Manitoba
CONSERVATION

WEST HAWK LAKE
WATER SUPPLY SYSTEM
ENVIRONMENTAL SITE ASSESSMENT (ESA)
WEST HAWK LAKE, MANITOBA

SUBMITTED BY: **FINAL REPORT** **JANUARY 2009**

KGS GROUP

KONTZAMANIS ▪ GRAUMANN ▪ SMITH ▪ MACMILLAN INC.
CONSULTING ENGINEERS & PROJECT MANAGERS

08-1521-02

KGS GROUP

KONTZAMANIS ▪ GRAUMANN ▪ SMITH ▪ MACMILLAN INC.
CONSULTING ENGINEERS & PROJECT MANAGERS

FINAL REPORT

WEST HAWK LAKE WATER SUPPLY SYSTEM
WEST HAWK LAKE, MANITOBA

ENVIRONMENTAL SITE ASSESSMENT (ESA)

JANUARY 2009

KGS Group Project 08-1521-02

Privileged and Confidential

Prepared for:
Manitoba Conservation
Box 46, 200 Saulteaux Crescent
Winnipeg, Manitoba R3J 3W3

KGS Group
Prepared by:

Marci Friedman Hamm, P.Geo
Senior Hydrogeologist

KGS Group
Reviewed by:

Robert D. Sinclair, P. Eng.
Manager, Environmental Services

Kontzamanis Graumann Smith MacMillan Inc.

KGS GROUP CONSULTING ENGINEERS

3rd Floor
865 Waverley Street
Winnipeg,
Manitoba
R3T 5P4
204.896.1209
fax: 204.896.0754
www.kgsgroup.com

January 23, 2009 File No. 08-1521-02

Manitoba Conservation
Operations Division, Environmental Services
Box 46, 200 Saulteaux Crescent
Winnipeg, Manitoba
R3J 3W3

ATTENTION: Mr. Mike Gilbertson
Manager, Environmental Section

RE: Manitoba Conservation
West Hawk Lake Water Supply System
West Hawk Lake, Manitoba
Environmental Site Assessment (ESA) - Final Report

Dear Mr. Gilbertson:

Please find enclosed two (2) paper copies and one electronic copy (pdf) of the Final Report for the West Hawk Lake Environmental Site Assessment (ESA) located in the community of West Hawk Lake, Manitoba.

Yours truly,

Robert D. Sinclair, P.Eng.
Manager, Environmental Services

MFH/BH/jr
Enclosure

EXECUTIVE SUMMARY

The West Hawk Lake townsite has had all municipal water supply requirements furnished by wells in the local sand aquifer located south of the Lake. In 2003, Manitoba Conservation detected petroleum hydrocarbon impacts at unacceptable levels in the groundwater. A new water plant was developed 300 m west of the impacted wells, supplied by groundwater from new wells located near the plant.

Once the groundwater hydrocarbon impacts were defined, monitoring of the impacts in the sand aquifer was conducted since the gasoline tanks were located 50 m north of the wellfield. Recent monitoring by KGS Group has shown that hydrocarbon impacts have persisted, but that the plume migration appears to be quite limited over the past few years. To further assess the potential hydrocarbon plume migration over the next few years, KGS Group is recommending an improved monitoring system with yearly monitoring. Groundwater modelling of the current wellfield in the sand aquifer indicates travel times of approximately 20 years and likely longer from the hydrocarbon impacted area to the new wellfield. There is time, therefore, to better define the actual plume movement in the field prior to implementing possible remediation options. A pumping system using the wells in the former wellfield to create a simple irrigation system operating only during warm weather periods each year could mitigate plume migration if required. The National Contaminated Sites Classification System demonstrated that the site would be a medium priority for remediation. With additional monitoring data, the rating can likely be lowered.

Testing and assessment of the current wellfield and water plant by KGS Group as part of the work program has demonstrated well capacity and quality concerns in addition to treated water storage and chlorine contact time concerns. The major water quality concern is data which indicates leakage from a sewage pumping station 10 m east of the new wellfield impacting on well water quality. Conductivity, chloride, sodium and nitrate levels are much higher in the well (Well 1A) closest to the pumping station as compared to the well furthest away (Well 5). There were no bacterial impacts defined by the KGS Group assessment and the silty fine sand is likely providing a good natural filter to potential bacterial migration in the aquifer. Also, the good natural filtering capacity of the local silty sand aquifer and no nearby surface water, indicate low GUDI related concerns.

The assessment of the current wellfield has shown that the 5 wells have similar capabilities, near 3 L/s (40 lgpm). The overall wellfield has a capacity near 9.6 L/s (120 lgpm). The flow data for the water plant demonstrates that the peak daily flow was 290 m^3/day (60,000 lgpd) in 2007 for an average peak day flow of 3.2 L/s (42 lpgm) and a peak hourly flow near 9.6 L/s (120 lgpm) for an estimated peaking factor of 3. A future peak design flow to 390 m^3/day (84,000 lgpd) is proposed for the West Hawk Lake water system and this is the equivalent of an average peak day flow of 4.5 L/s (60 lgpm) and an estimated peak hourly flow of 13.5 L/s (180 lgpm).

To provide the above peak water flows with redundancy, as well as mitigation of sewage pumping station impacts, KGS Group is proposing a total of 3 new large diameter wells 100 to 200 m to the northwest of the current wellfield. An expansion of the current water plant on the north side is proposed to accommodate 3 new 76.8 m^3(1,500 lgal) polyethylene tanks for additional storage for both chlorine contact time improvements and peaking flow demands. Iron and manganese are above aesthetic criteria but are not causing any visible staining within local

plumbing fixtures and are not required for aesthetic parameters by the Office by Drinking Water, therefore, iron and manganese removal has not been included in the new proposed upgrades.

Coupled with the above work, the sewage pumping station should be moved to a more appropriate location as soon as possible because of the impacts on water quality as shown by nitrates and indicator parameters. It is understood that the relocation of the sewage pumping station to a more appropriate location is in the planning process but has higher urgency based on recent KGS Group water quality assessments.

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS
(CONTINUED)

PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

Kontzamanis, Graumann, Smith and Macmillan Inc. (KGS Group) was contracted by Manitoba Conservation, Operations Division, Environmental Services to provide environmental services at West Hawk Lake, Manitoba (Figure 1 and Figure 2). The purpose of the investigations was to delineate previously identified hydrocarbon impacted groundwater at the Keystone Resort and former pumphouse area, prepare a Remedial Action Plan (RAP), perform a groundwater quality assessment of the current supply wells, and develop a cost analysis for a permanent water supply source. The area of investigation for hydrocarbon impacts included the Keystone Resort, the former pumphouse and well field, and the Manitoba Conservation Maintenance Compound (Figure 3). A groundwater assessment was also performed at the current water supply system located within the West Hawk Trailer Village seasonal camping area.

This report summarizes the results of field investigations conducted by KGS Group from July 31, 2008 to September 8, 2008. Figure 1 shows the site location map and Figure 2 illustrates the current features of the subject site together with the monitoring well locations and locations of the current supply wells.

1.1 OBJECTIVES

The objectives of the investigation, as described in the Manitoba Conservation Terms of Reference (TOR) were as follows:

- Completion of a groundwater monitoring/sampling program to determine the current groundwater chemistry with respect to on-site conditions. This will include the wells that form the former residential water supply and the current supply;
- Completion of a report discussing groundwater chemistry in terms of relevant remediation guidelines providing conclusions as to the extent and degree of impacts, if any. In addition, the reports will provide a detailed discussion on regional and site specific factors as established as the minimum data requirements within the 2008 CCME National Classification System for Contaminated Sites Guidance Document (NCSCS);
- Based on the findings of the groundwater sampling program and review of existing documentation, a report summarizing the available remedial alternatives will be prepared. An estimated cost of each alternative, complete with a remedial time frame and risks and KGS Group's recommended alternative will be provided. Several

alternatives will be considered and a Remedial Action Plan (RAP) will be prepared for the recommended option; and

- In the event that remediation is determined to be not feasible, not cost-effective or not likely to achieve the required level of assurance that the drinking water supply will be un-impacted by the petroleum hydrocarbon impacts over the short and long term, KGS Group will develop feasible options for a permanent alternate water supply. A cost analysis will be completed incorporating design and construction costs. Meetings will be required with all stakeholders so that the design and location of the supply is of a sufficient quantity to satisfy current and projected use.

1.2 SCOPE OF WORK

The scope of work for the investigations at the West Hawk Lake Water Supply System was to delineate previously identified hydrocarbon impacted groundwater at the subject area, prepare a Remedial Action Plan (RAP), perform a groundwater quality assessment of the current supply wells, and develop a Cost Analysis for a Permanent Water Supply Source. Specifically, KGS Group performed the following tasks:

- ***Review of Existing Information*** – Reviewed and evaluated the previous environmental investigations completed for the property, the existing information on the geological and hydrogeological setting of the area, as well as the identification of migration pathways and potential receptors.

- ***Groundwater Monitoring of Hydrocarbon Impacted Area*** – Obtained groundwater samples from existing monitoring wells within the Keystone Resort area, the old well field, and the Manitoba Conservation maintenance compound and submitted samples for laboratory analysis of petroleum hydrocarbons. Field investigations also included measuring the thickness of LNAPL, measuring the combustible vapour concentrations within each well using a photo-ionization detector, and field testing of pH, temperature, electrical conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP) and total dissolved solids.

- ***Field Hydraulic Conductivity Testing*** – Performed rising head tests on two of the monitoring wells located within the hydrocarbon impacted area.

- ***Groundwater Quality Assessment of Current Supply Wells*** – Obtained groundwater samples from each individual current water supply well located within the West Hawk Trailer Village seasonal camping area and submitted samples for laboratory analysis of inorganics as well as Total Coliforms and *E. Coli*.

- ***Capacity Assessment of the Current Supply Wells*** – Conducted short pump tests on each supply well and measured the drawdown within the pumping well as well as within adjacent wells in a non-pumping condition.

- ***Site Survey*** – Completed a survey at the West Hawk Lake Water Supply site to establish the elevations of the ground surface and water elevations of each monitoring well and supply well. The survey included locations and GPS coordinates of all monitoring and supply wells, as well as the locations of existing buildings, excavations, roadways, and all waterways (wells, rivers, creeks, ditches, etc).

- ***Groundwater Modeling*** – Developed a digital aquifer simulation model using Visual Modflow software to estimate the current and longer term drawdowns within the aquifer, and to estimate the time-of-travel of the hydrocarbon plume towards the current wells.

- ***Remedial Action Plan –*** Completed a remedial alternatives assessment, with a recommendation for the most appropriate remedial technology for the subject property, including the rationale and summary of the recommended remedial option with a cost estimate and implementation schedule.

- ***Cost Analysis of a Permanent Water Supply Source*** – Completed a cost analysis to convert the temporary water supply to a permanent water supply.

- ***Report Preparation*** – Prepared a comprehensive report detailing the results of the 2008 investigation, complete with a site plan of the property showing the locations of all supply and monitoring well locations, laboratory certificates of analyses, groundwater model results and documentation, the recommended remedial action plan, and the CCME National Classification System for Contaminated Sites (NCSCS) Site Classification Category System score for the impacted site.

The results of the investigation are discussed in subsequent sections of this report. Tables summarizing the results of the laboratory analyses are provided following the text, as is a detailed site plan illustrating the location of all supply wells and monitoring wells (Figure 3). Photographs taken at the time of the field activities are included in Appendix E.

1.3 SITE DESCRIPTION

The West Hawk Lake Water Supply site is located approximately 130 km east of the City of Winnipeg in the community of West Hawk Lake within the Whiteshell Provincial Park. Prior to August 2003, the community of West Hawk Lake obtained potable water from three water supply wells located within the West Hawk Lake pump house and well field area through a pipe distribution system as shown on Figure 3. Manitoba Conservation personnel detected petroleum hydrocarbons in community water supply well No. 3 during routine water sampling in August 2003. Information obtained from Manitoba Water Stewardship indicated that five new wells were drilled as a result of the hydrocarbon contamination and located in the campground area,

approximately 400 m west of the hydrocarbon impacted wells. Currently, these wells provide potable drinking water for the community of West Hawk Lake.

Based on the information provided in the TOR and previous environmental reports (including a Phase II Environmental Site Assessment, a Supplemental Phase II Environmental Site Assessment, and a Groundwater Monitoring Report) it is our understanding that the current West Hawk Lake Water Supply site includes the West Hawk Lake pump house and well field, the Manitoba Conservation maintenance compound and the Keystone Resort area. The former West Hawk Lake pump house and well field area includes a pump house and three inactive groundwater supply wells. A granular borrow pit was formerly located to the south of the former pump house and well field area and this low topographic area still remains. The Keystone Resort area includes a convenience store, motel, a pump island and two underground storage tanks (USTs) containing gasoline.

The project site is located within the Lake of the Woods Ecoregion, the general topography of which is characterized by bedrock outcroppings occurring throughout the region with glacial drift deposits located within the low areas of bedrock. Information obtained from the previous environmental studies at the West Hawk Lake Water Supply site indicated that the surficial geology in the area consists primarily of fine to medium grained sand with trace amounts of coarse sand and/or fine gravel deposits. Regional drainage is towards West Hawk Lake, located approximately 500 m east of the site.

1.4 SUMMARY OF PREVIOUS STUDIES

Several previous environmental studies have been completed for the subject property including: a Phase II Environmental Site Assessment in January 2004 by UMA Engineering Ltd. (UMA 2004a); a Supplemental Phase II Environmental Site Assessment in November 2004 by UMA Engineering Ltd. (UMA 2004b); and a Groundwater Monitoring Report in December 2007 by UMA Engineering Ltd. (UMA 2007). All three of the above-mentioned reports were reviewed by KGS Group and are summarized below.

Phase II Environmental Site Assessment, West Hawk Lake Well Field and Manitoba Conservation Maintenance Compound, West Hawk Lake, Manitoba. UMA Engineering Ltd. January 2004. Project No. 41-01-E107-006-00.

UMA Engineering Ltd. completed a Phase II ESA at the West Hawk Lake well field and Manitoba Conservation maintenance compound in October 2003 in order to determine the nature and extent of the soil and groundwater contamination that may have lead to the detection of dissolved petroleum hydrocarbons within Well No. 3 of the former community water supply system identified by Manitoba Conservation in August 2003. A total of four test holes within the well field and five test holes within the Manitoba Conservation maintenance compound were drilled, with all nine completed as monitoring wells. Results of the Phase II ESA were as follows:

- Elevated hydrocarbon vapours in soil measured in the field were encountered at WH-3 (south of the Keystone Resort) at approximately 4.3 - 4.9 m depth and at WH-7 (adjacent to the former above ground diesel fuel storage area) at approximately 0.9 - 1.5 m. No other elevated hydrocarbon vapours were measured at any other test holes.

- Residual hydrocarbons in soil were not detected at concentrations greater than soil quality guidelines (SQGs) published by the Canadian Council of Ministers of the Environment (CCME) in the Canadian Environmental Quality Guidelines, 2002 at samples collected within the Manitoba Conservation maintenance compound. Additionally, dissolved hydrocarbons were not detected within groundwater samples collected within the Manitoba Conservation maintenance compound.

- Residual hydrocarbons in soil were detected at concentrations greater than applicable SQGs adjacent to the Keystone Resort underground storage tank area. Concentrations of toluene (2.43 mg/kg) and xylene (5.04 mg/kg) in the soil sample from test hole WH-9 (3.8 - 4.1 m depth) exceeded the Canadian Council of Ministers the Environment (CCME) soil quality guidelines (toluene - 0.8 mg/kg, xylene - 1 mg/kg). Residual hydrocarbons in soil were also detected below applicable SQGs at test hole WH-7 (0.9 - 1.5 m depth).

- Concentrations of benzene, toluene, ethylbenzene, and xylenes in the groundwater samples collected at monitoring wells WH-3 and WH-9 were elevated above the CCME Canadian Drinking Water Quality Guidelines. Benzene and xylenes were also detected within the former community supply Well No. 3, but were below CCME Canadian Drinking Water Quality Guidelines.

- Recommendations were made to delineate the extent of the dissolved hydrocarbon plume, delineate the boundaries of the aquifer, and to maintain the former supply wells, pumps, and pump house for a potential remediation system to control the hydrocarbon plume.

Supplemental Phase II Environmental Site Assessment, West Hawk Lake, Manitoba. UMA Engineering Ltd. November 2004. Project No. 41-01-E107-006-00-02.

UMA Engineering Ltd. completed a Supplemental Phase II ESA at the West Hawk Lake former well field and Keystone Resort area in June and August 2004 in order to delineate the extent of the dissolved and liquid phase hydrocarbons identified between the well field and the Keystone Resort area during the previous Phase II ESA. A total of seventeen test holes, each completed with monitoring wells, and one recovery well were installed at the site. Results of the Supplemental Phase II ESA were as follows:

- Elevated hydrocarbon vapours measured in the field, were encountered at WH-19 and WH-20 (within the Keystone Resort area) as well as at WH-14, WH-15, WH-18, WH-27 (immediately to the southwest of the Keystone Resort).

- One or more components of BTEX and PHC (fractions F1-F4) in soil were detected at concentrations greater than applicable soil quality guidelines (SQGs) from samples collected from, or southwest of, the Keystone Resort underground storage tanks and fuelling area. Exceedances were observed in samples collected from WH-14 (5.5 m depth), WH-15 (5.3 m depth), WH-18 (4.9 m depth), WH-19 (3.5 m depth), WH-20 (3.8 m depth) and WH-27 (4.6 m depth). Residual hydrocarbons were not detected in soil samples collected from the remaining test holes.

- One or more components of BTEX in groundwater were detected at concentrations greater than applicable water quality guidelines (WQGs) from samples collected from, or southwest of, the Keystone Resort underground storage tanks and fuelling area. Exceedances were observed in samples collected from WH-9, WH-17, WH-19, WH-20, WH-21, and WH-25. Concentrations of BTEX and TVH in the remaining four sampled monitoring wells remained below laboratory detection limits.

- Nitrate concentrations in the vicinity of the dissolved phase hydrocarbon plume were detected below the laboratory detection limit, suggesting that hydrocarbon biodegradation is occurring via nitrate reduction. However, background levels of nitrate appear to be low around the area, and as such, nitrate reduction does not appear to be a significant contributor to hydrocarbon loss. Elevated dissolved iron and manganese concentrations were also observed along the core of the hydrocarbon plume, suggesting that anaerobic hydrocarbon degradation via iron and manganese reduction is occurring at the site.

- Recommendations were made to conduct semi-annual groundwater monitoring and sampling, to implement source reduction measures adjacent to the Keystone Resort tank basin, and to maintain the old supply wells and pumps, and pump house for a potential remediation system to control the hydrocarbon plume.

Groundwater Monitoring Report, West Hawk Lake, Manitoba. UMA Engineering Ltd. December 2007. Project No. E107-008-00-02 (4.6.1).

UMA Engineering Ltd. completed a Groundwater Monitoring Program for the West Hawk Lake former well field, Manitoba Conservation maintenance yard, and Keystone Resort area in November 2006 and June 2007 in order to monitor the movement of the dissolved petroleum hydrocarbons that were previously detected in the groundwater. A total of eight monitoring wells (WH-1, WH-3, WH-10, WH-11, WH-12, WH-17, WH-25, WH-26) were sampled for BTEX in November 2006 and June 2007. Results of the groundwater sampling program were as follows:

- All four components of BTEX in groundwater were detected at concentrations greater than applicable water quality guidelines (WQGs) from samples collected from monitoring wells WH-3, WH-17, and WH-25 (immediately to the southwest of the Keystone Resort underground storage tanks and fuelling area). Laboratory results were compared with the Community Drinking Water Quality Guidelines published by the CCME in Canadian Environmental Quality Guidelines, March 2006. The remaining five sampled monitoring wells were found to be below the laboratory method detection limits.

- Free phase product thickness at the site has been decreasing since September 2004. No free phase product was found in any of the monitoring wells during the June 2007 monitoring event.

- Groundwater flows in the area continue to be from the Keystone Resort tank basin toward the old well field and former borrow pit.

- Recommendations were made to continue to conduct semi-annual groundwater monitoring and sampling, perform weekly manual bailing of monitoring well WH-3 and /or the installation of a passive skimmer in the well, and to maintain the old supply wells, pumps, and pump house for a potential remediation system to control the hydrocarbon plume.

2.0 FIELD INVESTIGATION METHODOLOGY

2.1 HEALTH AND SAFETY PLAN

A site specific Job Safety Analysis (JSA) was completed through consultation with field personnel and the Project Manager prior to conducting field investigations. The JSA included a description of work to be completed, a list of applicable anticipated hazards, and safety controls to reduce or eliminate anticipated hazards. Also included were emergency numbers of the nearest ambulance, hospital, poison control centre and RCMP. Phone numbers for the KGS Group Project Manager, alternate KGS Group contact, and the Manitoba Conservation on-site contact were also kept available throughout the field investigations.

2.2 MONITORING WELL AND FORMER SUPPLY WELL SAMPLING

Groundwater monitoring and sampling of the Keystone Resort area, the former well field, and Manitoba Conservation maintenance yard was performed on July 31, August 1, and August 12, 2008 including the three former West Hawk Lake community supply wells, twenty-five existing monitoring wells and one recovery well previously installed by UMA in October 2003, June 2004, and August 2004. Immediately upon the location and opening of each monitoring well, the combustible vapour concentrations were measured using a Gastech photo-ionization detector. The depth to groundwater and the thickness of any liquid petroleum hydrocarbons (LPH) were measured using an ORS interface probe with an accuracy of 1.5 mm.

Groundwater samples were obtained from the monitoring wells using dedicated polyethylene disposable bailers. Prior to collecting the groundwater samples, the monitoring wells were purged a minimum of three well volumes or bailed until dry. This procedure was used to ensure the water samples collected were representative of the natural groundwater conditions. Groundwater samples were obtained from the former supply wells using new Waterra tubing. Prior to collecting the groundwater samples, the supply wells were purged a minimum of 30 L from the well screen zone. Each groundwater sample collected was immediately placed into an appropriate sample container and stored in a cooler at approximately 4 ^{o}C. The cooler was then transported to CANTEST LTD., an accredited analytical testing laboratory, in Winnipeg, Manitoba.

All groundwater samples were tested in the field for pH, temperature, electrical conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP) and total dissolved solids using a YSI 556 Multiprobe System.

2.3 ELEVATION SURVEY

An elevation survey was conducted on August 1, 2008 at the subject property by KGS Group to confirm ground and top of casing elevations for the monitoring wells established by UMA. Elevations were also established for the former supply wells as well as the current supply wells. The reference point for the survey was a benchmark (B.M. No. 69 M159, Elevation 369.99 m) located on the bedrock outcrop next to Hwy. 44, southwest of the well field. Standard survey practices were followed and the circuit was closed with an acceptable error. A summary of the surface and groundwater elevations measured at the monitoring wells is presented in Table 1 and Table 2.

2.4 FIELD HYDRAULIC CONDUCTIVITY TESTING

Rising head tests were conducted on monitoring wells WH-3 and WH-7A to determine an appropriate bulk hydraulic conductivity value for the overburden material. Prior to the start of the test, the static water level was recorded, and the water was bailed out. The rising water level was then measured at selected time intervals until the well had recovered to nearly the initial static water level. The data was analyzed using Aqtesolv for Windows version 3.5, and unconfined solutions developed by Bouwer-Rice.

2.5 CURRENT SUPPLY WELL CAPACITY ASSESSMENT

Short pump tests were conducted on each current supply well (PW-1A, PW-2, PW-3, PW-4, PW-5). The drawdown within the pumping well and within adjacent wells in a non-pumping condition was measured during each test. For each test one pump was turned on for a minimum of 30 minutes. Two In-Situ 9000 pressure transducers were installed in monitoring wells within the well field and local drawdown was measured during each test. All pumps were turned off for approximately 20 minutes to observe recovery in the pumping wells and to obtain an estimate of static water levels in the well field.

2.6 SUPPLY WELL SAMPLING

Groundwater sampling of the current supply wells was performed on July 31, 2008 including all five pumping wells (PW-1A, PW-2, PW-3, PW-4, PW-5). Due to the proximity of the Sewage Lift Station to the supply wells, the pumping wells were re-sampled on September 8, 2008 along with two monitoring wells so that a wider range of nutrient and organic parameters related to potential sewage contamination could be analyzed.

Groundwater samples were obtained from the supply wells using the existing sampling ports located within the current pumphouse. Prior to collecting the groundwater samples, the sampling ports were cleaned with bleach or flamed to disinfect the sampling port. Prior to sampling, the required pump was turned on and the lines were purged for a minimum of 5 minutes. This procedure was used to ensure the water samples collected were representative of the natural groundwater conditions. Groundwater samples were obtained from the monitoring wells using new Waterra tubing and a Whaler pump. Prior to collecting the groundwater samples, the monitoring wells were purged a minimum of three well volumes. The whaler pump was cleaned with a bleach solution between samples. Each groundwater sample collected was immediately placed into an appropriate sample container and stored in a cooler at approximately 4^{o}C. The cooler was then transported to CANTEST LTD., an accredited analytical testing laboratory, in Winnipeg, Manitoba.

All groundwater samples collected on July 31, 2008 were tested in the field for pH, temperature, electrical conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP) and total dissolved solids using a YSI 556 Multiprobe System.

2.7 LABORATORY ANALYSES

Former Well Field Groundwater Samples

A total of twenty-three groundwater samples were collected from all three former water supply wells and twenty previously installed monitoring wells and submitted for laboratory analyses of BTEX and hydrocarbon fractions F1 to F4. Four additional groundwater samples, including two field duplicates, one field blank, and one trip blank were submitted for QA/QC purposes.

Monitoring wells WH-5 and WH-13 could not be located and were not sampled. Monitoring wells WH-2, WH-4, WH-6, WH-7B, WH-8, and WH-24 were either dry or did not have enough water to sample.

Current Well Field Groundwater Samples

A total of twelve groundwater samples were collected from all five current water supply wells (2 dates) and two previously installed monitoring wells and submitted for laboratory analyses. Parameters analysed are shown in Tables 6 and 7 including metals (total), total coliform and *E.Coli* bacteria, potable water parameters nutrients (nitrate & nitrite, nitrate, nitrite, Ammonia as N, TKN, total phosphorus) and organic indicators, biological oxygen demand (BOD), chemical oxygen demand (COD) and dissolved organic carbon (DOC).

West Hawk Lake Surface Water Sample

One surface water sample (WHL-SW) was collected from West Hawk Lake at the beach at the north end of the campground and submitted for laboratory analyses of general groundwater chemistry including total coliform and *E.Coli* bacteria, and inorganics.

Quality Assurance/Quality Control (QA/QC)

Standardized sampling procedures and protocols were used during all sampling events to ensure that representative samples were collected in a controlled manner and that scientifically defendable comparisons can be made. KGS Group ensured that all Chain-of-Custody procedures were properly undertaken and that holding times were not exceeded. Samples were collected in sterile containers (supplied by the lab) and stored at the appropriate temperature using the proper preservatives. CANTEST LTD. (Burnaby, B.C. and Winnipeg, Manitoba Branch), is a Canadian Association Environmental Analytical Laboratories (CAEAL) accredited analytical testing laboratory. Criteria and guidelines used for assessment of analytical data were clearly established with the laboratory to ensure that appropriate detection limits were used.

Quality control of the chemical assessment process is provided by the laboratory to adhere to recognized analytical standards and methods. Part of the laboratory QC process includes the

running of laboratory duplicates, blanks and spiked samples. QA of the chemical assessment process is provided by field personnel through adherence to good field sampling practices including recognized protocols, and by retrieval of blind duplicates and field, trip and equipment blanks.

Field QA/QC

Blind field duplicates are submitted to the laboratory as a second aliquot of sample and are used as a blind check on method repeatability/precision. Blind field duplicates are generally very prone to bias introduced during field sampling for both water and soil samples. Trip blanks consist of analyte-free media supplied by the laboratory that is taken to the sampling site and returned to the laboratory unopened. Trip blanks are used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organics samples, such as BTEX. Field blanks consist of analyte-free media that is treated as a sample in all respects, including shipping to the sampling site, exposure to the sampling conditions, storage, preservation and all analytical procedures. Field blanks are useful to determine if method analytes or other interferences are present in the field environment.

Two field duplicate groundwater samples for hydrocarbons were submitted for laboratory analysis for QA/QC results. All field duplicates were labeled such that the laboratory did not know the samples are duplicates. Trip and field blanks were also submitted for groundwater QA/QC purposes.

Laboratory QA/QC

Methods blanks are samples taken through the analytical procedure and used to monitor the introduction of artifacts into the analysis. A laboratory replicate consists of a duplicate of a submitted sample that is taken through the entire analytical procedure. A matrix spike is a second aliquot of sample that is spiked with a known amount of the analytes of interest, which measures the effectiveness of the method in extracting the compounds of interest from the sample matrix. The matrix spike also provides a check of every aspect of the method used for analysis from preparation of the sample onwards. Surrogates are deuterated analogues or

compounds not normally found in nature that are added to samples prior to analysis and used to indicate the extraction efficiency. Method blanks, laboratory replicates, matrix spikes and surrogates are provided at the discretion of the laboratory.

3.0 PHYSICAL CHARACTERISTICS OF THE SITE

3.1 PHYSIOGRAPHIC SETTING AND CLIMATE

The West Hawk Lake Water Supply site is located approximately 130 km east of the City of Winnipeg in the community of West Hawk Lake within the Whiteshell Provincial Park. PTH 44 runs northwest from the TransCanada Highway as shown on Figure 2. It then runs west at the townsite. The former pumphouse and well field is located where Highway 44 turns west. The subject area is located within the Lake of the Woods Ecoregion within the Boreal Shield Ecozone (Environment Canada 2008). The average annual precipitation is 561 mm, with 434 mm falling as rain throughout the year (Environment Canada 2004). The mean monthly air temperature ranges from approximately +18.7°C in July to –18.3°C in January. Weather data is for the Falcon Lake weather station, located at 49° 41' N and 95° 22' W.

3.2 GEOLOGY

Bedrock geology beneath the subject property consists of Precambrian bedrock, consisting of mafic and intermediate metavolcanic rocks. The soil profile at the old well field area, as determined by the UMA 2003 subsurface investigation, was characterized by fine to medium grained sand with trace to some coarse sand and/or fine gravel from surface to a depth ranging from 4.7 m to 10.7 m across the site. A geologic cross-section was constructed from north to south from the Keystone Resort through the old well field. The cross-section location is shown in Appendix A-3. The bedrock forms a valley beneath the well field with sand extending from EL 365 to EL 353 m at its deepest portion. The bedrock elevation is shown in plan view in Appendix A-5. The bedrock rises steeply to the south. Particle size analysis was performed by UMA for the 2003 Phase II ESA within the sand layer at WH-9 (4.4 to 4.6 m depth). The analysis indicated the sample contained 5.7% gravel, 80.2% sand, 14.1% silt and clay particles. Test hole drilling at the Manitoba Conservation maintenance yard show a shallow soil depth over bedrock. Testhole logs are available in previous reports (UMA 2004a, UMA 2004b) and are not included in this report.

The geology at the new well field is described in the West Hawk Lake Groundwater Supply Reports prepared by Manitoba Water Services Board (Appendix A-6). The geology consists of

fine to medium sand from surface to approximately 16 m (53 ft) where bedrock was encountered. A 2 ft layer of clay from 7.2 to 7.9 m (24 to 26 ft) was found at Well No. 2, Well No. 3, and Well No. 4. Cobbles were encountered at Well No. 3. Well logs for the five wells in the current water system are found in Appendix A-6 as follows:

- Well No. 1A (Replaced Well No. 1 – 1973) – drilled August 15, 2003
- Well No. 2 – drilled July 21, 1981
- Well No. 3 – drilled August 14, 2003
- Well No. 4 – drilled August 14, 2003
- Well No. 5 – drilled August 15, 2003

Testhole logs TH-1, TH-2, and TH-3 drilled August 14, 2003 are also shown in Appendix A-6.

3.3 HYDROGEOLOGY

In the West Hawk Lake area, groundwater is available from within shallow unconfined sand aquifers that thicken where they lie above bedrock valleys. The three former community groundwater supply wells (Well 1, Well 2, and Well 3) are located within the former well field study area. These wells were taken out of use after hydrocarbon impacts were detected in one of the supply wells during routine water sampling by Manitoba Conservation in August 2003. The saturated thickness of the aquifer in the area from the Keystone Resort to the old water supply wells is less than 1 m to 7 m (Appendix A-4). Groundwater elevation was at EL 360 m in this area.

Twenty-eight monitoring wells were previously installed during the 2003 Phase II ESA and the 2004 Supplemental Phase II ESA by UMA. These wells were distributed throughout the old well field, the Keystone Resort area, and the Manitoba Conservation maintenance yard. Water level contours from the last sampling in June 2007 showed groundwater flow from EL 360.4 m near the Keystone Resort pump island south to EL 360.14 m with local flow also toward the borrow pit (Appendix A-7). The groundwater gradient toward the former water supply (during pumping conditions) was calculated to be approximately 0.01 to 0.003 m/m.

At the Manitoba Conservation maintenance yard groundwater levels are just above bedrock. In June 2007, four of six wells were dry. Groundwater elevations ranged from EL 362 to 364 m in

the other wells (UMA 2007). Groundwater flows north from the compound area towards the borrow pit, however, the flow volume north is anticipated to be minor, due to the high bedrock and limited aquifer.

At the current water supply location on the west side of the seasonal campground, groundwater was found at 1.5 to 2.3 m (5 to 7.5 ft) below ground surface. The saturated thickness of the aquifer is approximately 14 m under non-pumping conditions and 8.1 m under pumping conditions at this location. Aquifer transmissivity was low, estimated at 5.18×10^{-4} to 6.9×10^{-4} m^2/sec (3000 to 4000 Igpd/ft). During non-pumping conditions, groundwater flows from the current water supply wells to the west and northwest where an extensive peat bog area indicates discharging conditions.

Updated groundwater information is included in Section 4.0.

3.4 TOPOGRAPHY AND HYDROLOGY

East of PTH 44 (which is located on the west side of the former Pumphouse and Well Field) the topography slopes from an elevation of 373 m (1225 ft) to the northeast towards West Hawk Lake, the closest surface water body located approximately 500 m east of the old well field (Figure 1 and 2). The ground elevation around the former supply wells is approximately 365 m above mean sea level as shown on Figure 1 and Appendix A-1.

Bedrock outcrops are found southwest of the wells of the former well field at an elevation of 369 m and south of the Manitoba Conservation maintenance yard (Figure 3). A topographic high is also shown west of the Manitoba Conservation Heli-Pad area (Figure 3 and Appendix A-1). The ground rises to the south between the compound and the old well field as shown on Figure 1.

An old borrow pit is located south of the old well field. It is approximately 85 m long and 250 m wide. The borrow pit is shown on the topographic plan in Appendix A-1. The pit bottom is at elevation 356 m (1170 ft) about 9 m below the 365 m (1200 ft) ground surface near the old well field. Local surface water drains to this borrow area from the south to the north.

West of PTH 44 the ground slopes to the west to a low wetland area at an elevation of 345 m (1134 ft) (Figure 3 and Appendix A-2). Based on field reconnaissance and air photography, drainage from this wetland crosses PTH 44 and presumably continues north discharging to West Hawk Lake (Figure 2).

The ground elevation around the current supply wells is approximately 363 m above mean sea level.

4.0 RESULTS

4.1 WATER ELEVATION MONITORING

At the time of the July 2008 monitoring event, groundwater occurred at an elevation of 360.18 m (WH-22) to 364.79 m (WH-7A), and depths to water below the ground surface ranged from 3 m (WH-11) to 8 m (WH-6) (Figure 4). Groundwater monitoring data from the July 2008 monitoring event is summarized on Table 1. Monitoring data from the current well field is shown on Table 2 as discussed in Section 7.1.

4.2 FIELD HYDRAULIC CONDUCTIVITY TESTING

Two rising head tests were conducted at monitoring wells WH-3 (south of the pump island) and WH-7A (at the Manitoba Conservation maintenance compound) and the results are presented graphically in Appendix B-1. The calculated hydraulic conductivity of the sand unit was 1.1 x 10^{-6} m/s at WH-3 and 1.5 x 10^{-6} m/s at WH-7A. The data was analyzed using Aqtesolv, a commercial groundwater software package. These hydraulic conductivity readings appear low given the well capacities in the former well field. Hydraulic conductivity could range up to 1 x 10^{-4} m/s based on an estimated transmissivity of up to 5000 Igpd/ft at the current well field.

4.3 FIELD OBSERVATIONS

No staining or unusual odours were noted outside of the monitoring wells during the 2008 field investigation. Combustible vapour concentrations, as measured within each monitoring well upon opening, were elevated (from 100 ppm to >10,000 ppm) in several wells within or immediately down gradient of the Keystone Resort (WH-3, WH-9, WH-11, WH-18, WH-19, WH-20, WH-25). The results of headspace combustible vapour testing conducted on the monitoring wells are summarized in Table 1.

Measurable LNAPL was not detected in monitoring well WH-3 where it had been detected in 2007 (UMA 2007). Measurable LNAPL was detected in two monitoring wells, WH-17 (south of the pump island) and WH-8 (at the Manitoba Conservation maintenance yard) on July 31, 2008. Approximately 0.002 m of LNAPL was detected in both WH-17 and WH-8. The ORS interface

probe has an accuracy of 0.0015 m and the potential for error is present with LNAPL readings approaching this limit. The water level in WH-8 was near the bottom of the well and it is possible that interference from stirring up material at the bottom of the well caused the LNAPL reading with the interface probe. LNAPL has not been previously detected at WH-8 during previous sampling events. Hydrocarbon sheen was noted on the groundwater samples obtained at monitoring wells WH-9 (immediately downgradient of the pump island), WH-19 (immediately upgradient of the pump island), WH-20 (immediately downgradient of the pump island), and WH-21 (20 m downgradient of the pump island). Odours were observed from the groundwater sampled from several of the monitoring wells sampled on or immediately down gradient of the Keystone Resort.

No odours or colour were observed from groundwater samples obtained from the current supply wells (PW-1A, PW-2, PW-3, PW-4, PW-5).

4.4 GROUNDWATER FIELD CHEMISTRY

Former Well Field, Keystone Resort Area, Manitoba Conservation Maintenance Yard

Groundwater field chemistry results are summarized on Table 3. Laboratory reports are found in Appendix F. Electrical conductivity values in groundwater ranged from 79 μS/cm (WH-7A) to 2149 μS/cm (WH-9) in the monitoring wells located around the former well field, Keystone Resort, and the Manitoba Conservation maintenance yard. Total Dissolved Solids (TDS) in the groundwater ranged from 51 mg/L (WH-7A) to 1397 mg/L (WH-9). Dissolved oxygen in the groundwater at this site ranged from 1.03 mg/L (former supply Well No. 1) to 10.88 mg/L (WH-7A) and pH values ranged from 6.15 (WH-11) to 7.73 (WH-1). Oxidation Reduction Potential (ORP) in the groundwater ranged from –90.2 mV (WH-20) to 213.4 mV (WH-7A).

Current Supply Wells

Groundwater field chemistry results are summarized on Table 4. Electrical conductivity values in groundwater ranged from 282 μS/cm (PW-5) to 704 μS/cm (PW-1A) in the current supply wells located within the seasonal campground. Total Dissolved Solids (TDS) in the groundwater ranged from 183 mg/L (PW-5) to 458 mg/L (PW-1A). Dissolved oxygen in the groundwater at

this site ranged from 5.37 mg/L (PW-5) to 9.85 mg/L (PW-1A) and pH values ranged from 6.58 (PW-1A) to 7.34 (PW-5). Oxidation Reduction Potential (ORP) in the groundwater ranged from 29.6 mV (PW-5) to 99.8 mV (PW-1A).

4.5 ASSESSMENT GUIDELINES

The CCME Drinking Water Quality Guidelines, Chapter 2: Community Water (CCME 2007), were used to assess the groundwater at the study area. These guidelines are shown at the bottom of the summary tables for petroleum hydrocarbons in groundwater (Table 5) and for general water quality (Table 6).

4.6 RESULTS OF LABORATORY GROUNDWATER ANALYSES FOR HYDROCARBON IMPACTS

Results of petroleum hydrocarbon analysis for groundwater samples are summarized in Table 5. Laboratory results showed elevated concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) above applicable CCME water quality guidelines in monitoring wells WH-03, WH-09, WH-14, WH-16, WH-17, WH-18, WH-19, WH-20, WH-21, WH-25, and WH-27. Monitoring well WH-15 also had elevated concentrations of benzene, toluene, and ethylbenzene above applicable water quality guidelines and xylene close to the guideline.

Elevated concentrations of BTEX parameters were as follows:

- benzene ranged from 8.4 µg/L (WH-16) to 9,200 µg/L (WH-20);
- toluene ranged from 220 µg/L (WH-16) to 33,000 µg/L (WH-20);
- ethylbenzene ranged from 37 µg/L (WH-3) to 7,300 µg/L (WH-9); and
- xylene ranged from 330 µg/L (WH-3) to 49,000 µg/L (WH-9).

Concentrations of volatile hydrocarbons were elevated in monitoring wells WH-03, WH-09, WH-14, WH-15, WH-16, WH-17, WH-18, WH-19, WH-20, WH-21, WH-25, and WH-27 ranging from 900 µg/L (WH-15) to 310,000 µg/L (WH-09). Concentrations of volatile petroleum hydrocarbons (VPH) were elevated in monitoring wells WH-03, WH-09, WH-14, WH-16, WH-17, WH-18, WH-19, WH-20, WH-21, WH-25, and WH-27 ranging from 300 µg/L (WH-27) to 240,000 µg/L (WH-09). Concentrations of styrene were below detectable concentrations in all

monitoring wells. All hydrocarbon impacted wells were located on or immediately downgradient from the Keystone Resort area (Figure 5).

Laboratory results detected concentrations of hydrocarbon fraction F2 in monitoring wells WH-03, WH-14, WH-16, WH-17, WH-18, WH-19, WH-20, WH-21, and WH-27 ranging from 170 µg/L (WH-14) to 47,000 µg/L (WH-06).

At well WH-6 at the Former Oil Changing Area in the Manitoba Conservation Maintenance Yard BTEX and volatile hydrocarbons were below detection but hydrocarbon fractions F2 (47,000 µg/L), F3 (1900 µg/L), and F4 (510 µg/L) were detected indicating potential impact from non-gasoline petroleum products.

The Saskatchewan Environment Interim Risk Management Criteria are shown in reference in the absence of Manitoba Criteria. The sample exceeds the criteria of 2000 for F2.

4.7 RESULTS OF LABORATORY ANALYSES FOR GENERAL WATER QUALITY

Results of the general water quality and metals analysis for groundwater samples are summarized in Table 6 and 7. Samples were collected from all the current pumping wells on July 31, 2008 and again on September 8, 2008. No key water quality parameters exceeded the health-related CCME Drinking Water Guidelines in the current pumping wells. Laboratory results showed levels of iron above the CCME aesthetic objective (AO) in supply well PW-5 (0.42 mg/L). Concentrations of manganese also exceeded CCME aesthetic objectives (0.05 mg/L) in supply wells PW-2, PW-3, PW-4, and PW-5 ranging from 0.07 mg/L (PW-3 – September) to 0.351 mg/L (PW-5 – September). No Total Coliforms or *E.Coli* bacteria were detected in any of the current supply wells.

Samples were collected from two monitoring wells MW-1 and MW-3 (near the sewage lift station) on September 8, 2008. No key water quality parameters exceeded the health-related CCME drinking water guidelines. The results from the monitoring well samples are summarized in Table 6.

One sample was collected from monitoring well WH-1 (located adjacent to the former well field) on September 8, 2008. Laboratory results showed the electrical conductivity (1610 µS/cm) and concentrations of chloride (442 mg/L) and total dissolved solids (760 mg/L) were elevated in comparison to expected background groundwater quality. The results from the monitoring well sample are summarized in Table 6.

One surface water sample was collected from West Hawk Lake. Laboratory results showed detectable levels of Total Coliform (79 MPN/100 mL) and *E.Coli* bacteria (3 MPN/100 mL). The results for the surface water samples are summarized in Table 6.

4.8 QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

QA/QC results were calculated as the percent difference between duplicate samples. Acceptable percent differences are less than 40%. Percent differences for the groundwater field duplicates (WH-03 and WH-22) ranged from 0% to 75% (at WH-03). The probable cause of this discrepancy is likely due to the presence of high levels of hydrocarbons observed in the groundwater at WH-03 and the potential for sheen on the collected sample. Sheen was likely accidentally introduced into the duplicate sample at the time of the 2008 sampling event increasing the concentrations of petroleum hydrocarbons in that sample. Laboratory results for both trip and field blanks were below the laboratory minimum detection limits.

5.0 2008 NATIONAL CONTAMINATED SITES CLASSIFICATION SYSTEM

5.1 INTRODUCTION

The updated 2008 National Contaminated Sites Classification System (NCSCS), which supersedes the original 1992 NCSCS and the 2005 Federal Contaminated Sites Action Plan (FCSAP) classification system, is used as a tool to aid in the evaluation of contaminated sites. The 2008 NCSCS ranks contaminated sites into five general categories of concern (Class 1, High Priority for Action; Class 2, Medium Priority for Action; Class 3, Low priority for Action; Class N, No Priority for Action; and Class INS, Insufficient Information) according to their current or potential adverse impact on human health or the environment. It is used to screen sites with respect to "need for further action" (i.e. further characterization, risk assessment, remediation, etc.). The hazard or hazard potential of a site is evaluated by scoring site characteristics ("evaluation factors") that can be grouped under one (1) of three (3) categories:

I. Contaminant Characteristics – the relative hazard of contaminants present at a site.

II. Migration Potential – the potential for contaminants to leave the original residency media and move to another media, another portion of the site, or off-site.

III. Exposure – includes both the exposure pathway and receptors; the exposure pathway being the route a contaminant may follow (*e.g.*, groundwater, surface water, direct contact, and/or air) to receptor, including living beings or resources that may be exposed to and affected by contamination.

A scoring system (from 0 to 100 points) is used as a means of assessing the hazard of a site. Sites that exhibit observable or measured impacts on the surrounding environment or have a high potential for causing negative impact will score higher under the system.

5.2 IDENTIFICATION OF CONTAMINATED SITES

The following table describes the contaminated sites identified at West Hawk Lake.

SUMMARY OF CONTAMINATED SITE

Location	Areal Extent	Estimated Max. Thickness of Contaminated Soil	Estimated Impacted Soil Volume	Impacted Aquifer Volume	Remedial Concerns (above criteria)
Keystone Resort Area to South of PTH 44	2,500 m^2	2 m	5,000 m^3	4,700 m^3	BTEX above CCME Drinking Water Quality guidelines.

5.3 NCSCS CLASSIFICATION SUMMARY FOR CONTAMINATED SITE

The information obtained during the 2008 ESA and other previous studies were used to classify the West Hawk Lake Hydrocarbon Impacted Area under the updated 2008 NCSCS. The detailed scoring sheets for each area are included in Appendix D. On the basis of the available information, application of the updated 2008 NCSCS criteria produced scores and classification as follows:

NCSCS CLASSIFICATION OF CONTAMINATED SITES

Location	Category Score	Class	Score	Risk Potential	Action
Keystone Resort Areas South of PTH 44	C	2	52.5	Medium	Medium Priority for Action

6.0 ASSESSMENT

6.1 GROUNDWATER FLOW SYSTEM

A groundwater elevation contour plan for the site is shown in Figure 4. Groundwater flow continues to move from the Keystone Resort area toward the former borrow pit located to the southwest. The hydraulic gradient varies from 0.009 m/m within the Keystone Resort area to approximately 0.003 m/m toward the southwest and the old well field. The change in gradient is likely the result of bedrock contours beneath the site. Based upon field measurements, an estimated hydraulic conductivity of 1.1×10^{-6} m/s, hydraulic gradient of 0.003 m/m and an estimated porosity of 0.20, the groundwater velocity in the hydrocarbon impacted area is estimated to be approximately 5 m/year. The hydrocarbon impacted area, however has not increased at that rate and has demonstrated a generally lower expansion rate. Groundwater elevations at the Manitoba Conservation maintenance compound ranged from EL 364.79 to EL 362.42 m with groundwater flow direction to the northwest. Groundwater flow from the former well field is interpreted to flow southwest in the area north of the bedrock outcrop.

At the current well field groundwater elevations were taken after each well was allowed to recover for 30 minutes. However, measured static elevations were still 4 to 5 m below top casing, whereas the static elevation during drilling was 2.1 m below the top of casing. Groundwater flows from the former well field towards the current well field. However, a bedrock high between the two locations may limit flow to the current well field. The contours shown between the old and new well fields are approximate based on estimates from groundwater modelling. Groundwater further west in the bog area is likely close to the ground elevation of 345 m shown for the bog in Appendix A-2.

6.2 HYDROCARBON IMPACTED AREA

Hydrocarbon impacts around the Keystone Resort area and immediately down-gradient from the underground storage tanks have not moved substantially since previous studies. Monitoring wells containing dissolved hydrocarbons detected in previous sampling programs continue to be contaminated, while non-impacted wells from previous studies continue to show levels of dissolved hydrocarbons below laboratory detection levels. Concentrations of individual BTEX

and F1-F4 fractions determined during the 2008 sampling program vary from previous results (Appendix A-8), but no obvious trend is observable. The highest concentrations of BTEX occur in monitoring wells WH-9, WH-17, WH-20, and WH-27. Expansion of the impacted zone west toward the current well field does not appear to be occurring.

Hydrocarbon fractions F2, F3, and F4 were detected in monitoring well WH-06 within the Manitoba Conservation maintenance compound. WH-06 is located near a former oil changing area. Previous studies do not indicate any hydrocarbon impacts at that location.

Free phase product was only detectable at monitoring wells WH-08 (within the Manitoba Conservation maintenance yard) and at WH-17 (down-gradient from the underground storage tank). The detectable amount of free phase product was very low, approaching the detection limits of the oil/water interface probe. Free phase product thickness within the main hydrocarbon area, decreased from 2004 to 2006, with no free product detected in 2007 (UMA 2007). This is consistent with the current finding of no measureable free product in 2008.

In terms of the potential for free product to be still entering the environment from the Keystone Resort area, the data and information suggests no further hydrocarbons are entering the environment. The past 2 monitoring periods (UMA, 2007; KGS 2008) have demonstrated no measureable free product.

Historical information from Manitoba Conservation indicates that the UST's at the Keystone Resort were replaced in 1991 and no record of contamination was noted. In 2003, the above tanks were pressure tested and the premium tank failed at a valve and this was repaired. That summer impacts were detected in the West Hawk Lake groundwater supply system to the south and across the road from the Keystone Resort. In 2007, the product sales versus tank clips and purchases were within industry standards with no losses suspected.

Several field chemistry trends were noted: electrical conductivity appeared to have greater concentrations near the roadways (Figure 6), dissolved oxygen levels were lower in wells with hydrocarbon impacts, and the ORP was lower in wells on and immediately down-gradient of the Keystone Resort (Figure 6). Field conductivity collected from groundwater samples is plotted on Figure 6. Locations with elevated field conductivity from 1000 to 2000 µS/cm are clustered along

the highway indicating impacts from road salting. Monitoring well WH-1 has an elevated chloride level of 442 mg/L. The values decrease toward the centre of the old well field to 400 to 575 µS/cm. Conductivity is very low at the maintenance compound (79 to 89 µS/cm) due to the limited aquifer depth and resulting fresh water recharge each year.

6.3 WEST HAWK LAKE COMMUNITY SUPPLY WELLS

Laboratory results of samples collected from all five pumping wells show no exceedances of health-related CCME general water quality guidelines. Total Coliform and *E. Coli* bacteria were not detected. Levels of manganese continued to be elevated above aesthetic objectives for community water supply in four of five supply wells as indicated previously by the Office of Drinking Water. Concerns with elevated levels of manganese are related to staining.

Elevated levels of chloride (168 mg/L), sodium (75 mg/L), nitrate (1.7 mg/L), and total dissolved solids (385 mg/L) were observed in samples collected from supply well PW-1A in comparison to the other supply wells. Well PW-1A is located 10 m northwest of a sewage lift station. Conductivity values at the pumping wells and the two monitoring wells at the lift station are plotted on Figure 6. The conductivity behind the water plant to the west in well PW-5 is not impacted with a level of 304 µS/cm while PW-1A, closest to the sewage pumping station has a conductivity of 693 µS/cm with MW-3, closer to the pumping station but not in line with the station, having a conductivity of 629 µS/cm. Chloride, sodium, nitrate, and total dissolved solids (TDS) are indicators of potential sewage contamination. It is likely that the sewage from the lift station is leaking into the groundwater and is migrating toward the well field. The absence of bacteria in the samples tested indicates the local fine sand is currently providing a filter barrier between the wells and the sewage lift station, but the potential for bacterial contamination is high given the close proximity to the station.

Water quality data from September 2007 provided by the Office of Drinking Water (Appendix A-9) shows that elevated concentrations of chloride, sodium, TDS and nitrate concentrations were present in 2007, but current data shows that concentrations have increased substantially. It is this continually increasing water quality data that precipitated the KGS Group detailed monitoring of wells and monitored following the first analysis. Chloride at PW-1A in 2007 was 104 mg/L, while sodium was 45 mg/L, total dissolved solids was 296 mg/L and nitrate was

0.73 mg/L. At PW4 the 2007 results also showed lower concentrations of chloride 75 mg/L, sodium of 8.5 mg/L, total dissolved solids, and nitrate 0.16 mg/L, than the 2008 values.

Ongoing increases of water quality impacts as noted above would be expected from seepage from the sewage lift station to the adjacent wells. Recent discussions with park staff (January 9, 2009) indicate that the sewage pumping station is to be relocated in spring/early summer, 2009.

6.4 CURRENT WATER TREATMENT PLANT

The current water treatment plant is located within the campground area west of the highway entrances as presented on Figure 2. The location of the water plant does not pose any significant logistical problems and is reasonably well positioned relative to the groundwater resources in the area. The groundwater wells feeding the water plant do have significant water quality concerns based on close proximity to the sewage lift station and relatively small size of the well field; however, this has been assessed above in the previous sections.

The current water plant is a slab-on-grade structure and is only 5 years old and was constructed on an emergency, temporary basis. In overall terms, the facility is in reasonably good shape and with upgrades, could readily supply the water needs of the relatively small West Hawk Lake community for many years into the future.

The main concerns with the current facility are as follows:

1. There is very limited storage for chemicals such that chlorine is being stored in the old water plant, 400 m east. Double handling of these chemicals is time consuming and costly from a manpower perspective and will be addressed in the water plant expansion.

2. The total storage volume is currently only 23 m^3 (4500± gal) in 3 equal polyethylene tanks (3 x 7.6 m^3) and this volume is not sufficient to ensure a 20 minute reaction time for chlorine disinfection during peak flows on busy, long-weekends especially into the future. The fact that the tanks are all connected in parallel greatly increases the potential for short-circuiting through the individual 4.6 m^3 (1500 Igal) storage tanks. Additional treated water storage to manage increased future water demands will be required. This additional storage would be required during the June to September period and could be drained for the winter.

3. The water quality data demonstrates that iron and manganese are the 2 parameters that routinely exceed water quality criteria although the impact to the raw water storage and plumbing facilities in the community is quite minimal. As well, the Office of Drinking

Water does not require treatment for aesthetic parameters and for this reason, iron and manganese treatment equipment is not proposed for inclusion in the water treatment plant upgrades.

7.0 WATER SUPPLY ASSESSMENT

7.1 WATER SYSTEM DESCRIPTION AND CAPACITY ASSESSMENT OF CURRENT SUPPLY WELLS

The current well field has been in operation since 2003 and has met community water demands since 2003. Local drawdown appeared limited during pump tests on individual supply wells, with pumping rates ranging from 2.2 l/sec (29 lgpm, 35 USgpm) at PW-3 to 275 m^3/day 2.8 l/sec (36.6 lgpm , 44 USgpm) PW-2 from each supply well. The maximum demand for a single day reached 27 m^3/day (60,000 lgpd) in the summer of 2007, as indicated by Manitoba Conservation staff. The highest single-day demands for the summer 2008 was approximately 180 m^3 (40,000 lgpd) with the lower demand related to the cooler, wetter summer and significant jump in gasoline prices. Storage capacity within the pumphouse consists of three 7 m^3 (1,500 lgal) storage tanks for a total of 24 m^3 (4500 lgal). Chlorination injection occurs prior to the water reaching the storage tanks and the tanks are connected in parallel from the intake from the supply wells to distribution to the community. During peak demand times during the day, the contact time for chlorination is limited due to the lack of storage prior to distribution to the community.

Pump tests were performed on each individual current supply well as shown on Table 2 and B2. Water levels were recorded in the pumping well during the test as well as in nearby wells. Two In-Situ 9000 pressure transducers were installed in monitoring wells (MW-1, MW-2) within the well field and local drawdown was measured during each test. Pumping water elevations ranged from 353.34 m (PW-2) above mean sea level to 354.95 m (PW-3) above mean sea level. Measured drawdown in adjacent pumping wells ranged from 0.67 m (in PW-2 while PW-4 pumping) to 1.38 m (in PW-5 while PW-3 pumping). Wells were allowed to recover for 25 minutes to determine an approximate static water level that was measured at EL 358.60 m above mean sea level. However, original pumping tests shown on the drilling logs show that static water levels in 2003 were 2.1 m below the top of casing or approximately 260 to 261 m. Measurements of drawdown are approximate as the pump tests were performed with no recovery time between tests due to pumping requirements for the community.

7.2 WELL CAPACITY ASSESSMENT

As noted above, KGS Group has conducted pumping tests on the individual wells for short durations during pumping and shut-down periods in order to assess the peak pumping capacity of the current well field. The data and analysis of the above field capacity testing is presented in Table 8 and Figure 9. The analysis indicates that the individual wells have a combined total capacity of approximately 9.0 L/s (120 Igpm) when drawdown interference between wells is taken into account.

The current well field is adequate for most of the operating regimen but is insufficient for peak hourly flows on busy long weekends and this has also been observed by operations staff. A peak daily flow of 275 m^3/day (60,000 Igpd) was measured in 2007 and this is the equivalent of an average flow of 3.3 L/s (43 Igpm) with an estimated hourly peaking factor of 3 requiring 10 L/s (130 Igpm). This is above the current well capacity of approximately 9.0 L/s (120 Igpm) and suggests that the chlorine contact time may be less than 20 minutes as required for proper chlorine disinfection since the contact efficiency for an unbaffled tank with direct flow access from inlet to outlet is in the 25 to 35% range. The system does, however, provide some redundancy should a well or well pump fail. For future capacity, the water supply should be capable of producing at least 400 m^3/day (84,000 Igal/day or 4.6 L/s) with maximum pumping rates of approximately 14 L/s (180 Igpm) at a peaking factor of 3. This indicates that 3 additional wells will be required once the sewage lift station has been removed and the aquifer is remediated to allow the current well field to continue in operation.

7.3 ANALYSIS OF LONG TERM HYDROGRAPHS

Provincial well hydrographs for a chart recorder installed at monitoring well MW-1 are shown in Appendix B-3. The charts show the minimum and maximum daily groundwater elevations at the wells. Data for a portion of 2004 to 2005 appears to be switched. The hydrographs show the water level decline due to the May long weekend and summer pumping periods. Spring recharge of 0.6 to 0.8 m can be seen in April 2006 and April 2008 on the minimum log, and recharge of 0.8 to 0.9 m can be seen on the maximum log. Assuming a porosity of 20% for the sand soils, the recharge in the area is estimated at 0.12 to 0.18 m/yr (4.7 to 7 inches/year).

7.4 GROUNDWATER MODELING

7.4.1 Modeling Methodology

A groundwater model of the area was constructed using the Analytic Element model WhAEM 2000 version 3.2.1. This model is widely used to simulate wellfield drawdown and travel time and is appropriate in cases like this where field data is limited. Additional modeling was conducted using the three dimensional, finite difference model Visual Modflow Version 4.3.

The purpose of the modeling assessment was:

- To estimate the current and longer term drawdown in the aquifer.
- To estimate the time of travel for the hydrocarbon plume to move toward the wells if such migration is likely to occur based on the observed range of recharge from 120 mm to 175 mm (4.7 to 7 inches) from local hydrograph data.

7.4.2 Model Set-Up

The aquifer is assumed to be present in the area from the current pumping wells northeast to the former wellfield and Keystone Resort. The extent of the aquifer to the south in the trailer park area is not defined. To the west, the sand is present beneath an extensive peat layer.

Boundary Conditions

The model boundary conditions in the WhAEM model are as follows.

North and South	-	no flow
East	-	Constant Head 360.5 m
West	-	Constant Head 360.45 to produce a slight regional gradient to the west land area west of the current wells.

The model boundary conditions for the Modflow model were similar, except that the north and south boundary were input as a constant head gradient from east to west. An area of no flow in the southeast was input in the Modflow model as well.

Aquifer Properties

Hydraulic conductivity of sand aquifer $K=1x10^{-4}$ m/sec.

Aquifer saturated thickness based on pumping water levels in water supply well logs is 8 m. Porosity of 0.2 was used for the WhAEM model and 0.3 for the MODFLOW model.

Recharge

For the WhAEM model a recharge of zero, 150 mm and 200 mm was simulated. For the MODFLOW model a recharge of 150 mm and 200 mm was simulated. Recharge was chosen based on the aquifer response shown in the long-term provincial hydrographs.

Groundwater Withdrawals

Groundwater withdrawals were set to simulate an average annual withdrawal rate of 90 m^3/day (20,000 lgpd), at a daily average flow rate of 1.1 L/s, 13.9 lgpm distributed among the 5 wells pumping continuously.

Model Simulations

For the WhAEM model a simulation was run pumping the wells for a 20-year period to produce a drawdown cone in the aquifer. Particle tracking was performed from the wells to determine the time of travel to the wells from various points in the aquifer. For the MODFLOW model a steady state simulation was run.

7.4.3 Model Results

The model results are shown in Appendix C. The WhAEM results are shown in Figures C-1 for the zero recharge case, C-2 for the 150 mm recharge case and C-3 for the 200 m recharge case. For zero recharge the travel time to the southern edge of the hydrocarbon plume, estimated at a distance of 250 m is approximately 10 years. If 150 mm of recharge is added the influence of the wells does not reach the hydrocarcarbon contaminated area in 20 years. The

radius of influence of the wells in 20 years is only 150 m. Increasing the recharge to 200 m does not change this result significantly.

Using the MODFLOW model the time of travel to the south edge of the contaminated hydrocarbon plume is approximately 20 years for both the recharge cases at 150 mm (Figure C-4) and 200 mm (Figure C-5).

Both the models are very conservative given that there is no information about the connection of the aquifer from the hydrocarbon impacted area toward the current wellfield. There are also no monitoring calibration points between the current wellfield and the plume to verify the extent of influence. Given these uncertainties, the model results are conceptual and general and are best used to assess the general level of risk to the water supply.

7.4.4 Hand Calculations and Comparison to Model Results

The digital model developed using Visual Modflow has been developed using all available data however, many assumptions as to aquifer parameters and extent must be made as the data is quite limited.

Based on simple volumetric calculations, a recharge rate of 125 mm/year (5 inches) within a 300 m radius circle to the hydrocarbon plume from the current well field is about 5% more than the current yearly water demand based on an average consumption of approximately 90 m^3/day (20,000 lgpd). With recharge rate of 150 or 175 mm /year within this 300 m radius, groundwater would have to flow out of this 300 m radius area to maintain a water balance.

What the above means is that there is very little to no potential for movement of the hydrocarbon plume towards the current wellfield or over the long-term as the proposed additional wells are in the same general area. The groundwater quality data base concurs with this general assessment and shows no measureable change in the plume extent over the past 5 years. There are no significant receptors now in or near the hydrocarbon plume such that the situation is not environmentally serious and can be rationally managed over the near future with initial monitoring coupled possibly with a few potential “low tech” but effective remedial action plans.

7.5 GUDI ASSESSMENT

Bacteria results from raw water sampling at the individual pumphouse wells was obtained from Manitoba Water Stewardship Office of Drinking Water. Data was sorted by well by KGS Group and the number of positive detections and number of samples was totaled. Total Coliform was found on one date at Well # 2 in July 2007. There were no positive *E.Coli* readings. The total number of samples from the five wells is 39 with dates ranging from January 2, 2007 to August 11, 2008. An additional 10 samples are listed as raw water samples, from January 2007 to October 2008, but no wells are given. The total is 49 samples over the 1 year, 9 month period collected in the biweekly sampling. The 11 detections in the 49 samples represent a detection frequency of 2% for Total Coliform.

The data demonstrates that the wells have good bacteriological quality. Therefore, the wells would have a low potential to be classified as Groundwater under the Influence of Surface Water.

Future water sampling records should always include the individual well sampled for raw water.

8.0 SUMMARY AND CONCLUSIONS

1. The Town of West Hawk Lake had been supplied with water from groundwater sources from 3 wells developed within the local sand aquifer.

2. The above system is located within the main townsite and had operated adequately for approximately 20 years until hydrocarbon impacts were defined in the water in 2003 by Manitoba Conservation.

3. The hydrocarbon impacts were likely associated with the gasoline station across the road approximately 30 m north of the wellfield.

4. Historical information indicates that the tank at the Keystone Resort, north of the hydrocarbon impacts water plant demonstrated a leak in the premium gasoline line in 2003. This leak at a valve was repaired at that time but hydrocarbon testing that summer demonstrated BTEX impacts to the well water. Verification of tank dips, purchased and dispensed volumes indicate no measureable losses in 2007.

5. KGS Group sampling and testing of the previously installed monitoring wells demonstrated the continued presence of hydrocarbon impacts but relatively minor expansion of the hydrocarbon plume over the past 3 to 4 years. Digital modeling of the aquifer system suggests that flow times for the 250 to 300 m of travel to the current wellfield from the hydrocarbon impacts are in the order of 20 years and likely longer. Additional monitoring with an expanded monitoring network is the most practical methodology to provide a high degree of certainty relative to impact migration over time.

6. The National Contaminated Sites Classification System demonstrated that the site would be a medium priority for remediation. With additional monitoring data, the rating can likely be lowered.

7. A management concept for the hydrocarbon impacts is presented in Section 12, Recommendations.

8. A new wellfield and water treatment plant was installed in 2003 on an emergency basis, approximately 300 m west of the hydrocarbon impacted wellfield along the west edge of the main campsite area. Fire protection was not included in this system or the previous, hydrocarbon impacted system.

9. The current system is composed of 5 wells and approximately 21 m^3 (4,500 lgal) of storage from 7 m^3 (1,500 lgal) polyethylene tanks within a wood frame building.

10. The new system has functioned well for the past 5 years but has demonstrated water shortages for peak flows on busy summer long-weekends as well as insufficient chlorine contact time during these peak flow periods. Some minor iron and manganese staining can be observed in the polyethylene storage tanks but staining of plumbing fixtures within the townsite are very minor such that iron and manganese removal are not included in the proposed water plant upgrades.

11. KGS Group assessments of the current 5 well system for the water system demonstrated that each well has a capacity of approximately 3 L/s (40 lgpm) while the total wellfield has a peak capacity near 9 L/s (120 lgpm) when hydraulic interference between the wells is included. Additional well capacity is therefore, required for the long-term.

12. A review of the flow data and water treatment plant operation demonstrated that the highest daily flow for the system was approximately 275 m^3/day (60,000 lgpd) in 2007 for an average peak day flow of 3.3 L/s (43 lgpm) and an estimated peak hourly flow of 10 L/s (130 lgpm) for a peaking factor of 3. The current water storage system is connected in parallel, with each tank providing contact time on an individual basis. In spite of a storage volume being greater than the estimated 20 minute peak consumption, the non-baffled flowpath compromises chlorine contact time for peak flows. The contact efficiency for an unbaffled tank with direct flow access from inlet to outlet is in the 25 to 35% range and this, in conjunction with additional capacity for the future, necessitates additional treated water storage. Proposed upgrades for water treatment with associated cost are presented in Section 12, Recommendations.

13. Water quality testing of the wells and treated water conducted by KGS Group as part of this study has demonstrated water quality generally within Canadian Environmental Water Quality Guidelines with the exception of iron and manganese, which for some wells, exceed aesthetic limits. The major concern for the current water quality is data which indicates leakage from the sewage pumping station into the wells, located about 10 m east of the wellfield and water treatment plant. The current testing in conjunction with historic data has demonstrated increasing conductivity and chloride levels with time for the well (Well 1A) closest to the sewage pumping station while the well behind the water plant (Well 5) to the west demonstrates no measureable impact. The KGS data shows no bacterial impacts and this is likely due to the 10 m of silty fine sand acting as a good filter medium. Historically, as well, there have been no significant coliform bacteria measured in any of the raw well water samples, but the database is somewhat limited and does not appear to include the high demand, long weekend periods. KGS Group has provided a course of action for these water quality and wastewater impacts and these are presented in Section 12, Recommendations.

14. The local silty sand aquifer demonstrates a high potential to provide significant levels of natural filtration to bacteria and is unlikely to have any measureable GUDI related concerns.

15. In terms of the sewage pumping station, plans are in place to move the station to another location, away from the current water supply wells and water treatment plant. This should move forward on a priority basis, but is anticipated that the work would be completed by approximately mid-2009.

16. KGS Group has reviewed options for alternate groundwater sources other than the current supply as well as surface water from West Hawk Lake. For small systems in Manitoba, similar in size to West Hawk Lake, groundwater is always the source of choice when available, due to the lower capital and operating costs. A system that requires in the order of 1 L/s (13.2 lgpm) for much of the year is not well suited to a surface water supply unless there are absolutely no practical groundwater options, and this is not the case. As a consequence, surface water was not evaluated any further.

17. In terms of other groundwater development options, there are a few locations near West Hawk Lake that were considered for groundwater development. One location on the east side of the beach area was tested by Arne Pedersen 20 years ago and would have adequate capacity, however, recent concerns for groundwater under the direct influence (GUDI) of surface water would preclude the location near the lake shoreline. A second area in the campground on the west side of the beach area may be possible but is undesirable due to GUDI concerns as well as concerns with campsite occupancy, activities and traffic adjacent to possible well development areas. Areas close to the major roadways are also undesirable due to measured road salting impacts to groundwater. The current general area with wells to the northwest within 150 m of the current wellfield appears to be an optimum location for an increased groundwater supply. The wells will be spaced to mitigate significant inter-well hydraulic interference.

9.0 STATEMENT OF LIMITATIONS

KGS Group prepared this report in a professional manner using the degree of skill and care exercised for similar projects under similar conditions by reputable and competent environmental consultants. The information contained in this report, including its conclusions, is based on the information that was made available to KGS Group during the investigation and upon the services described which were performed within the time and budgetary requirements of Manitoba Conservation. As the report is based on available information, some of its conclusions could be different if the information upon which it is based is determined to be false, inaccurate or contradicted by additional information.

KGS Group has no contractual liability to third parties for the information or opinions contained in this report.

10.0 REFERENCES

1. UMA Engineering Ltd. 2004a. Phase II Environmental Site Assessment, West Hawk Lake Well Field and Manitoba Conservation Maintenance Compound, West Hawk Lake, Manitoba. Project No. 41-01-E107-006-00. January 2004.

2. UMA Engineering Ltd. 2004b. Supplemental Phase II Environmental Site Assessment, West Hawk Lake, Manitoba. Project No. 41-01-E107-006-00-02. November 2004.

3. UMA Engineering Ltd. 2007. Groundwater Monitoring Report, West Hawk Lake, Manitoba. Project No. E107-008-00-02 (4.6.1). December 2004.

4. Water Resources Branch (A. Pederson).1973. Groundwater Investigations and Well Installations at West Hawk Lake. August 7, 1973.

5. A. Pederson.1984. West Hawk Lake; Wells in Trailer Village Area. Inter-Departmental Memorandum. January 17, 1984.

6. The Manitoba Water Services Board (A. Pederson).1990. Test Drilling & Well Installation for West Hawk Lake Townsite System. Memorandum. November 5, 1990.

7. The Manitoba Water Services Board (A. Pederson). 2003. West Hawk Lake Groundwater Supply. August 19, 2003.

8. Manitoba Conservation 2007. Drinking Water Results. October 22, 2007.

9. Environment Canada A National Ecological Framework for Canada website, found at www. ec.gc.ca/soer-ree/English/Framework/default.cfm. Accessed October 2008.

10. Environment Canada. 2004. Canadian Climate Normals 1971-2000, found at http://www.msc-smc.ec.gc.ca/climate/climate_normals/index_e.cfm. Accessed October 2008.

11. Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines. Chapter 2. Update 2007.

12. Canadian Council of Ministers of the Environment. 2008. National Classification System for Contaminated Sites.

TABLES

TABLE 1
GROUNDWATER MONITORING DATA - HYDROCARBON IMPACTED AREA
WEST HAWK LAKE, MANITOBA

Well	Ground Elevation (m)	Top of Pipe Elevation (m)	Date	Organic Vapours (ppm)	Depth to Product (m)	Product Thickness (m)	Depth to Water (m)	Water Elevation (m)
Former Supply Well 1	365.00	365.63	12-Aug-08	-	-	-	-	-
Former Supply Well 2	364.62	365.27	12-Aug-08	-	-	-	-	-
Former Supply Well 3	364.84	365.35	12-Aug-08	-	-	-	5.165	360.185
WH-1	365.54	365.50	12-Aug-08	-	5.300	0.001	5.301	360.199
WH-2	366.44	367.65	31-Jul-08	20	-	-	Dry	-
WH-3	364.00	365.05	31-Jul-08	280	-	-	4.835	360.215
WH-4	369.41	369.34	31-Jul-08	15	-	-	Dry	-
WH-5	Could not locate (assumed destroyed)							
WH-6	369.52	370.46	31-Jul-08	5	8.041	-	8.042	362.418
WH-7A	369.88	370.89	31-Jul-08	5	-	-	6.154	364.736
WH-7B	369.86	370.94	31-Jul-08	35	-	-	Dry	-
WH-8	369.94	369.87	31-Jul-08	0	6.388	0.002	6.390	363.480
WH-9	364.13	364.04	31-Jul-08	120	Sheen	Sheen	3.619	360.421
WH-10	364.19	364.13	31-Jul-08	15	3.869	0.001	3.870	360.260
WH-11	363.44	363.34	31-Jul-08	210	-	-	3.010	360.330
WH-12	364.16	364.10	31-Jul-08	20	-	-	3.774	360.326
WH-13	Could not locate (assumed destroyed)							
WH-14	364.18	364.08	31-Jul-08	65	3.749	0.001	3.750	360.330
WH-15	364.07	364.01	31-Jul-08	50	-	-	3.763	360.247
WH-16	364.47	363.71	31-Jul-08	20	-	-	3.464	360.246
WH-17	364.50	365.64	31-Jul-08	20	5.436	0.002	5.438	360.202
WH-18	364.12	364.07	31-Jul-08	360	3.631	0.001	3.632	360.438
WH-19	363.95	363.87	31-Jul-08	2800	Sheen	Sheen	3.355	360.515
WH-20	363.96	363.90	31-Jul-08	>10000	Sheen	Sheen	3.485	360.415
WH-21	-	-	31-Jul-08	0	Sheen	Sheen	3.706	-
WH-22	364.66	364.61	31-Jul-08	20	-	-	4.429	360.181
WH-23	Could not locate (assumed destroyed)							
WH-24	365.05	365.00	31-Jul-08	90	-	-	Dry	-
WH-25	364.40	365.56	31-Jul-08	180	5.345	0.002	5.347	360.213
WH-26	365.16	365.10	31-Jul-08	25	4.865	0.002	4.867	360.233
WH-27	363.68	363.62	31-Jul-08	0	-	-	3.386	360.234

Note:
"-" = No data available

TABLE 2
GROUNDWATER MONITORING DATA - CURRENT WELL FIELD
WEST HAWK LAKE, MANITOBA

Well	Ground Elevation (m)	Casing Elevation (m)	Depth to Water (m) - 0.5hr after recovery	Water Elevation (m) - 0.5hr after recovery	Depth to Water During Pumping (m)	Pumping Water Elevation (m)	Pumping Rate		
							L/s	USgpm	Igpm
PW-1A	363.49	363.91	5.300	358.61	9.55	354.36	2.8	44	37
PW-2	363.04	363.40	4.810	358.59	10.06	353.34	2.8	44	37
PW-3	363.30	363.49	4.890	358.60	8.54	354.95	2.2	35	29
PW-4	363.09	363.45	4.870	358.58	9.75	353.70	2.3	36	30
PW-5	362.71	363.15	4.520	358.63	8.70	354.45	2.6	42	33

TABLE 3
GROUNDWATER FIELD CHEMISTRY - HYDROCARBON IMPACTED AREA
WEST HAWK LAKE, MANITOBA

Well ID	Date	Temperature (˚C)	pH	Electrical Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Total Dissolved Solids (mg/L)	Oxidation Reduction Potential (mV)
Former Supply Well 1	12-Aug-08	-	6.85	574	1.03	373	-
Former Supply Well 2	12-Aug-08	-	7.52	410	3.38	266	54.8
Former Supply Well 3	12-Aug-08	-	7.44	503	6.88	326	44.5
WH-1	12-Aug-08	9.3	7.73	1574	7.57	1023	45.8
WH-2	31-Jul-08	-	-	-	-	-	-
WH-3	31-Jul-08	12.7	6.37	395	3.97	257	75.5
WH-4	31-Jul-08	-	-	-	-	-	-
WH-5	Could not locate (assumed destroyed)						
WH-6	31-Jul-08	9.1	7.55	89	8.96	58	34.3
WH-7A	31-Jul-08	7.6	6.23	79	10.88	51	213.4
WH-7B	31-Jul-08	-	-	-	-	-	-
WH-8	31-Jul-08	-	-	-	-	-	-
WH-9	31-Jul-08	12.2	7.05	2149	5.04	1397	-19.3
WH-10	31-Jul-08	10.7	7.60	1600	8.83	1040	48.5
WH-11	31-Jul-08	12.9	6.15	300	6.34	195	120.2
WH-12	31-Jul-08	10.9	6.40	1537	7.60	999	120.6
WH-13	Could not locate (assumed destroyed)						
WH-14	31-Jul-08	11.0	7.19	1328	2.28	863	-69.5
WH-15	31-Jul-08	11.4	6.20	861	8.36	559	93.3
WH-16	31-Jul-08	14.2	6.64	937	7.73	609	90.5
WH-17	31-Jul-08	9.4	7.48	630	2.37	410	-55.9
WH-18	31-Jul-08	12.8	7.02	1097	1.78	713	-66.9
WH-19	31-Jul-08	11.7	7.09	400	2.05	260	-5.5
WH-20	31-Jul-08	11.6	6.93	881	1.54	572	-90.2
WH-21	31-Jul-08	11.5	7.48	2030	5.01	1319	-47.3
WH-22	31-Jul-08	10.0	6.57	1040	9.72	680	152.7
WH-23	Could not locate (assumed destroyed)						
WH-24	31-Jul-08	-	-	-	-	-	-
WH-25	31-Jul-08	11.5	7.52	622	1.88	404	-60.7
WH-26	31-Jul-08	9.2	7.45	545	8.85	354	65.7
WH-27	31-Jul-08	11.5	6.17	507	2.43	330	24.2

TABLE 4
GROUNDWATER FIELD CHEMISTRY - CURRENT WELL FIELD
WEST HAWK LAKE, MANITOBA

Well ID	Date	Temperature (˚C)	pH	Electrical Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Total Dissolved Solids (mg/L)	Oxidation Reduction Potential (mV)
PW-1A	31-Jul-08	-	6.58	704	9.85	458	99.8
PW-2	31-Jul-08	-	6.99	514	6.68	334	67.3
PW-3	31-Jul-08	-	6.82	427	7.51	277	49.3
PW-4	31-Jul-08	-	7.03	514	7.60	334	48.3
PW-5	31-Jul-08	-	7.34	282	5.37	183	29.6

TABLE 5
PETROLEUM HYDROCARBONS IN GROUNDWATER
WEST HAWK LAKE, MANITOBA

Sample No.	Date	Parameter [1]									
		Benzene	Toluene	Ethyl-benzene	Xylenes (-o,-m,-p)	Volatile Hydrocarbons (w)	VPHw	Styrene	F2 (C10 - C16)	F3 (C16 - C34)	F4 (C34 - C50)
FORMER WELL 1	12-Aug-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	<100	<250	<250
FORMER WELL 2	12-Aug-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	<100	<250	<250
FORMER WELL 3	12-Aug-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	<100	<250	<250
WH-01	12-Aug-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	<100	<250	<250
WH-03	31-Jul-08	**10.0**	260	37	330	1800	1200	<1	3400	<250	<250
WH-03 Dupl.	31-Jul-08	4.50	100	17	150	1100	830	<0.5	1700	<250	<250
WH-06	12-Aug-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	47000	1900	510
WH-09	12-Aug-08	**330**	16000	7300	49000	310000	240000	<20	<100	<250	<250
WH-10	12-Aug-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	<100	<250	<250
WH-11	31-Jul-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	<100	<250	<250
WH-12	31-Jul-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	<100	<250	<250
WH-14	12-Aug-08	**390**	4000	330	2800	12000	4500	<10	170	<250	<250
WH-15	31-Jul-08	**67**	500	45	290	900	<100	<2	<100	<250	<250
WH-16	31-Jul-08	**8.40**	220	100	850	2100	920	<0.5	110	<250	<250
WH-17	12-Aug-08	**3200**	9900	1600	9400	40000	16000	<10	1000	<250	<250
WH-18	12-Aug-08	**2100**	14000	720	13000	40000	10000	<20	1200	<250	<250
WH-19	12-Aug-08	**140**	3200	650	7800	35000	23000	<10	1200	<250	<250
WH-20	12-Aug-08	**9200**	33000	950	15000	100000	42000	<40	2600	<250	<250
WH-21	12-Aug-08	**1300**	5600	270	1900	12000	2900	<10	740	<250	<250
WH-22	31-Jul-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	<100	<250	<250
WH-22 Dupl.	31-Jul-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	<100	<250	<250
WH-25	12-Aug-08	**2800**	6700	550	3200	17000	3800	<20	<100	<250	<250
WH-26	12-Aug-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	<100	<250	<250
WH-27	31-Jul-08	**2500**	22000	1200	8000	34000	300	<40	490	<250	<250
WH-7A	31-Jul-08	<0.1	<0.1	<0.1	<0.1	<100	<100	<0.1	<100	<250	<250
Field Blank	31-Jul-08	<0.1	<0.1	<0.1	<0.1	-	-	-	-	-	-
Trip Blank	31-Jul-08	<0.1	<0.1	<0.1	<0.1	-	-	-	-	-	-
EQL		*0.1*	*0.1*	*0.1*	*0.1*	*100*	*100*	*<0.1/<10/<20/<40*	*100*	*250*	*250*
CCME [2]											
Drinking Water Quality		5 (MAC)	24 (AO)	2.4 (AO)	300 (AO)	-	-	-	-	-	-

Notes:
EQL = Estimated Quantitation Limit = Lowest level of the parameter that can be quantified with confidence.
"-" = No Data
V.P.H. = Volatile Petroleum Hydrocarbons

1. All concentrations in micrograms per litre (µg/L).
2. CCME - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines 1999. Update 7.0 - 2007
   Chapter 2 - Community Water
   MAC - Maximum Acceptable Concentration
   AO - Aesthetic Objective

BOLD	- Exceedance of Health Related Criteria (MAC)
Underlined	- Exceedance of Non-Health Related Criteria (AO)

TABLE 6
GENERAL WATER QUALITY
WEST HAWK LAKE, MANITOBA

Sample No.	Date	Parameters (1)																												
		Colour (T.C.U.)	Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as $CaCO_3$	Carbonate as $CaCO_3$	Hydroxide as $CaCO_3$	Hardness as $CaCO_3$	Chloride	Fluoride	Sulphate	Calcium	Iron	Magnesium	Manganese	Potassium	Silicon	Sodium	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	B.O.D.	C.O.D.	D.O.C	Ammonia as N	T.K.N.	Total Phosphorus	T.D.S.	Total Coliform (NPN/100mL)	E.coli
EQL		*5*	*0.1*	*-*	*1*	*1*	*0.5*	*0.5*	*0.5*	*0.2/1*	*0.2*	*0.05*	*0.5*	*0.01*	*0.01*	*0.01*	*0.0002*	*0.02*	*0.05*	*0.01*	*0.01*	*0.01*	*0.002*	*1*	*20*	*1*	*0.01*	*0.2*	*0.001*	*10*	*1*	*1*
Current Supply Wells																														
PW1A	31-Jul-08	<5	<0.1	6.92	721	48.8	59.5	<0.5	<0.5	91.9	168	<0.1	13.6	29.6	<0.01	4.37	0.019	1.92	4.36	74.9	1.68	1.63	<0.002	-	-	-	-	-	-	382	<1	<1
PW1A	8-Sep-08	<5	<0.1	6.72	693	50.4	61.5	<0.5	<0.5	99.6	162	<0.1	13.9	31.9	<0.01	4.84	0.028	2.12	4.72	75	1.42	1.42	<0.002	<1	<20	3.6	<0.01	0.6	0.005	385	<1	<1
PW2	31-Jul-08	13	0.1	7.33	530	96	117	<0.5	<0.5	122	92.2	<0.05	9.95	40.2	0.02	5.26	0.255	1.71	6.3	34.7	0.63	0.63	<0.002	-	-	-	-	-	-	301	<1	<1
PW2	8-Sep-08	16	<0.1	7.17	514	99.9	122	<0.5	<0.5	129	86.7	0.09	10.1	42.7	0.04	5.44	0.306	1.82	6.27	32.8	0.65	0.65	<0.002	<1	<20	5.9	0.05	0.4	0.006	313	<1	<1
PW3	31-Jul-08	8	0.3	6.97	437	45	54.9	<0.5	<0.5	127	79.9	<0.05	27.2	39.1	0.17	7.07	0.085	1.88	6.6	14.1	0.6	0.6	<0.002	-	-	-	-	-	-	240	<1	<1
PW3	8-Sep-08	13	0.3	6.91	438	53.4	65.1	<0.5	<0.5	138	75.6	0.07	30.9	42.6	0.18	7.68	0.07	2.05	6.72	13.1	0.45	0.45	<0.002	<1	<20	6.6	0.01	0.3	0.011	284	<1	<1
PW4	31-Jul-08	<5	<0.1	7.41	528	87	106	<0.5	<0.5	192	93.6	<0.05	15.5	61.8	<0.01	9.12	0.055	2.24	6.68	12.8	0.33	0.33	<0.002	-	-	-	-	-	-	255	<1	<1
PW4	8-Sep-08	<5	<0.1	7.3	523	91.2	111	<0.5	<0.5	180	91.2	<0.05	16.3	59.9	<0.01	7.89	0.076	2.45	6.87	13.8	0.3	0.3	<0.002	<1	<20	2.2	0.04	0.3	0.006	333	<1	<1
PW5	31-Jul-08	14	0.2	7.71	302	118	144	<0.5	<0.5	115	16	<0.05	3.27	37.2	0.39	5.43	0.303	1.78	7.45	3.97	<0.01	<0.01	<0.002	-	-	-	-	-	-	169	<1	<1
PW5	8-Sep-08	17	0.2	7.69	304	125	153	<0.5	<0.5	126	16.6	0.06	3.65	40.5	0.42	5.93	0.351	2.02	8.07	4.46	<0.01	<0.01	<0.002	3	<20	8.6	0.03	0.3	0.017	206	<1	<1
Monitoring Wells																														
MW1	8-Sep-08	<5	0.1	6.19	497	13.6	16.6	<0.5	<0.5	-	125	<0.05	10	-	-	-	-	-	-	-	0.97	0.97	<0.002	<1	<20	2.3	0.02	0.2	0.007	305	-	-
MW3	8-Sep-08	<5	0.2	5.93	629	9.7	11.8	<0.5	<0.5	-	163	<0.1	14.3	-	-	-	-	-	-	-	1.9	1.9	<0.002	<1	<20	2.1	<0.01	0.3	0.007	353	-	-
Former Well Field																														
WH-1	8-Sep-08	13	**5**	6.74	1610	59.2	72.2	<0.5	<0.5	-	442	<0.25	7.12	-	-	-	-	-	-	-	1.61	1.61	<0.002	-	-	-	-	-	-	760	-	-
Surface Water																														
WHL-SW	31-Jul-08	-	0.2	7.56	92	26	31.7	<0.5	<0.5	31	7.08	<0.05	4.27	-	-	-	-	-	-	-	0.09	-	-	-	-	-	-	-	-	67	**79**	**3**
CCME / Health Canada (2,3)																														
Drinking Water (2)		15 (AO)	1 (MAC) 5 (4) (AO)	6.5 - 8.5 (AO)	-	-	-	-	-	200 (7) (AO)	250 (AO)	1.5 (MAC)	500 (AO)	-	0.3 (AO)	-	0.05 (AO)	-	-	200 (AO)	10 (7) (MAC)	10 (MAC)	1 (MAC)	-	-	-	-	-	-	500 (AO)	nd per 100 mL	nd per 100 mL

Notes:

"-" = No Data
EQL = Estimated Quantitation Limit = The lowest level of the parameter that can be quantified with confidence
E.C. = Electrical Conductivity
B.O.D. = Biochemical Oxygen Demand
C.O.D. = Chemical Oxygen Demand
D.O.C. = Dissolved Organic Carbon
T.O.C. = Total Organic Carbon
T.K.N. = Total Kjeldahl Nitrogen
T.D.S. = Total Dissolved Solids
T.S.S. = Total Suspended Solids

1. All values are expressed in milligrams per litre (mg/L) unless indicated otherwise.
2. Guidelines for Canadian Drinking Quality, March 2007. Safe Environments Program, Health Canada, Federal-Provincial-Territorial Committee on Drinking Water.
   MAC - Maximum Acceptable Concentration
   AO - Aesthetic Objectives
3. CCME 2007 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999. Update 7.0 - 2007.
   Guidelines for Canadian Drinking Water Quality.
   Chapter 2 - Community Water
4. At the point of consumption
6. Equivalent to 10 mg/L as nitrate-nitrogen. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L.
7. Public acceptance of hardness varies considerably. Generally, hardness levels between 80 and 100 mg/L (as CaCO3) are considered acceptable; levels greater than 200 mg/L are considered poor but can be tolerated; those in excess of 500 mg/L are normally considered unacceptable. Where water is softened by sodium ion exchange, it is recommended that a separate, unsoftened supply be retained for culinary and drinking purposes.
8. Guideline is dependant on type of plant. See CCME summary table for details.
9. Colour Guidelines (see fact sheet for complete details):
True Colour: The mean absorbance of filtered water samples at 456 nm shall not be significantly less than the seasonally adjusted expected value for the system under consideration
Apparent Colour: The mean percent transmission of white light per metre shall not be significantly less than the seasonally adjusted expected value for the system under consideration.
10. Guideline for un-ionized ammonia is 0.019 mg/L. Un-ionized ammonia is pH and Temperature dependant. See Factsheet for details.
11. Suspended Sediments Guidelines (see fact sheet for complete details):
Clear Flow:
Maximum increase of 25 mg/L from background levels for any short-term exposure (eg. 24 hr period).
Maximum average increase of 5 mg/L from background levels for longer term exposures (eg. Inputs lasting between 24 hrs and 30 days).
High Flow:
Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L.
Clear Flow:
Maximum average increase of 2 NTUs from background levels for a longer exposure (e.g. 30 d period).
High Flow or Turbid Waters:
Maximum increase of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs.
Should not increase more than 10% of background levels when background is >80 NTUs.

BOLD - Exceedance of Health Related Guidelines (MAC, IMAC)
Underlined - Exceedance of Non-Health Related Guidelines (AO)

TABLE 7
METALS IN GROUNDWATER
WEST HAWK LAKE, MANITOBA

Well No.	Date	Parameter (1)																	
		Aluminum	Antimony	Arsenic	Barium	Boron	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury (µg/L)	Potassium	Selenium	Sodium	Uranium	Zinc
Current Supply Wells																				
PW1	31-Jul-08	0.004	0.0005	0.0003	0.034	0.02	<0.00004	-	0.0002	0.0046	<0.01	<0.0002	5.07	0.022	<0.02	-	0.0006	-	0.0004	0.008
PW1	8-Sep-08	0.002	0.0004	0.0003	0.034	0.02	<0.00004	-	0.0005	0.0049	<0.01	<0.0002	4.95	0.03	<0.02	-	0.0004	-	0.0005	0.014
PW2	31-Jul-08	0.01	0.0004	0.0013	0.02	0.01	<0.00004	-	0.0003	0.009	0.04	<0.0002	5.73	0.28	<0.02	-	0.0004	-	0.0015	0.002
PW2	8-Sep-08	0.006	0.0004	0.0014	0.02	0.02	<0.00004	-	0.0004	0.0088	0.05	<0.0002	5.82	0.337	<0.02	-	<0.0002	-	0.0016	0.003
PW3	31-Jul-08	0.01	0.0003	0.0009	0.032	0.04	0.00005	-	0.0002	0.0047	0.27	<0.0002	7.74	0.1	<0.02	-	0.0005	-	0.0012	0.005
PW3	8-Sep-08	0.008	0.0004	0.001	0.034	0.05	0.00004	-	0.0004	0.0067	0.26	0.0003	8.28	0.08	<0.02	-	0.0005	-	0.0016	0.01
PW4	31-Jul-08	0.003	0.0003	0.0005	0.022	0.02	<0.00004	-	<0.0002	0.0032	0.01	<0.0002	8.06	0.055	<0.02	-	0.0007	-	0.0021	0.004
PW4	8-Sep-08	0.001	0.0005	0.0006	0.024	0.03	<0.00004	-	0.001	0.004	0.02	<0.0002	8.27	0.082	<0.02	-	<0.0002	-	0.0024	0.006
PW5	31-Jul-08	0.009	0.0004	0.0033	0.012	0.01	<0.00004	-	0.0002	0.0081	0.46	<0.0002	5.88	0.325	<0.02	-	0.0005	-	0.0025	0.004
PW5	8-Sep-08	0.002	0.0004	0.0034	0.013	0.01	<0.00004	-	0.0002	0.0051	0.51	<0.0002	6.04	0.375	<0.02	-	<0.0002	-	0.0024	0.003
Surface Water																				
WHL-SW	31-Jul-08	-	-	-	-	-	-	9.53	-	-	0.01	-	1.37	0.0014	-	1.09	-	4.25	-	-
EQL		*0.001*	*0.002*	*0.002*	*0.0002*	*0.01*	*0.00004*	*0.01*	*0.0002*	*0.0002*	*0.01*	*0.0002*	*0.01*	*0.0002*	*0.02*	*0.02*	*0.0002*	*0.01*	*0.0001*	*0.001*
CCME (2)																				
Drinking Water		0.1 (3) (MAC)	0.006 (IMAC)	0.025 (IMAC)	1 (MAC)	5.0 (IMAC)	0.005 (MAC)	-	0.05 (MAC)	1 (AO)	0.3 (AO)	0.01 (MAC)	-	0.05 (AO)	0.001 (MAC)	-	0.01 (MAC)	200 (AO)	0.02 (IMAC)	5 (AO)

Notes:

EQL = Estimated Quantitation Limit = Lowest level of the parameter that can be quantified with confidence

1. All values are expressed in milligrams per litre (mg/L).
2. CCME - Canadian Council of Ministers of the Environment. Canadian Water Quality Guidelines, 1999. Update 7.0 - 2007.
   Chapter 2 - Community Water
   MAC - Maximum Acceptable Concentration
   IMAC - Interim Maximum Acceptable Concentration
   AO - Aesthetic Objective
3. A health-based guideline for aluminum in drinking water has not been established. However, water treatment plants using aluminum-based coagulants should optimize their operations to reduce residual aluminum levels in treated water to the lowest extent possible as a precautionary measure. Operational guidance values of less than 0.1 mg/L of total aluminum for conventional treatment plants, and less than 0.2 mg/L total aluminum for other types of treatment systems are recommended.
4. Total aluminum should not exceed 0.005 mg/L in waters with a pH equal to or below 6.5. The concentration of total aluminum should not exceed 0.1 mg/L in waters with a pH greater than 6.5.
5. Interim guideline.

a. Copper Guideline

Copper Criteria	Hardness as CaCO3
0.002	0-120
0.003	120-180
0.004	>180

b. Lead guideline

Lead Criteria	Hardness as CaCO3
0.001	0-60
0.002	60-120
0.004	120-180
0.007	>180

c. Nickel guideline

Nickle Criteria	Hardness as CaCO3
0.025	0-60
0.065	60-120
0.11	120-180
0.15	>180

BOLD - Exceedance of MAC and IMAC Criteria

UNDERLINE - Exceedance of AO Criteria

TABLE 8
WELL CAPACITY ASSESSMENT
WEST HAWK LAKE, MANITOBA

Well ID	Drawdown From Each Well (m)					Total Drawdown From All Wells (m)	Maximum Recommended Drawdown (m)	Drawdown is Less Than Maximum Recommended
	PW1A	PW2	PW3	PW4	PW5			
PW1A	6.24	0.5	1.52	0	0.7	8.96	6.9	No
PW2	0.55	6.24	0.3	0.8	0.55	8.44	10.6	Yes
PW3	1.52	0.3	6.24	0	0.7	8.76	6.9	No
PW4	0	0.85	0	6.24	0.1	7.19	6.9	No
PW5	0.7	1.55	0.7	0.1	6.24	9.29	6.9	No

Notes:

1. Maximum drawdown recommended at PW1A, 3, 4, and 5 is 6.9 m based on a pump setting of 10 m below ground surface, an optimal pumping level of at least 1 m above the pump and a static depth to water of 2.1 m below the ground surface.
2. Maximum drawdown recommended at PW2 is 10.6 m based on a pump setting of 13.7 m below ground surface, an optimal water level of at least 1 m above the pump and a static depth to water of 2.1 m below ground surface.
3. Drawdown from each well based on distance drawdown plot from 2003 pump test of PW1A (Figure 8).

TABLE 9
RAW WELL WATER BACTERIA RESULTS
WEST HAWK LAKE, MANITOBA

Sample Date	Sample Identification	TC	EC
WHL WELL #1A-RAW			
29-Jan-07	WH1 - WELL #1A	0	0
10-Apr-07	#1 WEST HAWK LAKE WELL#1A~ RAW	0	0
18-Jun-07	#1 WEST HAWK LAKE WELL#1A ~ RAW	0	0
18-Jun-07	#1 WEST HAWK LAKE WELL#1A ~ RAW	0	0
27-Aug-07	#1 WEST HAWK LAKE WELL#1A ~ RAW	0	0
27-Aug-07	#1 WEST HAWK LAKE WELL#1A ~ RAW	0	0
27-Aug-07	#1 WEST HAWK LAKE WELL#1A ~ RAW	0	0
27-Aug-07	#1 WEST HAWK LAKE WELL#1A ~ RAW	0	0
05-Nov-07	#1 WEST HAWK LAKE WELL#1A____~ RAW	0	0
03-Jan-08	#1 WEST HAWK LAKE WELL#_#1A___~ RAW	0	0
03-Jan-08	#2 WEST HAWK LAKE RAW WELL 1A	0	0
28-Jan-08	#1 WEST HAWK LAKE WELL#_1A___~ RAW	0	0
07-Apr-08	#1 WEST HAWK LAKE WELL# 1"A"~ RAW	0	0
16-Jun-08	WEST HAWK LAKE WELL # 1A - RAW	0	0
16-Jun-08	WEST HAWK LAKE WELL # 1A - RAW	0	0
Total # Positives		**0**	**0**
Total # Samples (excluding duplicates)		**7**	**7**
WHL WELL #2-RAW			
12-Feb-07	#1 - WEST HAWK LAKE WELL #2 - WH1	0	0
22-Jun-07	#1 WEST HAWK LAKE WELL#2	NR	<3
22-Jun-07	#1 WEST HAWK LAKE WELL#2	NR	<3
22-Jun-07	#10 WEST HAWK LAKE WELL #2	NR	NR
22-Jun-07	#10 WEST HAWK LAKE WELL #2	NR	NR
22-Jun-07	#4 WEST HAWK LAKE WELL #2 (MICEX)	NR	NR
22-Jun-07	#4 WEST HAWK LAKE WELL #2 (MICEX)	NR	NR
22-Jun-07	#6 WEST HAWK LAKE WELL #2	NR	NR
22-Jun-07	#6 WEST HAWK LAKE WELL #2	NR	NR
22-Jun-07	#8 WEST HAWK LAKE - WELL #2	NR	NR
22-Jun-07	#8 WEST HAWK LAKE - WELL #2	NR	NR
18-Jul-07	#2 WEST HAWK LAKE WELL #2 - RAW	11 **	0
18-Jul-07	#2 WEST HAWK LAKE WELL #2 - RAW	11 **	0
24-Sep-07	#1 WEST HAWK LAKE WELL#2~ RAW	0	0
19-Nov-07	#1 WEST HAWK LAKE WELL#__2__~ RAW	0	0
22-Apr-08	#1 WEST HAWK LAKE WELL#__2__~ RAW	0	0
Total # Positives		**2**	**0**
Total # Samples (excluding duplicates)		**6**	**8**

TABLE 9
RAW WELL WATER BACTERIA RESULTS
WEST HAWK LAKE, MANITOBA

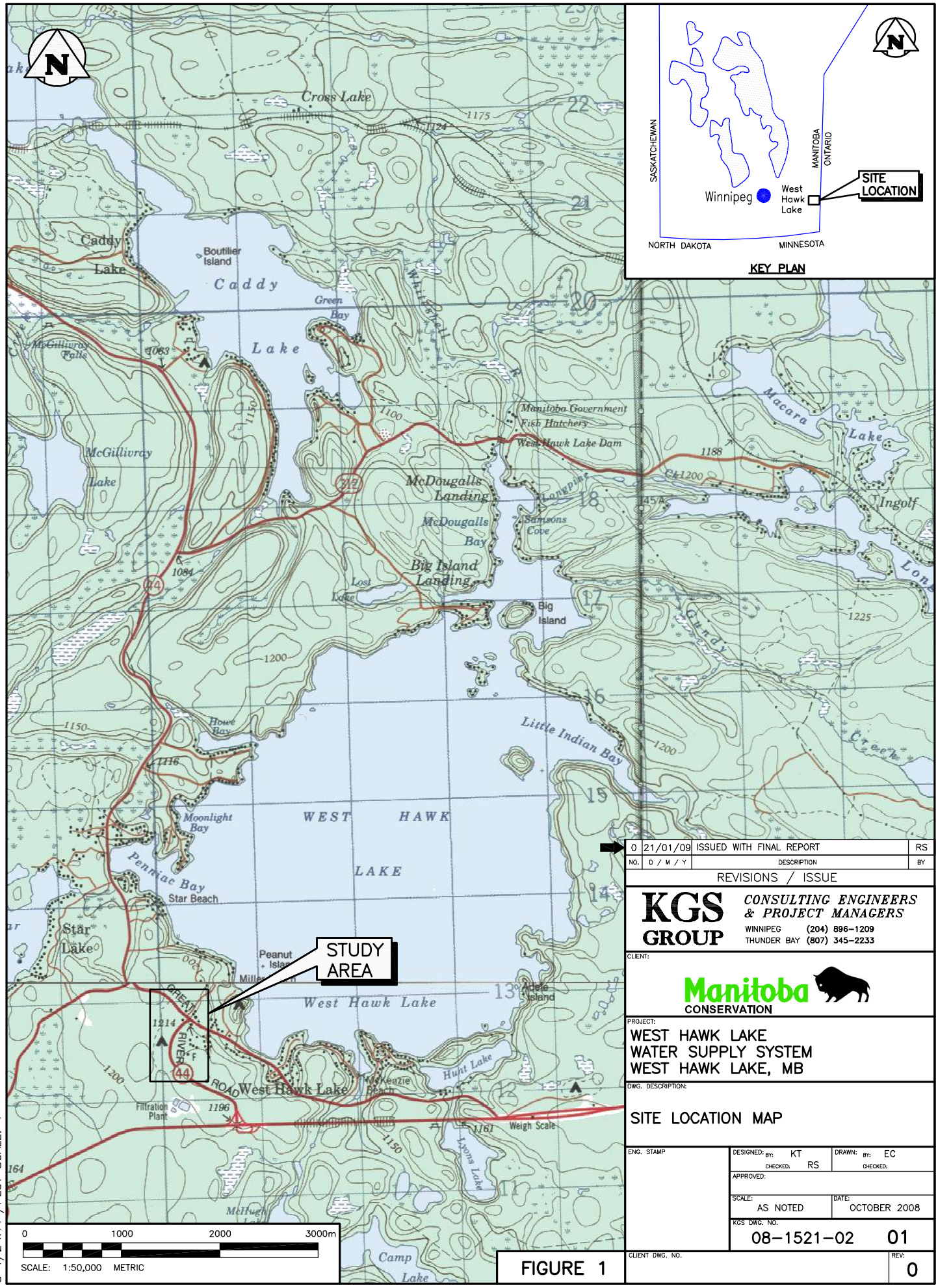
Sample Date	Sample Identification	TC	EC
WHL WELL #3-RAW			
6-Feb-07	#1 WEST HAWK LAKE WELL#3~ RAW	0	0
11-Feb-07	#1 WEST HAWK LAKE WELL#_3___~ RAW	0	0
12-Mar-07	#1 WEST HAWK LAKE WELL#3~ RAW	0	0
23-Apr-07	#1 WEST HAWK LAKE WELL#3~ RAW	0	0
23-Apr-07	#1 WEST HAWK LAKE WELL#3~ RAW	0	0
6-May-07	#1 WEST HAWK LAKE WELL#_3___~ RAW	0	0
7-May-07	#1 WEST HAWK LAKE WELL#3~ RAW	0	0
7-May-07	#1 WEST HAWK LAKE WELL#3~ RAW	0	0
3-Dec-07	#1 WEST HAWK LAKE WELL#_3 RAW	0	0
25-Feb-08	#1 WEST HAWK LAKE WELL#3~ RAW	0	0
28-Jul-08	WEST HAWK LAKE 1 - RAW WELL 3	0	0
Total # Positives		**0**	**0**
Total # Samples (excluding duplicates)		**9**	**9**
WHL WELL #4-RAW			
15-Jan-07	#1 WEST HAWK LAKE WELL#4 WELL WH1	0	0
30-Jul-07	#1 WEST HAWK LAKE WELL#4 ~ RAW	0	0
30-Jul-07	#1 WEST HAWK LAKE WELL#4 ~ RAW	0	0
10-Sep-07	#1 WEST HAWK LAKE WELL#4~ RAW	0	0
10-Sep-07	#1 WEST HAWK LAKE WELL#4~ RAW	0	0
17-Dec-07	#1 WEST HAWK LAKE WELL#__4__~ RAW	0	0
2-Jan-08	#1 WEST HAWK LAKE WELL#_4___~ RAW	0	0
10-Mar-08	#1 WEST HAWK LAKE WELL#_4___~ RAW	0	0
22-May-08	#1 WEST HAWK LAKE WELL#__4__~ RAW	0	0
Total # Positives		**0**	**0**
Total # Samples (excluding duplicates)		**7**	**7**
WHL WELL #5-RAW			
26-Mar-07	#1 WEST HAWK LAKE WELL#5~ RAW	0	0
4-Jun-07	#1 WEST HAWK LAKE WELL #5 ~ RAW	0	0
4-Jun-07	#1 WEST HAWK LAKE WELL #5 ~ RAW	0	0
22-Jun-07	#10 WEST HAWK LAKE WELL #5	NR	NR
22-Jun-07	#10 WEST HAWK LAKE WELL #5	NR	NR
22-Jun-07	#2 WEST HAWK LAKE WELL #5	0	0
22-Jun-07	#2 WEST HAWK LAKE WELL #5	0	0
22-Jun-07	#5 WEST HAWK LAKE WELL #5 (MICEX)	NR	NR
22-Jun-07	#5 WEST HAWK LAKE WELL #5 (MICEX)	NR	NR
22-Jun-07	#7 WEST HAWK LAKE WELL #5	NR	NR
22-Jun-07	#7 WEST HAWK LAKE WELL #5	NR	NR
22-Jun-07	#9 WEST HAWK LAKE WELL #5	NR	NR
22-Jun-07	#9 WEST HAWK LAKE WELL #5	NR	NR
18-Jul-07	#1 WEST HAWK LAKE WELL#5 - RAW	0	0
18-Jul-07	#1 WEST HAWK LAKE WELL#5 - RAW	0	0
13-Aug-07	#1 WEST HAWK LAKE WELL#5 RAW	0	0
13-Aug-07	#1 WEST HAWK LAKE WELL#5 RAW	0	0
22-Nov-07	#1 WEST HAWK LAKE WELL#5____~ RAW	0	0
14-Jan-08	#1 WEST HAWK LAKE WELL#_5__~ RAW	0	0

TABLE 9
RAW WELL WATER BACTERIA RESULTS
WEST HAWK LAKE, MANITOBA

Sample Date	Sample Identification	TC	EC
WHL WELL #5-RAW Con't.			
25-Mar-08	#1 WEST HAWK LAKE WELL#_5___~ RAW	0	0
2-Jun-08	#1 WEST HAWK LAKE WELL#__5_~ RAW	0	0
2-Jun-08	#1 WEST HAWK LAKE WELL#__5_~ RAW	0	0
11-Aug-08	WEST HAWK LAKE 1 - RAW WELL #5	0	0
Total # Positives		**0**	**0**
Total # Samples (excluding duplicates)		**10**	**10**
WHL WELL - RAW (No Well Specified)			
2-Jan-07	#1 WEST HAWK LAKE RAW	0	0
22-May-07	#1 WEST HAWK LAKE WELL#____~ RAW	0	0
22-May-07	#1 WEST HAWK LAKE WELL#____~ RAW	0	0
3-Jul-07	#1 WEST HAWK LAKE WELL#____~ RAW	0	0
3-Jul-07	#1 WEST HAWK LAKE WELL#____~ RAW	0	0
16-Jul-07	#1 W HAWK LKE WELL# MAIN PUMPHSE - RAW	0	0
16-Jul-07	#1 WE HAWK LAKE WELL# MAIN PUMPH - RAW	0	0
2-Jul-08	WEST HAWK LAKE 1 - RAW	0	0
2-Jul-08	WEST HAWK LAKE 1 - RAW	0	0
14-Jul-08	WEST HAWK LAKE 1 - RAW	0	0
14-Jul-08	WEST HAWK LAKE 1 - RAW	0	0
25-Aug-08	WEST HAWK LAKE 1 - RAW	0	0
8-Sep-08	WEST HAWK LAKE 1 - RAW	0	0
22-Sep-08	WEST HAWK LAKE 1 - RAW	0	0
6-Oct-08	WEST HAWK LAKE 1 - RAW	0	0
Total # Positives		**0**	**0**
Total # Samples (excluding duplicates)		**10**	**10**

Notes:
1. Data from MWS Office of Drinking Water. Summary from KGS Group

FIGURES



NO.	D / M / Y	DESCRIPTION	BY
0	21/01/09	ISSUED WITH FINAL REPORT	RS

REVISIONS / ISSUE

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

CLIENT: Manitoba CONSERVATION

PROJECT:
WEST HAWK LAKE
WATER SUPPLY SYSTEM
WEST HAWK LAKE, MB

DWG. DESCRIPTION:
SITE LOCATION MAP

ENG. STAMP

DESIGNED: BY: KT CHECKED: RS
DRAWN: BY: EC CHECKED:
APPROVED:
SCALE: AS NOTED
DATE: OCTOBER 2008
KGS DWG. NO. 08-1521-02 01
CLIENT DWG. NO.
REV: 0

FIGURE 1

KGS FILE NO.:P:\Projects\2008\08-1521-02\Dwg\Env\Revision 0\08-1521-02-01rev0.dwg - Tab: Layout 1 - Jan 21, 2009 - 2:51pm : UserName: EChubey
8 1/2"x11"/PLOT SCALE: 1

LEGEND:

ASSUMED DRAINAGE ROUTE

SW1 SURFACE WATER SAMPLE LOCATION

0 100 200 300 400m

SCALE: 1:4000 METRIC 24"x36"
1:8000 METRIC 11"x17"

NO.	DATE	REVISIONS	BY	CKD.	APP.
0	21/01/09	ISSUED WITH FINAL REPORT	KT	RS	

REVISIONS / ISSUE

A. SECTION LETTER OR DETAIL NUMBER
B. DRAWING WHERE SECTION OR DETAIL IS DRAWN
OR
DRAWING WHERE SECTION OR DETAIL WAS INDICATED
— SECTION OR DETAIL SHOWN ON SAME DRAWING

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

CLIENT: Manitoba CONSERVATION

PROJECT:
WEST HAWK LAKE
WATER SUPPLY SYSTEM
WEST HAWK LAKE, MB

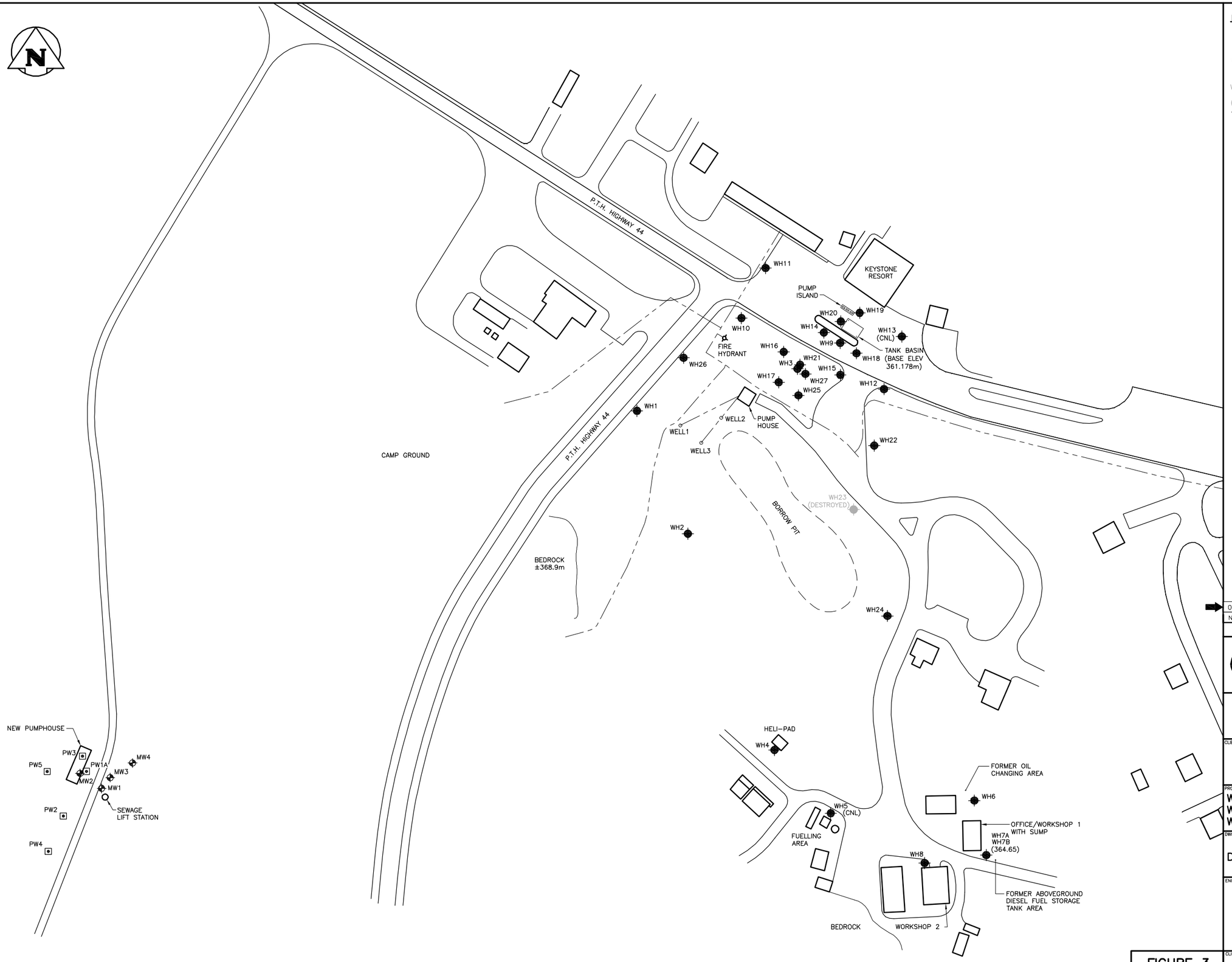
DWG. DESCRIPTION:
AERIAL PHOTOGRAPH OF SITE

ENG. STAMP

DESIGNED: BY: KT	DRAWN: BY: EC
CHECKED: RS	CHECKED:
APPROVED:	
SCALE: AS NOTED	DATE: OCTOBER 2008
KGS DWG. NO. 08-1521-02 02	
CLIENT DWG. NO.	REV: 0

FIGURE 2

24"x36"
KGS FILE NO.: P:\Projects\2008\08-1521-02\Dwg\Env\Revision 0\08-1521-02-02rev0.dwg — Tab: Layout 1 — Jan 21, 2009 — 2:53pm : UserName: EChubey
24"x36"/PLOT SCALE: 1:1



LEGEND

- MW2 — MONITORING WELL BY KGS GROUP
- PW5 — PUMPING WELL BY KGS GROUP
- WH11 — MONITORING WELL (BY OTHERS)
- (CNL) — COULD NOT LOCATE
- WH23 (DESTROYED) — DESTROYED MONITORING WELL (BY OTHERS)
- WATER LINE

0 15 30 45 60 75m

SCALE: 1:750 METRIC 24"x36"
1:1500 METRIC 11"x17"

NO.	DATE	REVISIONS	BY	CKD.	APP.
0	21/01/09	ISSUED WITH FINAL REPORT	KT	RS	

REVISIONS / ISSUE

A. SECTION LETTER OR DETAIL NUMBER
B. DRAWING WHERE SECTION OR DETAIL IS DRAWN
OR
DRAWING WHERE SECTION OR DETAIL WAS INDICATED
— SECTION OR DETAIL SHOWN ON SAME DRAWING

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

CLIENT: Manitoba CONSERVATION

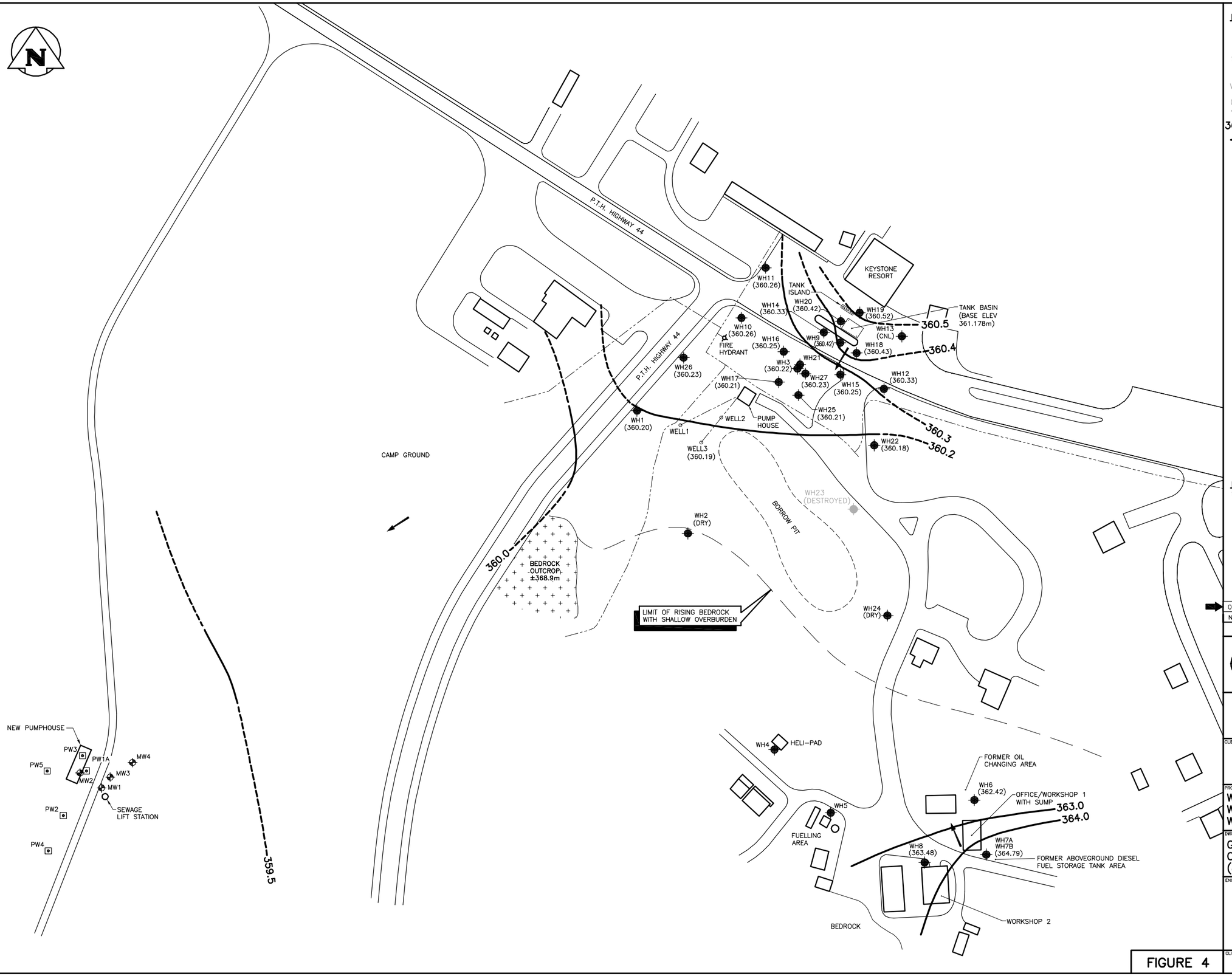
PROJECT:
WEST HAWK LAKE
WATER SUPPLY SYSTEM
WEST HAWK LAKE, MB

DWG. DESCRIPTION:
DETAILED SITE PLAN

ENG. STAMP

DESIGNED: BY: KT	DRAWN: BY: EC
CHECKED: RS	CHECKED:
APPROVED:	
SCALE: AS NOTED	DATE: OCTOBER 2008
KGS DWG. NO. 08-1521-02 03	
CLIENT DWG. NO.	REV: 0

FIGURE 3



LEGEND

- MW2 — MONITORING WELL BY KGS GROUP
- PW5 — PUMPING WELL BY KGS GROUP
- WH11 — MONITORING WELL (BY OTHERS)
- (360.33) — GEODETIC GROUNDWATER LEVEL AT WELL (m)
- WH23 (DESTROYED) — DESTROYED MONITORING WELL (BY OTHERS)
- WATER LINE
- 360.5 — GEODETIC GROUNDWATER CONTOUR
- ASSUMED GEODETIC GROUNDWATER CONTOUR
- ASSUMED DIRECTION OF GROUNDWATER FLOW (JULY 2008)

NOTES:

1. GROUNDWATER CONTOURS NEAR THE NEW WELL FIELD ESTIMATED BASED ON MODELING RESULTS.

0 15 30 45 60 75m

SCALE: 1:750 METRIC 24"x36"
1:1500 METRIC 11"x17"

NO.	DATE	REVISIONS	BY	CKD.	APP.
0	21/01/09	ISSUED WITH FINAL REPORT	KT	RS	

REVISIONS / ISSUE

A. SECTION LETTER OR DETAIL NUMBER
B. DRAWING WHERE SECTION OR DETAIL IS DRAWN
OR
DRAWING WHERE SECTION OR DETAIL WAS INDICATED
— SECTION OR DETAIL SHOWN ON SAME DRAWING

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

CLIENT: Manitoba CONSERVATION

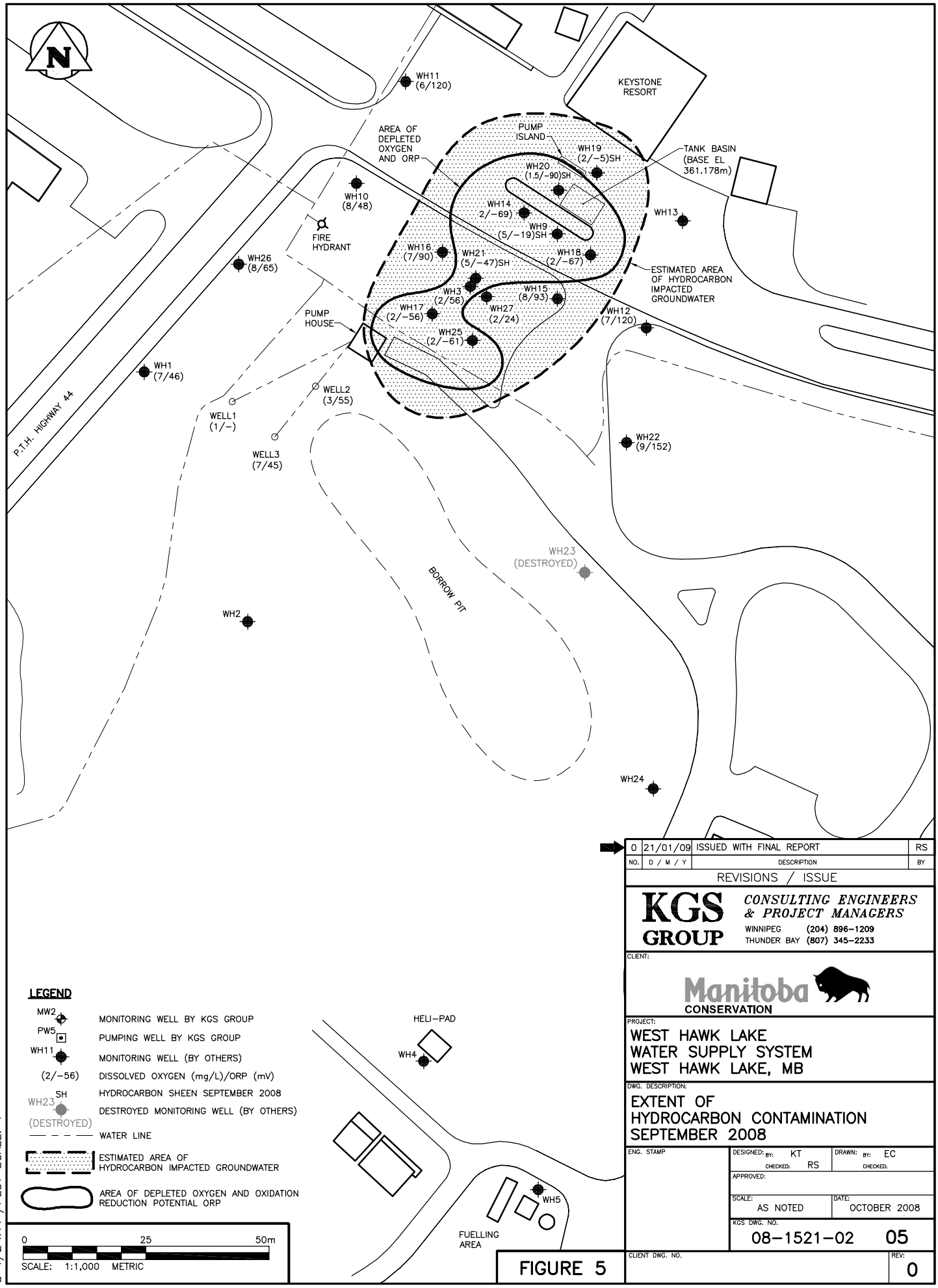
PROJECT:
WEST HAWK LAKE
WATER SUPPLY SYSTEM
WEST HAWK LAKE, MB

DWG. DESCRIPTION:
GROUNDWATER SURFACE CONTOUR PLAN (JULY 31, 2008)

ENG. STAMP

DESIGNED: BY: KT CHECKED: RS
DRAWN: BY: EC CHECKED:
APPROVED:
SCALE: AS NOTED
DATE: OCTOBER 2008
KGS DWG. NO. 08-1521-02 04
CLIENT DWG. NO.
REV: 0

FIGURE 4



NO.	D / M / Y	DESCRIPTION	BY
0	21/01/09	ISSUED WITH FINAL REPORT	RS

REVISIONS / ISSUE

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896–1209
THUNDER BAY (807) 345–2233

CLIENT: Manitoba CONSERVATION

PROJECT:
WEST HAWK LAKE
WATER SUPPLY SYSTEM
WEST HAWK LAKE, MB

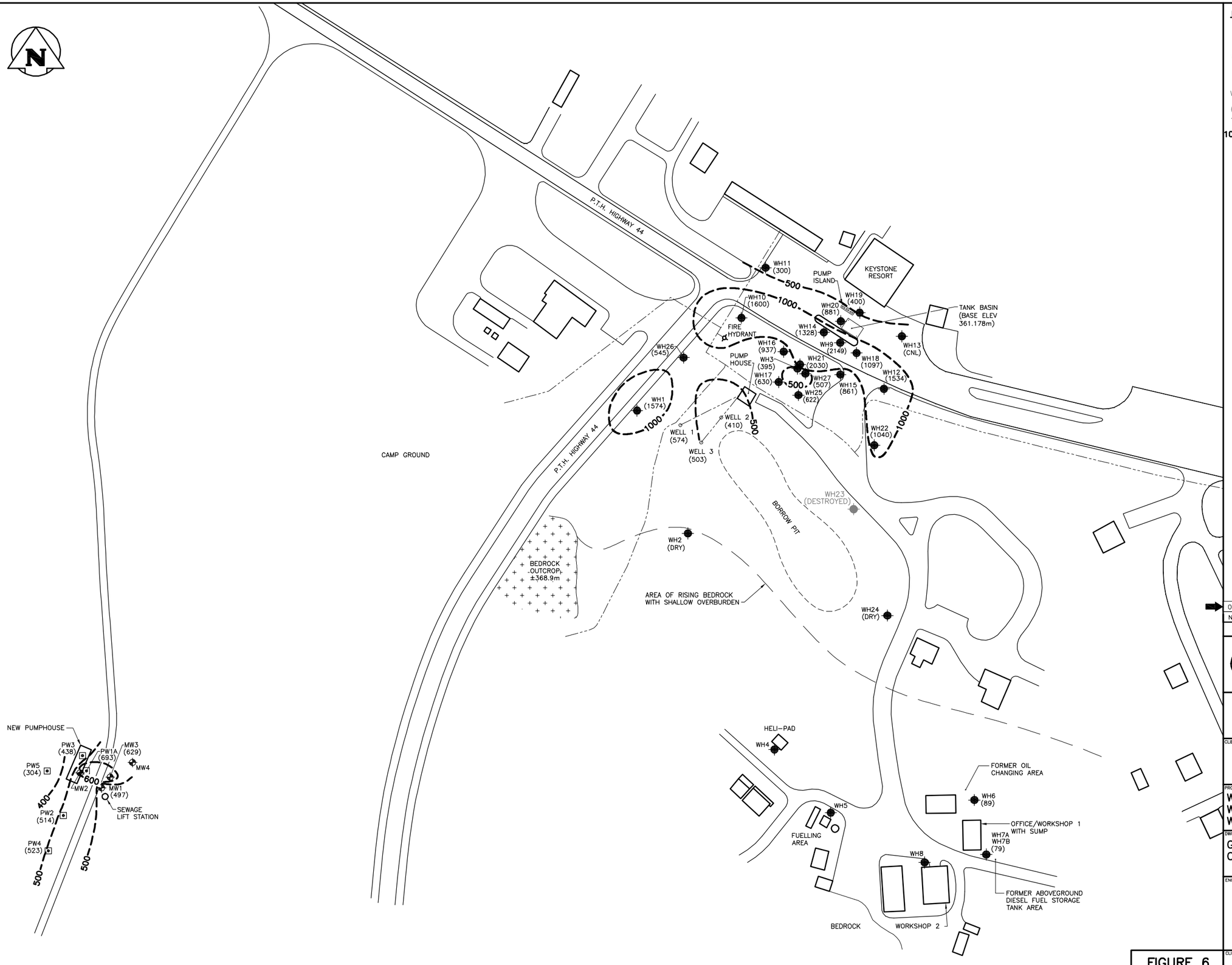
DWG. DESCRIPTION:
EXTENT OF
HYDROCARBON CONTAMINATION
SEPTEMBER 2008

ENG. STAMP

DESIGNED: BY: KT CHECKED: RS
DRAWN: BY: EC CHECKED:
APPROVED:
SCALE: AS NOTED
DATE: OCTOBER 2008
KGS DWG. NO. 08–1521–02 05
CLIENT DWG. NO.
REV: 0

FIGURE 5

KGS FILE NO.:P:\Projects\2008\08–1521–02\Dwg\Env\Revision 0\08–1521–02–05rev0.dwg – Tab: Layout 1 – Jan 21, 2009 – 3:01pm : UserName: EChubey
8 1/2"x11"/PLOT SCALE: 1



LEGEND

- MW2 — MONITORING WELL BY KGS GROUP
- PW5 — PUMPING WELL BY KGS GROUP
- WH11 — MONITORING WELL (BY OTHERS)
- (1574) — FIELD ELECTRICAL CONDUCTIVITY JULY 2008 (µS/cm)
- WH23 (DESTROYED) — DESTROYED MONITORING WELL (BY OTHERS)
- WATER LINE
- 1000 — ELECTRICAL CONDUCTIVITY CONTOUR (ESTIMATED)

0 15 30 45 60 75m

SCALE: 1:750 METRIC 24"x36"
1:1500 METRIC 11"x17"

NO.	DATE	REVISIONS	BY	CKD.	APP.
0	21/01/09	ISSUED WITH FINAL REPORT	KT	RS	

REVISIONS / ISSUE

A. SECTION LETTER OR DETAIL NUMBER
B. DRAWING WHERE SECTION OR DETAIL IS DRAWN
OR
DRAWING WHERE SECTION OR DETAIL WAS INDICATED
— SECTION OR DETAIL SHOWN ON SAME DRAWING

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

CLIENT: Manitoba CONSERVATION

PROJECT:
WEST HAWK LAKE
WATER SUPPLY SYSTEM
WEST HAWK LAKE, MB

DWG. DESCRIPTION:
GROUNDWATER CONDUCTIVITY CONTOUR PLAN

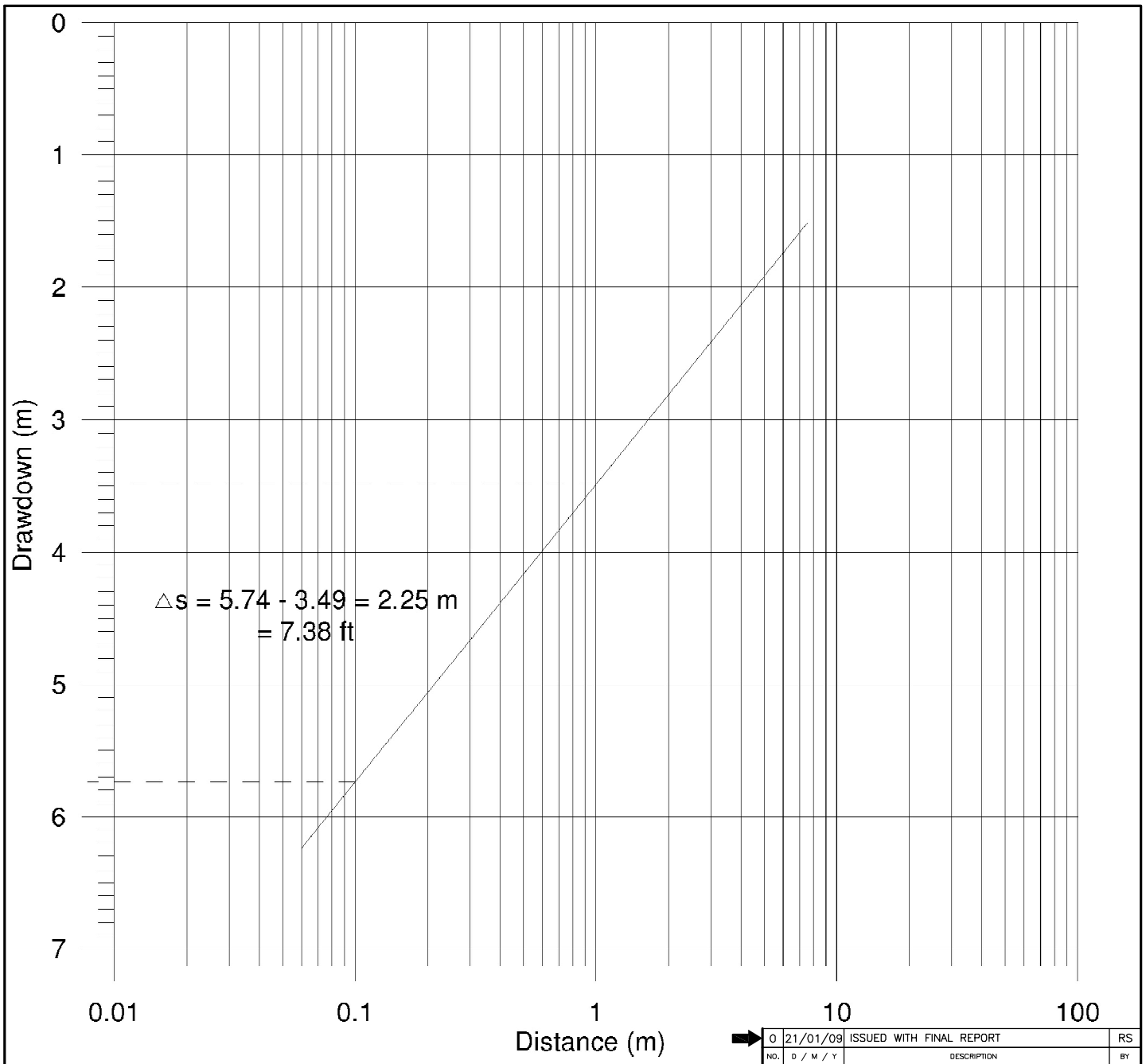
ENG. STAMP

DESIGNED: BY: KT CHECKED: RS
DRAWN: BY: EC CHECKED:
APPROVED:
SCALE: AS NOTED
DATE: OCTOBER 2008
KGS DWG. NO. 08-1521-02 06

CLIENT DWG. NO.
REV: 0

FIGURE 6

KGS FILE NO.: P:\Projects\2008\08-1521-02\Dwg\Env\Revision 0\08-1521-02-06rev0.dwg - Tab: Layout 1 - Jan 21, 2009 - 3:01pm : UserName: EChubey
24"x36"/PLOT SCALE: 1:1



Note: MWSB 2003 PW1A Log (Appendix A-6)

Pumping Well PW1A
2003 Pump Test
Q= 40 IGPM
Distance-Drawdown

T = 528Q/△s = (528)*(40 Igpm)/(7.38 ft)
= 2861 Igpd/ft
= 3434 USgpd/ft

NO.	D / M / Y	DESCRIPTION	BY
0	21/01/09	ISSUED WITH FINAL REPORT	RS

REVISIONS / ISSUE

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

CLIENT: Manitoba CONSERVATION

PROJECT:
WEST HAWK LAKE
WATER SUPPLY SYSTEM
WEST HAWK LAKE, MB

DWG. DESCRIPTION:
SUPPLY WELL PW1A 2003 PUMP TEST

ENG. STAMP

DESIGNED: BY: KT CHECKED: RS
DRAWN: BY: EC CHECKED:
APPROVED:
SCALE: AS NOTED
DATE: OCTOBER 2008
KGS DWG. NO. 08-1521-02 07
CLIENT DWG. NO.
REV: 0

FIGURE 7

APPENDICES

APPENDIX A

BACKGROUND INFORMATION

APPENDIX A-1

TOPOGRAPHIC MAP – FORMER WELL FIELD (PEDERSEN 1973)

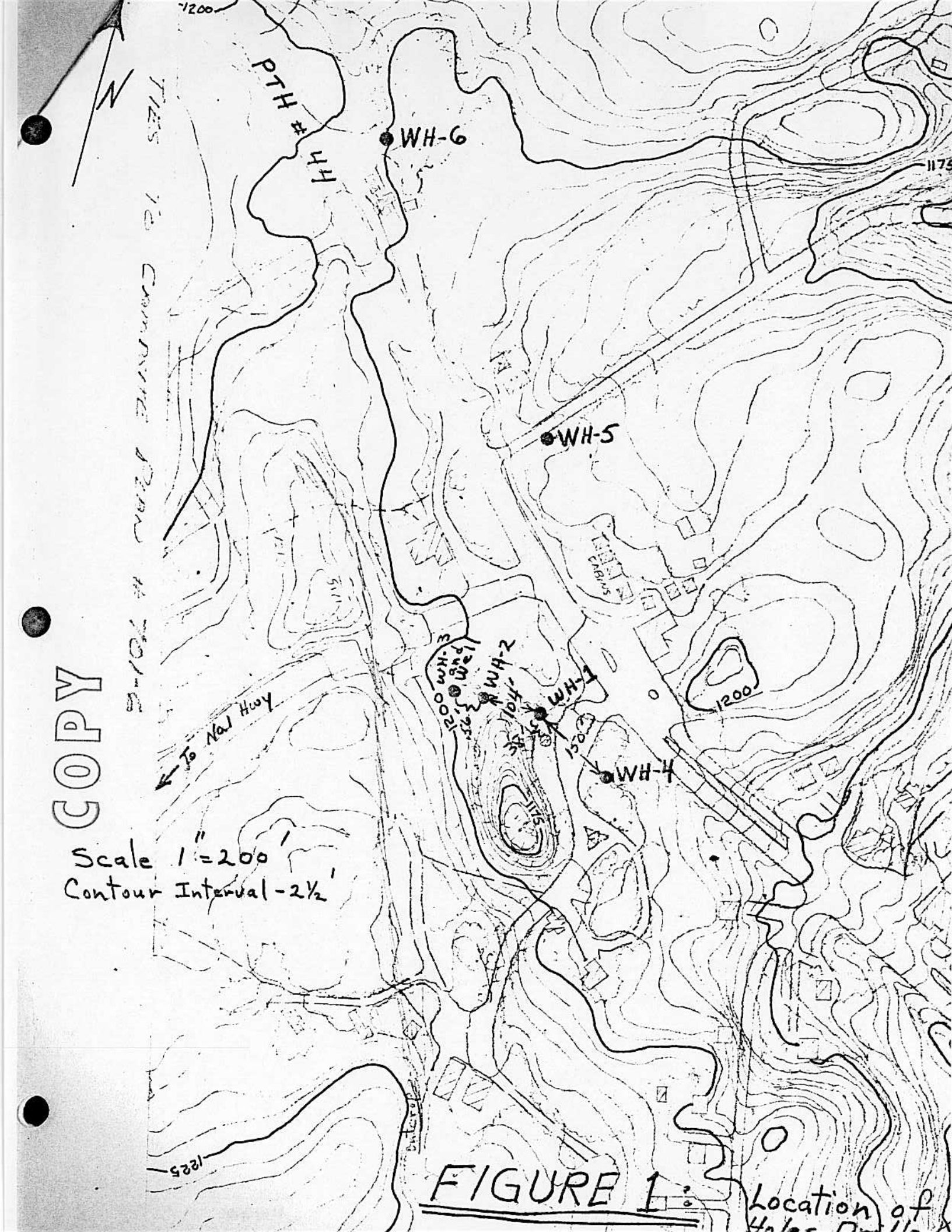


FIGURE 1: Location of

APPENDIX A-2

TOPOGRAPHIC MAP – CURRENT WELL FIELD (PEDERSEN 1973)

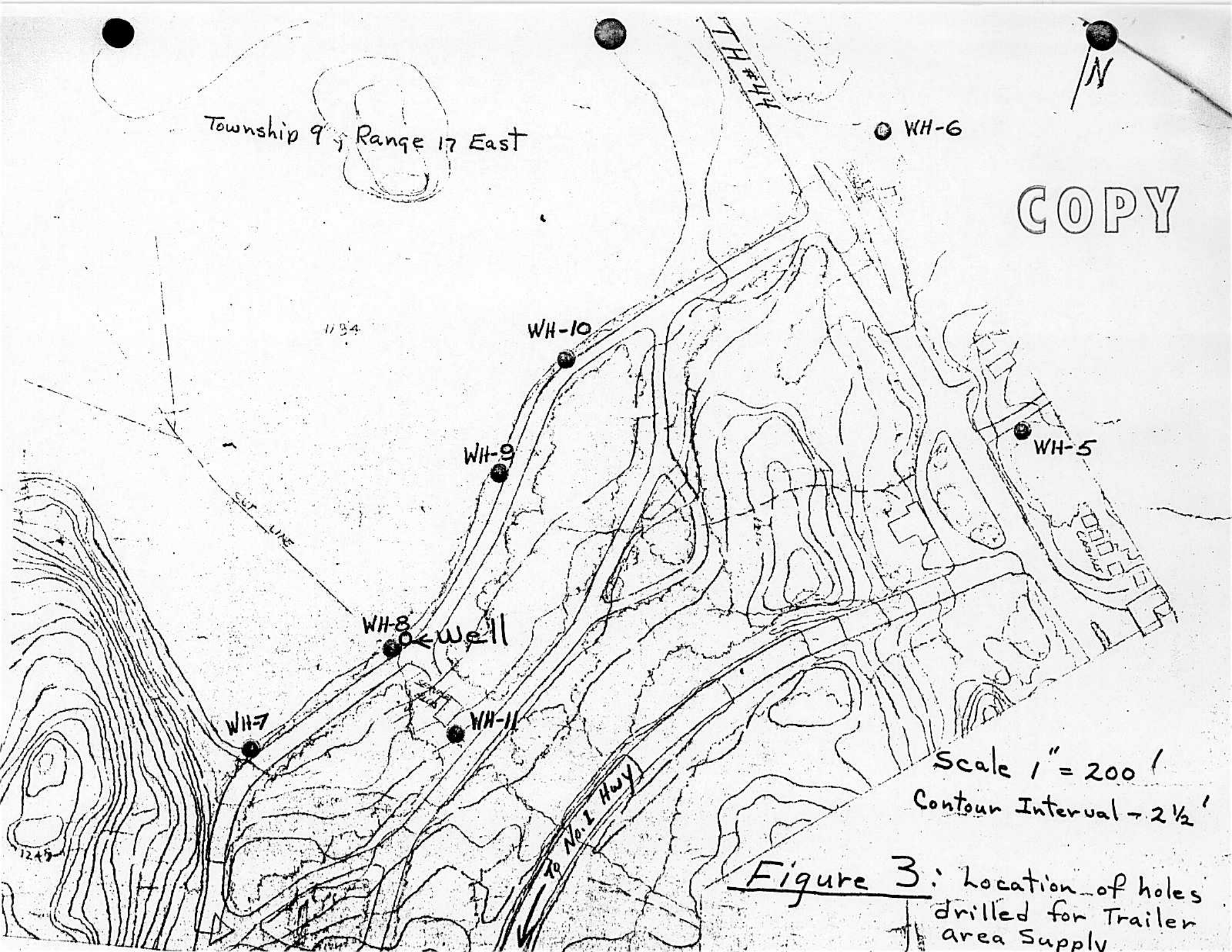
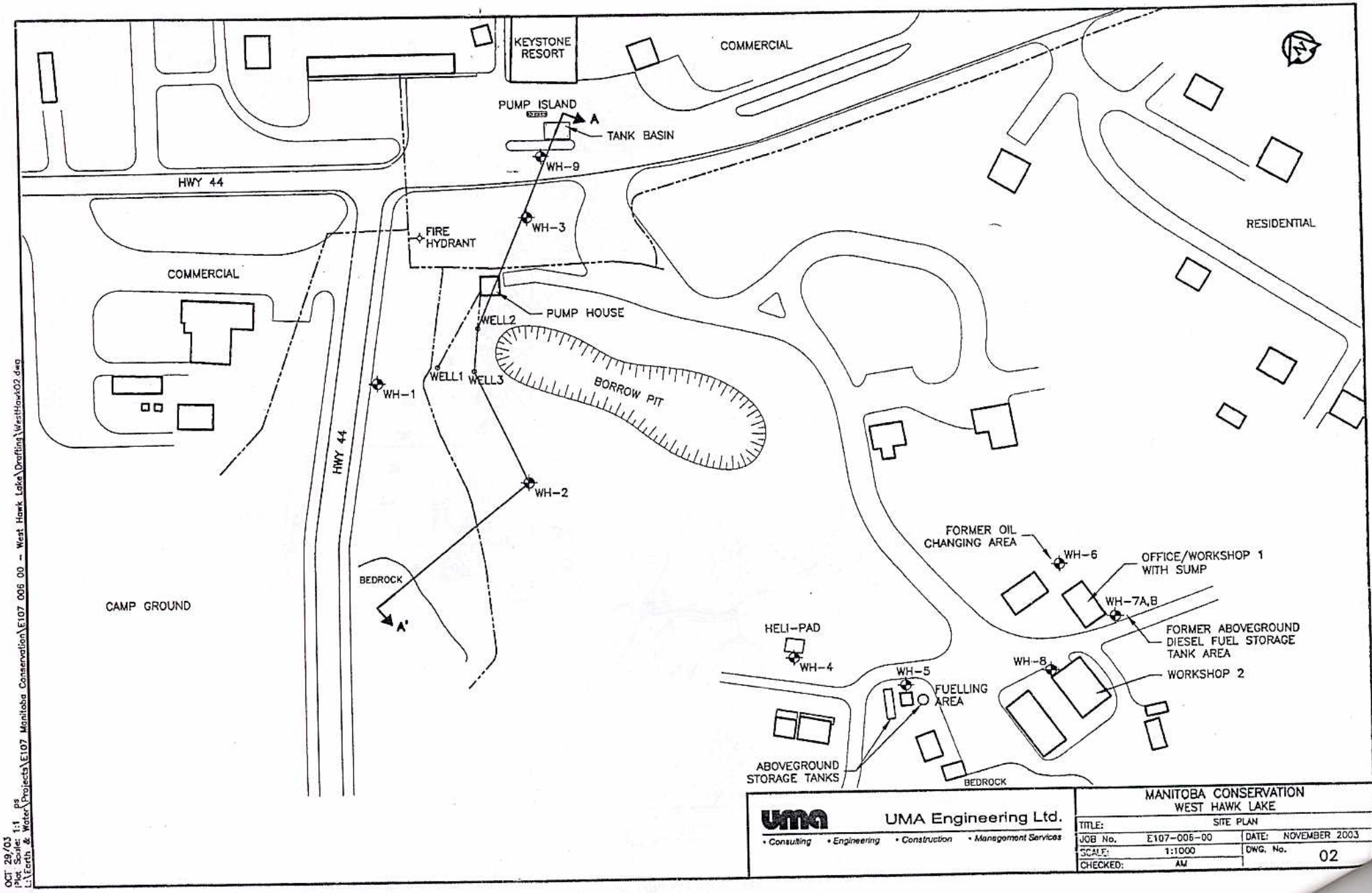


Figure 3: Location of holes drilled for Trailer area Supply

APPENDIX A-3

SITE PLAN AND CROSS SECTION LOCATION (UMA 2004a)



UMA Engineering Ltd.

• Consulting • Engineering • Construction • Management Services

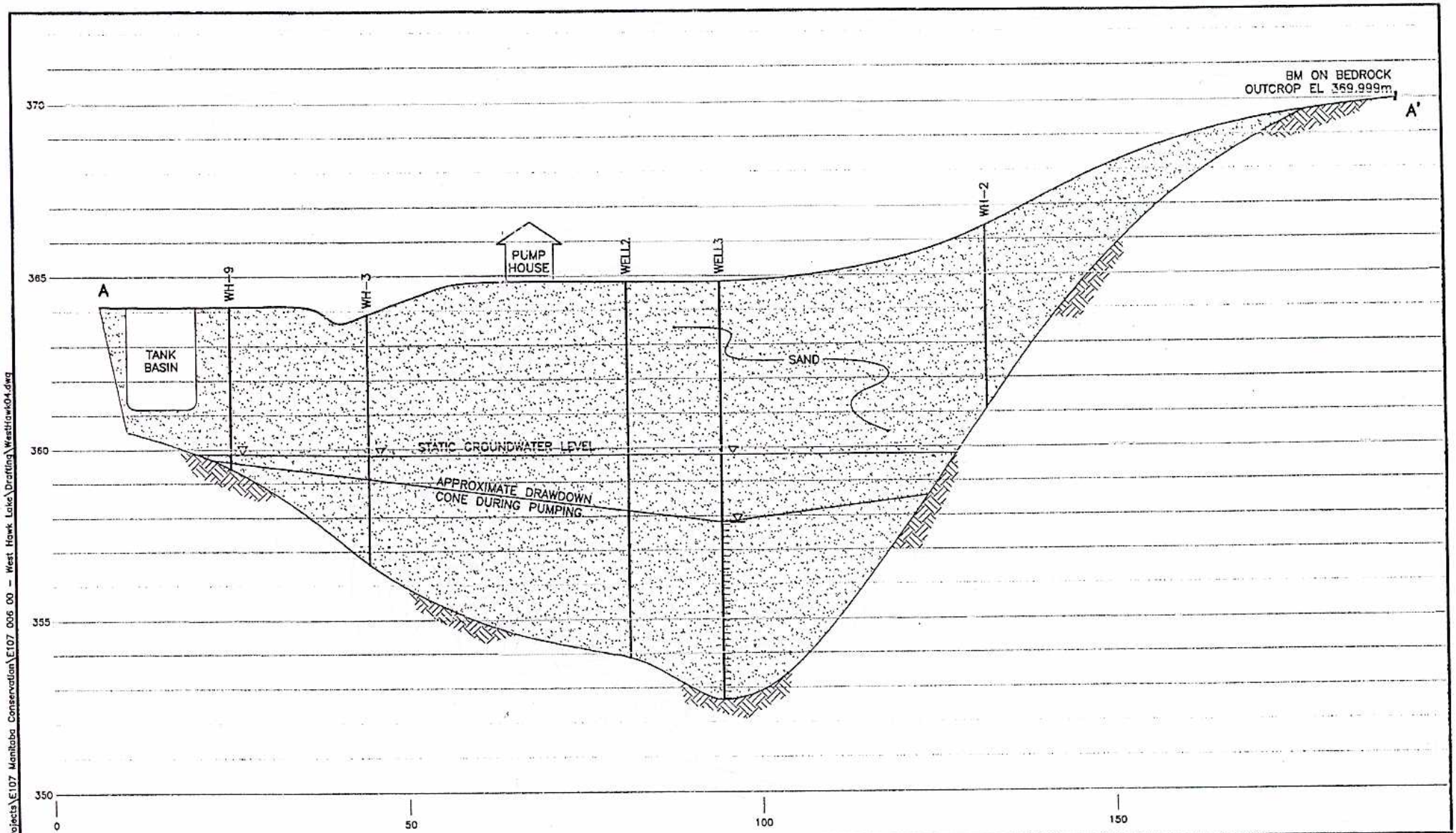
MANITOBA CONSERVATION
WEST HAWK LAKE

TITLE:	SITE PLAN		
JOB No.	E107-006-00	DATE:	NOVEMBER 2003
SCALE:	1:1000	DWG. No.	02
CHECKED:	AM		

OCT 29/03
Plot Scale: 1:1 ps
L:\Earth & Water\Projects\E107 Manitoba Conservation\E107 006 00 - West Hawk Lake\Drafting\WestHawk02.dwg

APPENDIX A-4

CROSS-SECTION (UMA 2004a)



UMA Engineering Ltd.

• Consulting • Engineering • Construction • Management Services

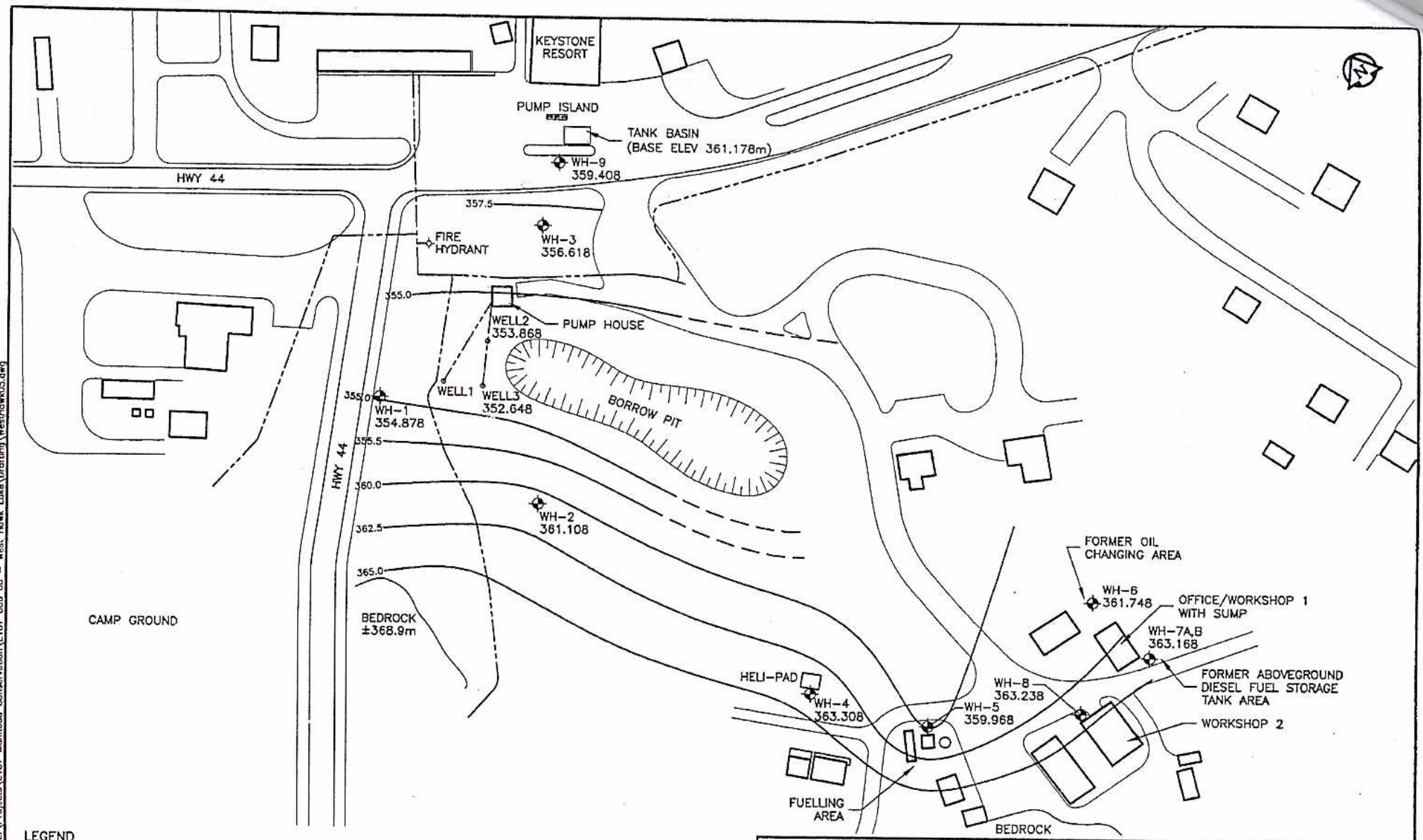
MANITOBA CONSERVATION
WEST HAWK LAKE

TITLE:	CROSS SECTION		
JOB No.	E107-006-00	DATE:	NOVEMBER 2003
SCALE:	HOR 1:500 VER 1:100	DWG. No.	04
CHECKED:	AM		

DEC 3/03
Plot Scale: 1:1 ps
C:\Earth & Water\Projects\E107 Manitoba Conservation\E107 006 00 - West Hawk Lake\Drafting\WestHawk04.dwg

APPENDIX A-5

BEDROCK ELEVATION (UMA 2004a)



UMA Engineering Ltd.

• Consulting • Engineering • Construction • Management Services

MANITOBA CONSERVATION
WEST HAWK LAKE

TITLE:	BEDROCK ELEVATION		
JOB No.	E107-006-00	DATE:	NOVEMBER 2003
SCALE:	1:1000	DWG. No.	05
CHECKED:	AM		

DEC 3,03
Plot Scale: 1:1 ps
L:\Earth & Water\Projects\E107 Manitoba Conservation\E107 006 00 - West Hawk Lake\Drafting\WestHawk05.dwg

APPENDIX A-6

CURRENT WATER SUPPLY DEVELOPMENT AND WELL LOGS (PEDERSEN 1973, 1984, 1990 AND 2003)

MANITOBA

Inter-Departmental Memo

COPY

PS-f-25

Date January 17, 1984

To Don Rocan
Environment & Workplace Safety
& Health
Bldg. 2 - 139 Tuxedo Blvd.

From A. Pedersen, P. Eng.
Senior Groundwater Engineer

FILE: 5.7.4.5.

Telephone 944-7422

Subject West Hawk Lake; Wells in Trailer Village Area.

First | Fold

Attached are copies of reports on the West Hawk Lake groundwater supply system.

The wells at the trailer court site are constructed with screens set at 31 - 41 feet in Well No. 1 and at 47 - 57 in Well No. 2. The wells and the test holes in this area show a thin clay layer which may or may not be continuous.

These type of aquifer (sand) and the well construction make the system safe from bacterial contamination.

The aquifer is susceptible to pollution from chemical, fuel or waste spills. The trailer court wells are relatively safely located. The clay layers and the depth of the developed aquifer zone would help provide some lead time if a spill did occur.

Please let me know if you require more data.

A. Pedersen, P. Eng.

AP:dlm

c.c. R. Stokes
Eng. & Construction.

Attachment.

Manitoba

COPY

Memorandum

Date 90 12 28

To Dave Shwaluk, P. Eng.
Chief of Operations
The Manitoba Water Services Board

From Lewis Hopper
Well Construction Superintendent
The Manitoba Water Services Board

Subject West Hawk
1990 Town Site Well Rehabilitation

Telephone

First | Fold

Well #1

Before Chemical Treatment
SWL 20.8' MP
MP 1.5' AGL
3 IGPF before chemical treatment

After Rehab

Pump from #2 well is now in this well (#1)
50 IGM @ 33. ft. = 4.1 GPF
No sand problem.
These wells should be serviced in 3 years using chemicals and cable tool.
I would expect to bring #1 well up to 6 or 8 GPF and some improvement on #2 well.
Clear depth 41.7'.
Top of riser pipe is 29 1/2'.
10' of new 2" black pipe installed (Bottom).
Top 10" should be replaced in 3 years.
New O rings installed on pitless unit.
New wires installed on pump.
Old pump should be taken apart, cleaned and necessary repairs made (pump is in shop at West Hawk).

Well #2

Before Rehab - 6 IGPF
MP 1.8' AGL, S.L. 19.8 from MP.
Swag nipple is at 28 1/2'.
Clear depth 35 1/2'.

After Rehab

New pump installed as requested.
Pitless unit has to be dug up and straightened before next service.
Well is now good for 18.8 IGPF.
A new 10' x 2" pipe will be required for the pump when pitless unit is straightened.
I believe well #3 could be pulled and installed in a new location, close to #1 & #2 wells.

A. Hopper for

Lewis Hopper
Well Construction Superintendent

LH/vs

MANITOBA

Inter-Departmental Memo

COPY

PS-1-25

Date January 26, 1982

To Pat Martin
Engineering & Construction
Floodway Field Office

From A. Pedersen, P. Eng.
Senior Groundwater Engineer

File: 5.7.4.5

Telephone 786-9590

Subject West Hawk Lake - Main Water Supply.

First | Fold

Your request was (a) for an additional well in the trailer village near the 1973 well with a required capacity in the 30 USGPM range (b) test the 1973 well for capacity and quality.

The new well (Well No. 2) was installed 63 feet west of the pumphouse over Well No. 1. The test and well data are given on the attached drillers report. Well No. 2 has a recommended pumping rate of 40 USGPM with a pump base setting of 45 feet below ground and a pumping lift of 35 feet.

Well No. 1 was checked; the recommended pumping rate is 20 USGPM with a pump base setting at 32 feet from the top of the pipe. Pumping lift is approximately 25 feet. Water quality is excellent; a lab analysis for Well No. 2 is attached.

You also requested that the two main wells be retested. These wells were checked, redeveloped and retested in November, 1980 and reported by memo to you on January 13, 1981.

AP

A. Pedersen, P. Eng.

COPY

DRILLER'S REPORT

WELL LOCATION
QTR. NW SEC. 16 TWP. 9 RGE. 17 E. ☒ W. ☐
R. LOT ____ PARISH ____
REMARKS ____

WELL OWNER
NAME Parks Branch
ADDRESS Westhawk Lake Trailer Area PHONE ____

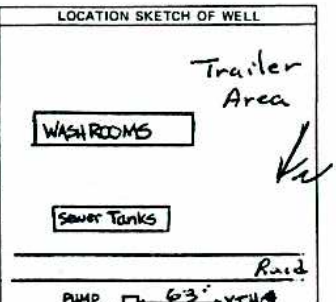
WELL IDENTIFICATION (NO., NAME) Well No. 2

WELL USE: PRODUCTION ☒ TEST WELL ☐ RECHARGE ☐ OBSERVATION WELL ☐

WATER USE: DOMESTIC ☐ LIVESTOCK ☐ MUNICIPAL ☐ INDUSTRIAL ☐ IRRIGATION ☐
AIR-CONDITIONING ☐ OTHER ☐ (Specify) Park

DATE WELL COMPLETED: DAY 21 MONTH July 19 81

LOCATION SKETCH OF WELL



WELL LOG

DEPTH BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
		T.H.-1 (63' from 1st well)	
0	7	brown sand	
7	23	grey sand; coarser with depth bottom is granite rubble trace of clay @ 19'	
23	25	clay	
25	58	sand; fine grey; brown after 35'; coarser	
58		solid rock	
		Test No. 1	Well No. 1
		- set 2-inch 18 slot screen 48-54'	Check Test on 1973 Trailer well
		- pump 111 GPM for 20 min (with air)	- Pumped 251 GPM w suction for 30 min
		EC - 80 mmhos	- EC - 160
		Iron - 0.3 mg/l	Iron - 0.6
		Test No. 2	P.L - 23 ft from top of pipe
		- set 2-inch 18 slot screen 44-50	SWL - 5.07 " " "
		- pump 102 GPM w air	
		- 17½ IGPM w suction	
		- after 30 min EC - 75	
		Iron - 0.1	

WELL CONSTRUCTION

DEPTH BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE	MATERIAL	MAKE
+1.3	47	X						5			PVC		
47	57			X				5		18	WW	SS	
38	58				X			5	11		1500 lb	20-40 uniform	

TOP OF CASING ~~OR PITLESS UNIT~~ 1.3 FEET ABOVE ☒ BELOW ☐ GROUND LEVEL

REMARKS: - develop with air & 150 block
Drawdown data → T = 6300 IGPD/ft
Drawdown in well No. 1 — 4.3 feet after 30 min.

PUMPING TEST

DATE OF TEST: DAY ____ MONTH ____ 19 ____
PUMPING ☒ FLOWING ☐ RATE 37 I.G.P.M.
WATER LEVEL BEFORE PUMPING 38 FT. ABOVE ☐ BELOW ☒ GRD. LEVEL
PUMPING LEVEL AT END OF TEST 22 FT. ABOVE ☐ BELOW ☒ GRD. LEVEL
DURATION OF TEST ____ HOURS 30 MINUTES
WATER TEMPERATURE ____ °F
RECOMMENDED PUMPING RATE 40 US I.G.P.M. Lift = 35'
WITH PUMP ~~INTAKE~~ base AT 45' FEET BELOW GROUND LEVEL.

CONTRACTOR

LICENCE NO. ____
NAME M & M. Drilling
ADDRESS Box 508 Rivers Man
DRILL OPERATOR M. Dickson
Signature of Contractor

FORM MG-2435 DRILLING CONTRACTOR'S COPY

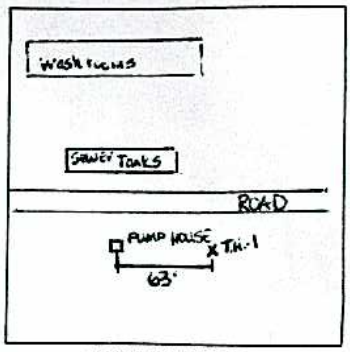
COPY

WATER ANALYSIS REPORT

L.S.D. OR QTR. NW SEC. 16 TP. 9 RGE. 17 E. ☒ W. ☐ OF PRINCIPAL MERIDIAN
Lot _____ Parish _____
U.T.M GRID: ZONE _____ 100,000M SQUARE _____ EASTING _____ NORTHING _____
REMARKS: _____

PROJECT: _____
OWNER: Parks Branch
OWNER'S ADDRESS: Westhawk Trailer Area
WELL NAME AND/OR NUMBER: Well No. 2
OBSERVATION STATION NUMBER _____ NAME _____
DATE SAMPLED: D. 21 M. 07 19 81 TIME _____

Owner of Well or Water Rights Licencee



LOCATION SKETCH

CHEMICAL ANALYSIS

LABORATORY: The National Testing Laboratories Ltd.
ANALYSIS No. M-2640
SAMPLE RECEIVED D. 24 M. July 19 81
ANALYSIS COMPLETED: D. 31 M. July 19 81
ANALYZED BY: Susan C. Dalyan CHECKED BY: J. C. Laidlaw

APPEARANCE: ☐ _____
COLOR: ☐ _____ HAZEN UNITS TURBIDITY ☐ _____
E.C. ☑ 65 MICROMHOS/CM 25° C. pH ☑ 7.0

CATIONS	mgs./L.	me./L.	$CaCO_3$ mgs./L.	ANIONS	mgs./L.	me./L.	$CaCO_3$ mgs./L.
Ca ☑	18	0.89		HCO_3 ☑	61	0.94	
Mg ☑	1	0.08		CO_3 ☑	0		
Na ☑	6	0.26		OH ☑	0		
K ☑	2	0.05		SO_4 ☑	7	0.14	
☑	0.30			Cl ☑	8	0.22	
Mn. ☑	<0.1			F ☑	0.035	-	
☐				PO_4 ☑	.39	-	
☐				NO_3 ☑	N 0.66		
☐				NO_3 ☐	2.9		
☐				☐			
TOTAL	27.3	1.28		TOTAL	79.32	1.35	

B ☐ _____ mgs./L
SiO_2 ☐ _____ mgs./L

	mgs./L.
SUSPENDED SOLIDS ☐	
DISSOLVED SOLIDS ☑	80
TOTAL SOLIDS ☐	
☐	
☐	
☐	
TOTAL HARDNESS ($CaCO_3$) ☑	51
N.C. HARDNESS ($CaCO_3$) ☑	1
P. ALKALINITY 8.5 ($CaCO_3$) ☑	0
M. ALKALINITY 4.5 ($CaCO_3$) ☑	50

C. DIOXIDE ☐ _____ mgs./L. CO_2
DISSOLVED OXYGEN ☐ _____ mgs./L.O_2
B.O.D ☐ _____ mgs./L.
AMMONIA, FREE ☐ _____ mgs./L.N.
AMMONIA, ALBD. ☐ _____ mgs./L.N.

% Na ☐ _____
SAR ☐ _____

SATURATION INDEX
AT 42°F. ☐
AT 172° F. ☐

DETERMINATIONS REQUESTED "X"

REMARKS: _____

GROUND WATER

SOURCE

Name Sand AQUIFER
WATER BEARING FORMATION _____
FROM _____ TO _____ FT. BELOW GROUND L.
Conditions STATIC WATER LEVEL _____ FEET
FACTORS THAT MAY AFFECT QUALITY _____
TEMPERATURE _____ MEASURED _____

SAMPLING

SAMPLE OBTAINED FROM WELL ☒ SPRING ☐
Method 1. WATER SAMPLER ☐
2. WATER SYSTEM OR PUMP OUTLET ☒
LOCATED _____
Conditions SAMPLE DEPTH _____ FT. BELOW GR. L.
ZONE SAMPLED FROM _____ TO _____ FT. BELOW GR. L.
SAMPLED AFTER _____ HOURS _____ MINUTES OF PUMPING _____ I.G.P.M.
SAMPLE APPEARANCE, ODOUR ETC. _____
REMARKS _____

FIELD ANALYSIS

D. 21 M. 7 19 81 BY: A. Pedersen
TEST KIT: HACH
NaCl _____ p.p.m. pH _____
Fe 0.1 p.p.m.
HARDNESS _____ GR/GAL _____ p.p.m.

E.C. 75 MICROMHOS/CM 25°C.
DISSOLVED SOLIDS _____ GR/GAL. NaCL.
DISSOLVED SOLIDS _____ p.p.m. NaCL.
REMARKS: _____

REPORT TO: A. Pedersen

M-2640

COPY

Manitoba

Memorandum

Date 91 11 05

To Pat Martin
Engineering & Construction
Natural Resources
1577 Dublin Avenue
Winnipeg, Manitoba

From A. Pedersen, P. Eng.
Senior Groundwater Engineer
The Manitoba Water Services Board
Box 1059, 2022 Currie Blvd.
Brandon, Manitoba R7A 6A3

Telephone 726-6085

Subject Test Drilling & Well Installation for West Hawk Lake Townsite System

As requested, test drilling was done to establish a third well at this site. Three test holes were drilled. The locations, logs and test data for these holes are given on the attached drillers reports. A six inch well was installed at the TH-3(91) site. The location, log and construction details for the well are given on the attached drillers report.

The recommended pumping rate is 40 IGPM with the pump intake set at 32 feet below the top of the casing or 30 feet from ground.

A. Pedersen

A. Pedersen, P. Eng.
Senior Groundwater Engineer

AP/vs

Encl.

First | Fold

COPY

Driller's Report

Manitoba
Natural Resources

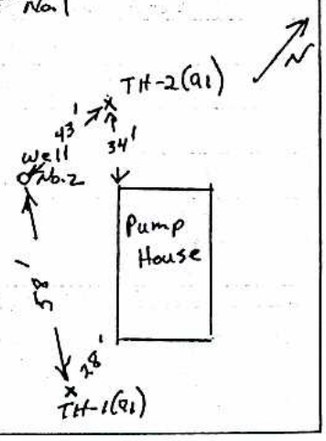
WELL LOCATION

QTR. NW SEC. 16 TWP. 9 RGE. 17 E. X W. ☐

R. LOT ____ PARISH ____

REMARKS ____

LOCATION SKETCH OF WELL



WELL OWNER

NAME West Hawk Lake Town Site

ADDRESS Parks Branch PHONE

WELL IDENTIFICATION (NO., NAME) TH-1(91)

WELL USE: PRODUCTION ☐ TEST WELL ☒ RECHARGE ☐ OBSERVATION WELL ☐

WATER USE: DOMESTIC ☐ LIVESTOCK ☐ MUNICIPAL ☐ INDUSTRIAL ☐ IRRIGATION ☐
AIR-CONDITIONING ☐ OTHER ☐ (Specify) ____

DATE WELL COMPLETED: DAY 24 MONTH Oct. 19 91

WELL LOG

DEPTH BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
		TH-1(91) 28 ft from S corner of pumphouse & 58 ft from Well No. 2	
0	13	Sand; fine to medium	
13	26	Gravel & sand; sand is coarse	
26	27½	Gravel; rough	
27½	30	Sand	
30	34	Coarse gravel; rough	
34	36	Hard black rock; fine grained	
		Set 2-inch slotted pipe 29-34	
		S.W.L - 18 ft bel. gd	
		P.R - 12 IGPM	
		Pumping Level - 21.5 S.C = 3.4 IGPM/Ft	
		TH-2(91) 34 ft from NW corner of pump house & 43 ft from well No. 2	
0	30	Fine gravel and sand	
30	35	Gravel; rough	
35	36	Hard black rock; fine grained	
		Set 2-inch slotted 30-35 ft	
		SWL - 19 feet bel. gd	
		Pumping Rate - 6.7 IGPM	
		Pumping Level - 26 ft bel. gd S.C. Low	

WELL CONSTRUCTION

DEPTH BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE	MATERIAL	MAKE

TOP OF CASING OR PITLESS UNIT ____ FEET ABOVE ☐ BELOW ☐ GROUND LEVEL

REMARKS: ____

PUMPING TEST

DATE OF TEST: DAY ____ MONTH ____ 19 ____

PUMPING ☐ FLOWING ☐ RATE ____ I.G.P.M.

WATER LEVEL BEFORE PUMPING ____ FT. ABOVE ☐ BELOW ☐ GRD. LEVEL

PUMPING LEVEL AT END OF TEST ____ FT. ABOVE ☐ BELOW ☐ GRD. LEVEL

DURATION OF TEST ____ HOURS ____ MINUTES

WATER TEMPERATURE ____ °F

RECOMMENDED PUMPING RATE ____ I.G.P.M.

WITH PUMP INTAKE AT ____ FEET BELOW GROUND LEVEL.

CONTRACTOR

LICENCE NO. ____

NAME Friesen Drillers Ltd

ADDRESS Dugald

DRILL OPERATOR James

AP.
Signature of Contractor

COPY

VGWDRILL

Driller's Report

Manitoba Natural Resources

WELL LOCATION

QTR. NW SEC. 16 TWP. 9 RGE. 17 E. [X] W. [ ]

R. LOT [ ] PARISH Note : Old Well No.3 was pulled out

REMARKS 24 feet south of Well No.1

WELL OWNER

NAME West Hawk Lake Town Site

ADDRESS Parks Branch PHONE

WELL IDENTIFICATION (NO., NAME) Well No.3.

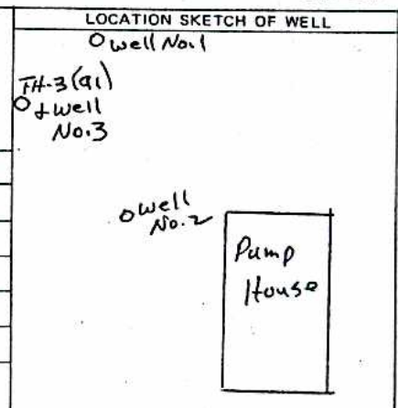
WELL USE PRODUCTION [X] TEST WELL [ ] RECHARGE [ ] OBSERVATION WELL [ ]

WATER USE DOMESTIC [ ] LIVESTOCK [ ] MUNICIPAL [X] INDUSTRIAL [ ] IRRIGATION [ ]

AIR-CONDITIONING [ ] OTHER [ ] (Specify)

DATE WELL COMPLETED: DAY 25 MONTH Oct 19 91

LOCATION SKETCH OF WELL



WELL LOG

DEPTH BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
		TH-3 (91) & well (in same hole)	
0	15	Fine gravel & sand	
15	33	Sand w fine gravel	
33	42¼	Gravel and sand	
42¼	42½	Hard black rock ; some light green	
		Set 2-inch slotted 32-42	
		SWL - 19.7 bel. gd	
		Pumped - 13 IGPM	
		Pumping level - 20.8 SC = 11	

WELL CONSTRUCTION

DEPTH BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE		MATERIAL		MAKE
0	31	X						6			Series 200		PVC		
31	36			X				5		15	ww		SS		
36	41			X				5		35	ww		SS		
20	42				X			5	9 7/8		8-12		Filter Sand		

TOP OF CASING ~~OR PITLESS UNIT~~ 2 FEET ABOVE [ ] BELOW [ ] GROUND LEVEL

REMARKS:

Spec. Cap. = 7.8 IGPM/ft

PUMPING TEST

DATE OF TEST: DAY [ ] MONTH [ ] 19 [ ]

PUMPING [X] FLOWING [ ] RATE 65 I.G.P.M.

WATER LEVEL BEFORE PUMPING 19.7 FT. ABOVE [ ] BELOW [X] GRD. LEVEL

PUMPING LEVEL AT END OF TEST 28 FT. ABOVE [ ] BELOW [X] GRD. LEVEL

DURATION OF TEST 1 HOURS [ ] MINUTES

WATER TEMPERATURE [ ] °F

RECOMMENDED PUMPING RATE 40 I.G.P.M.

WITH PUMP INTAKE AT 30 FEET BELOW GROUND LEVEL.

CONTRACTOR

LICENCE NO. [ ] [ ]

NAME Friesen Drillers Ltd

ADDRESS Dugald

DRILL OPERATOR James

AP

Signature of Contractor

COPY

August 19, 2003

Arne Pedersen
Manitoba Water Services Board
Groundwater Consultant
Brandon, Manitoba

Pat Martin
Construction Superintendant
Natural resources
Floodway Field Office
Dugald, Manitoba
R0E 0K0

Subject: West Hawk Lake Groundwater Supply

As requested, the West Hawk Lake Trailer area well system was expanded to provide a temporary water supply to the main supply because of the quality problem with that system. This expansion would serve as a permanent backup supply.

The existing Trailer area supply consisted of two wells. A new well (Well No. 1A) was installed to replace the original Well No. 1. Three new sites were developed.

The detailed locations, logs, and test data are given on the attached driller's reports. Three sites tested were unsuitable and the details for these are given on an attached driller's report.

Aquifer Capacity

The transmissivity of the sand aquifer is quite low (3000-4000 IGPD/ft), thus the capacity of the well system is limited. The aquifer is sand that extends from surface to approximately 52 feet at the well sites.

It is estimated that the aquifer capacity is approximately 60 IGPM. Intermittent pumping, as would be required, can probably be done at up to 120 IGPM.

Well System Capacity and Pumping Recommendations

The testing of the wells shows that they all have basically the same performance characteristics. It is recommended to equip the wells with pumps capable of pumping 20 IGPM and set with the pump intakes at 34 feet below ground. The maximum lift at this rate should be in the 25 to 30 feet range.

The estimated interference with all wells operating for several days is 10 to 15 feet. This should accommodate the long weekend peak demands.

Comments on Current Contamination Problem

- since we first put the main well system in, I thought that it was just a matter of time before this type of problem would occur.
- the main system and the Trailer area system are approximately 1000 feet apart.
- it appears that the two well systems are developed in parts of the sand aquifer that have now and had originally different flow systems. The main system was developed because a high flow spring nearby suggested that the aquifer had the capacity to supply the required water. This spring indicated a flow south from the area of the main well system site. The main well system basically intercepted this flow.

- the Trailer area well sites are in an area where the groundwater flow is to the north west and the area just north west of these wells is a strong groundwater discharge area.

- the different flow directions at the well system sites, the distance between the sites, and the topographic high between the sites suggest that there is little to no danger of the contamination affecting the Trailer area well system.

- the aquifer is extremely susceptible to contamination because sand occurs from the surface to the depth of the wells. Even when the main site is cleaned up, the same problem could happen again. The Trailer area is safer in that there is no commercial activity there.

Alternate Water Sources

1. The Trailer area system should only be used as a backup system.

2. The other possible sources are the lake and other well sites.

    a. The feasibility of the lake as a source has to be evaluated by others.

    b. A handpump well site in the cottage area in the east area of Crescent Beach can probably be developed as the main water supply. The data from this well indicates that a well with a capacity of at least 200 IGPM (and probably much higher) can be developed here. This site is relatively safe from any contamination.

        The estimated cost to develop two high yield wells at this site is $60-80,000. Water quality should require no treatment other than chlorination.

COPY

Recommendations

1. Equip the four new wells to pump 20 IGPM (25 IGPM maximum) and set the pumps with intakes between 33 and 34 feet below ground.

2. When the main wells are stopped being pumping into the distribution system, keep one well pumping to waste. This will help to control the contamination plume. This pumping should be discharged into the low area south of the wells and be done so that the water is sprayed into the air.

A. Pedersen

Arne Pedersen, P.Eng.

Manitoba Conservation

Driller's Report

WELL LOCATION
QTR. NW SEC. 16 TWP. 9 RGE. 17 E. [X] W. [ ]
R. LOT [ ] PARISH 6 ft from NE corner
REMARKS of pumphouse

WELL OWNER
NAME Parks Branch
ADDRESS West Hawk Lake Trailer Area
PHONE

WELL IDENTIFICATION (NO., NAME) Well No. 1A (Replaces Well No 1-1973)

WELL USE: PRODUCTION [X] TEST WELL [ ] RECHARGE [ ] OBSERVATION WELL [ ]

WATER USE: DOMESTIC [ ] LIVESTOCK [ ] MUNICIPAL [X] INDUSTRIAL [ ] IRRIGATION [ ]
AIR CONDITIONING [ ] OTHER [ ] (Specify)

DATE WELL COMPLETED DAY 15 MONTH Aug 20 03

LOCATION SKETCH OF WELL

See Sketch for Well No. 3

COPY

WELL LOG

DEPHT BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
0	43	Sand; fine	
43	-	layer of ~~con~~ cobbles	
43	52	Sand; fine to medium	
52	53	Rubble rock	

WELL CONSTRUCTION

DEPHT BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE	MATERIAL	MAKE
0	35	X						5				PVC	
35	50			X				4.5		15	WW	SS	
30	50				X			4.5	8		20-40	Sand	
0	30					X		5	8		Backfill	cuttings	

TOP OF CASING ~~OR PITLESS UNIT~~ 1.5 FEET ABOVE [X] BELOW [ ] GROUND LEVEL

REMARKS:
Note: WL in well No. 3 shows approx. 5 ft of interference when pumping Well 1A.

PUMPING TEST

DATE OF TEST: DAY [ ] MONTH [ ] 20 [ ]
PUMPING [X] FLOWING [ ] RATE 40 I.G.P.M.
WATER LEVEL BEFORE PUMPING ~7.5 FT. ABOVE [ ] BELOW [X] TC GRD. LEVEL
WATER LEVEL AT END OF TEST ~28 FT. ABOVE [ ] BELOW [X] TC GRD. LEVEL
DURATION OF TEST 1 HOURS [ ] MINUTES
WATER TEMPERATURE [ ] °F
RECOMMENDED PUMPING RATE [ ] I.G.P.M.
WITH PUMP INTAKE AT [ ] FEET BELOW GROUND LEVEL.

CONTRACTOR

LICENCE NO. [ ] [ ]
NAME Friesen Drillers
ADDRESS Steinbach
DRILL OPERATOR Paul Sharples
AP.
Signature of Contractor

FORM MG-2435

DRILLING CONTRACTOR'S COPY

Driller's Report

Manitoba Conservation

WELL LOCATION
QTR. NW SEC. 16 TWP. 9 RGE. 17 E. X W.
R. LOT PARISH 20.5 feet from
REMARKS NE wall of pumphouse

WELL OWNER
NAME Parks
ADDRESS West Hawk Trailer Area PHONE

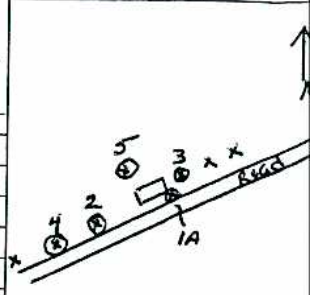
WELL IDENTIFICATION (NO., NAME) Well No. 3

WELL USE: PRODUCTION X TEST WELL ☐ RECHARGE ☐ OBSERVATION WELL ☐

WATER USE: DOMESTIC ☐ LIVESTOCK ☐ MUNICIPAL X INDUSTRIAL ☐ IRRIGATION ☐
AIR CONDITIONING ☐ OTHER ☐ (Specify)

DATE WELL COMPLETED DAY 14 MONTH Aug 20 03

LOCATION SKETCH OF WELL



⊛ - wells
x - 2003 Test Hole

WELL LOG

DEPHT BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
0	42	Sand; fine	
42	43	Cobbles	
43	52	Sand; fine to medium	
52	53	Cobbles	
53	-	Rock	

WELL CONSTRUCTION

DEPHT BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE	MATERIAL	MAKE
0	35	X						5				PVC	
35	50			X				4.5		15	WW	SS	
30	50				X			4.5	8		Sand	20-40	10 bags
0	30					X		5	8		Backfill	Cuttings	

TOP OF CASING ~~OR PITLESS UNIT~~ 1.5 FEET ABOVE X BELOW ☐ GROUND LEVEL

REMARKS:
Field anal.
EC - 500 Amhos
Fe - .07 mg/l
Mang - .035 "

PUMPING TEST
DATE OF TEST: DAY MONTH 20
PUMPING X FLOWING ☐ RATE 40 I.G.P.M.
WATER LEVEL BEFORE PUMPING ~7 FT. ABOVE ☐ BELOW X ~~GRD.~~ TC LEVEL
WATER LEVEL AT END OF TEST 27 FT. ABOVE ☐ BELOW X ~~GRD.~~ TC LEVEL
DURATION OF TEST 2 HOURS MINUTES SC=2
WATER TEMPERATURE °F
RECOMMENDED PUMPING RATE I.G.P.M.
WITH PUMP INTAKE AT FEET BELOW GROUND LEVEL

CONTRACTOR
LICENCE NO.
NAME Friesen Drillers
ADDRESS Steinbach
DRILL OPERATOR Paul Sharples
A.P.
Signature of Contractor

FORM MG-2435

DRILLING CONTRACTOR'S COPY

COPY

Driller's Report

Manitoba Conservation

WELL LOCATION
QTR. NW SEC. 16 TWP. 9 RGE. 17 E. X W.
R. LOT PARISH 50 ft sw of well No. 2
REMARKS

WELL OWNER
NAME Parks
ADDRESS West Hawk Lake Trailer Greg PHONE

LOCATION SKETCH OF WELL
See Sketch for Well No. 3

WELL IDENTIFICATION (NO., NAME) Well No. 4

WELL USE PRODUCTION [X] TEST WELL [ ] RECHARGE [ ] OBSERVATION WELL [ ]

WATER USE DOMESTIC [ ] LIVESTOCK [ ] MUNICIPAL [X] INDUSTRIAL [ ] IRRIGATION [ ]
AIR CONDITIONING [ ] OTHER [ ] (Specify)

DATE WELL COMPLETED DAY 14 MONTH Aug 20 03

WELL LOG

DEPHT BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
0	24	Fine Sand	
24	26	Clay	
26	52	Fine to medium sand	
53	54	Rubble	
54	-	Rock	

WELL CONSTRUCTION

DEPHT BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE		MATERIAL		MAKE
0	36	X						5					PVC		
36	51			X				4.5		15	WW		SS		
30	51				X			4.5	8		Sand		20-40		
0	30					X		5	8		Sand Backfill		Cuttings		

TOP OF CASING ~~OR PITLESS UNIT~~ 1.5 FEET ABOVE [X] BELOW [ ] GROUND LEVEL
REMARKS:

PUMPING TEST
DATE OF TEST: DAY MONTH 20
PUMPING [X] FLOWING [ ] RATE 40 I.G.P.M.
WATER LEVEL BEFORE PUMPING 7.3 FT. ABOVE [ ] BELOW [X] TC GRD. LEVEL
WATER LEVEL AT END OF TEST 28 FT. ABOVE [ ] BELOW [X] TC GRD. LEVEL
DURATION OF TEST 2 HOURS MINUTES SC = 2
WATER TEMPERATURE °F
RECOMMENDED PUMPING RATE I.G.P.M.
WITH PUMP INTAKE AT FEET BELOW GROUND LEVEL.

CONTRACTOR
LICENCE NO.
NAME Friesen Drillers
ADDRESS Steinbach
DRILL OPERATOR Paul Sharples
AP
Signature of Contractor

FORM MG-2435

DRILLING CONTRACTOR'S COPY

COPY

Manitoba Conservation

Driller's Report

WELL LOCATION
QTR. NW SEC. 16 TWP. 9 RGE. 17 E. X W.
R. LOT ____ PARISH ____
REMARKS ____

WELL OWNER
NAME Parks
ADDRESS West Hawk Lake Trailer Area PHONE

WELL IDENTIFICATION (NO., NAME) Well No. 5

WELL USE: PRODUCTION [X] TEST WELL [ ] RECHARGE [ ] OBSERVATION WELL [ ]

WATER USE: DOMESTIC [ ] LIVESTOCK [ ] MUNICIPAL [X] INDUSTRIAL [ ] IRRIGATION [ ]
AIR CONDITIONING [ ] OTHER [ ] (Specify) ____

DATE WELL COMPLETED DAY 15 MONTH Aug 20 03

LOCATION SKETCH OF WELL

See Sketch for Well No. 3

WELL LOG

DEPHT BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
0	24	Sand	
24	26	Clay	
26	52	Sand	
52	52½	Rubble	
52½	-	Rock	

WELL CONSTRUCTION

DEPHT BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE	MATERIAL	MAKE
0	37	X						5				PVC	
37	52			X				4.5		15	WW	SS	
30	52				X			4.5	8		20-40	Filter Sand	
0	30					X		5	8		Backfill	Cuttings	

TOP OF CASING ~~OR PITLESS UNIT~~ ~1.5 FEET ABOVE [X] BELOW [ ] GROUND LEVEL

REMARKS:

PUMPING TEST

DATE OF TEST: DAY ____ MONTH ____ 20 ____
PUMPING [X] FLOWING [ ] RATE 40 I.G.P.M.
WATER LEVEL BEFORE PUMPING ~5 FT. ABOVE [ ] BELOW [X] GRD. LEVEL TC
WATER LEVEL AT END OF TEST 25 FT. ABOVE [ ] BELOW [X] GRD. LEVEL TC
DURATION OF TEST ____ HOURS ____ MINUTES SC-2
WATER TEMPERATURE ____ °F
RECOMMENDED PUMPING RATE ____ I.G.P.M.
WITH PUMP INTAKE AT ____ FEET BELOW GROUND LEVEL.

CONTRACTOR

LICENCE NO. ____
NAME Freisen Drillers
ADDRESS Steinbach
DRILL OPERATOR Paul Sharples.
Signature of Contractor

FORM MG-2435

DRILLING CONTRACTOR'S COPY

COPY

Driller's Report

Manitoba Conservation

WELL LOCATION

QTR. NW SEC. 16 TWP. 9 RGE. 17 E. [X] W. [ ]

R. LOT [ ] PARISH _____

REMARKS _____

LOCATION SKETCH OF WELL

See Sketch for Well No. 3

WELL OWNER

NAME Parks

ADDRESS West Hawk Lake Trailer Area PHONE

WELL IDENTIFICATION (NO., NAME)

WELL USE PRODUCTION [ ] TEST WELL [X] RECHARGE [ ] OBSERVATION WELL [ ]

WATER USE DOMESTIC [ ] LIVESTOCK [ ] MUNICIPAL [ ] INDUSTRIAL [ ] IRRIGATION [ ]
AIR CONDITIONING [ ] OTHER [ ] (Specify) _____

DATE WELL COMPLETED DAY 14 MONTH Aug 20 03

WELL LOG

DEPHT BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
		TH-1 (03) 81 feet NE of Well No. 3	
0	23	Sand	
23	26	Rubble rock	
26	27	Rock	
		TH-2 (03) 65 feet SW of Well No. 4	along road
0	21	Fine sand; clean	
21	24	Clay	
24	27	Fine sand	
27	31	clay	
31	56	Fine silty sand	
56	-	Rock	
		TH-3 approx 35 feet NE of well	No. 3
0	43	Fine Sand	
43	-	Rock	

WELL CONSTRUCTION

DEPHT BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE		MATERIAL		MAKE

TOP OF CASING OR PITLESS UNIT _____ FEET ABOVE [ ] BELOW [ ] GROUND LEVEL

REMARKS:

PUMPING TEST

DATE OF TEST: DAY [ ] MONTH _____ [ ] 20 [ ]

PUMPING [ ] FLOWING [ ] RATE [ ] I.G.P.M.

WATER LEVEL BEFORE PUMPING [ ] FT. ABOVE [ ] BELOW [ ] GRD. LEVEL

WATER LEVEL AT END OF TEST [ ] FT. ABOVE [ ] BELOW [ ] GRD. LEVEL

DURATION OF TEST [ ] HOURS [ ] MINUTES

WATER TEMPERATURE [ ] °F

RECOMMENDED PUMPING RATE _____ I.G.P.M.

WITH PUMP INTAKE AT _____ FEET BELOW GROUND LEVEL.

CONTRACTOR

LICENCE NO. [ ] [ ]

NAME Friesen Drillers

ADDRESS Steinbach

DRILL OPERATOR Paul Skerples

Signature of Contractor

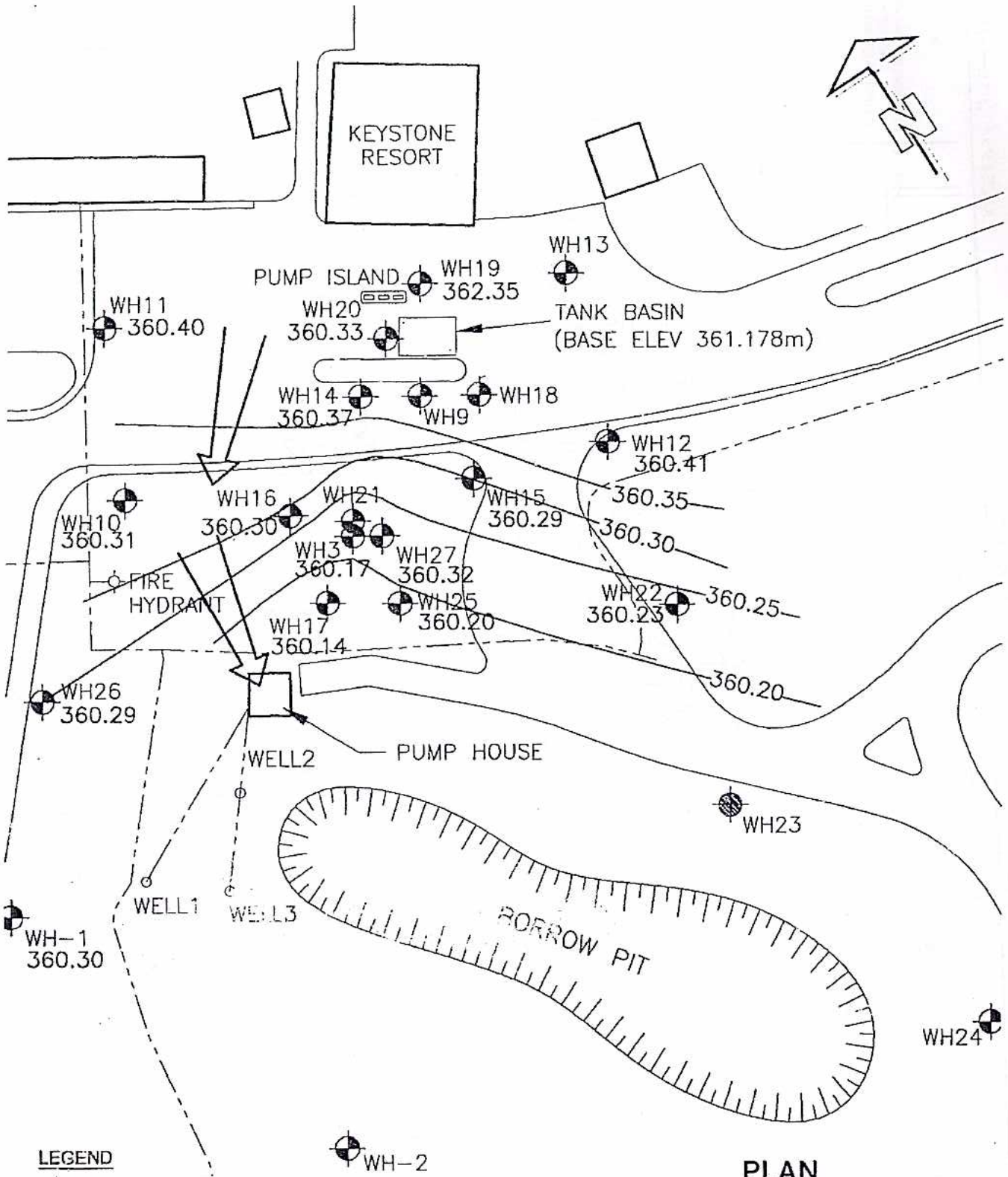
FORM MG-2435

DRILLING CONTRACTOR'S COPY

COPY

APPENDIX A-7

WATER LEVEL CONTOURS JUNE 2007 (UMA 2007)



LEGEND

WH22	MONITORING WELL (UMA)
WH23	DESTROYED MONITORING WELL
	WATER LINE
360.00	GROUNDWATER ELEVATION
96.52	GROUNDWATER CONTOUR
	GROUNDWATER FLOW DIRECTION

PLAN

0 7.5 15 m SCALE 1:750

Manitoba Conservation
West Hawk Lake
Phase II Environmental Site Investigation
Water Level Contours
June 2007
Figure - 04

UMA | AECOM

A SIZE 8.5" x 11" (215.9mm x 279.4mm)
PLOT: 07/09/24 1:44:46 PM
Saved By: ferrazk
ISS/REV: A
UMA FILE NAME: E107-008-00_00-H-F009_RX.dwg

APPENDIX A-8

HISTORIC WATER CHEMISTRY DATA (UMA 2007)

Table 3. Summary of Groundwater Analytical Results (November 2006)
West Hawk Lake, Manitoba

Parameter	Method Detection Limit and Units	CCME CEQG Community Drinking Water	Monitoring Well No.								
			WH-1	WH-3	WH-10	WH-11	WH-12	WH-17	WH-25	WH-26	Duplicate (WH-17)
Benzene	0.2 ug/L	5 ug/L (MAC)	<0.2	820*	<0.2	<0.2	<0.2	360*	4500*	<0.2	340*
Toluene	0.2 ug/L	24 ug/L (AO)	<0.2	4200*	<0.2	<0.2	<0.2	4700*	17000*	<0.2	4600*
Ethylbenzene	0.2 ug/L	2.4 ug/L (AO)	<0.2	2300*	<0.2	<0.2	<0.2	880*	1200*	<0.2	870*
Xylenes (Total)	0.4 ug/L	300 ug/L (AO)	<0.4	20000*	<0.4	<0.4	<0.4	5800*	8500*	<0.4	5900*

CCME CEQG - Canadian Council of Ministers of the Environment Canadian Environmental Quality Guidelines, Updated December 2003;

AO - aesthetic objective; MAC - maximum acceptable concentration (health related)

5909 indicates concentration exceeds the CCME CEQG for community/drinking water;

* RDL was adjusted by the lab due to high concentrations of target compounds

Table 4. Summary of Groundwater Analytical Results (June 2007)
West Hawk Lake, Manitoba

Parameter	Method Detection Limit and Units	CCME CEQG Community/ Drinking Water	Monitoring Well No.								
			WH-1	WH-3	WH-10	WH-11	WH-12	WH-17	WH-25	WH-26	Duplicate (WH-60)
Benzene	0.2 ug/L	5 ug/L (MAC)	<0.1	175*	<0.1	<0.1	<0.1	2870*	394*	<0.1	370*
Toluene	0.2 ug/L	24 ug/L (AO)	<0.1	2310*	<0.1	<0.1	<0.1	9040*	2010*	<0.1	2980*
Ethylbenzene	0.2 ug/L	2.4 ug/L (AO)	<0.1	55.1*	<0.1	<0.1	<0.1	417*	130*	<0.1	147*
Xylenes (Total)	0.4 ug/L	300 ug/L (AO)	<0.3	2190*	<0.3	<0.3	<0.3	7750*	1450*	<0.3	1420*

CCME CEQG - Canadian Council of Ministers of the Environment Canadian Environmental Quality Guidelines, Updated December 2003;

AO - aesthetic objective; MAC - maximum acceptable concentration (health related)

5900 indicates concentration exceeds the CCME CEQG for community/drinking water;

* RDL was adjusted by the lab due to high concentrations of target compounds

APPENDIX A-9

HISTORIC CURRENT WATER SUPPLY GROUNDWATER CHEMISTRY DATA (MANITOBA CONSERVATION 2007)

REPORTED TO: Manitoba Conservation - Drinking Water

REPORT DATE: October 22, 2007

GROUP NUMBER: 80927020

CANTEST

Potability (Aesthetic Criteria) in Water

CLIENT SAMPLE IDENTIFICATION:		245.00 Raw Well #1	245.00 Raw Well #2	245.00 Raw Well #3	245.00 Raw Well #4	Aesthetic Objective	UNITS
DATE SAMPLED:		Sep 26/07	Sep 26/07	Sep 26/07	Sep 26/07		
CANTEST ID:		709270116	709270120	709270122	709270125		
Monocyclic Aromatic Hydrocarbons							
Surrogate Recovery							
Toluene-d8		103	101	103	104	-	%
Bromofluorobenzene		91	95	92	92	-	%
Conventional Parameters							
Total Dissolved Solids		296	216	168	307	500	mg/L
Dissolved Chloride	Cl	104	18.1	31.5	75.0	250	mg/L
Dissolved Sulphate	SO4	10.0	6.87	7.57	13.5	500	mg/L
Conventional Parameters-Winnipeg Laboratory-							
pH, Laboratory		6.70	7.31	6.87	7.11	6.5 - 8.5	pH units
Total Alkalinity	CaCO3	64.3	128	75.5	88.7	-	mg/L
Bicarbonate Alkalinity	HCO3	78.4	157	92.1	108	-	mg/L
Carbonate Alkalinity	CO3	< 0.5	< 0.5	< 0.5	< 0.5	-	mg/L
Hydroxide Alkalinity	OH	< 0.5	< 0.5	< 0.5	< 0.5	-	mg/L
Total Metals Analysis							
Copper	Cu	0.0055	0.029	0.0077	0.0034	1.0	mg/L
Iron	Fe	0.09	0.20	0.26	0.09	0.3	mg/L
Manganese	Mn	**0.081 X**	**0.400 X**	**0.219 X**	0.042	0.05	mg/L
Sodium	Na	44.7	3.1	6.4	8.5	200	mg/L
Zinc	Zn	0.004	0.003	0.003	0.003	5	mg/L

mg/L = milligrams per liter
< = Less than detection limit
X = Result is outside the Aesthetic Objective

REPORTED TO: Manitoba Conservation - Drinking Water

REPORT DATE: October 22, 2007

GROUP NUMBER: 80927020

CANTEST

Potability (Aesthetic Criteria) in Water

CLIENT SAMPLE IDENTIFICATION:		245.00 Raw Well #5	245.00 Treated	245.00 Distributed		
DATE SAMPLED:		Sep 26/07	Sep 26/07	Sep 26/07	Aesthetic Objective	UNITS
CANTEST ID:		709270127	709270131	709270132		
Monocyclic Aromatic Hydrocarbons						
Surrogate Recovery						
Toluene-d8		101	-	-	-	%
Bromofluorobenzene		92	-	-	-	%
Conventional Parameters						
Total Dissolved Solids		177	285	300	500	mg/L
Dissolved Chloride	Cl	8.41	84.7	90.7	250	mg/L
Dissolved Sulphate	SO4	0.89	9.94	9.92	500	mg/L
Conventional Parameters-Winnipeg Laboratory-						
pH, Laboratory		7.72	6.81	6.85	6.5 - 8.5	pH units
Total Alkalinity	CaCO3	163	72.4	72.4	-	mg/L
Bicarbonate Alkalinity	HCO3	199	88.4	88.4	-	mg/L
Carbonate Alkalinity	CO3	< 0.5	< 0.5	< 0.5	-	mg/L
Hydroxide Alkalinity	OH	< 0.5	< 0.5	< 0.5	-	mg/L
Total Metals Analysis						
Copper	Cu	0.0097	0.0084	0.0038	1.0	mg/L
Iron	Fe	0.14	0.12	0.13	0.3	mg/L
Manganese	Mn	0.066 X	0.092 X	0.029	0.05	mg/L
Sodium	Na	3.5	31.8	35.2	200	mg/L
Zinc	Zn	0.002	0.004	0.002	5	mg/L

mg/L = milligrams per liter
< = Less than detection limit
X = Result is outside the Aesthetic Objective

REPORTED TO: Manitoba Conservation - Drinking Water

REPORT DATE: October 22, 2007

GROUP NUMBER: 80927020

CANTEST

Potability (Health Criteria at Point of Use) in Water

CLIENT SAMPLE IDENTIFICATION:		245.00 Raw Well #1	245.00 Raw Well #2	245.00 Raw Well #3	245.00 Raw Well #4		
DATE SAMPLED:		Sep 26/07	Sep 26/07	Sep 26/07	Sep 26/07	Max. Acceptable Concentration	UNITS
CANTEST ID:		709270116	709270120	709270122	709270125		
Monocyclic Aromatic Hydrocarbons							
Surrogate Recovery							
Toluene-d8		103	101	103	104	-	%
Bromofluorobenzene		91	95	92	92	-	%
Conventional Parameters							
Hardness (Total)	CaCO3	119	152	105	182	-	mg/L
Dissolved Fluoride	F	< 0.05	0.08	0.08	0.07	1.5	mg/L
Nitrate and Nitrite	N	0.73	0.04	0.01	0.16	10	mg/L
Dissolved Sulphate	SO4	10.0	6.87	7.57	13.5	-	mg/L
Ammonia Nitrogen	N	< 0.01	0.18	< 0.01	0.02	-	mg/L
Conventional Parameters-Winnipeg Laboratory-							
Conductivity		542	331	279	462	-	µS/cm
Total Metals Analysis							
Aluminum	Al	0.006	0.012	0.009	0.003	-	mg/L
Antimony	Sb	0.0003	0.0004	0.0004	0.0003	0.006	mg/L
Arsenic	As	0.0004	0.0016	0.0014	0.0004	0.010	mg/L
Barium	Ba	0.034	0.0090	0.023	0.022	1.0	mg/L
Boron	B	0.02	< 0.01	0.01	0.02	5.	mg/L
Cadmium	Cd	< 0.00004	< 0.00004	< 0.00004	< 0.00004	0.005	mg/L
Calcium	Ca	37.8	52.7	32.1	58.6	-	mg/L
Chromium	Cr	< 0.0002	0.0005	< 0.0002	< 0.0002	0.05	mg/L
Lead	Pb	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.01	mg/L
Magnesium	Mg	6.08	4.96	6.04	8.52	-	mg/L
Potassium	K	2.05	1.58	1.79	2.35	-	mg/L
Selenium	Se	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.01	mg/L
Silver	Ag	< 0.00005	< 0.00005	< 0.00005	< 0.00005	-	mg/L
Uranium	U	0.0018	0.0035	0.0020	0.0027	0.02	mg/L
Volatile Organic Compounds							
1,1-Dichloroethene		< 0.1	< 0.1	< 0.1	< 0.1	14	µg/L
Methylene Chloride		< 6	< 6	< 6	< 6	50	µg/L
Tetrachloroethene		< 0.1	< 0.1	< 0.1	< 0.1	30	µg/L
Trichloroethene		< 0.1	< 0.1	< 0.1	< 0.1	30	µg/L

mg/L = milligrams per liter
µg/L = micrograms per liter
< = Less than detection limit

µS/cm = microsiemens per centimeter

REPORTED TO: Manitoba Conservation - Drinking Water

REPORT DATE: October 22, 2007

GROUP NUMBER: 80927020

CANTEST

Potability (Health Criteria at Point of Use) in Water

CLIENT SAMPLE IDENTIFICATION:		245.00 Raw Well #5	245.00 Treated	245.00 Distributed		
DATE SAMPLED:		Sep 26/07	Sep 26/07	Sep 26/07	Max. Acceptable Concentration	UNITS
CANTEST ID:		709270127	709270131	709270132		
Monocyclic Aromatic Hydrocarbons						
Surrogate Recovery						
Toluene-d8		101	-	-	-	%
Bromofluorobenzene		92	-	-	-	%
Conventional Parameters						
Hardness (Total)	CaCO3	162	128	125	-	mg/L
Dissolved Fluoride	F	0.06	0.06	0.06	1.5	mg/L
Nitrate and Nitrite	N	< 0.01	0.53	0.60	10	mg/L
Dissolved Sulphate	SO4	0.89	9.94	9.92	-	mg/L
Ammonia Nitrogen	N	0.05	0.01	0.03	-	mg/L
Conventional Parameters-Winnipeg Laboratory-						
Conductivity		340	466	479	-	µS/cm
Total Metals Analysis						
Aluminum	Al	0.005	0.005	0.004	-	mg/L
Antimony	Sb	0.0004	0.0003	0.0003	0.006	mg/L
Arsenic	As	0.0031	0.0006	0.0006	0.010	mg/L
Barium	Ba	0.0099	0.029	0.029	1.0	mg/L
Boron	B	< 0.01	0.02	0.02	5	mg/L
Cadmium	Cd	< 0.00004	< 0.00004	< 0.00004	0.005	mg/L
Calcium	Ca	53.4	40.5	39.4	-	mg/L
Chromium	Cr	0.0003	< 0.0002	< 0.0002	0.05	mg/L
Lead	Pb	< 0.0002	0.0003	< 0.0002	0.01	mg/L
Magnesium	Mg	6.97	6.49	6.36	-	mg/L
Potassium	K	2.33	2.01	2.03	-	mg/L
Selenium	Se	< 0.0002	< 0.0002	< 0.0002	0.01	mg/L
Silver	Ag	< 0.00005	< 0.00005	< 0.00005	-	mg/L
Uranium	U	0.0031	0.0020	0.0020	0.02	mg/L
Volatile Organic Compounds						
1,1-Dichloroethene		< 0.1	-	-	14	µg/L
Methylene Chloride		< 6	-	-	50	µg/L
Tetrachloroethene		< 0.1	-	-	30	µg/L
Trichloroethene		< 0.1	-	-	30	µg/L

mg/L = milligrams per liter
µg/L = micrograms per liter
< = Less than detection limit

µS/cm = microsiemens per centimeter

REPORTED TO: Manitoba Conservation - Drinking Water

REPORT DATE: October 22, 2007

GROUP NUMBER: 80927020

CANTEST

Conventional Parameters, Metals Analysis, Volatile Organic Compounds, Conventional Parameters-Winnipeg Laboratory-, Langelier Saturation Index in Water

CLIENT SAMPLE IDENTIFICATION:		245.00 Raw Well #1	245.00 Raw Well #2	245.00 Raw Well #3	245.00 Raw Well #4	DETECTION LIMIT	UNITS
DATE SAMPLED:		Sep 26/07	Sep 26/07	Sep 26/07	Sep 26/07		
CANTEST ID:		709270116	709270120	709270122	709270125		
Conventional Parameters							
Bromide	Br	<	<	<	<	1	mg/L
Total Organic Carbon	C	3.2	9.3	6.0	1.0	1	mg/L
Total Inorganic Carbon	C	16	32	18	22	1	mg/L
Total Carbon	C	19	41	24	23	1	mg/L
Cation-Anion Balance		-1.0	0.3	2.5	-1.4	-	% Difference
Total Metals Analysis							
Beryllium	Be	<	<	<	<	0.0002	mg/L
Bismuth	Bi	<	<	<	<	0.0002	mg/L
Cobalt	Co	0.0003	0.0013	0.0008	<	0.0002	mg/L
Lithium	Li	0.0015	0.0025	0.0016	0.0027	0.0002	mg/L
Molybdenum	Mo	0.0004	0.0009	0.0006	<	0.0001	mg/L
Nickel	Ni	<	0.0009	<	<	0.0002	mg/L
Phosphorus	P	<	<	<	<	0.03	mg/L
Rubidium	Rb	0.0005	0.0031	0.0008	0.0014	0.0002	mg/L
Silicon	Si	4.65	6.06	5.92	5.72	0.05	mg/L
Strontium	Sr	0.22	0.065	0.11	0.15	0.001	mg/L
Tellurium	Te	<	<	<	<	0.0002	mg/L
Thallium	Tl	<	<	<	<	0.00002	mg/L
Thorium	Th	<	<	<	<	0.0001	mg/L
Tin	Sn	<	<	<	<	0.0002	mg/L
Titanium	Ti	0.0004	0.0013	0.0005	0.0003	0.0002	mg/L
Ceslum	Cs	<	0.0007	<	<	0.0001	mg/L
Vanadium	V	0.0003	0.0009	0.0006	0.0004	0.0002	mg/L
Zirconium	Zr	<	<	<	<	0.002	mg/L
Volatile Organic Compounds							
cis-1,2-Dichloroethene		<	<	<	<	0.1	µg/L
trans-1,2-Dichloroethene		<	<	<	<	0.1	µg/L
Methyl tert-Butyl Ether		<	<	<	<	0.5	µg/L
1,1,1-Trichloroethane		<	<	<	<	0.1	µg/L
1,1,2-Trichloroethane		<	<	<	<	0.1	µg/L
Conventional Parameters-Winnipeg Laboratory-							

(Continued on next page)

REPORTED TO: Manitoba Conservation - Drinking Water

REPORT DATE: October 22, 2007

GROUP NUMBER: 80927020

CANTEST

Conventional Parameters, Metals Analysis, Volatile Organic Compounds, Conventional Parameters-Winnipeg Laboratory-, Langelier Saturation Index in Water

CLIENT SAMPLE IDENTIFICATION:	245.00 Raw Well #1	245.00 Raw Well #2	245.00 Raw Well #3	245.00 Raw Well #4		
DATE SAMPLED:	Sep 26/07	Sep 26/07	Sep 26/07	Sep 26/07	DETECTION LIMIT	UNITS
CANTEST ID:	709270116	709270120	709270122	709270125		
True Color	<	38	13	<	5	CU
Turbidity	0.4	0.4	0.5	<	0.1	NTU
Langelier Saturation Index						
Saturation Index at 4.4C	-1.86	-0.79	-1.67	-1.12	-	SI 4.4C
Saturation Index at 60C	-0.82	0.25	-0.63	-0.081	-	SI 60C

mg/L = milligrams per liter
µg/L = micrograms per liter
NTU = nephelometric turbidity units
SI 60C = Saturation Index at 60C
< = Less than detection limit

% Difference = Percent Difference
CU = color units
SI 4.4C = Saturation Index at 4.4C

REPORTED TO: Manitoba Conservation - Drinking Water

REPORT DATE: October 22, 2007

GROUP NUMBER: 80927020

CANTEST

Conventional Parameters, Metals Analysis, Volatile Organic Compounds, Conventional Parameters-Winnipeg Laboratory-, Langelier Saturation Index in Water

CLIENT SAMPLE IDENTIFICATION:		245.00 Raw Well #5	245.00 Treated	245.00 Distributed	DETECTION LIMIT	UNITS
DATE SAMPLED:		Sep 26/07	Sep 26/07	Sep 26/07		
CANTEST ID:		709270127	709270131	709270132		
Conventional Parameters						
Bromide	Br	<	<	<	1	mg/L
Total Organic Carbon	C	5.1	3.3	3.0	1	mg/L
Total Inorganic Carbon	C	40	18	18	1	mg/L
Total Carbon	C	45	21	21	1	mg/L
Cation-Anion Balance		-0.7	-1.0	-2.1	-	% Difference
Total Metals Analysis						
Beryllium	Be	<	<	<	0.0002	mg/L
Bismuth	Bi	<	<	<	0.0002	mg/L
Cobalt	Co	<	0.0004	<	0.0002	mg/L
Lithium	Li	0.0044	0.0017	0.0016	0.0002	mg/L
Molybdenum	Mo	0.0004	0.0004	0.0003	0.0001	mg/L
Nickel	Ni	<	<	<	0.0002	mg/L
Phosphorus	P	<	<	<	0.03	mg/L
Rubidium	Rb	0.0039	0.0007	0.0007	0.0002	mg/L
Silicon	Si	6.03	5.11	4.97	0.05	mg/L
Strontium	Sr	0.066	0.19	0.20	0.001	mg/L
Tellurium	Te	<	<	<	0.0002	mg/L
Thallium	Tl	<	<	<	0.00002	mg/L
Thorium	Th	<	<	<	0.0001	mg/L
Tin	Sn	<	<	<	0.0002	mg/L
Titanium	Ti	0.0006	0.0004	0.0003	0.0002	mg/L
Cesium	Cs	<	<	<	0.0001	mg/L
Vanadium	V	0.0006	0.0003	0.0003	0.0002	mg/L
Zirconium	Zr	<	<	<	0.002	mg/L
Volatile Organic Compounds						
cis-1,2-Dichloroethene		<	-	-	0.1	µg/L
trans-1,2-Dichloroethene		<	-	-	0.1	µg/L
Methyl tert-Butyl Ether		<	-	-	0.5	µg/L
1,1,1-Trichloroethane		<	-	-	0.1	µg/L
1,1,2-Trichloroethane		<	-	-	0.1	µg/L

Conventional Parameters-Winnipeg Laboratory-

(Continued on next page)

REPORTED TO: Manitoba Conservation - Drinking Water

REPORT DATE: October 22, 2007

GROUP NUMBER: 80927020

CANTEST

Conventional Parameters, Metals Analysis, Volatile Organic Compounds, Conventional Parameters-Winnipeg Laboratory-, Langelier Saturation Index in Water

CLIENT SAMPLE IDENTIFICATION:	245.00 Raw Well #5	245.00 Treated	245.00 Distributed		
DATE SAMPLED:	Sep 26/07	Sep 26/07	Sep 26/07	DETECTION LIMIT	UNITS
CANTEST ID:	709270127	709270131	709270132		
True Color	12	<	<	5	CU
Turbidity	0.3	<	0.1	0.1	NTU
Langelier Saturation Index					
Saturation Index at 4.4C	-0.26	-1.67	-1.64	-	SI 4.4C
Saturation Index at 60C	0.78	-0.63	-0.60	-	SI 60C

mg/L = milligrams per liter
µg/L = micrograms per liter
NTU = nephelometric turbidity units
SI 60C = Saturation Index at 60C
< = Less than detection limit

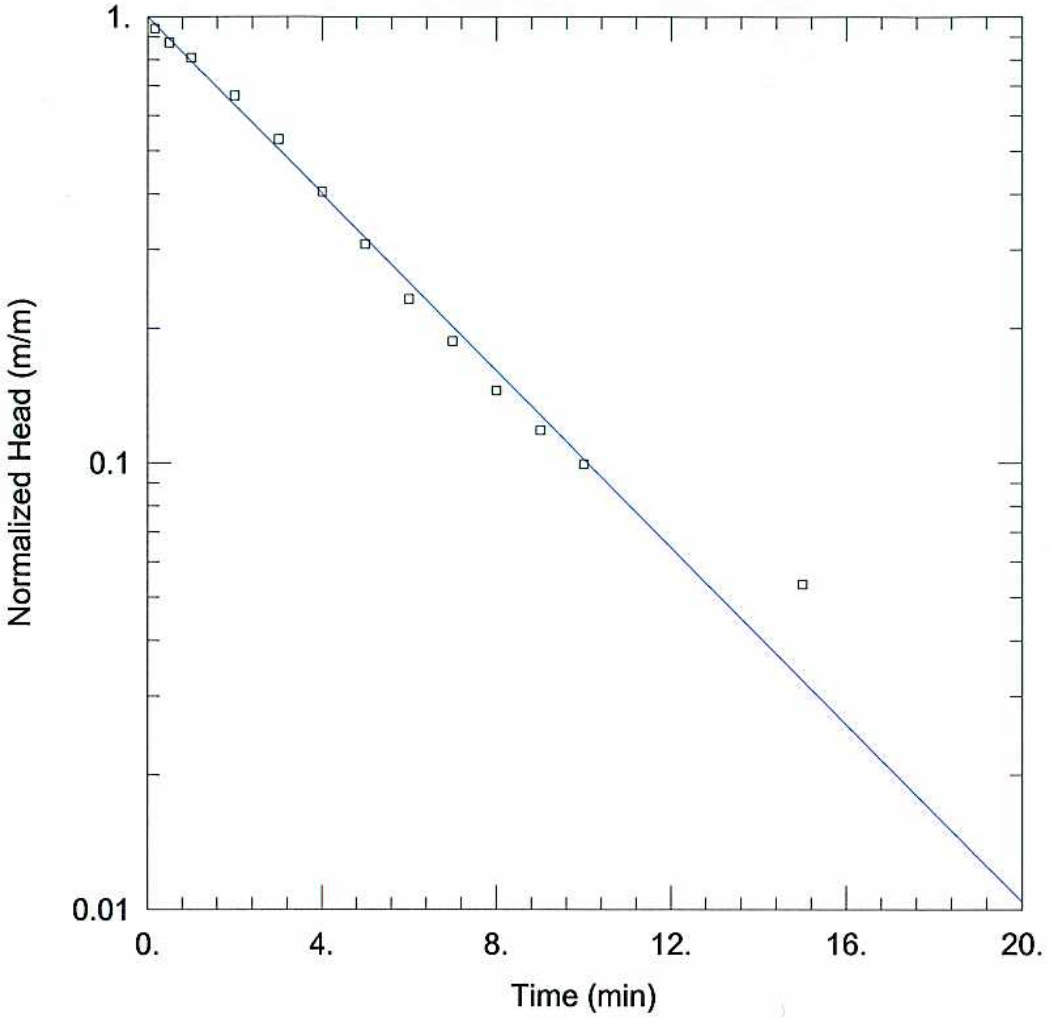
% Difference = Percent Difference
CU = color units
SI 4.4C = Saturation Index at 4.4C

APPENDIX B

WELL HYDRAULIC CONDUCTIVITY, PUMP TESTS AND PROVINCIAL HYDROGRAPHS

APPENDIX B-1

FIELD HYDRAULIC CONDUCTIVITY TESTING



WELL TEST ANALYSIS

Data Set: P:\Projects\2008\08-1521-02\Design\Env\Rising Head Tests\WH7A_HydraulicConductivity.aqt
Date: 10/14/08 Time: 13:24:55

PROJECT INFORMATION

Company: KGS Group
Client: Manitoba Conservation
Project: 08-1521-02
Location: West Hawk Lake
Test Well: WH-07A
Test Date: August 1, 2008

AQUIFER DATA

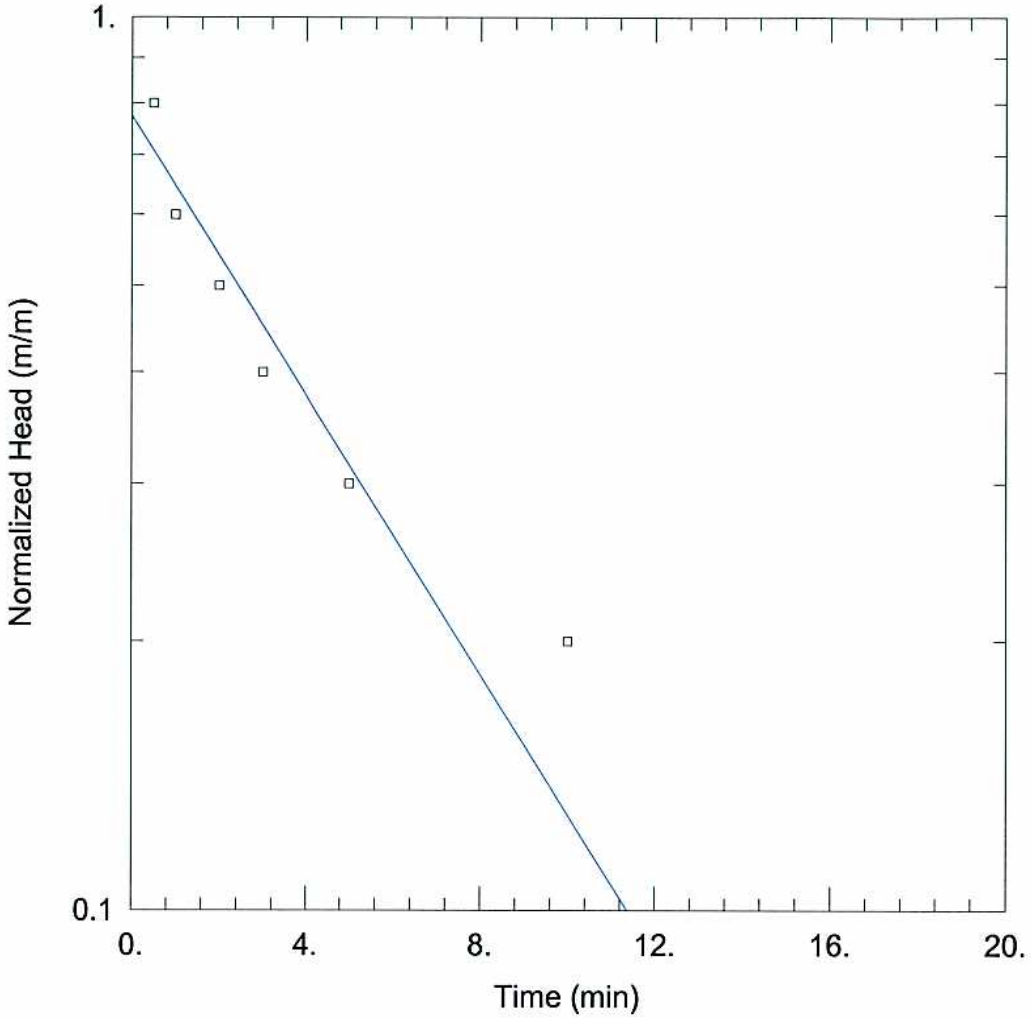
Saturated Thickness: 3.1 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (WH-07A)

Initial Displacement: -2.62 m
Total Well Penetration Depth: 3.1 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.1 m
Screen Length: 3. m
Wellbore Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.513E-6 m/sec
y0 = -2.613 m



WELL TEST ANALYSIS

Data Set: P:\Projects\2008\08-1521-02\Design\Env\Rising Head Tests\WH3_HydraulicConductivity.aqt
Date: 10/14/08 Time: 13:23:28

PROJECT INFORMATION

Company: KGS Group
Client: Manitoba Conservation
Project: 08-1521-02
Location: West Hawk Lake
Test Well: WH-03
Test Date: August 1, 2008

AQUIFER DATA

Saturated Thickness: 3.24 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (WH-03)

Initial Displacement: -0.05 m
Total Well Penetration Depth: 3.24 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.24 m
Screen Length: 3.24 m
Wellbore Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.117E-6 m/sec
y0 = -0.03864 m

APPENDIX B-2

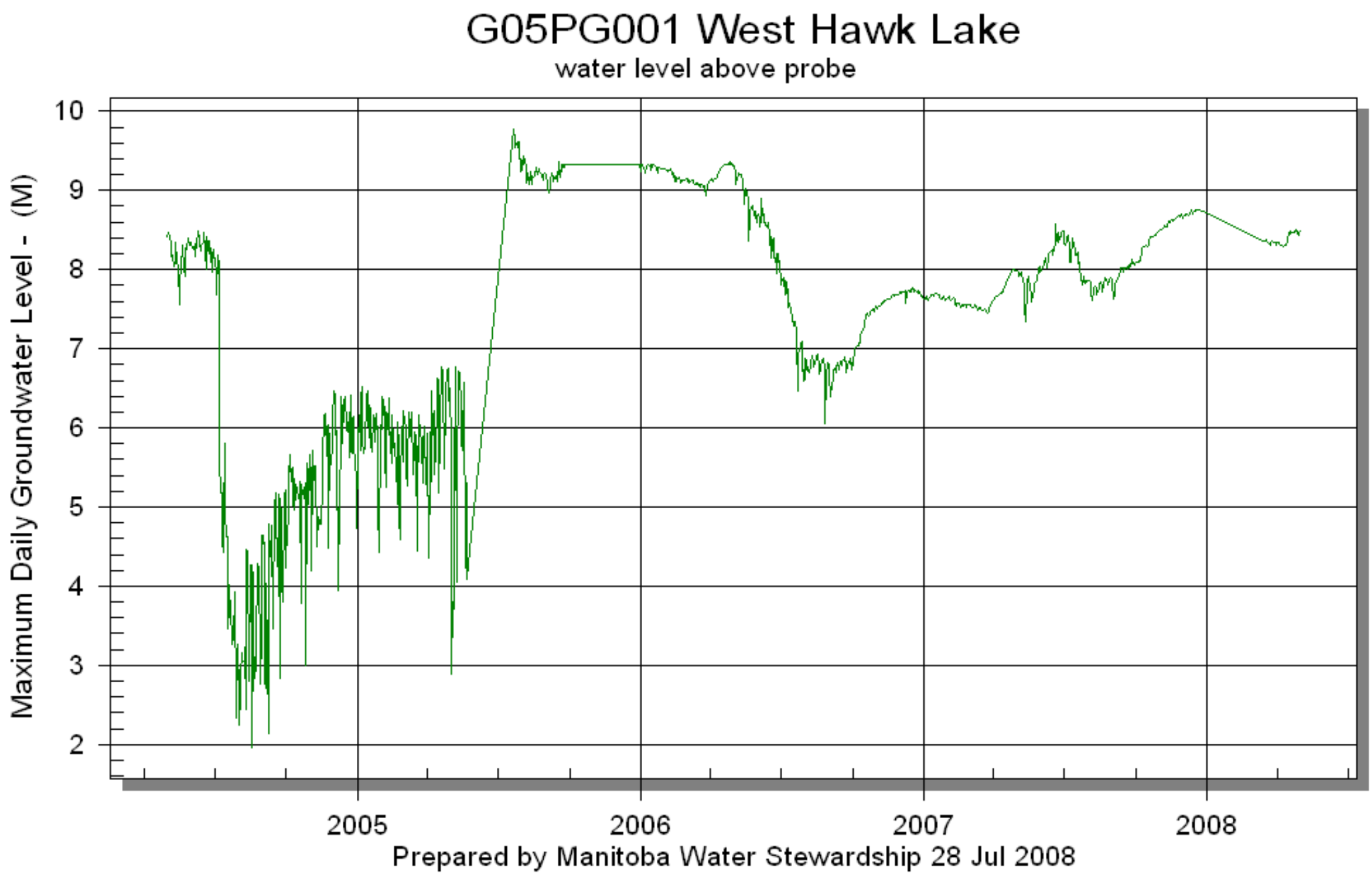
CURRENT WATER SUPPLY WELL PUMP TEST

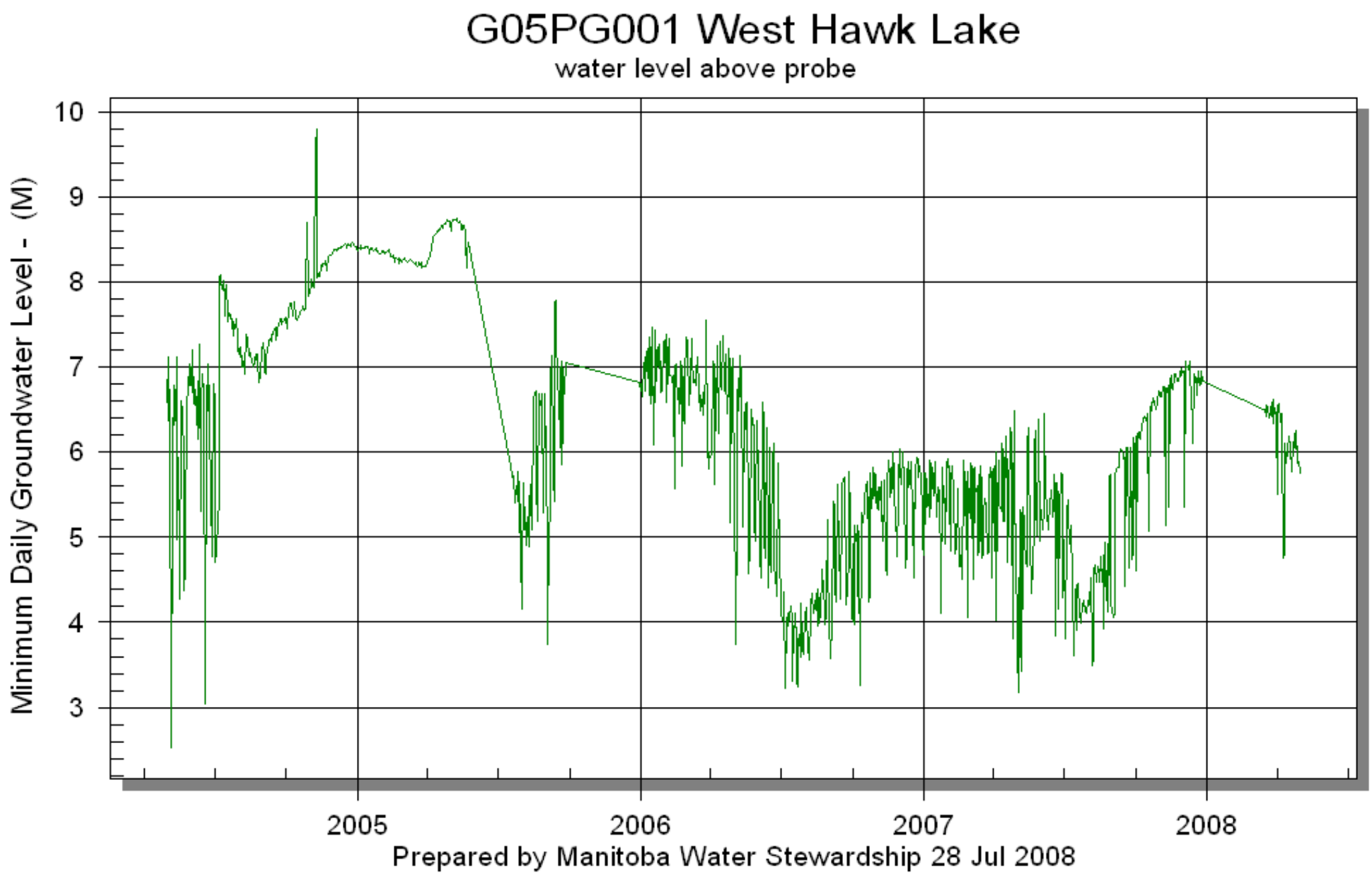
TABLE B-2
PUMP TEST WATER LEVELS AT CURRENT SUPPLY WELLS
WEST HAWK LAKE, MANITOBA

Time (July 31, 2008)	PW-1A Depth to Water (m)	PW-2 Depth to Water (m)	PW-3 Depth to Water (m)	PW-4 Depth to Water (m)	PW-5 Depth to Water (m)	MW-1 Depth to Water (m)	MW-2 Depth to Water (m)	Pumping Well
12:25						6.15		PW-2
12:44							5.79	
12:49						6.15		
13:36		10.13						
13:40		10.13						
13:54		10.14						
13:56				6.17				
13:58					5.63			
13:58	6.27							
14:01			5.74					
14:42		10.06						
14:53							5.81	
14:58				6.15				
15:01					5.62			
15:02	6.26							
15:05			5.74					
15:09	6.26							
15:11	9.72							PW-1A
15:13	9.7							
15:15	9.67							
15:18							6.54	
15:20	9.61							
15:24	9.57							
15:26							6.43	
15:28	9.55							
15:30		5.53						
15:35				5.36				
15:36					5.32			
15:39			6.17					
15:41					8.73			PW-1A & PW-5
15:43					8.87			
15:44							6.86	
15:46					9.03			
15:59					9.27			
16:00							7.27	
16:05	10.19							
16:25							6.71	
16:28	6.27							None
16:30					5.35			
18:38					8.7			PW-5
18:49					8.7			
19:00					8.7			
19:15					8.7			
19:18			8.54					PW-3
19:19							6.05	
19:22			8.51					
19:43			8.42					
20:07					5.9			
20:09				5.72				
20:15			8.54					
20:16				8.85				PW-4
20:17				9.35				
20:20				9.62				
20:35				9.71				
21:02				9.74				
21:05		5.97						
21:06					5.29			
21:15				9.75				
21:16				6.56				None
21:17				5.87				
21:18				5.7				
21:19				5.54				
21:20				5.43				
21:25				5.1				
21:30				4.87				
21:36		4.81						
21:38					4.52			
21:39	5.3							
21:41			4.89					

APPENDIX B-3

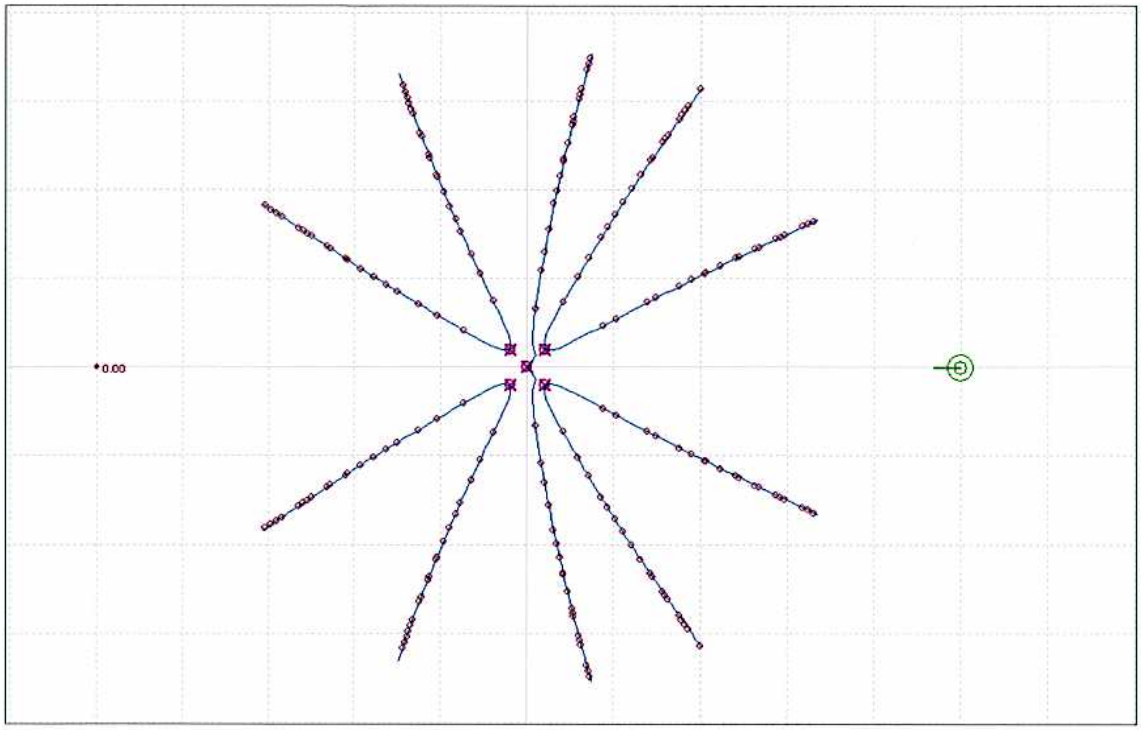
PROVINCIAL HYDROGRAPHS


G05PG001 West Hawk Lake
water level above probe
Maximum Daily Groundwater Level - (M)
10
9
8
7
6
5
4
3
2
2005
2006
2007
2008
Prepared by Manitoba Water Stewardship 28 Jul 2008


G05PG001 West Hawk Lake
water level above probe
Minimum Daily Groundwater Level - (M)
10
9
8
7
6
5
4
3
2005
2006
2007
2008
Prepared by Manitoba Water Stewardship 28 Jul 2008

APPENDIX C

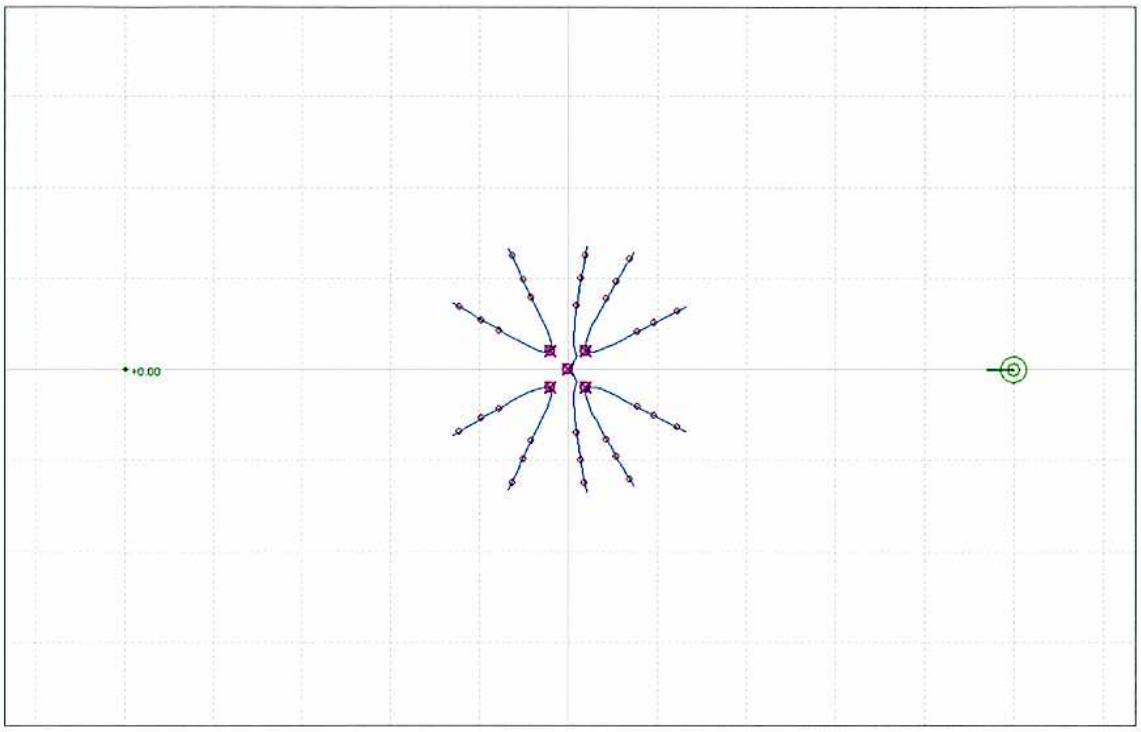
GROUNDWATER MODELING



Notes:

1. Grid spacing is 100 m
2. Each circle represent 1 year of travel
3. K=1 x 10^{-4} m/sec
4. N_e = 0.20
5. Q = 13.9 lgpm

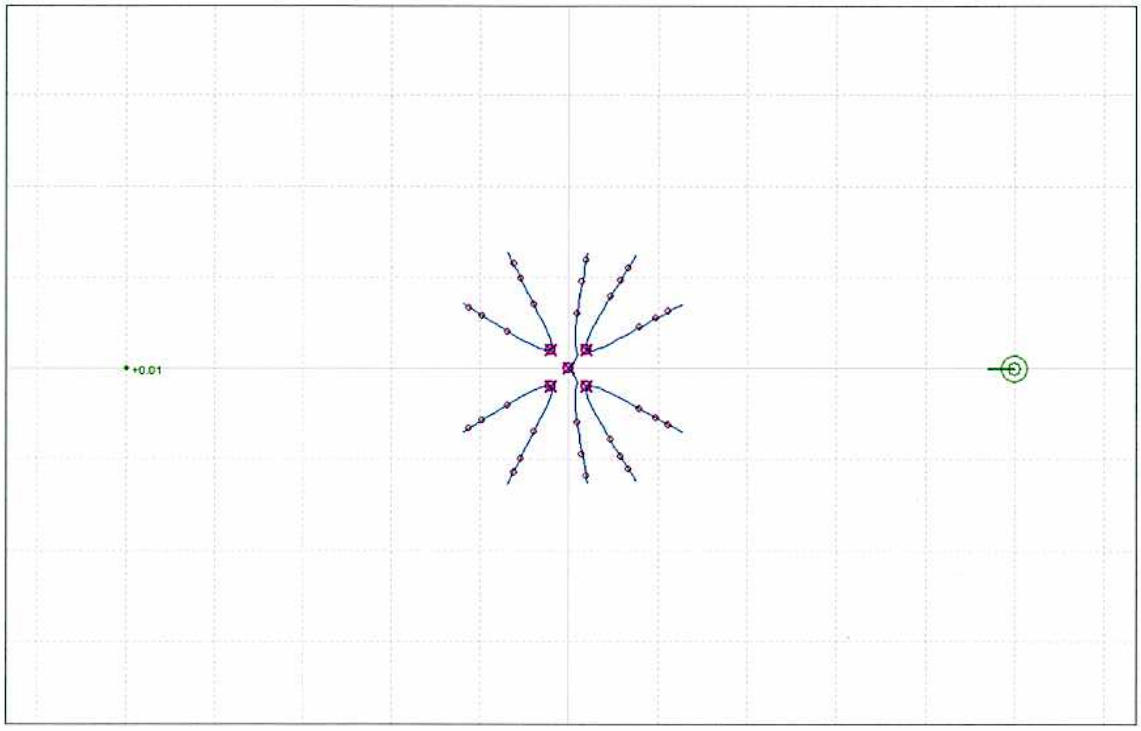
Appendix C-1
WhAEM Model
Zero mm/yr Recharge



Notes:

1. Grid spacing is 100 m
2. Each circle represent 1 year of travel
3. K=1 x 10^{-4} m/sec
4. N_e = 0.20
5. Q = 13.9 lgpm

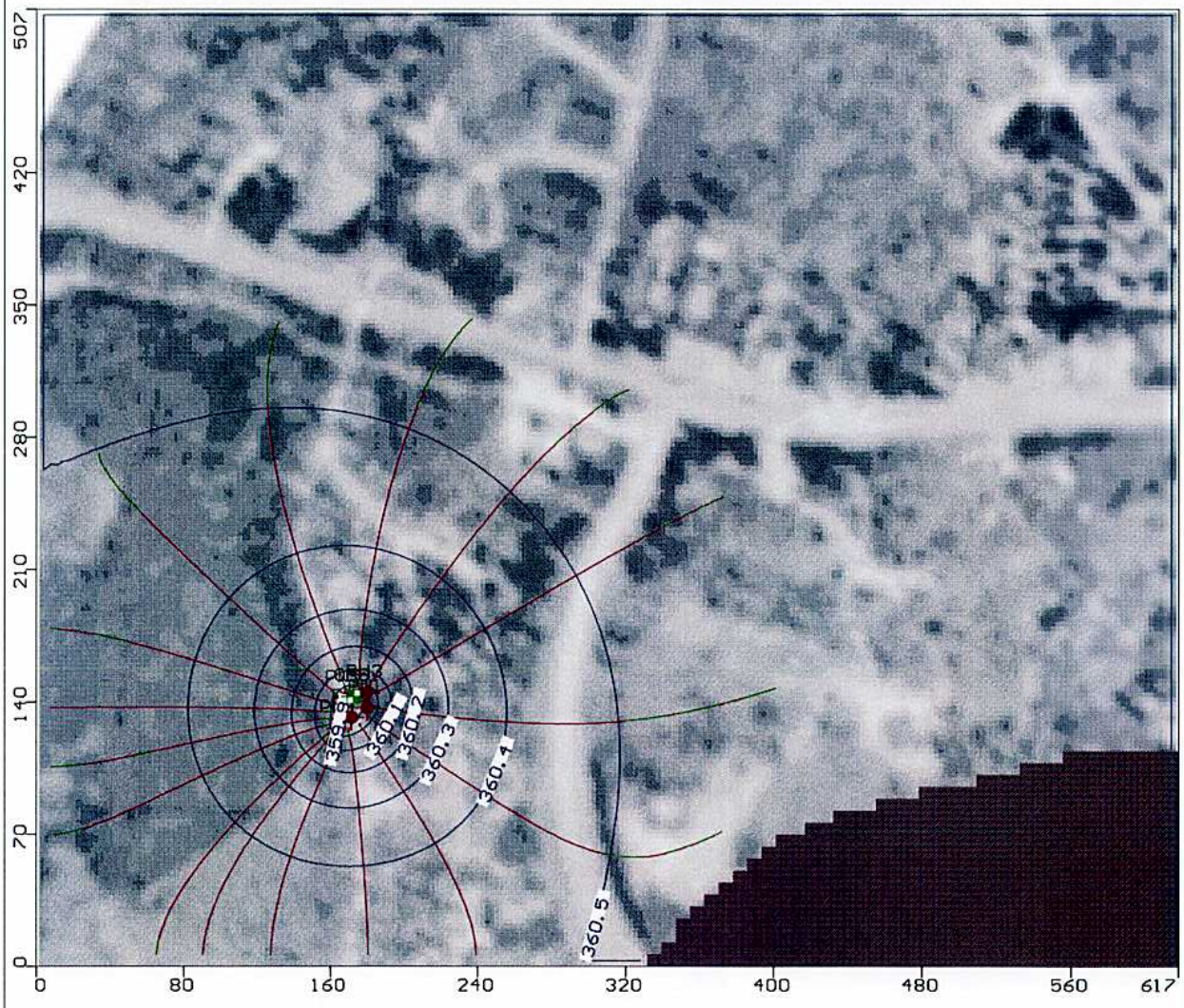
Appendix C-2
WhAEM Model
150 mm/yr Recharge



Notes:

1. Grid spacing is 100 m
2. Each circle represent 1 year of travel
3. K=1 x 10^{-4} m/sec
4. N_e = 0.20
5. Q = 13.9 lgpm

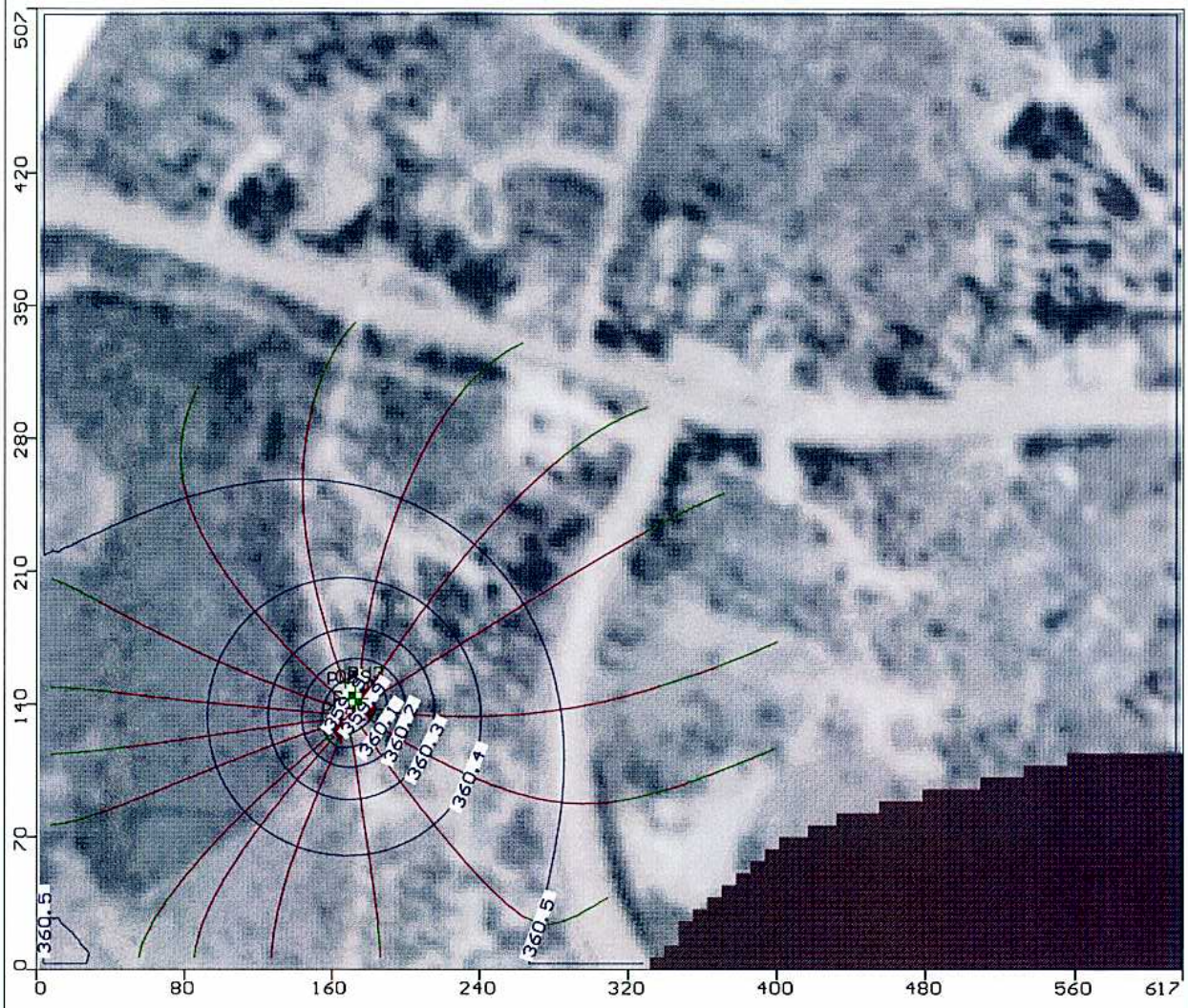
Appendix C-3
WhAEM Model
200 mm/yr Recharge



Notes:

1. K = 1 x 10^{-4} m/sec
2. N_e = 0.30
3. 13.9 lgpm total

Figure C-4
Modflow Model
150 mm Recharge



Notes:

1. $K = 1 \times 10^{-4}$ m/sec
2. $N_e = 0.30$
3. 13.9 lgpm total

Figure C-5
Modflow Model
200 mm Recharge

APPENDIX D

NCSCS SCORING SHEETS

CCME National Classification System for Contaminated Sites (2008)
Pre-Screening Checklist

Question	Response (yes / no)	Comment
1. Are **Radioactive material**, **Bacterial contamination** or **Biological hazards** likely to be present at the site?	No	If yes, do not proceed through the NCSCS. Contact applicable regulatory agency immediately.
2. Are there **no contamination exceedances** (known or suspected)? Determination of exceedances may be based on: 1) CCME environmental quality guidelines; 2) equivalent provincial guidelines/standards if no CCME guideline exists for a specific chemical in a relevant medium; or 3) toxicity benchmarks derived from the literature for chemicals not covered by CCME or provincial guidelines/standards.	No	If yes (i.e., there are no exceedances), do not proceed through the NCSCS.
3. Have **partial/incompleted or no environmental site investigations** been conducted for the Site?	No	If yes, do not proceed through the NCSCS.
4. Is there direct and signficant evidence of **impacts to humans** at the site, or off-site due to migration of contaminants from the site?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
5. Is there direct and significant evidence of **impacts to ecological receptors** at the site, or off-site due to migration of contaminants from the site?	No	Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are considered to be severe, the site may be categorized as Class 1, regardless of the numerical total NCSCS score. For the purpose of application of the NCSCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction.
6. Are there indicators of significant **adverse effects in the exposure zone** (i.e., the zone in which receptors may come into contact with contaminants)? Some examples are as follows: -Hydrocarbon sheen or NAPL in the exposure zone -Severely stressed biota or devoid of biota; -Presence of material at ground surface or sediment with suspected high concentration of contaminants such as ore tailings, sandblasting grit, slag, and coal tar.	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
7. Do measured concentrations of volatiles or unexploded ordnances represent an **explosion hazard**?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, and do not continue until the safety risks have been addressed. Consult your jurisdiction's occupational health and safety guidance or legislation on exposive hazards and measurement of lower explosive limits.

If none of the above applies, proceed with the NCSCS scoring.

CCME National Classification System for Contaminated Sites (2008)
Summary of Site Conditions

Subject Site:	**Test Site**	
Civic Address: *(or other description of location)*	Keystone Resort, West Hawk Lake, Manitoba	
Site Common Name : *(if applicable)*	Community of West Hawk Lake, Manitoba	
Site Owner or Custodian: *(Organization and Contact Person)*	Manitoba Conservation, Keystone Resort	
Legal description *or* metes and bounds:		
Approximate Site area:	Keystone Resort fuelling area and former community well field south of Keystone Resort	
PID(s) : *(or Parcel Identification Numbers [PIN] if untitled Crown land)*		
Centre of site: *(provide latitude/longitude or UTM coordinates)*	Latitude: Longitude:	_____ degrees _____ min _____ secs _____ degrees _____ min _____ secs
	UTM Coordinate:	Northing _5512768_____ Easting _340315_____
Site Land Use:	Current:	Keystone Resort is used as a fuel station and the former well field is a green space.
	Proposed:	
Site Plan	**To delineate the bounds of the Site a site plan MUST be attached. The plan must be drawn to scale indicating the boundaries in relation to well-defined reference points and/or legal descriptions. Delineation of the contamination should also be indicated on the site plan.**	
Provide a brief description of the Site:	The Keystone Resort and former well field are located within the community of West Hawk Lake within the Whiteshell Provincial Park. The Keystone Resort is used as a fuel station and has an underground storage tank located next to the fuelling pumps. The former well field is located immediately south of the Resort. The well field discontinued use in 2003 after routine testing by Manitoba Conservation detected hydrocarbons in one of the wells. Three former supply wells remain on the site along with the pumphouse and numerous monitoring wells drilled by UMA Engineering during previous environmental investigations. Monitoring wells are also located on the Keystone Resort site.	

CCME National Classification System for Contaminated Sites (2008)
Summary of Site Conditions

Affected media and Contaminants of Potential Concern (COPC):	The affected media is groundwater and soil in the area of the Keystone Resort and former well field. The contaminants of concern are Benzene, Toluene, Ethylbenzene, Xylenes, and hydrocarbon fractions F1-F4.

Please fill in the "letter" that best describes the level of information available for the site being assessed:

Site Letter Grade **C**

If letter grade is F, do not continue, you must have a minimum of a Phase I Environmental Site Assessment or equivalent.

Scoring Completed By:	**KGS Group**
Date Scoring Completed:	**23-Oct-08**

CCME National Classification System (2008)

(I) Contaminant Characteristics

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method of Evaluation	Notes
1. Residency Media (replaces physical state)				
Which of the following residency media are known (or strongly suspected) to have one or more exceedances of the applicable CCME guidelines? **yes** = has an exceedance or strongly suspected to have an exceedance **no** = does not have an exceedance or strongly suspected not to have an exceedance			The overall score is calculated by adding the individual scores from each residency media (having one or more exceedance of the most conservative media specific and land-use appropriate CCME guideline). Summary tables of the Canadian Environmental Quality Guidelines for soil, water (aquatic life, non-potable groundwater environments, and agricultural water uses) and sediment are available on the CCME website at http://www.ccme.ca/publications/cegg_rcqe.html?category_id=124. For potable groundwater environments, guidelines for Canadian Drinking Water Quality (for comparison with groundwater monitoring data) are available on the Health Canada website at http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html.	An increasing number of residency media containing chemical exceedances often equates to a greater potential risk due to an increase in the number of potential exposure pathways.
A. Soil	Yes	Soil testing was performed during environmental investigations by UMA in 2003 which confirmed exceedances for hydrocarbons in soil. Groundwater sampling from 2003 until 2008 has confirmed exceedances of hydrocarbons in groundwater. The source of the contamination was an underground storage tank, the groundwater level is well below ground surface and there are no surface water receptors near to the site, thus surface water and sediment media are not suspected to have exceedances.		
Yes / No / Do Not Know				
B. Groundwater	Yes			
Yes / No / Do Not Know				
C. Surface water	No			
Yes / No / Do Not Know				
D. Sediment	No			
Yes / No / Do Not Know				
"Known" -score	4			
"Potential" - score	---			
2. Chemical Hazard				
What is the relative degree of chemical hazard of the contaminant in the list of hazard rankings proposed by the Federal Contaminated Sites Action Plan (FCSAP)?	High	Petroleum hydrocarbons are a known contaminant at the site.	The relative degree of chemical hazard should be selected based on the most hazardous contaminant known or suspected to be present at the site. The degree of hazard has been defined by the Federal Contaminated Sites Action Plan (FCSAP) and a list of substances with their associated hazard (Low, Medium and High) has been provided as a separate sheet in this file. *See Attached Reference Material for Contaminant Hazard Rankings.*	Hazard as defined in the revised NCS pertains to the physical properties of a chemical which can cause harm. Properties can include toxic potency, propensity to biomagnify, persistence in the environment, etc. Although there is some overlap between hazard and contaminant exceedance factor below, it will not be possible to derive contaminant exceedance factors for many substances which have a designated chemical hazard designation, but don't have a CCME guideline. The purpose of this category is to avoid missing a measure of toxic potential.
High / Medium / Low / Do Not Know				
"Known" -score	8			
"Potential" - score	---			
3. Contaminant Exceedence Factor				
What is the ratio between the measured contaminant concentration and the applicable CCME guidelines (or other "standards")?	High (>100x)	See groundwater quality reports. Several samples collected from 2003 until 2008 contained BTEX levels greater than 100x the Maximum Acceptable Concentration. No mobile NAPL was measured during investigations.	Ranking of contaminant "exceedance" is determined by comparing contaminant concentrations with the *most conservative media-specific and land-use appropriate CCME* environmental quality guidelines. **Ranking should be based on contaminant with greatest exceedance of CCME guidelines.** Ranking of contaminant hazard as high, medium and low is as follows: High = One or more measured contaminant concentration is greater than 100 X appropriate CCME guidelines Medium = One or more measured contaminant concentration is 10 - 99.99 X appropriate CCME guidelines Low = One or more measured contaminant concentration is 1 - 9.99 X appropriate CCME guidelines Mobile NAPL = Contaminant is a non-aqueous phase liquid (i.e., due to its low solubility, it does not dissolve in water, but remains as a separate liquid) and is present at a sufficiently high saturation (i.e., greater than residual NAPL saturation) such that there is significant potential for mobility either downwards or laterally. Other standards may include local background concentration or published toxicity benchmarks. Results of toxicity testing with site samples can be used as an alternative. This approach is only relevant for contaminants that do not biomagnify in the food web, since toxicity tests would not indicate potential effects at higher trophic levels. High = lethality observed. Medium = no lethality, but sub lethal effects observed. Low = neither lethal nor sub lethal effects observed.	In the event that elevated levels of a material with no associated CCME guidelines are present, check provincial and USEPA environmental criteria. Hazard Quotients (sometimes referred to as a screening quotient in risk assessments) refer to the ratio of measured concentration to the concentration believed to be the threshold for toxicity. A similar calculation is used here to determine the contaminant exceedance factor (CEF). Concentrations greater than one times the applicable CCME guideline (i.e., CEF=>1) indicate that risks are possible. Mobile NAPL has the highest associated score (8) because of its highly concentrated nature and potential for increase in the size of the impacted zone.
Mobile NAPL / High (>100x) / Medium (10x to 100x) / Low (1x to 10x) / Do Not Know				
"Known" -score	6			
"Potential" - score	---			

CCME National Classification System (2008)

(I) Contaminant Characteristics

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method of Evaluation	Notes
4. Contaminant Quantity (known or strongly suspected)				
What is the known or strongly suspected quantity of all contaminants? >10 hectare (ha) or 5000 m^3 2 to 10 ha or 1000 to 5000 m^3 <2 ha or 1000 m^3 Do Not Know	2 to 10 ha or 1000 to 5000 m3	Contaminants are found in an area of approximately 2500 m^2. During soil sampling by UMA contaminants were found from 3.5 to 5.5 m depth.	Measure or estimate the area or quantity of total contamination (i.e, all contaminants known or strongly suspected to be present on the site). The "Area of Contamination" is defined as the area or volume of contaminated media (soil, sediment, groundwater, surface water) exceeding appropriate environmental criteria.	A larger quantity of a potentially toxic substance can result in a larger frequency of exposure as well as a greater probability of migration, therefore, larger quantities of these substances earn a higher score.
"Known" -score	6			
"Potential" - score	---			
5. Modifying Factors				
Does the chemical fall in the class of persistent chemicals based on its behavior in the environment? Yes No Do Not Know	No	Petroleum hydrocarbons are not considered a persistent chemical.	Persistent chemicals, e.g., PCBs, chlorinated pesticides etc. either do not degrade or take longer to degrade, and therefore may be available to cause effects for a longer period of time. Canadian Environmental Protection Act (CEPA) classifies a chemical as persistent when it has at least one of the following characteristics: (a) in air, (i) its half-life is equal to or greater than 2 days, or (ii) it is subject to atmospheric transport from its source to a remote area; (b) in water, its half-life is equal to or greater than 182 days; (c) in sediments, its half-life is equal to or greater than 365 days; or (d) in soil, its half-life is equal to or greater than 182 days. This list does not include metals or metalloids, which in their elemental form do not degrade. However metals and metalloids form chemical species in the environment, many of which are not readily bioavailable.	*Examples of Persistent Substances are provided in attached Reference Materials*
Are there contaminants present that could cause damage to utilities and infrastructure, either now or in the future, given their location? Yes No Do Not Know	No	There is no known infrastructure in the area of the contamination.		Some contaminants may react or absorb into underground utilities and infrastructure. For example, organic solvents may degrade some plastics, and salts could cause corrosion of metal.
How many different contaminant classes have representative CCME guideline exceedances? one two to four five or more Do Not Know	two to four	Volatile petroleum hydrocarbons, light extractable petroleum hydrocarbons, and heavy extractable petroleum hydrocarbons.	For the purposes of the revised NCS ranking system, the following chemicals represent distinct chemical "classes": inorganic substances (including metals), volatile petroleum hydrocarbons, light extractable petroleum hydrocarbons, heavy extractable petroleum hydrocarbons, PAHs, phenolic substances, chlorinated hydrocarbons, halogenated methanes, phthalate esters, pesticides.	*Refer to the Reference Material sheet for a list of example substances that fall under the various chemical classes.*
"Known" - Score	2			
"Potential" - Score	---			

Contaminant Characteristic Total

Raw Total Scores- "Known"	26
Raw Total Scores- "Potential"	0
Raw Combined Total Scores	26
Total Score (Raw Combined / 40 * 33)	**21.5**

CCME National Classification System (2008)

(II) Migration Potential (Evaluation of contaminant migration pathways)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
1. Groundwater Movement				
A. Known COPC exceedances and an operable groundwater pathway within and/or beyond the property boundary.				
i) For **potable groundwater environments** 1) groundwater concentrations exceed background concentrations and 1X the Guideline for Canadian Drinking Water Quality (GCDWQ) or 2) there is known contact of contaminants with groundwater, based on physical evidence of groundwater contamination. For **non-potable environments**(typically urban environments with municipal services), 1) groundwater concentrations exceed 1X the applicable non potable guidelines or modified generic guidelines (which exclude ingestion of drinking water pathway) or 2) there is known contact of contaminants with groundwater, based on physical evidence of groundwater impacts.	12		Review chemical data and evaluate groundwater quality. The evaluation method concentrates on 1) a potable or non-potable groundwater environment; 2) the groundwater flow system and its potential to be an exposure pathway to known or potential receptors An aquifer is defined as a geologic unit that yields groundwater in usable quantities and drinking water quality. The aquifer can currently be used as a potable water supply or could have the potential for use in the future. Non-potable groundwater environments are defined as areas that a serviced with a reliable alternative water supply (most commonly provided in urban areas). The evaluation of a non-potable environment will be based on a site specific basis. Physical evidence includes significant sheens, liquid phase contamination, or contaminant saturated soils. Seeps and springs are considered part of the groundwater pathway. In Arctic environments, the potability and evaluation of the seasonal active layer (above the permafrost) as a groundwater exposure pathway will be considered on a site-specific basis.	The 1992 NCS rationale evaluated the off-site migration as a regulatory issue. The exposure assessment and classification of hazards should be evaluated regardless of the property boundaries. Someone experienced must provide a thorough description of the sources researched to determine the presence/absence of a groundwater supply source in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resources such as internet links. Note that for potable groundwater that also daylights into a nearby surface water body, the more stringent guidelines for both drinking water and protection of aquatic life should be considered. **Selected References** Potable Environments Guidelines for Canadian Drinking Water Qualitywww.hc-sc.gc.ca/ewh-semt/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html Non-Potable Environments Canadian Water Quality Guidelines for Protection of Aquatic Life. CCME. 1999 www.ccme.ca Compilation and Review of Canadian Remediation Guidelines, Standards and Regulations. Science Applications International Corporation (SAIC Canada), report to Environment Canada, January 4, 2002.
ii) Same as (i) except the information is not known but strongly suspected based on indirect observations.	9			
iii) Meets GCDWQ for **potable environments** meets non-potable criteria or modified generic criteria (excludes ingestion of drinking water pathway) for **non-potable environments** **or** Absence of groundwater exposure pathway (i.e., there is no aquifer (see definition at right) at the site or there is an adequate isolating layer between the aquifer and the contamination, and within 5 km of the site there are no aquatic receiving environments and the groundwater does not daylight).	0	Groundwater sampling has confirmed that the groundwater contains petroleum hydrocarbons in exceedance of applicable guidelines.		
	12			
Score	12			
NOTE: If a score is assigned here for Known COPC Exceedances, then you can skip Part B (Potential for groundwater pathway) and go to Section 2 (Surface Water Pathway)				
B. Potential for groundwater pathway.				
a. Relative Mobility High Moderate Low Insignificant Do Not Know			Organics Koc (L/kg) / Metals with higher mobility at acidic conditions / Metals with higher mobility at alkaline conditions Koc < 500 (i.e., log Koc < 2.7) — pH < 5 — pH > 8.5 Koc = 500 to 5000 (i.e., log Koc = 2.7 to 3.7) — pH = 5 to 6 — pH = 7.5 to 8.5 Koc = 5,000 to 100,000 (i.e., log Koc = 3.7 to 5) — pH > 6 — pH < 7.5 Koc > 100,000 (i.e., log Koc > 5)	Reference: US EPA Soil Screening Guidance (Part 5 - Table 39) If a score of zero is assigned for relative mobility, it is still recommended that the following sections on potential for groundwater pathway be evaluated and scored. Although the K of an individual contaminant may suggest that it will be relatively immobile, it is possible that, with complex mixtures, there could be enhanced mobility due to co-solvent effects. Therefore, the Koc cannot be relied on solely as a measure of mobility. An evaluation of other factors such as containment, thickness of confining layer, hydraulic conductivities and precipitation infiltration rate are still useful in predicting potential for groundwater migration, even if a contaminant is expected to have insignificant mobility based on its chemistry alone.
	Do Not Know			
Score	2			
b. Presence of engineered sub-surface containment? No containment Partial containment Full containment Do Not Know			Review the existing engineered systems or natural attenuation processes for the site and determine if full or partial containment is achieved. Full containment is defined as an engineered system or natural attenuation processes, monitored as being effective, which provide for full capture and/or treatment of contaminants. All chemicals o concern must be contained for "Full Containment" scoring. Natural attenuation must have sufficie data, and reports cited with monitoring data to support steady state conditions and the attenuation processes. If there is no containment or insufficient natural attenuation process, this category is evaluated as high. If there is less than full containment or if uncertain, then evaluate as medium. I Arctic environments, permafrost will be evaluated, as appropriate, based on detailed evaluations, effectiveness and reliability to contain/control contaminant migration.	Someone experienced must provide a thorough description of the sources researched to determine the containment of the source at the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps, geotechnical reports or natural attenuation studies and other resources such as internet links. **Selected Resources:** United States Environmental Protection Agency (USEPA) 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. EPA/600/R-98/128. Environment Canada – Ontario Region – Natural Attenuation Technical Assistance Bulletins (TABS) Number 19 –21.
	Do Not Know			
Score	1.5			
c. Thickness of confining layer over aquifer of concern or groundwater exposure pathway 3 m or less including no confining layer or discontinuous confining layer 3 to 10 m > 10 m Do Not Know			The term "confining layer" refers to geologic material with little or no permeability or hydraulic conductivity (such as unfractured clay); water does not pass through this layer or the rate of movement is extremely slow. Measure the thickness and extent of materials that will impede the migration of contaminants to t groundwater exposure pathway. The evaluation of this category is based on: 1) The presence and thickness of saturated subsurface materials that impede the vertical migration of contaminants to lower aquifer units which can or are used as drinking water sources or 2) The presence and thickness of unsaturated subsurface materials that impede the vertical migration of contaminants from the source location to the saturated zone (e.g., water table aquifer, first hydrostratigraphic unit or other groundwater pathway).	
	Do Not Know			
Score	0.5			
d. Hydraulic conductivity of confining layer >10^{-4} cm/s or no confining layer 10^{-4} to 10^{-6} cm/s <10^{-6} cm/s Do Not Know			Determine the nature of geologic materials and estimate hydraulic conductivity from published material (or use "Range of Values of Hydraulic Conductivity and Permeability" figure in the Reference Material sheet). Unfractured clays should be scored low. Silts should be scored medium. Sand, gravel should be scored high. The evaluation of this category is based on: 1) The presence and hydraulic conductivity ("K") of saturated subsurface materials that impede th vertical migration of contaminants to lower aquifer units which can or are used as a drinking water source, groundwater exposure pathway or 2) The presence and permeability ("k") of unsaturated subsurface materials that impede the vertical migration of contaminants from the source location to the saturated water table aquifer, fi hydrostratigraphic unit or other groundwater pathway.	
	Do Not Know			
Score	0.5			
B. Potential for groundwater pathway.				

(II) Migration Potential (Evaluation of contaminant migration pathways)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
e. Precipitation infiltration rate (Annual precipitation factor x surface soil relative permeability factor) High Moderate Low Very Low None Do Not Know	Do Not Know		Precipitation Refer to Environment Canada precipitation records for relevant areas. Divide annual precipitation by 1000 and round to nearest tenth (e.g., 667 mm = 0.7 score). Permeability For surface soil relative permeability (i.e., infiltration) assume: gravel (1), sand (0.6), loam (0.3) and pavement or clay (0). Multiply the surface soil relative permeability factor with precipitation factor to obtain the score for precipitation infiltration rate.	
Score	0.4			
f. Hydraulic conductivity of aquifer $>10^{-2}$ cm/s 10^{-2} to 10^{-4} cm/s $<10^{-4}$ cm/s Do Not Know	Do Not Know		Determine the nature of geologic materials and estimate hydraulic conductivity of all aquifers of concern from published material (refer to "Range of Values of Hydraulic Conductivity and Permeability" in the Reference Material sheet).	
Score	1			
Potential groundwater pathway total	5.9			
Allowed Potential score	---	Note: If a "known" score is provided, the "potential" score is disallowed.		
Groundwater pathway total	**12**			
2. Surface Water Movement				
A. Demonstrated migration of COPC in surface water above background conditions				
Known concentrations of surface water: i) Concentrations exceed background concentrations and exceed CCME CWQG for protection of aquatic life, irrigation, livestock water, and/or recreation (whichever uses are applicable at the site) by >1 X; or There is known contact of contaminants with surface water based on site observations. or In the absence of CWQG, chemicals have been proven to be toxic based on site specific testing (e.g. toxicity testing; or other indicator testing of exposure).	12		Collect all available information on quality of surface water near to site. Evaluate available data against Canadian Water Quality Guidelines (select appropriate guidelines based on local water use, e.g., recreation, irrigation, aquatic life, livestock watering, etc.). The evaluation method concentrates on the surface water flow system and its potential to be an exposure pathway. Contamination is present on the surface (above ground) and has the potential to impact surface water bodies. Surface water is defined as a water body that supports one of the following uses: recreation, irrigation, livestock watering, aquatic life.	General Notes: Someone experienced must provide a thorough description of the sources researched to classify the surface water body in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resource such as internet links. Selected References: CCME. 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life www.ccme.ca CCME. 1999. Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) www.ccme.ca Health and Welfare Canada. 1992. Guidelines for Canadian Recreational Water Quality.
ii) Same as (i) except the information is not known but strongly suspected based on indirect observations.	8			
iii) Meets CWQG or absence of surface water exposure pathway (i.e., Distance to nearest surface water is > 5 km.)	0			
Score	Go to Potential ---			
NOTE: If a score is assigned here for Demonstrated Migration in Surface Water, then you can skip Part B (Potential for migration of COPCs in surface water) and go to Section 3 (Surface Soils)				
B. Potential for migration of COPCs in surface water				
a. Presence of containment No containment Partial containment Full containment Do Not Know	Partial containme	Partial containment includes bedrock ridges and outcrops.	Review the existing engineered systems and relate these structures to site conditions and proximity to surface water and determine if full containment is achieved: score low if there is full containment such as capping, berms, dikes; score medium if there is partial containment such as natural barriers, trees, ditches, sedimentation ponds; score high if there are no intervening barriers between the site and nearby surface water. Full containment must include containment of all chemicals.	
Score	3			
b. Distance to Surface Water 0 to <100 m 100 - 300 m >300 m Do Not Know	>300 m	The nearest surface water body is West Hawk Lake located approximately 500 m from the contaminated site.	Review available mapping and survey data to determine distance to nearest surface water bodies.	
Score	0.5			

CCME National Classification System (2008)

(II) Migration Potential (Evaluation of contaminant migration pathways)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
c. Topography Contaminants above ground level and slope is steep Contaminants at or below ground level and slope is steep Contaminants above ground level and slope is intermediate Contaminants at or below ground level and slope is intermediate Contaminants above ground level and slope is flat Contaminants at or below ground level and slope is flat Do Not Know		The general topography of the contaminated site is flat. The known contaminated media is below ground level.	Review engineering documents on the topography of the site and the slope of surrounding terrain. Steep slope = >50% Intermediate slope = between 5 and 50% Flat slope = < 5% Note: Type of fill placement (e.g., trench, above ground, etc.).	
	At/below and flat			
Score	0			
d. Run-off potential High (rainfall run-off score > 0.6) Moderate (0.4 < rainfall run-off score <0.6) Low (0.2 < rainfall run-off score <0.4) Very Low (0 < rainfall run-off score < 0.2) None (rainfall run-off score = 0) Do Not Know		Annual precipitation 561 mm = 0.6 (Canadian Climate Normals); sand (2003 Phase II ESA by UMA).	Rainfall Refer to Environment Canada precipitation records for relevant areas. Divide rainfall by 1000 and round to nearest tenth (e.g., 667 mm = 0.7 score). The former definition of "annual rainfall" did not include the precipitation as snow. This minor adjustment has been made. The second modification was the inclusion of permeability of surface materials as an evaluation factor. Permeability For infiltration assume: gravel (0), sand (0.3), loam (0.6) and pavement or clay (1). Multiply the infiltration factor with precipitation factor to obtain rainfall run off score.	Selected Sources: Environment Canada web page linkwww.msc.ec.gc.ca Snow to rainfall conversion apply ratio of 15 (snow):1(water)
	Very Low (0 < rainfall run-off			
Score	0.4			
e. Flood potential 1 in 2 years 1 in 10 years 1 in 50 years Do Not Know		Site is not in a flood plain.	Review published data such as flood plain mapping or flood potential (e.g., spring or mountain run-off) and Conservation Authority records to evaluate flood potential of nearby water courses both up and down gradient. Rate zero if site not in flood plain.	
	1 in 50 years			
Score	0.2			
Potential surface water pathway total	4.1			
Allowed Potential score	4.1	Note: If a "known" score is provided, the "potential" score is disallowed.		
Surface water pathway total	**4.1**			
3. Surface Soils (potential for dust, dermal and ingestion exposure)				
A. Demonstrated concentrations of COPC in surface soils (top 1.5 m)				
COPCs measured in surface soils exceed the CCME soil quality guideline.	12		Collect all available information on quality of surface soils (i.e., top 1.5 metres) at the site. Evaluate available data against Canadian Soil Quality Guidelines. Select appropriate guidelines based on current (or proposed future) land use (i.e, agricultural, residential/parkland, commercial, or industrial), and soil texture if applicable (i.e., coarse or fine).	Selected References: CCME. 1999. Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health www.ccme.ca
Strongly suspected that soils exceed guidelines	9			
COPCs in surface soils does not exceed the CCME soil quality guideline or is not present (i.e., bedrock).	0			
	Go to Potential			
Score	---			
NOTE: If a score is assigned here for Demonstrated Concentrations in Surface Soils, then you can skip Part B (Potential for a surface soils migration pathway) and go to Section 4 (Vapour)				
B. Potential for a surface soils (top 1.5 m) migration pathway				
a. Are the soils in question covered? Exposed Vegetated Landscaped Paved Do Not Know		Area covered with grass.	Consult engineering or risk assessment reports for the site. Alternatively, review photographs or perform a site visit. Landscaped surface soils must include a minimum of 0.5 m of topsoil.	The possibility of contaminants in blowing snow have not been included in the revised NCS as it is difficult to assess what constitutes an unacceptable concentration and secondly, spills to snow or ice are most efficiently mitigated while freezing conditions remain.
	Vegetated			
Score	4			
b. For what proportion of the year does the site remain covered by snow? 0 to 10% of the year 10 to 30% of the year More than 30% of the year Do Not Know		Snow cover for approximately 4 months per year.	Consult climatic information for the site. The increments represent the full span from soils which are always wet or covered with snow (and therefore less likely to generate dust) to those soils which are predominantly dry and not covered by snow (and therefore are more likely to generate dust).	
	>30% of year			
Score	0			
Potential surface soil pathway total	4			
Allowed Potential score	4	**Note: If a "known" score is provided, the "potential" score is disallowed**		
Soil pathway total	**4**			

CCME National Classification System (2008)

(II) Migration Potential (Evaluation of contaminant migration pathways)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
4. Vapour				
A. Demonstrated COPCs in vapour.				
Vapour has been measured (indoor or outdoor) in concentrations exceeding risk based concentrations.	12		Consult previous investigations, including human health risk assessments, for reports of vapours detected.	
Strongly suspected (based on observations and/or modelling)	9			
Vapour has not been measured and volatile hydrocarbons have not been found in site soils or groundwater.	0			
	Go to Potential			
Score	---			
NOTE: If a score is assigned here for Demonstrated COPCs in Vapour, then you can skip Part B (Potential for COPCs in vapour) and go to Section 5 (Sediment)				
B. Potential for COPCs in vapour				
a. Relative Volatility based on Henry's Law Constant, H' (dimensionless) High (H' > 1.0E-1) Moderate (H' = 1.0E-1 to 1.0E-3) Low (H' < 1.0E-3) Not Volatile Do Not Know			Reference: US EPA Soil Screening Guidance (Part 5 - Table 36) *Provided in Attached Reference Materials*	If the Henry's Law Constant for a substance indicates that it is not volatile, and a score of zero is assigned here for relative volatility, then the other three questions in this section on Potential for COPCs will be automatically assigned scores of zero and you can skip to section 5.
	High			
Score	4			
b. What is the soil grain size? Fine Coarse Do Not Know		Grain Size Analysis by UMA 2003.	Review soil permeability data in engineering reports. The greater the permeability of soils, the greater the possible movement of vapours. Fine-grained soils are defined as those which contain greater than 50% by mass particles less than 75 µm mean diameter (D50 < 75 µm). Coarse-grained soils are defined as those which contain greater than 50% by mass particles greater than 75 µm mean diameter (D50 > 75 µm).	
	Coarse			
Score	4			
c. Is the depth to the source less than 10m? Yes No Do Not Know		Groundwater depth below site at approximately 4 m depth.	Review groundwater depths below grade for the site.	
	Yes			
Score	2			
d. Are there any preferential pathways? Yes No Do Not Know			Visit the site during dry summer conditions and/or review available photographs. Where bedrock is present, fractures would likely act as preferential pathways.	Preferential pathways refer to areas where vapour migration is more likely to occur because there is lower resistance to flow than in the surrounding materials. For example, underground conduits such as sewer and utility lines, drains, or septic systems may serv as preferential pathways. Features of the building itself that may also be preferential pathways include earthen floors, expansion joints, wall cracks, or foundation perforations for subsurface features such as utility pipes, sumps, and drains.
	Do Not Know			
Score	1			
Potential vapour pathway total	11			
Allowed Potential score	11	Note: If a "known" score is provided, the "potential" score is disallowed.		
Vapour pathway total	**11**			
5. Sediment Movement				
A. Demonstrated migration of sediments containing COPCs				
There is evidence to suggest that sediments originally deposited to the site (exceeding the CCME sediment quality guidelines) have migrated.	12		Review sediment assessment reports. Evidence of migration of contaminants in sediments must be reported by someone experienced in this area.	Usually not considered a significant concern in lakes/marine environments, but could be very important in rivers where transport downstream could be significant.
Strongly suspected (based on observations and/or modelling)	9			
Sediments have been contained and there is no indication that sediments will migrate in future. **or** Absence of sediment exposure pathway (i.e., within 5 km of the site there are no aquatic receiving environments, and therefore no sediments).	0	Absence of sediment exposure pathway.		
	0			
Score	0			
NOTE: If a score is assigned here for Demonstrated Migration of Sediments, then you can skip Part B (Potential for Sediment Migration) and go to Section 6 (Modifying Factors)				

CCME National Classification System (2008)

(II) Migration Potential (Evaluation of contaminant migration pathways)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
B. Potential for sediment migration				
a. Are the sediments having COPC exceedances capped with sediments having no exceedances ("clean sediments")?	Do Not Know		Review existing sediment assessments. If sediment coring has been completed, it may indicate that historically contaminated sediments have been covered over by newer "clean" sediments. Th assessment will require that cores collected demonstrate a low concentration near the top and higher concentration with sediment depth.	
Yes				
No				
Do Not Know	2			
b. For lakes and marine habitats, are the contaminated sediments in shallow water and therefore likely to be affected by tidal action, wave action or propeller wash?	Do Not Know		Review existing sediment assessments. If the sediments present at the site are in a river, select "no" for this question.	
Yes				
No				
Do Not Know	2			
c. For rivers, are the contaminated sediments in an area prone to sediment scouring?	Do Not Know		Review existing sediment assessments. It is important that the assessment is made under worst case flows (high yearly flows). Under high yearly flows, areas which are commonly depositional	
Yes				
No				
Do Not Know	2			
Potential sediment pathway total	6			
Allowed Potential score	---	Note: If a "known" score is provided, the "potential" score is disallowed.		
Sediment pathway total	**0**			
6. Modifying Factors				
Are there subsurface utility conduits in the area affected by contamination?	Yes		Consult existing engineering reports. Subsurface utilities can act as conduits for contaminant migration.	
Yes				
No				
Do Not Know				
Known	4			
Potential	0			

Migration Potential Total		
Raw "known" total	16	
Raw "potential" total	19.1	
Raw combined total	35.1	Note: If "Known" and "Potential" scores are provided, the checklist defaults to known. Therefore, the total "Potential" Score may not reflect the sum of the individual "Potential" scores.
Total (max 33)	**18.1**	

CCME National Classification System (2008)

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
1. Human				
A. Known exposure				
Documented adverse impact or high quantified exposure which has or will result in an adverse effect, injury or harm or impairment of the safety to humans as a result of the contaminated site. (Class 1 Site*)	22		*Where adverse effects on humans are documented, the site should be automatically designated as a Class 1 site (i.e., action required). There is no need to proceed through the NCS in this case. However, a scoring guideline (22) is provided in case a numerical score for the site is still desired (e.g., for comparison with other Class 1 sites). This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients >1 for noncarcinogenic chemicals and incremental cancer risks that exceed acceptable levels defined by the jurisdiction for carcinogenic chemicals (for most jurisdictions this is typically either $>10^{5}$ or $>10^{-6}$). Known impacts can also be evaluated based on blood testing (e.g. blood lead >10 ug/dL) or other health based testing. This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients of less than 0.2 for non-carcinogenic chemicals and incremental lifetime cancer risks for carcinogenic chemicals that are within acceptable levels as defined by the jurisdictio (for most jurisdictions this is less than either 10^{6} or 10^{-5}).	Known adverse impact includes domestic and traditional food sources. Adverse effects based on food chain transfer to humans and/or animals can be scored in this category. However, the weight of evidence must show a direct link of a contaminated food source/supply and subsequent ingestion/transfer to humans. Any associated adverse effects to the environment are scored separately later in this worksheet. Someone experienced must provide a thorough description of the sources researched to evaluate and determine the quantified exposure/impact (adverse effect) in the vicinity of the contaminated site. **Selected References:** Health Canada – Federal Contaminated Site Risk Assessment in Canada Parts 1 and 2 Guidance on Human Heath Screening Level Risk Assessments (www.hc-sc.gc.ca/ewh-semt/pubs/contamsite/index_e.html) United States Environmental Protection Agency, Integrated Risk Information System (IRIS) http://toxnet.nml.nih.gov
Same as above, but "Strongly Suspected" based on observations or indirect evidence.	10			
No quantified or suspected exposures/impacts in humans.	0			
	Go to Potential			
Score	---			
NOTE: If a score is assigned here for Known Exposure, then you can skip Part B (Potential for Human Exposure) and go to Section 2 (Human Exposure Modifying Factors)				
B. Potential for human exposure				
a) Land use (provides an indication of potential human exposure scenarios) Agricultural Residential / Parkland Commercial Industrial Do Not Know		Community located within Whiteshell Provincial Park.	Review zoning and land use maps over the distances indicated. If the proposed future land use is more "sensitive" than the current land use, evaluate this factor assuming the proposed future use is in place. Agricultural land use is defined as uses of land where the activities are related to the productive capability of the land or facility (e.g., greenhouse) and are agricultural in nature, or activities related to the feeding and housing of animals as livestock. Residential/Parkland land uses are defined as uses of land on which dwelling on a permanent, temporary, or seasonal basis is the activity (residential), as well as uses on which the activities are recreational in nature and require the natural or human designed capability of the land to sustain that activity (parkland). Commercial/Industrial land uses are defined as land on which the activities are related to the buying, selling, or trading of merchandise or services (commercial), as well as land uses which are related to the production, manufacture, or storage of materials (industrial).	This is the main "receptor" factor used in site scoring. A higher score implies a greater exposure and/or exposure of more sensitive human receptors (e.g., children).
	Res / Parkland			
Score	2			
b. Indicate the level of accessibility to the contaminated portion of the site (e.g., the potential for coming in contact with contamination) Limited barriers to prevent site access; contamination not covered Moderate access or no intervening barriers, contaminants are covered. Remote locations in which contaminants not covered. Controlled access or remote location and contaminants are covered Do Not Know		Contamination is covered by approximately 4 m of soil.	Review location and structures and contaminants at the site and determine if there are intervening barriers between the site and humans. A low rating should be assigned to a (covered) site surrounded by a fence or in a remote location, whereas a high score should be assigned to a site th has no cover, fence, natural barriers or buffer.	
	Mod. access, covered			
Score	1			
B. Potential for human exposure				
c) Potential for intake of contaminated soil, water, sediment or foods fo operable or potentially operable pathways, as identified in Worksheet II (Migration Potential). i) direct contact Is dermal contact with contaminated surface water, groundwater, sediments or soils anticipated? Yes No Do Not Know			If soils or potable groundwater are present exceeding their respective CCME guidelines, dermal contact is assumed. Exposure to surface water, non-potable groundwater or sediments exceeding their respective CCME guidelines will depend on the site. Select "Yes" if dermal exposure to surface water, non-potable groundwater or sediments is expected. For instance, dermal contact with sediments would not be expected in an active port. Only soils in the top 1.5 m are defined by CCME (2003) as surface soils. If contaminated soils are only located deeper than 1.5 m, direct contact with soils is not anticipated to be an operable contaminant exposure pathway.	Exposure via the skin is generally believed to be a minor exposure route. However for some organic contaminants, skin exposure can play a very important component of overall exposure. Dermal exposure can occur while swimming in contaminated waters, bathing with contaminated surface water/groundwater and digging in contaminated dirt, etc.
	No			
Score	0			
ii) inhalation (i.e., inhalation of dust, vapour) Vapour - Are there inhabitable buildings on the site within 30 m of soils or groundwater with volatile contamination as determined in Worksheet II (Migration Potential)? Yes No Do Not Know			If inhabitable buildings are on the site within 30 m of soils or groundwater exceeding their respective guidelines for volatile chemicals, there is a potential of risk to human health (Health Canada, 2004). Review site investigations for location of soil samples (having exceedances of volatile substances) relative to buildings. Refer to (II) Migration Potential worksheet, 4B.a) *Potential for COPCs in Vapour* for a definition of volatility.	Exposure via the lungs (inhalation) can be a very important exposure pathway. Inhalation can be via both particulates (dust) and gas (vapours). Vapours can be a problem where buildings have been built on former industrial sites or where volatile contaminants have migrated below buildings resulting in the potential for vapour intrusion. Assesses the potential for humans to be exposed to vapours originating from site soils. The closer the receptor is to a source of volatile chemicals in soil, the greater the potential of exposure. Also, coarser-grained soil will convey vapour much more efficiently in the soil than finer grained material such as clays and silts. General Notes; Someone experienced must provide a thorough description of the sources researched to determine the presence/absence of a vapour migration and/or dust generation in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including conta names, phone numbers, e-mail correspondence and/or reference maps/reports and other resource such as internet links. Selected References; Canadian Council of Ministers of the Environment (CCME). 2006. Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. PN 1332www.ccme.ca Golder, 2004. Soil Vapour Intrusion Guidance for Health Canada Screening Level Risk Assessment (SLRA) Submitted to Health Canada, Burnaby, BC
	Yes			
Score	3			
Dust - If there is contaminated surface soil (e.g. top 1.5 m) , indicat whether the soil is fine or coarse textured. If it is known that surfac soil is not contaminated, enter a score of zero. Fine Coarse Surface soil is not contaminated or absent (bedrock) Do Not Know Texture		The Keystone Resort buildings are located next to the contaminated site.	Consult grain size data for the site. If soils (containing exceedances of the CCME soil quality guidelines) predominantly consist of fine material (having a median grain size of 75 microns; as defined by CCME (2006)) then these soils are more likely to generate dusts.	
	Not contaminated			
Score	0			
inhalation total	3			

CCME National Classification System (2008)

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
B. Potential for human exposure				
iii) Ingestion (i.e., ingestion of food items, water and soils [for children]), including traditional foods.			Review available site data to determine if drinking water (groundwater, surface water, private, commercial or municipal supply) is known or suspected to be contaminated above Guidelines for Canadian Drinking Water Quality. If drinking water supply is known to be contaminated, some immediate action (e.g., provision of alternate drinking water supply) should be initiated to reduce or eliminate exposure. The evaluation of significant potential for exceedances of the water supply in the future may be based on the capture zones of the drinking water wells; contaminant travel times; computer modelling of flow and contaminant transport.	**Selected References:** Guidelines for Canadian Drinking Water Qualitywww.hc-sc.gc.ca/hecs-sesc/water/publications/drinking_water_quality_guidelines/toc.htm Drinking water can be an extremely important exposure pathway to humans. If site groundwater or surface water is not used for drinking, then this pathway is considered to be inoperable. Consider both wild foods such as salmon, venison, caribou, as well as agricultural sources of food items if the contaminated site is on or adjacent to agricultural land uses.
Drinking Water: Choose a score based on the proximity to a drinking water supply, to indicate the potential for contamination (present or future).				
0 to 100 m 100 to 300 m 300 m to 1 km 1 to 5 km No drinking water present Do Not Know	100 to 300 m	The current community well field is located approximately 300 m from the contaminated site.		
Score	2.5			
Is an alternative water supply readily available?				
Yes No Do Not Know	Yes	Water from West Hawk Lake could serve as an alternative water supply.		
Score	0			
Is human ingestion of contaminated soils possible?			If contaminated soils are located within the top 1.5 m, it is assumed that ingestion of soils is an operable exposure pathway. Exposure to soils deeper than 1.5 m is possible, but less likely, and the duration is shorter. Refer to human health risk assessment reports for the site in question.	
Yes No Do Not Know	No	No contaminated soils were detected with the top 1.5 m of soil (UMA 2003), although testing was limited.		
Score	0			
Are food items consumed by people, such as plants, domestic animals or wildlife harvested from the contaminated land and its surroundings?			Use human health risk assessment reports (or others) to determine if there is significant reliance on traditional food sources associated with the site. Is the food item in question going to spend a large proportion of its time at the site (e.g., large mammals may spend a very small amount of time at a small contaminated site)? Human health risk assessment reports for the site in question will also provide information on potential bioaccumulation of the COPC in question.	
Yes No Do Not Know	No			
Score	0			
Ingestion total	2.5	Contaminated site is small and large animals would spend a very small amount of time on the site		
Human Health Total "Potential" Score	8.5	Note if a "Known" Human Health score is provided, the "Potential" score is disallowed.		
Allowed "Potential" Score	8.5			
2. Human Exposure Modifying Factors				
a) Strong reliance of local people on natural resources for survival (i.e., food, water, shelter, etc.)	No			
Yes No Do Not Know				
Known	0			
Potential	---			
Raw Human "known" total	0			
Raw Human "potential" total	8.5			
Raw Human Exposure Total Score	8.5			
Human Health Total (max 22)	**8.5**			
3. Ecological				
A. Known exposure				
Documented adverse impact or high quantified exposure which has or will result in an adverse effect, injury or harm or impairment of the safety to terrestrial or aquatic organisms as a result of the contaminate site.	18		Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are deemed to be severe, the s may be categorized as class one (i.e., a priority for remediation or risk management), regardless of the numerical total NCS score. For the purpose of application of the NCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction. If ecological effects are determined to be severe and an automatic Class 1 is assigned, there is no need to proceed through the NCS. However, a scoring guideline (18) is provided in case a numerical score for the site is still desired (e.g., for comparison with other Class sites). This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients >1. Alternatively, known impacts can also be evaluated based on a weight of evidence assessment involving a combination of site observations, tissue testing, toxicity testing and quantitative community assessments. Scoring of adverse effects on individual rare or endangered species will be completed on a case-by-case basis with full scientific justification.	CCME, 1999: Canadian Water Quality Guidelines for the Protection of Aquatic Lifewww.ccme.ca CCME, 1999: Canadian Water Quality Guidelines for the Protection of Agricultural Water Useswww.ccme.ca Sensitive receptors- review: Canadian Council on Ecological Areaswww.ccea.org. Ecological effects should be evaluated at a population or community level, as opposed to at the level of individuals. For example, population-level effects could include reduced reproduction, growth or survival in a species. Community-level effects could include reduced species diversity or relative abundances. Further discussion of ecological assessment endpoints is provided in*A Framework for Ecological Risk Assessment: General Guidance* (CCME 1996). Notes: Someone experienced must provide a thorough description of the sources researched to classify the environmental receptors in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resource such as internet links.
Same as above, but "Strongly Suspected" based on observations or indirect evidence.	12			
No quantified or suspected exposures/impacts in terrestrial or aquatic organisms	0		This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients of less than 1 and no other observable or measurable sign of impacts. Alternatively, it can be based on a combination of other lines of evidence showing no adverse effects, such as site observations, tissue testing, toxicity testing and quantitative community assessments.	
	Go to Potential			
Score	---			
NOTE: If a score is assigned here for Known Exposure, then you can skip Part B (Potential for Ecological Exposure) and go to Section 4 (Ecological Exposure Modifying Factors)				

CCME National Classification System (2008)

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
B. Potential for ecological exposure (for the contaminated portion of the site)				
a) Terrestrial			Review zoning and land use maps. If the proposed future land use is more "sensitive" than the current land use, evaluate this factor assuming the proposed future use is in place (indicate in the worksheet that future land use is the consideration). Agricultural land use is defined as uses of land where the activities are related to the productive capability of the land or facility (e.g., greenhouse) and are agricultural in nature, or activities related to the feeding and housing of animals as livestock. Wild lands are grouped with agricultural land due to the similarities in receptors that would be expected to occur there (e.g., herbivorous mammals and birds) and the similar need for a high level of protection to ensure ecological functioning. Residential/Parkland land uses are defined as uses of land on which dwelling on a permanent, temporary, or seasonal basis is the activity (residential), as well as uses on which the activities are recreational in nature and require the natural or human designed capability of the land to sustain that activity (parkland). Commercial/Industrial land uses are defined as land on which the activities are related to the buying, selling, or trading of merchandise or services (commercial), as well as land uses which are related to the production, manufacture, or storage of materials (industrial).	
i) Land use				
Agricultural (or Wild lands) Residential/Parkland Commercial Industrial Do Not Know	Residential/Parkland			
Score	2			
ii) Uptake potential				
Direct Contact - Are plants and/or soil invertebrates likely exposed to contaminated soils at the site?	Do Not Know	Soil sampling by UMA 2003 did not show contamination of soil in top 1.5 m, but testing was limited.	If contaminated soils are located within the top 1.5 m, it is assumed that direct contact of soils with plants and soil invertebrates is an operable exposure pathway. Exposure to soils deeper than 1.5 m possible, but less likely.	
Yes No Do Not Know				
Score	0.5			
iii) Ingestion (i.e., wildlife or domestic animals ingesting contaminated food items, soils or water)				
Are terrestrial animals likely to be ingesting contaminated water at the site?			Refer to an Ecological Risk Assessment for the site. If there is contaminated surface water at the site, assume that terrestrial organisms will ingest it.	
Yes No Do Not Know	No			
Score	0			
Are terrestrial animals likely to be ingesting contaminated soils at the site?			Refer to an Ecological Risk Assessment report. Most animals will co-ingest some soil while eating plant matter or soil invertebrates.	
Yes No Do Not Know	Do Not Know			
Score	0.5			
Can the contamination identified bioaccumulate?			Bioaccumulation of contaminants within food items is considered possible if: 1) The Log(Kow) of the contaminant is greater than 4 (as per the chemical characteristics work sheet) and concentrations in soils exceed the most conservative CCME soil quality guideline for the intended land use, or 2) The contaminant in collected tissue samples exceeds the Canadian Tissue Residue Guidelines.	
Yes No Do Not Know	No			
Score	0			
Distance to sensitive terrestrial ecological area			It is considered that within 300 m of a site, there is a concern for contamination. Therefore an environmental receptor located within this area of the site will be subject to further evaluations. It is also considered that any environmental receptor located greater than 5 km will not be a concern for evaluation. Review Conservation Authority mapping and literature including Canadian Council on Ecological Areas link:www.ccea.org.	Environmental receptors include: local, regional or provincial species of interest or significance; arctic environments (on a site specific basis); nature preserves, habitats for species at risk, sensitive forests, natural parks or forests.
0 to 300 m 300 m to 1 km 1 to 5 km > 5 km Do Not Know		Contaminated site located within Whiteshell Provincial Park.		
	0 to 300 m			
Score	3			
Raw Terrestrial Total Potential	6	Note if a "Known" Ecological Effects score is provided, the "Potential" score is disallowed.		
Allowed Terrestrial Total Potential	6			
B. Potential for ecological exposure (for the contaminated portion of the site)				
b) Aquatic			"Sensitive aquatic environments" include those in or adjacent to shellfish or fish harvesting areas, marine parks, ecological reserves and fish migration paths. Also includes those areas deemed to have ecological significance such as for fish food resources, spawning areas or having rare or endangered species. "Typical aquatic environments" include those in areas other than those listed above.	
i) Classification of aquatic environment				
Sensitive Typical Not Applicable (no aquatic environment present) Do Not Know	Not Applicable (no aquatic environ			
Score	0			
ii) Uptake potential				
Does groundwater daylighting to an aquatic environment exceed the CCME water quality guidelines for the protection of aquatic life at the point of contact?			Groundwater concentrations of contaminants at the point of contact with an aquatic receiving environment can be estimated in three ways: 1) by comparing collected nearshore groundwater concentrations to the CCME water quality guidelines (this will be a conservative comparison, as contaminant concentrations in groundwater often decrease between nearshore wells and the point of discharge). 2) by conducting groundwater modeling to estimate the concentration of groundwater immediately before discharge. 3) by installing water samplers, "peepers", in the sediments in the area of daylighting groundwater.	
Yes No (or Not Applicable) Do Not Know	No			
Score	0			
Distance from the contaminated site to an important surface water resource				Environmental receptors include: local, regional or provincial species of interest or significance, sensitive wetlands and fens and other aquatic environments
0 to 300 m 300 m to 1 km 1 to 5 km > 5 km Do Not Know		West Hawk Lake located approximately 500 m from contaminated site.	It is considered that within 300 m of a site, there is a concern for contamination. Therefore an environmental receptor or important water resource located within this area of the site will be subject to further evaluation. It is also considered that any environmental receptor located greater than 5 km away will not be a concern for evaluation. Review Conservation Authority mapping and literature including Canadian Council on Ecological Areas link:www.ccea.org.	
	300 m to 1 km			
Score	2			
			Bioaccumulation of food items is possible if:	

CCME National Classification System (2008)

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
Are aquatic species (i.e., forage fish, invertebrates or plants) that are consumed by predatory fish or wildlife consumers, such as mammals and birds, likely to accumulate contaminants in their tissues?			1) The Log(Kow) of the contaminant is greater than 4 (as per the chemical characteristics work sheet) and concentrations in sediments exceed the CCME ISQGs. 2) The contaminant in collected tissue samples exceeds the CCME tissue quality guidelines.	
Yes				
No				
Do Not Know	No			
Score	0			
Raw Aquatic Total Potential	2	Note if a "Known" Ecological Effects score is provided, the "Potential" score is disallowed.		
Allowed Aquatic Total Potential	2			
4. Ecological Exposure Modifying Factors				
a) Known occurrence of a species at risk.			Consult any ecological risk assessment reports. If information is not present, utilize on-line databas such as Eco Explorer. Regional, Provincial (Environment Ministries), or Federal staff (Fisheries and Oceans or Environment Canada) should be able to provide some guidance.	Species at risk include those that are extirpated, endangered, threatened, or of special concern. For a list of species at risk, consult Schedule 1 of the federal Species at Risk Act (http://www.sararegistry.gc.ca/species/schedules_e.cfm?id=1). Many provincial governments may also provide regionally applicable lists of species at risk. For example, in British Columbia, consult: BCMWLAP. 2005. Endangered Species and Ecosystems in British Columbia. Provincial red and blue lists. Ministry of Sustainable Resource Management and Water, Land and Air Protectionhttp://srmwww.gov.bc.ca/atrisk/red-blue.htm
Is there a potential for a species at risk to be present at the site?				
Yes				
No				
Do Not Know	Do Not Know			

Score	1			
b) Potential impact of aesthetics (e.g., enrichment of a lake or tainting of food flavor).				
Is there evidence of aesthetic impact to receiving water bodies?	No	Documentation does not exist on the potential impact of aesthetics, but it is thought highly unlikely as the contaminant does not appear to be migrating and the proximity to a surface water reciever is approximately 500 m from the site.	Documentation may consist of environmental investigation reports, press articles, petitions or other records.	This Item will require some level of documentation by user, including contact names, addresses, phone numbers, e-m addresses. Evidence of changes must be documented, please attach copy of report containing relevant information.
Yes				
No	0			
Do Not Know	---			
Is there evidence of olfactory impact (i.e., unpleasant smell)?	No		Examples of olfactory change can include the smell of a COPC or an increase in the rate of decay in an aquatic habitat.	
Yes				
No	0			
Do Not Know	---			
Is there evidence of increase in plant growth in the lake or water body?	No		A distinct increase of plant growth in an aquatic environment may suggest enrichment. Nutrients e.g nitrogen or phosphorous releases to an aquatic body can act as a fertilizer.	
Yes				
No	0			
Do Not Know	---			
Is there evidence that fish or meat taken from or adjacent to the site smells or tastes different?	No		Some contaminants can result in a distinctive change in the way food gathered from the site tastes smells.	
Yes	0			
No	---			
Do Not Know				
Ecological Modifying Factors Total - Knowr	**0**			
Ecological Modifying Factors Total - Potentia	**1**			
Raw Ecological Total - Known	0			
Raw Ecological Total - Potential	9			
Raw Ecological Total	9			
Ecological Total (Max 18)	**9.0**			
5. Other Potential Contaminant Receptors				
a) Exposure of permafrost (leading to erosion and structural concerns)				Plants and lichens provide a natural insulating layer which will help prevent thawing of the permafrost during the summer. Plants and lichens may also absorb less solar radiation. Solar radiation is turned into heat which can also cause underlying permafrost to melt.
Are there improvements (roads, buildings) at the site dependant upon the permafrost for structural integrity?	No		Consult engineering reports, site plans or air photos of the site. When permafrost melts, the stability of the soil decreases, leading to erosion. Human structures, such as roads and/or buildings are often dependent on the stability that the permafrost provides.	
Yes				
No	0			
Do Not Know	---			
Is there a physical pathway which can transport soils released by damaged permafrost to a nearby aquatic environment?	No		Melting permafrost leads to a decreased stability of underlying soils. Wind or surface run-off erosion can carry soils into nearby aquatic habitats. The increased soil loadings into a river can cause an increase in total dissolved solids and a resulting decrease in aquatic habitat quality. In addition, the erosion can bring contaminants from soils to aquatic environments.	
Yes				
No	0			
Do Not Know	---			
Other Potential Receptors Total - Known	**0**			
Other Potential Receptors Total - Potential	**0**			

Exposure Total		
Raw Human Health + Ecological Total - Known	0	
Raw Human Health + Ecological Total - Potential	17.5	Only includes "Allowed potential" - if a "Known" score was supplied under a given category then the "Potential" score was not included.
Raw Total	17.5	
Exposure Total (max 34)	**12.9**	

CCME National Classification System (2008)
Score Summary

Scores from individual worksheets are tallied in this worksheet.
Refer to this sheet after filling out the revised NCS completely.

I. Contaminant Characteristics	Known	Potential
1. Residency Media	4	---
2. Chemical Hazard	8	---
3. Contaminant Exceedance Factor	6	---
4. Contaminant Quantity	6	---
5. Modifying Factors	2	---
Raw Total Score	26	0
Raw Total Score (Known + Potential)	26	
Adjusted Total Score (Raw Total / 40 *33)	**21.5**	(max 33)

II. Migration Potential	Known	Potential
1. Groundwater Movement	12	---
2. Surface Water Movement	---	4.1
3. Soil	---	4
4. Vapour	---	11
5. Sediment Movement	0	---
6. Modifying Factors	4	0
Raw Total Score	16	19.1
Raw Total Score (Known + Potential)	35.1	
Adjusted Total Score (Raw Total / 64 * 33)	**18.1**	(max 33)

III. Exposure	Known	Potential
1. Human Receptors		
A. Known Impact	---	
B Potential		
a. Land Use		2
b. Accessibility		1
c. Exposure Route		
i. Direct Contact		0
ii. Inhalation		3
iii. Ingestion		2.5
2. Human Receptors Modifying Factors	0	---
Raw Total Human Score	0	8.5
Raw Total Human Score (Known + Potential)	8.5	
Adjusted Total Human Score	8.5	(maximum 22)
3. Ecological Receptors		
A. Known Impact	---	
B. Potential		
a. Terrestrial		6
b. Aquatic		2
4. Ecological Receptors Modifying Factors	0	1
Raw Total Ecological Score	0	9
Raw Total Ecological Score (Known + Potential)	9	
Adjusted Total Ecological Score	9.0	(maximum 18)
5. Other Receptors	0	0
Total Other Receptors Score (Known + Potential)	0	
Total Exposure Score (Human + Ecological + Other)	**17.5**	
Adjusted Total Exposure Score (Total Exposure / 46 * 34)	**12.9**	(max 34)

Site Score

Test Site

Site Letter Grade	**C**
Certainty Percentage	**69%**
% Responses that are "Do Not Know"	**7%**
Total NCSCS Score for site	**52.5**
Site Classification Category	**2**

Site Classification Categories*:

Class 1 - High Priority for Action (Total NCS Score >70)
Class 2 - Medium Priority for Action (Total NCS Score 50 - 69.9)
Class 3 - Low Priority for Action (Total NCS Score 37 - 49.9)
Class N - Not a Priority for Action (Total NCS Score <37)
Class INS - Insufficient Information (>15% of responses are "Do Not Know")

* NOTE: The term "action" in the above categories does not necessarily refer to remediation, but could also include risk assessment, risk management or further site characterization and data collection.

APPENDIX E

PHOTOGRAPHS

SITE PHOTOGRAPHIC LOG – Former Water Supply System
West Hawk Lake Water Supply System
West Hawk Lake, Manitoba

Photo 1. North-west view of former pumphouse and well field.

Photo 2. South-west view of former pumphouse and well field.

Photo 3. South view of former pumphouse and well field.

Photo 4. South-east view of former pumphouse and well field.

Photo 5. North-east view of former pumphouse and well field.

Photo 6. East view of former supply wells Well 1, Well 2, and Well 3.

SITE PHOTOGRAPHIC LOG – Former Water Supply System
West Hawk Lake Water Supply System
West Hawk Lake, Manitoba

Photo 7. Adjacent property to the north of the subject property (Keystone Resort).

Photo 8. Pumphouse and adjacent property to the north (Keystone Resort).

Photo 9. Community drinking water tap next to the former pumphouse.

Photo 10. Parking area located south-east of former pumphouse.

Photo 11. Recycling and waste collection area south-east of the former pumphouse.

Photo 12. South view of borrow pit area.

SITE PHOTOGRAPHIC LOG – Former Water Supply System
West Hawk Lake Water Supply System
West Hawk Lake, Manitoba

Photo 13. North-west view of borrow pit area.

Photo 14. Entrance to Manitoba Conservation maintenance yard.

Photo 15. South view of fuelling area.

Photo 16. South view of workshop 2.

Photo 17. North view of monitoring wells WH-7A and WH-7B.

Photo 18. West view of heli-pad.

SITE PHOTOGRAPHIC LOG – Current Water Supply System
West Hawk Lake Water Supply System
West Hawk Lake, Manitoba

Photo 1. West view of the current pumphouse and supply well PW-1A.

Photo 2. South view of pumphouse and well field.

Photo 3. North view of supply well PW-4 and current pumphouse.

Photo 4. East view of supply well PW-5 and pumphouse.

Photo 5. West view of supply well PW-5 and trail into boggy area.

Photo 6. Supply well PW-2.

SITE PHOTOGRAPHIC LOG – Current Water Supply System
West Hawk Lake Water Supply System
West Hawk Lake, Manitoba

Photo 7. Supply well PW-4.

Photo 8. Supply well PW-3 located within pumphouse.

Photo 9. East view of monitoring well MW-1 and sewage lift station.

Photo 10. Monitoring well MW-2 located within pumphouse.

Photo 11. Sampling ports for all supply wells.

Photo 12. Control panel for all supply wells.

SITE PHOTOGRAPHIC LOG – Current Water Supply System
West Hawk Lake Water Supply System
West Hawk Lake, Manitoba

Photo 13. Chlorine injection system.

Photo 14. Flow meter monitoring flow into pumphouse.

Photo 15. Storage tanks located within the pumphouse.

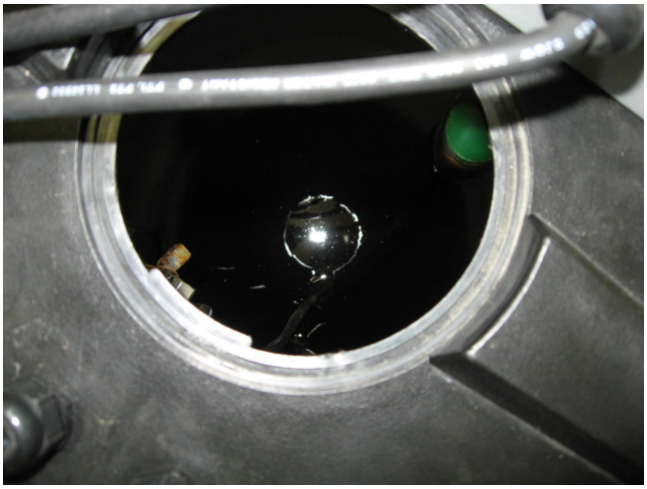


Photo 16. Water in storage tank with dark staining on sides of tank.

Photo 17. Community supply pumps located within pumphouse.

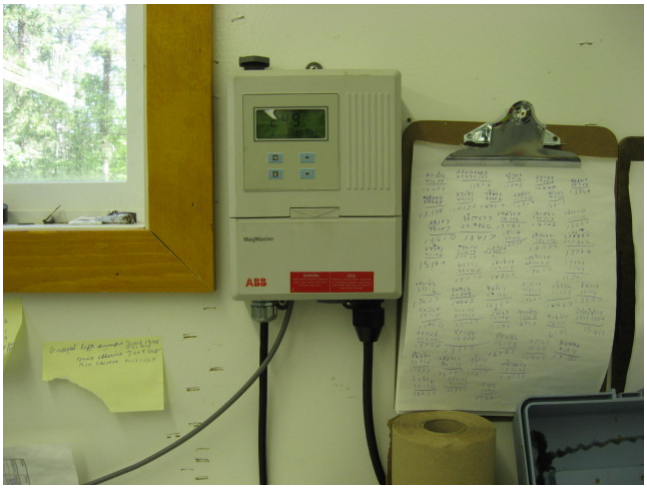


Photo 18. Flow meter monitoring flow out of pumphouse.

SITE PHOTOGRAPHIC LOG – Current Water Supply System
West Hawk Lake Water Supply System
West Hawk Lake, Manitoba

Photo 19. East view of bike path located near entrance to seasonal camping area.

Photo 20. Entrance to seasonal camping area.

APPENDIX F

LABORATORY REPORTS
KGS GROUP 2008 SAMPLING

Analysis Report

CANTEST

REPORT ON: Analysis of Water Sample

REPORTED TO: KGS Group-Environmental Remediation Program
3rd Floor
865 Waverley Street
Winnipeg, MB
R3T 5P4

08-1521-02

Att'n: Loni Stewart

CHAIN OF CUSTODY: 43396 mb, 43397 Mb, 43397 Mb
PROJECT NAME: West Hawk Lake

NUMBER OF SAMPLES: 12

REPORT DATE: August 11, 2008

DATE SUBMITTED: August 1, 2008

GROUP NUMBER: 90801062

SAMPLE TYPE: Water

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHODS:

Volatile Organic Compounds in Water and Soil - analysis was performed using procedures based on U.S. EPA Methods 624/8240/8260, involving sparging with a Purge and Trap apparatus and analysis using GC/MS.

Volatile Hydrocarbons (VH) and Volatile Petroleum Hydrocarbons (VPH) in Water - analysis was performed using B.C. MOELP CSR-Analytical Method 2 "Volatile Hydrocarbons in Water by GC/FID" and CSR-Analytical Method 5 "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water (VPH)" approved August 12, 1999. The method involves sparging/collection using a Purge & Trap apparatus with GC/MS analysis; VH components ranging from C6 to C10 are quantified against m-xylene and 1,2,4-trimethylbenzene. VPH is calculated by subtraction of specified MAH compounds from VH concentrations.

Petroleum Hydrocarbons (C10-16 and C16-C34) in Water - analysis was performed by extraction, silica gel clean-up and analysis by Gas Chromatography with flame ionization detection (GC/FID).

Petroleum Hydrocarbons (C34-50) in Water - analysis was performed by extraction, silica gel clean-up and analysis by Gas Chromatography with flame ionization detection (GC/FID).

TEST RESULTS:

(See following pages)

CANTEST LTD.

Zhenyong Gao, M.Sc.
Coordinator, Trace Organics

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801062

CANTEST

Monocyclic Aromatic Hydrocarbons in Water

CLIENT SAMPLE IDENTIFICATION:	WH16	WH3	wH27	WH12	
DATE SAMPLED:	Jul 31/08	Jul 31/08	Jul 31/08	Jul 31/08	
CANTEST ID:	808010188	808010192	808010194	808010195	DETECTION LIMIT
ANALYSIS DATE:	Aug 1/08	Aug 1/08	Aug 1/08	Aug 1/08	
Benzene	8.4	10	2500	<	0.1
Ethylbenzene	100	37	1200	<	0.1
Toluene	220	260	22000	<	0.1
Xylenes	850	330	8000	<	0.1
Volatile Hydrocarbons VHw6-10	2100	1800	34000	<	100
VPHw	920	1200	300	<	100
Styrene	< 0.5	< 1	< 40	<	0.1
Surrogate Recovery					
Toluene-d8	104	102	96	97	-
Bromofluorobenzene	96	94	93	92	-

Results expressed as micrograms per liter (μg/L)
Surrogate recoveries expressed as percent (%)
< = Less than detection limit

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801062

CANTEST

Monocyclic Aromatic Hydrocarbons in Water

CLIENT SAMPLE IDENTIFICATION:	WH22	wH15	WH11	WH7B	
DATE SAMPLED:	Jul 31/08	Jul 31/08	Jul 31/08	Jul 31/08	
CANTEST ID:	808010196	808010197	808010199	808010200	
ANALYSIS DATE:	Aug 1/08	Aug 1/08	Aug 1/08	Aug 1/08	DETECTION LIMIT
Benzene	<	67	<	<	0.1
Ethylbenzene	<	45	<	<	0.1
Toluene	<	500	<	<	0.1
Xylenes	<	290	<	<	0.1
Volatile Hydrocarbons VHw6-10	<	900	<	<	100
VPHw	<	<	<	<	100
Styrene	<	< 2	<	<	0.1
Surrogate Recovery					
Toluene-d8	97	99	97	96	-
Bromofluorobenzene	91	93	92	87	-

Results expressed as micrograms per liter (μg/L)
Surrogate recoveries expressed as percent (%)
< = Less than detection limit

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801062

CANTEST

Monocyclic Aromatic Hydrocarbons in Water

CLIENT SAMPLE IDENTIFICATION:	WH100 Dup WH-03	WH101 Dup WH-22	Feild Blank	Trip Blank	
DATE SAMPLED:	Jul 31/08	Jul 31/08	Jul 31/08	Jul 31/08	
CANTEST ID:	808010201	808010202	808010209	808010211	
ANALYSIS DATE:	Aug 1/08	Aug 1/08	Aug 1/08	Aug 1/08	DETECTION LIMIT
Benzene	4.5	<	<	<	0.1
Ethylbenzene	17	<	<	<	0.1
Toluene	100	<	<	<	0.1
Xylenes	150	<	<	<	0.1
Volatile Hydrocarbons VHw6-10	1100	<	-	-	100
VPHw	830	<	-	-	100
Styrene	< 0.5	<	-	-	0.1
Surrogate Recovery					
Toluene-d8	104	99	96	103	-
Bromofluorobenzene	89	90	92	96	-

Results expressed as micrograms per liter (µg/L)
Surrogate recoveries expressed as percent (%)
< = Less than detection limit

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801062

CANTEST

Extractable Petroleum Hydrocarbons - Silica-gel Cleanup in Water

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Petroleum Hydrocarbons C10-16	Petroleum Hydrocarbons C16-34	Petroleum Hydrocarbons C34-50
WH16	Jul 31/08	808010188	110	<	<
WH3	Jul 31/08	808010192	3400	<	<
wH27	Jul 31/08	808010194	490	<	<
WH12	Jul 31/08	808010195	<	<	<
WH22	Jul 31/08	808010196	<	<	<
wH15	Jul 31/08	808010197	<	<	<
WH11	Jul 31/08	808010199	<	<	<
WH7B	Jul 31/08	808010200	<	<	<
WH100	Jul 31/08	808010201	1700	<	<
WH101	Jul 31/08	808010202	<	<	<
DETECTION LIMIT			100	250	250
UNITS			µg/L	µg/L	µg/L

µg/L = micrograms per liter
< = Less than detection limit

CHAIN OF CUSTODY RECORD

CANTEST

43396 **MB**

Unit D
675 Berry Street
Winnipeg, Manitoba
R3H 1A7

Tel: 204 772 7276
Fax: 204 772 2386

www.cantest.com

Client Name:* KGS Group | Postal Code* R3T 5P4

Street Address (including suite number):* 3rd Floor 865 Waverley St. | City: Winnipeg

Telephone:* 866-1200, 204-918-1964 | Fax: — | E-Mail Address (Required for "AutoEmail" Reports): LStewart@kgsgroup.com

Contact Name:* Kenton Thiessen | Sampler's Name: Kenton Thiessen

Project Name: West Hawk Lake | Project Number: 08-1521-02 | Quotation Number: | P.O. Number

Page 1 of 2

RESULTS REQUESTED BY:* Day / Month / Year

(Surcharges May Apply)

Special Instructions: ☐ AutoFax ☒ AutoEmail

☐ Return Cooler ☐ Ship Containers (please specify)

☐ Apply Drinking Water Limits

~~5 SWR~~ ~~4 SWR~~ ~~6 SWR 6 coolers~~ CX12 1AGS X24 VOCV KGS200

Sample Identification*	Date/Time Sampled	Sample Type (Matrix)
9080162		
8080101 88 WH16	Date: July 31/08 Time: 19:00	GW
080192 WH3	Date: July 31/08 Time: 19:20	"
0194 WH27	Date: " Time: 19:44	"
0195 WH12	Date: " Time: 20:50	"
0196 WH22	Date: " Time: 20:30	"
0197 WH15	Date: " Time: 20:00	"
0199 WH11	Date: " Time: 20:15	"
0200 WH73	Date: " Time: 21:20	"
0201 WH100	Date: " Time: 20:15	"
0202 WH101	Date: " Time: 19:30	"

CCME Metals - Water Type (see reverse): T D FF E
CCME Metals - Soil
pH
Conductivity
TSS TDS TS
Alkalinity (total / spec.)
Biological Oxygen Demand
Chemical Oxygen Demand
Ammonia TKN
Nitrate and Nitrite
F Cl SO_4 NO_3
BETX
VOC
PAH
#1 PAHs ERH

HOLD - DO NOT ANALYZE
Number of Containers

Does this source supply multiple households? ☐ Yes ☐ No
Is this a Public water supply source? ☐ Yes ☐ No

Drinking Water Sample? ☐ Yes

Relinquished by:	Date	Time	Received by:
Kenton Thiessen	Aug 1/08		
Relinquished by:	Date	Time	Received by:

* = *Required Field*

Total Number of Containers:

Method of Shipment:	Waybill No.:	Received for Lab by:	Date	Time
Client	n/a		Aug 1/08	14:20
Shipped by:	Shipment Condition:	Cooler opened by:	Date	Time
Client	acceptable			

Please send a copy of the: ☐ Report (by Mail) ☐ Report (by Fax) ☐ Results (by E-mail) ☐ Invoice (by Mail)

Company Name:

Address: Postal Code:

Contact: E-Mail:

Phone: Fax:

FOR LABORATORY USE ONLY

Sample State at Receipt: ☐ Ambient ☑ Cold ☐ Frozen ☐ N/A Comments:

Temperature 1.6 °C Custody Seal Intact? ☐ Yes ☐ No ☐ n/a Number of Coolers/Shipping Containers: 1

WHITE: FOLLOWS REPORT YELLOW: LAB COPY PINK: CLIENT COPY/GENERAL INFORMATION

CHAIN OF CUSTODY RECORD

CANTEST

43397 **MB**

Unit D
675 Berry Street
Winnipeg, Manitoba
R3H 1A7

Tel: 204 772 7276
Fax: 204 772 2386

www.cantest.com

Client Name:* KGS Group | Postal Code* R3T 5P4

Street Address (including suite number):* 3rd Floor - 865 Waverley St. | City: Winnipeg

Telephone:* 204-918-1964 | Fax: - | E-Mail Address (Required for "AutoEmail" Reports):* LStewart@kgsgroup.com

Contact Name:* Kenton Thiessen | Sampler's Name: Kenton Thiessen

Project Name: West Hawk Lake | Project Number: 08-1521-0002 | Quotation Number: | P.O. Number

Page 2 of 2

RESULTS REQUESTED BY:*

Day / Month / Year

(Surcharges May Apply)

Special Instructions: ☐ AutoFax ☒ AutoEmail

☐ Return Cooler ☐ Ship Containers (please specify)

☐ Apply Drinking Water Limits

	Sample Identification*	Date/Time Sampled	Sample Type (Matrix)
808010209	Field Blank	Date: Jul 31/08 Time: 19:00	GW
0211	Trip Blank	Date: Jul 31/08 Time: 21:30	"
		Date: Time:	
		Date: Time:	
		Date: Time:	
		Date: Time:	
		Date: Time:	
		Date: Time:	
		Date: Time:	
		Date: Time:	

CCME Metals - Water Type (see reverse): T D FF E | CCME Metals - Soil | pH | Conductivity | TSS TDS TS | Alkalinity (total / spec.) | Biological Oxygen Demand | Chemical Oxygen Demand | Ammonia TKN | Nitrate and Nitrite | F Cl SO_4 NO_3 | BETX | VOC | PAH | @ BTX-TB | @ BTEX-W | | | | | | | HOLD - DO NOT ANALYZE | Number of Containers

															X							2	2
														X	X							2	2

Drinking Water Sample? ☐ Yes

Does this source supply multiple households? ☐ Yes ☐ No

Is this a Public water supply source? ☐ Yes ☐ No

Relinquished by: Kenton Thi	Date Aug 1/08	Time	Received by:
Relinquished by:	Date	Time	Received by:

* = Required Field

Total Number of Containers:

Method of Shipment: client	Waybill No.: n/a	Received for Lab by:	Date Aug 1/08	Time 14:20
Shipped by: client	Shipment Condition: acceptable	Cooler opened by:	Date	Time

Please send a copy of the: ☐ Report (by Mail) ☐ Report (by Fax) ☐ Results (by E-mail) ☐ Invoice (by Mail)

Company Name:

Address: Postal Code:

Contact: E-Mail:

Phone: Fax:

FOR LABORATORY USE ONLY

Sample State at Receipt: ☐ Ambient ☑ Cold ☐ Frozen ☐ N/A Comments:

Temperature 5.0 °C Custody Seal Intact? ☐ Yes ☐ No ☐ n/a Number of Coolers/Shipping Containers: 1

WHITE: FOLLOWS REPORT YELLOW: LAB COPY PINK: CLIENT COPY/GENERAL INFORMATION

AUG 22 2008

CANTEST

Analysis Report

REPORT ON: Analysis of Water Samples

REPORTED TO: KGS Group-Environmental Remediation Program
3rd Floor
865 Waverley Street
Winnipeg, MB
R3T 5P4

Att'n: Loni Stewart

CHAIN OF CUSTODY: 43398 Mb
PROJECT NAME: West Hawk Lake

NUMBER OF SAMPLES: 6

REPORT DATE: August 11, 2008

DATE SUBMITTED: August 1, 2008

GROUP NUMBER: 90801064

SAMPLE TYPE: Water

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHODS:

Anions in Water by Ion Chromatography - was determined based on Method 4110 in Standard Methods (21st Edition) and EPA Method 300.0 (Revision 2.1).

Nitrate and Nitrite in Water - was performed using Flow Injection Analysis where Nitrate is reduced to nitrite by passing the sample through a cadmium reduction column. The nitrite produced is then determined by diazotizing sulphanilamide and N-(1-naphthyl)-ethylenediamine dihydrochloride to form a reddish azo dye which is then measured colorimetrically at 540 nm.

Total Dissolved Solids in Water - was determined based on Method 2540 C in Standard Methods for the Examination of Water and Wastewater (21st Edition).

Conventional Parameters - analyses were performed using procedures based on those described in the most current editions of "British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials", (2005 edition) Province of British Columbia and "Standard Methods for the Examination of Water and Wastewater" (21st Edition), published by the American Public Health Association.

Conventional Parameters - Winnipeg Laboratory (Unit D-675 Berry Street, Winnipeg, Manitoba R3H 1A7): - Analyses performed at Cantest's Winnipeg facilities follow procedures based on those described in the "British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials" (2005 Edition) and "Standard Methods for the Examination of Water and Wastewater" (21st Edition).

(Continued)

CANTEST LTD.

Anna Becalska, PhD
Trace Metals Coordinator

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801064

Mercury in Water - analysis was performed using procedures based on U. S. EPA Method 245.7, oxidative digestion using bromination, and analysis using Cold Vapour Atomic Fluorescence Spectroscopy.

Metals in Water - analysis was performed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP), Inductively Coupled Plasma-Mass Spectroscopy (ICP/MS).

Dissolved Metals in Water - Samples were filtered in the laboratory and quantitatively determined using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP) and/or Inductively Coupled Plasma-Mass Spectroscopy (ICP/MS).

Microbiological Parameters - analyses were performed using procedures based on those described in "B. C. Environmental Laboratory Manual For the Analysis of Water, Wastewater, Sediment and Biological Materials" (2005 Edition), "Standard Methods for the Examination of Water and Wastewater", (21st Edition) and Colilert Quanti-tray Standard Operating Procedure. Results are reported as Most Probable Number(MPN) per unit volume. Note: <1 MPN is equivalent to "Absent" Analysis was performed at CANTEST LTD Unit D 675 Berry Street Winnipeg, Manitoba R3H 1A7.

TEST RESULTS:

(See following pages)

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801064

CANTEST

Conventional Parameters in Water

CLIENT SAMPLE IDENTIFICATION:		PW1	PW2	PW3	PW4	
DATE SAMPLED:		Jul 31/08	Jul 31/08	Jul 31/08	Jul 31/08	DETECTION LIMIT
CANTEST ID:		808010191	808010203	808010205	808010206	
Hardness	CaCO3	-	-	-	192	1
Hardness	CaCO3	91.9	122	127	-	0.2
Total Dissolved Solids		382	301	240	255	10
Dissolved Fluoride	F	< 0.1	<	<	<	0.05
Dissolved Chloride	Cl	168	92.2	79.9	93.6	0.2
Nitrate and Nitrite	N	1.68	0.63	0.60	0.33	0.01
Nitrate	N	1.68	0.63	0.60	0.33	0.01
Dissolved Sulphate	SO4	13.6	9.95	27.2	15.5	0.5

Results expressed as milligrams per liter (mg/L)
< = Less than detection limit

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801064

CANTEST

Conventional Parameters in Water

CLIENT SAMPLE IDENTIFICATION:		PW5	WHL-SW	
DATE SAMPLED:		Jul 31/08	Aug 1/08	DETECTION LIMIT
CANTEST ID:		808010208	808010214	
Hardness	CaCO3	-	31	1
Hardness	CaCO3	115	-	0.2
Total Dissolved Solids		169	67	10
Dissolved Fluoride	F	<	<	0.05
Dissolved Chloride	Cl	16.0	7.08	0.2
Nitrate and Nitrite	N	<	0.09	0.01
Nitrate	N	<	-	0.01
Dissolved Sulphate	SO4	3.27	4.27	0.5

Results expressed as milligrams per liter (mg/L)
< = Less than detection limit

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801064

CANTEST

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		PW1	PW1	PW2	PW2		
SAMPLE PREPARATION:		TOTAL	DISSOLVED	TOTAL	DISSOLVED		
DATE SAMPLED:		Jul 31/08	Jul 31/08	Jul 31/08	Jul 31/08	DETECTION LIMIT	UNITS
CANTEST ID:		808010191	808010191	808010203	808010203		
Aluminum	Al	0.004	-	0.01	-	0.001	mg/L
Antimony	Sb	0.0005	-	0.0004	-	0.0002	mg/L
Arsenic	As	0.0003	-	0.0013	-	0.0002	mg/L
Barium	Ba	0.034	-	0.02	-	0.0002	mg/L
Boron	B	0.02	-	0.01	-	0.01	mg/L
Cadmium	Cd	<	-	<	-	0.00004	mg/L
Calcium	Ca	-	29.6	-	40.2	0.01	mg/L
Chromium	Cr	0.0002	-	0.0003	-	0.0002	mg/L
Copper	Cu	0.0046	-	0.009	-	0.0002	mg/L
Iron	Fe	<	<	0.04	0.02	0.01	mg/L
Lead	Pb	<	-	<	-	0.0002	mg/L
Magnesium	Mg	5.07	4.37	5.73	5.26	0.01	mg/L
Manganese	Mn	0.022	0.019	0.28	0.255	0.0002	mg/L
Mercury	Hg	<	-	<	-	0.02	µg/L
Potassium	K	-	1.92	-	1.71	0.02	mg/L
Selenium	Se	0.0006	-	0.0004	-	0.0002	mg/L
Silicon	Si	-	4.36	-	6.3	0.05	mg/L
Sodium	Na	-	74.9	-	34.7	0.01	mg/L
Uranium	U	0.0004	-	0.0015	-	0.0001	mg/L
Zinc	Zn	0.008	-	0.002	-	0.001	mg/L

mg/L = milligrams per liter
µg/L = micrograms per liter
< = Less than detection limit

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801064

CANTEST

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		PW3	PW3	PW4	PW4		
SAMPLE PREPARATION:		TOTAL	DISSOLVED	TOTAL	DISSOLVED		
DATE SAMPLED:		Jul 31/08	Jul 31/08	Jul 31/08	Jul 31/08		
CANTEST ID:		808010205	808010205	808010206	808010206	DETECTION LIMIT	UNITS
Aluminum	Al	0.01	-	0.003	-	0.001	mg/L
Antimony	Sb	0.0003	-	0.0003	-	0.0002	mg/L
Arsenic	As	0.0009	-	0.0005	-	0.0002	mg/L
Barium	Ba	0.032	-	0.022	-	0.0002	mg/L
Boron	B	0.04	-	0.02	-	0.01	mg/L
Cadmium	Cd	0.00005	-	<	-	0.00004	mg/L
Calcium	Ca	-	39.1	-	61.8	0.01	mg/L
Chromium	Cr	0.0002	-	<	-	0.0002	mg/L
Copper	Cu	0.0047	-	0.0032	-	0.0002	mg/L
Iron	Fe	0.27	0.17	0.01	<	0.01	mg/L
Lead	Pb	<	-	<	-	0.0002	mg/L
Magnesium	Mg	7.74	7.07	8.06	9.12	0.01	mg/L
Manganese	Mn	0.1	0.085	0.055	0.052	0.0002	mg/L
Mercury	Hg	<	-	<	-	0.02	µg/L
Potassium	K	-	1.88	-	2.24	0.02	mg/L
Selenium	Se	0.0005	-	0.0007	-	0.0002	mg/L
Silicon	Si	-	6.6	-	6.68	0.05	mg/L
Sodium	Na	-	14.1	-	12.8	0.01	mg/L
Uranium	U	0.0012	-	0.0021	-	0.0001	mg/L
Zinc	Zn	0.005	-	0.004	-	0.001	mg/L

mg/L = milligrams per liter
µg/L = micrograms per liter
< = Less than detection limit

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801064

CANTEST

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		PW5	PW5	WHL-SW		
SAMPLE PREPARATION:		TOTAL	DISSOLVED	TOTAL		
DATE SAMPLED:		Jul 31/08	Jul 31/08	Aug 1/08		
CANTEST ID:		808010208	808010208	808010214	DETECTION LIMIT	UNITS
Aluminum	Al	0.009	-	-	0.001	mg/L
Antimony	Sb	0.0004	-	-	0.0002	mg/L
Arsenic	As	0.0033	-	-	0.0002	mg/L
Barium	Ba	0.012	-	-	0.0002	mg/L
Boron	B	0.01	-	-	0.01	mg/L
Cadmium	Cd	<	-	-	0.00004	mg/L
Calcium	Ca	-	37.2	9.53	0.01	mg/L
Chromium	Cr	0.0002	-	-	0.0002	mg/L
Copper	Cu	0.0081	-	-	0.0002	mg/L
Iron	Fe	0.46	0.39	0.01	0.01	mg/L
Lead	Pb	<	-	-	0.0002	mg/L
Magnesium	Mg	5.88	5.43	1.37	0.01	mg/L
Manganese	Mn	0.325	0.303	0.0014	0.0002	mg/L
Mercury	Hg	<	-	-	0.02	µg/L
Potassium	K	-	1.78	1.09	0.02	mg/L
Selenium	Se	0.0005	-	-	0.0002	mg/L
Silicon	Si	-	7.45	-	0.05	mg/L
Sodium	Na	-	3.97	4.25	0.01	mg/L
Uranium	U	0.0025	-	-	0.0001	mg/L
Zinc	Zn	0.004	-	-	0.001	mg/L

mg/L = milligrams per liter
< = Less than detection limit

µg/L = micrograms per liter

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801064

CANTEST

Microbiological Analysis in Water

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Total Coliform	E. coli
PW1	Jul 31/08	808010191	<	<
PW2	Jul 31/08	808010203	<	<
PW3	Jul 31/08	808010205	<	<
PW4	Jul 31/08	808010206	<	<
PW5	Jul 31/08	808010208	<	<
WHL-SW	Aug 1/08	808010214	79	3
DETECTION LIMIT			1	1
UNITS			MPN/100mL	MPN/100mL

MPN/100mL = Most Probable Number / 100 mL
< = Less than detection limit

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801064

CANTEST

Conventional Parameters-Winnipeg Laboratory- in Water

CLIENT SAMPLE IDENTIFICATION:		PW1	PW2	PW3	PW4	DETECTION LIMIT	UNITS
DATE SAMPLED:		Jul 31/08	Jul 31/08	Jul 31/08	Jul 31/08		
CANTEST ID:		808010191	808010203	808010205	808010206		
pH, Laboratory		6.92	7.33	6.97	7.41	-	pH units
Conductivity		721	530	437	528	1	µS/cm
True Color		<	13	8	<	5	CU
Turbidity		<	0.1	0.3	<	0.1	NTU
Total Alkalinity	$CaCO_3$	48.8	96.0	45.0	87.0	1	mg/L
Bicarbonate Alkalinity	HCO_3	59.5	117	54.9	106	0.5	mg/L
Carbonate Alkalinity	CO_3	<	<	<	<	0.5	mg/L
Hydroxide Alkalinity	OH	<	<	<	<	0.5	mg/L
Nitrite	N	<	<	<	<	0.002	mg/L

µS/cm = microsiemens per centimeter
NTU = nephelometric turbidity units
< = Less than detection limit

CU = color units
mg/L = milligrams per liter

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: August 11, 2008

GROUP NUMBER: 90801064

CANTEST

Conventional Parameters-Winnipeg Laboratory- in Water

CLIENT SAMPLE IDENTIFICATION:		PW5	WHL-SW	DETECTION LIMIT	UNITS
DATE SAMPLED:		Jul 31/08	Aug 1/08		
CANTEST ID:		808010208	808010214		
pH, Laboratory		7.71	7.56	-	pH units
Conductivity		302	92	1	µS/cm
True Color		14	-	5	CU
Turbidity		0.2	0.2	0.1	NTU
Total Alkalinity	$CaCO_3$	118	26.0	1	mg/L
Bicarbonate Alkalinity	HCO_3	144	31.7	0.5	mg/L
Carbonate Alkalinity	CO_3	<	<	0.5	mg/L
Hydroxide Alkalinity	OH	<	<	0.5	mg/L
Nitrite	N	<	-	0.002	mg/L

µS/cm = microsiemens per centimeter
NTU = nephelometric turbidity units
< = Less than detection limit

CU = color units
mg/L = milligrams per liter

CHAIN OF CUSTODY RECORD

CANTEST

43398 **MB**

Unit D
675 Berry Street
Winnipeg, Manitoba
R3H 1A7

Tel: 204 772 7276
Fax: 204 772 2386

www.cantest.com

Client Name:* KGS Group | Postal Code* R3T 5P4

Street Address (including suite number):* 3rd Floor - 865 Waverley St. | City: Winnipeg

Telephone:* 896-1209 | Fax: - | E-Mail Address (Required for "AutoEmail" Reports): LSteuart@kgsgroup.com

Contact Name:* Kenton Thiessen | Sampler's Name: Kenton Thiessen

Project Name: West Hawk Lake | Project Number: 08-190-02 | Quotation Number: | P.O. Number

Page ____ of ____

RESULTS REQUESTED BY:*

Day ____ Month ____ Year ____

(Surcharges May Apply)

Special Instructions: ☐ AutoFax ☒ AutoEmail

☐ Return Cooler ☐ Ship Containers (please specify)

☐ Apply Drinking Water Limits

~~X6~~ SWN ✓X6 SWR KGS200

~~X11~~ SWM x6 coli cups

90801064	Sample Identification*	Date/Time Sampled	Sample Type (Matrix)
80801019	~~PW1~~ PW1	Date: Jul 31/08 Time: 20:46	GW
0203	PW2	Date: Jul 31/08 Time: 20:40	"
0205	PW3	Date: Jul 31/08 Time: 19:43	"
0206	PW4	Date: Jul 31/08 Time: 20:20	"
0208	PW5	Date: Jul 31/08 Time: 19:10	"
0214	WHL-SW	Date: Aug 1/08 Time: 7:40	SW
		Date: Time:	
		Date: Time:	
		Date: Time:	
		Date: Time:	

CCME Metals - Water Type (see reverse): T D FF E	CCME Metals - Soil	pH	Conductivity	TSS	TS (TDS)	Alkalinity (total / spec. HALITE)	Biological Oxygen Demand	Chemical Oxygen Demand	Ammonia	TKN	Nitrate and Nitrite	Cl (SO4)	NO3	BETX	VOC	PAH	HFCT2-M	Surfactant	HARDNESS	CA-MST	K-MST	MG-MST	NA-MST	FE-MST	MN-MST	TURBDW @WCA-ST	HOLD - DO NOT ANALYZE	Number of Containers
																	X											
																	X											
																	X											
																	X											
																	X											
		X	X	X	X						X	X						*	X	X	X	X	X	X	X	X		

Does this source supply multiple households? ☐ Yes ☐ No

Is this a Public water supply source? ☐ Yes ☐ No

Drinking Water Sample? ☐ Yes

Relinquished by: Keith Jh	Date Aug 1/08	Time	Received by:
Relinquished by:	Date	Time	Received by:
Method of Shipment: client	Waybill No.: NA	Received for Lab by:	Date Aug 1/08 Time 14:20
Shipped by: client	Shipment Condition: acceptable	Cooler opened by:	Date Time

* = Required Field

Total Number of Containers:

Please send a copy of the: ☐ Report (by Mail) ☐ Report (by Fax) ☐ Results (by E-mail) ☐ Invoice (by Mail)

Company Name:

Address: Postal Code:

Contact: E-Mail:

Phone: Fax:

FOR LABORATORY USE ONLY

Sample State at Receipt: ☐ Ambient ☑ Cold ☐ Frozen ☐ N/A Comments:

Temperature 7.6 °C Custody Seal Intact? ☐ Yes ☐ No ☑ n/a Number of Coolers/Shipping Containers: 1

WHITE: FOLLOWS REPORT YELLOW: LAB COPY PINK: CLIENT COPY/GENERAL INFORMATION

Analysis Report

SEP 03 2008 CANTEST

REPORT ON: Analysis of Water Samples

REPORTED TO: KGS Group
3rd Floor
865 Waverly St
Winnipeg, MB
R3T 5T4

Att'n: Ms. Marci Friedman-Hamm

CHAIN OF CUSTODY: 38358 MB
PROJECT NAME: West Hawk Lake
PROJECT NUMBER: 8-1521-02

NUMBER OF SAMPLES: 15

REPORT DATE: August 21, 2008

DATE SUBMITTED: August 13, 2008

GROUP NUMBER: 90813008

SAMPLE TYPE: Water

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHODS:

Volatile Organic Compounds in Water and Soil - analysis was performed using procedures based on U.S. EPA Methods 624/8240/8260, involving sparging with a Purge and Trap apparatus and analysis using GC/MS.

Volatile Hydrocarbons (VH) and Volatile Petroleum Hydrocarbons (VPH) in Water - analysis was performed using B.C. MOELP CSR-Analytical Method 2 "Volatile Hydrocarbons in Water by GC/FID" and CSR-Analytical Method 5 "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water (VPH)" approved August 12, 1999. The method involves sparging/collection using a Purge & Trap apparatus with GC/MS analysis; VH components ranging from C6 to C10 are quantified against m-xylene and 1,2,4-trimethylbenzene. VPH is calculated by subtraction of specified MAH compounds from VH concentrations.

Petroleum Hydrocarbons (C10-16 and C16-C34) in Water - analysis was performed by extraction, silica gel clean-up and analysis by Gas Chromatography with flame ionization detection (GC/FID).

Petroleum Hydrocarbons (C34-50) in Water - analysis was performed by extraction, silica gel clean-up and analysis by Gas Chromatography with flame ionization detection (GC/FID).

TEST RESULTS:

(See following pages)

CANTEST LTD.

Zhenyong Gao, M.Sc.
Coordinator, Trace Organics

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

REPORTED TO: KGS Group

REPORT DATE: August 21, 2008

GROUP NUMBER: 90813008

CANTEST

Monocyclic Aromatic Hydrocarbons in Water

CLIENT SAMPLE IDENTIFICATION:	Well 1	Well 2	Well 3	WH-01	
DATE SAMPLED:	Aug 12/08	Aug 12/08	Aug 12/08	Aug 12/08	
CANTEST ID:	808130013	808130014	808130015	808130016	DETECTION LIMIT
ANALYSIS DATE:	Aug 15/08	Aug 15/08	Aug 15/08	Aug 15/08	
Benzene	<	<	<	<	0.1
Ethylbenzene	<	<	<	<	0.1
Toluene	<	<	<	<	0.1
Xylenes	<	<	<	<	0.1
Volatile Hydrocarbons VHw6-10	<	<	<	<	100
VPHw	<	<	<	<	100
Styrene	<	<	<	<	0.1
Surrogate Recovery					
Toluene-d8	102	102	100	98	-
Bromofluorobenzene	95	88	95	89	-

Results expressed as micrograms per liter (μg/L)
Surrogate recoveries expressed as percent (%)
< = Less than detection limit

REPORTED TO: KGS Group

REPORT DATE: August 21, 2008

GROUP NUMBER: 90813008

CANTEST

Monocyclic Aromatic Hydrocarbons in Water

CLIENT SAMPLE IDENTIFICATION:	WH-06	WH-09	WH-10	WH-14	
DATE SAMPLED:	Aug 12/08	Aug 12/08	Aug 12/08	Aug 12/08	
CANTEST ID:	808130017	808130018	808130019	808130020	
ANALYSIS DATE:	Aug 15/08	Aug 15/08	Aug 15/08	Aug 15/08	DETECTION LIMIT
Benzene	<	330	<	390	0.1
Ethylbenzene	<	7300	<	330	0.1
Toluene	<	16000	<	4000	0.1
Xylenes	<	49000	<	2800	0.1
Volatile Hydrocarbons VHw6-10	<	310000	<	12000	100
VPHw	<	240000	<	4500	100
Styrene	<	< 20	<	< 10	0.1
Surrogate Recovery					
Toluene-d8	103	104	101	103	-
Bromofluorobenzene	95	93	88	94	-

Results expressed as micrograms per liter (μg/L)
Surrogate recoveries expressed as percent (%)
< = Less than detection limit

REPORTED TO: KGS Group

REPORT DATE: August 21, 2008

GROUP NUMBER: 90813008

CANTEST

Monocyclic Aromatic Hydrocarbons in Water

CLIENT SAMPLE IDENTIFICATION:	WH-17	WH-18	WH-19	WH-20	
DATE SAMPLED:	Aug 12/08	Aug 12/08	Aug 12/08	Aug 12/08	
CANTEST ID:	808130021	808130022	808130023	808130024	DETECTION LIMIT
ANALYSIS DATE:	Aug 15/08	Aug 15/08	Aug 15/08	Aug 15/08	
Benzene	3200	2100	140	9200	10
Ethylbenzene	1600	720	650	950	10
Toluene	9900	14000	3200	33000	10
Xylenes	9400	13000	7800	15000	10
Volatile Hydrocarbons VHw6-10	40000	40000	35000	100000	100
VPHw	16000	10000	23000	42000	100
Styrene	<	< 20	<	< 40	10
Surrogate Recovery					
Toluene-d8	103	104	106	105	-
Bromofluorobenzene	94	94	92	91	-

Results expressed as micrograms per liter (μg/L)
Surrogate recoveries expressed as percent (%)
< = Less than detection limit

REPORTED TO: KGS Group

REPORT DATE: August 21, 2008

GROUP NUMBER: 90813008

CANTEST

Monocyclic Aromatic Hydrocarbons in Water

CLIENT SAMPLE IDENTIFICATION:	WH-21	WH-25	WH-26	
DATE SAMPLED:	Aug 12/08	Aug 12/08	Aug 12/08	
CANTEST ID:	808130025	808130026	808130027	DETECTION LIMIT
ANALYSIS DATE:	Aug 15/08	Aug 15/08	Aug 15/08	
Benzene	1300	2800	<	0.1
Ethylbenzene	270	550	<	0.1
Toluene	5600	6700	<	0.1
Xylenes	1900	3200	<	0.1
Volatile Hydrocarbons VHw6-10	12000	17000	<	100
VPHw	2900	3800	<	100
Styrene	< 10	< 20	<	0.1
Surrogate Recovery				
Toluene-d8	105	104	99	-
Bromofluorobenzene	92	91	84	-

Results expressed as micrograms per liter (μg/L)
Surrogate recoveries expressed as percent (%)
< = Less than detection limit

REPORTED TO: KGS Group

REPORT DATE: August 21, 2008

GROUP NUMBER: 90813008

CANTEST

Extractable Petroleum Hydrocarbons - Silica-gel Cleanup in Water

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Petroleum Hydrocarbons C10-16	Petroleum Hydrocarbons C16-34	Petroleum Hydrocarbons C34-50
Well 1	Aug 12/08	808130013	<	<	<
Well 2	Aug 12/08	808130014	<	<	<
Well 3	Aug 12/08	808130015	<	<	<
WH-01	Aug 12/08	808130016	<	<	<
WH-06	Aug 12/08	808130017	<	<	<
WH-09	Aug 12/08	808130018	47000	1900	510
WH-10	Aug 12/08	808130019	<	<	<
WH-14	Aug 12/08	808130020	170	<	<
WH-17	Aug 12/08	808130021	1000	<	<
WH-18	Aug 12/08	808130022	1200	<	<
WH-19	Aug 12/08	808130023	1200	<	<
WH-20	Aug 12/08	808130024	2600	<	<
WH-21	Aug 12/08	808130025	740	<	<
WH-25	Aug 12/08	808130026	<	<	<
WH-26	Aug 12/08	808130027	<	<	<
DETECTION LIMIT			100	250	250
UNITS			µg/L	µg/L	µg/L

µg/L = micrograms per liter
< = Less than detection limit

CHAIN OF CUSTODY RECORD

CANTEST

38358 MB

Unit D
675 Berry Street
Winnipeg, Manitoba
R3H 1A7

Tel: 204 772 7276
Fax: 204 772 2386

www.cantest.com

Client Name:* KGS Group | Postal Code* R3T 5P4

Street Address (including suite number):* 3rd Floor-865 Waverley St. | City: Winnipeg

Telephone:* 896-1209 | Fax: - | E-Mail Address (Required for "AutoEmail" Reports): LStewart@kgsgroup.com

Contact Name:* Kenton Thiessen | Sampler's Name: Ariel Melvin

Project Name: West Hawk Lake | Project Number: 08-1521-02 | Quotation Number: | P.O. Number

Page ____ of ____

RESULTS REQUESTED BY:*

Day ____ Month ____ Year ____

(Surcharges May Apply)

Special Instructions: ☐ AutoFax ☒ AutoEmail

☐ Return Cooler ☐ Ship Containers (please specify)

☐ Apply Drinking Water Limits

15x IAGS ✓ 30x BTEX ✓ KGS100

	Sample Identification*	Date/Time Sampled	Sample Type (Matrix)	CCME Metals - Water Type (see reverse): T D FF E	CCME Metals - Soil	pH	Conductivity	TSS TDS TS	Alkalinity (total / spec.)	Biological Oxygen Demand	Chemical Oxygen Demand	Ammonia TKN	Nitrate and Nitrite	F Cl SO_4 NO_3	BETX	VOC	PAH	#VPH EPH							HOLD - DO NOT ANALYZE	Number of Containers
90813008																										
80813013	Well 1	Date: Aug 12/08 Time: 13:45	GW															X								
0014	Well 2	Date: " Time: 13:50	"															X								
0015	Well 3	Date: " Time: 13:55	"															X								
0016	WH-01	Date: " Time: 14:05	"															X								
0017	WH-06	Date: " Time: 15:00	"															X								
0018	WH-09	Date: " Time: 14:35	"															X								
0019	WH-10	Date: " Time: 14:10	"															X								
0020	WH-14	Date: " Time: 14:40	"															X								
0021	WH-17	Date: " Time: 14:20	"															X								
0022	WH-18	Date: " Time: 14:30	"															X								

Drinking Water Sample? ☐ Yes

Does this source supply multiple households? ☐ Yes ☐ No

Is this a Public water supply source? ☐ Yes ☐ No

Relinquished by:	Date	Time	Received by:
Kalev Liivamagi	08/13/08	10:00am	
Relinquished by:	Date	Time	Received by:

* = Required Field

Total Number of Containers:

Please send a copy of: ☐ Report (by Mail) ☐ Report (by Fax) ☐ Results (by E-mail) ☐ Invoice (by Mail)

Method of Shipment:	Waybill No.:	Received for Lab by:	Date	Time
Shipped by:	Shipment Condition:	Cooler opened by:	Date	Time

Company Name:

Address: Postal Code:

Contact: E-Mail:

Phone: Fax:

FOR LABORATORY USE ONLY

Sample State at Receipt: ☐ Ambient ☐ Cold ☐ Frozen ☐ N/A Comments:

Temperature 15.1 °C Custody Seal Intact? ☐ Yes ☐ No ☐ n/a Number of Coolers/Shipping Containers: ____

WHITE: FOLLOWS REPORT YELLOW: LAB COPY PINK: CLIENT COPY/GENERAL INFORMATION

CHAIN OF CUSTODY RECORD

CANTEST

38359 MB

Unit D
675 Berry Street
Winnipeg, Manitoba
R3H 1A7

Tel: 204 772 7276
Fax: 204 772 2386

www.cantest.com

Page ____ of ____

RESULTS REQUESTED BY:*

Day ____ Month ____ Year ____

(Surcharges May Apply)

Client Name:* KGS Group			Postal Code* R3T 5P4
Street Address (including suite number):* 3rd Floor - 865 Waverley St.		City: Winnipeg, MB	
Telephone:* 896-1209	Fax: -	E-Mail Address (Required for "AutoEmail" Reports): LStewart@kgsgroup.com	
Contact Name:* Kenton Thiessen		Sampler's Name: Ariel Melvin	
Project Name: West Hawk Lake	Project Number: 08-152-02	Quotation Number:	P.O. Number

Special Instructions: ☐ AutoFax ☒ AutoEmail

☐ Return Cooler ☐ Ship Containers (please specify)

☐ Apply Drinking Water Limits

KGS100.

	Sample Identification*	Date/Time Sampled	Sample Type (Matrix)	CCME Metals - Water Type (see reverse): T D FF E	CCME Metals - Soil	pH	Conductivity	TSS TDS TS	Alkalinity (total / spec.)	Biological Oxygen Demand	Chemical Oxygen Demand	Ammonia TKN	Nitrate and Nitrite	F Cl SO_4 NO_3	BETX	VOC	PAH	#VPHEPH							HOLD - DO NOT ANALYZE	Number of Containers
0023	WH-19	Date: Aug 12 Time: 14:45	GW															X								
0024	WH-20	Date: " Time: 14:40	"															X								
0025	WH-21	Date: " Time: 14:15	"															X								
0026	WH-25	Date: " Time: 14:25	"															X								
0027	WH-26	Date: " Time: 14:00	"															X								
		Date: Time:																								
		Date: Time:																								
		Date: Time:																								
		Date: Time:																								
		Date: Time:																								

Does this source supply multiple households? ☐ Yes ☐ No

Is this a Public water supply source? ☐ Yes ☐ No

Drinking Water Sample? ☐ Yes

Relinquished by: Kalev Liivamagi	Date 08/13/08	Time 10:00 am	~~Received by:~~		
Relinquished by:	Date	Time	Received by:		
Method of Shipment:	Waybill No.:	Received for Lab by:	Date	Time	
Shipped by:	Shipment Condition:	Cooler opened by:	Date	Time	

FOR LABORATORY USE ONLY

Sample State at Receipt: ☐ Ambient ☐ Cold ☐ Frozen ☐ N/A Comments:

Temperature ____°C Custody Seal Intact? ☐ Yes ☐ No ☐ n/a Number of Coolers/Shipping Containers: ____

* = Required Field

Total Number of Containers:

Please send a copy of the: ☐ Report (by Mail) ☐ Report (by Fax) ☐ Results (by E-mail) ☐ Invoice (by Mail)

Company Name:	
Address:	Postal Code:
Contact:	E-Mail:
Phone:	Fax:

WHITE: FOLLOWS REPORT YELLOW: LAB COPY PINK: CLIENT COPY/GENERAL INFORMATION

CHROMATOGRAM COVER SHEET

CANTEST

CONTACT	COMPANY NAME	
Marci Friedman – Hamm	KGS Group	
FAX NUMBER	**DATE**	**PGS INCL. COVER**
1-204-896-0754	Aug 20, '08	8
FROM	**RETURN FAX**	**TELEPHONE**
CANTEST LTD	604 731 2386	604 734 7276

SUBJECT

Chromatogram(s).

Please find the attached chromatograms associated with:

CANTEST Group # 90813008

Your Project Name West Hawk Lake

Your Project Number 8-1521-02

Sample Matrix Water

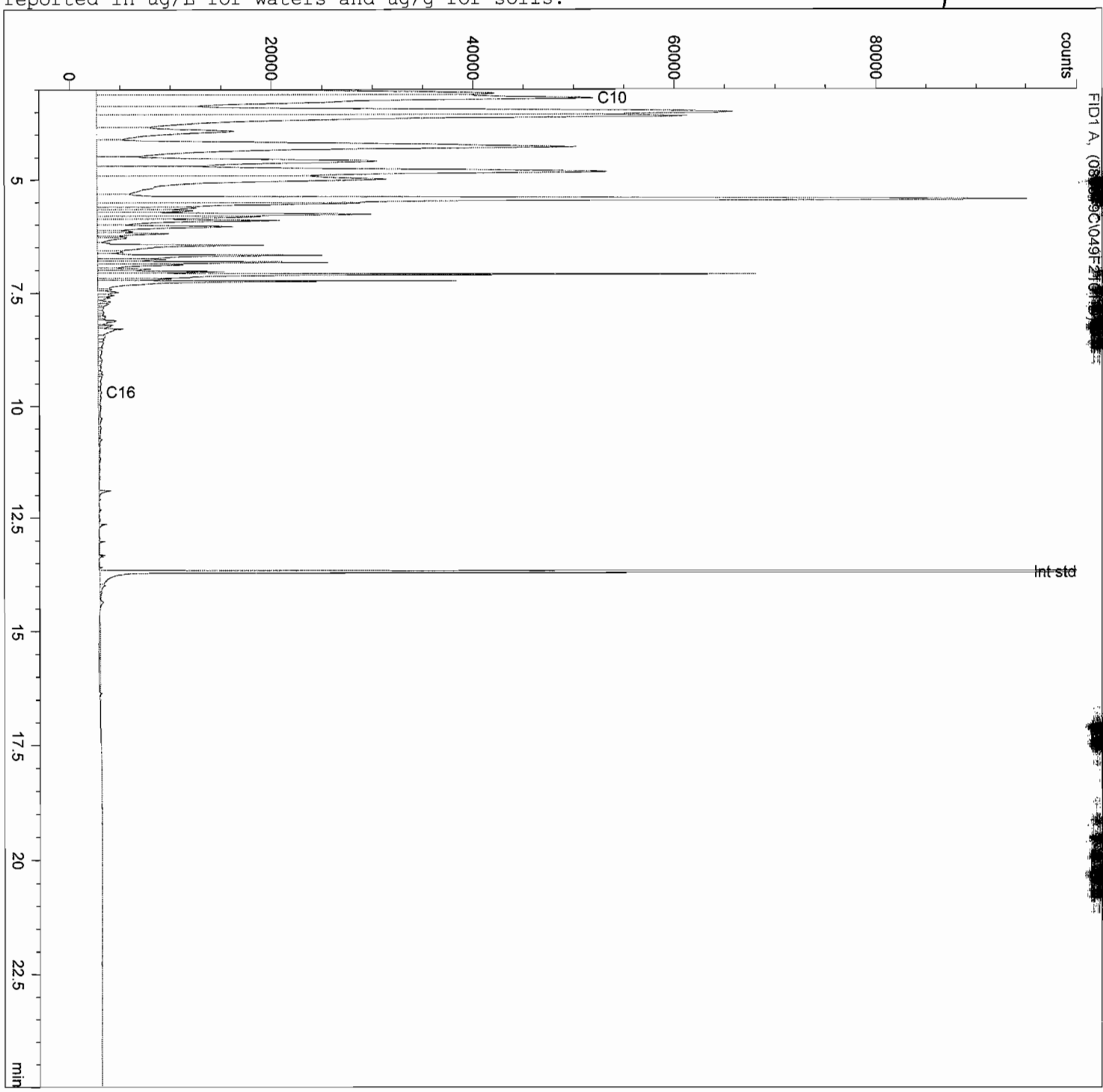
The originals will follow with the report.

Injection Date	: 8/20/08 1:01:04 AM	Seq. Line	: 21
Sample Name	: 808130025	Vial	: 49
Acq. Operator	: pcn	Inj	: 1
		Inj Volume	: 2 µl
Acq. Method	: C:\HPCHEM\1\METHODS\CCMEHT.M		
Last changed	: 8/19/08 9:44:08 PM by pcn		
Analysis Method	: C:\HPCHEM\1\METHODS\CCMEHTP.M		
Last changed	: 8/20/08 8:16:00 AM by pcn (modified after loading)		

KGS 100
G# 90813008

Total Extractable Hydrocarbons. Soils and Waters are extracted using methylene chloride and then analyzed using an HPGC-FID. Calculations are based on an internal standard and reported in ug/L for waters and ug/g for soils.

WH-21

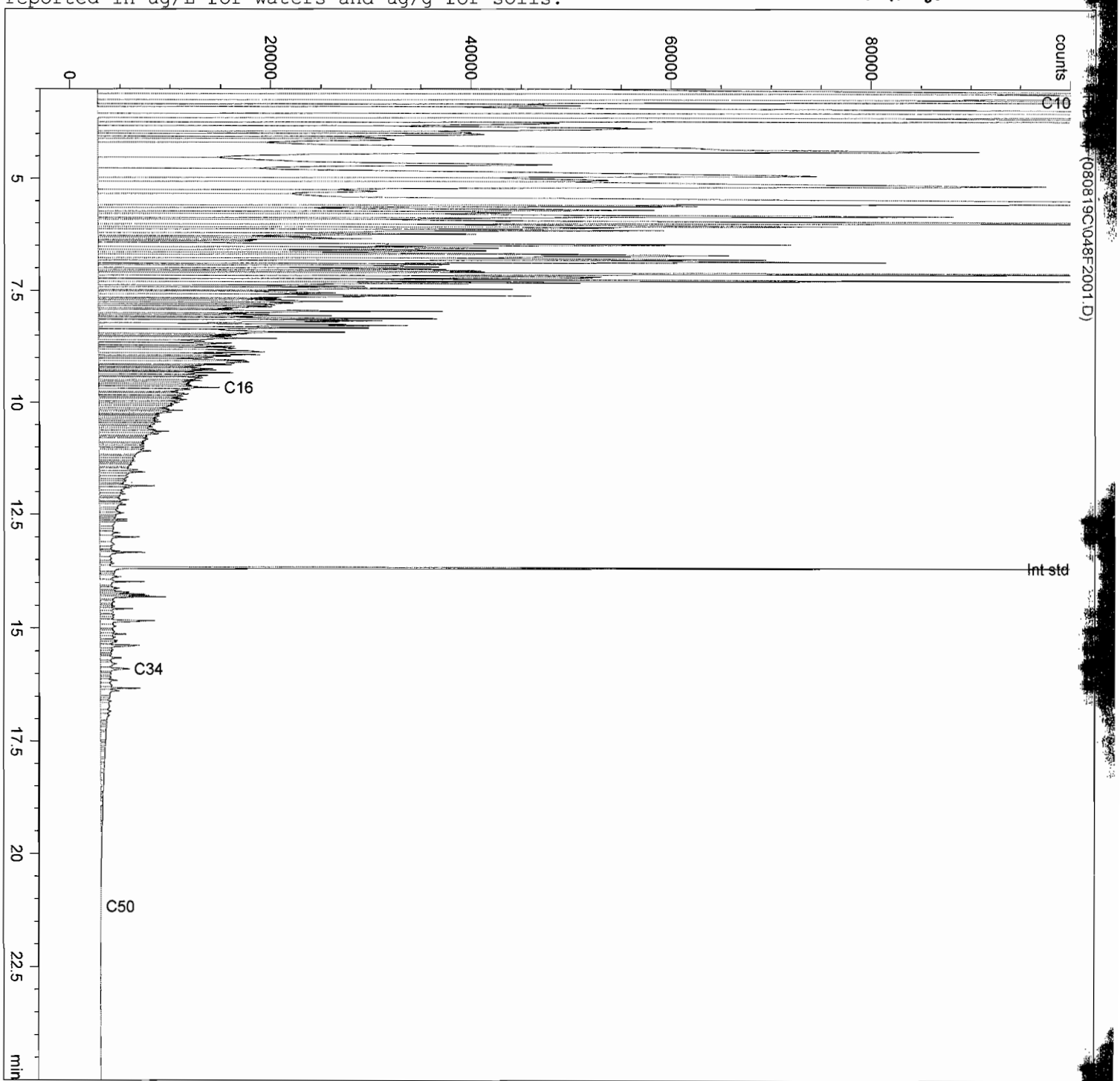


Injection Date	: 8/20/08 12:23:15 AM	Seq. Line :	20
Sample Name	: 808130024	Vial :	48
Acq. Operator	: pcn	Inj :	1
		Inj Volume :	2 µl
Acq. Method	: C:\HPCHEM\1\METHODS\CCMEHT.M		
Last changed	: 8/19/08 9:44:08 PM by pcn		
Analysis Method	: C:\HPCHEM\1\METHODS\CCMEHTP.M		
Last changed	: 8/20/08 8:16:00 AM by pcn (modified after loading)		

KGS 100
G# 90813008

Total Extractable Hydrocarbons. Soils and Waters are extracted using methylene chloride and then analyzed using an HPGC-FID. Calculations are based on an internal standard and reported in ug/L for waters and ug/g for soils.

WH-20



Injection Date : 8/19/08 11:45:26 PM
Sample Name : 808130023
Acq. Operator : pcn

Seq. Line : 19
Vial : 47
Inj : 1
Inj Volume : 2 µl

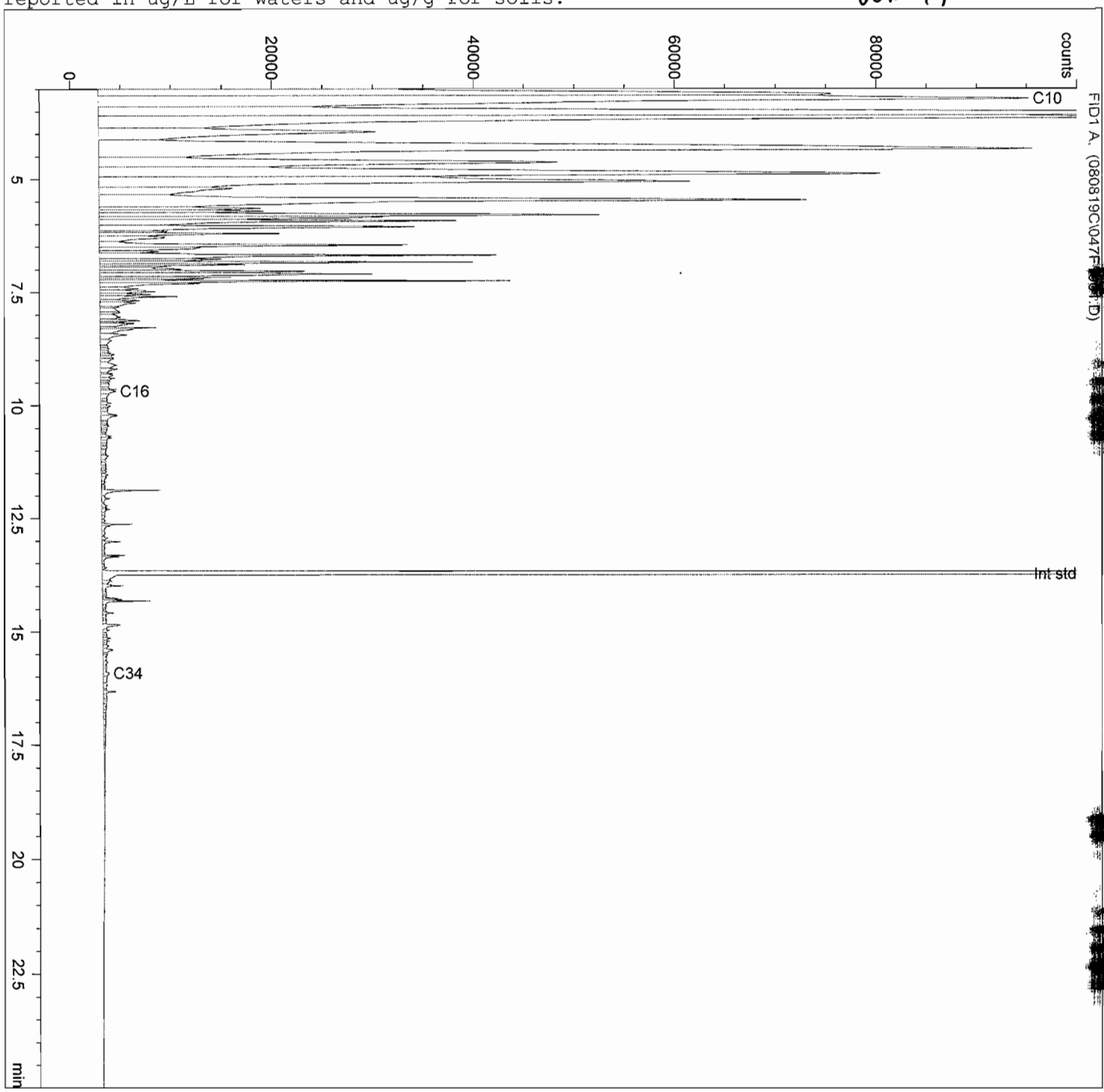
Acq. Method : C:\HPCHEM\1\METHODS\CCMEHT.M
Last changed : 8/19/08 9:44:08 PM by pcn
Analysis Method : C:\HPCHEM\1\METHODS\CCMEHTP.M
Last changed : 8/20/08 8:16:00 AM by pcn
(modified after loading)

ICGS 100

G# 90813008

Total Extractable Hydrocarbons. Soils and Waters are extracted using methylene chloride and then analyzed using an HPGC-FID. Calculations are based on an internal standard and reported in ug/L for waters and ug/g for soils.

WH-19



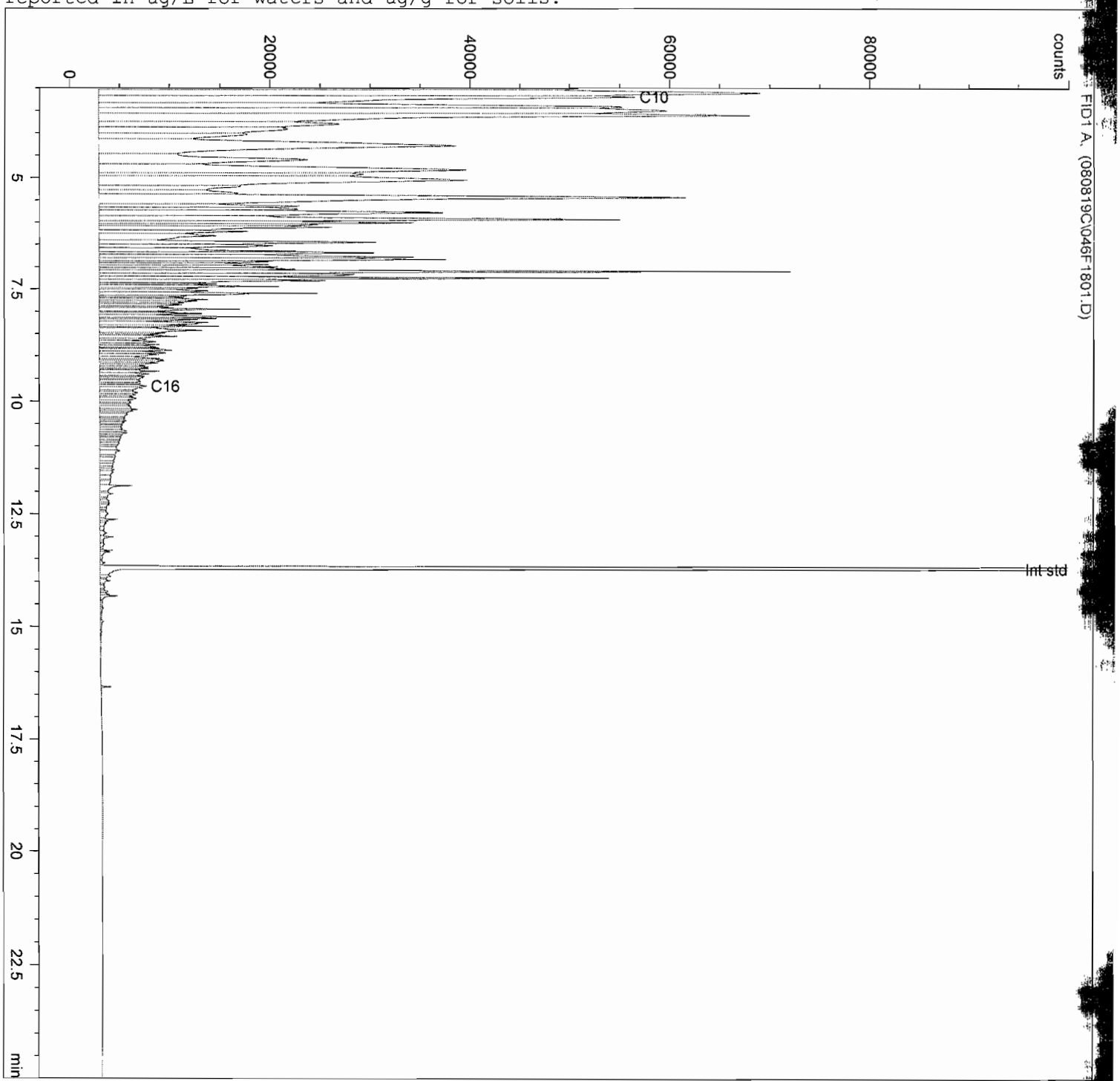
Injection Date : 8/19/08 11:07:34 PM Seq. Line : 18
Sample Name : 808130022 Vial : 46
Acq. Operator : pcn Inj : 1
Inj Volume : 2 µl

Acq. Method : C:\HPCHEM\1\METHODS\CCMEHT.M
Last changed : 8/19/08 9:44:08 PM by pcn
Analysis Method : C:\HPCHEM\1\METHODS\CCMEHTP.M
Last changed : 8/20/08 8:16:00 AM by pcn
(modified after loading)

KGS 100
G# 90813008

Total Extractable Hydrocarbons. Soils and Waters are extracted using methylene chloride and then analyzed using an HPGC-FID. Calculations are based on an internal standard and reported in ug/L for waters and ug/g for soils.

WA-18



Injection Date : 8/19/08 10:29:39 PM
Sample Name : 808130021
Acq. Operator : pcn

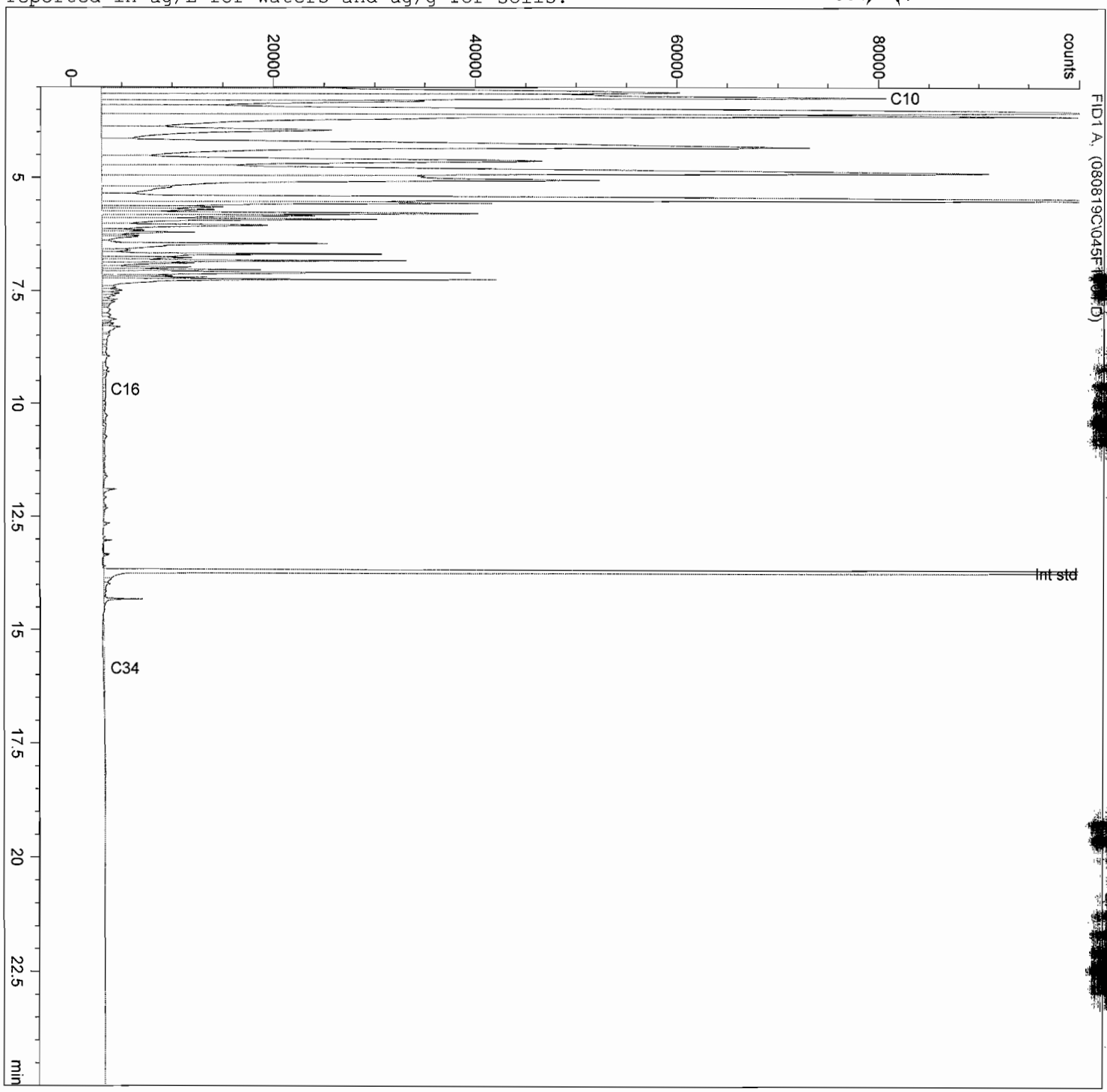
Seq. Line : 17
Vial : 45
Inj : 1
Inj Volume : 2 µl

Acq. Method : C:\HPCHEM\1\METHODS\CCMEHT.M
Last changed : 8/19/08 9:44:08 PM by pcn
Analysis Method : C:\HPCHEM\1\METHODS\CCMEHTP.M
Last changed : 8/20/08 8:16:00 AM by pcn
(modified after loading)

ICGS 100
G# 90813008

Total Extractable Hydrocarbons. Soils and Waters are extracted using methylene chloride and then analyzed using an HPGC-FID. Calculations are based on an internal standard and reported in ug/L for waters and ug/g for soils.

WH-17



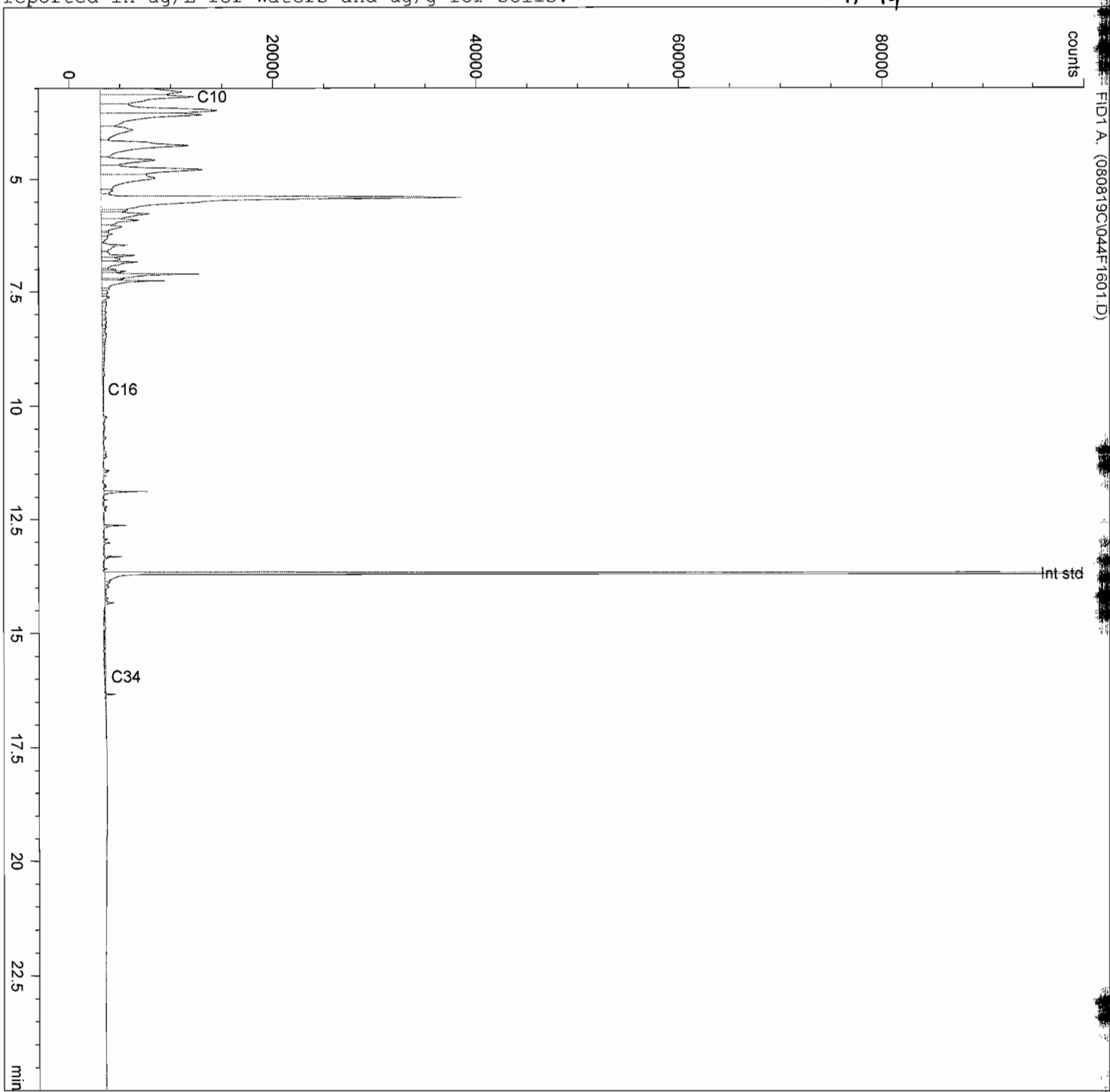
Injection Date : 8/19/08 9:51:49 PM Seq. Line : 16
Sample Name : 808130020 Vial : 44
Acq. Operator : pcn Inj : 1
Inj Volume : 2 µl

Acq. Method : C:\HPCHEM\1\METHODS\CCMEHT.M
Last changed : 8/19/08 9:44:08 PM by pcn
Analysis Method : C:\HPCHEM\1\METHODS\CCMEHTP.M
Last changed : 8/20/08 8:24:22 AM by pcn
(modified after loading)

KGS 100
G# 9081 3008

Total Extractable Hydrocarbons. Soils and Waters are extracted using methylene chloride and then analyzed using an HPGC-FID. Calculations are based on an internal standard and reported in ug/L for waters and ug/g for soils.

WH-14



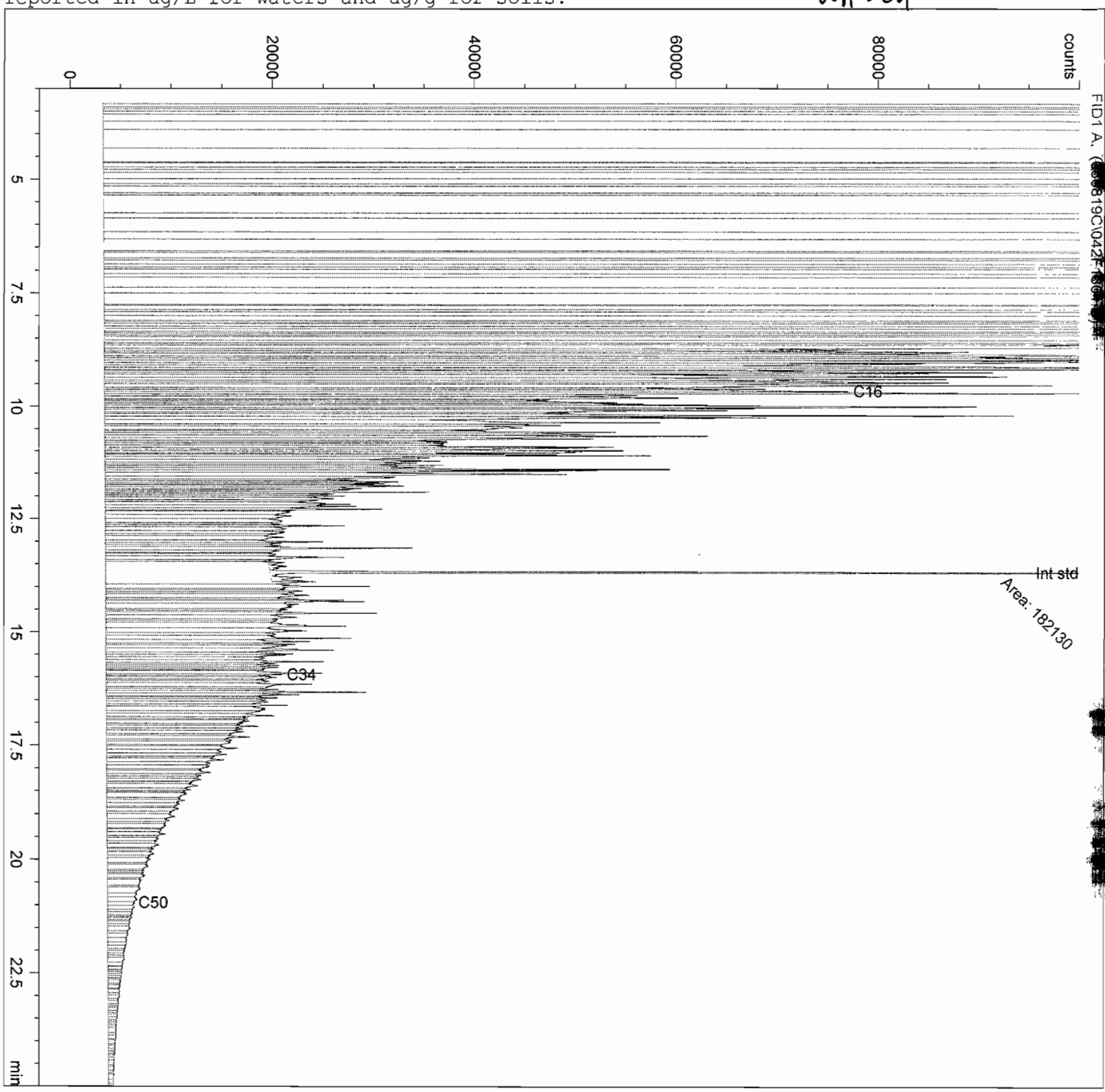
Data File C:\HPCHEM\1\DATA\080819C\042F1301.D Sample Name: 808130018

Injection Date	: 8/19/08 7:58:25 PM	Seq. Line	: 13
Sample Name	: 808130018	Vial	: 42
Acq. Operator	: pcn	Inj	: 1
		Inj Volume	: 2 µl
Acq. Method	: C:\HPCHEM\1\METHODS\CCMEHT.M		
Last changed	: 8/19/08 2:48:09 PM by pcn		
Analysis Method	: C:\HPCHEM\1\METHODS\CCMEHTP.M		
Last changed	: 8/20/08 8:15:09 AM by pcn (modified after loading)		

KGS 100
G# 90813008

Total Extractable Hydrocarbons. Soils and Waters are extracted using methylene chloride and then analyzed using an HPGC-FID. Calculations are based on an internal standard and reported in ug/L for waters and ug/g for soils.

WH-09



Analysis Report

CANTEST

REPORT ON: Analysis of Water Samples

REPORTED TO: KGS Group-Environmental Remediation Program
3rd Floor
865 Waverley Street
Winnipeg, MB
R3T 5P4

Att'n: Kenton Theissen

CHAIN OF CUSTODY: 38429 Mb, 38429 MB
PROJECT NAME: West Hawk Lake
PROJECT NUMBER: 08-1521-02

NUMBER OF SAMPLES: 8

REPORT DATE: September 17, 2008

DATE SUBMITTED: September 9, 2008

GROUP NUMBER: 90909074

SAMPLE TYPE: Water

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHODS:

Anions in Water by Ion Chromatography - was determined based on Method 4110 in Standard Methods (21st Edition) and EPA Method 300.0 (Revision 2.1).

Chemical Oxygen Demand in Water - was determined based on Method 8000 "Oxygen Demand, Chemical - Reactor Digestion Method" in the HACH Water Analysis Handbook. The sample is heated for two hours with a strong oxidizing agent (potassium dichromate). Oxidizable organic compounds react, reducing the dichromate ion to green chromic ion. The amount of the chromic ion is determined using UV/Vis spectrophometry at 620 nm.

Dissolved Organic Carbon in Water - was determined based on Method 5310 A and B in Standard Methods (21st Edition) and Method X314 in the BC Laboratory Manual (2005 Edition).

Nitrate and Nitrite in Water - was performed using Flow Injection Analysis where Nitrate is reduced to nitrite by passing the sample through a cadmium reduction column. The nitrite produced is then determined by diazotizing sulphanilamide and N-(1-naphthyl)-ethylenediamine dihydrochloride to form a reddish azo dye which is then measured colorimetrically at 540 nm.

Ammonia in Water - was performed using Flow Injection Analysis where the aqueous sample is injected into a carrier stream, which merges a sodium hydroxide stream. Gaseous ammonia is formed, which diffuses through a gas permeable membrane into an indicator stream. This indicator stream is comprised of a mixture of acid-base indicators, which will react with the ammonia gas; resulting in a colour shift which is measured photometrically @

(Continued)

CANTEST LTD.

Anna Becalska, PhD
Trace Metals Coordinator

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

Ammonia in Water

590 nm.

Total Dissolved Solids in Water - was determined based on Method 2540 C in Standard Methods for the Examination of Water and Wastewater (21st Edition).

Total Kjeldahl Nitrogen in Water - was determined based on Method 4500-N in Standard Methods (21st Edition) and Method X325 in the BC Laboratory Manual (2005).

Conventional Parameters - analyses were performed using procedures based on those described in the most current editions of "British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials", (2005 edition) Province of British Columbia and "Standard Methods for the Examination of Water and Wastewater" (21st Edition), published by the American Public Health Association.

Conventional Parameters - Winnipeg Laboratory (Unit D-675 Berry Street, Winnipeg, Manitoba R3H 1A7): - Analyses performed at Cantest's Winnipeg facilities follow procedures based on those described in the "British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials" (2005 Edition) and "Standard Methods for the Examination of Water and Wastewater" (21st Edition).

Mercury in Water - analysis was performed using procedures based on U. S. EPA Method 245.7, oxidative digestion using bromination, and analysis using Cold Vapour Atomic Fluorescence Spectroscopy.

Metals in Water - analysis was performed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP), Inductively Coupled Plasma-Mass Spectroscopy (ICP/MS).

Dissolved Metals in Water - Samples were filtered in the laboratory and quantitatively determined using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP) and/or Inductively Coupled Plasma-Mass Spectroscopy (ICP/MS).

Microbiological Parameters - analyses were performed using procedures based on those described in "B. C. Environmental Laboratory Manual For the Analysis of Water, Wastewater, Sediment and Biological Materials" (2005 Edition), "Standard Methods for the Examination of Water and Wastewater", (21st Edition) and Colilert Quanti-tray Standard Operating Procedure. Results are reported as Most Probable Number(MPN) per unit volume. Note: <1 MPN is equivalent to "Absent" Analysis was performed at CANTEST LTD Unit D 675 Berry Street Winnipeg, Manitoba R3H 1A7.

TEST RESULTS:

(See following pages)

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: September 17, 2008

GROUP NUMBER: 90909074

CANTEST

Conventional Parameters in Water

CLIENT SAMPLE IDENTIFICATION:		PW1	PW2	PW3	PW4		
DATE SAMPLED:		Sep 8/08	Sep 8/08	Sep 8/08	Sep 8/08	DETECTION LIMIT	UNITS
CANTEST ID:		809090271	809090277	809090278	809090280		
Hardness	CaCO3	99.6	129	138	180	0.2	mg/L
Total Dissolved Solids		385	313	284	333	10	mg/L
Dissolved Fluoride	F	< 0.1	0.09	0.07	<	0.05	mg/L
Dissolved Chloride	Cl	162	86.7	75.6	91.2	0.2	mg/L
Nitrate and Nitrite	N	1.42	0.65	0.45	0.30	0.01	mg/L
Nitrate	N	1.42	0.65	0.45	0.30	0.01	mg/L
Dissolved Sulphate	SO4	13.9	10.1	30.9	16.3	0.5	mg/L
Chemical Oxygen Demand		<	<	<	<	20	mg/L
Dissolved Organic Carbon	C	3.6	5.9	6.6	2.2	1	mg/L
Ammonia Nitrogen	N	<	0.05	0.01	0.04	0.01	mg/L
Total Kjeldahl Nitrogen	N	0.6	0.4	0.3	0.3	0.2	mg/L
Total Phosphorus	P	0.005	0.006	0.011	0.006	0.001	mg/L as P

mg/L = milligrams per liter
< = Less than detection limit

mg/L as P = milligrams per liter as P

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: September 17, 2008

GROUP NUMBER: 90909074

CANTEST

Conventional Parameters in Water

CLIENT SAMPLE IDENTIFICATION:		PW5	MW1	MW3	WH-1	DETECTION LIMIT	UNITS
DATE SAMPLED:		Sep 8/08	Sep 8/08	Sep 8/08	Sep 8/08		
CANTEST ID:		809090281	809090286	809090297	809090304		
Hardness	CaCO3	126	-	-	-	0.2	mg/L
Total Dissolved Solids		206	305	353	760	10	mg/L
Dissolved Fluoride	F	0.06	<	< 0.1	< 0.25	0.05	mg/L
Dissolved Chloride	Cl	16.6	125	163	442	0.2	mg/L
Nitrate and Nitrite	N	<	0.97	1.90	1.61	0.01	mg/L
Nitrate	N	<	0.97	1.90	1.61	0.01	mg/L
Dissolved Sulphate	SO4	3.65	10.0	14.3	7.12	0.5	mg/L
Chemical Oxygen Demand		<	<	<	-	20	mg/L
Dissolved Organic Carbon	C	8.6	2.3	2.1	-	1	mg/L
Ammonia Nitrogen	N	0.03	0.02	<	-	0.01	mg/L
Total Kjeldahl Nitrogen	N	0.3	0.2	0.3	-	0.2	mg/L
Total Phosphorus	P	0.017	0.007	0.007	-	0.001	mg/L as P

mg/L = milligrams per liter
< = Less than detection limit

mg/L as P = milligrams per liter as P

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: September 17, 2008

GROUP NUMBER: 90909074

CANTEST

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		PW1	PW1	PW2	PW2		
SAMPLE PREPARATION:		TOTAL	DISSOLVED	TOTAL	DISSOLVED		
DATE SAMPLED:		Sep 8/08	Sep 8/08	Sep 8/08	Sep 8/08		
CANTEST ID:		809090271	809090271	809090277	809090277	DETECTION LIMIT	UNITS
Aluminum	Al	0.002	-	0.006	-	0.001	mg/L
Antimony	Sb	0.0004	-	0.0004	-	0.0002	mg/L
Arsenic	As	0.0003	-	0.0014	-	0.0002	mg/L
Barium	Ba	0.034	-	0.02	-	0.0002	mg/L
Boron	B	0.02	-	0.02	-	0.01	mg/L
Cadmium	Cd	<	-	<	-	0.00004	mg/L
Calcium	Ca	-	31.9	-	42.7	0.01	mg/L
Chromium	Cr	0.0005	-	0.0004	-	0.0002	mg/L
Copper	Cu	0.0049	-	0.0088	-	0.0002	mg/L
Iron	Fe	<	<	0.05	0.04	0.01	mg/L
Lead	Pb	<	-	<	-	0.0002	mg/L
Magnesium	Mg	4.95	4.84	5.82	5.44	0.01	mg/L
Manganese	Mn	0.03	0.028	0.337	0.306	0.0002	mg/L
Mercury	Hg	<	-	<	-	0.02	µg/L
Potassium	K	-	2.12	-	1.82	0.02	mg/L
Selenium	Se	0.0004	-	<	-	0.0002	mg/L
Silicon	Si	-	4.72	-	6.27	0.05	mg/L
Sodium	Na	-	75	-	32.8	0.01	mg/L
Uranium	U	0.0005	-	0.0016	-	0.0001	mg/L
Zinc	Zn	0.014	-	0.003	-	0.001	mg/L

mg/L = milligrams per liter
< = Less than detection limit

µg/L = micrograms per liter

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: September 17, 2008

GROUP NUMBER: 90909074

CANTEST

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		PW3	PW3	PW4	PW4		
SAMPLE PREPARATION:		TOTAL	DISSOLVED	TOTAL	DISSOLVED		
DATE SAMPLED:		Sep 8/08	Sep 8/08	Sep 8/08	Sep 8/08		
CANTEST ID:		809090278	809090278	809090280	809090280	DETECTION LIMIT	UNITS
Aluminum	Al	0.008	-	0.001	-	0.001	mg/L
Antimony	Sb	0.0004	-	0.0005	-	0.0002	mg/L
Arsenic	As	0.001	-	0.0006	-	0.0002	mg/L
Barium	Ba	0.034	-	0.024	-	0.0002	mg/L
Boron	B	0.05	-	0.03	-	0.01	mg/L
Cadmium	Cd	0.00004	-	<	-	0.00004	mg/L
Calcium	Ca	-	42.6	-	59.9	0.01	mg/L
Chromium	Cr	0.0004	-	0.001	-	0.0002	mg/L
Copper	Cu	0.0067	-	0.004	-	0.0002	mg/L
Iron	Fe	0.26	0.18	0.02	<	0.01	mg/L
Lead	Pb	0.0003	-	<	-	0.0002	mg/L
Magnesium	Mg	8.28	7.68	8.27	7.89	0.01	mg/L
Manganese	Mn	0.08	0.07	0.082	0.076	0.0002	mg/L
Mercury	Hg	<	-	<	-	0.02	µg/L
Potassium	K	-	2.05	-	2.45	0.02	mg/L
Selenium	Se	0.0005	-	<	-	0.0002	mg/L
Silicon	Si	-	6.72	-	6.87	0.05	mg/L
Sodium	Na	-	13.1	-	13.8	0.01	mg/L
Uranium	U	0.0016	-	0.0024	-	0.0001	mg/L
Zinc	Zn	0.01	-	0.006	-	0.001	mg/L

mg/L = milligrams per liter
µg/L = micrograms per liter
< = Less than detection limit

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: September 17, 2008

GROUP NUMBER: 90909074

CANTEST

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		PW5	PW5		
SAMPLE PREPARATION:		TOTAL	DISSOLVED		
DATE SAMPLED:		Sep 8/08	Sep 8/08		
CANTEST ID:		809090281	809090281	DETECTION LIMIT	UNITS
Aluminum	Al	0.002	-	0.001	mg/L
Antimony	Sb	0.0004	-	0.0002	mg/L
Arsenic	As	0.0034	-	0.0002	mg/L
Barium	Ba	0.013	-	0.0002	mg/L
Boron	B	0.01	-	0.01	mg/L
Cadmium	Cd	<	-	0.00004	mg/L
Calcium	Ca	-	40.5	0.01	mg/L
Chromium	Cr	0.0002	-	0.0002	mg/L
Copper	Cu	0.0051	-	0.0002	mg/L
Iron	Fe	0.51	0.42	0.01	mg/L
Lead	Pb	<	-	0.0002	mg/L
Magnesium	Mg	6.04	5.93	0.01	mg/L
Manganese	Mn	0.375	0.351	0.0002	mg/L
Mercury	Hg	<	-	0.02	µg/L
Potassium	K	-	2.02	0.02	mg/L
Selenium	Se	<	-	0.0002	mg/L
Silicon	Si	-	8.07	0.05	mg/L
Sodium	Na	-	4.46	0.01	mg/L
Uranium	U	0.0024	-	0.0001	mg/L
Zinc	Zn	0.003	-	0.001	mg/L

mg/L = milligrams per liter
< = Less than detection limit

µg/L = micrograms per liter

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: September 17, 2008

GROUP NUMBER: 90909074

CANTEST

Microbiological Analysis in Water

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Total Coliform	E. coli
PW1	Sep 8/08	809090271	<	<
PW2	Sep 8/08	809090277	<	<
PW3	Sep 8/08	809090278	<	<
PW4	Sep 8/08	809090280	<	<
PW5	Sep 8/08	809090281	<	<
DETECTION LIMIT			1	1
UNITS			MPN/100mL	MPN/100mL

MPN/100mL = Most Probable Number / 100 mL
< = Less than detection limit

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: September 17, 2008

GROUP NUMBER: 90909074

Conventional Parameters-Winnipeg Laboratory- in Water

CLIENT SAMPLE IDENTIFICATION:		PW1	PW2	PW3	PW4		
DATE SAMPLED:		Sep 8/08	Sep 8/08	Sep 8/08	Sep 8/08	DETECTION LIMIT	UNITS
CANTEST ID:		809090271	809090277	809090278	809090280		
pH, Laboratory		6.72	7.17	6.91	7.30	-	pH units
Conductivity		693	514	438	523	1	µS/cm
True Color		<	16	13	<	5	CU
Turbidity		<	<	0.3	<	0.1	NTU
Total Alkalinity	$CaCO_3$	50.4	99.9	53.4	91.2	1	mg/L
Bicarbonate Alkalinity	HCO_3	61.5	122	65.1	111	0.5	mg/L
Carbonate Alkalinity	CO_3	<	<	<	<	0.5	mg/L
Hydroxide Alkalinity	OH	<	<	<	<	0.5	mg/L
Nitrite	N	<	<	<	<	0.002	mg/L
Total BOD		<	<	<	<	1	mg/L
% Transmittance @ 254 nm		85.4	66.3	67.4	91.6	-	% Trans.
UV Absorbance @ 254 nm		0.069	0.178	0.172	0.038	0.005	Abs. Units

µS/cm = microsiemens per centimeter
NTU = nephelometric turbidity units
% Trans. = Percent Transmittance
< = Less than detection limit

CU = color units
mg/L = milligrams per liter
Abs. Units = Absorbance Units

REPORTED TO: KGS Group-Environmental Remediation Program

REPORT DATE: September 17, 2008

GROUP NUMBER: 90909074

CANTEST

Conventional Parameters-Winnipeg Laboratory- in Water

CLIENT SAMPLE IDENTIFICATION:		PW5	MW1	MW3	WH-1	DETECTION LIMIT	UNITS
DATE SAMPLED:		Sep 8/08	Sep 8/08	Sep 8/08	Sep 8/08		
CANTEST ID:		809090281	809090286	809090297	809090304		
pH, Laboratory		7.69	6.19	5.93	6.74	-	pH units
Conductivity		304	497	629	1610	1	µS/cm
True Color		17	<	<	13	5	CU
Turbidity		0.2	0.1	0.2	5.0	0.1	NTU
Total Alkalinity	$CaCO_3$	125	13.6	9.7	59.2	1	mg/L
Bicarbonate Alkalinity	HCO_3	153	16.6	11.8	72.2	0.5	mg/L
Carbonate Alkalinity	CO_3	<	<	<	<	0.5	mg/L
Hydroxide Alkalinity	OH	<	<	<	<	0.5	mg/L
Nitrite	N	<	<	<	<	0.002	mg/L
Total BOD		3	<	<	-	1	mg/L
% Transmittance @ 254 nm		62.2	93.3	93.4	70.6	-	% Trans.
UV Absorbance @ 254 nm		0.206	0.030	0.030	0.152	0.005	Abs. Units

µS/cm = microsiemens per centimeter
NTU = nephelometric turbidity units
% Trans. = Percent Transmittance
< = Less than detection limit

CU = color units
mg/L = milligrams per liter
Abs. Units = Absorbance Units

CHAIN OF CUSTODY RECORD

CANTEST

38429 MB

Unit D
675 Berry Street
Winnipeg, Manitoba
R3H 1A7

Tel: 204 772 7276
Fax: 204 772 2386

www.cantest.com

Page 1 of 1

RESULTS REQUESTED BY:* Day / Month / Year

(Surcharges May Apply)

Client Name:* KGS Group | Postal Code* R3T 5P4

Street Address (including suite number):* 3rd Floor 865 Waverley St | City: Wpg

Telephone:* 896-1209 | Fax: — | E-Mail Address (Required for "AutoEmail" Reports): lstewart@kgsgroup.com

Contact Name:* Kenton Thiessen | Sampler's Name: Kenton Thiessen

Project Name: West Hawk Lake | Project Number: 08-1521-02 | Quotation Number: | P.O. Number

Special Instructions: ☐ AutoFax ☒ AutoEmail

☐ Return Cooler ☐ Ship Containers (please specify)

☐ Apply Drinking Water Limits

KGS200 Bill to Man Cons

8 2LRAW (7 wpg)
5 COLI (8 wpg)
3 SWN ✓
8 SWR (7) ✓
5 SWM ✓

	Sample Identification*	Date/Time Sampled	Sample Type (Matrix)	CCME Metals - Water Type (see reverse): T D FF E	CCME Metals - Soil	pH	Conductivity	TSS TDS TS	Alkalinity (total / spec.)	Biological Oxygen Demand	Chemical Oxygen Demand	Ammonia (TKN)	Nitrate and Nitrite	F Cl SO_4 NO_3	BETX	VOC	PAH	#PQT2-N	#PQT2-N minus metals minus bath		DOC	TP-Total Phos	Colour	Turbidity	UV Transmittance calibrated at 254	HOLD - DO NOT ANALYZE	Number of Containers
1090907 4																										
8090907 1	PW1	Date: 9/8/08 Time: 14:55	GW							X	X	X						X			X	X	##	##	X		5
0277	PW2	Date: 9/8/08 Time: 14:30	GW							X	X	X						X			X	X	##	##	X		5
0278	PW3	Date: 9/8/08 Time: 14:45	GW							X	X	X						X			X	X	##	##	X		5
0280	PW4	Date: 9/8/08 Time: 14:35	GW							X	X	X						X			X	X	##	##	X		5
0281	PW5	Date: 9/8/08 Time: 15:00	GW							X	X	X						X			X	X	##	##	X		5
0286	MW1	Date: 9/8/08 Time: 15:40	GW							X	X	X							X		X	X	X	X	X		3
0297	MW3	Date: 9/8/08 Time: 15:40	GW							X	X	X							X		X	X	X	X	X		3
0304	WH-1	Date: 9/8/08 Time: 16:40	GW																X				X	X	X		1
		Date: Time:																									
		Date: Time:							—												sample if enough available						

Drinking Water Sample? ☐ Yes

Does this source supply multiple households? ☐ Yes ☐ No

Is this a Public water supply source? ☐ Yes ☐ No

Relinquished by:	Date	Time	Received by:
Relinquished by:	Date	Time	Received by:

* = Required Field

Total Number of Containers:

Please send a copy of the: ☐ Report (by Mail) ☐ Report (by Fax) ☐ Results (by E-mail) ☐ Invoice (by Mail)

Method of Shipment: client	Waybill No.:	Received for Lab by:	Date	Time
Shipped by:	Shipment Condition: OK	Cooler opened by:	Date	Time

Company Name:

Address: Postal Code:

Contact: E-Mail:

Phone: Fax:

FOR LABORATORY USE ONLY

Sample State at Receipt: ☐ Ambient ☐ Cold ☐ Frozen ☐ N/A

Temperature 16.4°C

Comments: LOGIN

Custody Seal Intact? ☐ Yes ☐ No ☐ n/a

Number of Coolers/Shipping Containers: ____

WHITE: FOLLOWS REPORT YELLOW: LAB COPY PINK: CLIENT COPY/GENERAL INFORMATION