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PLAN OF RESTORATION

SOIL AND WATER MANAGMENT PROCEDURES FOR EXCAVATION OF HYDROCARBON CONTAMINATED SOIL CARCROSS PUMP STATION

Submitted to:

The British Yukon Railway Company
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May 1998 962-1818A

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1.0 INTRODUCTION

1.1 Background

Yukon Pipelines Limited (YPL) is in the process of decommissioning its pipeline and associated facilities located in British Columbia and the Yukon Territory. In accordance National Energy Board (NEB) hearing MH-3-96 and NEB Order MO-7-96 and as part of the decommissioning planning process, YPL retained Golder Associates Ltd. (Golder) to conduct an Environmental Site Assessment (ESA) and prepare a Plan of Restoration for the Carcross Pump Station (the Site, see Figure 1). Results of the ESA and Plan of Restoration for the Site are contained in Golder's report "*Phase I and Phase II Environmental Site Assessment and Plan of Restoration, The Yukon Pipelines Limited Carcross Pump Station*", February 1998.

Soils beneath and near the Site generally consist of unconsolidated granular sands and silts that extend to depths exceeding 18.3 m, the maximum depth investigated. Approximately 5,000 m^3 of soils located within the upper 3.0 m of the soil profile contain volatile petroleum hydrocarbons (VPH) and light extractable petroleum hydrocarbons (LEPH) concentrations in excess of the Yukon Contaminated Sites Regulations (CSR) and the Canadian Council of the Ministers of Environment (CCME) guidelines for industrial land use.

The depth to groundwater beneath the Site ranges from 6.0 to 16.0 m. The main direction of horizontal groundwater flow is toward the southwest at an average linear seepage velocity of approximately 3 m/yr. Benzene, toluene, ethylbenzene and xylene (BTEX) and selected polycyclic aromatic hydrocarbons (PAH) concentrations exceed the Yukon CSR aquatic life standard in the immediate area of the Site; however, this plume of hydrocarbon contamination has migrated a distance of less than 200 m over the past 20 to 50 years. A free-phase liquid product, ranging in thickness from 0.29 m to 1.1 m, was detected in two groundwater monitoring wells located in the immediate vicinity of the former Pump House (BH96-13 and MW97-13, respectfully, see Figure 2). The lateral extent of the liquid product is estimated to be on the order of 5,000 m^2. This layer of product is confined to the property boundaries and appears to be stable and immobile.

1.2 Regulatory Requirements

The approach to the remediation and assessment of soils and water at the Site is consistent with the Yukon (CSR) and CCME guidelines. The CSR and CCME standards for industrial land use were established as the criteria for all soils and water at the Site.

1.3 Approach

In order to meet the Yukon CSR and CCME standards for the Site the petroleum hydrocarbon contaminated soils will need to be remediated and any mobile liquid hydrocarbon removed. Excavation followed by land farming was the option chosen to address the shallow soil contamination located at the former above ground storage tanks (AST 7A and 7B, see Figure 2). This involves excavating the zone of contaminated soil, transporting the soil to a central location and actively tilling the soil with the addition of water and nutrients as required.

The free-phase product recovery option was chosen to address the free-phase product present in and around the former pump house building (Figure 2). This option involves the removal of mobile free-phase product through the use of skimmer pumps.

At the Carcross Pump Station site 10 monitoring wells were installed on-site and 3 were installed off-site during the Phase I and II ESA (Figure 2). We propose four additional groundwater monitoring events over the next two years to ensure that the groundwater quality continues to meet the applicable Yukon CSR standards.

2.0 EXCAVATION OF CONTAMINATED SHALLOW SOILS

2.1 General

This section describes briefly the procedures that will be used in managing soil and water that is or potentially will be handled during excavation of the shallow soils (up to 3.0 m deep). The approach adopted with respect to the excavation, stockpiling and sampling of contaminated soils at the Site is consistent with the guidelines and criteria developed by the Contaminated Sites Unit of B.C. Environment. These guidelines are presented in their document entitle *"Guidance on Contaminated Sites: Site Characterization and Confirmation Testing"*. The guidelines present a generic approach to perform detailed

characterisation of soils either prior to or following excavation, to ensure that the soils are adequately characterised to define disposal and/or remediation requirements.

The results of the field investigation and sampling programs ("*Phase I and Phase II Environmental Site Assessment and Plan of Restoration, The Yukon Pipelines Limited Carcross Pump Station*", Golder report, February 1998) indicated that there are elevated concentrations of hydrocarbon vapours in the vicinity of former AST 7A and 7B to a depth of approximately 3 m (Figure 2). Total-organic vapour concentrations in the shallow soils decrease rapidly with distance from the hydrocarbon-release areas. Such vapour distributions suggest that any liquid hydrocarbons migrated mainly downward rather than laterally. This migration behaviour is consistent with the coarse-grained character of the near-surface soils at the Site.

2.2 Remediation Plan

The planned remediation program at the Carcross former Pump Station is to remove the shallow soil contamination from the area associated with AST 7A and 7B. The depths and limits of the proposed excavation are summarised in the attached Figure 3. The soils excavated from the Site will be stockpiled for confirmation sampling and analyses.

Water will only be collected from the excavation if the water impedes or interferes with the excavation of the contaminated or potentially contaminated soils, or the placement of backfill. Due to the depth of the water table no groundwater is anticipated to enter the excavations, however, if rainwater or other surface water enters the excavation it will be removed and placed in the lined holding ponds located on the Site (Figure 2). The collected water will be sampled for the constituent(s) required to permit its discharge to the ground via an infiltration system.

Backfilling of the excavated areas will be done with soils that generally consist of clean, granular soils obtained from a local borrow area.

2.3 Soil and Water Management Procedures

It is anticipated that the soil and water (if required) handling procedures required for this site will include:

- monitoring the excavation of soil, prior to and during land farming;
- confirmatory sampling of the exposed soils in the excavation to verify chemical concentrations in the soils remaining in-place:
- confirmatory sampling of water collected from the excavations; and
- monitoring backfilling of the excavation.

2.3.1 Proposed Management Procedures for Soil

The excavation program will be conducted in the areas identified on Figure 3. If feasible, the excavation will commence in the most heavily contaminated areas, that is, in the centre of the former ASTs. Once the zones of the higher contamination have been removed, the excavation will then proceed to areas with lower levels of contamination. This sequence of excavation will allow a visual (and olfactory) recognition of heavily contaminated materials, such that other materials possessing similar characteristics and can be recognised accordingly during subsequent excavation.

Exposed soil sidewall surfaces and the base of the excavation will be sampled following the removal of all suspected contaminated soils, to determine if the remediation objective has been met. The results of the confirmatory sampling program will determine whether additional excavation is required to meet the CSR and CCME criteria.

The locations of the samples collected, together with observations and contents of land farmed soil and any other relevant information, will be recorded in field notebooks and/or on appropriate forms. Samples will be distinctly numbered and/or identified, and will be located on a site plan showing the locations of the samples, such that further excavation of the soils within AST areas can be conducted, if necessary.

2.3.2 Proposed Management Procedures for Water

Where water ponds and/or pools at and around the excavations are encountered and must be removed to facilitate further excavation, the Excavation Contractor shall collect this water. The collected water will be sampled and analysed to determine whether the water can be discharged without further treatment or requires treatment prior to discharge.

The anticipated zone and depth of excavation at the Site will not likely encounter the groundwater table. Precipitation and runoff are the only likely sources of water. Precipitation and runoff water will be collected, as required, by the Contractor in an appropriate manner. The collected water will be placed into one of the retention ponds located on-site.

The water in the pond will be sampled and analysed for the appropriate chemical constituents to allow its permitted disposal or treatment. The results of the chemical analyses of the water samples obtained from the storage tank will determine the appropriate means of treatment, if necessary, or disposal of the water.

2.4 Land Farming of Excavated Soils

Shallow soils excavated in and around the former ASTs will be spread over the area indicated on Figure 3. The soils will be placed in lifts a maximum of 0.3 m thick, which is optimum for tilling. An above ground sprinkler system will be used to apply water and nutrients to the tilled soil in order to enhance biodegradation of the petroleum hydrocarbons. The water/nutrient application will also aid in preventing wind dispersal of contaminated dust. The rate of water/nutrient application will be such that it maximises the biodegradation rate (maintains a moisture content of approximately 40 to 80 percent of the water holding capacity of the soil), but does not permit surface runoff. Small ditches will surround the land farming area to intercept any runoff, which will then be placed in one of the retention ponds on site.

Soil samples will be collected from the tilled area to confirm compliance with the Yukon CSR and CCME criteria for industrial land use. Soil samples will be collected on a 20 m by 20 m grid pattern over the entire land farming area. The locations of the samples and any relevant information will be recorded in field notebooks and/or on appropriate forms. Samples will be distinctly labelled and will be located on a site plan showing the locations of the samples, such that further tilling and irrigating of soils can be conducted, if necessary.

Soil samples will be collected in glass sample jars and visually examined for the presence of hydrocarbon or other signs of contamination. To further assess the presence of

product, field shake tests and screening using the dry headspace method may be performed.

3.0 FREE-PHASE PRODUCT REMOVAL

3.1 General

This section describes briefly the procedures that will be used to remove and dispose of the free-phase product present at the Site (Figure 2). The results of the field investigation and sampling programs (*"Phase I and Phase II Environmental Site Assessment and Plan of Restoration, The Yukon Pipelines Limited Carcross Pump Station"*, Golder report, February 1998) indicated that there is free-phase product floating on the water table in the vicinity of the former pump house.

The planned remediation program at the Carcross former Pump Station involves using a passive skimmer to bail the floating product from two existing wells (BH96-13 and MW97-13). The thickness of product varies from 0.29 m (BH96-13) to 1.1 m (MW97-13) and the estimated extent of free-phase product is approximately 5,000 m^2.

3.2 Free-Phase Product Recovery

Passive skimmers (PetroTrap™) will be installed in both BH96-13 and MW97-13. The skimmers will be lowered such that the bottom of the unit extends about 1 m into the groundwater, the "sump" action will then permit the free-phase product to enter the unit. Once the skimmer is filled or is partially filled with product it will be removed and the product placed into a 45-gal drum located beside the well. The empty skimmer is then replaced in the well. A record of the product recovery rate will be kept in order to assess the time required to remove the product plume and to determine the optimum removal/replacement time of the skimmers.

The 45-gal drums will be place on a pallet and stored on site. Once free-phase product recovery has been completed the product contained in the drums will be reused or disposed of in accordance with Yukon regulations.

4.0 ADDITIONAL INVESTIGATIONS

4.1 Test Pit Excavation

A test pit excavation program, focusing on the upper 3 m of the soil profile, was conducted as part of the Phase I and II ESA at each of the former storage area at the Site.

Additional test pits are required to identify further areas of possible contamination. These test pits will be located at the direction of Harold Gatensby, Carcross-Tagish First Nations, who has knowledge of the Site. Mr. Gatensby indicated his view that several areas of potential contamination were not identified during the Phase I and II ESA soil vapour survey. The locations of the test pits will be in the general area of the former filter house, maintenance shop and former building (see Figure 2).

5.0 FIELD PROCEDURES

5.1 Health and Safety

The Health and Safety Plan prepared as part of the site investigation work plan will be implemented during the monitoring program. This plan is a modification of Golder's existing health and safety plan used on other active petroleum hydrocarbon sites in British Columbia and the Yukon. YPL's safety instructions were incorporated in to the Health and Safety Plan. Additional direction on health and safety issues related to YPL's requirements will be given on-site before the start of field investigation.

5.2 Groundwater Sampling

Groundwater sampling will proceed in accordance with protocols that are standard for the environmental industry. Each well will be purged of at least three well volumes and monitored for temperature, pH, electrical conductivity, and dissolved oxygen until stable, prior to obtaining representative samples. Samples will be appropriately preserved in laboratory-supplied bottles, labelled and placed in a cooler on ice.

5.3 Water Level Monitoring

Golder will conduct a water level survey at each well across the entire site. An electric water-level meter will be used to monitor water levels and an interface probe will be used to measure free-product thickness, if present.

5.4 Soil Sampling

Discrete samples from the excavation sidewalls will be collected by digging into the exposed soil surface approximately 0.15-m. Soil samples will then be collected from the base of this excavation. A series of five discrete samples will be collected for every 20 m of sidewall. The five discrete samples from each sidewall segment will be composited in a clean, stainless steel bowl to form a wall composite sample. The wall composite will be submitted for selected chemical analyses.

The location of the sidewall samples with respect to prominent site features and/or field measurements, together with observations of soil condition, staining odour and /or other relevant information will be recorded in field notebooks and/or on appropriate sampling forms.

5.5 Test Pitting and Chemical Analysis

The shallow soil sampling and chemical analysis program will use a hand auger or a backhoe. Shallow soil sample will be collected at specific locations in order to assess the soil conditions at potentially contaminated areas.

Soil samples will be collected in glass sample jars and visually examined for the presence of hydrocarbon or other signs of contamination. All descriptions will be recorded and logged in the field. To further assess the presence of product, field shake tests and screening using the dry headspace method will be performed. Selected shallow soil samples will be analysed for EPH and VPH, which where the only petroleum related constituents found above or near the Yukon CSR during the Phase I and II ESA. No metals will be analysed for unless there is indication, based on the location, that possible contamination exists.

5.6 Groundwater Chemistry

Groundwater samples collected from the monitoring wells will be submitted to a qualified laboratory for chemical analyses. Based on previous studies at the Site, petroleum hydrocarbons are considered the primary contaminant of concern (COC), therefore all groundwater samples will be analysed for EPH, BTEX, LEPH and HEPH.

5.7 Soil Chemistry

Samples collected from the sidewalls and base of the excavation will be submitted, with appropriately completed chain-of-custody forms, for chemical analyses of selected constituents (COC) and/or for archiving.

5.8 Soil Vapour Probe Installation

The soil vapour surveying procedure involves driving a hollow steel rod into the soil using a sledgehammer. Prior to advancing the rod, a carriage bolt is inserted into the lower end of the rod to prevent soil from entering the rod as it is driven into the soil. After the rod tip has been advanced to a depth of approximately 1.0-m, a solid steel rod is inserted into the hollow rod. Then the carriage bolt is driven approximately 15 cm further into the soil using the solid steel rod and a sledgehammer, and the solid steel rod is withdrawn. Concentrations of combustible organic-vapours, carbon dioxide and oxygen within the hollow steel rod, representative of the *in situ* concentrations of these variables within the soils surrounding the rod, are then measured. Concentrations of ambient temperature and atmospheric pressure at the time of the soil-gas measurements are also measured. Cleaning of the survey rods, prior to their use at the next survey location, using laboratory detergent and distilled water is completed at the discretion of the field technician.

5.9 Notification of Chemical Analysis

The laboratory will be instructed to notify YPL immediately, by phone, if any analyses indicate the presence of contaminant levels above Yukon CSR standards. Upon notification, YPL will immediately inform the Contaminated Sites Coordinator, Mr. Kevin McDonnell (867-667-5851) of the results.

5.10 QA/QC Chemistry

In addition to the above, for Quality Assurance purposes blind duplicates will be submitted for analysis. All sampling will be performed in accordance with Golder protocols. Analytical laboratories routinely conduct 10 percent laboratory replication and 10 percent to 20 percent reference standard samples with each sample batch.

6.0 SAMPLING PROCEDURES

6.1 Sample Collection

Groundwater samples will be collected once the monitoring wells have been appropriately developed and allowed to recover. The water level will be measured in each well and the probe will be triple rinsed prior to monitoring each well.

Removing approximately three times the calculated well water volume before sampling will purge each well. After allowing the well to recover, groundwater samples will be collected with a bailer or a pump. Sampling equipment used to obtain samples from more than one well will be cleaned prior to each use. A clean glass container will be filled with groundwater collected from each well for field measurements of pH, temperature, dissolved oxygen and electrical conductivity. Samples will be labelled and placed in an insulated cooler so that they can be kept at 4°C ± 2°C. In order to assure sample integrity, strict chain of custody procedures will be followed.

6.2 Decontamination of Sampling Equipment

Non-disposable groundwater and soil sampling equipment will be decontaminated between sampling points. The wash and rinse fluids will be discharged to the ground on site at the completion of each sampling point. If any solvent is used it will be collected, stored, and disposed of in accordance with applicable hazardous waste disposal guidelines.

6.3 Waste Management

All disposable personnel protective equipment and disposable sampling tools will be rinsed with potable water prior to disposal. This equipment will be collected in plastic bags, sealed, and disposed of as solid waste.

6.4 Sample Containers

The sample containers utilised will be pre-cleaned by the manufacturer and will be certified to be clean prior to use. Sample containers will be delivered to Golder sampling personnel by the analytical laboratory. Container types and volumes will be appropriate for the intended analyses.

All sample containers will be inspected prior to transit to the Site to verify that they are undamaged and are tightly sealed. Any damaged or unsealed containers will not be used for sampling. All containers will be retained under chain of custody during this sampling program.

6.5 Sample Holding Times

All samples collected under this plan will be stored and transported in insulated coolers. Sufficient cold packs will be placed in the coolers with the samples to maintain the interior temperature 4°C ± 2°C until the samples are delivered to the laboratory. Care will be taken to prevent the filled sample containers from freezing. Upon receipt, the laboratory will process the samples and complete analysis within the maximum allowable holding time.

7.0 SCHEDULE AND REPORT PREPARATION

Groundwater sampling will be carried out after the "spring thaw" (May) and prior to the "winter freeze" (October). Excavation of soils around AST 7A and 7B will begin in May or June and continue for approximately one week. Land farming of the excavated soils will occur in conjunction with the excavation activities. Tilling of the land farm area will commence once a 0.3-m lift has been place and irrigation system is in place. Tilling of the soil will occur twice during the remainder of the summer. Confirmatory sampling of the land farmed soil will occur after the soil has been tilled twice. Whether or not two

tilling events has occurred, soil samples will be collected from the area prior to the "winter freeze" in order to determine the following seasons sampling program.

Test pitting will begin this summer and will be dependent on Harold Gatensby's schedule.

The same groundwater sampling events will be carried out in 1999. A report will be prepared after the final sampling event and will include the results of each sampling event.

8.0 CLOSING COMMENTS

We trust that this sampling plan is adequate for your current needs. Should you have any questions or need any further information please call.

GOLDER ASSOCIATES LTD.

G.J. Hamilton, P.Geo.
Associate – Project Manager

D. Grady, Ph.D.
Project Hydrogeologist

GJH/DG/vw
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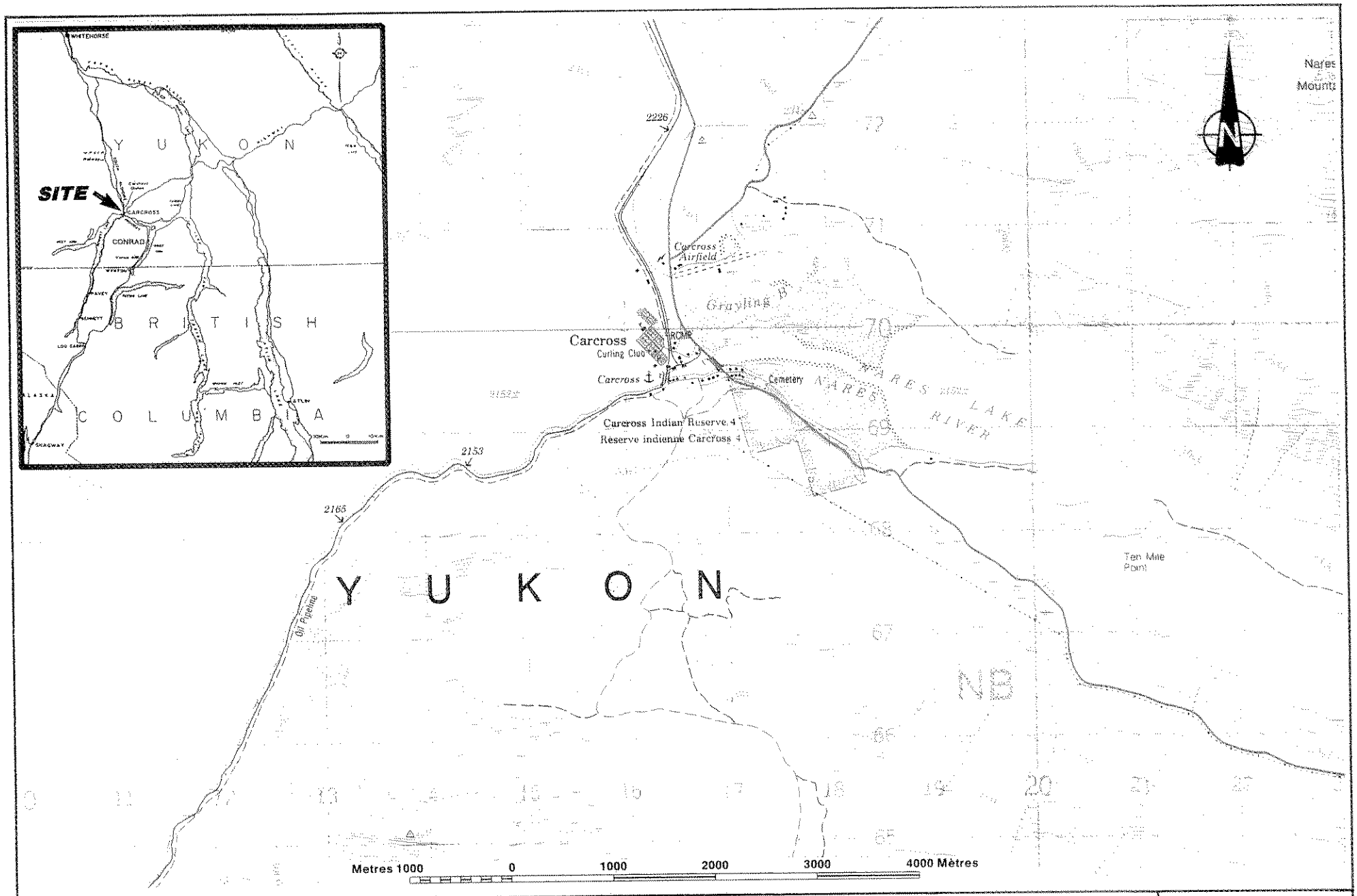

Project No. 962-1818A Drawn S.S. Reviewed D.B. Date Feb.'98	Golder Associates	**KEY PLAN**	Figure **1**

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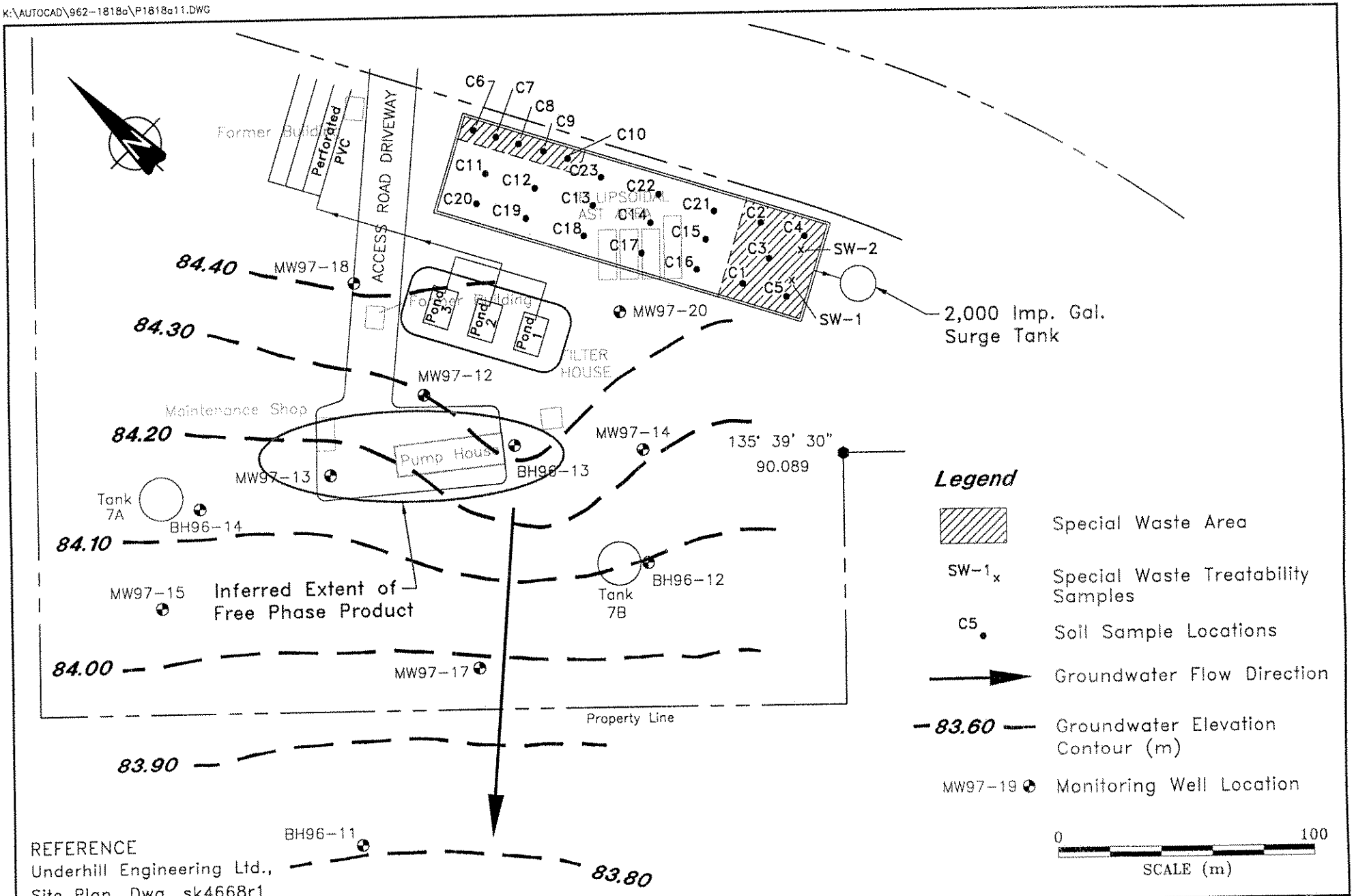

REFERENCE
Underhill Engineering Ltd.,
Site Plan ,Dwg. sk4668r1

Project No.: 962-1818a Drawn: s.s.s Reviewed: D.E.G. Rev.: 30-APR-98	Golder Associates	**SITE PLAN**	Figure 2

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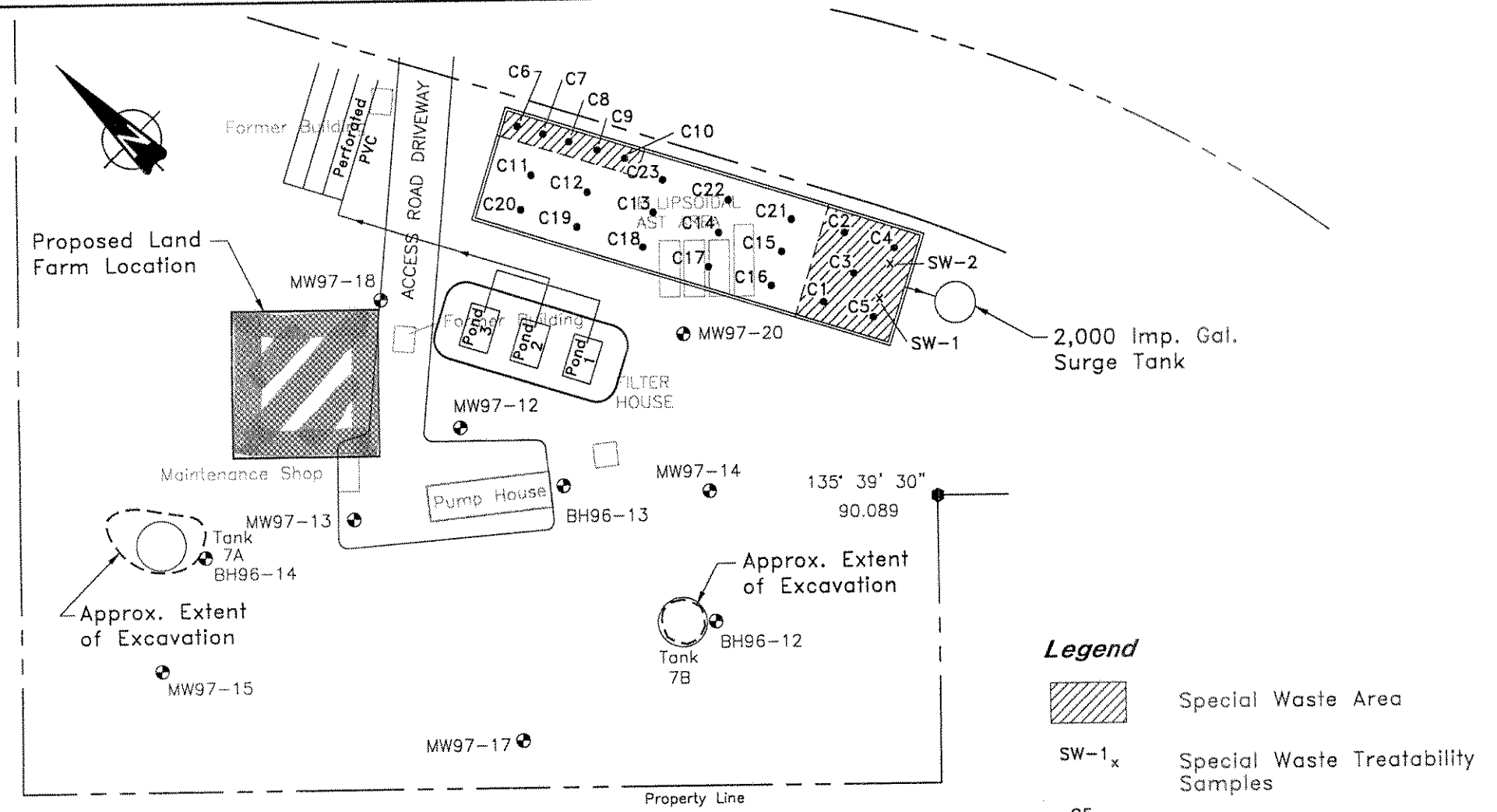

Legend

- Special Waste Area
- $SW-1_x$ Special Waste Treatability Samples
- $C5_\bullet$ Soil Sample Locations
- MW97-19 Monitoring Well Location

0 100
SCALE (m)

REFERENCE
Underhill Engineering Ltd.,
Site Plan ,Dwg. sk4668r1

Project No.: 962-1818a
Drawn: s.s.s
Reviewed: D.E.G.
Rev.: 30-APR-98

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APPROXIMATE EXTENT OF EXCAVATION AND LAND FARM LOCATION

Figure 3