SITE C CLEAN ENERGY PROJECT

IMPERVIOUS CORE MATERIAL SOURCE

DEVELOPMENT PLAN

85TH AVENUE INDUSTRIAL LANDS

Doc EIS-1A-005
[Final]

Prepared for BC Hydro by

Tetra Tech

November 2012

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(by section)

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1.0 INTRODUCTION AND PURPOSE

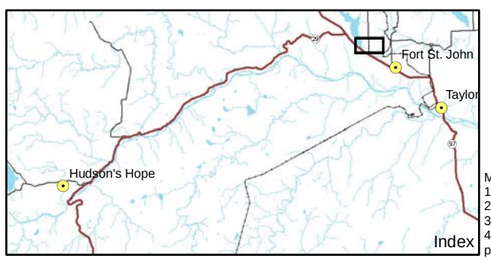
If the Site C Clean Energy Project (the Project) proceeds, it would require impervious core material for the proposed earthfill dam, approach channel lining and temporary cofferdams. The preferred source for the impervious material should:

- Be close to the dam to minimize haul distance
- Be high quality material

Impervious materials available locally include glacio-lacustrine silty clays and glacial tills (mixtures of gravel, sand, silt and clay laid down by glaciers). Glacial tills are preferred due to their superior engineering characteristics.

BC Hydro has identified the preferred source of impervious core material on what is referred to as the 85th Avenue Industrial Lands, located approximately 4.5 kilometres north of the proposed Site C Dam site. The lands are adjacent to the City of Fort St. John and within the boundary of the Peace River Regional District, as shown in Figure 1.1. The area of the 85th Avenue Industrial Lands is 98 hectares, bordered by 85th Avenue to the north, 100th Street to the east, Old Fort Road to the west, and extending approximately 780 metres to the south, as shown in Figure 1.1. This area contains sufficient glacial till to meet the Project's needs. Further details on the requirements of the earthfill dam are provided in Project Description (Section 4.3 of the EIS).

The objective of this plan is to: 1) facilitate environmental assessment approvals; 2) support permitting requirements; and 3) plan for guiding the use of the pit site during construction and operations.



Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Orthophotos created from 1:15,000 photos taken Aug 26th 2011; TRIM.

Legend

- 85th Avenue Industrial Lands Boundary
- Highway
- Road

1:35,000 0 1.25 km

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SITE C CLEAN ENERGY PROJECT

Figure 1.1: Location of the Proposed 85th Avenue Industrial Lands Impervious Core Source

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2.0 BACKGROUND

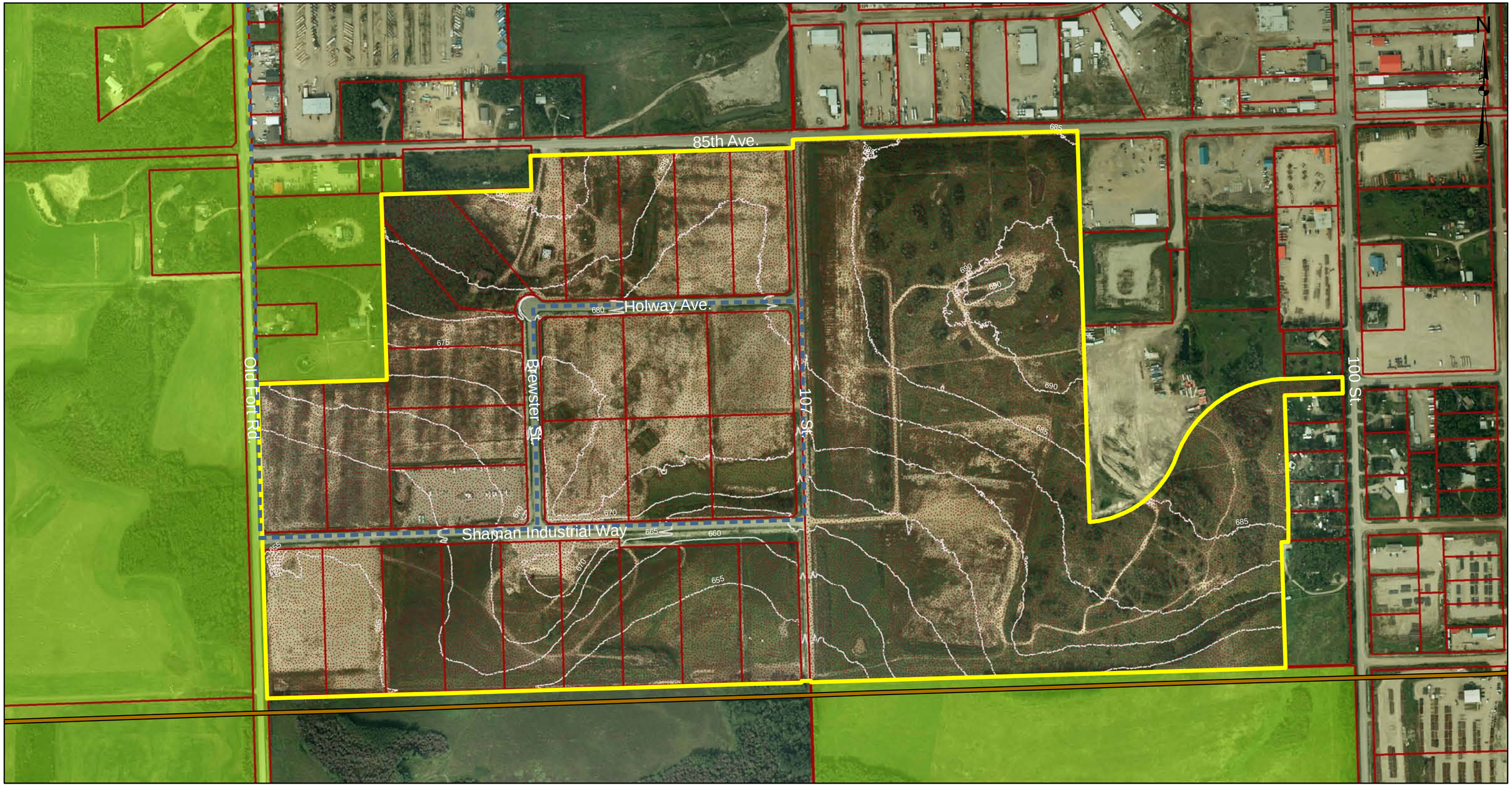
BC Hydro selected the 85th Avenue Industrial Lands as the preferred location for the impervious core material for the following reasons:

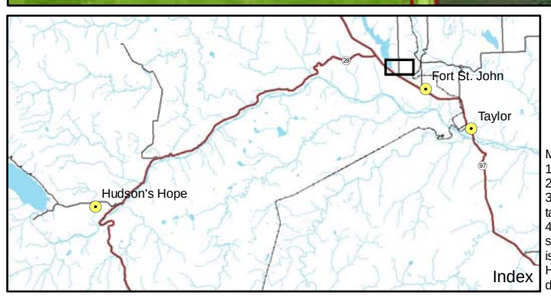
- The material met the quantity, quality and suitability requirements for impervious material
- The site includes materials that would be suitable for constructing other parts of the dam, such as the approach channel lining and temporary cofferdams
- The site is close to the proposed Site C Dam (approximately 4.5 kilometres)

Testing of the material from the 85th Avenue Industrial Lands has confirmed the following soil characteristics:

- Maximum particle size of 150 millimetres
- The material consists of 31.5 per cent gravel sizes, 39 per cent fines and the remainder sand
- Compacted density is 2,050 kilograms per cubic metre
- The optimum moisture content for the material is approximately 11 per cent
- The water table is variable, ranging from 11 metres to 32 metres below existing grade

Most of the site is cleared with the northwest corner forested (Figure 2.1). The site is zoned for light industrial use. The eastern half of the site is undeveloped. The western half of the site has a combined 1,500 metres of paved road developed to BC Ministry of Transportation and Infrastructure standards (107th Street, Shaman Industrial Way, Brewster Street and Holway Avenue) with natural gas and overhead electrical services. Figure 2.1 illustrates the current land use and infrastructure.





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Orthophotos created from 1:15,000 photos taken Aug. 26th 2011.
4. Property boundary locations are best available but should be considered approximate. Property information is a combination of surveyed data representing BC Hydro's current ownership records and ICIS data. Property data is current as of Sept 24th, 2012.

Legend

- 85th Avenue Industrial Lands
- Agricultural Land Reserve
- Natural Gas Line
- Transmission Line
- BC Hydro Owned (Leased)
- BC Hydro Owned
- Crown Land
- Private Land
- Contour - Major 5m

1:5,500 0 250 m

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Figure 2.1: 85th Avenue Current Land Use and Infrastructure

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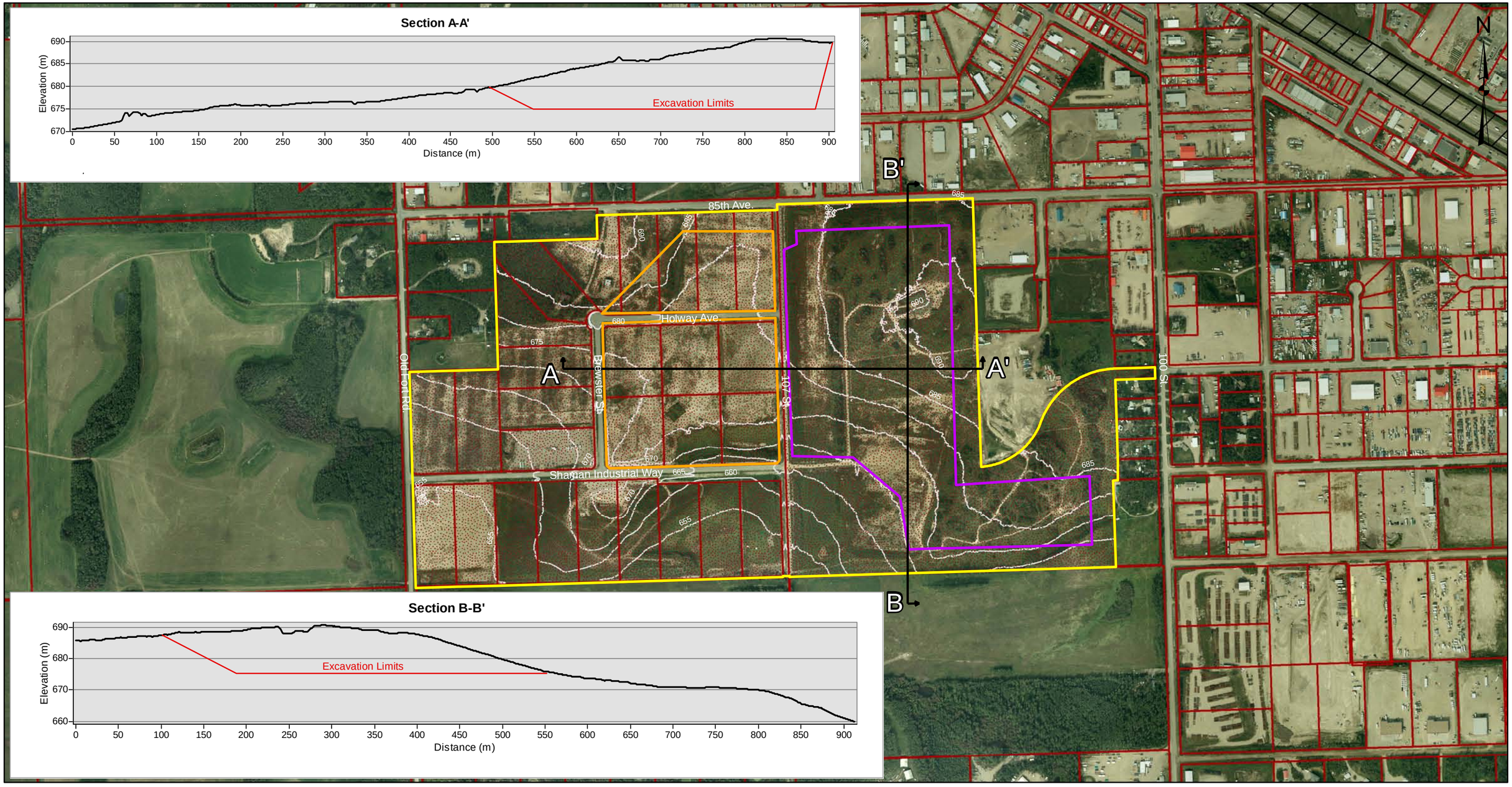
3.0 DEVELOPMENT PLAN BASIS

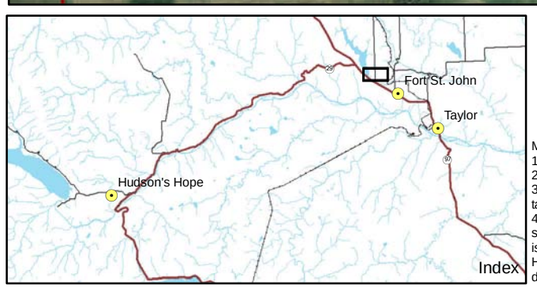
The development plan for the source of impervious core material is based on the following information:

- A drill and test pit program conducted in 2009 focused on confirming potential sources for obtaining the impervious till material. A total of 109 auger holes and seven test pits were completed.
- A further drill and test pit investigation was conducted in 2010 in the 85th Avenue Industrial Lands. A total of 15 auger holes and eight test pits were completed.
- It was determined that the material within the 85th Avenue source is within the ideal range for fines content for the dam core, the material is at a depth up to 30 metres, is thinly covered with overburden, and the material is consistent in nature.
- Preparations in the 85th Avenue Industrial Lands would occur in Year 2 and Year 3 concurrent with construction of the conveyor belt system which will transport the material to the dam site.
- The total excavated material would range from 2,921,000 cubic metres to 4,866,000 cubic metres depending on quality and processing requirements of the source.
- The 85th Ave site would provide 2,921,000 cubic metres for the dam core, and the remaining 414,000 cubic metres of till would be sourced from the dam site excavations.
- The yearly requirements beginning in Year 4 and ending in Year 7 would be 100,000 cubic metres, 1,521,000 cubic metres, 975,000 cubic metres, 325,000 cubic metres, respectively.
- Material placement would occur during the seasonal placing windows between May and October.
- A conveyor belt system will be used to transport the till material from the pit to the dam site.
- The final excavation is to be at an elevation of approximately 675 metres (as shown in Figure 3.1)
- The maximum slopes for excavation and embankments for overburden and surplus storage would be 2H:1V.

Bulking factors were applied to excavated and quarried volumes. A bulking factor represents the volume increase (expressed as a percent) that a material undergoes when removed from its natural state, and is applied to estimate the total volume of quarried or excavated material. Different materials have different bulking factors based on their ability to reconsolidate once excavated. A bulking factor of 1.2 means that a volume of naturally existing material would undergo an increase of 20 per cent once excavated and placed in its final location. Based on an understanding of similar materials within the province the following bulking factors were applied:

- The impervious till material bulking factor would be 1.1.
- The overburden bulking factor would be 1.0.





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Legend

- 85th Avenue Industrial Lands Boundary
- BC Hydro Owned (Leased)
- BC Hydro Owned
- Crown Land
- Private Land
- Additional Excavation Area
- Main Excavation Area
- Contour - Major 5m
- Section Profile

1:8,000 0 250 m

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Figure 3.1: Predicted Excavation Extents

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4.0 85TH AVENUE INDUSTRIAL LANDS – OPERATIONS

4.1 PRODUCTION AND SCHEDULING ESTIMATES

The material production at the 85th Avenue Industrial Lands would be based on the scheduled impervious core material requirements at the proposed Site C Dam site (reference EIS Volume 1, Section 4.3). The development and excavation of the site would take place over a six year period. Preparation at the site would be required in order to prepare the area for material excavation. It is anticipated that preparation work at the 85th Avenue Industrial Lands and for the proposed haul route would be completed by early Year 2 in preparation for the commencement of transporting material.

The preferred excavation area would be east of 107th Street, which bisects the site. If this area does not produce the required quantities, excavation west of 107th Street would be required to obtain the remaining material. This approximately 20 hectare area is noted as "Additional Evacuation Area" in Figure 4.1.

Other activities and uses in the western half would include installation of facilities and infrastructure. The property would be fenced and gated to maintain site and public safety. Figure 4.1 illustrates a proposed development.

Placement of the impervious core material would begin in the spring of Year 4 and continue at a consistent rate until early fall of Year 7. Material placement (e.g., excavation and loading) would also occur during the seasonal placing windows from spring to early fall. The schedule would be weather dependent, where rain and frozen ground conditions would decrease or stop production in order to maintain quality. Table 4.1 illustrates the volumes of material that could be excavated and hauled during the four-year haul period.

Table 4.1 Volume of Impervious Materials Placed and Compacted from 85th Avenue Industrial Lands

Year of Operation	Volume Placed (compacted m^3)
4	100,000
5	1,521,000
6	975,000
7	325,000
Total	2,921,000

Based on the estimated 2,921,000 cubic metres of impervious core material required for the proposed dam construction, it is estimated that till would be excavated 6 days per week, 12 hours per day between the months of May and October (approximately 170 days per year), for four years (Year 4 through Year 7).

4.2 OPERATIONS

The province's Aggregate Management Principles (MOEM 2009) have been established to ensure that aggregate activities are undertaken in compliance with health and safety standards and environmental protection requirements. The reference documents are:

- Aggregate Operators Best Management Practices Handbook for British Columbia, 2002, Ministry of Energy and Mines (MOEM 2002)
- Health and Safety: A Practical Guide for Aggregate Operations, 2007, Ministry of Energy, Mines and Petroleum Resources, Mining and Minerals Division (MOEM 2007)

The annual placed volumes that would be hauled to the proposed dam site are shown in Table 4.1. Total extraction volumes would be based on the suitability and quality of the materials as they are processed. The unsuitable materials would remain within the site and would be stockpiled or leveled in conformance with the future land uses.

Potable water for the office and service area, and water to be used for moisture conditioning and dust control, would not be a substantial volume and would be brought to the site from an offsite location. Alternatively, a well may be established for the water supply.

The equipment required for operations would be as follows, with the number of equipment pieces to be determined at a later stage:

- Loaders and trucks or Scrapers (to remove and stock pile topsoil, excavate and haul material to the stockpile and moisture condition the material)
- Bulldozers (to push scrapers or material for stripping stockpiles and berm barriers)
- Disking Equipment (to mix and moisture condition the material)
- Loaders (to load material onto hopper or directly onto conveyor)
- Water Trucks (to control dust and add moisture to material as required)
- Personnel Site Pick-ups (for onsite mobility)
- Service vehicle (mechanic, fuel trucks)

The borrow area would operate starting with the extraction from the highest lands on the north eastern portion and remove the material in horizontal layers across a pit face.

Extraction would not require any drilling or blasting and, therefore, no explosives will be used. Only a relatively small volume of materials would require processing, such as screening, prior to being removed from the site. More than one area is predicted to be actively excavated with room in between to maintain equipment manoeuvrability and production rates. This would allow blending of the materials, if required, to produce a consistent material to meet the gradation specification required for the dam. The 85th Avenue Industrial Lands would include stockpiles for materials requiring moisture control, and stockpiles for materials ready to be moved to the dam site. The impervious core material would be transported to the proposed dam site by the conveyor belt system.

Site reclamation of the 85th Avenue Industrial Lands would be completed in Year 7. Section 4.5 of this development plan addresses site reclamation.

4.3 ACCESS

Public access to the 85th Avenue Industrial Lands would be restricted during the extraction operations. Safety issues on the site would be related to the increased project traffic on the 85th Avenue Industrial Lands. Traffic disruption caused by the dedicated conveyor belt system would be limited to the two public roads near the borrow area: Old Fort Road and 240 Road (reference Volume 4 Appendix B Project Traffic Analyses Report). Underpass structures would be constructed for the conveyor belt system at Old Fort Road and at 240 Road to avoid traffic conflicts. With the installation of the underpasses, once the material has left the site and is on the conveyor belt system, the overlap with the public road system and area traffic would be removed.

4.4 SAFETY AND ENVIRONMENTAL MANAGEMENT DURING OPERATION

In order to maintain worker safety and in consideration of adjacent lands, a safety and environmental management plan would be developed by the pit operator to manage safety, visual, noise, and operational needs.

The area would be surrounded by a fence along the entire perimeter. Gate access would be installed at two locations; at Shaman Industrial Way and Old Fort Road, and at 107th Street and 85th Avenue as shown on Figure 4.1.

As shown on Figure 4.1, berms would be constructed to provide a visual barrier and act as a noise attenuation feature. Other berm locations within the site may be considered as additional visual and noise attenuation features. The 85th Avenue Industrial Lands are located within the regional district so noise bylaws would not be applicable outside of the municipal boundaries. Best management practices in noise and visual attenuation will be implemented during the operational period.

Portable toilet facilities would be used within the borrow area and near the project site offices. These facilities would be maintained as required. The planning and installation of the lighting system required for the safe operation of the site would follow guidelines in the Aggregate Operators Best Management Practices Handbook (MOEM 2002). Lighting would be used to facilitate safe and secure operations for the extraction, processing and stockpiling locations while minimizing offsite visual nuisance. Lighting would be needed inside buildings and at their entrances, at working extraction faces, along haul roads, at stockpiles, and for equipment and vehicles. Lighting would be directed downward or shielded by buildings to minimize off-site spill and glare, and would be minimized during the off season. The lighting of road junctions and site entrances would be kept to the minimum required for safety purposes.

Other best management practices would include:

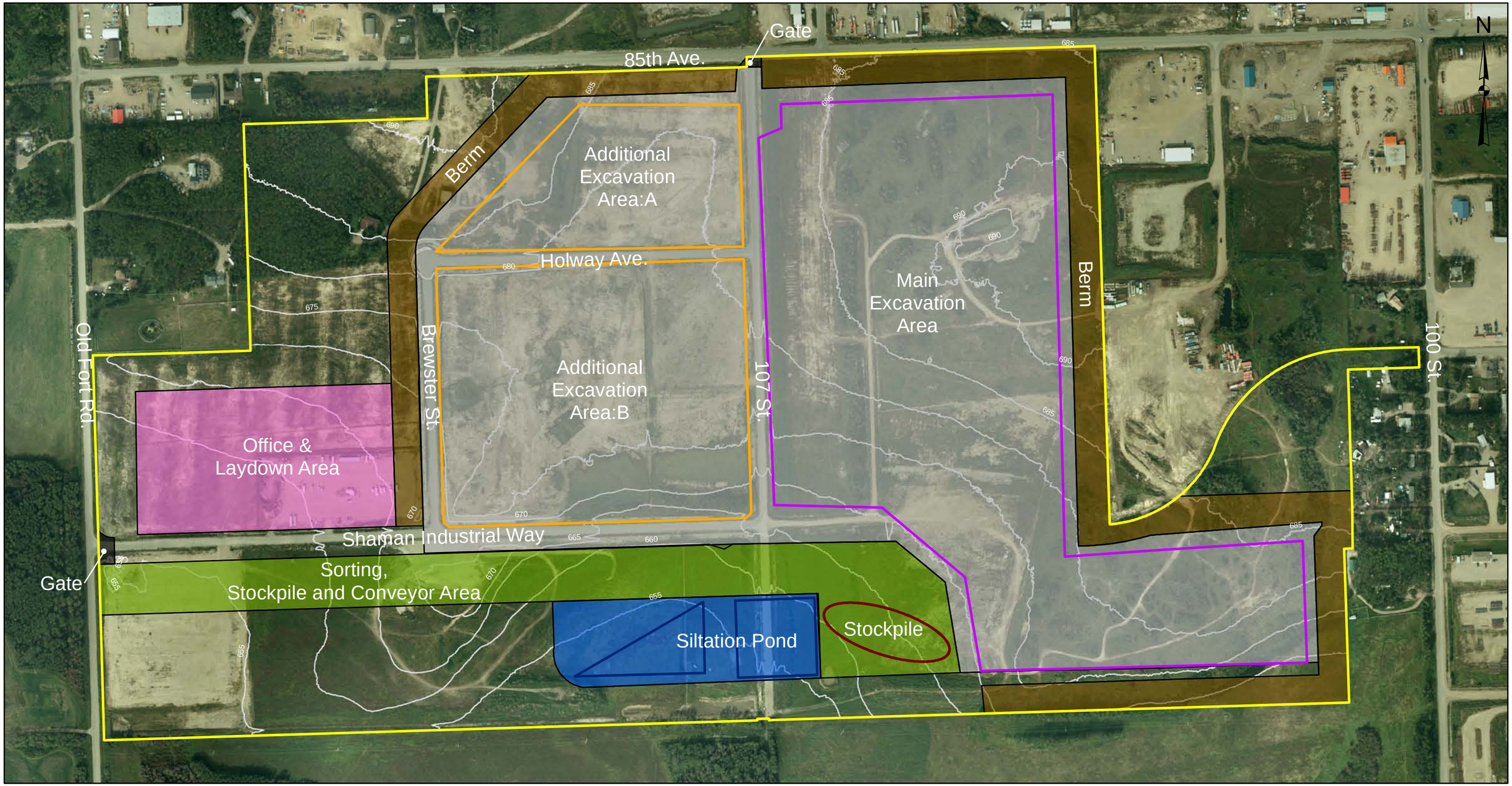
- Sediment control, and oil control separation
- Control of noxious weeds through vegetation cover or seeding, and the provision of a truck wash station as required

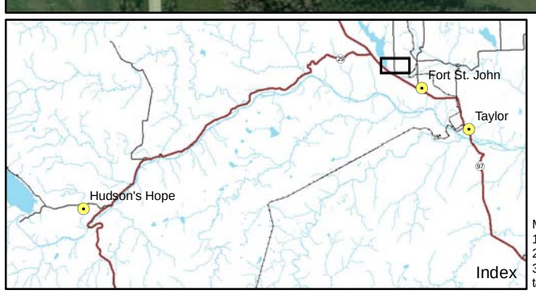
- Maintenance of road surfaces to reduce vibration
- Control of air emissions and wind generated dust

4.5 SITE RECLAMATION AND FUTURE USE

As the operation progresses, slopes would be stabilized and drainage features would be established to control drainage. Seeding to control noxious weeds would be done on soil slopes and surplus material stockpiles and berms.

The site is located within the Peace River Regional District and adjacent to the City of Fort St. John, the future use of the site should be considered in relation to the official community plans of both the regional and local government.





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Orthophotos created from 1:15,000 photos taken Aug. 26th 2011.

Legend

- 85th Avenue Industrial Lands Boundary
- Gate
- Office & Laydown Area
- Potential Area of Extraction & Laydown
- Siltation Pond
- Sorting, Stockpile, and Conveyor Area
- Berm
- Main Excavation Area
- Additional Excavation Area
- Stockpile
- Siltation Pond
- Contour - Major 5m

1:4,500 0 250m

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Figure 4.1: Proposed Development of 85th Avenue Industrial Lands Impervious Core Source

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5.0 REFERENCES

Ministry of Energy, Mines and Petroleum Resources, Mining and Minerals Division (MOEM). 2009. November 2009. Aggregate Management Principles.,http://www.empr.gov.bc.ca/Mining/Aggregate/BMP/Pages/default.aspx

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