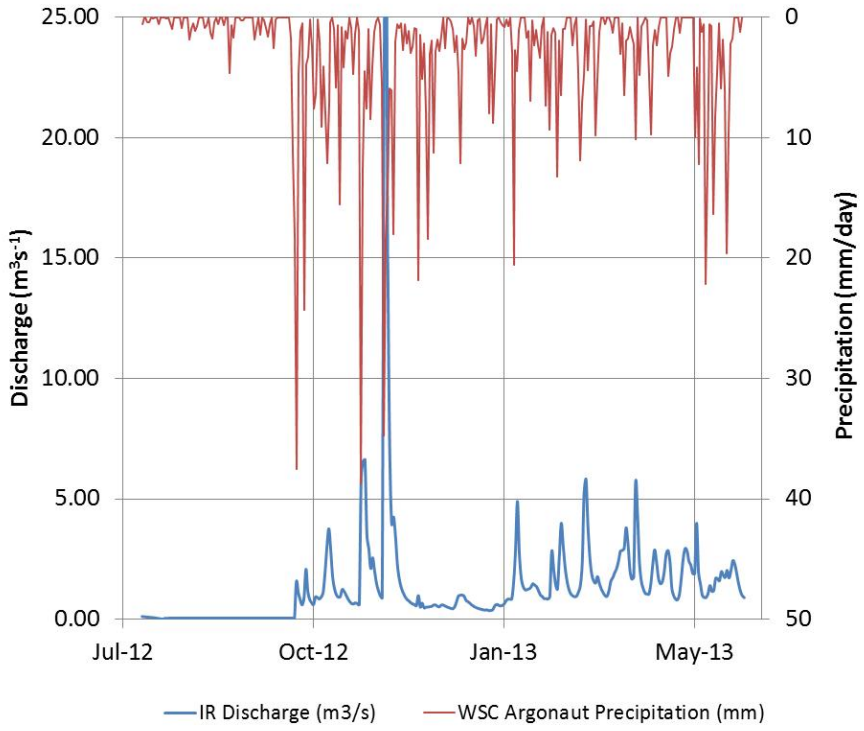


Figure A6.3: Daily discharge data for IR hydrometric station. Precipitation data from the Water Survey of Canada rain gauge near Argonaut Bridge is shown on the secondary y-axis.

Appendix B:
Regional Hydrology

B1. Hydrometric Stations in Zone 28

B2. Elevation-runoff and low-flow relationships for Zone 28

B3. Summary Flow Statistics for nearby Hydrometric Stations

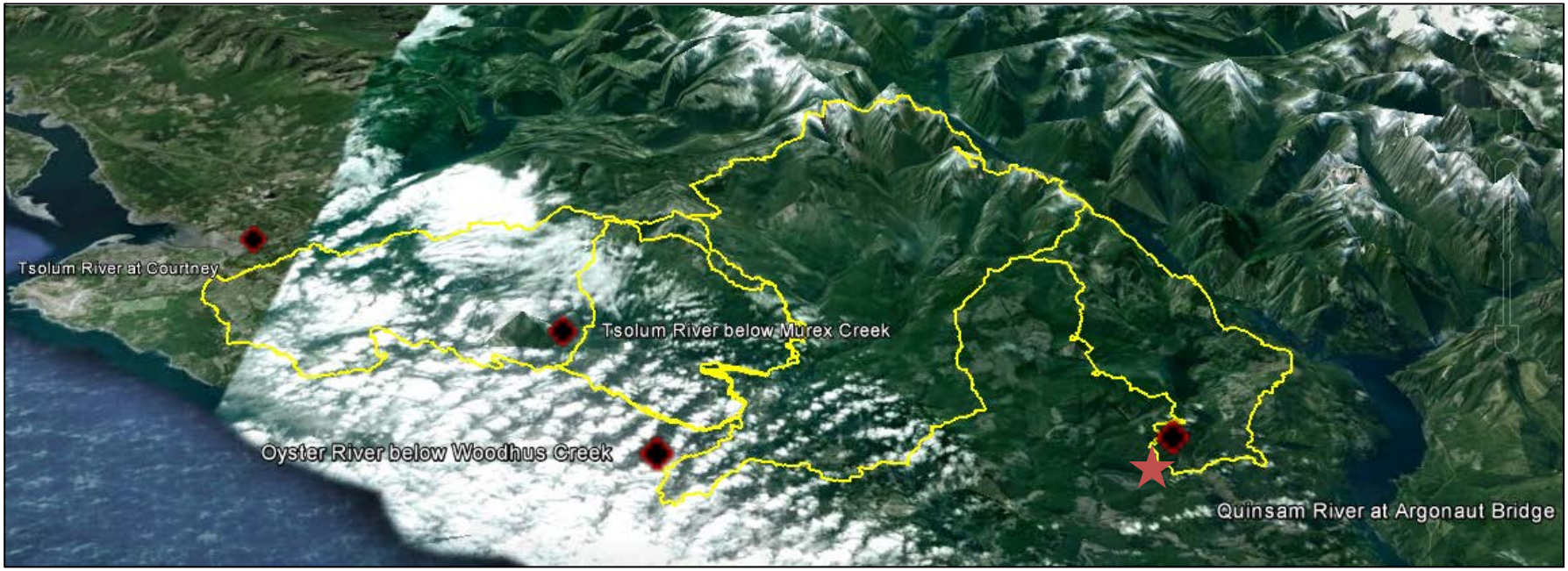


Figure B1: Schematic illustrating the location of Water Survey of Canada stations nearest to the Quinsam Mine (denoted by the pink star). These stations fall within Zone 28 as defined by Obedkoff (2003).

Table B1.1:
Summary of station data, drainage characteristics and period of record for hydrometric stations near the Quinsam Coal mine.

Station	WSC Station Code	Lat/Long	Period of Record	Area (km^2)	Mean Elevation (m)
Oyster River below Woodhus Creek*	08HD011	49°53'38" N 125°14'18" W	1997-present	306	909
Tsolum River near Courtney*	08HB011	49°42'26" N 125°0'41" W	1997-present	250	331
Tsolum River below Murex Creek*	08HB089	49°48'46" N 125°12'10" W	1997-present	88	551
Quinsam River at Argonaut Bridge*	08HD021	49°55'53" N 125°30'33" W	1997-present	84	710
Quinsam River diversion near Campbell River	08HD026	49°56'36" N 125°30'29" W	1997-present	na	Na
Browns River near Courtney*	08HB025	49°41'31" N 125°4'11" W	1960-present	88	858
Long Lake Outlet (LLO)	Na	49° 56.315'N 125° 25.038'W	Spot measurements from 2001; July 2012-present	18.2	423
Iron River at Hydrometric Station (IR)	Na	49° 55.585'N 125° 25.926'W	Spot measurements from 2001; July 2012-present	57	683

*denotes a hydrometric station included in the Obedkoff (2003) regional analysis.

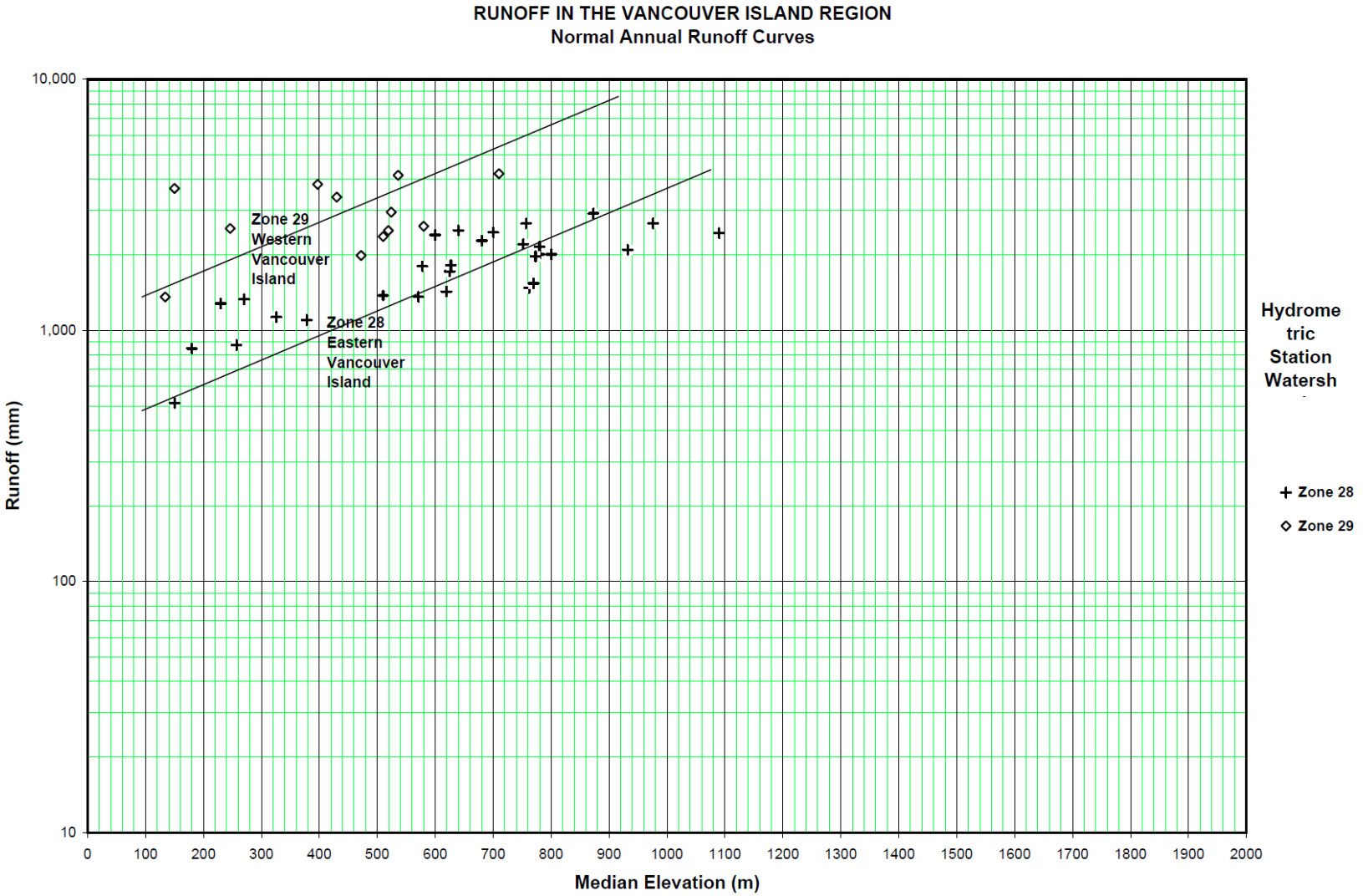


Figure B2.1: Relationship between annual runoff and watershed elevation for Zone 28 (Eastern Vancouver Island) after Obedkoff (2003).

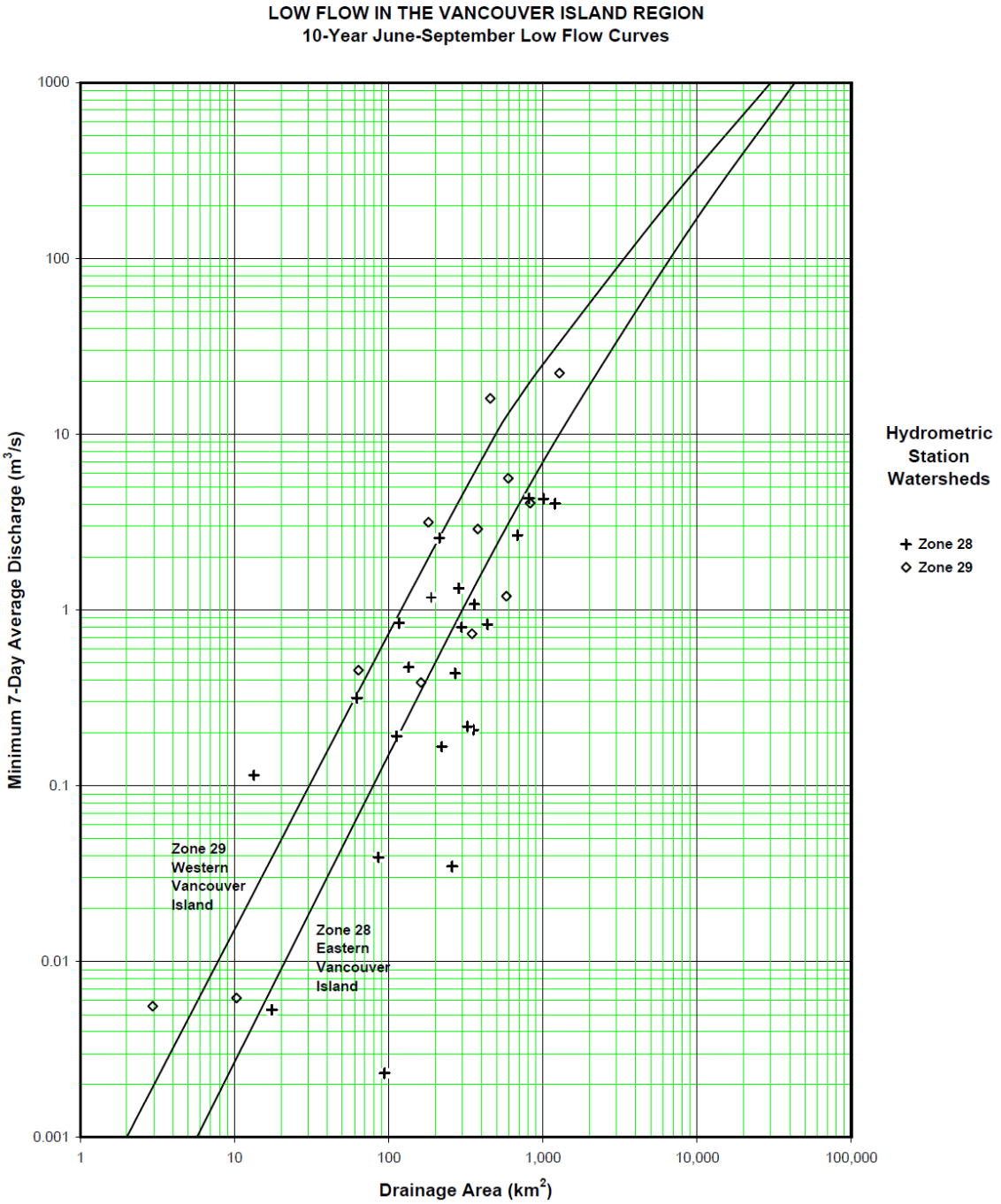


Figure B.2.1: Relationship between minimum 7-day average discharge and drainage area for Zone 28 (Eastern Vancouver Island) after Obedkoff (2003).

Table B3.1:
Summary of monthly flow statistics for Water Survey of Canada stations nearest to the Quinsam Mine.

	Discharge (m3/s)												
Station	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Avg/Total**
Tsolum River near Courtney	24.3	15.2	14.6	10.8	7.3	4.3	1.3	0.7	1.5	9.1	22.1	23.9	11.3
Tsolum River below Murex Creek	8.2	5.4	4.9	4.4	4.4	2.8	0.9	0.3	0.4	3.4	7.7	7.2	4.2
Oyster River below Woodhus Creek	20.2	9.2	12.3	14.7	20.9	15.9	7.0	2.4	2.2	12.9	22.2	17.1	13.1
Quinsam River at Argonaut Bridge (naturalized)	5.8	3.1	3.3	3.7	3.9	2.9	1.2	0.9	1.4	2.1	4.9	4.6	3.2
Browns River Near Courtney	7.9	3.8	5.1	7.1	10.9	7.6	2.4	0.8	1.1	5.4	8.9	6.4	5.6

	Runoff (mm)												
Station	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Avg/Total**
Tsolum River near Courtney	260.4	148.4	156.2	111.9	78.4	44.4	14.4	7.3	15.2	97.4	229.2	256.2	1421.1
Tsolum River below Murex Creek	250.0	149.7	148.5	129.0	134.5	82.0	27.8	9.5	11.3	104.4	225.4	218.9	1493.0
Oyster River below Woodhus Creek	176.8	73.5	107.2	124.2	183.2	134.4	61.0	21.2	18.6	112.7	187.6	149.8	1347.7
Quinsam River at Argonaut Bridge (naturalized)	186.3	90.9	105.5	113.8	123.7	88.3	38.9	28.6	43.3	68.5	151.8	145.1	1184.7
Browns River near Courtney	240.1	105.8	156.0	207.9	331.2	222.9	72.3	23.9	32.1	164.6	261.3	194.0	2009.4

APPENDIX VIII

SPILLS

Spill Incident, Quinsam Coal Minesite

At 3:05 A.M. on May 14, 2012 two underground vehicles collided on the main surface ramp leading to the underground portal entries. The vehicle operators were not injured. The collision resulted in a hydrocarbon spill on the ramp. The volume of spilled fluids includes 227 litres of hydraulic oil and 197 litres of diesel fuel. The spill was attended to immediately and a containment dyke was constructed on the downhill side of the ramp. Absorbent pads were deployed to soak up a good portion of the spilled fluids. The absorbent pads were disposed of in plastic drums, stored at the minesite for eventual pick-up by Newalta. Following the absorbent pad exercise, an excavator graded off the contaminated soil and gravel on the ramp and loaded it into a tandem dump truck. Approximately 10 cubic metres of contaminated soil was recovered. The contaminated soil was placed on a polyethylene liner for sampling and possible treatment. Figure 1 illustrates the location of the spill relative to other surface infrastructure.



Figure 1. – Location of the spill within the minesite infrastructure.

Plates 1 to 3 inclusive documents the extent of the spill and methods of remediation used to contain and manage the materials.



Plate 1. The damaged machine on the 10% gradient main ramp leading to the underground portals.



Plate 2. – Location of the fluid spill downhill from the damaged machine, with a containment berm constructed near the downhill base of the grade.



Plate 3. – After removing the oil-soaked absorbent pads into plastic spill drums, final cleanup involves an excavator to scrape and load contaminated soil into a truck which deposits the soil onto a plastic liner, for sampling and possible treatment, or removal to an approved contaminated waste disposal facility.

Risk Assessment

As the spill was located on a hard, well-compacted roadway within the mine surface footprint, it was a relatively simple exercise to contain it on the downslope side. Quick response by Quinsam mine workers to prevent the spilled fluids from leaking into the water management system indicates that the risk attributed to this incident is low.

On-going Monitoring

Daily visual checks to monitor the downslope side of the ramp to ensure no additional fluid migration occurring. Weekly sampling events at the 2N Portal Sump will record any anomalous levels in the sump.

Preventative Measures Being Contemplated

Preventative Measures Being Contemplated include:

- One-way designation for the access ramp (loaded vehicles only).
- Better signage.
- Changing configuration of the access ramp (to reduce the gradient and improve visibility).
- Deploying a spotter to monitor and direct traffic leaving the maintenance shop area.

Signed,

Steve Gardner

Technical Services Manager

Spill Incident, Quinsam Coal Minesite

At 10:15am on July 17, 2012, an excavator working at the 2 South Pit encountered a 205 litre drum of diesel fuel while digging. The barrel was punctured which resulted in approximately 205 litre of diesel fuel being leaked onto the surrounding soil. Spill response procedures began immediately and absorbent pads were distributed to minimize the extent and impact of the spill. The majority of fuel was then pumped into a storage container. The remainder of the fuel, which seeped into the soil, needed to be removed by excavation. The contaminated material was dug out and taken to an on-site waste storage area where it was placed on an impenetrable polyethylene liner to contain any leakage. At the time of this report, approximately 32 cubic metres of contaminated soil was recovered. It is estimated that an additional 10-15 cubic metres will be removed as well. When soil removal and storage is complete, soil samples from the spill site will be taken to establish if there is any remaining contaminant. Work at the spill site will not resume until the soil is confirmed to be uncontaminated. Soil samples will also be taken from the waste containment site to determine how the contaminated material will be disposed of. Absorbent pads were placed on the surface of the water holes adjacent to the spill site to determine if any contaminate had affected these areas as well. They remained there for approximately 24 hours and showed no sign of contaminant.

Risk Assessment

Because of the immediate spill response the majority of the diesel fuel was captured through pumping or excavation. Although some contaminant could have entered the water table, the flow of water away from the spill site ends primarily at the 2 South Sump water collection area, which will be monitored through our water sampling analyses. If water at the 2 South Sump area showed evidence of contamination, it would flow to the 3 South Pit – a contained water collection area. An absorbent boom was also placed across the mouth of the drainage ditch that runs from 2 South Sump area toward the 3 South Pit to help prevent the movement of contaminant. Therefore there is little chance of contaminant entering the surrounding environment as there are several areas where it could be observed and contained before it would be released.

Preventative Measures

The preventative measures being implicated to prevent further environmental damage and subsequent spills include:

- For the remainder of excavation operations at this area of the digging site a flat edged excavator will be used (as opposed to an excavator with teeth). This is meant to prevent any further punctures should the digger encounter any other barrels.
- A sentry will be posted to oversee further digging in this area to provide closer visual monitoring of any further risks and to provide immediate response if an additional barrel is exposed.



Figure 1 – Location of the spill within the minesite infrastructure.



Figure 2 – Diesel fuel immediately after the drum was punctured by the excavator



Figure3 – Container used to store the fuel pumped out of the spill site. Container is full to the orange tape line.



Figure 4 – Hose used to pump out fuel. It is also full of fuel that needs to be disposed of.



Figure 5 – Spill site after removal of fuel and the majority of contaminated soil. The wooden stake represents the approximate spot of the original drum. The water in the photo is ground water that has been exposed while digging out the contaminated soil. The film on the water appears to be coal dust.



Figure 6 – Absorbent boom placed across the drainage ditch that leads from the 2 South Sump water collection to the 3 South Pit to prevent contaminants from moving further through the water system.

APPENDIX IX

Long Lake Seep Passive Treatment System

Long Lake Seep Passive Treatment System
Quarterly Report

(covering the period up to January 6, 2013)

Submitted to:
Ministry of Energy, Mines and Natural Gas

and
Ministry of Environment

Prepared by:
Quinsam Coal Corporation and Golder Associates

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Introduction

The Long Lake Seep Passive Treatment System ("PTS") consists of a series of lined cells or lagoons formed by cut-and-fill earth construction and backfilled with prescribed substrate mixtures for the purposes of reducing sulphate and iron levels in the water emitting from the Long Lake seep.

The Long Lake seep is a discharge of water into Long Lake, with the flow path being bedding planes and/or jointing associated with the No. 1 coal seam and the source being the pool of water in the 2-South underground mine workings. The 2-South underground workings, accessed from three adits developed from the 2-South open pit in 1994, were mined (development and depillar mining) from 1994 to 1997. The northern extent of the underground mine development approached the sub-crop in the vicinity of Long Lake, where faulted ground was encountered that created a water pathway to the lake. The rate of flow varies seasonally, with a range from 0 to over 20 litres/second.

In 2009 the Ministry of Environment ("MOE") directed Quinsam Coal to collect and treat the flow of effluent currently entering Long Lake via the seep with the objectives of:

- Reducing the sulphate levels
- Reducing the iron levels to below the Permit limits for settling pond 1 (0.5 mg/litre)

Quinsam Coal has taken a staged approach to the development, design, construction and operation of the PTS, including the following steps:

- Bench Scale Testing
- Construction and Operation of a Demonstration System (the system that is being reported on in this document)
- Up-scaling for Full Treatment

Bench Scale Testing: the bench scale testing was conducted to test different substrate mixtures to optimize sulphate reduction to sulphide and to test sequestration of the sulphide produced. The bench test system consisting of five biochemical reactor (BCR) cells was constructed at the end of March, 2011. The substrate in the cells consisted of varying amounts of wood chips, sawdust, hay and limestone plus an animal manure inoculum. Two of the cells also contained iron (one iron ore the other iron hydroxide) to test sequestration of the suphide. The cells were operated from April through to mid-September of 2011 and provided the following observations which were then used to design the demonstration system.

- Sulphate can be removed to the levels targeted (at least 50%). A benchmark of 0.30 $mol/m^3/day$ was used for the demonstration system design.
- The cells containing iron provided acceptable sulphide sequestration. For the demonstration system design a separate sulphide polish cell (not mixed in with the BCR substrate) is used.



Photograph 1: Bench Scale Testing

The second stage of the project, to which this document applies, involves the construction, operation and monitoring of a demonstration system. The design basis for the demonstration system was to use the results from the bench scale testing to provide a PTS that would handle 25% of the flow (estimated at 4.5 L/sec) at the seep.

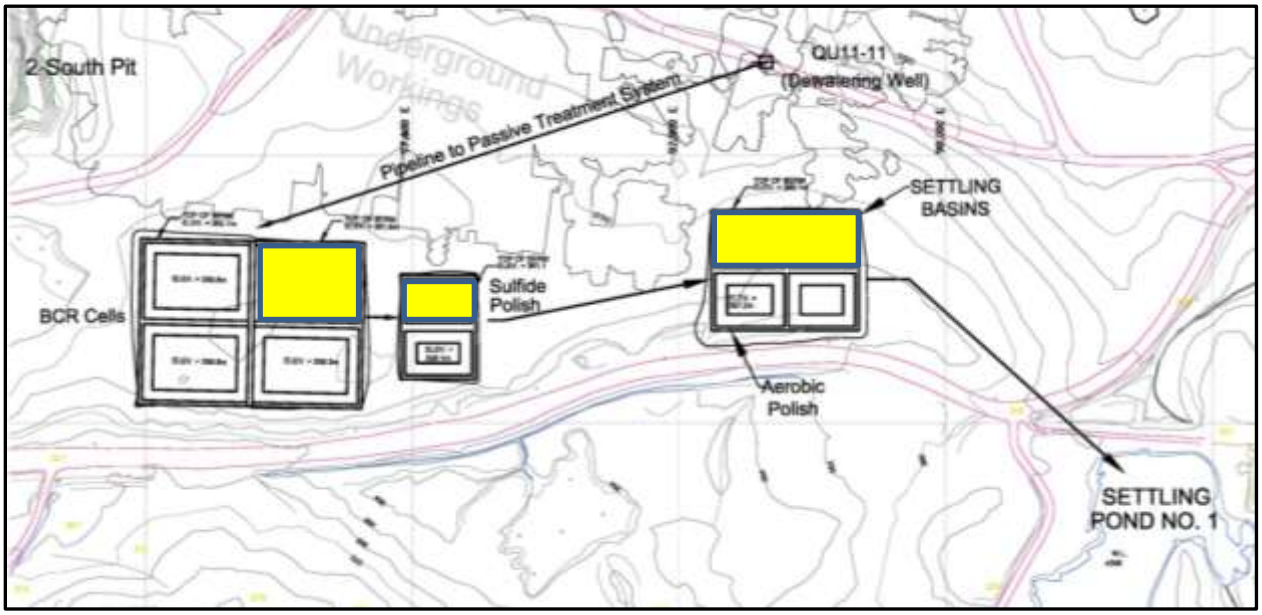
The demonstration system contains three treatment components: a BCR cell followed by a sulphide polishing cell and an aerobic polishing system, and includes piping and valving that will allow for future expansion.

The Table below summarizes the design aspects of the different cells that make up the demonstration module[1].

Cell		Criteria	Volume Required (m^3)	Bottom Surface Area (m^2)
BCR		Treat 0.3 moles of sulphate per day per cubic meter of substrate. 14 days HRT.	6,700	2,580 (63m x 41m)
Sulphide Polish		Iron for at least 2 years of sulphide sequestration. 2.2 days HRT.	1,000	500 (32m x 15m)
Aerobic Polish	Aerated Lagoon	Sediment retention time of 4 days.	3,110	750 (34m x 22m)
	Settling Pond	3.5 day HRT	2,950	700 (32m x 22m)

[1] Mine Permit (C-172) Amendment: Long Lake Seep Mitigation Passive Treatment System (Demonstration Module, October 2011.

The figure below provides the layout for the full scale system, with the highlighted components representing the demonstration system.



Construction

The treatment system is designed to remove sulphate and iron from mine influenced water pumped from the 2-South underground mine workings. A dewatering well (QU11-11) was drilled into the deepest part of the underground workings (285m elevation compared to Long Lake at 297m elevation) and fitted with a 40 horsepower pump to deliver water to the BCR cell. The pump is fitted with a variable frequency drive so that the output flow rate can be managed. Once water enters the BCR cell, all flows through the system are by gravity.

The general construction method was cut-and-fill to form the earthen embankments for the different cells that make-up the system. The design cut-and-fill volumes are tabulated (all as bank cubic metres) below.

	BCR Cell	Sulphide Polish Cell	Aeration and Settling Cells	Total
Cut (-) m^3	-3,840	-2,335	-6,141	-12,316
Fill (+) m^3	+12,742	+1,425	+1,837	+16,004
Net	+8,902	-910	-4,304	+3,688

Additional fill required for construction came from the cut material swell through excavation and placement and borrow from the adjacent full system construction areas. Approximately 75% of the cut material required drilling and blasting.

Three passive treatment technologies are utilized to treat the water pumped from the underground workings. A description of these three technologies and the design of each are described below.

Biochemical Reactor (BCR) Cell

Specific objectives of the BCR cell are to:

- Remove sulphate by reduction to dissolved sulphide ions
- Remove heavy metals (e.g., cobalt, iron) as sulphide precipitates
- Remove aluminum as a hydroxyl-sulphate
- Add alkalinity to the water in the form of bicarbonate
- Maintain a near neutral pH

The BCR cell is designed to treat up to 4.5L/sec of mining influenced water collected and pumped from the underground mine workings and pumped to the BCR cell.

The BCR cell is essentially a lined pond that is filled with a mixture of organic substrate and submerged in the mining influenced water. Soon after the organic constituents are submerged in water, the oxygen is consumed by aerobic microbes for respiration. When the oxygen has been fully depleted, the conditions in the substrate transition from aerobic to anaerobic. The

anaerobic microbial community performs the integral function of reducing sulphate to sulphide. The sulphide produced is a transitory sulphur species that can revert back to sulphate. To avoid this, the BCR cell effluent is discharged to the sulphide polish cell.

The demonstration BCR cell is constructed on cut and compacted fill, covered with a geomembrane liner and filled with a mixture of organic substrate submerged in the water pumped from the 2-South underground workings. With reference to Figure 1 below, the interior base of the cell is 41m x 63m, with 3H:1V sidelopes to a 4m wide embankment top 3.3m higher than the base.

The common header pipe that connects all of the cells is embedded in the south embankment of the BCR cell and has the required controls to accommodate any future additional BCR cells. The BCR cell also has distribution piping, collection piping and cleanouts.

The base and slopes of the BCR cell are lined with a field welded 60mil linear low density polyethylene ("LLDPE") geomembrane with an 8 oz/sy non-woven geotextile underlay and overlay.

The BCR was first backfilled with a 0.60m thick layer of drain gravel followed by a 2.0m thick layer of substrate composed of woodchips, hay/straw and limestone, then followed by manure mixed into the upper zone of the substrate. The substrate volumes backfilled in the BCR cell are tabulated below.

Material	Amount (kg)	Amount (m^3)
Animal Manure	7,500	13
Wood Chips	1,850,500	7,480
Hay/Straw	250,500	1,655
Limestone	375,500	190
Drainage Gravel		1,850

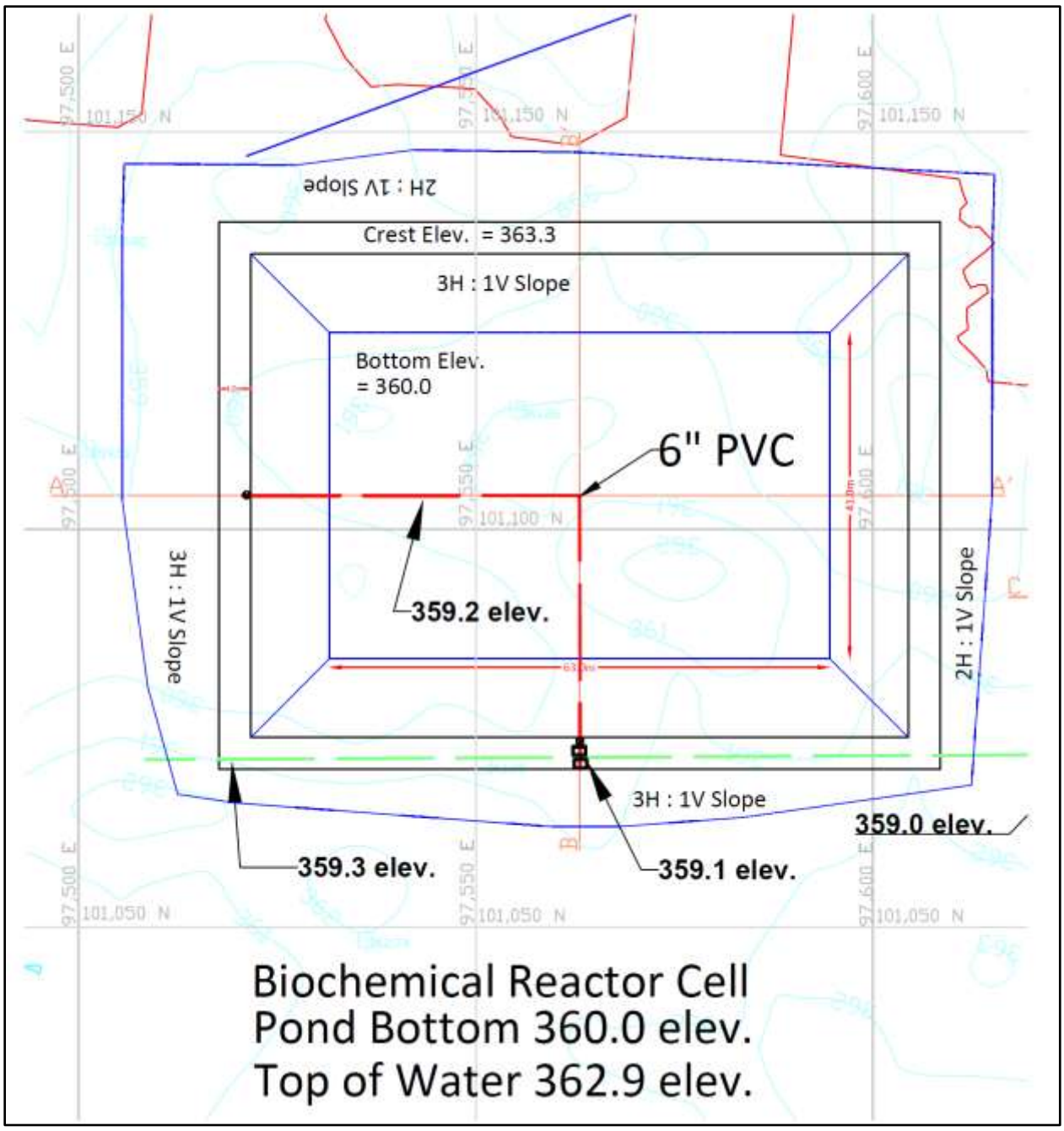


Figure 1: *BCR Cell Construction Design – Layout*

Sulphide Polishing Cell (SPC)

The specific objective of the SPC is to provide sequestration of hydrogen sulphide that is produced in the BCR cell. It is also possible that the SPC will provide arsenic removal through absorption to the iron media. The SPC system is designed to treat 4.5L/sec of water from the BCR cell effluent. The SPC includes distribution piping, collection piping and pipe cleanouts.

The SPC is essentially a lined pond that is filled with a mixture of iron media and wood chips submerged in the BCR cell effluent. The purpose of the iron is to bind with the hydrogen sulphide creating an iron sulphide precipitate and thereby sequestering the hydrogen sulphide. The wood chips are intended to provide greater hydraulic conductivity through the mixed media and reduce the possibility of clogging.

Similar to the BCR cell, the SPC was constructed on cut and compacted fill and covered with a geomembrane liner sandwiched between two layers of geotextile. The liner system for the SPC consists of a field welded 60mil thick LLPDE panels which were installed over an 8 oz/sy non-woven geotextile layer which acts as a cushioning sub-grade layer. Another 8 oz/sy non-woven geotextile is installed over the liner to protect it from puncture during the installation of the drainage gravel and iron media.

After the liner was installed a thin layer of drainage gravel was spread on the SPC floor and the lower distribution pipes (perforated and non-perforated) were installed including cleanouts that extend to the top edges of the SPC. The distribution pipes were then covered with additional drainage gravel.

The 2m thick iron media, substrate of wood chips mixed with iron fines, layer was then placed above the drainage gravel. The water collection piping, which serves to collect the effluent from the SPC, was then installed over the substrate.

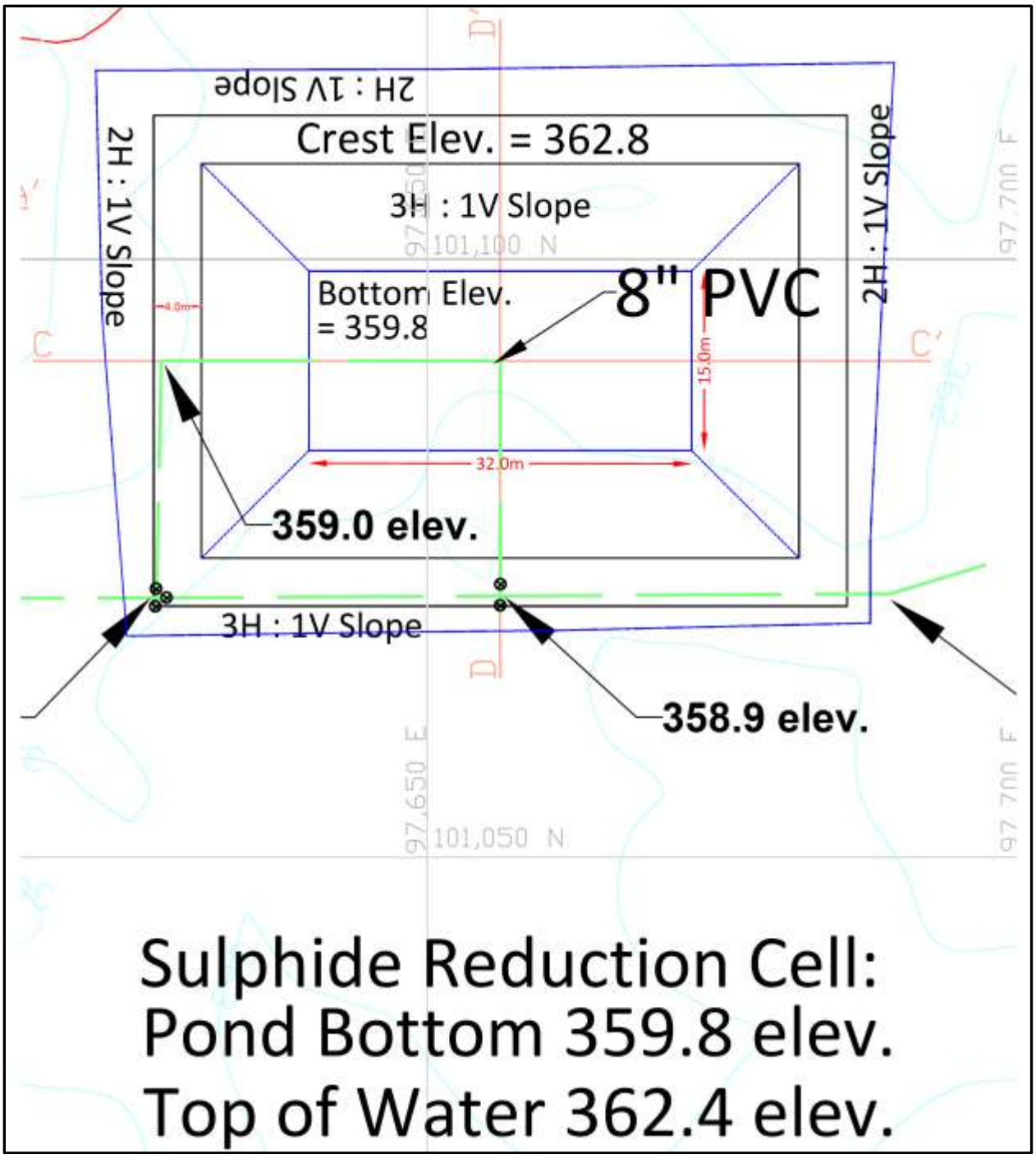


Figure 2: *Sulphide Polish Cell Construction Design – Layout*

Aerobic Polishing System (APS)

The APS includes both the Aerobic Lagoon (AL) and the Settling Pond (SP). Specific objectives of the APS are to remove nutrients introduced by the BCR cell and SPC, provide precipitation of excess iron introduced by the SPC and provide settling and storage of suspended solids. The Al and SP are both designed to treat 4.5L/sec of water from the BCR cell effluent or SPC effluent.

The APS was constructed on cut and compacted fill and covered with a geomembrane liner underlain by a layer of geotextile. The liner system for the AL and SP consists of field-welded 60-mil thick LLDPE panels which were installed over an 8 oz/sy geotextile layer which acts as a cushioning sub-grade layer.

A floating aerator and floating mixers are installed in the AL.

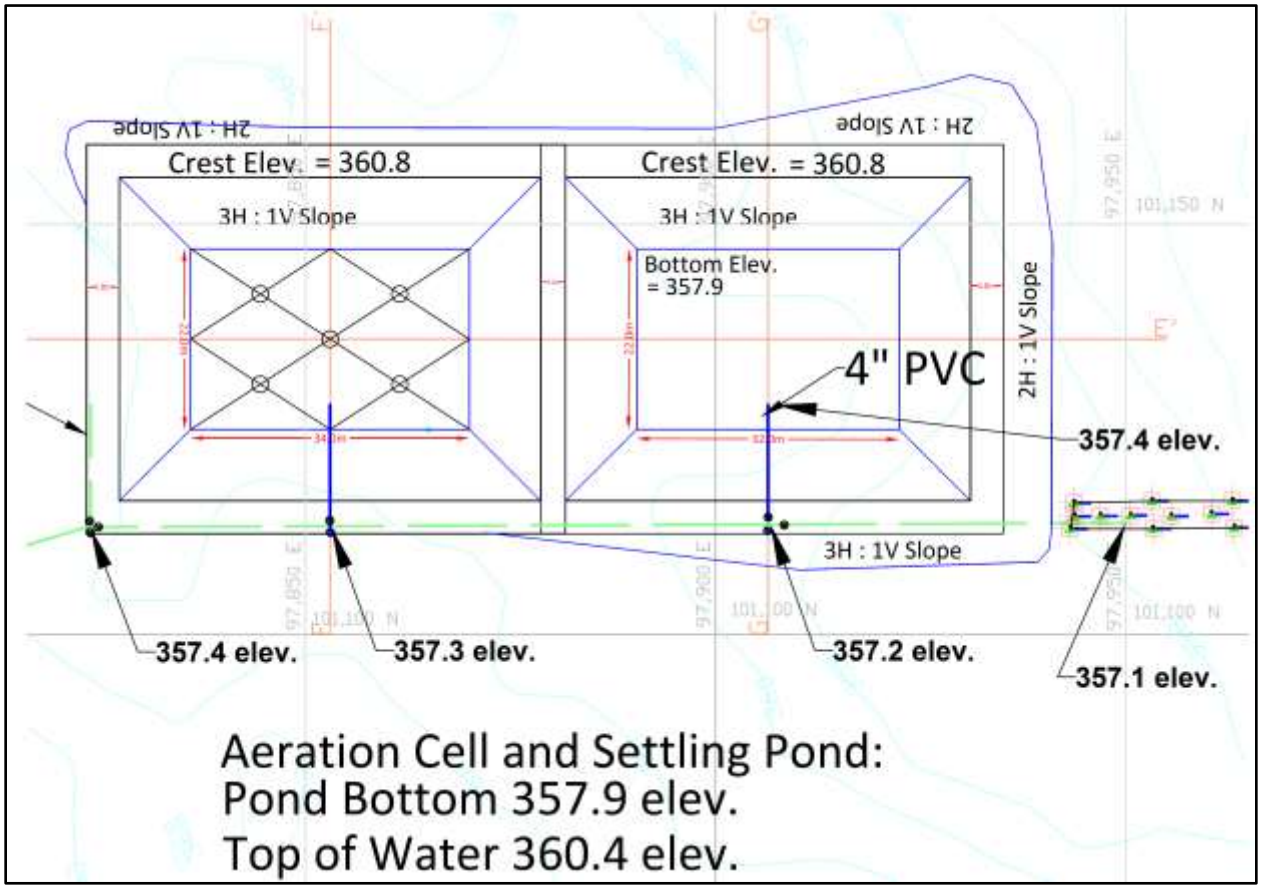


Figure 3: *Aerobic Polishing System Construction Design – Layout*

Settling Pond Effluent Channel

Effluent from the SP discharges to a rock lined open channel (with a non-woven geotextile underlay) that conveys the system water to the Settling Pond 1 (SP1) outflow channel.

(Note, this alignment is a variation from what was presented in the Mine Permit amendment application, which indicated the SP effluent being directed into SP1. The change in location was made to avoid drilling and blasting through the haul road and to provide a better gradient.)

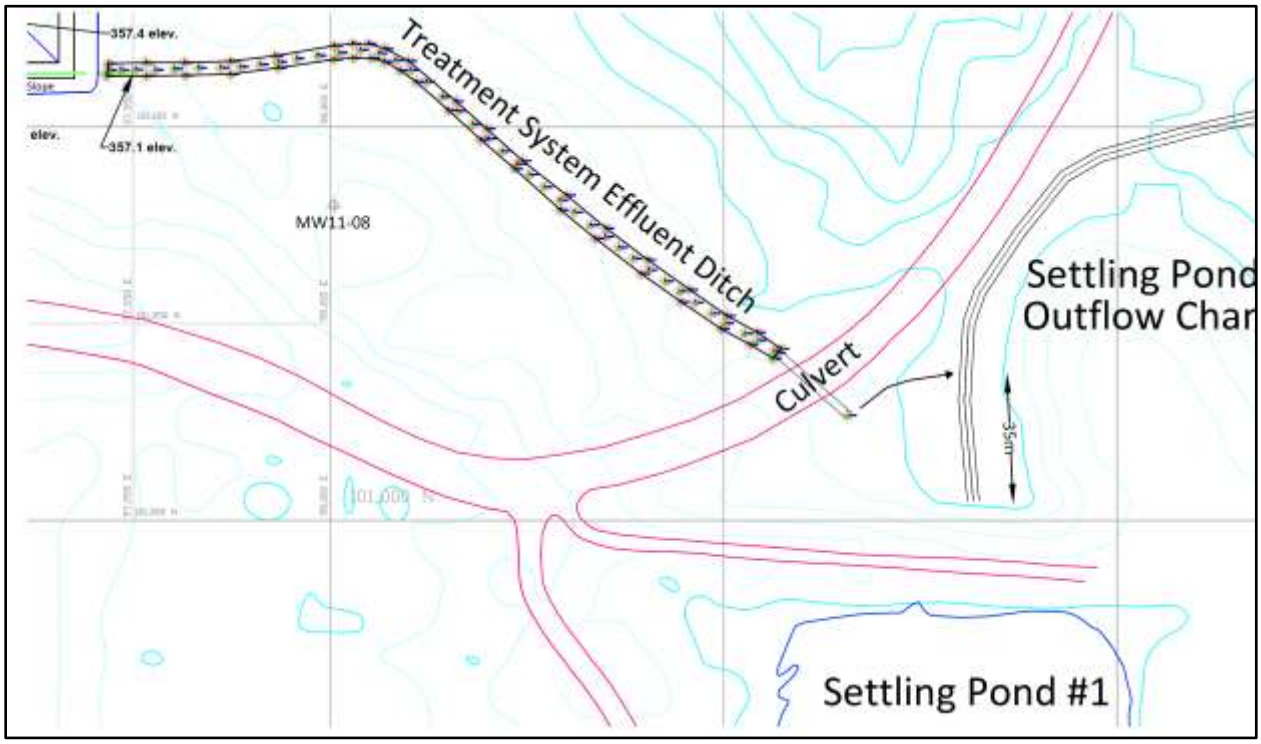


Figure 4: *Settling Pond Effluent Channel Construction Design – Layout*

Commissioning

Commissioning to-date has involved filling the BCR cell with an initial charge of water pumped from the 2-South underground pool, allowing that water to incubate for a period of time, starting the flow of water from the BCR cell through the aeration cell and settling pond and release to the environment. To this point in time (January 28, 2013) the sulphide polish cell is being by-passed.

Following is a chronology of commissioning activities:

August 30 to September 10: the BCR cell was filled (6,470 m^3) with an initial charge of water pumped from the 2-South underground mine pool and an incubation period started.

September 22 – 25: The aeration cell was partially filled (1,350m^3) with water pumped directly from the 2-South underground mine pool. This was done to accommodate the installation of the aerator and mixers.

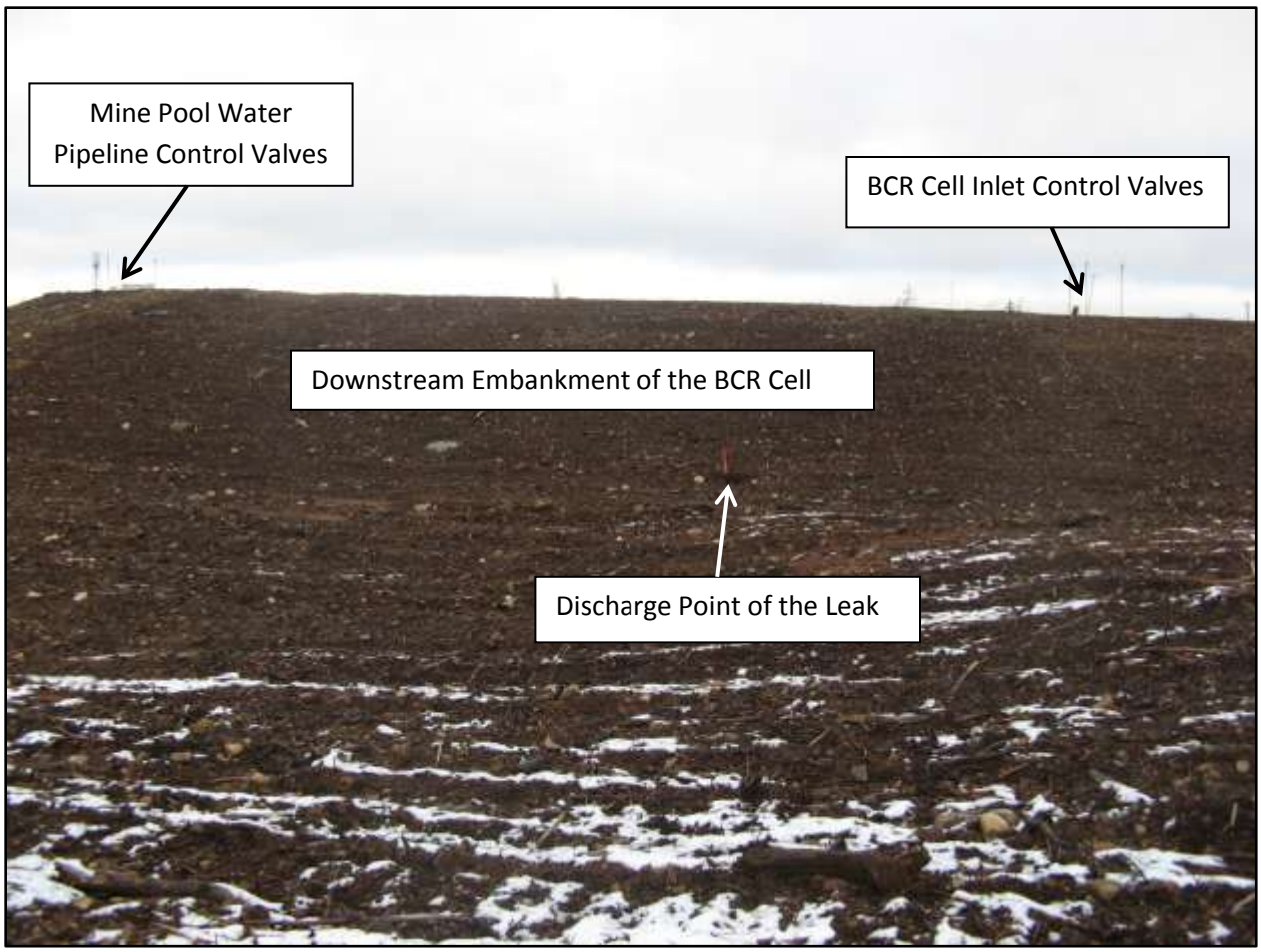
October 12: Started discharging BCR cell effluent to the aeration cell, bypassing the sulphide polish cell.

November 13: The aeration cell started overflowing in the settling pond.

November 19: The settling pond started discharging to the open channel, with the outflow mixing with the SP1 outflow.

December 5: A leak was noted at the base of the BCR cell embankment (inlet side). Pumping into the BCR cell was stopped and the water level in the cell dropped by allowing the effluent to continue to discharge to the aeration cell. Refer to *Photograph 2* below.

December 13: The water level has dropped below the elevation on the inlet pipe boot through the geomembrane at which point the leak stopped. Pumping recommences into the BCR cell at a rate of 2.2 L/s. The pumping rate has been gradually increased to 4.0 L/s.



Photograph 2: *Leak from the BCR Cell*

Since the initial 6,470 m^3 charge of water was pumped into the BCR cell, 9,450m^3 (to January 4, 2013) has been put through the BCR cell.

Monitoring Results

Figure 1: Flow Rate



This figure shows the flow rate through the PTS as measured from the influent pipe flow meters. Since startup this flow has been directed through the biochemical reactor (BCR), aerobic lagoon (AL), and settling pond (SP) components of the system. The important thing to note from this figure is that the flow rates were decreased from approximately 4.5 L/sec to under 3 L/sec in November. This decrease in flow was a result of a leak noticed on the west side of the cell, thought to be the result of a failure in the pipe boot where the pipe passes through the liner near valves V5 and V6. It was decided to keep the flow at a rate which kept the water level below that pipe boot until further investigation can be conducted in the spring/summer of 2013 and the leak fixed. Golder agrees with this path forward and recommended against altering the flow rate through the PTS for the next few sampling events to eliminate that as a variable in treatment performance.

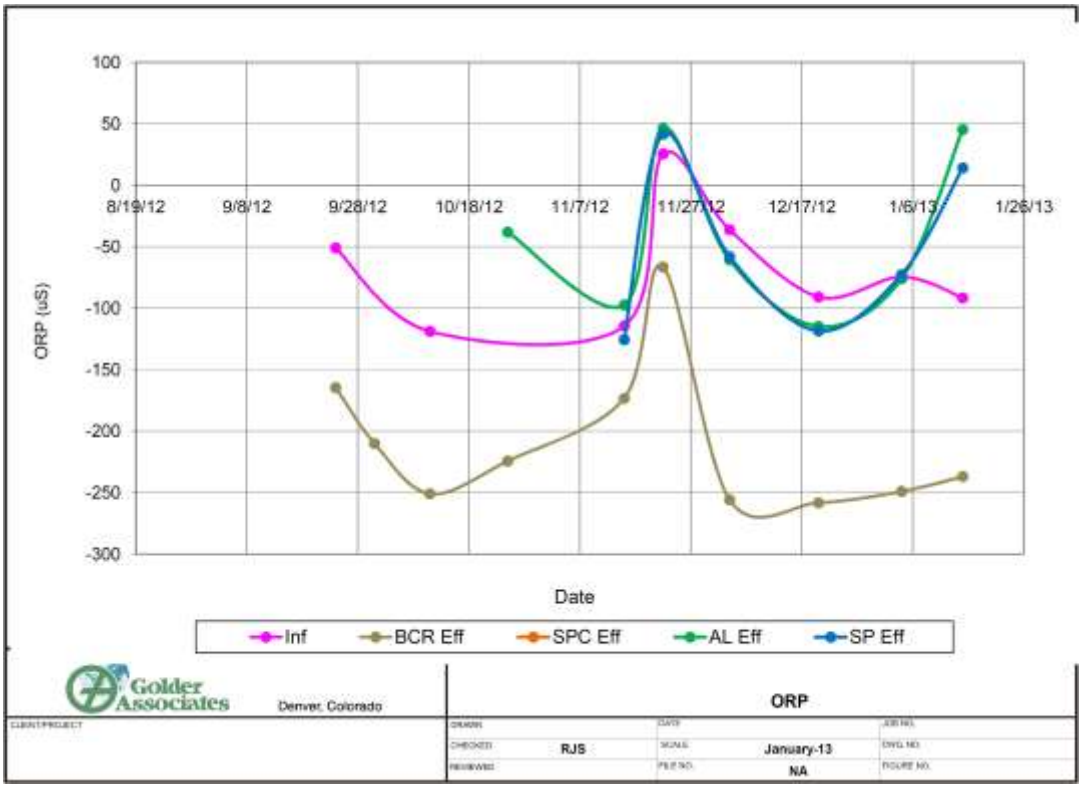
One theory discussed as to why the pipe boot may have failed is that the piping was elevated by the substrate when the BCR cell was filled with water. Golder mentioned that this may have been due to the way in which substrate was placed in the cell (in one or two lifts, rather than in one foot lifts). Future BCR cell construction/substrate placement should be conducted in smaller lifts to avoid this occurrence in the future.

Figure 2: pH



This figure shows that the pH decreases as the water flows through the BCR and then increases as it passes through the AL and SP. The pH values shown are typical of what is normally seen in other passive treatment systems. We expect the BCR, AL, and SP effluent pH to normalize around the levels they are currently at.

Figure 3: ORP

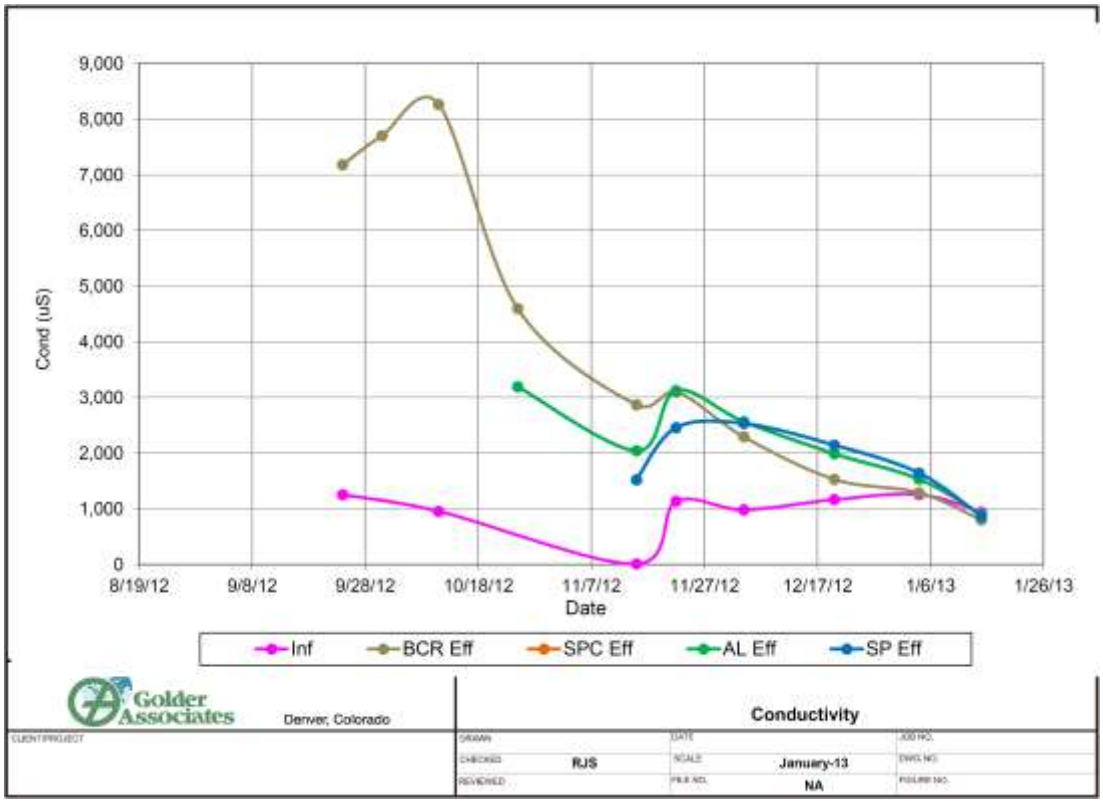


ORP or Oxidation Reduction Potential is the measure of a chemical species tendency to acquire electrons and therefore become reduced. While ORP is a notoriously hard parameter to measure, values around -200uS or less should indicate that conditions are favorable for sulfate reduction to sulfide.

The ORP in the BCR is reduced by microbes that respire oxidized species. The ORP figure shows that the BCR is generally maintaining conditions that can provide sulfate reduction. The higher ORP values measured during the Nov 22nd 2012 sampling event appear to be an issue with the probe or sampling. This is assumed because the ORP is elevated at all sampling locations (you would expect that a higher influent ORP would not show up in the downstream components until later sampling events because of the long retention time through the system).

As expected, the ORP increases in the AL as oxygen is introduced and oxidizes many of the species that were previously reduced by microbes.

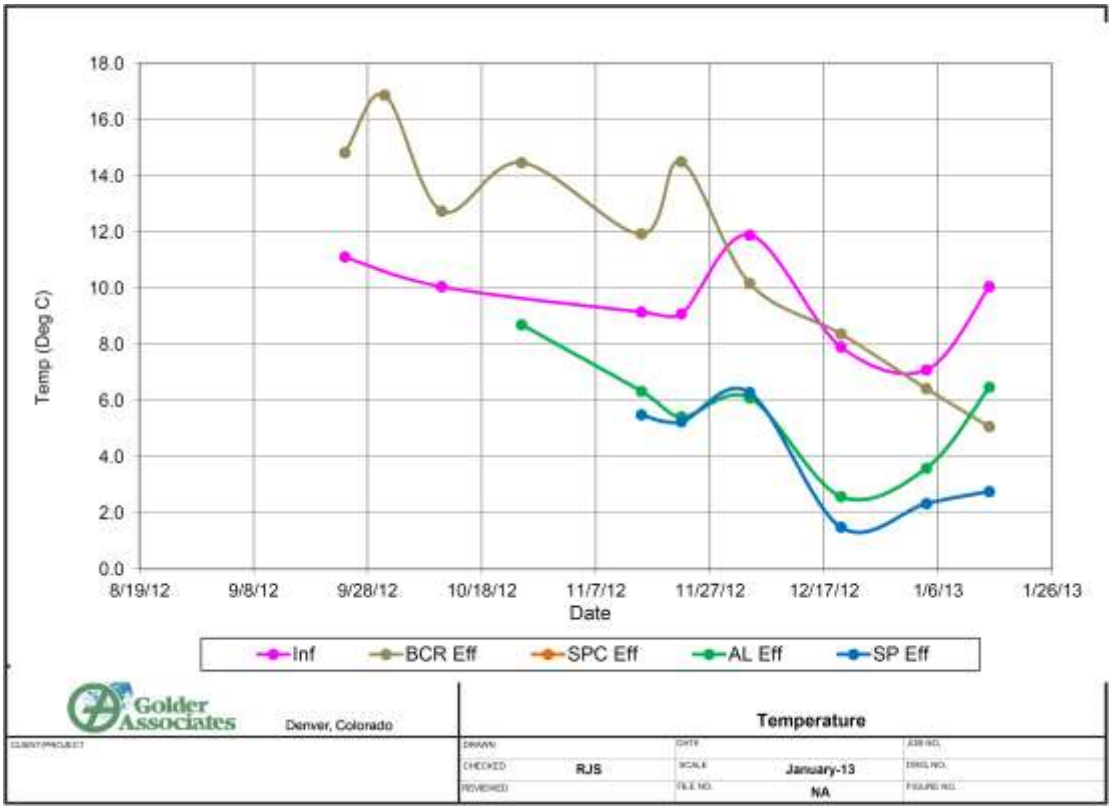
Figure 4: Conductivity



Conductivity is a measure of liquid's ability to transmit electrical current. Higher conductivity values indicate that electrical current can flow more easily through the water. Dissolved ions in the water help create an easy path for electrical current, and therefore conductivity can be correlated with the total dissolved species.

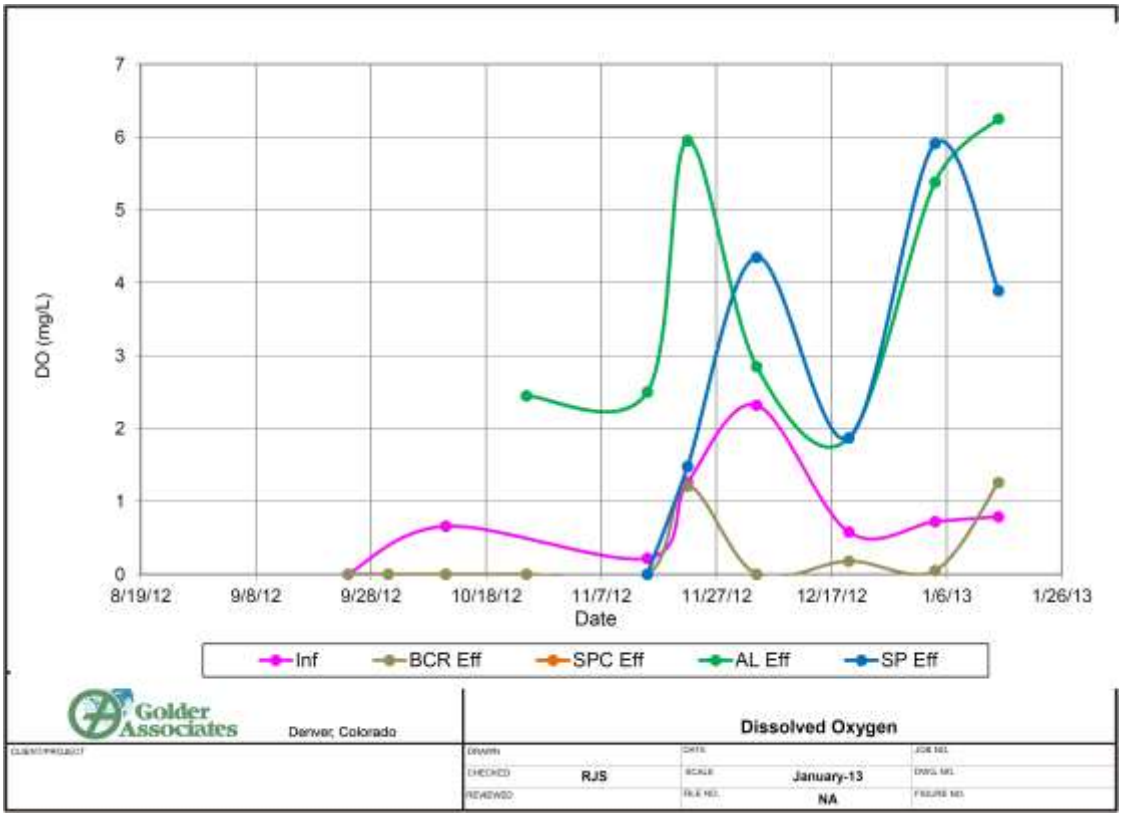
Figure 4 shows that there is a spike in the conductivity of the water as the PTS goes through startup. The conductivity values are decreasing as mobile organics and other suspended solids flush from the BCR. This is typical of BCR systems during startup. As the BCR matures, the conductivity of the PTS components should be similar or less than the influent because dissolved sulfate is being removed from the water and substrate leaching should be substantially reduced (this is observed during the Jan 15th 2013 sampling event).

Figure 5: Temperature



Microbial activity in the PTS components is highly dependent on the temperature. Bench testing has shown that temperatures below about 10 °C will result in decreased sulfate reduction. Figure 5 shows that the temperature in the BCR has decreased during the winter months and may have caused a decrease in sulfate reduction (as shown in Figure 8). Additional sampling data will show if this trend continues.

Figure 6: Dissolved Oxygen



Microbes that reduce sulfate cannot tolerate high concentrations of oxygen, and therefore the dissolved oxygen (DO) in the BCR should be less than 1mg/L to achieve better sulfate reduction. Oxygen that is present in the influent water is generally consumed by aerobic microbes before the sulfate reducing microbes can do their job.

Figure 6 shows that the DO in the BCR is generally below 1mg/L. Higher DO concentrations during the January 15th, 2013 sampling event may be due to decreasing temperature in the BCR or could be a product of the BCR startup. Additional sampling data may confirm this. As expected, the DO increases in the AL where the surface aerators facilitate the diffusion of oxygen into the water. The DO is partially consumed (via respiration) in the AL and SP by aerobic microbes that also consume residual nutrients and carbon from the BCR.

Figure 7: Dissolved Sulphate

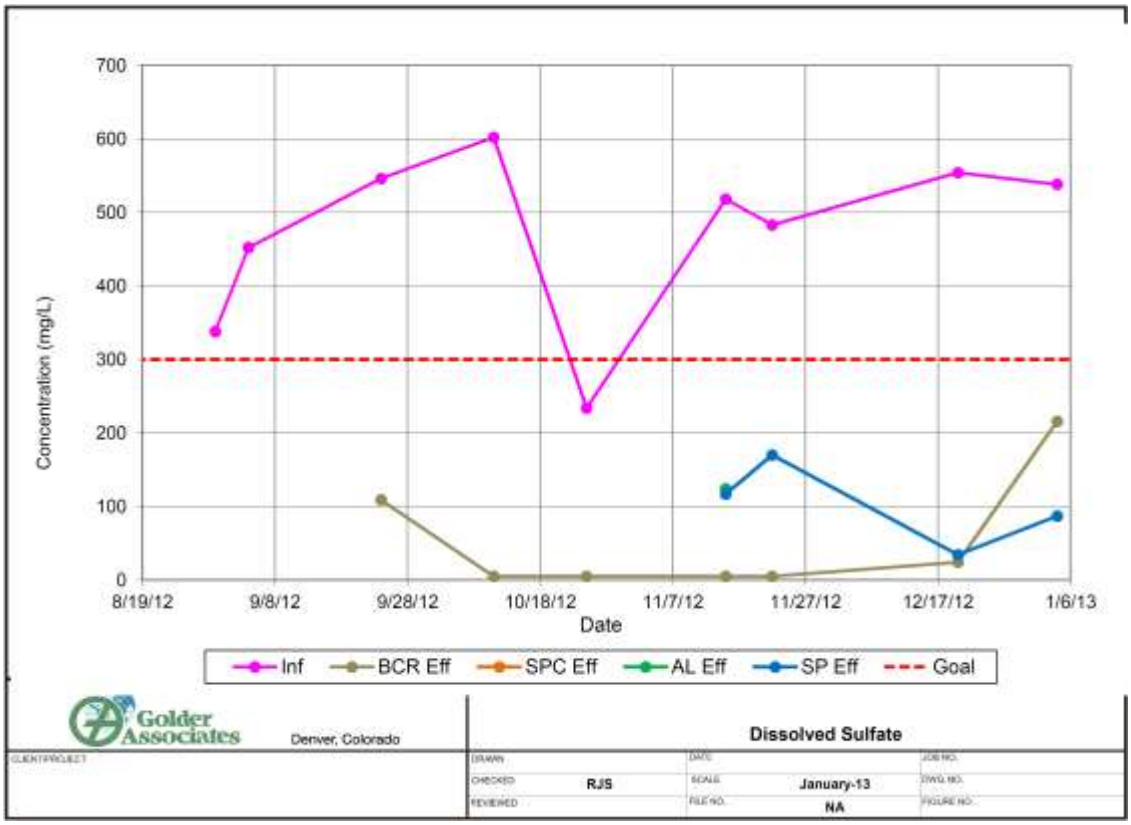


Figure 7 shows the dissolved sulfate throughout the PTS system. The last two sampling events have shown that the sulfate concentrations are increasing in the BCR. Some possible reasons for the sulfate increase may include:

- Lower BCR temperatures that lead to reduce microbial activity;
- Lower iron concentrations in the BCR (as we get to the end of startup conditions);
- Higher sulfate concentrations in the influent after the October 25th 2012 sampling event;
- Reduced retention time in the BCR due to a reduction in the water level; and/or
- The BCR may still be in a startup condition.

Additional sampling data in the coming months will help to show why the sulfate concentrations are increasing.

Figure 8: Sulphide

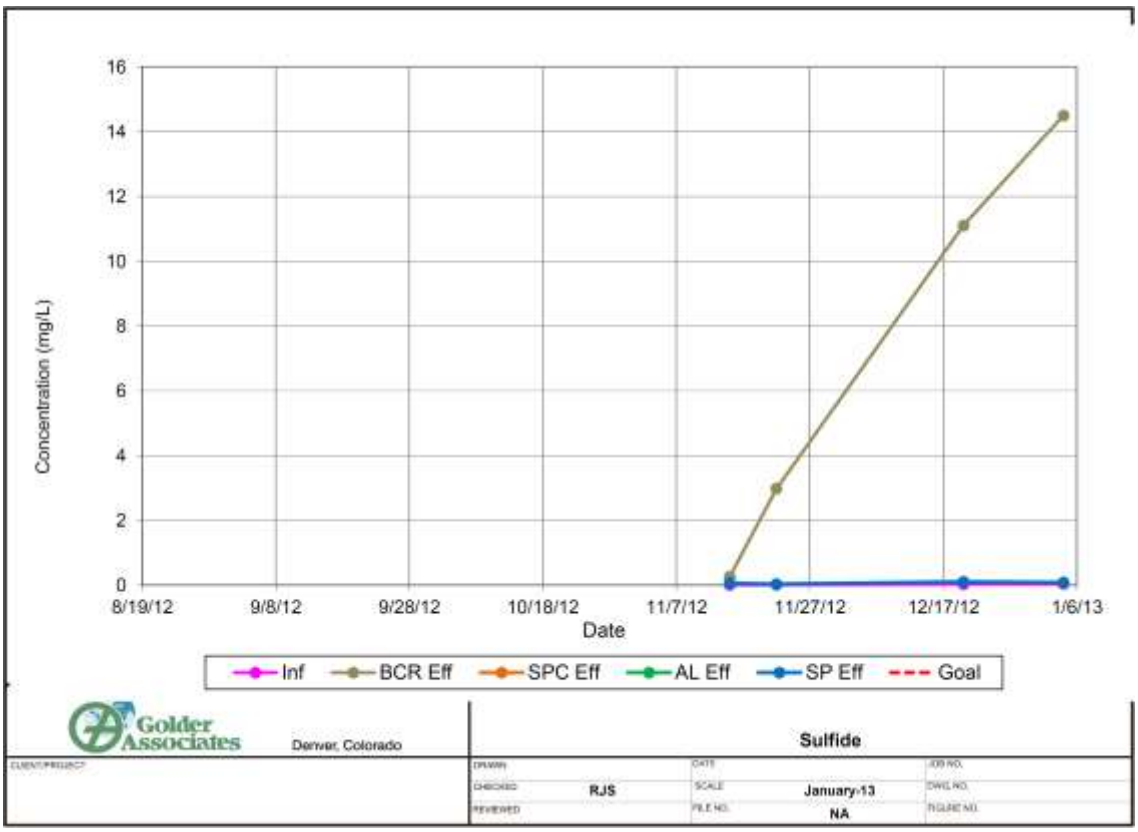
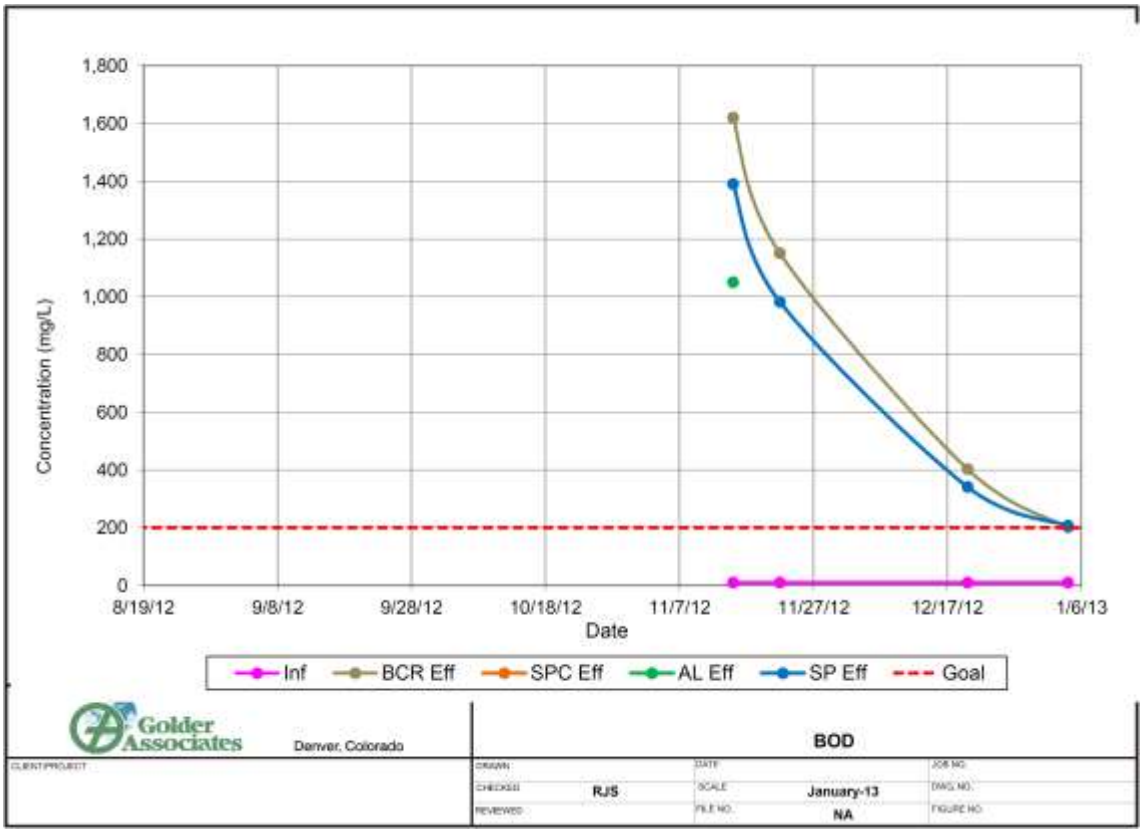


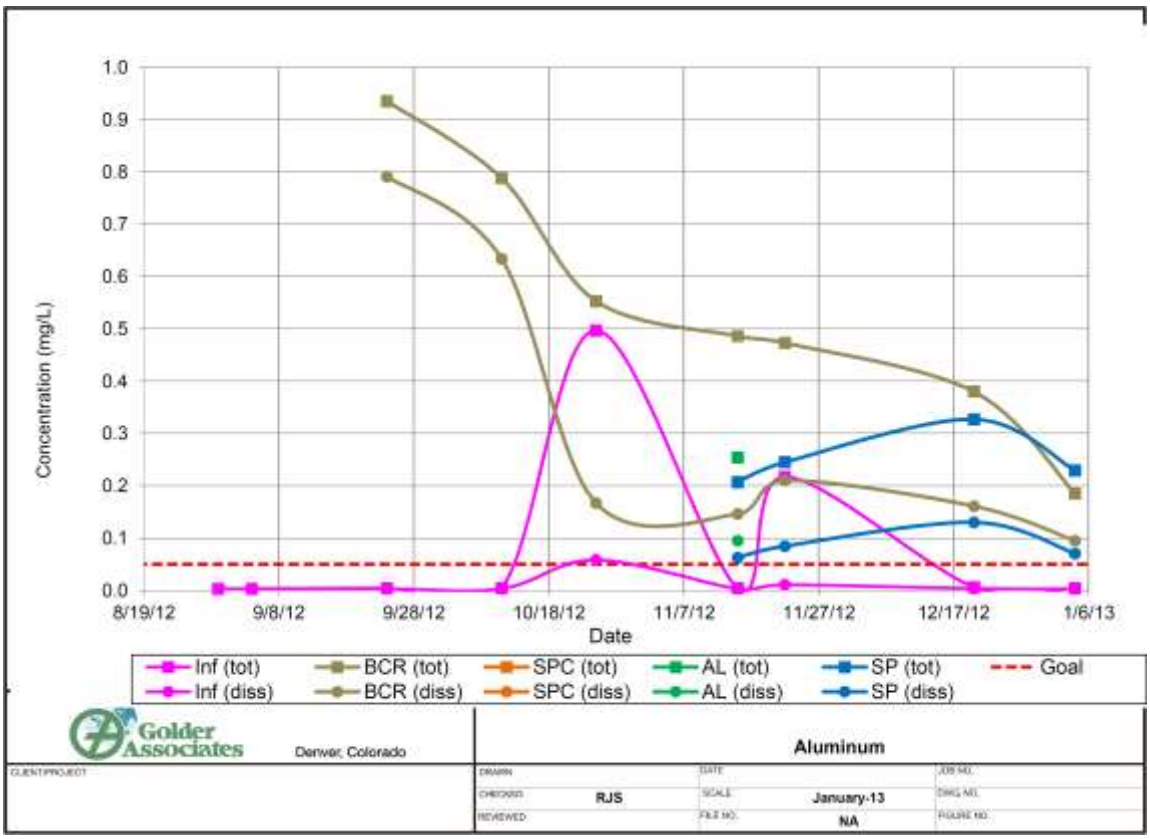
Figure 8 shows the sulphide concentrations throughout the PTS components. Because the BCR removes sulfate by reducing it to sulphide, you would expect that sulphide in the BCR would increase after startup. The initial sulphide that was produced in the BCR may have bound to the iron that was leached earlier in the startup period. As iron flushes out from the BCR (Figure 13), there will be less iron for the sulphide to bind to, resulting in a higher sulphide concentration leaving the BCR. Additional sampling data will help us determine when the SPC should be brought on line to provide additional iron for binding the sulfide.

Figure 9: BOD



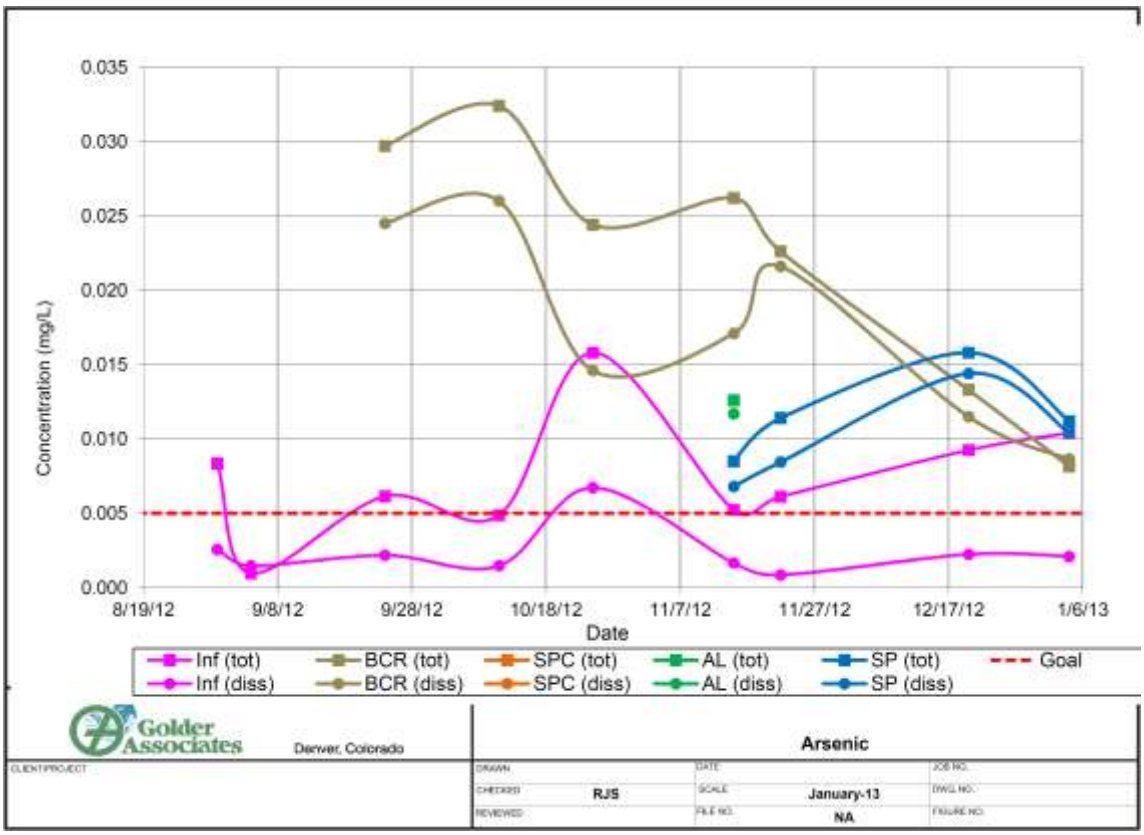
The BOD concentrations shown in Figure 9 are typical of what is observed in a PTS during startup. The BOD concentrations should continue to drop as additional pore volumes are sent through the BCR. The AL and SP appear to be doing a good job of reducing the BOD levels from the BCR effluent. Note that there is a chance that the BOD in the BCR effluent may increase somewhat during the warm summer months, but that increase should be offset by a greater removal efficiency in the AL and SP.

Figure 10: Aluminum



The leaching of aluminum during BCR startup can be observed in Figure 10. Aluminum concentrations should continue to decrease as additional pore volumes are sent through the BCR.

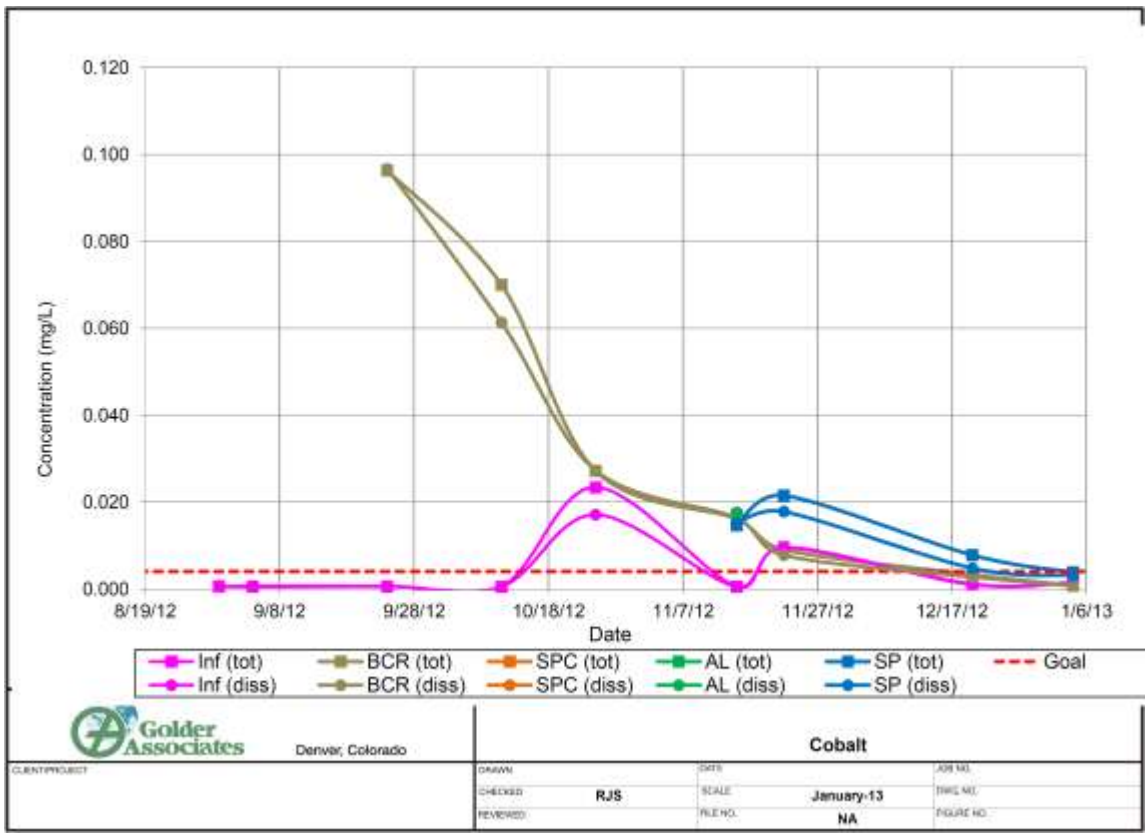
Figure 11: Arsenic



The leaching of arsenic during BCR startup can be observed in Figure 11. Arsenic concentrations should continue to decrease as additional pore volumes are sent through the BCR. Arsenic is removed by absorption to iron hydroxides and the arsenic concentration may be reduced further when flow is sent through the SPC (The SPC will have its own leaching period when the arsenic concentrations may temporarily increase).

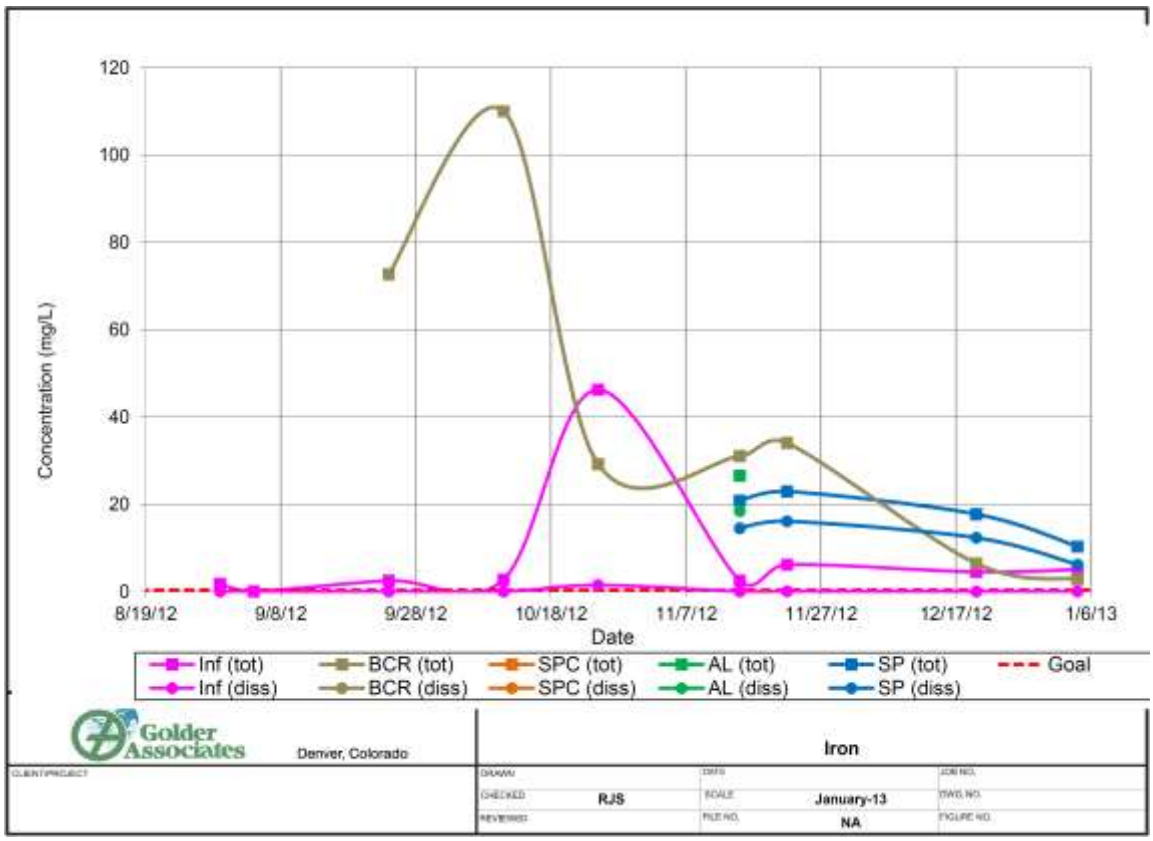
Of note is that the arsenic present in the BCR effluent and SP is almost entirely in the dissolved form. The arsenic should be removed from the water as it is oxidized to the As(V) species and co-precipitates with the iron oxyhyroxide in the AL and SP steps.

Figure 12: Cobalt



The leaching of cobalt during BCR startup can be observed in Figure 12. Cobalt concentrations should continue to decrease as additional pore volumes are sent through the BCR.

Figure 13: Iron



The leaching of iron during BCR startup can be observed in Figure 13. Iron concentrations should continue to decrease as additional pore volumes are sent through the BCR. As discussed in Figure 8 above the decreasing iron concentrations may be responsible for the increasing sulfide concentrations. It is unclear why the dissolved iron concentrations are above the solubility limit at this pH, as it is expected that most iron present in the SP water should be in the total form, rather than what is seen in the last few sampling events (approximately 50% of iron is in the dissolved form).

Several outstanding issues with respect to iron behavior are evident including iron solubility and poor particulate settling in the SP. A silt screen or other physical barrier could be installed in the settling pond if short circuiting is expected.

Construction Photographs

Photograph 3: *Coversoil Salvage and Initial Excavation of the BCR Cell*

Photograph 4: *Excavation (primarily in drilled and blasted rock) for the Settling Pond*

Photograph 5: *Placing the Geomembrane Liner (60 mil LLPE) over the Non-Woven Geotextile in the Settling Pond*

Photograph 6: *Placing the Common Header Pipeline and Valves Between the Sulphide Polish Cell and Aerobic Pond*

Photograph 7: *Cut-and-Fill Construction for the BCR Cell*

Photograph 8: *Installation of the Water-Level-Controllers in the BCR Cell*

Photograph 9: *Lined (geomembrane with a geotextile underlay and overlay) Sulphide Polish Cell (with the BCR Cell in the background)*

Photograph 10: *Placing the Drain Rock into the BCR Cell*

Photograph 11: *Drain Gravel and Lower Piping in the Sulphide Polish Cell*

Photograph 12: *Mixing Substrate (wood chips, hay and limestone) for the BCR Cell*

Photograph 13: *Placing Substrate into the BCR Cell*

Photograph 14: *BCR Fill filled with Substrate and Initial Charge of Water for Commissioning*

Photograph 15: *Substrate (mixture of wood chips and iron) and Upper Piping in the Sulphide Polish Cell*

Photograph 16: *Aerobic Cell with Aerator and Mixers (settling pond in the background)*

Photograph 17: *Settling Pond Effluent Channel Construction*



Photograph 3: Coversoil Salvage and Initial Excavation of the BCR Cell



Photograph 4: Excavation (primarily in drilled and blasted rock) for the Settling Pond



Photograph 5: Placing the Geomembrane Liner (60 mil LLPE) over the Non-Woven Geotextile in the Settling Pond



Photograph 6:
Placing the Common Header Pipeline and Valves Between the Sulphide Polish Cell and Aerobic Pond



Photograph 7: Cut-and-Fill Construction for the BCR Cell



Photograph 8: Installation of the Water-Level-Controllers in the BCR Cell



Photograph 9: Lined (geomembrane with a geotextile underlay and overlay) Sulphide Polish Cell (with the BCR Cell in the background)



Photograph 10: Placing the Drain Rock into the BCR Cell



Photograph 11: Drain Gravel and Lower Piping in the Sulphide Polish Cell



Photograph 12: Mixing Substrate (wood chips, hay and limestone) for the BCR Cell



Photograph 13: Placing Substrate into the BCR Cell



Photograph 14: BCR Fill filled with Substrate and Initial Charge of Water for Commissioning



Photograph 15: Substrate (mixture of wood chips and iron) and Upper Piping in the Sulphide Polish Cell

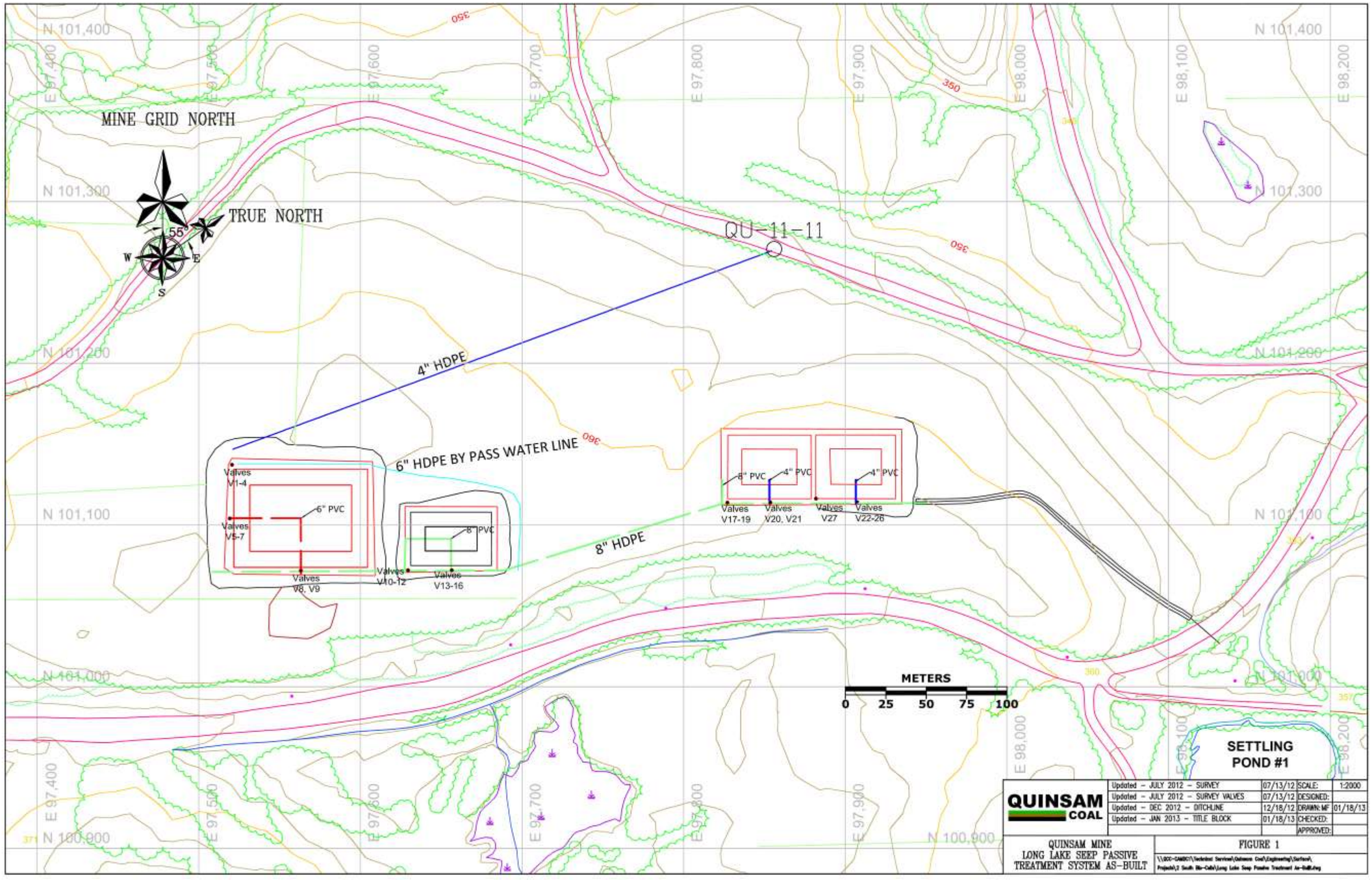


Photograph 16: Aerobic Cell with Aerator and Mixers (settling pond in the background)



Photograph 17: *Settling Pond Effluent Channel Construction*

As-Built Drawing



APPENDIX X

Site Maps

MINE GRID NORTH

TRUE NORTH

53°

WA = Inflow to Middle Quinsam Lake

WC = Mid-Point between Settling Pond #4 & Middle Quinsam Lake

WD = Discharge from Settling Pond #4

SETTLING POND #4

WP = North Pit Sump Water

PDS_R

MW00-1

MW00-6

2 NORTH PIT SUMP PAG CCR Disposal Site

PDS

PLANT SITE

OFFICE

FIRST AID

2NP_Sump = 2 North Portal Sump

3 NORTH

2 NORTH

QU-04-02

QU-04-03

QU-05-11

QN-07-02

MIDDLE QUINSAM LAKE

FINE REFUSE IMPOUNDMENT

South Dyke Sump = Receives seepage from the South Dyke of the Tailings Dam

87 PANEL PAG-CCR STORAGE

QU-13-15

QU-13-16

QRDS-1 = Quinsam River Downstream Site #1

MQL = Middle Quinsam Lake

WB = Outflow from Middle Quinsam Lake

NNO = No Name Lake Outlet

MW12-19

MW12-20

QU-13-18

QU-13-19

QU-13-17

7S = 7 South Preliminary Dischargepoint from 7 South Mine

QU-13-08

5 SOUTH PHASE 1

QU-13-14

7 SOUTH MINE

LLS - Long Lake Seep

3S = 3-South Pit Water

NO NAME LAKE

MW11-9

LLO = Long Lake Outflow

5 SOUTH PHASE 2

QU-13-10

5 SOUTH MINE

QU-13-09

QU-13-01

QU-13-02

QU-13-03

LONG LAKE

LLM = Long Lake Middle

ROCK QUARRY

MW00-2

MW00-5

MW00-3

MW00-4

MW12-23

MW12-24

3 SOUTH PIT PAG CCR Disposal Site

1 SOUTH SUMP

2 SOUTH SUMP

MW11-7

4S Under the PAD

4S LOWER

QU-13-13

QU-13-20

QU-13-12

7SVENTR

QU-13-21

7SPS = 7 South Portal Pond

7SSD = 7 South Surface Decant

QU-13-11

QU-13-22

2 SOUTH MINE

QU-11-11

2 South PAG-CCR Facility

4S Pond

LLE = Long Lake Entrance

4S Inflow

4S Upper Inflow

MW11-8

3S77

SPC = Downstream Discharge from Settling Pond #1

Downstream Wetland Receives flow from SPD

BDS - Biocell Down Stream

SPD = Settling Pond #1 Discharge

7SQR = 7S Quinsam River Downstream site for 7S Baseline Monitoring

4 SOUTH MINE

QU-13-24

QU-13-05

QU-13-06

QU-13-23

QU-13-07

METERS

0 100 200 300 400 500

QUINSAM COAL	Updated – January 2014 – Cleaned Dwg	01/13/14	SCALE:	1:5000
	Updated – January 2014 – Sample Sites	01/13/14	DESIGNED:	
	Updated – January 2014 – MW Sites	01/13/14	DRAWN: MF	01/13/14
			CHECKED:	
			APPROVED:	

QUINSAM COAL CORPORATION
ANNUAL RECLAMATION
REPORT FOR 2013

FIGURE 1

\\QCC-CAMDC1\Environmental\Reclamation\2013 \Site Map\2013 - Quinsam Annual Reclamation.dwg