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COMPLETION REPORT FOR MATSQUI AND VEDDER DIKE UPGRADES ABBOTSFORD, BC

Submitted to:

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1.0 BACKGROUND AND PROJECT SETTING

In March 2007, the British Columbia Government approved a Provincial program to provide funding for urgent mitigative dike works in anticipation of the 2007 Freshet. The funding was allocated due to a larger than average snow pack in the interior of the province and an anticipated 1 in 100 year flood event on the Fraser River. The program allocated $4 million in funding to the City of Abbotsford (City) for the upgrade of the City's existing dikes. In addition to provincial funding, the City allocated an additional $4.7 million in funding for the Matsqui and Vedder Dikes. The total project budget was split with an allocation of $7.45 million for the Matsqui Dike and $1.25 million for the Vedder Dike respectively.

The Matsqui Dike was originally constructed between 1920 and 1922 and has since been upgraded several times in addition to regular maintenance by the City. The dike extends approximately 11.5 km along the southern bank of the Fraser River from the Matsqui First Nations Reserve off Harris Road at the west end, to Page road at the east end.

The section of the Vedder dike that lies within the City's jurisdiction is located on the west side of the Vedder Canal and extends from the Keith Wilson Road Bridge at the south end, to the Barrowtown Pump Station overpass at the east end, intersecting the Trans-Canada Highway Bridge and adjoining the bridge embankments on either side.

2.0 REVIEW OF AVAILABLE INFORMATION

Schemes for diking and draining of the low lying areas around Sumas and Matsqui had been considered since 1875 however it was not until the Land Settlement Board took over responsibility from the Diking Commission in 1918 that planning for the current dike infrastructure was proposed. The Matsqui and Vedder Dikes were first constructed between 1920 and 1922 in conjunction with the Barrowtown Pump Station using a large electric suction dredge and dragline to move material and baffle boards and an earth bulkhead to form the dike section. The works were completed in 1925.

The original design of the Vedder dike allowed for a crest elevation of 11.98 m; however, the location of this elevation was not identified in the original construction and subsequent dike upgrades completed in 1948 and 1949 by the Valley Diking Board indicated a re-grading of the side slopes to 1V to 4H to 9.14 m with a crest elevation of 10.36 m.

Following extensive investigation and research in 1977, a second upgrade was completed on the dikes in 1978 providing additional foundation and edge stabilization and regrading

of the crest to the current level of 10.36 m on the Vedder Dike and between 8.48 and 9.81 m (west to east) on the Matsqui Dike.

3.0 CONSTRUCTION MANAGEMENT AND DESIGN APPROACH

Due to the significant site presence and machinery requirements during the construction phase of the project, the City closed all public access locations and the public trail system along the dike and provided 24 hour security patrols to prevent members of the public from accessing the site outside designated work hours. In addition, the Greater Vancouver Regional District (GVRD), at the request of the City, closed all regional parks accessed from the Matsqui dike for the duration of the project.

Construction of the dike upgrade, hiring of trucks, engagement of contractors and equipment and appointment of consultants was managed by the City. The City awarded contracts for the bulk earthworks to Strohmaier's Excavating Limited and Marpaul Construction for the Matsqui Dike with Double M Contracting for the Vedder Dike. Separate contracts for civil works at the JAMES PCC, installation of new control gates and fencing works were issued by the City. The contract for civil works at the JAMES PCC was awarded to Martens Asphalt.

Golder Associates Ltd (Golder) was retained by the City to provide geotechnical engineering services for the proposed dike upgrades including input to the design and construction methodology and construction monitoring and materials testing on the Matsqui dike and construction monitoring on the Vedder dike. Technical Memoranda were issued by Golder and are included in Appendix I.

This report shall be read in conjunction with "***Important Information and Limitations of This Report***" which is appended following the text of this report. The reader's attention is specifically drawn to this information as it is essential that it is followed for the proper use and interpretation of this report.

All construction on the Matsqui Dike and Vedder Dike upgrades was completed between April 10 and May 31, 2007.

4.0 GENERAL SUBSURFACE CONDITIONS

General subsurface conditions at the dike sites have been inferred from available information and Golder's experience in the area. No detailed field investigation to determine the subsurface conditions at the sites was completed prior to the commencement of work on the dike upgrades with the exception of some site-specific investigation carried out at the JAMES Pollution Control Centre (JAMES PCC).

4.1 Surficial Geology

The 1:50,000 scale Fraser Valley sheet of the British Columbia Surficial Geology series of maps indicates the majority of the Matsqui, Sumas and Vedder Dikes are underlain by Fraser River Sediments comprising sandy loam and loamy sand with some silt, clay and minor organic sediments overlying glaciofluvial sand and gravel, deposited by melt water streams.

4.2 Groundwater

Groundwater levels along the alignment of the Matsqui and Vedder Dikes are directly influenced by water levels in the Fraser River. Historical information indicates the highest recorded water level in the Fraser River occurred during the flood in June 1894 at a measured elevation of 9.85 m GSC. Details of other peak water level events are included in Table 1 below.

Table 1
Historical Fraser River Peak Water Level Events

Date	Fraser River Elevation (m GSC)
1882	9.24
June 1894	9.85
1903	8.47
May 1948	9.11

During the construction period from 10 April to 31 May 2007, measured water levels in the Fraser River varied between about 1 m and 6 m GSC with the peak water level occurring between June 9 and 11, 2007. A plot of recorded water levels at the Mission, B.C. monitoring station (obtained from the Ministry of Environment website) during the 2007 Freshet period is shown in Figure 1 below.

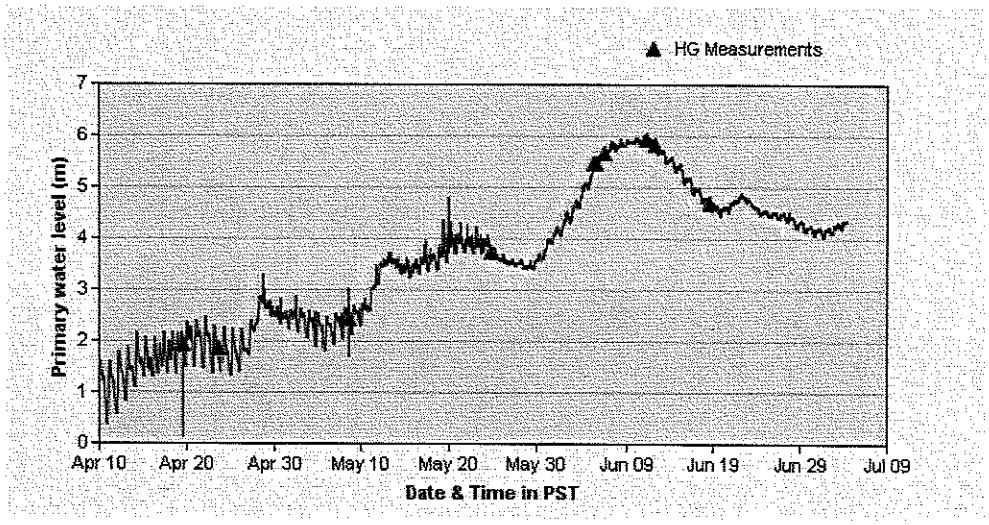

Figure 1: Recorded Water Levels in the Fraser River Between April and July, 2007 (Monitoring Station at Mission, B.C.)

5.0 DIKE FILL MATERIAL SPECIFICATION

A gradation specification for proposed fill materials was provided by Golder to the City (see Technical Memoranda in Appendix I) for all fill imported to the site to be used for the proposed dike upgrade. The specification was modified from the Master Municipal Specification for Pit Run Gravel to allow for additional fines to control seepage through the dike during a flood event whilst ensuring the material was able to be placed and compacted during inclement weather conditions. A fill material with a higher fines content (clay content) would have been preferable to reduce permeability; however, compaction of such a material would have been difficult, if not impossible, to achieve in wet weather conditions which occurred during the construction period.

The gradation specification for the proposed fill materials as used during the dike upgrades is summarized in Table 2 below:

Table 2
Gradation Specification for Imported Dike Fill

Sieve Designation	Percent Passing
75 mm	100
50 mm	70 - 100
25 mm	50 - 100
4.75 mm	22 - 100
2.36 mm	10 - 85
0.075 mm	5 - 10

Dike fill material complying with the gradation specification and used for the dike upgrades was sourced from a number of local suppliers. In some cases exceptions were made where the fill was not acting as fill material to extend the lower permeability core of the existing dike.

- Valley Gravel – Bradner Road Pit (Quantity: 122,199 tonnes): 25 mm minus sand and gravel with 11% fines. This material was used to widen and raise the dike;
- LaFarge Gravel – Ward Road Pit (Quantity: 112,123 tonnes): 75 mm minus crushed rock with less than 5 % fines. This material was used to build up and widen the dike on the land site but was not considered suitable for use to raise the lower permeability zone of the dike above crest level;
- Columbia National - Quadling Road Pit (Quantity: 36,112 tonnes): 75 mm minus crushed rock and gravel containing 14% fines. This material was used exclusively on the Vedder dike with some useage on the Matsqui dike as it remained workable during rainfall events;
- Little Rock Quarry – Ross Road (Quantity: 28,525 tonnes): 75 mm screened pit run used as bulk fill to widen and build up the dike on the land side;
- 4B Development Pit (Quantity: 13,557 tonnes): 75 mm minus pit run gravel containing 18 to 20% fines. Due to the high fines content this material was used mostly in dry weather conditions and was blended with crushed rock where required;
- Mainland Gravel – Keeping Road Pit (Quantity: 8,730 tonnes): 75 mm minus crushed rock with 2% fines. This material was used as an initial lift on the Matsqui dike and as required to provide a trafficable surface for construction traffic on the land side of the dike; and
- Eagle Mountain Development Site (Quantity: 8,120 tonnes): 75 mm pit run gravel containing approximately 28% fines. Due to the high fines content this material was used primarily to raise dike, but in dry weather conditions.

Results of grain size distribution analyses carried out by Valley Testing Services on samples taken from various local pits and quarries, listed above, are included in Appendix VIII.

The new dike fill materials were required to be placed in loose lifts not exceeding 300 mm in thickness and were to be compacted to at least 90 per cent of Modified Proctor maximum dry density (ASTM D1557). Periodic density testing of the placed fill was carried out throughout the construction program by Golder with Valley Testing Services providing density testing for fill placed at the JAMES PCC (see Appendices VI and VII).

From the results of the laboratory testing, an average Modified Proctor value of 2271 kg/m^3 was calculated for pit run fill.

6.0 MATSQUI DIKE

6.1 Design concept

In a Technical Memorandum to the City dated April 9, 2007 (see Appendix I), Golder provided a concept design which outlined a proposed construction methodology including site preparation requirements and construction considerations necessary to raise the dikes to a proposed design elevation varying between 9.18 m at Station 1+000 to 10.15 m at Station 12+240. The proposed methodology was designed in accordance with the recommendations made in the Northwest Hydraulics Report to the Fraser Basin Council dated December 2006 entitled "Final Report Lower Fraser River Hydraulic Model", that the crest of the existing dike be raised to provide 0.6 m freeboard in the event of a predicted 1 in 100 yr flood event. Key aspects of the design included:

- Removal and stockpile of topsoil and sod from the land side of the existing dike;
- Construction of successive 300 mm thick lifts, benched into the existing land side slope and compacted to at least 90% Modified Proctor maximum dry density (ASTM D1557) to design level;
- Scarifying the existing riding surface of the dike prior to placement of fill lifts on top to provide a "key in" effect;
- Maintaining a 3.6 m crest width at the top of the dike;
- Maintaining a 2.5H to 1V slope on new land side and water side slopes; and,
- Replacing topsoil and sod on the land side slope following widening and raising of the dike sections.

At the Glenmore Slough, a design involving the construction of a two row high gravity Lock Block wall was adopted to allow the crest of the dike across the slough to be raised to the design elevation. Backfill behind the wall was to remain at the existing slope (approximately 2.5 horizontal to 1 vertical).

At Station 11+820 a two-row high gravity Lock Block wall was constructed within the dike cross section to allow continued access to the existing watermain line air valve chamber located at the toe of the existing dike slope.

6.2 Construction

The dike project area was divided into a number of smaller work sections which provided easy access and egress from the dike for placement of fill. The break down of sections and the responsible earthworks contractor for each is shown in Table 3 below:

Table 3
Breakdown of Work Sections on Matsqui Dike

Station		Reference Location		Contractor
Start	End	Start	End	
1+000	1+560	Harris Rd	CN Railway	Marpaul Construction Ltd.
1+600	2+080	CN Railway	Glenmore Rd	Marpaul Construction Ltd.
2+080	2+560	Glenmore Rd	JAMES PCC	Marpaul Construction Ltd.
2+560	3+920	JAMES PCC	Gladwin Rd	Martens Asphalt Ltd
3+920	5+800	Gladwin Rd	CP Railway	Marpaul Construction Ltd.
5+800	8+680	CP Railway	Walters St	Strohmaiers Excavating Ltd.
8+680	9+880	Walters St	Beharrell Rd	Marpaul Construction Ltd.
9+880	12+560	Beharrell Rd	Page Rd	Marpaul Construction Ltd.

Prior to the placement of the fill, the dike was stripped of all topsoil and sod on the land side slope and for a minimum width of approximately 5 m at the toe of the slope to expose the subgrade. Stripped material was stockpiled on the land adjacent to the dike. Compaction of the stripped subgrade was achieved using a smooth drum vibratory roller; however, the natural moisture content of the existing subgrade soils limited the effect of the applied compaction.

An initial loose lift of 600 mm was placed on the exposed subgrade to provide a stable working platform and allow greater effectiveness of compaction on subsequent lifts. The material used was a 75 mm crushed rock aggregate from the Ward Road Pit as detailed in Section 5.0 and was transported to site and placed using conventional truck and trailer. Bulldozers were used to spread the fill.

Compaction was measured by resistance to driving a 300 mm long steel pin. Blow counts were recorded in conjunction with visual inspection by Golder to determine if adequate compaction had been achieved. Confirmation of compaction using a Nuclear Density Gauge is not considered appropriate in crushed rock material.

Subsequent lifts of fill were completed using 'dirty' pit run or crushed aggregate from a combination of the sources listed in Section 5.0. Throughout all stages of the construction, compaction verification was conducted by Golder using either resistance to driving of a 300 mm long steel pin or by Nuclear Density Gauge. Throughout the construction an average density of 91% Modified Proctor was achieved along the dike. Daily inspection reports and field density test results are included in Appendices V and VI.

During periods of heavy rain, placement of material was suspended due to difficulties encountered with the passage of loaded trucks on recently placed fill lifts and fill materials being delivered to site in a wet condition (i.e. above optimum moisture content). To allow compaction to be effectively achieved during these times, the material was allowed a drying period to remove some of the excess moisture.

Once the design level had been achieved, the side slopes were graded back to a slope angle of between 2.5 and 3 horizontal to 1 vertical in accordance with the design. Topsoil was then spread up the slope and smoothed out for aesthetics. A final 19 mm minus crushed stone mix was placed on the crest in a lift of between 50 and 100 mm to provide a riding surface for traffic.

New page wire fencing was installed along the toe of the landside of the dike and steel framed posts and gates were installed on the dike crest by contractors engaged by the City. Several photographs taken during construction are included in Appendix II.

6.3 Railway Crossings

Special consideration was given to two railway crossings that intersected the Matsqui Dike at Station 1+560 to the south of the Cedar Plant and at Station 12+500 at Page Road. At these locations the existing railway line was below the proposed crest level of the dike; however, as access for trains was to remain available until such time that a breach of the river at the crossing locations was imminent, no fill could be placed over the tracks in these areas.

A temporary railway track filling procedure was developed that required little construction time and could be easily removed following recession of the floodwaters. The procedure involved minor clearing of the existing surface to remove excess vegetation or deleterious material, placement of a thin layer of bentonite chips or pellets on the railway ties and ballast along the river side edge, placing a geotextile across the area, placing pre-stockpiled dirty pit run to crest level of the adjacent dike and compaction by passage of the construction machinery. The procedure was issued to the City and instruction was provided to City workers on the requirements prior to and during the work and limitations to ensure no damage was done to the railway tracks during the works.

Due to the lower than expected water levels during the freshet the plan was not implemented.

7.0 JAMES POLLUTION CONTROL CENTRE

The JAMES Pollution Control Centre (James PCC) is responsible for the primary and secondary treatment of effluent received from Abbotsford and Mission and is located off the north end of Gladwin Road immediately south of the Fraser River.

7.1 Design Concept

Design of the civil works at the plant was overseen by the City with geotechnical input from Golder as required. The primary design utilized a five course high concrete Lock Block wall with geogrid reinforcement on the north side of the plant that would extend from the Matsqui Slough located to the immediate east of the main building to an interface with a new section of dike at the western end of the JAMES PCC facility. The new section of dike was to tie into the existing primary dike where a secondary dike surrounding the plant terminated and was to be protected downstream of the interface by a rip-rap surfacing layer on the land side slope. The design elevation for the JAMES PCC section varied from 9.28 m at the western end to 9.3 m at the eastern end.

On the southern side of the plant a secondary dike was to extend in an east-west direction adjacent to the Canadian National and Canadian Pacific Railway tracks before turning 90 degrees at the Matsqui Slough to tie into the existing southeast retaining wall of the JAMES PCC. Due to setback requirements between the new dike structure and the railway embankment a section of the dike was to be built to design elevation with a 3 course concrete Lock Block wall with a mass (placed) concrete core.

To raise the height of the access bridge across the slough, a 2 course high Lock Block retaining wall was integrated into the existing embankments on both sides with the walls constructed at a slight inward batter.

7.2 Construction

To create a stable wall foundation, the existing embankment and rock armouring was removed with the rock stockpiled elsewhere on the site to be re-used. Where required, vegetation along the river bank was removed to allow safe working distances for the construction equipment.

Base preparation for the wall included placement and compaction of a base layer of 10 mm minus crush rock to provide a stable foundation. Compaction was achieved using a 1,000 lb vibratory plate compactor. Isolated areas of weak foundation material identified during the site preparation were sub-excavated and replaced with pit run and compacted at the instruction of Golder.

Lock Block flood walls were constructed along the alignment with construction joints sealed by pinching lengths of 25 mm closed cell backer rod between blocks and injecting expanding foam into the joint corners. Checkmate UX120HD geogrid was used as the reinforcement in constructing the flood walls. Nonwoven geotextile was wrapped around the inside edge of the Lock Blocks for the full height of the wall to minimize the potential for loss of fines through the open voids between blocks.

The wall was backfilled with a combination of dirty pit run and 75 mm minus crush rock compacted by a smooth drum static roller. A prefabricated geocomposite drain (Nu-drain) was placed near the base of the wall to collect rainwater and runoff from the JAMES PCC and outlet pipes with one way valves installed at the east and west ends discharging into the Fraser River.

A large area of deleterious material was encountered during base preparation for the new section of dike from Station 29+60 to Station 31+20. The area contained significant amounts of wood, vegetation and debris and was sub-excavated and replaced with pit run material. The new dike was raised in 300 mm high lifts to the design elevation. To protect the new dike slope, a 600 mm minus size rip rap protective layer was placed with an excavator on the water side slope of the new dike section. A nonwoven geotextile was placed between the coarse rip rap protective layer and the underlying dike fill to act as a filter to reduce the potential for soil loss though the open voids in the rip rap.

At the western end of the wall, the new section of dike was transitioned in some 10 blocks to the east to provide a gradual transition and to reduce the potential for scour of the new section of dike in the event of high water.

Following construction of the new Lock Block flood wall and new dike, the 2 m wide GVRD parks trail along the Fraser River bank below the new Lock Block flood wall was replaced.

Along the southern boundary of the JAMES PCC, the existing features restrict the area available to construct the secondary dike. To the immediate south of the plant offices the design height was achieved by constructing parallel sections of Lock Block wall 3 courses high. The walls were less than 500 mm apart at the base and were battered inward. Lean mix concrete was placed as infill between the two parallel walls to the crest.

Three (3) layers of Checkmate BX2525 biaxial geogrid reinforcement were placed within the lower part of the secondary dike that was constructed over the existing sanitary influent pipes between about Sta. 4+20 and Sta. 4+27. The purpose of the geogrid reinforced fill was to distribute loads from both the dike fill and construction traffic over the existing sanitary influent pipes.

A number of photographs taken during construction are included in Appendix III.

7.3 Site Specific Geotechnical Investigation

On April 26, 2007, an augerhole investigation was completed at the JAMES PCC. The investigation was carried out at several locations to confirm subsurface conditions along the alignment of the dike upgrade at the JAMES PCC and more specifically to confirm the ground conditions beneath the existing sewage inflow pipes along the proposed new secondary dike section between the JAMES PCC and the CN Railway tracks, as well as, just east of the existing Trickling Filter building.

The investigation consisted of putting down 5 solid stem augerholes, three (3) in the vicinity of the existing sewage inflow pipes and two (2) on the walkway along the south shoreline of the Fraser River just east of the existing Trickling Filters building. The augerholes were put down to depths ranging between 6.1 and 12.2 m below existing ground surface at the time of the investigation. In addition, Dynamic Cone Penetration Test (DCPT) probes were conducted adjacent to each augerhole location to infer the relative density or consistency of the materials encountered.

A factual Technical Memorandum, dated June 1, 2007, summarizing the geotechnical investigation was provided to the City, following the investigation and is included in Appendix I.

7.4 Pavement and Surfacing

To achieve the design elevation, the access road leading to the JAMES PCC required raising by approximately 100 mm. This involved ripping the existing surface with a Bomag, removing the ripped pavement materials, placing and compacting 19 mm minus crushed sand and gravel and applying the new asphalt surface.

Martens Asphalt was responsible for the hire of equipment used to rip the existing pavement and lay the new surface. Field compaction testing was completed by Valley Testing Services.

7.5 Fencing

At the outset of the project, the majority of the security fencing around the JAMES PCC was removed to facilitate the dike construction. The City engaged a security contractor to provide 24 hour security during the after work hours. On completion of the contract works, a new 1.8 m high chain link fence was constructed along the landside of the dike crest.

8.0 VEDDER DIKE

The section of the Vedder Dike that was upgraded during the 2007 earthworks program extends from the Barrowtown Pump Station to the Keith Wilson Bridge. The dike is intersected at one location by the Trans Canada Highway where it crosses the Vedder Canal.

8.1 Design concept

In a Technical Memorandum dated April 16, 2007, a construction methodology including site preparation requirements and construction considerations necessary to raise the existing dike to a design elevation of 10.95 m was proposed. The key aspects of the design were the same as that for the Matsqui Dike and as identified in Section 6.1. A copy of the Technical Memorandum detailing the design is included in Appendix I.

Due to limitations with available construction methodologies to raise the height of the dike across the Barrowtown Pump Station, a 300 mm high concrete curb system was designed to extend across the Pump Station on the eastern side of the roadway. The curb was designed to act as a barrier and provide the additional elevation required to meet the minimum freeboard requirements.

8.2 Construction

Bulk earthworks at the Vedder Dike were completed by Double M Construction. Following removal of the topsoil and sod, level construction benches were created on the land side of the dike to allow placement and compaction of fill material. Material used during the construction was generally sourced from the Quadling Road Pit due to the proximity of the pit to the site.

Golder carried our periodic field monitoring and copies of field inspection reports are included in Appendix V. Field compaction testing was carried out by Valley Testing Services (see Appendix VII).

Once the design level had been achieved, the side slopes were graded back to a slope angle of between 2.5 and 3 horizontal to 1 vertical in accordance with the design. Topsoil was then spread up the slope and smoothed out for aesthetics. A final 19 mm minus crushed rock mix was placed on the crest in a lift of between 50 and 100 mm to provide a riding surface for service vehicles.

Several photographs taken during construction are included in Appendix IV.

8.3 Site Specific Investigation

On September 17, 2007 an augerhole investigation was conducted on the Vedder Dike. The investigation was carried out at two locations to confirm the subsurface conditions beneath the dike and obtain information required to complete a stability and seepage analysis of the new dike geometry to assess the potential impact to dike performance (stability and seepage aspects) of having raised the dikes to the new design level of 10.95 m.

The investigation consisted of putting down two solid stem augerholes and two electronic Cone Penetration Test (CPT) probes including measurement of pore water pressure; one location was at Station 47+20 between Barrowtown Pump Station and Highway 1 with the second location at Station 74+05 between Highway 1 and the Keith Wilson Bridge. The CPT probes were advanced to refusal at depths of 20 and 20.5 m, respectively, with the augerholes put down following completion of the CPT probe at each location. The augerholes were positioned immediately adjacent to the CPT locations.

Models for the detailed seepage and stability analysis were developed using the cross section information from the 'as-constructed' drawings together with information from previous reports and the results of the field investigation and laboratory testing.

Hydraulic conductivity values used in the seepage analysis were obtained from the results of dissipation testing carried out during advance of the CPT probes and values provided in previous Crippen Engineering Ltd. (CEL) reports.

A detailed engineering report for this investigation will be prepared and submitted to the City under separate cover.

9.0 INDEPENDENT EXPERT REVIEW

During the field program, independent expert review was sought from qualified individuals with significant experience in the areas of diking and drainage and dike remediation; namely Mr. Peter Morgan and Mr. Neil Peters from the Inspector of Dikes Office and Mr. Fred Wodtke of Flood Protection Works. The review was conducted on an ongoing basis throughout the construction program to ensure compliance with the British Columbia Dike Design and Construction Manual (2003) and to provide an expert opinion on construction methods, compaction control and design issues.

A report was prepared by Mr. Fred Wodtke following a visual inspection of the dike on May 30, 2007 detailing Mr. Wodtke's observations from the inspection. No significant

issues were raised in the reports however some minor concerns were identified that were addressed shortly thereafter.

10.0 FRASER RIVER SHORELINE PROTECTION

At the commencement of works on the Matsqui Dike a visual inspection of the existing foreshore along the Matsqui Dike was carried out on April 12, 2007 using a boat owned and operated by Fraser River Safari and hired by the City. The inspection was attended by:

- Mr. Brian Mylleville, P.Eng, Golder Associates Ltd.;
- Mr. Fred Wodtke of Flood Protection Works, Consulting Services;
- Mr. Jan Loots, P.Eng. City of Abbotsford;
- Mr. Pardeep Aginhotri, E.I.T., City of Abbotsford; and,
- Several members of the City of Abbotsford Works Department.

Following the visual inspection a report was prepared by Mr. Fred Wodtke and attached to a Technical Memorandum prepared by Golder and issued to the City dated April 19, 2007 providing a summary of the existing shoreline condition and comments and recommendations for improvement. A copy of the Technical Memorandum is included in Appendix I.

The Technical Memorandum identified no specific areas along the shoreline that required immediate attention and made a recommendation that future maintenance of the existing dikes include preparation of a plan to provide additional shoreline protection and/or mitigation including periodic visual inspections from a boat and provision for photographic or video documentation.

A second inspection was conducted on May 23, 2007 by representatives from the City (Engineering, Diking and Drainage and an Arborist from the Parks Department), Greater Vancouver Regional District Parks and Golder to view several areas along the existing shoreline on the river side of the Matsqui Dikes and to discuss the need to remove trees along the existing shoreline. The meeting included site visits to four (4) areas along the existing shoreline; adjacent to an existing parking lot for the GVRD Park near Page Road, the Norrish Creek water main crossing of the Fraser River, the Hard Point Eddies (west of Beharrell Road) and the dike opposite Glenmore Road.

Based on observations made during the site meeting it was determined that undercutting of the existing river banks is likely to continue to occur where the river impacts the south bank irrespective of whether or not trees are removed and that existing trees on the bank may provide a "reinforcing effect" on the soil along the river bank providing they do not

topple into the river. A copy of the Technical Memorandum is also included in Appendix I.

11.0 FUTURE WORK

It is expected that the following issues will need to be addressed in the future:

- Regrading and re-leveling of the surface of all dikes will be required on an ongoing basis;
- Annual inspections of the Fraser River shoreline should be completed to monitor performance and identify areas of scour; and,
- Removal of trees along the Matsqui Dike shoreline should be considered to protect the bank from de-stabilization due to falling trees.

12.0 RECORD DRAWINGS AND O&M MANUAL UPDATE

The City engineering staff conducted profile and cross sectional surveys of the Matsqui, JAMES and Vedder Dikes. Cross sections were obtained at 25 m intervals and interpolated to 30 m intervals for the profile drawings. Dayton & Knight Ltd. Were retained to survey the as-built design of the JAMES PCC Dike. The surveys were completed between June 12 and October 6 2007.

Record drawings were prepared by the City Engineering Department drafting department under the supervision of Jan Loots, P.Eng. Two sets of full size and reduced drawings have been prepared for submission with this report and are included as Appendix IX. It is noted that the cross sections of the Vedder Dike show that a crest width of 4.0 m has been achieved.

The City Engineering Department will be undertaking revisions to the existing O&M Manuals and a separate submission will be provided to the Inspector of Dikes.

13.0 CLOSURE

We trust that the information presented in this report is sufficient for immediate needs. Should you have any questions concerning the information presented please do not hesitate to contact us.

Yours truly,

GOLDER ASSOCIATES LTD.

for

Brendan Wright, B.Eng (Hons)
Geotechnical Group

Dec 13/2007

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IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety, and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (cont'd)

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX I

TECHNICAL MEMORANDA AND CORRESPONDENCE

TECHNICAL MEMORANDUM

Golder Associates Ltd.
#202 - 2790 Gladwin Road
Abbotsford, B.C., Canada V2T 4S8

Telephone: 604-850-8786
Fax Access: 604-850-8756

TO:	Phil Blaker, P.Eng. City of Abbotsford	**DATE:**	April 11, 2007
FROM:	Brian Mylleville, P.Eng.	**JOB NO:**	07-1450-0039/3000
EMAIL:	bmylleville@golder.com		
RE:	**PROPOSED DESIGN AND CONSTRUCTION METHODOLOGY DIKE UPGRADES FOR 2007 FRESHET ABBOTSFORD, BC**		

This Technical Memorandum outlines the proposed design and construction methodology for the upgrades to the existing Abbotsford dikes in anticipation of the 2007 Freshet on the Fraser River.

1.0 DESIGN CONSIDERATIONS

It is understood that the existing dikes need to be upgraded (and raised) to meet the new flood elevation in anticipation of the 2007 Freshet on the Fraser River. It is also understood that the existing dikes were originally constructed with a low permeability core. A review of survey information contained in the City of Abbotsford's Drawing No. M526 (sheets 1 to 12) indicates that the dike crest elevation will need to be raised between about 300 mm and 1200 mm. A visual inspection of the existing dikes was carried out on April 4, 2007.

Due to the urgency of this project and the compressed timeline in which it must be completed, no provision has been made for any site-specific geotechnical investigations including test holes and/or detailed analysis unless field observations warrant more detailed assessment in specific locations.

Given the compressed timeline available within which to complete the dike upgrades, it is proposed to implement the dike upgrades (widening the base and raising the crest elevation) on the landside of the existing dikes. This will minimize impacts to existing vegetated slopes thus reducing the need for further armouring and protection of newly placed fill slopes (if the dike upgrades were carried out on the water side) and minimize the potential for impacts to the adjacent sensitive riparian areas.

A boat will be used to carry out a visual inspection of the existing shoreline in areas where the existing dikes are in proximity of the edge of the Fraser River to assess if any additional armour rock needs to be placed to protect vulnerable areas.

The gradation specification for the proposed fill materials to be used in the dike upgrade is as follows:

Sieve Designation	Percent Passing
75 mm	100
50 mm	70 - 100
25 mm	50 - 100
4.75 mm	22 - 100
2.36 mm	10 - 85
0.075 mm	5 - 10

The gradation specification outlined above was modified from the Master Municipal Specification for Pit Run Gravel with an allowance for some additional fines. A fill material could be specified containing significantly more fines; however, compaction would be difficult to achieve in wet weather conditions which typically occur in early spring.

It is proposed to upgrade the existing dikes such that the crest width is maintained at 3.6 m and the side slopes are developed not steeper than 2.5 Horizontal to 1 Vertical on the land side of the dike where the widening upgrade will occur.

The attached Figure 1 illustrates the proposed dike upgrade concept. Floodwalls and/or similar Lock-Block retaining walls or reinforced fill structures may be required in areas where upgrades to the existing dikes or proposed new dikes will be in proximity of existing structures (e.g. JAMES Pollution Control Centre), other facilities and/or areas of limit space. Specific details for these floodwalls are in the process of being developed.

2.0 SITE PREPARATION

Site preparation will include the select removal of existing large cottonwood or other trees that could impact the existing dike structure should they be toppled and root balls pulled from the dike during freshet high water conditions. It is recommended that these large trees be close cut and the root ball left in place until after the flood waters have receded and then they can be removed and the surrounding areas reinstated with fill materials and revegetated.

Site preparation will also include temporary removal (and reinstatement) of all fences, gates and the like.

The sod and topsoil cover will be removed along the land side slopes of the existing dike and stockpiled adjacent to the work area for reinstatement following the dike upgrade work.

3.0 CONSTRUCTION CONSIDERATIONS

Low height horizontal benches shall be cut into the existing side slopes to key the new fill widening into the existing fill side slopes. Excavation for the benches must not penetrate into the existing lower permeability core material.

The new dike fill materials shall be placed in loose lifts not exceeding 300 mm in thickness and compacted to at least 90 per cent of Modified Proctor maximum dry density (ASTM D1557). The thickness of the initial lift of fill placed near the toe of the side slope of the dike on the land side may need to be increased for construction trafficability purposes. Periodic field density testing will be carried out by Golder Associates Ltd. to confirm that the density specification is achieved. The top riding surface of the existing dike shall be scarified to a depth of 150 mm prior to placement of the initial lift of fill on top of the existing dike crest.

The side slopes of the new fill placed on the land side of the dike shall be developed not steeper than 2.5 Horizontal to 1 Vertical. The top of the dike shall be provided with a 2 per cent cross fall down toward the water side of the dike to prevent ponding of water on top of the dike crest.

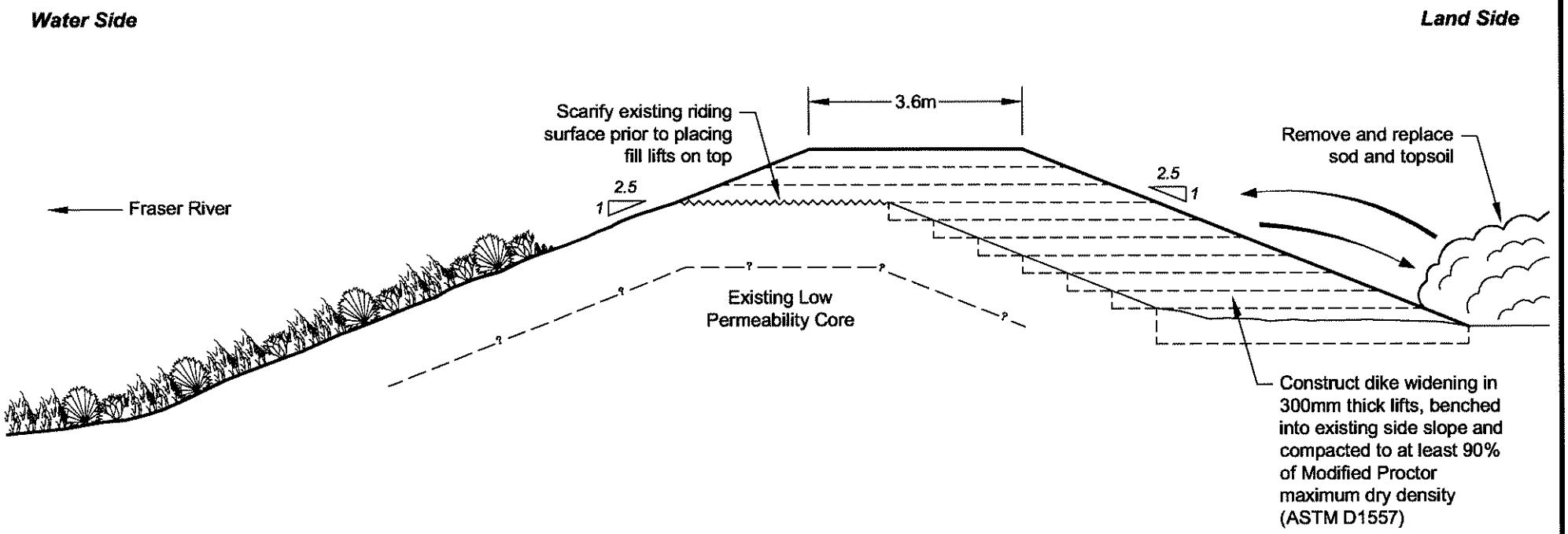
The stockpiled sod and topsoil mixture shall be reinstated on the newly constructed side slopes along the land side of the dike and these slopes shall be revegetated with hydroseed or similar methods.

Armour rock will be placed in areas where visual inspections indicate that the existing river bank, in proximity of the existing dikes, have been significantly impacted by erosion.

Attachment
BLJM/SL/tk

N:\ACTIVE\YEAR 2007\1450\07-1450-0039\WORDPRO\TECH MEMO - 0411 2007 ABBOTSFORD DIKE UPGRADES.DOC

N:\Active\Year 2007\1450\07-1450-0039\Drafting\CAD\ Drawing file: D0714500039-2.dwg Apr 11, 2007 - 1:13pm



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APPROXIMATE SCALE (m)

PROJECT

CITY OF ABBOTSFORD
MATSQUI DIKE UPGRADE CONCEPT
ABBOTSFORD, B.C.

TITLE

MATSQUI DIKE UPGRADE CONCEPT

Golder Associates
Abbotsford, BC

PROJECT No. 07-1450-0039			FILE No. D0714500036-2.dwg	
DESIGN	B.L.J.M.	APR-10-07	SCALE 1:100	REV. 0
CADD	J.S.D.	APR-10-07	FIGURE 1	
CHECK				
REVIEW				

TECHNICAL MEMORANDUM

Golder Associates Ltd.
#202 - 2790 Gladwin Road
Abbotsford, B.C., Canada V2T 4S8

Telephone: 604-850-8786
Fax Access: 604-850-8756

TO:	Phil Blaker, P.Eng. City of Abbotsford	**DATE:**	April 16, 2007
FROM:	Brian Mylleville, P.Eng.	**JOB NO:**	07-1450-0039/3000
EMAIL:	bmylleville@golder.com		
RE:	**PROPOSED DESIGN AND CONSTRUCTION METHODOLOGY VEDDER DIKE UPGRADES FOR 2007 FRESHET ABBOTSFORD, BC**		

This Technical Memorandum outlines the proposed design and construction methodology for the upgrades to the existing Vedder dikes within the City of Abbotsford limits (i.e. dike on the west side of Vedder Canal from the Barrowtown Pump Station to Keith Wilson Bridge) in anticipation of the 2007 Freshet.

1.0 DESIGN CONSIDERATIONS

It is understood that the existing Vedder dikes need to be upgraded and raised by about 0.55 m to the meet the new flood elevation in anticipation of the 2007 Freshet. It is also understood that the existing dikes were originally constructed with a low permeability core. A review of information contained in Drawing No. 4844-5, sheets 1 and 6 to 9 inclusive indicates that the side slopes on the existing dike, near the crest of dike, were constructed to 2.5 Horizontal to 1 Vertical on the river side and 3 Horizontal to 1 Vertical on the land side. A visual inspection of the existing dikes was carried out on April 4, 2007.

Due to the urgency of this project and the compressed timeline in which it must be completed, no provision has been made for any site-specific investigations including test holes and/or detailed analysis unless field observations warrant more detailed assessment in specific locations.

Given the compressed timeline available within which to complete the dike upgrades, it is proposed to implement the dike upgrades (raising the crest elevation and widening onto the existing side slopes) on the landside of the existing dikes. This will minimize impacts to existing vegetated slopes thus reducing the need for further armouring and protection of newly placed fill slopes and minimize the potential for impacts to the adjacent sensitive riparian areas.

The gradation specification for the proposed fill materials to be used in the dike upgrade is as follows:

Sieve Designation	Percent Passing
75 mm	100
50 mm	70 - 100
25 mm	50 - 100
4.75 mm	22 - 100
2.36 mm	10 - 85
0.075 mm	5 - 10

The gradation specification outlined above was modified from the Master Municipal Specification for Pit Run Gravel with an allowance for some additional fines. A fill material could be specified containing significantly more fines; however, compaction would be difficult to achieve in wet weather conditions which typically occur in early spring. If the weather conditions are favourable and suitable fill material containing more fines are available, such material will be used.

It is proposed to upgrade the existing dikes such that the crest width is maintained at 3.6 m and the newly constructed side slopes are developed not steeper than 2.5 Horizontal to 1 Vertical on the land side of the dike where the widening upgrade will occur. The proposed 2.5 Horizontal to 1 Vertical slope near the top of the land side of the existing dike will minimize the widening footprint and prevent covering the existing filter blanket near the base of the existing dike slope. The attached Figure 1 illustrates the proposed dike upgrade concept.

2.0 SITE PREPARATION

Site preparation will also include temporary removal (and reinstatement) of all fences, gates and the like.

The sod and topsoil cover will be removed along the land side slopes of the existing dike and stockpiled adjacent to the work area for reinstatement following the dike upgrade work.

3.0 CONSTRUCTION CONSIDERATIONS

Low height horizontal benches shall be cut into the existing side slopes to key the new fill widening into the existing fill side slopes. Excavation for the benches must not penetrate into the existing lower permeability core material.

The new dike fill materials shall be placed in loose lifts not exceeding 300 mm in thickness and compacted to at least 90 per cent of Modified Proctor maximum dry density (ASTM D1557). Periodic field density testing will be carried out by Golder Associates Ltd. to confirm that the density specification is achieved. The top riding surface of the existing dike shall be scarified to a depth of 150 mm prior to placement of the initial lift of fill on top of the existing dike crest.

The side slopes of the new fill placed on the land side of the dike shall be developed not steeper than 2.5 Horizontal to 1 Vertical. The top of the dike shall be provided with a 2 per cent cross fall down towards the river side to prevent ponding of water on top of the dike crest.

The stockpiled sod and topsoil mixture shall be reinstated on the newly constructed side slopes along the land side of the dike and these slopes shall be revegetated with hydroseed or similar methods.

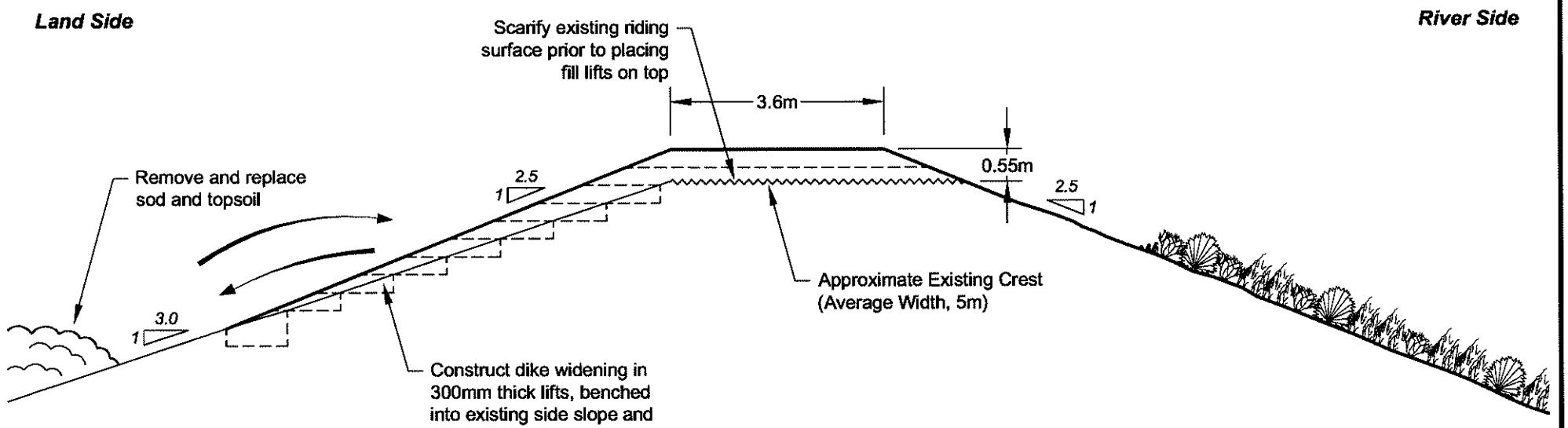
4.0 CONSTRUCTION MONITORING

Full-time construction monitoring will be carried out during construction including inspection of import fill materials and compaction testing. Daily records of site inspection and field density testing will be maintained.

Attachment
BLJM/SL/tk

N:\ACTIVE\YEAR 2007\1450\07-1450-0039 (ABB-EMERGENCY DYKING-ABB)\WORDPRO\TECH MEMO - 0416 2007 ABBOTSFORD VEDDER DIKE UPGRADES-D.DOC

N:\Active\Year 2007\1450\07-1450-0039 (Abb-Emergency Dyking-Abb)\Drafting\CAD\ Drawing file: D0714500039-3.dwg Apr 16, 2007 - 1:30pm



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APPROXIMATE SCALE (m)

PROJECT

CITY OF ABBOTSFORD
VEDDER DIKE UPGRADE
ABBOTSFORD, B.C.

TITLE

VEDDER DIKE UPGRADE CONCEPT

Golder Associates
Abbotsford, BC

PROJECT No. 07-1450-0039			FILE No. D0714500036-3.dwg	
DESIGN	B.L.J.M.	APR-16-07	SCALE 1:100	REV. 0
CADD	J.S.D.	APR-16-07		
CHECK				
REVIEW				

FIGURE 1

TECHNICAL MEMORANDUM

Golder Associates Ltd.
#202 - 2790 Gladwin Road
Abbotsford, B.C., Canada V2T 4S8

Telephone: 604-850-8786
Fax Access: 604-850-8756

TO: Phil Blaker, P.Eng. **DATE:** April 20, 2007
FROM: Brian Mylleville, P.Eng. **JOB NO:** 07-1450-0039
EMAIL: bmylleville@golder.com

RE: VISUAL INSPECTION OF FORESHORE ALONG MATSQUI DIKE ABBOTSFORD, BC

This Technical Memorandum documents visual observations made during an inspection of the Fraser River foreshore along the existing Matsqui Dike on April 12, 2007. The purpose of the inspection was to look for signs of recent sloughing or other vulnerable areas along the existing foreshore, primarily in the area of JAMES Pollution Control Centre, which might require some localized bank protection as part of the proposed dike upgrade works.

1.0 DIKE INSPECTION

A visual inspection of the existing foreshore along the Matsqui Dike was carried out on April 12, 2007 using a boat owned and operated by Fraser River Safari and hired by the City of Abbotsford. The inspection was attended by:

- Mr. Brian Mylleville, P.Eng, Golder Associates Ltd.;
- Mr. Fred Wodtke of Flood Protection Works, Consulting Services;
- Mr. Jan Loots, P.Eng. City of Abbotsford;
- Mr. Pardeep Aginhotri, E.I.T., City of Abbotsford; and,
- Several members of the City of Abbotsford's Public Works Department.

A copy of Mr. Wodtke's inspection report is included as Appendix II to this Technical Memorandum.

2.0 SUMMARY OF GENERAL OBSERVATIONS

Twenty three (23) photographs were taken from the boat during the visual inspection and copies of these photographs with approximate locations are provided in Appendix I following the text of this report. The chainages indicated with each Photograph are approximate only and are referenced to The City of Abbotsford Drawing No. M-526 – Fraser River Dyke Ortho & Stationing, dated May 2005.

Bank protection was observed along the existing shoreline from the existing Cedar Shake and Shingle Mill (See Photograph 1) near the west end of the existing Matsqui Dike to the GVRD Park located near the Mission Bridge (Highway No. 11 crossing over the Fraser River). In the area of the GVRD Park, the foreshore gradients are flat. The majority of armour stone bank protection downstream of the Mission Bridge has large patches of moss cover (see Photograph 2) inferring that this material has been in place and relatively undisturbed for a number of years. A localized area of recently placed armour stone was observed along the foreshore near the existing flare at the JAMES PCC (see Photograph 9). Armour stone bank protection, brush and trees were observed along the existing foreshore at the JAMES PCC (see Photographs 4 to 12). In many areas, the brush cover obscures the upper portions of the armour stone protection layer. Some minor sloughing was observed in several locations along the foreshore but no significant areas of concern were observed near the JAMES PCC.

Near the Mission Bridge and the existing CP Rail Bridge, there are areas where there is presently no bank protection (see Photographs 13 to 15).

Between Walters Road and Beharrell Road (Approx. Sta. 9+475 to Sta. 9+725), there are three (3) areas where significant recession of the riverbank has occurred. These features are also referred to as the "Hard Point Eddies" (see Photographs 16 to 19). In this area, several large trees have been undercut and have toppled into the river (see Photograph 18). The existing dike is setback at least 150 m south of this area and at present these features do not threaten the dike.

Some sloughing of the riverbank, about 10 m or so in width, was observed near Beharrell Road (see Photograph 20). In this area, the existing dike is setback at least 80 m to the south of the riverbank and hence this feature does not currently threaten the dike.

Photographs 21 to 23 show the typical condition of present shoreline protection upstream of Beharrel Road to Page Road. Some shoreline protection work has been carried out in recent years and this area appears to be stable.

3.0 GEOTECHNICAL COMMENTS

In general, most of the shoreline along the Fraser River and adjacent to the Matsqui Dikes is protected with armour stone and much of that armour stone has been in place for many years now. Several localized slumps were observed along the shoreline; however, no significant areas of instability were noted with the exception of the Hard Point Eddies which are located at some distance from the dikes and are not expected to impact the dike at this time. Based on the visual inspection, there are no specific areas along the

shoreline that require immediate attention. It is recommended that future maintenance of the existing dikes include periodic visual inspections from a boat and provision for photographic or video documentation.

BLJM/CC/tk

N:\ACTIVE\YEAR 2007\1450\07-1450-0039 (ABB-EMERGENCY DYKING-ABB)\WORDPRO\TECH MEMO - 0420 2007 FORESHORE INSPECTION ALONG MATSQUI DIKE - APRIL 12, 2007 .DOC

APPENDIX I

PHOTOGRAPHS

PHOTOGRAPH 1

Looking south, near Sta. 1+650. Cedar Shake & Shingle Mill.

PHOTOGRAPH 2

Looking south, near Sta. 2+200.

PHOTOGRAPH 3

Looking southwest, opposite Sta. 3+100.

PHOTOGRAPH 4

Looking south, opposite Sta. 3+225. Northwest corner of Trickling Filter Building, JAMES PCC.

PHOTOGRAPH 5

Looking south, opposite Sta. 3+250. Trickling Filter Building, JAMES PCC.

PHOTOGRAPH 6

Looking south, opposite Sta. 3+300. JAMES PCC.

PHOTOGRAPH 7

Looking southeast, opposite Sta. 3+350. JAMES PCC.

PHOTOGRAPH 8

Looking southeast, opposite Sta. 3+375. JAMES PCC.

PHOTOGRAPH 9

Looking southeast, opposite Sta. 3+425. JAMES PCC (Flare).

PHOTOGRAPH 10

Looking southeast, opposite Sta. 3+475. Slough at JAMES PCC.

PHOTOGRAPH 11

Looking southeast, opposite Sta. 3+500. Slough at JAMES PCC.

PHOTOGRAPH 12

Looking southeast, opposite Sta. 3+500. JAMES PCC.

PHOTOGRAPH 13

Looking southeast, opposite Sta. 5+650.

PHOTOGRAPH 14

Looking southeast, opposite Sta. 5+675.

PHOTOGRAPH 15

Looking south, between about Sta. 5+900 and 6+000.

PHOTOGRAPH 16

Looking southeast, opposite Sta. 9+500 (western most "Hard Point Eddy").

PHOTOGRAPH 17

Looking southeast, opposite Sta. 9+550 (middle "Hard Point Eddy").

PHOTOGRAPH 18

Looking southwest, opposite Sta. 5+575 (toppled trees).

PHOTOGRAPH 19

Looking southeast, opposite Sta. 9+625 (eastern most "Hard Point Eddy").

PHOTOGRAPH 20

Looking south, near Sta. 9+900.

PHOTOGRAPH 21

Looking southeast, near Sta. 10+000.

PHOTOGRAPH 22

Looking southeast, opposite about Sta. 12+200.

PHOTOGRAPH 23

Looking southeast, opposite about Sta. 12+400.

APPENDIX II

APRIL 12, 2007 REPORT TO THE CITY OF ABBOTSFORD

PREPARED BY FLOOD PROTECTION WORKS CONSULTING SERVICES

REPORT to the CITY OF ABBOTSFORD

MATSQUI DIKE FORESHORE INSPECTION BY BOAT : APRIL 12, 2007

Bank observations were made from the d/s end of the dike at the lumber mill going u/s to the bank tie-in with the C.N. R. embankment

In general, the bank appears fairly stable where rip rap was placed in conjunction with the construction of the FRFCP dike, except localized minor slips, as noted. These minor sloughs above the present w/l appear not to be very active. Note: older overlaying silt deposits (on overbank) obscure top elevations of placed bank protection which limits visual confirmation of rock presence.

- Two 3 m wide small sloughs at d/s end of the James Plant dike loop.
- Small 6 m wide slough just u/s of large building near river (James Plant).
- No bank protection evident at old pier site, just u/s of Mission Bridge (no rock was placed here??)
- Bank protection (BP) continuous to approx. 700 m u/s of rail bridge, except:
- Some rock loss for 50 lin. m section, approx. 400 m u/s of rail bridge, and:
- One 8 m and one 10 m wide sloughs, about 550 m u/s of rail bridge.
- Unprotected bank u/s of Walters Rd: 3 larger bank scallops ("Hard eddy points") are presently 150 to 180 m from the dike alignment. These washouts started in 1999, but should pose no threat to the dike presently. They should be monitored, however, for future additional bank losses. There are other bank impacts visible in this reach (no BP here), such as tree uprooting along the river bank.
- Beharrell Rd: local 10 m wide slough in BP visible.
- More localized small disturbances observed from Beharrell to approx. 500 m u/s.
- Ridgedale BP to C.N.R. tie-in looks very stable now.

RECOMMENDATIONS:

No work is presently required. The above noted bank disturbances as seen today above w/l do not tell, however, submerged bank conditions. Therefore, the City should inspect riverbank conditions, including erosion at the 3 'scalloped' eddies, again after this year's freshet when water levels are lower in the late summer.

Fred Wodtke
Flood Protection Works
Consulting Services

TECHNICAL MEMORANDUM

Golder Associates Ltd.
#202 - 2790 Gladwin Road
Abbotsford, B.C., Canada V2T 4S8

Telephone: 604-850-8786
Fax Access: 604-850-8756

TO: Phil Blaker, P.Eng.
City of Abbotsford

DATE: May 9, 2007

FROM: Brian Mylleville, P.Eng.

JOB NO: 07-1450-0039/3000

EMAIL: bmylleville@golder.com

RE: **PROPOSED DESIGN AND CONSTRUCTION METHODOLOGY EAST WING DIKE UPGRADES FOR 2007 FRESHET GLEN VALLEY, ABBOTSFORD, BC**

This Technical Memorandum outlines the proposed design and construction methodology for the proposed upgrades to the existing Glen Valley dikes in anticipation of the 2007 Freshet.

1.0 DESIGN CONSIDERATIONS

It is understood that the existing Glen Valley East wing dike needs to be upgraded and raised by about 0.3 m (average) to meet the new flood elevation in anticipation of the 2007 Freshet. It is also understood that the existing dikes were originally constructed with a lower permeability core. A review of information contained in Drawing No. 88-9-2-2A, dated April 1989, and prepared by CBA Engineering Ltd. indicates that the side slopes on the existing dike were constructed to about 3 Horizontal to 1 Vertical on the river (Bradner Road) side and about 2.5 Horizontal to 1 Vertical on the land side. A visual inspection of the existing dikes was carried out on May 7, 2007.

Due to the urgency of this project and the compressed timeline in which it must be completed, no provision has been made for any site-specific investigations including test holes and/or detailed analysis unless field observations during construction warrant more detailed assessment in specific locations.

Given the compressed timeline available within which to complete the dike upgrades, it is proposed to implement the dike upgrades (raising the crest elevation and widening onto the existing side slopes) on the land side of the existing dikes. This will minimize impacts to existing vegetated slopes thus reducing the need for further armouring and protection of newly placed fill slopes.

The gradation specification for the proposed fill materials to be used in the dike upgrade is as follows:

Sieve Designation	Percent Passing
75 mm	100
50 mm	70 - 100
25 mm	50 - 100
4.75 mm	22 - 100
2.36 mm	10 - 85
0.075 mm	5 - 10

The gradation specification outlined above was modified from the Master Municipal Specification for Pit Run Gravel with an allowance for some additional fines. A fill material could be specified containing significantly more fines; however, compaction will be difficult to achieve in wet weather conditions which typically occur in early spring. If the weather conditions are favourable and suitable fill material containing more fines are available, such material may be used.

It is proposed to upgrade the existing dikes such that the crest width is maintained at about 3.6 m and the newly constructed side slopes are developed not steeper than 2.5 Horizontal to 1 Vertical on the land side of the dike where the widening upgrade will occur. Lock-Blocks™ may be required to support the land side of the dike raising/widening locally at the south end of the dike at the existing flood box. The attached Figure 1 illustrates the proposed dike upgrade concept.

2.0 SITE PREPARATION

Site preparation will also include temporary removal (and reinstatement) of all fences, gates and the like.

The sod and topsoil cover will be removed along the land side slopes of the existing dike and stockpiled adjacent to the work area for reinstatement following the dike upgrade work.

3.0 CONSTRUCTION CONSIDERATIONS

Low height horizontal benches shall be cut into the existing side slopes to key the new fill widening into the existing fill side slopes. Based on available information contained in the as-built drawings for the existing dike, it is anticipated that granular fill materials will be encountered along the side slopes on the land side.

The new dike fill materials shall be placed in loose lifts not exceeding 300 mm in thickness and compacted to at least 90 per cent of Modified Proctor maximum dry density (ASTM D1557). Periodic field density testing will be carried out by Golder Associates Ltd. to confirm that the density specification is achieved. The top riding surface of the existing dike shall be scarified to a depth of 150 mm prior to placement of the initial lift of fill on top of the existing dike crest.

The side slopes of the new fill placed on the land side of the dike shall be developed not steeper than 2.5 Horizontal to 1 Vertical. The top of the dike shall be provided with a 2 per cent cross fall down towards Bradner Road to prevent ponding of water on top of the dike crest.

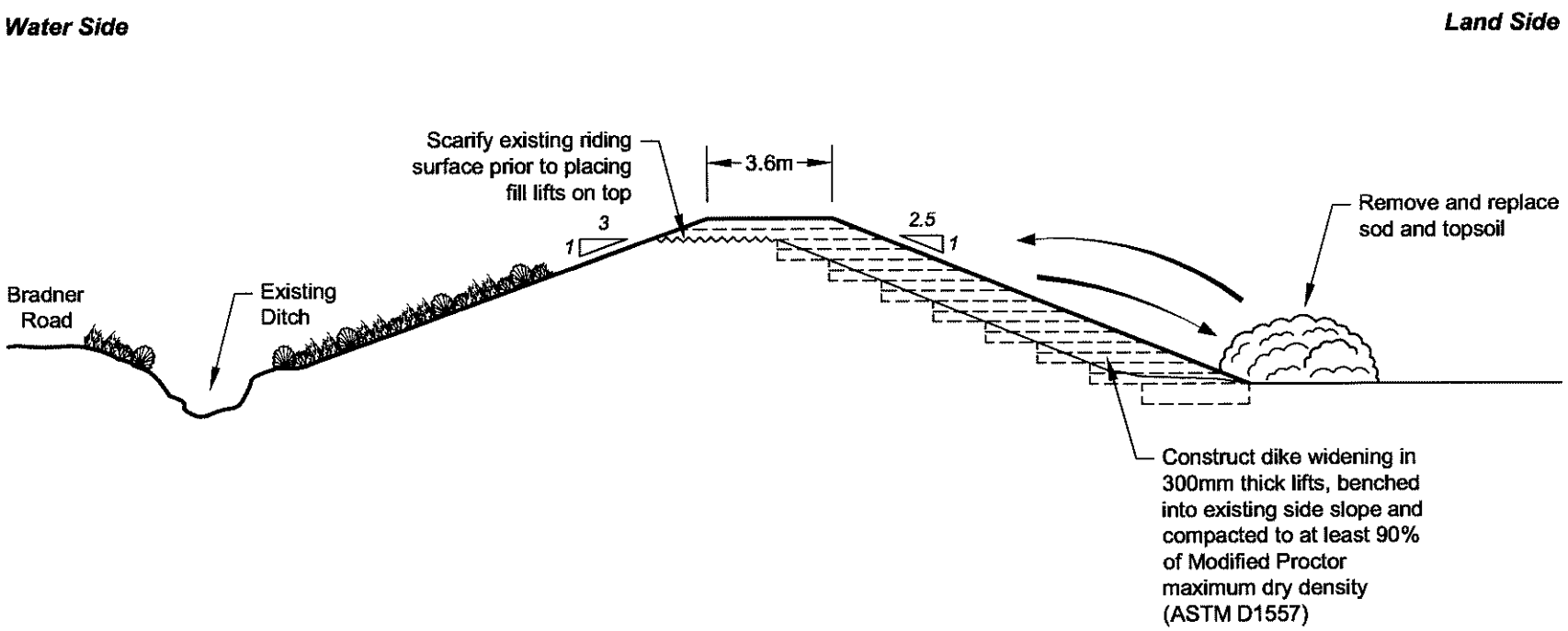
The stockpiled sod and topsoil mixture shall be reinstated on the newly constructed side slopes along the land side of the dike and these slopes shall be revegetated with hydroseed or similar methods.

4.0 CONSTRUCTION MONITORING

Full-time construction monitoring will be carried out during construction including inspection of import fill materials and compaction testing. Daily records of site inspection and field density testing will be maintained.

Attachment
BLJM/SL/lh

N:\ACTIVE\YEAR 2007\1450\07-1450-0039 (ABB-EMERGENCY DYKING-ABB)\WORDPRO\TECH MEMO- 0508 2007 ABBOTSFORD GLEN VALLEY DIKE UPGRADES.DOC



0 10

APPROXIMATE SCALE (m)

PROJECT

CITY OF ABBOTSFORD
MATSQUI DIKE UPGRADE
ABBOTSFORD, B.C.

TITLE

GLEN VALLEY DIKE UPGRADE CONCEPT

Golder Associates
Abbotsford, BC

PROJECT No. 07-1450-0039			FILE No. D0714500036-4.dwg	
DESIGN	B.L.J.M.	MAY-09-07	SCALE 1:200	REV. 0
CADD	J.S.D.	MAY-09-07		
CHECK				
REVIEW				

FIGURE 1

TECHNICAL MEMORANDUM

Golder Associates Ltd.
#202 - 2790 Gladwin Road
Abbotsford, B.C., Canada V2T 4S8

Telephone: 604-850-8786
Fax Access: 604-850-8756

TO: Phil Blaker, P.Eng., City of Abbotsford **DATE:** June 1, 2007

FROM: Brian Mylleville **JOB NO:** 07-1450-0039

EMAIL: bmylleville@golder.com

RE: **FACTUAL INFORMATION**
AUGERHOLE INVESTIGATION – APRIL 26, 2007
JAMES POLLUTION CONTROL CENTRE, ABBOTSFORD, BC

This brief technical memorandum provides factual information collected during an augerhole investigation carried out by Golder Associates Ltd. (Golder) at the above referenced site on April 26, 2007. The augerhole investigation was carried out at several locations to confirm subsurface conditions along the alignment for the proposed dyke upgrades at the JAMES Pollution Control Centre in Abbotsford, BC. More specifically, the investigation was carried out to confirm the ground conditions likely to underlie the existing sewage inflow pipes between the main PCC office building and Matsqui Slough to the east and, to confirm the general ground conditions near the toe of the new flood wall constructed on the north side of the site.

Golder carried out the investigation using a track-mounted auger drilling rig owned and operated by Downrite Drilling Co. Ltd. of Chilliwack, B.C. The investigation consisted of drilling five (5) solid stem augerholes designated as AH07-1 to AH07-5. The augerholes were advanced to depths ranging between about 6.1 and 12.2 m below the existing ground surface at the time of drilling and at the approximate locations shown on Figure 1.

In addition to the augering and sampling described above, Dynamic Cone Penetration Test (DCPT) probes were conducted adjacent to all of the augerhole locations to depths of up to about 12.2 m to assess the penetration resistance of the various horizons encountered and, from this, to infer the relative density or consistency of the subsurface soils at these locations.

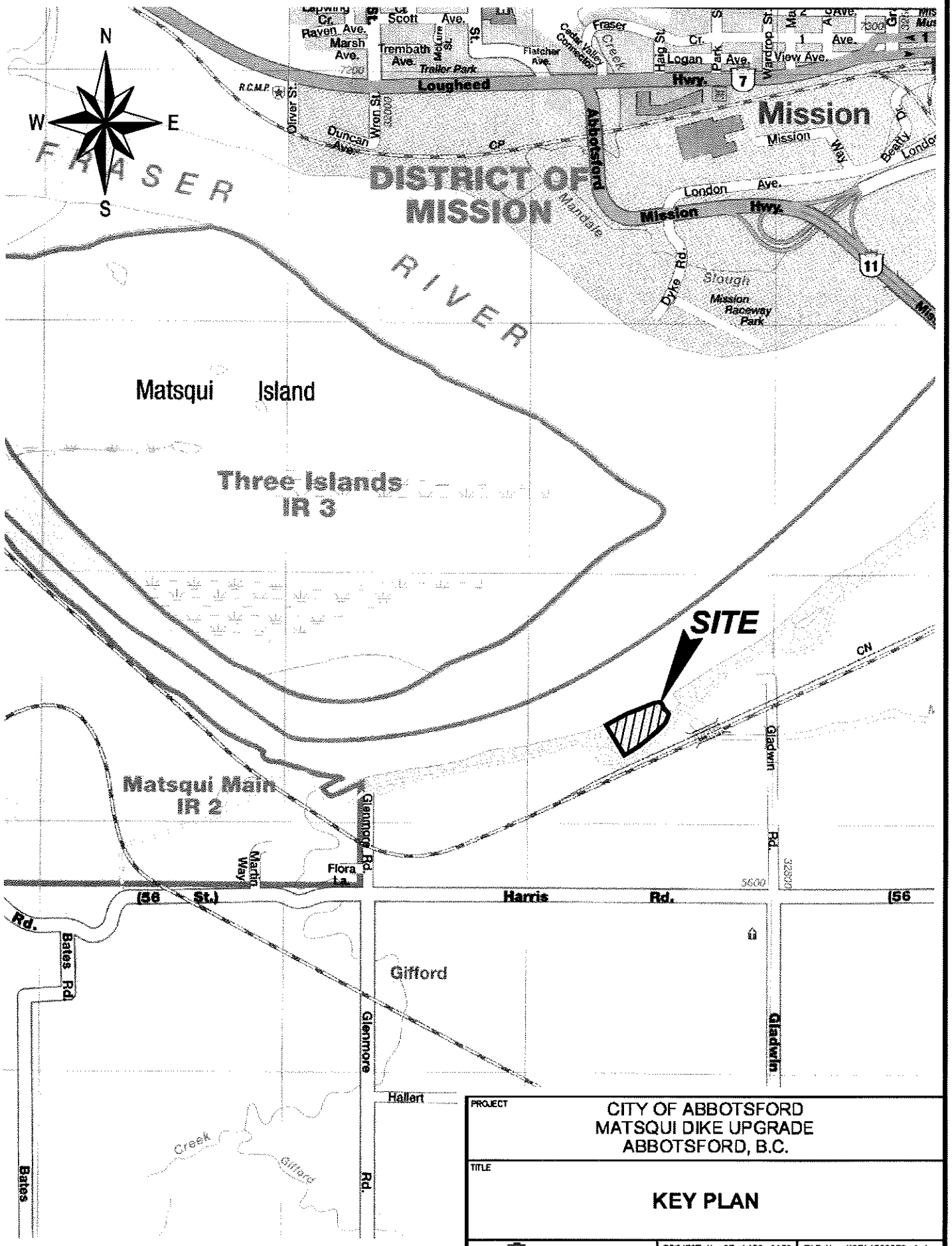
The fieldwork was carried out under the full-time inspection of a member of our geotechnical engineering staff, who located the augerholes, logged in detail the soil and groundwater conditions encountered, recorded the results of the DCPT probes, and collected representative soil samples for detailed examination and index testing in our Abbotsford laboratory. Detailed descriptions of the soil and groundwater conditions encountered in each of the augerholes put down are presented in the Record of Augerholes sheets attached to this technical memorandum.

Following completion of the logging and sample collection, all augerholes were sealed with bentonite chips and/or backfilled with drill cuttings in accordance with current British Columbia Groundwater Protection Legislation. The augerholes were approximately located in the field by a handheld GPS unit accurate to within 5 m; no survey work was carried out to determine the exact locations or elevations of the augerholes.

It should be noted that some variation in subsurface conditions was noted at the augerhole locations. Similar, and possibly greater, variations in subsurface conditions should be anticipated across the site.

BLJM/BGW/tk

N:\ACTIVE\YEAR 2007\1450\07-1450-0039 (ABB-EMERGENCY DYKING-ABB)\WORDPRO\TECH MEMO - 0601 2007 AUGERHOLE INVESTIGATION - JAMES PCC.DOC



PROJECT

CITY OF ABBOTSFORD
MATSQUI DIKE UPGRADE
ABBOTSFORD, B.C.

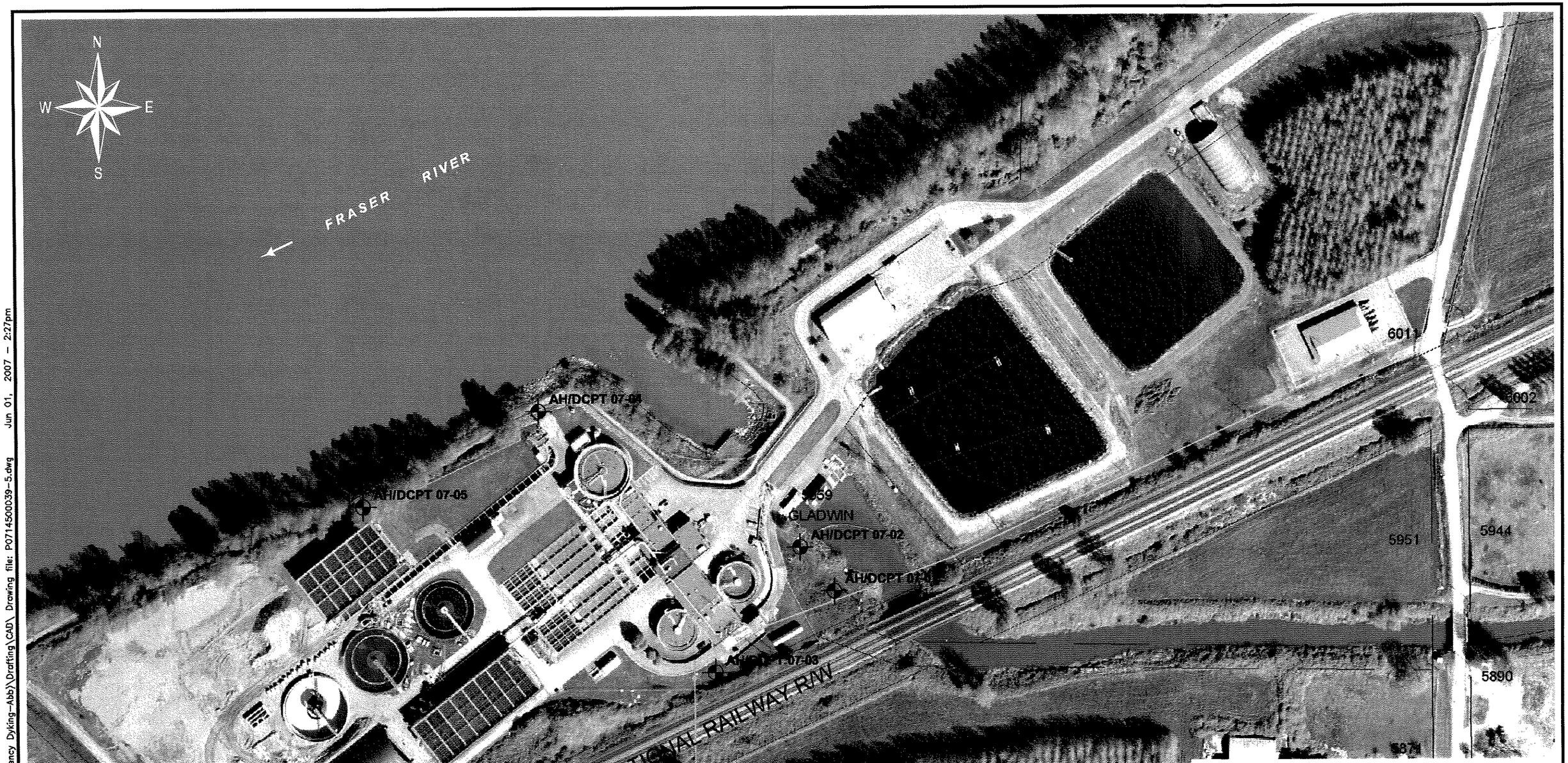
TITLE

KEY PLAN

Golder Associates
Abbotsford, BC

PROJECT No. 07-1450-0039			FILE No. K0714500039-1.dwg	
DESIGN			SCALE 1:20,000	REV. 0
CADD	J.S.D.	MAY-29-07	FIGURE 1	
CHECK				
REVIEW				

N:\Active\Year 2007\1450\07-1450-0039 (Abb-Emergency Dyking-Abb)\Drafting\CAD\ Drawing file: K0714500039-1.dwg Jun 01, 2007 - 2:26pm



LEGEND

Approximate Augerhole Location

PROJECT	CITY OF ABBOTSFORD MATSQUI DIKE UPGRADE ABBOTSFORD, B.C.
TITLE	**SITE PLAN**

REFERENCE

CITY OF ABBOTSFORD, Image File: JamesPlantA1photo.jpg, Date Recieved: May 2007.

0 100

APPROXIMATE SCALE (m)

Golder Associates Abbotsford, BC

PROJECT No. 07-1450-0039			FILE No. P0714500039-5.dwg		
DESIGN	B.W.	MAY-29-07	SCALE	1:2000	REV. 0
CADD	J.S.D.	MAY-29-07	**FIGURE 2**		
CHECK					
REVIEW					

N:\Active\Year 2007\1450\07-1450-0039 (Abb-Emergency Dyking-Abb)\Drafting\CAD\ Drawing file: P0714500039-5.dwg Jun 01, 2007 - 2:27pm

PROJECT No.: 07-1450-0039

RECORD OF AUGERHOLE: AH/DCPT 07-01

SHEET 1 OF 2

LOCATION: See Figure 2.

BORING DATE: April 26, 2007

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Downrite Drilling Ltd.	Ground Surface											
		TOPSOIL.		0.00									
		Loose, grey SILT, some fine sand, trace gravel. [FILL]		0.15									
1		Loose, grey SAND, trace to some silt, trace gravel. [FILL]		0.91									
2				1.52									Backfill.
3		Firm, brown to grey, SILT, trace fine sand.			1	AS							April 26/07 ▽
4					2	AS							
5		Loose, grey, sandy GRAVEL.		4.88									Bentonite Seal.
				5.49									Backfill.
8					3	AS							
7													Bentonite Seal.
		Loose to compact, grey SAND, trace silt, poorly graded.			4	AS							
8													
9					5	AS							Collapsed.
10		CONTINUED NEXT PAGE											

BOREHOLE 071-450-0039.GPJ GLDR_CAN.GDT 1/6/07

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: B.G.W.

CHECKED:

PROJECT No.: 07-1450-0039

RECORD OF AUGERHOLE: AH/DCPT 07-01

SHEET 2 OF 2

LOCATION: See Figure 2.

BORING DATE: April 26, 2007

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	Downrite Drilling Ltd.	Loose to compact, grey SAND, trace silt, poorly graded. *(continued)*									
				10.67							
11		Firm, grey, sandy SILT.									Collapsed.
				11.58							
12		Compact, grey, silty fine SAND.									
		End of AUGERHOLE.		12.19							
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: B.G.W.

CHECKED:

BOREHOLE 071-450-0039.GPJ GLDR_CAN.GDT 1/6/07

PROJECT No.: 07-1450-0039

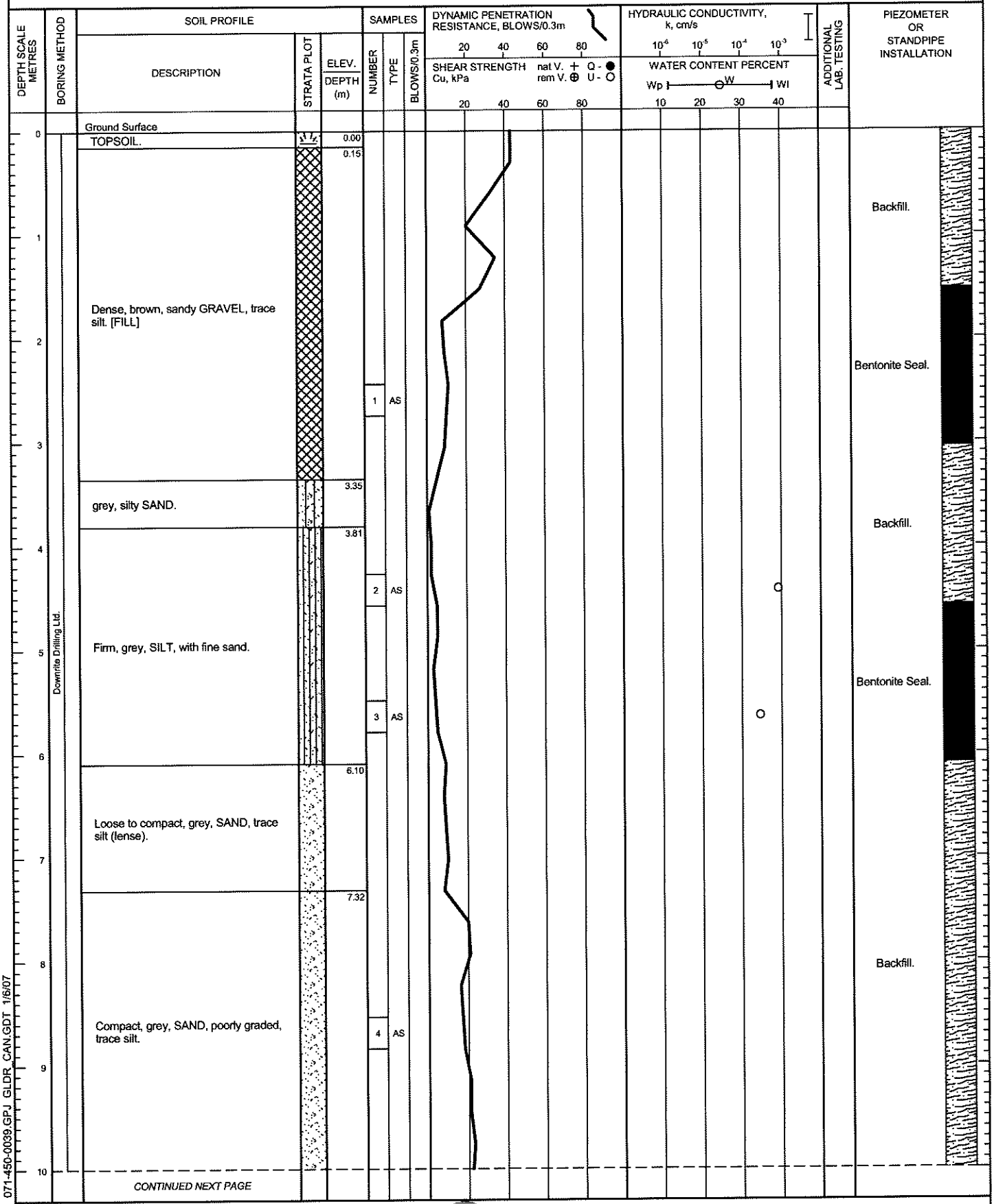
RECORD OF AUGERHOLE: AH/DCPT 07-02

SHEET 1 OF 2

LOCATION: See Figure 2.

BORING DATE: April 26, 2007

DATUM: Local



DEPTH SCALE

1 : 50

LOGGED: B.G.W.

CHECKED:

Golder Associates

BOREHOLE 071-450-0039.GPJ GLDR_CAN.GDT 1/6/07

PROJECT No.: 07-1450-0039

RECORD OF AUGERHOLE: AH/DCPT 07-02

SHEET 2 OF 2

LOCATION: See Figure 2.

BORING DATE: April 26, 2007

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	Downrite Drilling Ltd.	Compact, grey, SAND, poorly graded, trace silt. *(continued)*									
				10.38	5	AS					Backfill.
11		Compact, grey, silty fine SAND.									
12											
		End of AUGERHOLE.		12.19							
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: B.G.W.

CHECKED:

BOREHOLE 071-450-0039.GPJ GLDR_CAN.GDT 1/6/07

PROJECT No.: 07-1450-0039

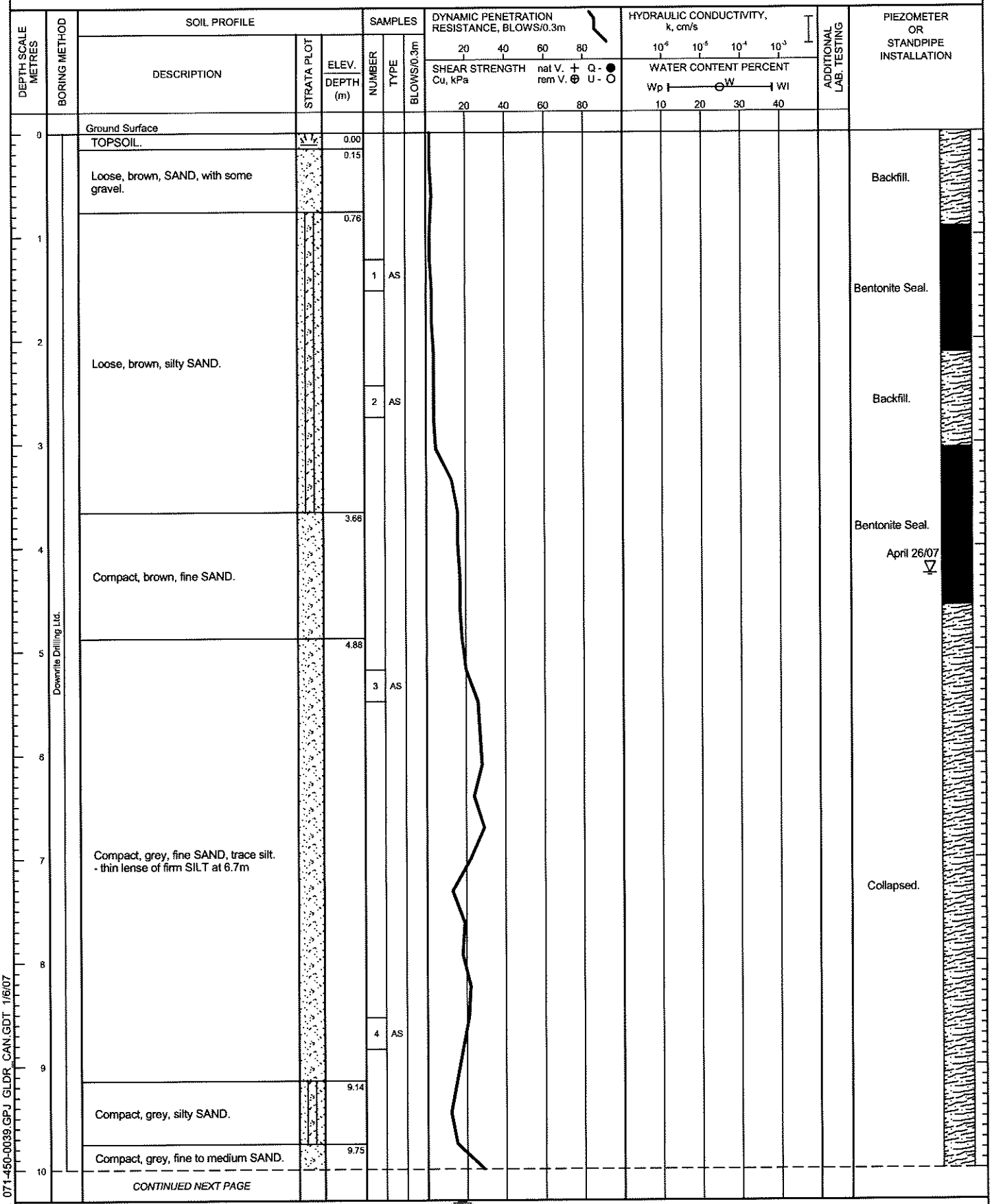
RECORD OF AUGERHOLE: AH/DCPT 07-03

SHEET 1 OF 2

LOCATION: See Figure 2.

BORING DATE: April 26, 2007

DATUM: Local



DEPTH SCALE

1 : 50

LOGGED: B.G.W.

CHECKED:

Golder Associates

BOREHOLE 071-450-0039.GPJ GLDR_CAN.GDT 1/6/07

PROJECT No.: 07-1450-0039

RECORD OF AUGERHOLE: AH/DCPT 07-03

SHEET 2 OF 2

LOCATION: See Figure 2.

BORING DATE: April 26, 2007

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		Compact, grey, fine to medium SAND. *(continued)*			5	AS					Collapsed.
		End of AUGERHOLE.		10.67							
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: B.G.W.

CHECKED:

BOREHOLE 071-450-0039.GPJ GLDR_CAN.GDT 1/6/07

PROJECT No.: 07-1450-0039

RECORD OF AUGERHOLE: AH/DCPT 07-04

SHEET 1 OF 2

LOCATION: See Figure 2.

BORING DATE: April 26, 2007

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp ⊢ ○ W ⊣ Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Downrite Drilling Ltd.	Ground Surface									
		Compact, brown, sandy GRAVEL, trace silt. [FILL]		0.00							
		Firm, brown, sandy SILT, fine sand. [FILL]		0.46	1	AS					Backfill.
1		Compact, gravely SILT, trace sand. trace roots.		1.22							
		Firm, grey/brown mottled, clayey SILT, trace rootlets.		1.83							Bentonite Seal.
2		Brown, fine grained silty SAND.		2.13							
		Firm, brown, fine grained sandy SILT.		2.74	2	AS					Backfill.
3		NO RECOVERY Inferred firm, sandy SILT to silty SAND.		3.96	3	AS					Bentonite Seal.
4		Loose to compact, grey to brown, silty fine SAND.		5.49							
5		Compact, grey and brown, SAND, trace silt.		6.71	4	AS					Backfill.
6											
7											
8											
9											
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

LOGGED: B.G.W.

CHECKED:

Golder Associates

BOREHOLE 071-450-0039.GPJ GLDR_CAN.GDT 1/6/07

PROJECT No.: 07-1450-0039

RECORD OF AUGERHOLE: AH/DCPT 07-04

SHEET 2 OF 2

LOCATION: See Figure 2.

BORING DATE: April 26, 2007

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10											
11	Downrite Drilling Ltd.	Compact, grey and brown, SAND, trace silt. *(continued)*			5	AS					Backfill.
12		End of AUGERHOLE.		12.19							
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: B.G.W.

CHECKED:

BOREHOLE 071-450-0039.GPJ GLDR_CAN.GDT 1/6/07

PROJECT No.: 07-1450-0039

RECORD OF AUGERHOLE: AH/DCPT 07-05

SHEET 1 OF 2

LOCATION: See Figure 2.

BORING DATE: April 26, 2007

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Downrite Drilling Ltd.	Compact, brown, gravelly SAND, trace silt.		0.00							Backfill.
		Firm, brown, clayey SILT, trace fine sand.		0.61							
1		Firm, brown, SILT, trace fine sand.		0.91							Bentonite Seal.
		Loose to compact, brown, fine SAND, trace silt		1.52							
2				1.98							
3											Backfill.
4		Compact, brown, fine SAND, trace silt.									April 26/07 ▽
5											Bentonite Seal.
6											Backfill.
		End of AUGERHOLE.		6.10							
7											
8											
9											
10		*CONTINUED NEXT PAGE*									

BOREHOLE 071-450-0039.GPJ GLDR_CAN.GDT 1/6/07

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: B.G.W.

CHECKED:

PROJECT No.: 07-1450-0039

RECORD OF AUGERHOLE: AH/DCPT 07-05

SHEET 2 OF 2

LOCATION: See Figure 2.

BORING DATE: April 26, 2007

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: B.G.W.

CHECKED:

BOREHOLE 071-450-0039.GPJ GLDR_CAN.GDT 1/6/07

TECHNICAL MEMORANDUM

Golder Associates Ltd.
#202 - 2790 Gladwin Road
Abbotsford, B.C., Canada V2T 4S8

Telephone: 604-850-8786
Fax Access: 604-850-8756

TO:	Phil Blaker, P.Eng., City of Abbotsford	**DATE:**	June 4, 2007
FROM:	Brian Mylleville, P.Eng.	**JOB NO:**	07-1450-0039
EMAIL:	bmylleville@golder.com		
RE:	**TREE REMOVAL ALONG FRASER RIVER SHORELINE MATSQUI DIKES, ABBOTSFORD, BC**		

This brief technical memorandum summarizes Golder Associates Ltd.'s observations and recommendations relating to tree removal along the Fraser River shoreline adjacent to the Matsqui Dikes in preparation for the 2007 Freshet.

Representatives from the City of Abbotsford (Engineering, Diking and Drainage and an Arborist from the Parks Department), Greater Vancouver Regional District Parks and Golder Associates Ltd. attended a meeting on May 23, 2007 to view several areas along the existing shoreline on the river side of the Matsqui Dikes and to discuss the need to remove trees along the existing shoreline in preparation for the 2007 Freshet.

The meeting included site visits to four (4) areas along the existing shoreline; adjacent to an existing parking lot for the GVRD Park near Page Road, the Norrish Creek water main crossing of the Fraser River, the Hard Point Eddies (west of Beharrell Road) and the dike opposite Glenmore Road.

During the meeting, the following general observations were made:

- The existing shoreline of the Fraser River supports a large variety of brush and trees along it length and the species vary from low scrub brush and some dense stands of small to medium cottonwoods to some very large cottonwoods and a few cedars;
- Several trees were observed to be leaning and/or toppled into the river at the time of our site visit; but most were likely a result of the river currents impacting and undercutting the existing south bank (several toppled trees were noted near Beharrell Road and the Hard Point Eddies; however, in this area the existing shoreline is about 130 to 150 m away from the dikes); and,
- Opposite Glenmore Road, where the existing Matsqui Dike is in closest proximity to the shoreline of the Fraser River and the existing rock shoreline protection is moss covered and overgrown with scrub brush and smaller trees, no significant bank erosion or areas of instability were observed at the time of our site inspection.

Based on the observations made during the site meeting, together with the knowledge obtained during foreshore inspection of April 12, 2007, the following comments and recommendations are provided:

- It likely that many of the existing leaning and/or toppled trees along the shoreline are likely a result of the river currents impacting and undercutting the existing river bank;
- Undercutting of the existing river banks is likely to continue to occur where the river impacts the south bank irrespective of whether or not trees are removed;
- The existing trees may remain in place as the roots are likely to have a "reinforcing effect" on the soil along the river bank providing they do not topple into the river (it is noted that where toppled trees were observed during the site visit, the shoreline was at some distance from the existing dike); and,
- It is recommended that at least yearly inspections be carried out to document the performance of the shoreline (either with photographs or video) and based on a review of this information, develop a plan to provide additional shoreline protection and/or mitigation, if deemed necessary.

BLJM/CC/BGW/tk

N:\ACTIVE\YEAR 2007\1450\07-1450-0039 (ABB-EMERGENCY DYKING-ABB)\WORDPRO\TECH MEMO - 0604 2007 TREE REMOVAL.DOC

TECHNICAL MEMORANDUM

Golder Associates Ltd.
#202 - 2790 Gladwin Road
Abbotsford, B.C., Canada V2T 4S8

Telephone: 604-850-8786
Fax Access: 604-850-8756

TO: Keith Martin, City of Abbotsford **DATE:** June 7, 2007

FROM: Brendan Wright **JOB NO:** 07-1450-0039

EMAIL: bwright@golder.com

RE: **TEMPORARY RAILWAY TRACK FILLING PROCEDURE**
MATSQUI DIKES, ABBOTSFORD, BC

This technical memorandum details the recommended procedure for filling over railway tracks where a railway line intersects an existing dike. The procedure has been developed by Golder Associates for use by the City of Abbotsford on the Matsqui Dike and should not be used for any other dike application without prior review and assessment of the specific scenario by a qualified Engineer.

PROCEDURE FOR PLACING TEMPORARY FILL OVER RAILWAY TRACKS

1. Remove all vegetation and deleterious materials (including debris, wood, and uncontrolled material stockpiles) from within the dike alignment.
2. Where ballast is present, trench across the embankment and between the concrete ties (sleepers) as deep as practical ensuring not to undermine the sleepers. This should be carried out by manual excavation to avoid damaging the sleepers, tracks or any buried services in the immediate area.
3. Place bentonite chips across the embankment and rails ensuring continuous coverage of the chips across the section and onto the dyke embankment. Where the rails are on sleepers ensure the bentonite chips are mounded either side of the rails as shown on the design drawing. The bentonite layer should be minimum 200 mm wide and 25 mm thick (at the level crossing near Page Road). Where a trench has been dug through ballast the bentonite should be placed level with the surrounding ballast (at the crossing near the cedar mill).
4. Cut the Nilex 2006 woven geotextile to the required length and place across the section so that the ends of the woven geotextile terminate on the dike slope. Overlap the woven geotextile strips to cover the required width of the fill.
5. Place material conforming to the specifications for dike fill material (i.e. a well graded material with not less than 10% fines content) and compact by tamping/driving over the material with the available plant to crest level of the existing adjacent dike. The fill shall be compacted to 90 percent of Modified Proctor maximum dry density (ASTM D1557).

Important Note

- No construction equipment shall traffic over the rails until a minimum thickness of 300 mm of fill has been placed across the top of the rail.
- CN Rail or CP Rail personnel must be onsite during the works.
- Confirmation of the location of any underground services in the area is to be provided by CN and CP Rail prior to the commencement of works.

Attachment
BGW/BLJM/tk

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I hereby confirm that I have read and understand the recommended procedures for temporary filling over the railway tracks as detailed in this technical memorandum.

Name	Date	Company	Signature