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Remediation and redevelopment of the former highway maintenance yard, Grande Prairie, Alberta, Canada

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Abstract

Komex International Ltd., in conjunction with Hazco Environmental Ltd., has implemented a remediation and redevelopment program for a 21.8 hectare industrial property located in Grande Prairie, Alberta, Canada. The property was first developed in the early 1960's as a small petroleum refinery which manufactured heating oil, gasoline and diesel. In the early 1970's, the refinery was decommissioned and the property was given to the Province of Alberta which operated a highway maintenance yard. In 2000, Hazco and Komex entered into an agreement with the Province to remediate and redevelop the site for subsequent industrial/commercial use. This program was completed in 2001.

The property in question was contaminated by crude oil and refined products associated with the original refinery, as well as by salt storage and underground fuel tanks associated with the highway maintenance yard. Organic contaminants were remediated to a level appropriate for industrial/commercial reuse. Salt impacts were managed on-site by installing containment systems. The project is significant because it was completed for the Province of Alberta, who are the responsible party in this case and are also the regulatory body. This shows the Province's support of the Brownfields development concept and the idea of transition of environmental responsibilities. It is also significant because the property is the only remaining industrial land in Grande Prairie, a fast growing northern centre for natural gas exploration. Redevelopment of the property ultimately conserves the natural areas and farmland that surround Grande Prairie.

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1 Introduction

1.1 Background

Komex International Ltd. and Hazco Environmental Services Ltd. (the Joint Venture) entered into an agreement with the Province to purchase and remediate the former Alberta Transportation maintenance yard (Site), which comprises a 21.8 hectare subject property that is located in the industrial area of Grande Prairie, Alberta (Figure 1). The Site was used as a small refining facility from 1956 to 1964, producing gasoline, stove oil, diesel fuel and oils. In 1964, the Province purchased the Site for use as a transportation maintenance yard. It operated as such until the 1990's when activities started to wind down. Environmental impacts associated with the refining operations were noted at the time and were further characterised from 1989 to 1997. In 1999, Alberta Infrastructure, a division of the Alberta government and owner of the Site, initiated a process to sell the Site to a remediation/development company with the requirement to complete specific remediation. Komex/Hazco was selected as the successful bidder in 2000 and an Agreement to purchase and remediate was signed in 2001. The Site has been remediated and is in the process of being re-developed for light industrial and commercial uses.

The project is unique in that it involves an agreement between private companies, 2 departments of the Alberta government, and the City of Grande Prairie, to implement a Brownfields remediation program to return the Site to productive industrial use. The project was initiated at a time when environmental guidelines for site clean-ups in Alberta were in a state of change, requiring the Province to 'select' remediation criteria appropriate for subsequent industrial use from an array of federal and provincial guidelines. The project is also unique in

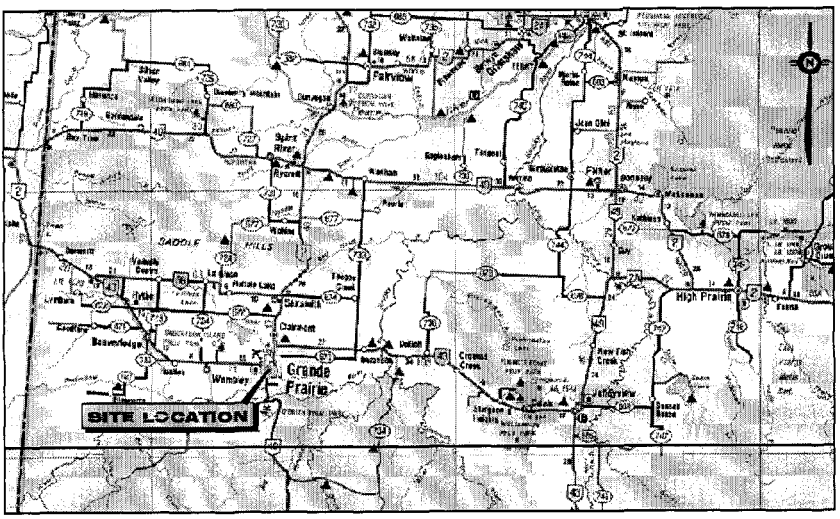


Figure 1: Site location map

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that it allowed for on-Site risk management of salt contamination, which is a regulated substance in Alberta.

1.2 Remediation and development agreement

The idea to sell the Site as a potential Brownfields development was initiated by the Province as part of a program to consolidate its maintenance operations and sell lands no longer needed. The process of bidding involved pre-qualification of 3 bidders, followed by selection of the successful bidder through conventional tender. The process of qualifying required demonstration of financial, environmental and development qualifications. The bid and selection process involved submission of financial terms and a comprehensive remediation plan consistent with the requirements of the bid form. The eventual Agreement included the following aspects:

- subsequent land use was restricted to industrial;
- remediation criteria and implementation of the comprehensive remediation plan were specified as part of the contract;
- the Province remained responsible for off-Site impacts;
- the Joint Venture became responsible for on-Site impacts;
- remediation was to occur over a specified period of time; and
- assurances were documented in an Indemnification which was attached to the Agreement as a separate Schedule.

All conditions specified in the Agreement and associated schedules have been fulfilled by the signing parties.

1.3 Remediation criteria

The Site was remediated and re-developed for industrial and related commercial use. To this end, the Province specified remediation criteria for the Site as part of the Agreement. In general, the lands are expected to support light and heavy industrial activities with a few landscaped areas that are expected to support an ecological function. Initially, an agreement with the Province cited the following remediation criteria for these areas of the Site.

- Provincial storage tank standards for bulk and specific hydrocarbon compounds.
- Federal standards for industrial lands for other compounds.

In accordance with the agreement with the Province, the remediation criteria included reducing E.C. < 4 dS/m, within 1.5 m of the ground surface in areas expected to maintain an ecological function. In other areas, the remedial objective was to manage salt impacts on Site such that the salts did not spread onto adjacent lands or impact areas that are expected to maintain an ecological function.

1.4 Environmental investigations

Investigations and studies of the Site were completed on behalf of the Province in preparation for sale and/or decommissioning of the Site. Knowledge of the Site history and related environmental impacts was developed through these

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studies as well as additional investigations completed by the Joint Venture in preparation for entering into the Agreement. Together, the studies indicated the presence of salt and hydrocarbon impacts on-Site, as well as the potential for off-Site migration of salts to the south and west at the south end of the Site, and to the west at the northwest corner of the Site.

2 Site description

2.1 General

Grande Prairie is a robust and growing community that serves as the northern Alberta centre for agriculture, petroleum exploration and production, and forestry. Despite its rural location, the resource activity in the area is taxing the available industrial space in the City, to the extent that development of natural lands will be required to meet the ongoing demand. Hence, remediation and redevelopment of the Site was key to putting the lands back into service, improving the City's tax base and reducing the pressure to develop otherwise productive agricultural lands.

The Site is situated in light industrial and commercial lands within the City's original core and adjacent to Wapiti Road, a major highway serving lands to the south of Grande Prairie.

2.2 Site topography and drainage

The topography at the study site is relatively flat to slightly undulating. The highest elevations occur on the west side of the property and the ground surface slopes toward the northeast and southward. Total relief is on the order of 2 metres over the 21.8 hectare area. Surface drainage is controlled by the local topography, with site runoff trending towards the south and northeast. A stormsewer system was originally installed over the southern portion of the Site to service the former highway maintenance yard and discharge to the City's stormsewer system which is located on 84th Avenue and Wapiti Road.

2.3 Site geology

The surface soils are primarily composed of fill material (sand and gravel, or sandy, silty clay) and native soils (sandy clay). The fill material most likely represents foreign material transported to the site during facilities construction and site operations. Previously developed areas comprising approximately 70% of the Site had been covered with up to 2 metres. In addition, lagoons and pits associated with the former refinery had been filled in.

Across the site, glaciolacustrine clay underlies the fill and native soils to a depth of approximately 6 m below ground surface (bgs). The clays are typically varied with alternating light brown silty layers and dark grey clay layers up to 5 mm thick. Occasionally, the clay contains thin sandy layers. The top portion of the clay appears weathered, as evidenced by its brown colour, and contains vertical fractures and visible plant roots.

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Beneath the layer of lacustrine clay is a grey, pebbly, clay till. This material is dense, compact, and contains minor sand and gravel lenses. In some locations, the upper portion of the till (2 m or so) is moderately to highly weathered and has a reworked appearance. In these particular areas, the till is fractured and the fracture zones are oxidised to a reddish brown colour. The fracture orientation is predominantly vertical to sub-vertical, with the occasional horizontal fracture. The fracture infilling material consists of light brown rusty material or white gypsum crystals. The till is described as being dry with no visible moisture except along the occasional sand seam or highly weathered fracture. The depth of the base of the till exceeds 15 m bgs.

2.4 Site hydrogeology

There are two main water-bearing intervals in the drift sediments covering this site. The uppermost interval is situated within the fill material and weathered portion of the glaciolacustrine clay. Hydraulic conductivities in this interval are typically on the order of 10^{-7} m/s as measured by single well response tests. The deeper water-bearing interval is confined to the glaciolacustrine clay, and represents a more sluggish interval, with wells requiring up to one year to recover. Hydraulic conductivity values calculated for wells completed in this material ranged from 6.5×10^{-11} to 3.2×10^{-10} m/s. Based on these values, the clay represents an effective containment layer protecting deeper water-bearing intervals from contamination originating from above. In essence, the pits and lagoons excavated into this clay would have their fluids contained within the area, much like a bathtub, due to the very low permeability of the surrounding material. Anticipated lateral groundwater flow velocities in this interval will be negligible compared to the upper fill material.

The Site is assumed to be in an area of groundwater recharge (downward flow direction) because there are no areas of groundwater discharge apparent in the immediate Site vicinity. The containment properties of the low permeability clay layer blanketing the site will impede the downwards component of groundwater flow. There is no groundwater use in the vicinity of the Site.

2.5 Pre-remediation condition

2.5.1 Soils

Contaminated conditions within the soils of the Site were determined by conducting geophysical surveys over the entire Site and by drilling and sampling approximately 100 boreholes and test pits. The following areas of hydrocarbon contamination were identified from these data (Figure 2):

- a former crude oil bunker lagoon at the north end of the property that was associated with the former refinery;
- a former wastewater lagoon at the south end of the property that was associated with the former refinery;
- an underground storage tank associated with the former maintenance yard; and
- a foundation area associated with the former hydrocarbon processing facilities.

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The total volume of hydrocarbon contaminated soil was on the order of 25,000 m^3. Contamination in these areas is characterised by the following:

- the hydrocarbon fraction included light and heavy-end fractions up to 8% by weight;
- total BTEX concentrations were relatively low, generally less than 100 mg/kg;
- total phenols concentrations were relatively low, less than 0.5 mg/kg;
- PAH's were present in the former bunker and lagoon areas, at concentrations up to 10 mg/kg;
- elevated nickel and arsenic concentrations were observed, but were determined to be of natural original; and,
- all materials were classified as non-hazardous in accordance with Alberta Regulations and, hence, were suitable for disposal at conventional industrial landfills.

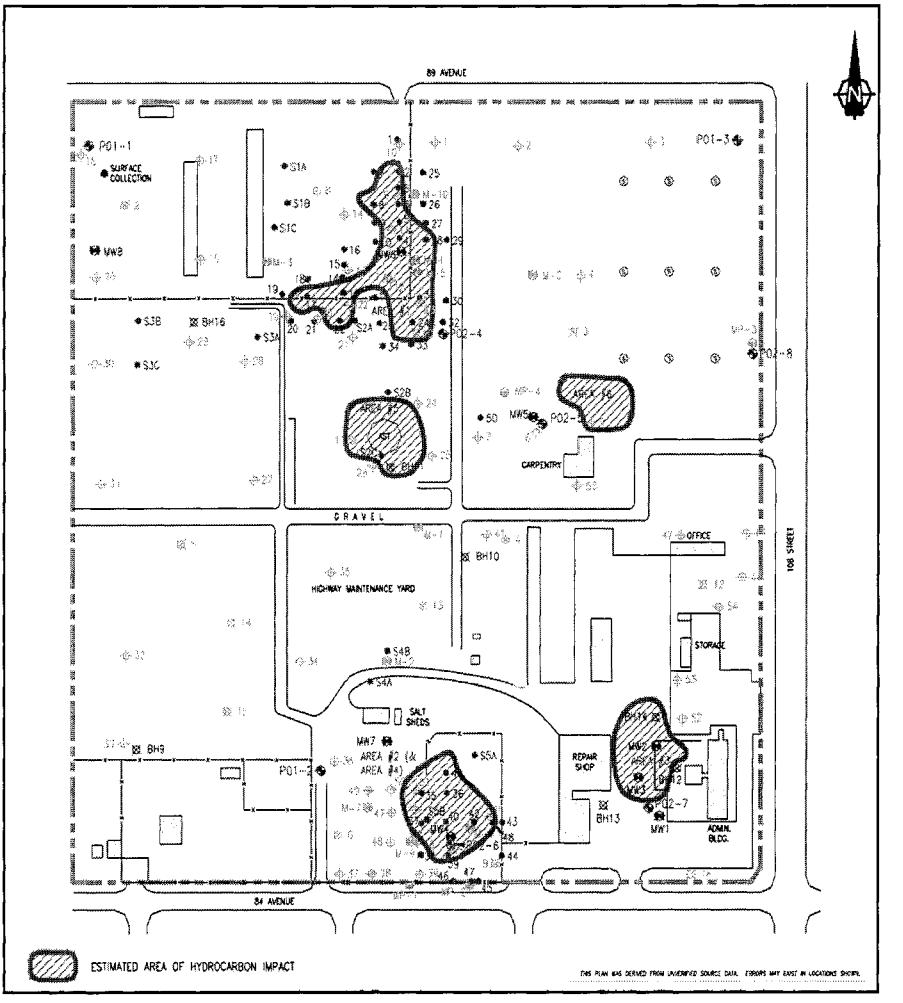


Figure 2: Site plan with all monitoring locations

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Salt contaminated zones were present in the northwest corner, where the salt was handled and stockpiled, as well as at the south end of the property, adjacent to the former salt shed. The total area of salt impacts exceeded 2 hectares, and the depth of impact varied from 1 to more than 3 m bgs. The size of the salt impact made removal impractical. Also, the salt impacts affect plant growth, which is not a significant issue for the subsequent industrial land use.

2.5.2 Groundwater

Hydrocarbon impact to groundwater was confined to the immediate areas of past hydrocarbon storage. The only exceedances of groundwater remediation criteria occurred in the monitoring wells installed within the contaminated area associated with the UST in the southeast corner of the Site (Figure 2). Additionally, the only significant zones of hydrocarbon impact to groundwater occurred in zones that were contaminated by hydrocarbons. These impacts were expected to be effectively addressed through the remediation of the hydrocarbon-impacted soils that served as the source of groundwater impacts. No exceedances of hydrocarbon remediation criteria occurred outside of the areas of hydrocarbon contamination that were excavated and either treated or disposed off-Site.

Significant salt impact to the shallow groundwater was noted in the vicinity of the former salt storage shed at the south end of the Site and in the northwest corner of the Site. Salinity impacts occurred within the range of naturally high groundwater mineralization, and are restricted to areas of past salt storage. Because the groundwater seepage velocities are so low, the risk of adverse effect to any ecological receptors is essentially zero. These data supported the position that salt impacts could be managed effectively on-Site.

3 Remediation

3.1 Remediation Program Overview

A formal remediation plan was submitted to the Province for formal review and approval as a condition of the Agreement. A copy of this plan was also submitted to the City of Grande Prairie and area stakeholders, such as adjacent landowners and businesses. The objective of the remediation plan was to establish 'equivalent land capability' in a manner that does not result in 'release of a substance that causes an adverse effect' as is defined by the Environmental Protection and Enhancement Act. These remedial objectives were met by implementing the following:

- excavating heavy-end hydrocarbon contaminated soils that could not be practically treated and disposing of these materials at an approved industrial landfill;
- excavating light-end hydrocarbon contaminated soils and treating these soils in an on-Site treatment area;
- managing salt impacted areas on-Site by constructing groundwater collection systems; and

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- dismantling and removing facilities and buildings that were no longer required or useful and disposing of the demolition debris in the Grande Prairie Landfill.

The remediation was completed over 1 year, from approximately April to October, 2001. The work was completed in a co-operative manner, by the Joint Venture partners, Hazco and Komex.

3.2 Verification program

3.2.1 Soils

Excavation limits were verified by collecting representative discrete samples and analysing for purgeable hydrocarbons, extractable hydrocarbons and BTEX. Salinity parameters and metals were also determined for approximately 1 in every 4 verification samples. A minimum of 1 verification sample was collected for every 500 m^2 of excavation area, accounting for both the excavation walls and base, and additional samples were collected whenever results were inconclusive.

Treated soils were verified by collecting representative composite samples and analysing them for purgeable hydrocarbons, extractable hydrocarbons and BTEX. The minimum sampling frequency was one sample per 500 m^3 of treated soils which correlates to approximately 5 representative samples per 0.3 meter lift. Additional samples were collected if results were inconclusive. Salinity and metals analyses were also completed where the treated soils were potentially impacted by salts and metals, such as those located at the north end of the former wastewater lagoon (approximately 1 in every 5 verification samples). The verification analyses were assessed against the remediation criteria specified in Section 1.4.

All samples were sealed in air-tight jars, refrigerated, and delivered directly to the laboratory under standard chain-of-custody protocols. All standard laboratory QA/QC procedures were followed and reported with laboratory data sheets. Based on the consistency of the results that were obtained through the program and the inherent variability of hydrocarbon concentrations in soil samples, duplicate sampling and analyses were completed on only a few samples. Analytical work was completed by Maxxam Analytics and/or ETL Laboratories of Grande Prairie, Alberta.

3.2.2 Groundwater

Additional groundwater investigations and monitoring was completed to confirm the absence of groundwater contamination in areas of possible past impacts and within and/or down-gradient of the areas of remediation, as follows:

- in the northwest corner of the Site;
- along the east side of the Site where previous investigations indicated the potential for impact;
- in the area of the former UST in the southeast corner of the Site;
- in the area of the former wastewater pond and salt storage shed; and
- in the area of the former crude oil storage.

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Analyses included full VOC scans, routine potability parameters and dissolved metals. Groundwater monitoring will also be continued in areas where active hydraulic controls are implemented as part of the remediation plan (in the northwest corner and in the area of the former salt storage shed).

4 Development

The land has been re-developed for industrial use in accordance with the layout shown in Figure 3. Based on existing sales agreements, approximately 75% of the lands have been sold or committed. The City of Grande Prairie has welcomed the efficient use of space within the its existing area of industrial development. The majority of purchasers and interested parties are existing businesses that are needing to expand or augment their existing facilities to meet the increasing demand for services in the area. Further, the Province has been able to sell and re-develop an unused facility in an efficient, reliable and responsible manner. The Joint Venture partners (Hazco and Komex) have been

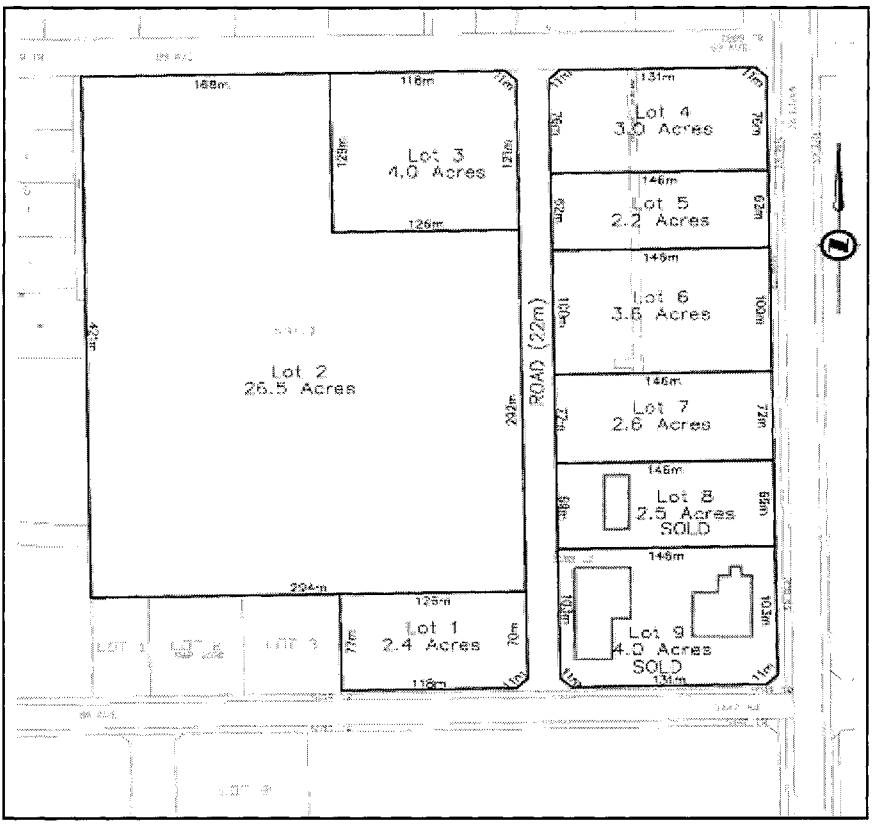


Figure 3: Plan showing proposed concept #12 of part of Plan 5102 LZ

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able to work to their respective area of expertise, at the same time as they initiated a new area of business. In essence, all participants in the process were able to realise the beneficial principles of a Brownfields development.