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Golder Associates

REPORT ON

GEOTECHNICAL ASSESSMENT
FRESHET 2007
URGENT MITIGATIVE FLOOD WORKS
PITT RIVER DIKE
PORT COQUITLAM, BC

Submitted to:

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DISTRIBUTION:

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July 26, 2007 07-1411-0098/3000

50 BEST EMPLOYERS IN CANADA 2007

CANADA'S 50 BEST MANAGED COMPANIES

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1.0 INTRODUCTION

As requested, Golder Associates Ltd (Golder) has provided geotechnical input for upgrading a 9 km section of the Pitt River Dike located along De Boville Slough between Cedar Drive and Lincoln Avenue and along the Pitt River between Lincoln Drive and Argue Street, Port Coquitlam, BC. The proposed dike upgrade involved increasing the height of the dike crest by up to 0.5 m to reach El 5.5 m geodetic datum. The requirement for the dike raise was identified after potential flood levels predicted for the Fraser River during the 2007 freshet were estimated to exceed current dike crest levels.[1] The project was considered urgent with a required completion date of June 15, 2007.

The City of Port Coquitlam (the City) was granted approval from the Ministry of Environment (MoE) to proceed with the proposed dike upgrade, under provisions within the Dike Maintenance Act (ref: 07-02-01A letter dated May 15, 2007). The approval was granted with the following terms and conditions:

- The design and construction standards should conform, where possible, to the "Dike Design and Construction Guide-Best Management Practices for British Columbia, July 2003";
- The timing of construction should be carefully scheduled to take into account and / or accommodate the elevated water levels that occur during the annual freshet;
- The quality control and assurance (QA/QC) monitoring shall be under the supervision of a Professional Engineer;
- Any damage to the dike caused by the construction should be restored to equal or better than its original condition;
- A completion report shall be submitted including project description, photos, drawings, geotechnical conditions, material specifications, and any other relevant information;
- As-built drawings shall be submitted including detailed information on the specifications for the materials used;
- The geotechnical consultant shall complete seepage and slope stability analysis of several typical dike sections and provide factors of safety; and
- The project consultants shall provide recommendations for future work to upgrade the dike (including any subsurface and geotechnical investigations) to fully meet provincial guidelines with respect to dike stability, side slopes and crest widths.

[1] Northwest Hydraulic Consultants (NHC) identified an increase in the design water level along the Pitt River Dike of 350 mm, outlined in their 2006 Fraser River Hydraulic Model Report.

The City appointed Associated Engineering (BC) Ltd (AE) as the project consultant and Jack Cewe Ltd (Cewe) as the construction contractor. AE requested Golder assist with the geotechnical aspects of the project. The scope of work for the geotechnical input was outlined in our proposal submitted to AE on April 18, 2007 (reference: e-mail from Randy Williams) and included:

- Review available documentation related to the existing dike conditions (including previous geotechnical investigations where available);
- Review and verify selected sections for geotechnical conditions and stability; and
- Provide recommendations for implementation of the proposed upgrade.

The scope of this assessment was limited solely to the geotechnical aspects of the project and did not include any investigation, analytical testing or assessment of potential soil and groundwater contamination or for any bio-environmental considerations.

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

2.0 SITE DESCRIPTION

The Pitt River Dike (herein referred to as the site) includes an east-west leg and a north-south leg in Port Coquitlam, BC as shown on Figure 1.

The east-west leg of the Pitt River Dike runs adjacent the south bank of De Boville Slough over 1.9 km between Cedar Drive and Lincoln Avenue, Port Coquitlam, BC. The land downstream (landside) of the dike includes green areas, with some designated as parks and other areas likely to be developed for residential use in the future.

The north-south leg of the Pitt River Dike runs adjacent the west bank of the Pitt River over 6.8 km between Lincoln Avenue and Argue Street in Port Coquitlam, BC. The part of the dike located north of the Lougheed Highway is mostly farmland, and the areas south of the highway are mostly industrial / commercial.

In terms of construction nomenclature, the east-west leg extends from STA: 7+800 at its eastern boundary to STA: 9+700 at its western boundary; the north-south leg extends from STA: 1+000 at its southern boundary to STA: 7+800 at its northern boundary.

Figures 2A to 2E show a plan and profile of the Site with construction nomenclature.

3.0 AVAILABLE INFORMATION

3.1 Geological Map

The surficial geology map prepared by the Geological Survey of Canada (Map 1484A, dated 1980) indicates the site is underlain by Quaternary age Fraser River overbank sediments comprising silty clay loam to 2 m thick overlying deltaic and tidal flat deposits comprising sandy silt loam up to 40 m thick. The eastern end of the east-west leg of the dike may be underlain by Quaternary age mountain stream channel fill comprising gravel and sand deposits up to 15 m thick.

3.2 Construction History

The original dike was probably constructed in the early 1900's, although records were not available. The original dike has been upgraded as follows:

In 1976 the original crest was raised by about 0.15 m to 0.3 m to the design elevation of 5.15 m geodetic datum. As-constructed drawings for the 1976 dike raise (ref: Drawings 4944-1-D204 to 4944-1-D214 dated August 1976) indicate the dike section geometry included a new crest width of at least 3.6 m placed to overlap with the existing crest. Fill was placed on the downstream side to form slopes of 1 vertical to 2 horizontal. The dike was constructed of "Type II" fill specified as having less than 8% fines and maximum particle size of 150 mm. A 0.15 m running surface was placed over the crest.

In 1999 the crest was raised by 0.1 m to 0.45 m to the same design elevation of 5.15 m geodetic datum. As-constructed drawings for the 1999 dike raise (ref: Drawings 982863-00 to 982863-26 dated March 1999) indicate the raise consisted of a 3.6 m wide capping layer placed generally on the crest of the dike. The material used was not specified.

3.3 1975 Investigation

Crippen Engineering Ltd (Crippen) carried out a geotechnical investigation at the site for the first dike raising project in 1975 (report dated May 30, 1975). The geotechnical investigation included 17 boreholes to depths of between 11 m to 23 m and moisture content testing on disturbed samples. The report also made reference to some boreholes drilled in 1962 by the Water Resources Branch. The locations of the previous test holes, and the borehole logs, are included in Appendix I.

4.0 SUBSURFACE CONDITIONS AND FILL MATERIALS

4.1 Soil Stratigraphy

The previous geotechnical assessment indicated the dike fill generally consists of clayey and sandy silt with minor organic content; and the native materials consist of loose silt and fine silty sand varying in thickness from 1.5 m to 9 m underlain by clean fine sand. The stratigraphy is shown on the profile of the alignment on Figures 2A to 2E.

4.2 Groundwater

The groundwater level recorded in the Crippen investigation as varying between El 0.6 m and El 2.2 m geodetic datum. The water levels are expected to vary with season and precipitation. The location and elevation of measured groundwater levels are shown on Figures 2A to 2E.

4.3 2007 Dike Raising Materials

The fill materials proposed to be used to raise the dike came from two sources, Jervis Inlet Pitrun and Pipeline Road Pitrun. Laboratory testing was carried out on selected samples; results are summarized in Table 1 and report sheets included in Appendix II.

TABLE 1: Summary of Laboratory Test Results on Various Fill Materials

Material Source		Particle Size Distribution			Compaction Characteristics		Permeability (m/sec)
		% Gravel	% Sand	% Fines	SPMDD (kg/m^3)	OMC (%)	
Jervis Inlet		11	82	7	1883	5.6	9.3 x 10-6
		37	58	5	1936	9.0	
Pipeline Road Pit Run	unscreened	15	56	29	-	-	3.75 x 10-8
		13	64	23	-	-	
					2107	7.3	
					2049	7.7	
	screened	29	57	14	2047	9.1	
Road mulch					2240	7.3	

5.0 GEOTECHNICAL ASSESSMENT

5.1 Design Section

The design cross-sections were provided by AE (ref: 20021102 to 20251124). The section geometry comprised a 4 m wide crest, with capping placed over the crest to El 5.5 m geodetic datum and with side slopes of 2 horizontal to 1 vertical. It is understood the design crest elevation of 5.5 m geodetic datum was based on accommodating the 1 in 200 year HWL of 4.9 m geodetic datum with a freeboard allowance of 0.6 m. The raise was confined to the crest and upstream (riverside) slope.

5.2 Geotechnical Model

The geotechnical parameters required for the assessment included unit weight, shear strength and hydraulic conductivity. These parameters were selected for each soil layer based on available historical information (including grain size analyses and fines content) and typical values for the soil types described on the borehole logs. The geotechnical parameters for each soil layer are summarized in Table 2.

TABLE 2: Geotechnical Parameters

Soil Description		Unit Weight (kN/m3)	Undrained Cohesion (kPa)	Friction Angle (degrees)	Hydraulic Conductivity (m/s)
Dyke Fill	2007: 5% to 30% fines	19		32	1×10^{-5}
	1998: unknown	19		32	1×10^{-3}
	1976: <8% fines	19		32	1×10^{-3}
	Original: Silt	19	15		1×10^{-8}
Native Soils	Peat: outside dike footprint	17	15		1×10^{-5}
	Peat: beneath dike footprint	17	20		1×10^{-7}
	Silt: outside dike footprint	17	15		1×10^{-6}
	Silt: beneath dike footprint	17	25		1×10^{-6}
	Sand	19		35	1×10^{-4}

5.3 Settlement

Long-term settlement over the remaining design life of the dike is likely to be fairly limited and can be managed by topping-up the dike as part of on-going dike maintenance. This assumes the design dike crest elevation does not change in time.

5.4 Seepage

Seepage analyses were carried out using the computer program Geostudio 2004 Seep/W version 6.21. The analyses assumed the water level on the upstream side of the dike would be at 4.9 m geodetic datum for a sufficient period to develop steady state seepage conditions through and beneath the dike. Two sections were selected for analyses; one at STA 2+900 and the other at STA 5+600. The stratigraphy at these locations was based on that shown on Figures 2A to 2E and the geotechnical parameters were as detailed in Table 2.

The results of the analyses indicate that exit gradients at the toe of the dike are acceptable and in the order of 0.1 to 0.2. The results are presented on Figure 3.

5.5 Stability

Stability analyses were conducted using the computer program Geostudio 2004-Slope/W, version 6.21 with the Morgenstern-Price solution method. Static limit-equilibrium stability analyses were carried out for short-term conditions for both upstream and downstream failure directions. No earthquake loads were applied. Two sections were selected for analyses; one at STA 2+900 and the other at STA 5+600.

The water level was modeled at 4.9 m geodetic datum, with the exception of the rapid drawdown case for upstream failure which modeled the water level at the ground surface. In all cases, the stability models assumed the phreatic surface as that output from the Seep/W model under steady state seepage conditions.

The results of the stability analyses are presented on Figures 4A and 4B and are summarized in Table 3.

TABLE 3: Summary of Slope Stability Results

Failure Direction	Load Case	Factor of Safety	
		STA: 2+900	STA: 5+600
Downstream	1 in 200 year flood	1.7	1.4
Upstream	1 in 200 year flood	1.8	1.5
	Rapid drawdown after 1 in 200 year flood	1.4	1.3

The factors of safety are considered acceptable.

5.6 Harbour Street Pump Station

It was recommended that the possibility of piping at the Harbour Street pump station be addressed as follows:

- Remove vegetation from the entire downstream slope within a width of 10 m either side of the pipe. If possible the roots and topsoil should remain in place;
- Place geofabric on the entire downstream slope within a width of 5 m either side of the pipe and beneath the pipe. The geofabric should be anchored at the top of the slope in a 0.5 m deep anchor trench backfilled with gravel;
- Place and hoe-pack a 0.5 m thick layer of free-draining material over the geofabric. The drainage layer should extend as far down the slope as practical and may have to taper out at the top of the retaining walls located either side of the pipe; and
- Place drainage material around and beneath the exit of the pipe.

The work at the Harbour Street pump station was carried out between June 2 to 4, 2007. Daily reports provided by AE indicate vegetation was stripped, Nilex 4512 geofabric was placed over a 10 m width on either side of the pipe and 3 inch minus Pipeline pitrun was placed over the geofabric. Final inspection by Golder on June 12, indicated the recommendations had generally been followed, except for the increase in width of the geofabric and drainage blanket,

Temporary retaining "structures" had also been constructed around the pipe to contain the fill placed around and beneath the exit of the pipe. These structures included a timber wall about 1 m high located perpendicular to, and at the base of the pipe and extending to the underside of the walkway. The geofabric was located parallel to, and at the base of the pipe and extending to be secured to the top of the walkway. These retaining structures are considered suitable for the emergency period only, and should be replaced with a more permanent solution as soon as possible.

Leaking joints in the pipe had been "sealed" with rubber and ties. Whilst this is considered an appropriate solution for the emergency period, it is considered a temporary measure and should also be replaced with a more permanent solution as soon as possible.

The as-built drawings for the Harbour Street Pump Station are included as Figures 5A and 5B.

It was reported by a member of the public that the pipeline at the original Harbour Street pump station had been constructed without the use of a seepage collar. This is a concern as this condition may lead to piping failure within the vicinity of the pipeline, as the backfill adjacent to the pipeline may allow seepage flow.

The pipeline area was inspected by Golder on May 4 and June 2, 2007. It was noted that there was heavy vegetative growth on the downstream face that would prevent early identification of piping failure. Also there was a 0.3 m long and 0.1 m diameter hole beneath the exit of the pipe and significant erosion was apparent with no exit control or filter zone. Construction Recommendations and monitoring

6.0 2007 DIKE UPGRADE

6.1 Subgrade Preparation Dike Construction

It was recommended that subgrade preparation for the new dike construction include removal of vegetation from the side slopes to expose the original dike fill and scarifying the existing crest.

Based on the daily reports provided by AE, the upstream of the existing dike was stripped between March 29 and April 5, 2007.

6.2 Fill Materials

Imported fill materials was to come from established borrow pits. The materials should be free from organic, man made materials and environmental contaminants. The proposed borrow materials described in Section 4.3 are considered suitable.

Daily reports indicate fill was placed as follows:

- Jervis Inlet Pit Run-March 30 to May 8, 2007;
- Pipeline Road Pit Run-April 10 to April 26, 2007; and
- Road Mulch-April 30 to May 22, 2007.

6.3 Fill Compaction

It was recommended that the fill should be placed in uniform horizontal lifts not exceeding 300 mm in loose thickness. The fill should be compacted to a minimum of 95% of Standard Proctor Maximum Dry Density (SPMDD). Compaction testing was carried out by Golder on an as-requested basis and the results are summarized on the following page in Table 4.

TABLE 4: Compaction Test Results

TEST DATE	TEST LOCATION BY STATION	COMPACTION ACHIEVED: MEASURED FIELD DENSITY AS A PERCENT OF SPMDD (%)	
		Surface	0.5m Below Grade
April 3	1+100	100	-
	1+400	101	-
	1+550	101	100
	1+750	100	100
	1+900	100	97
	2+000	99	98
	2+090	98	98
	2+130	99	98
	2+200	100	99
	2+400	99	98
	2+500	101	-
	2+600	100	-
	2+750	99	-
April 19	7+100	99	
	7+200	98	
	7+250	98	
	8+800	98	
	9+000	96	
	9+145	95	
	9+280	96	
	9+350	100/99	
	9+440	100	
	9+500	95	
	9+600	95	
	9+700	95	

6.4 Hydroseeding

It was recommended that the finished side slopes be hydroseeded. Placement of topsoil was not recommended on the upstream slope as it would be unlikely to remain in place. The daily reports from AE indicate topsoil was placed on the downstream slope from Coast Meridan Road to Kebet Way Avenue and hydroseeding was carried out on the side slopes from May 7 to May 28, 2007.

7.0 RECOMMENDATIONS

7.1 Low Permeability Core

Based on the available information about construction history of the Pitt River dike, the original dike was constructed of silt while the subsequent raises may have been constructed using relatively clean sands. The current elevation of the original dike is likely between 4.4m and 4.9 m geodetic datum. The 1 in 200 year HWL is estimated at 4.9 m. Therefore, it is possible that the permeable materials exist above-below the high water level in some parts of the dike.

It is recommended that further investigation be carried out to assess the extent of permeable material below elevation 4.9 m geodetic datum. If the depth and plan extent is significant, consideration may be given to constructing a 2 m wide low permeability zone on the upstream face. The low permeability zone would key into the original dike and extend at least to elevation 4.9 m geodetic datum.

7.2 Harbour Street Pump Station

The area surrounding the Harbour Street Pump Station should be inspected during periods of high water, to look for possible signs of piping. Evidence of piping may include water (particularly if dirty) exiting from the downstream face, areas of drainage material noticeably wetter than surrounding drainage material, crest settlement or sinkhole formation and downstream slope instability.

Future work at the Harbour Street Pump Station would include, as a minimum, removing the existing retaining structures and replacing with engineer designed structures; identifying and properly sealing the leaking joints in the pipe. In the long-term the potential piping problem may be addressed by increasing the length of the seepage flow path to the pipe backfill. This could be achieved by constructing a key of low permeability material into the upstream face near the pipe, or excavating a trench parallel to the pipe extending down below the base of the pipe to construct a cutoff wall that would act as a seepage collar. However the above solutions do not address the potential leaks within the pipe itself. In order to alleviate both problems, the above solutions may be used in combination with infilling the pipe, alternatively the pipe can be removed and replaced, or removed with backfilling the excavation with appropriate dike construction materials (assumes pump station is closed and removed).

8.0 CLOSURE

The factual data, interpretations and recommendations contained in this report are based on the soil conditions encountered at the test locations, and local experience. This report has been prepared for the exclusive use of Associated Engineering Ltd. and its representatives (specifically including the City of Port Coquitlam) for specific application to the development described within this report. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it are the responsibility of such third parties. Golder accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report. This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied is made.

Yours very truly,

GOLDER ASSOCIATES LTD.

Jo-Anne I. Perrett
Geotechnical Engineer

John A. Hull, P.Eng.
Principal

JIP/JAH/nnv
07-1411-0098/3000

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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.

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

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.

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.

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

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.

PROJECT

ASSOCIATED ENGINERING (BC) LTD.
URGENT MITIGATIVE FLOOD WORKS
PITT RIVER, PORT COQUITLAM, BC

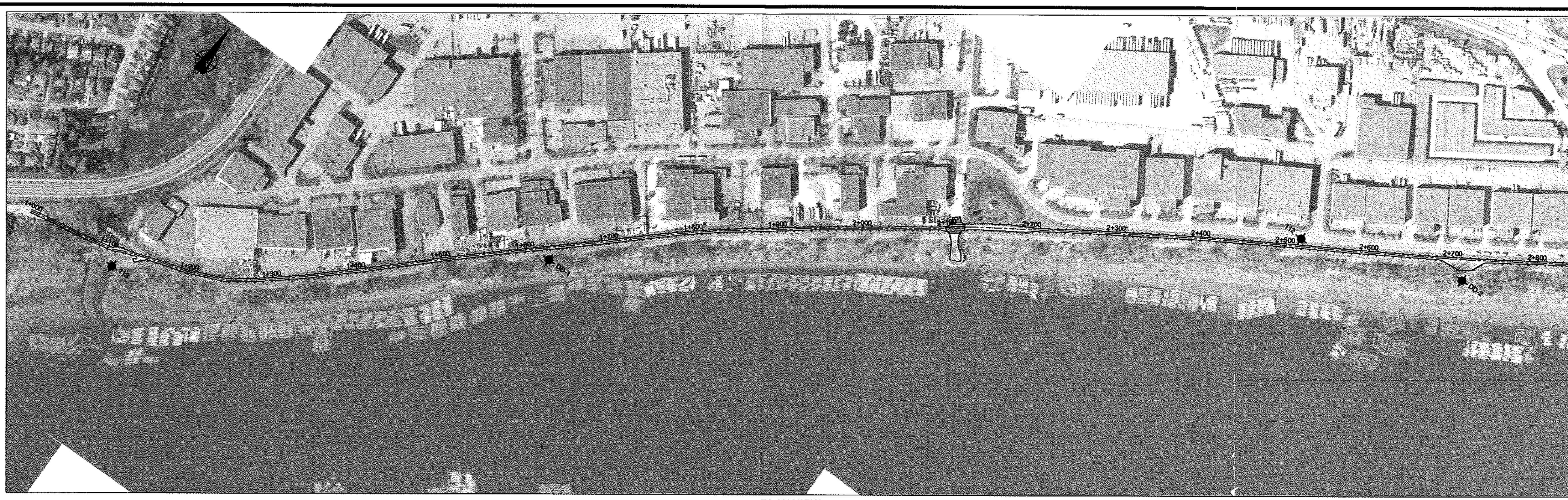
TITLE

Location Plan

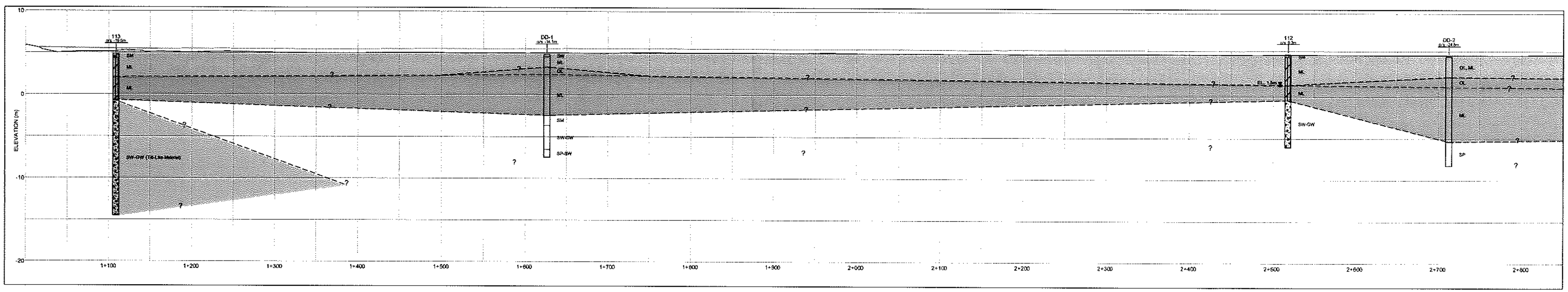
Golder Associates

PROJECT No. 07-1411-0098			PHASE / TASK No. 2000	
DESIGN	GGG	03JUL07	SCALE NTS	REV.
CADD	MCM	03JUL07	**FIGURE 1**	
CHECK	JIP	03JUL07		
REVIEW				

REVISION DATE: July 3, 2007 BY: MGM and GGG FILE: FINAL\2007\1411\07-1411-0098\3000\FIGURE 1 – LOCATION LOCATION.PPT



PLAN VIEW



PROFILE

LEGEND

- 113 — 1975 Borehole (Crippen Engineering)
- DD-1 — 1962 Borehole (Water Resources Branch)
- June 2007 As-Built Dyke Crest Elevation
- March 2007 Existing Dyke Crest Elevation
- — ? — Inferred Soil Stratigraphy

POST - GLACIAL DEPOSITS:

- FILL / Surficial Mineral Soils
- PEAT / Organic Soils
- SILT / Clayey SILT to Silty CLAY / Organic SILT
- SAND / Silty SAND / Gravelly Sand

GLACIAL DEPOSITS:

- TILL-LIKE Material

REFERENCES

1) Base plan provided by Associated Engineering on June, 2007.

PROJECT

ASSOCIATED ENGINEERING
URGENT MITIGATIVE FLOOD WORKS
PITT RIVER, PORT COQUITLAM, B.C.

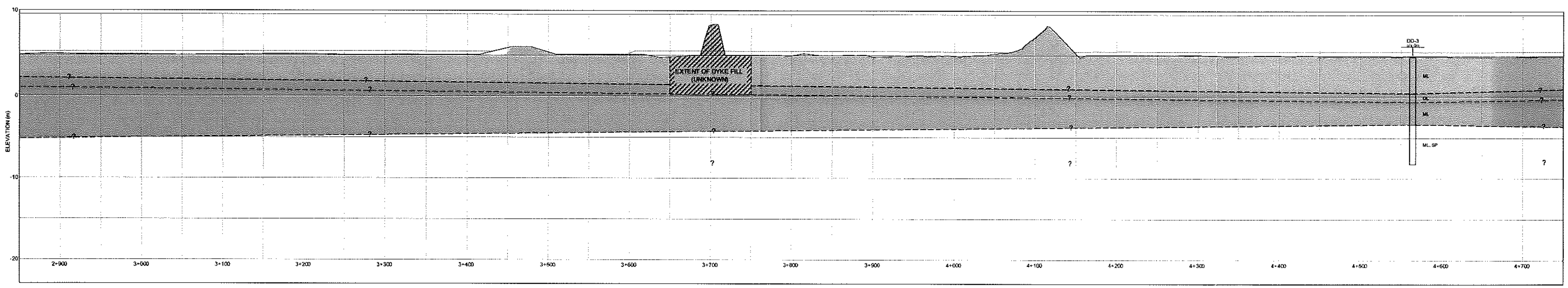
TITLE

PITT RIVER DIKE
STATION 1+000 TO STATION 2+850

Golder Associates

PROJECT No. 07-1411-0098			FILE No.	1000
DESIGN	JP	23APR07	SCALE AS SHOWN	REV. -
CADD	SRR	23APR07		
CHECK			FIGURE 2A	
REVIEW				

PLAN VIEW



PROFILE

LEGEND

- 113 — 1975 Borehole (Crippen Engineering)
- DD-1 — 1962 Borehole (Water Resources Branch)
- June 2007 As-Built Dyke Crest Elevation
- March 2007 Existing Dyke Crest Elevation
- – – ?– – Inferred Soil Stratigraphy

POST - GLACIAL DEPOSITS:

- FILL / Surficial Mineral Soils
- PEAT / Organic Soils
- SILT / Clayey SILT to Silty CLAY / Organic SILT
- SAND / Silty SAND / Gravelly Sand

GLACIAL DEPOSITS:

- TILL-LIKE Material

REFERENCES

1) Base plan provided by Associated Engineering on June, 2007.

Horizontal Scale in Meters: 0 20 40 60 80 100

Vertical Scale in Meters: 0 2 4 6 8 10

PROJECT

ASSOCIATED ENGINEERING
URGENT MITIGATIVE FLOOD WORKS
PITT RIVER, PORT COQUITLAM, B.C.

TITLE

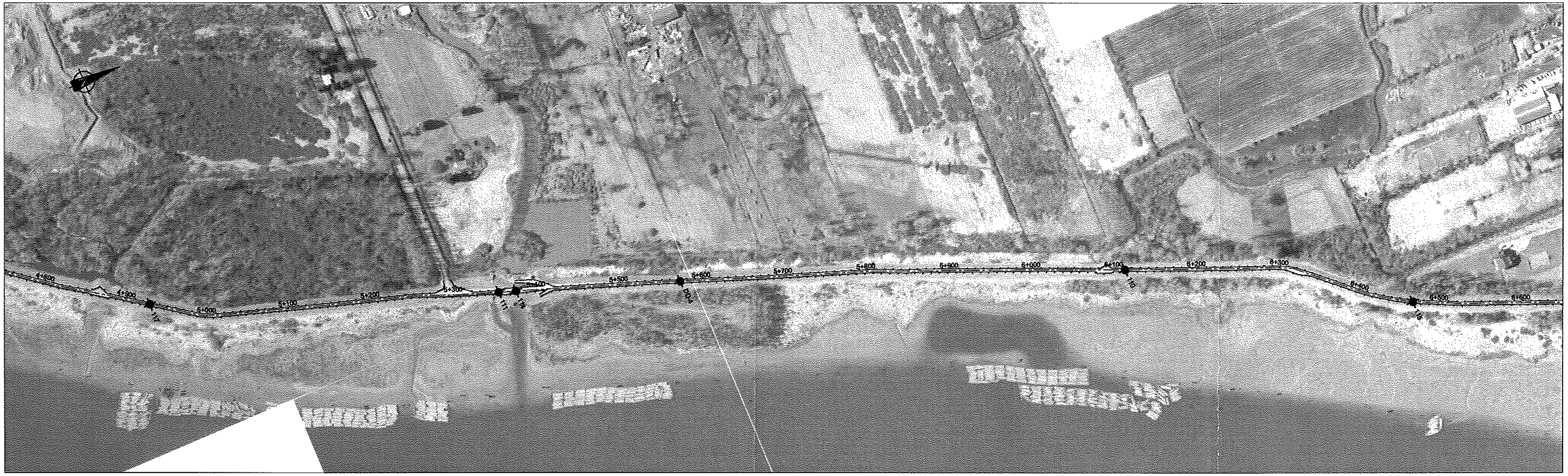
PITT RIVER DIKE
STATION 2+850 TO STATION 4+750

Golder Associates

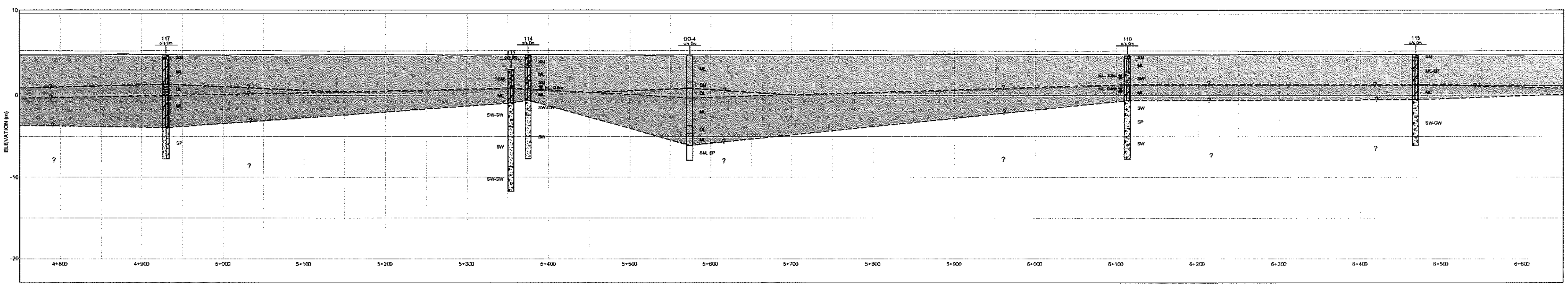
PROJECT No. 07-1411-0098			FILE No. 1000	
DESIGN	JP	23APR07	SCALE AS SHOWN	REV. –
CADD	SRR	23APR07	**FIGURE 2B**	
CHECK				
REVIEW				

REVISION DATE: 07/07/13 04:04PM By: wesley CADD FILE: N:\Bur-Graphics\Projects\2007\1411\07-1411-0098\Drafting\1000\0714110098-1000-A_2A-2E.dwg

Drawing file: 0714110098-1000-A_2A-2E.dwg Jul 13, 2007 - 4:07pm



PLAN VIEW



PROFILE

LEGEND

- 113 — 1975 Borehole (Crippen Engineering)
- DD-1 — 1962 Borehole (Water Resources Branch)
- June 2007 As-Built Dyke Crest Elevation
- March 2007 Existing Dyke Crest Elevation
- – – ? – – Inferred Soil Stratigraphy

POST - GLACIAL DEPOSITS:

- FILL / Surficial Mineral Soils
- PEAT / Organic Soils
- SILT / Clayey SILT to Silty CLAY / Organic SILT
- SAND / Silty SAND / Gravelly Sand

GLACIAL DEPOSITS:

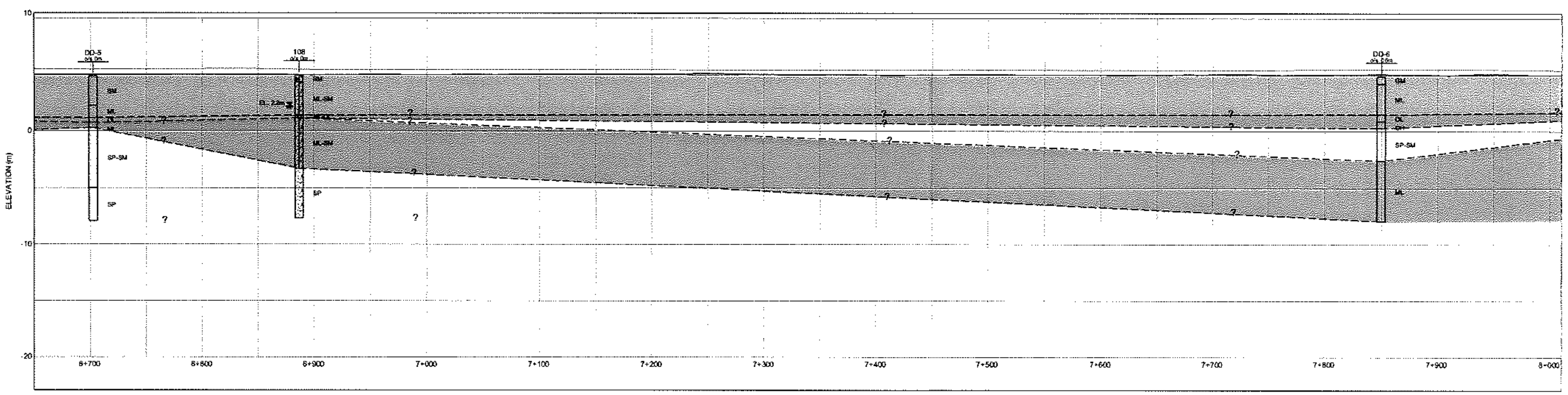
- TILL-LIKE Material

REFERENCES

1) Base plan provided by Associated Engineering on June, 2007.

PROJECT	ASSOCIATED ENGINEERING URGENT MITIGATIVE FLOOD WORKS PITT RIVER, PORT COQUITLAM, B.C.			
TITLE	**PITT RIVER DIKE STATION 4+750 TO STATION 6+650**			
Golder Associates	PROJECT No. 07-1411-0098		FILE No. 1000	
	DESIGN	JP	23APR07	SCALE AS SHOWN	REV. –
	CADD	SRR	23APR07	**FIGURE 2C**
	CHECK			
	REVIEW			

PLAN VIEW



PROFILE

LEGEND

- 113 — 1975 Borehole (Crippen Engineering)
- DD-1 — 1962 Borehole (Water Resources Branch)
- June 2007 As-Built Dyke Crest Elevation
- March 2007 Existing Dyke Crest Elevation
- — ? — Inferred Soil Stratigraphy

POST - GLACIAL DEPOSITS:

- FILL / Surficial Mineral Soils
- PEAT / Organic Soils
- SILT / Clayey SILT to Silty CLAY / Organic SILT
- SAND / Silty SAND / Gravelly Sand

GLACIAL DEPOSITS:

- TILL-LIKE Material

REFERENCES

1) Base plan provided by Associated Engineering on June, 2007.

Horizontal Scale in Metres: 0 20 40 60 80 100

Vertical Scale in Metres: 0 2 4 6 8 10

PROJECT

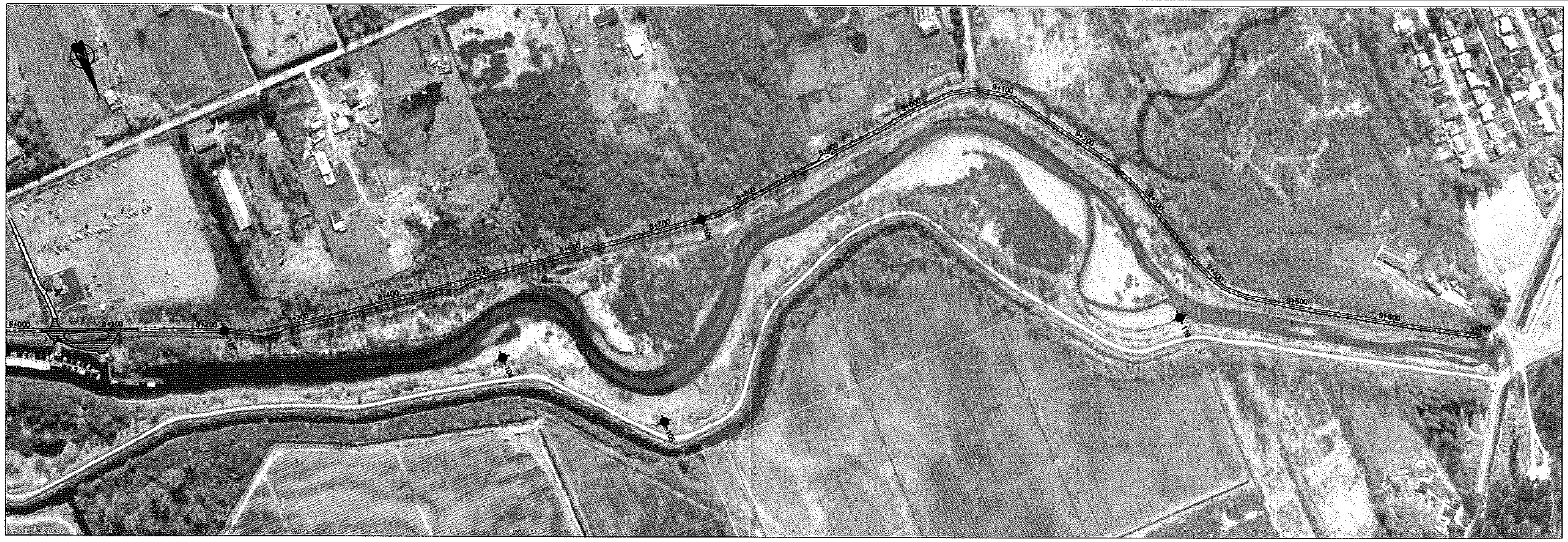
ASSOCIATED ENGINEERING
URGENT MITIGATIVE FLOOD WORKS
PITT RIVER, PORT COQUITLAM, B.C.

TITLE

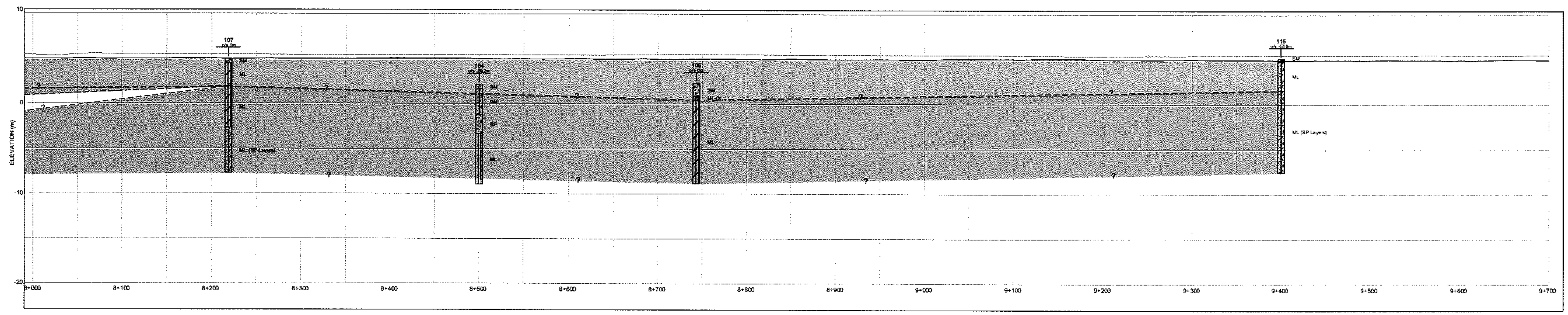
PITT RIVER DIKE
STATION 6+650 TO STATION 8+000

Golder Associates

PROJECT No. 07-1411-0098			FILE No. 1000
DESIGN	JP	23APR07	SCALE AS SHOWN REV. –
CADD	SRR	23APR07	
CHECK			**FIGURE 2D**
REVIEW			



PLAN VIEW



PROFILE

LEGEND

- 113 — 1975 Borehole (Crippen Engineering)
- DD-1 — 1962 Borehole (Water Resources Branch)
- June 2007 As-Built Dyke Crest Elevation
- March 2007 Existing Dyke Crest Elevation
- --?-- Inferred Soil Stratigraphy

POST - GLACIAL DEPOSITS:

- FILL / Surficial Mineral Soils
- PEAT / Organic Soils
- SILT / Clayey SILT to Silty CLAY / Organic SILT
- SAND / Silty SAND / Gravelly Sand

GLACIAL DEPOSITS:

- TILL-LIKE Material

REFERENCES

1) Base plan provided by Associated Engineering on June, 2007.

PROJECT

ASSOCIATED ENGINEERING
URGENT MITIGATIVE FLOOD WORKS
PITT RIVER, PORT COQUITLAM, B.C.

TITLE

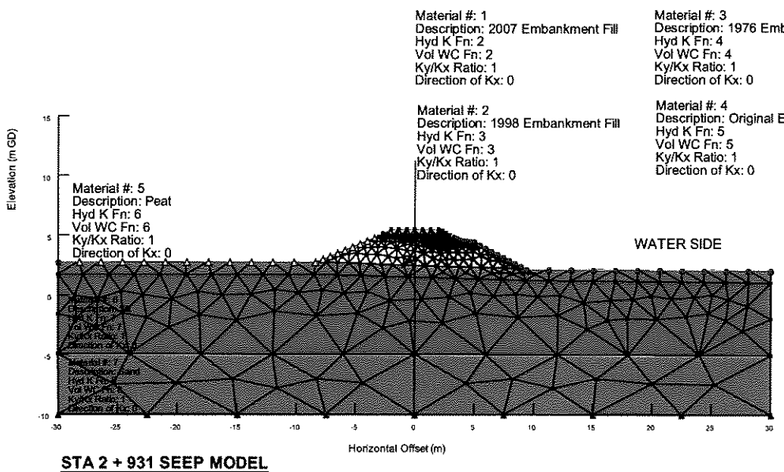
PITT RIVER DIKE
STATION 8+000 TO STATION 9+741

PROJECT No. 07-1411-0098			FILE No. 1000	
DESIGN	JP	23APR07	SCALE AS SHOWN	REV. –
CADD	SRR	23APR07	**FIGURE 2E**	
CHECK				
REVIEW				

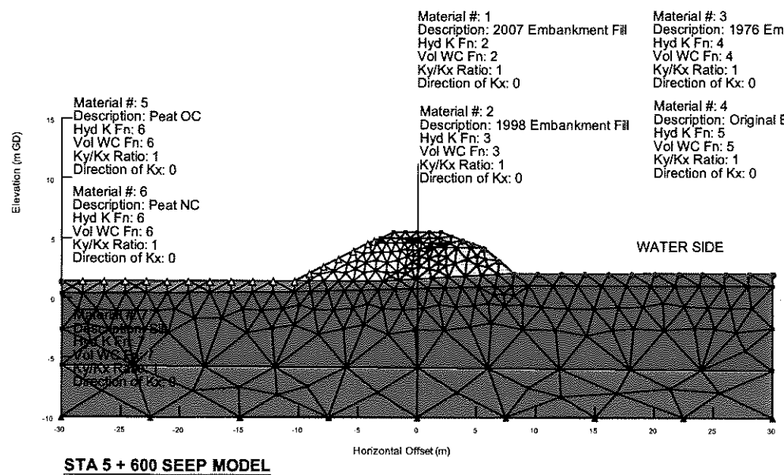
Golder Associates

REVISION DATE: 07/07/13 04:04PM By: sreddy CADD FILE: N:\Bur-Graphics\Pro...

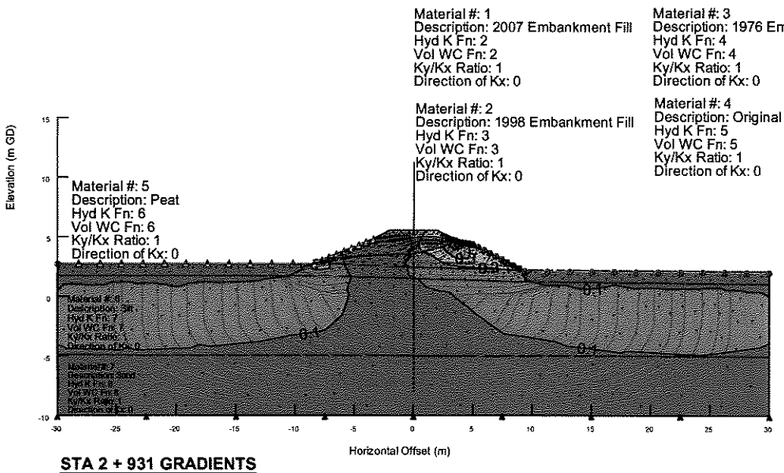
Jul 13, 2007 - 4:09pm Drawing file: 07141100098-1000-A_2A-2E.dwg



STA 2 + 931 SEEP MODEL



STA 5 + 600 SEEP MODEL



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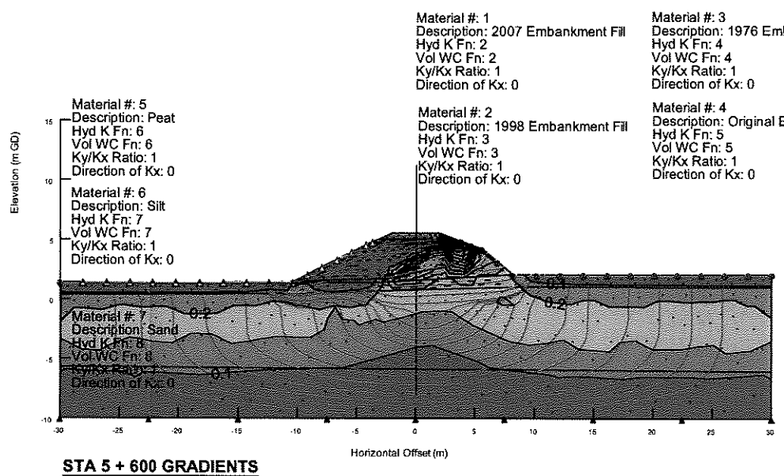
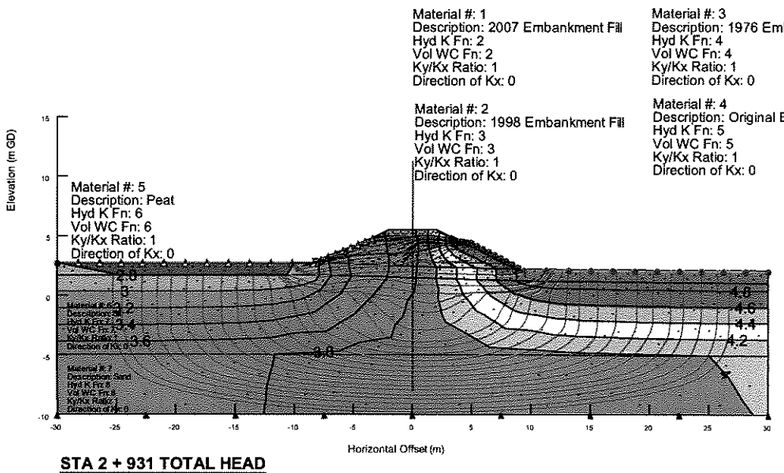
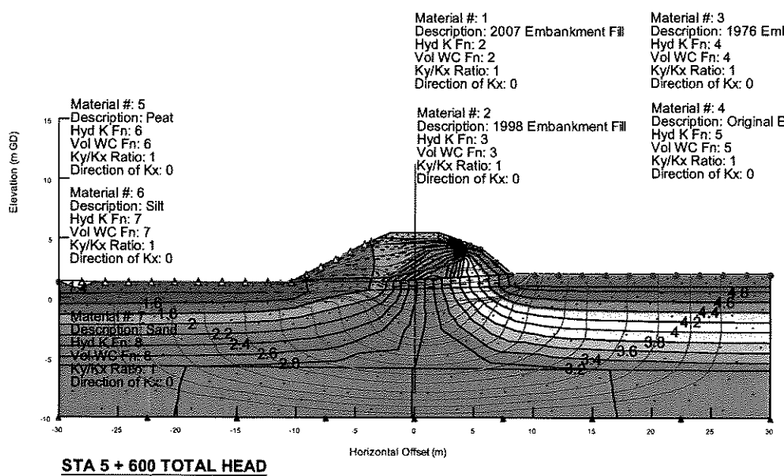


STA 5 + 600 GRADIENTS



STA 2 + 931 TOTAL HEAD



STA 5 + 600 TOTAL HEAD

PROJECT

ASSOCIATED ENGINEERING
URGENT MITIGATIVE FLOOD WORKS
PITT RIVER, PORT COQUITLAM, B.C.

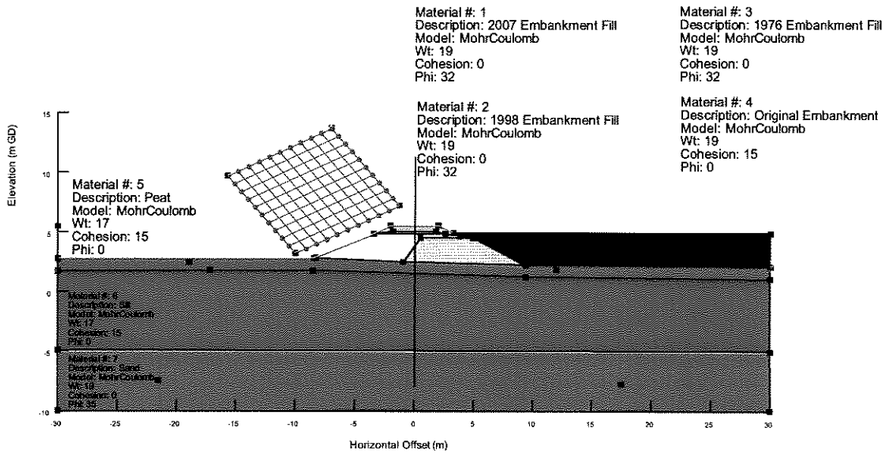
TITLE

PITT RIVER DIKE
RESULTS OF SEEPAGE ANALYSIS

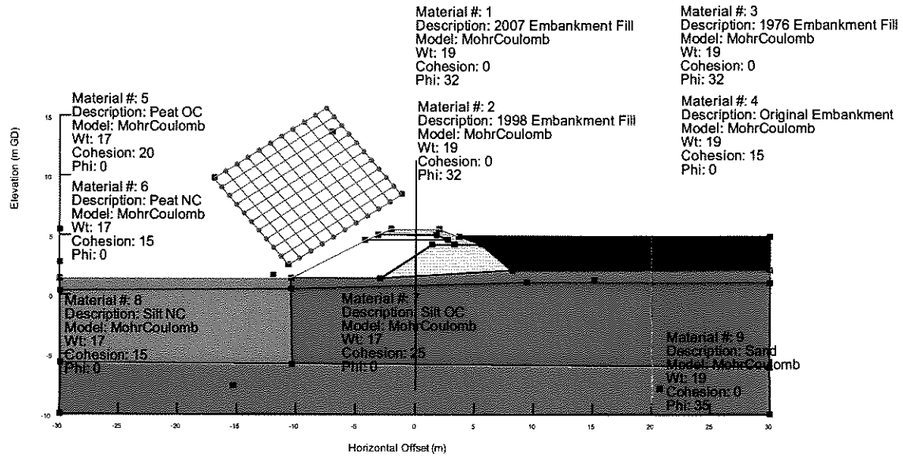
Golder Associates

PROJECT No. 07-1411-0098			FILE No.		1000
DESIGN	JP	23APR07	SCALE	AS SHOWN	REV. –
CADD	SRR	23APR07			
CHECK					
REVIEW					

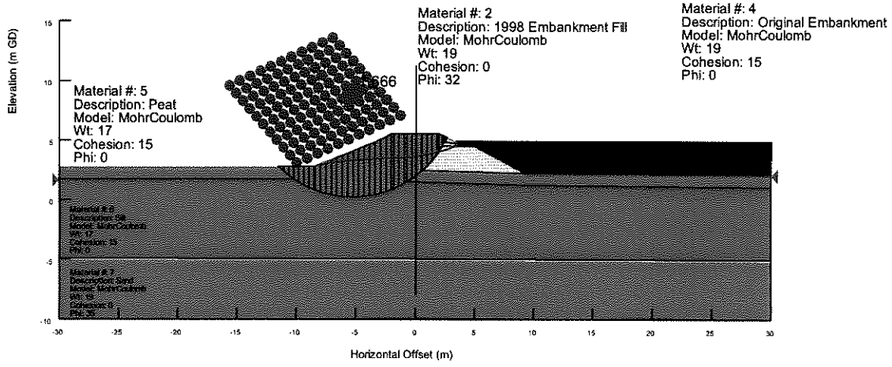
FIGURE 3



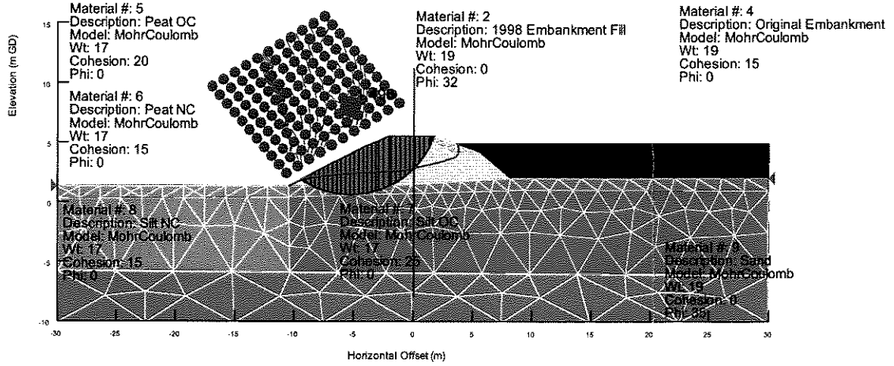
STA 2 + 931 DOWNSTREAM MODEL



STA 5 + 600 DOWNSTREAM MODEL



STA 2 + 931 DOWNSTREAM CIRCLE



STA 5 + 600 DOWNSTREAM CIRCLE

PROJECT
ASSOCIATED ENGINEERING
URGENT MITIGATIVE FLOOD WORKS
PITT RIVER, PORT COQUITLAM, B.C.

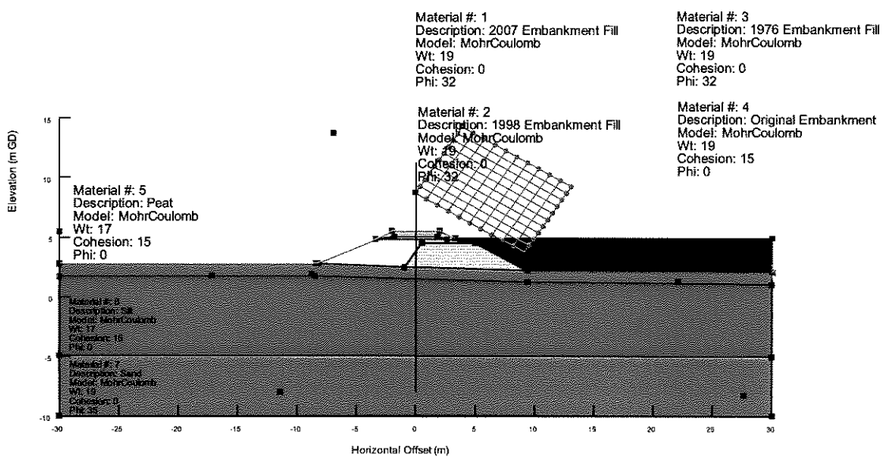
TITLE
PITT RIVER DIKE
RESULTS OF STABILITY ANALYSIS

Golder Associates

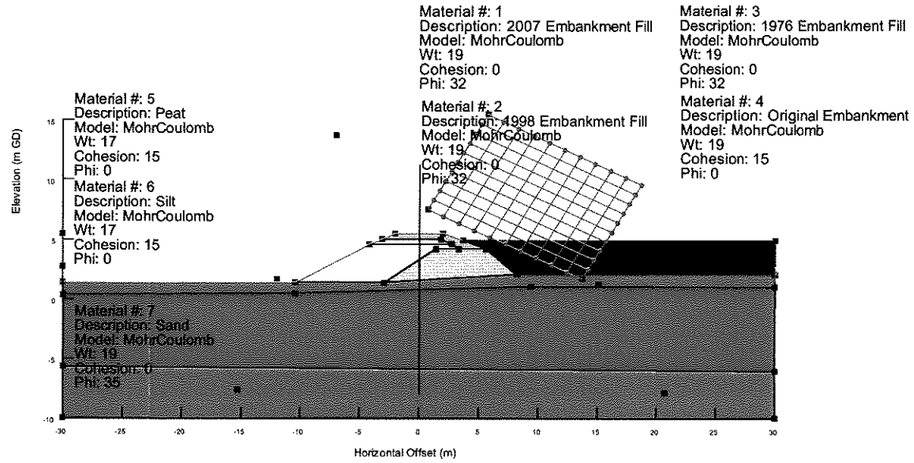
PROJECT No. 07-1411-0098			FILE No.	1000
DESIGN	JP	23APR07	SCALE AS SHOWN	REV. –
CADD	SRR	23APR07		
CHECK				
REVIEW				

FIGURE 4A

REVISION DATE: 07/07/13 03:58PM By: smalby CADD FILE: N:\Burnaby\Projects\2007\1411\07-1411-0098\Drafting\1000\07141110098-1000-A_03-A1-fig.dwg
Jul 13, 2007 - 3:47pm Drawing File: 07141110098-1000-A_03-A1-fig.dwg



STA 2 + 931 UPSTREAM MODEL



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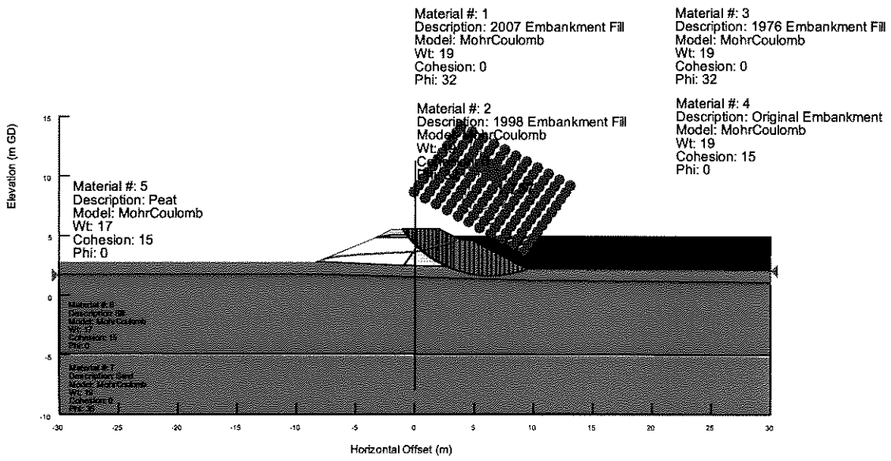
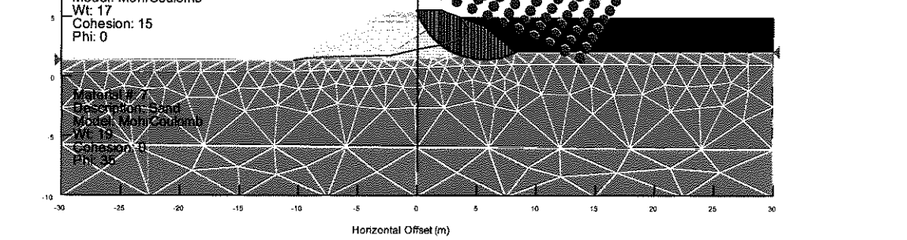
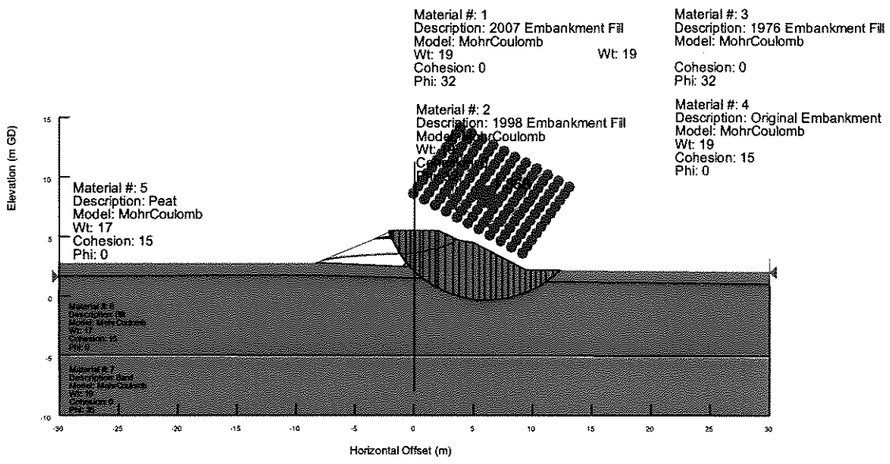


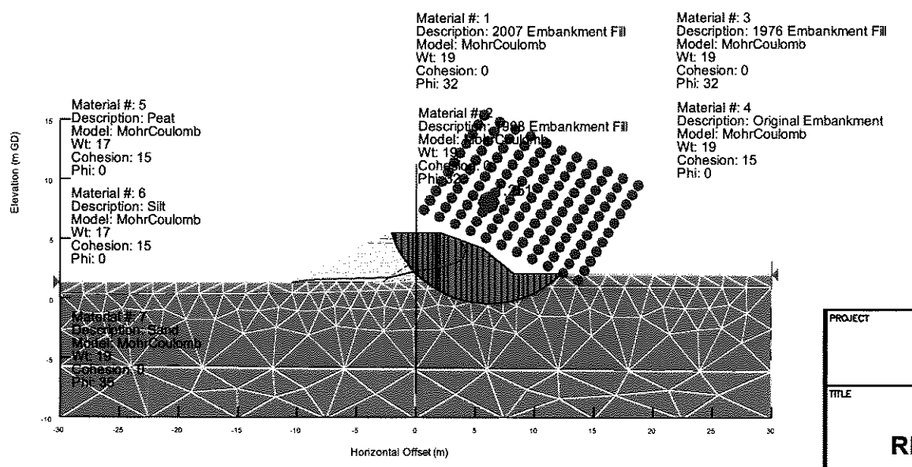
STA 2 + 931 UPSTREAM CIRCLE



STA 5 + 600 UPSTREAM CIRCLE



STA 2 + 931 UPSTREAM CIRCLE WITH RAPID DRAWDOWN



STA 5 + 600 UPSTREAM CIRCLE WITH RAPID DRAWDOWN

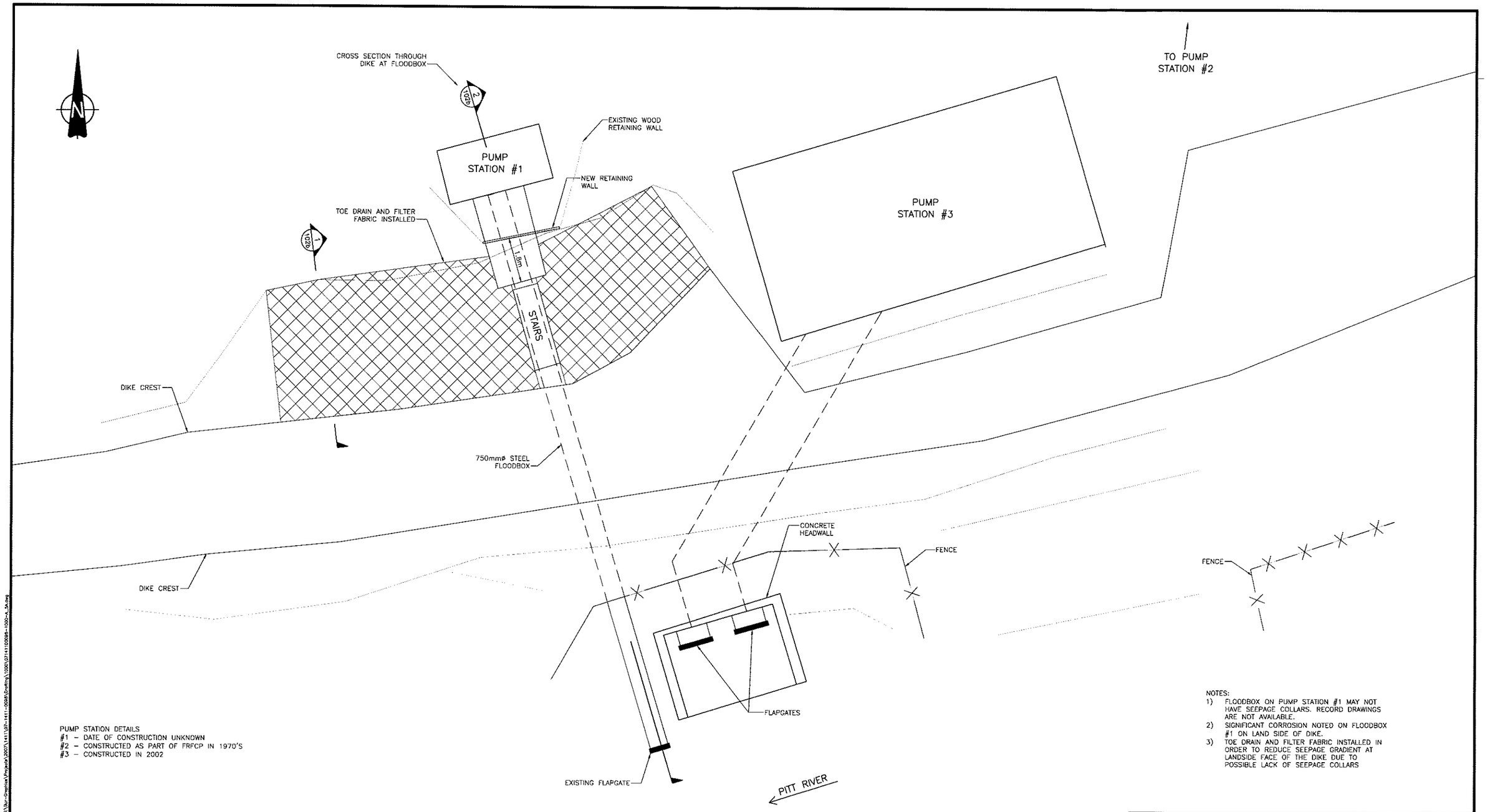
PROJECT
ASSOCIATED ENGINEERING
URGENT MITIGATIVE FLOOD WORKS
PITT RIVER, PORT COQUITLAM, B.C.

TITLE
PITT RIVER DIKE
RESULTS OF STABILITY ANALYSIS

Golder Associates

PROJECT No. 07-1411-0098			FILE No.		1000
DESIGN	JP	23APR07	SCALE	AS SHOWN	REV. –
CADD	SRR	23APR07			
CHECK					
REVIEW					

FIGURE 4B



PUMP STATION DETAILS
#1 – DATE OF CONSTRUCTION UNKNOWN
#2 – CONSTRUCTED AS PART OF FRFCP IN 1970'S
#3 – CONSTRUCTED IN 2002

NOTES:
1) FLOODBOX ON PUMP STATION #1 MAY NOT HAVE SEEPAGE COLLARS. RECORD DRAWINGS ARE NOT AVAILABLE.
2) SIGNIFICANT CORROSION NOTED ON FLOODBOX #1 ON LAND SIDE OF DIKE.
3) TOE DRAIN AND FILTER FABRIC INSTALLED IN ORDER TO REDUCE SEEPAGE GRADIENT AT LANDSIDE FACE OF THE DIKE DUE TO POSSIBLE LACK OF SEEPAGE COLLARS

SPECIAL NOTE

Temporary works as constructed in May at pump station will be investigated this summer and the temporary retaining wall under the pump station access ramp will be checked and removed or fixed by December 2007.

REFERENCES

1) Associated Engineering
Received July 12, 2007
City of Port Coquitlam - Plan
Dwg.No. 20021102a

0 0.5 1 1.5 2 2.5
Scale in Metres

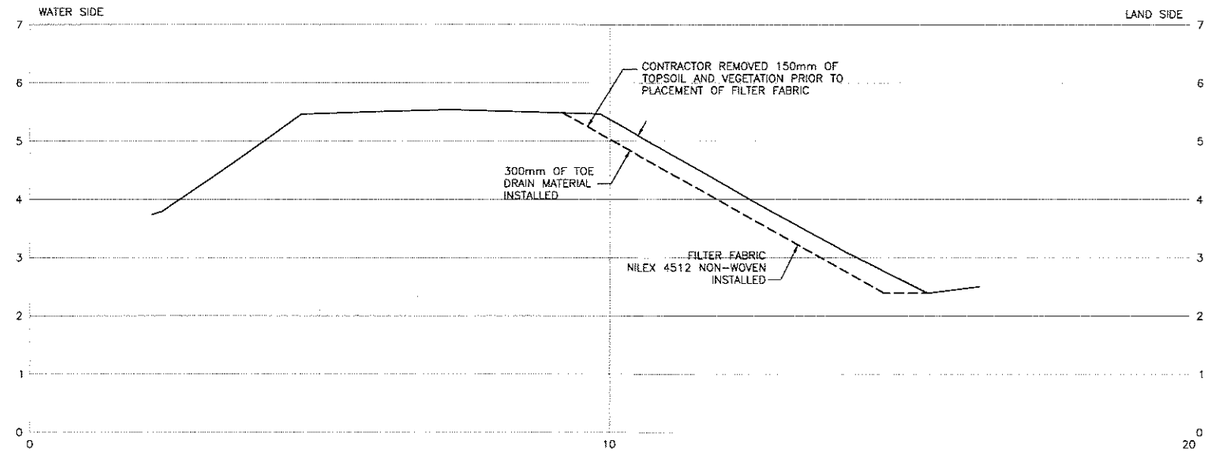
PROJECT
ASSOCIATED ENGINEERING
URGENT MITIGATIVE FLOOD WORKS
PITT RIVER, PORT COQUITLAM, B.C.

TITLE
HARBOUR STREET PUMP STATION AS-CONSTRUCTED DRAWINGS

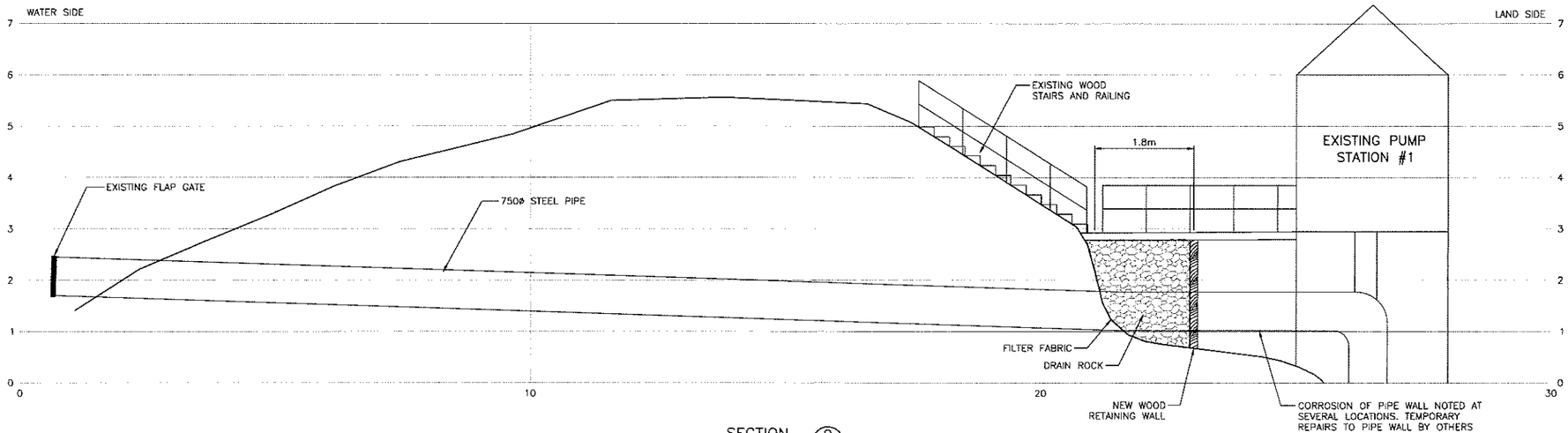
Golder Associates

PROJECT No. 07-1411-0098			FILE No.		1000
DESIGN	JP	13JUL07	SCALE	AS SHOWN	REV. –
CADD	SRR	13JUL07	**FIGURE 5A**		
CHECK					
REVIEW					

CADD FILE: N:\Burnaby-Coquitlam\Projects\2007\1411-07-1411-0098\Drafting\1000\07141110098-1000-A_SA.dwg
PLOTTED: Jul 27, 2007 - 1:45pm
Drawing File: 07141110098-1000-A_SA.dwg
REVISION DATE: 07/07/13 04:03PM By: jmolby



SECTION 1/102
SCALE 1:50



SECTION 2/102
SCALE 1:50

NOTES:
1) TOE DRAIN MATERIAL IS 3" MINUS SGSB FROM PIPELINE QUARRY.
2) CORRODED PIPE WALL RESULTED IN SIGNIFICANT LEAKAGE

SPECIAL NOTE

Temporary works as constructed in May at pump station will be investigated this summer and the temporary retaining wall under the pump station access ramp will be checked and removed or fixed by December 2007.

REFERENCES

1) Associated Engineering
Received July 12, 2007
City of Port Coquitlam - Cross Sections
Dwg.No. 20021102b

PROJECT
ASSOCIATED ENGINEERING
URGENT MITIGATIVE FLOOD WORKS
PITT RIVER, PORT COQUITLAM, B.C.

TITLE
HARBOUR STREET PUMP STATION AS-CONSTRUCTED DRAWINGS

Golder Associates

PROJECT No. 07-1411-0098			FILE No.	1000
DESIGN	JP	13JUL07	SCALE AS SHOWN	REV. –
CADD	SRR	13JUL07		
CHECK				
REVIEW				

FIGURE 5B

REVISION DATE: 07/07/27 - 1:39pm By: gpaczynski CADD FILE: K:\Burnaby\Projects\2007\1411-0098\Drafting\1000\0714110098-1002-A_38.dwg
Drawing file: 0714110098-1000-A_53.dwg Jul 27, 2007 - 1:39pm

APPENDIX I

1975 GEOTECHNICAL INVESTIGATION-BOREHOLE LOGS

CRIPPEN ENGINEERING LTD.

NORTH VANCOUVER B.C.

HOLE NO. 103

SHEET 1 OF 1

LOG OF DRILL HOLE

PROJECT Port Coquitlam Dykes.

LOCATION OF HOLE 102,666.87N. 69,909.46E

ELEVATION 15.9

CONTRACTOR Keller Soiltest Drilling

TYPE OF DRILL Rotary

DATE OF DRILLING 14-17 Feb 1975

LEGEND

- SPLIT SPOON
- WASH SAMPLE
- SHELBY TUBE
- CORE SAMPLE
- % passing #200 sieve

SHEAR STRENGTH

- UNCONFINED COMPRESSION
- LAB. VANE

PENETRATION RESISTANCE

- STANDARD N - VALUE

ATTERBERG LIMITS

P.L. L.L.

MOISTURE CONTENT

SYMBOL	DESCRIPTION	DEPTH FEET	ELEV. FEET	TEST RESULTS (200 400 600 800 PSF; 20 40 60 80 BLOWS/FT. OR %)	SAMPLE NO.	RECOVERY INCHES
			15.9			
	DYKE FILL 0-2.0' sand and gravel, silty, cobbles. 2.0-11.5' silt, clayey, sandy, trace organic matter, fine sand in thin layers	11.5	4.4		1	20/24
					2	4/18
					3	16/24
					4	4/18
					5	12/18
					6	14/18
					7	24/24
	SILT, clayey, trace fine sand, trace organic matter	21.5	-5.6		8	14/18
	SILT, sandy, trace organic matter, fine sand in thin layers	30			9	
		33.0	-17.1		10	24/24
	SAND, fine to medium, thin layers of silt to 45' depth, clean sand below.	40			11	14/18
					12	4/18
					13	10/18
		50			14	7/18
	SILT, organic, grey, soft	54.5	-38.6		15	18/18
		59.0	-43.1		16	10/18
	SAND, medium, grey, dense, trace silt in thin bands.				17	8/18
		75.0	-59.1			

CRIPPEN ENGINEERING LTD.

NORTH VANCOUVER B.C.

HOLE NO. 104

SHEET 1 OF 1

LOG OF DRILL HOLE

PROJECT Port Coquitlam Dykes

LOCATION OF HOLE 103,060.36N
67,096.11E

ELEVATION 7.1

CONTRACTOR Kelley Soiltest Drilling

TYPE OF DRILL Rotary

DATE OF DRILLING 17-18 Feb 1975

LEGEND

- SPLIT SPOON
- WASH SAMPLE
- SHELBY TUBE
- CORE SAMPLE
- % passing #200 sieve

SHEAR STRENGTH

- UNCONFINED COMPRESSION
- LAB. VANE

PENETRATION RESISTANCE

- STANDARD N-VALUE

ATTERBERG LIMITS

P.L. ——×—— L.L.

MOISTURE CONTENT

SYMBOL	DESCRIPTION	DEPTH FEET	ELEV. FEET	TEST RESULTS (200 400 600 800 PSF; 20 40 60 80 BLOWS/FT. OR %)	SAMPLE NO.	RECOVERY INCHES
			7.1			
TOPSOIL	TOPSOIL, silty sand, gravel with roots	1.5	5.6		1	22/24
	SAND, silty, grey, loose silt in thin layers	11.0	- 3.9		2	5/18
	SAND, fine to medium, grey, loose	18.0	-10.9		3	12/24
	SILT, trace fine sand, trace organic matter, fine sand in thin layers	30			4	15/18
					5	24/24
					6	18/18
		36.5	-29.4		7	18/18
	End of hole					

CRIPPEN ENGINEERING LTD.

NORTH VANCOUVER B.C.

HOLE NO. 106

SHEET 1 OF 1

LOG OF DRILL HOLE

PROJECT Port Coquitlam Dykes

LOCATION OF HOLE 102,917.39N
66,283.30E

ELEVATION 7.5

CONTRACTOR Keller Soiltest Drilling

TYPE OF DRILL Rotary

DATE OF DRILLING 19 Feb. 1975

LEGEND

- SPLIT SPOON
- WASH SAMPLE
- SHELBY TUBE
- CORE SAMPLE
- % passing #200 sieve

SHEAR STRENGTH

- UNCONFINED COMPRESSION
- LAB. VANE

PENETRATION RESISTANCE

- STANDARD N-VALUE

ATTERBERG LIMITS

P.L. ⟼ L.L.

MOISTURE CONTENT

SYMBOL	DESCRIPTION	DEPTH FEET	ELEV. FEET	TEST RESULTS (200 400 600 800 PSF / 20 40 60 80 BLOWS/FT. OR %)	SAMPLE NO.	RECOVERY INCHES
			7.5			
	SAND, some gravel, well graded, probably fill					
	SILT, organic, grey, soft	4.5 6.0	3.0 1.5		1	6/18
	SILT, clayey, grey, trace fine sand, trace organic matter	10			2	12/24
					3	18/18
		20			4	24/24
					5	18/18
		30			6	24/24
					7	18/18
	End of Hole	36.5	-29.0			

CRIPPEN ENGINEERING LTD.

NORTH VANCOUVER B.C.

HOLE NO. 107

SHEET 1 OF 1

LOG OF DRILL HOLE

PROJECT Port Coquitlam Dykes

LOCATION OF HOLE 102,602.20N
67,917.28E

ELEVATION 16.3

CONTRACTOR Keller Soiltest Drilling

TYPE OF DRILL Rotary

DATE OF DRILLING 20 Feb. 1975

LEGEND

- SPLIT SPOON
- WASH SAMPLE
- SHELBY TUBE
- CORE SAMPLE
- % passing #200 sieve

SHEAR STRENGTH

- UNCONFINED COMPRESSION
- LAB. VANE

PENETRATION RESISTANCE

- STANDARD N-VALUE

ATTERBERG LIMITS

P.L. ⊢×⊣ L.L.

MOISTURE CONTENT

SYMBOL	DESCRIPTION	DEPTH FEET	ELEV. FEET	TEST RESULTS	SAMPLE NO.	RECOVERY INCHES
			16.3	200 400 600 800 PSF 20 40 60 80 BLOWS/FT. OR %		
	DYKE FILL 0-1.5' silty sand and gravel 1.5-10.0 SILT, clayey, trace fine sand, trace organic matter				1	24/24
					2	24/24
					3	24/24
					4	24/24
		10.0	6.3		5	12/18
	SILT, clayey, grey, trace fine sand, trace organic matter				6	24/24
		20			7	14/18
		25.0	-8.7		8	24/24
	SILT, some fine sand in thin partings, trace organic matter	30			9	12/18
					10	10/18
					11	12/18
		41.5	-25.2			
	End of Hole					

CRIPPEN ENGINEERING LTD.

NORTH VANCOUVER B.C.

HOLE NO. 108

SHEET 1 OF 1

LOG OF DRILL HOLE

PROJECT Port Coquitlam Dykes

LOCATION OF HOLE 99,237.36N
68,570.83E

ELEVATION 16.3

CONTRACTOR Keller Soiltest Drilling

TYPE OF DRILL Rotary

DATE OF DRILLING 31 Jan - 3 Feb. 1975

LEGEND

- SPLIT SPOON
- WASH SAMPLE
- SHELBY TUBE
- CORE SAMPLE
- % passing #200 sieve

SHEAR STRENGTH

- UNCONFINED COMPRESSION
- LAB. VANE

PENETRATION RESISTANCE

- STANDARD N-VALUE

ATTERBERG LIMITS

P.L. ×—— L.L.

MOISTURE CONTENT

SYMBOL	DESCRIPTION	DEPTH FEET	ELEV. FEET	TEST RESULTS (200 400 600 800 PSF / 20 40 60 80 BLOWS/FT. OR %)	SAMPLE NO.	RECOVERY INCHES
			16.3			
	DYKE FILL 0-2.0' Silty sand and gravel 2.0'-11.5' Silt and silty fine sand, trace clay, trace organic matter				1	9/18
					2	9/18
					3	9/18
					4	3½/18
					5	18/24
		11.5	4.8			
	SILT, organic, peat intrusions	12.5	3.8		6	11/18
	SILT, stratified with silty fine sand, trace organic matter				7	18/18
		20			8	6/24
					9	18/18
		27.0	-10.7		10	18/18
	SAND, fine to medium, trace silt, trace organic matter	30			11	24/24
					12	13½/18
		41.5	-25.2		13	13½/18
	End of Hole					

CRIPPEN ENGINEERING LTD.

NORTH VANCOUVER B.C.

HOLE NO. 110

SHEET 1 OF 1

LOG OF DRILL HOLE

PROJECT Port Coquitlam Dykes

LOCATION OF HOLE 96,850.47N
67,438.54E

ELEVATION 16.0

CONTRACTOR Keller Soiltest Drilling

TYPE OF DRILL Rotary

DATE OF DRILLING 4-5 Feb 1975

LEGEND

- SPLIT SPOON
- WASH SAMPLE
- SHELBY TUBE
- CORE SAMPLE
- % passing #200 sieve

SHEAR STRENGTH

- UNCONFINED COMPRESSION
- LAB. VANE

PENETRATION RESISTANCE

- STANDARD N - VALUE

ATTERBERG LIMITS

P.L. L.L.

MOISTURE CONTENT

SYMBOL	DESCRIPTION	DEPTH FEET	ELEV. FEET	TEST RESULTS	SAMPLE NO.	RECOVERY INCHES
			16.0	200 400 600 800 PSF 20 40 60 80 BLOWS/FT. OR %		
	DYKE FILL 0 - 1.0' Silty sand and gravel 1.0-6.5' Silt weathered, trace clay, trace fine sand 6.5'-11.5' Sand and gravel well graded, trace silt	11.5	4.5		1 2 3 4 4	14/24 19/24 22/24 14/24 18/18
	SILT, clayey, some organic matter, trace fine sand in thin partings	18.0	-2.0		6	24/24
	SAND, well graded, some gravel	24.0	-8.0		7	0/18
	SAND, fine to medium	29.0	-13.0		8	11/18
	SAND, well graded, some gravel	41.5	-25.5		9 10 11	9/18 5/18 9/18
	End of hole					

piezo at 7 to 20.

CRIPPEN ENGINEERING LTD.

NORTH VANCOUVER B.C.

HOLE NO. 111

SHEET 1 OF 1

LOG OF DRILL HOLE

PROJECT Port Coquitlam Dykes

LOCATION OF HOLE 94,599.47N
66,534.65E

ELEVATION 10.5

CONTRACTOR Keller Soiltest Drilling

TYPE OF DRILL Rotary

DATE OF DRILLING 5-7 Feb 1975

LEGEND

- SPLIT SPOON
- WASH SAMPLE
- SHELBY TUBE
- CORE SAMPLE
- % passing #200 sieve

SHEAR STRENGTH

- UNCONFINED COMPRESSION
- LAB. VANE

PENETRATION RESISTANCE

- STANDARD N-VALUE

ATTERBERG LIMITS

P.L. ×—— L.L.

MOISTURE CONTENT

SYMBOL	DESCRIPTION	DEPTH FEET	ELEV. FEET	TEST RESULTS (200 400 600 800 PSF / 20 40 60 80 BLOWS/FT. OR %)	SAMPLE NO.	RECOVERY INCHES
			10.5			
	FILL, sand and gravel, silty, some cobbles	7.5	3.0		1	0/18
	SILT, clayey, trace fine sand, trace organic matter	10			2	24/24
		13.5	-3.0		3	3½/18
	SAND, some gravel, well graded	20			4	0/18
		23.0	-12.5		5	0/18
	SAND, well graded, trace organic matter				6	0/18 0/24
					7	0/24
		39.0	-28.5		8	0/18
	SAND, some gravel, well graded, trace organic matter					
		49.0	-38.5		9	12/18
	End of hole					

CRIPPEN ENGINEERING LTD.

NORTH VANCOUVER B.C.

HOLE NO. 113

SHEET 1 OF 1

LOG OF DRILL HOLE

PROJECT Port Coquitlam Dykes

LOCATION OF HOLE 86,227.33N
56,465.38E

ELEVATION 15.9

CONTRACTOR Keller Soiltest Drilling

TYPE OF DRILL Rotary

DATE OF DRILLING 25-26 Feb 1975

LEGEND

- SPLIT SPOON
- WASH SAMPLE
- SHELBY TUBE
- CORE SAMPLE
- % passing #200 sieve

SHEAR STRENGTH

- UNCONFINED COMPRESSION
- LAB. VANE

PENETRATION RESISTANCE

- STANDARD N - VALUE

ATTERBERG LIMITS

P.L. ——×—— L.L.

MOISTURE CONTENT

SYMBOL	DESCRIPTION	DEPTH FEET	ELEV. FEET	TEST RESULTS (200 400 600 800 PSF / 20 40 60 80 BLOWS/FT. OR %)	SAMPLE NO.	RECOVERY INCHES
			15.9			
	DYKE FILL 0-1.5' Silty sand and gravel, trace clay 1.5'-9.0' Silt, clayey, trace fine sand, trace organic matter	9.0	6.9		1 2 3 4 5 6 7	6/18 0/18 8/18 14/18 12/18 24/24 16/18
	SILT, clayey, trace fine sand, decomposed wood pieces near top, trace organic matter below	18.0	-2.1		8	24/24
	SAND and GRAVEL, silty, very dense, some cobbles and boulders, particularly below 45' depth (Till-like)	30 40 50 60			9 10 11 12 13 14 15	0/18 4/6 2/6 6/12 6/12
	End of hole	63.5	-47.6			

CRIPPEN ENGINEERING LTD.

NORTH VANCOUVER B.C.

HOLE NO. 114

SHEET 1 OF 1

LOG OF DRILL HOLE

PROJECT Port Coquitlam Dykes

LOCATION OF HOLE 94,634.36N
66,568.56E

ELEVATION 16.2

CONTRACTOR Keller Soiltest Drilling

TYPE OF DRILL Rotary

DATE OF DRILLING 26-28 Feb 1975

LEGEND

- SPLIT SPOON
- WASH SAMPLE
- SHELBY TUBE
- CORE SAMPLE
- % passing #200 sieve

SHEAR STRENGTH

- UNCONFINED COMPRESSION
- LAB. VANE

PENETRATION RESISTANCE

- STANDARD N - VALUE

ATTERBERG LIMITS

P.L. ——×—— L.L.

MOISTURE CONTENT

SYMBOL	DESCRIPTION	DEPTH FEET	ELEV. FEET	TEST RESULTS	SAMPLE NO.	RECOVERY INCHES
			16.2	200 400 600 800 PSF 20 40 60 80 BLOWS/FT. OR %		
	0-5.0' Silty sand and gravel occasional cobbles 5.0'-10.0' Silt, clayey trace fine sand, trace organic matter 10.0'-13.5' Silty sand and gravel				1 2 3 4 5 6	12/18 24/24 9/18 20/24 2/18 15/18
	SILT, clayey, trace fine sand, trace organic matter	13.5	2.7			
	SAND and GRAVEL, well graded, trace silt	18.0	-1.8		7	4/18
	SAND, well graded, trace gravel, trace silt	24.0	-7.8		8 9 10	9/18 8/18 10/18
	End of hole	41.5	-25.3		11	8/18

CRIPPEN ENGINEERING LTD.

NORTH VANCOUVER B.C.

HOLE NO. 116

SHEET 1 OF 1

LOG OF DRILL HOLE

PROJECT Port Coquitlam Dykes

LOCATION OF HOLE 103;896.36N
64;859.65E

ELEVATION 16.8

CONTRACTOR Keller Soiltest Drilling

TYPE OF DRILL Rotary

DATE OF DRILLING 4 March 1975

LEGEND

- SPLIT SPOON
- WASH SAMPLE
- SHELBY TUBE
- CORE SAMPLE
- % passing #200 sieve

SHEAR STRENGTH

- UNCONFINED COMPRESSION
- LAB. VANE

PENETRATION RESISTANCE

- STANDARD N-VALUE

ATTERBERG LIMITS

P.L. ——×—— L.L.

MOISTURE CONTENT

SYMBOL	DESCRIPTION	DEPTH FEET	ELEV. FEET	TEST RESULTS	SAMPLE NO.	RECOVERY INCHES
			16.8	200 400 600 800 PSF 20 40 60 80 BLOWS/FT. OR %		
	DYKE FILL 0-1.0 silty sand and gravel 1.0-11.5' silt, sandy, trace organic matter				1	24/24
					2	9/18
					3	24/24
					4	10/18
					5	16/24
		11.5	5.3		6	6/18
	SILT, sandy, with fine sand layers, a thin layer of peat near surface, trace organic matter below				7	24/24
		20			8	8/18
					9	15/24
		30			10	12/18
					11	8/18
		41.5	-24.7		12	9/18
	End of hole					

CRIPPEN ENGINEERING LTD.

NORTH VANCOUVER B.C.

HOLE NO. 117

SHEET 1 OF 1

LOG OF DRILL HOLE

PROJECT Port Coquitlam Dykes

LOCATION OF HOLE 93,260.52N
66,034.14E

ELEVATION 16.1

CONTRACTOR Keller Soiltest Drilling

TYPE OF DRILL Rotary

DATE OF DRILLING 5 March 1975

LEGEND

- SPLIT SPOON
- WASH SAMPLE
- SHELBY TUBE
- CORE SAMPLE
- % passing #200 sieve

SHEAR STRENGTH

- UNCONFINED COMPRESSION
- LAB. VANE

PENETRATION RESISTANCE

- STANDARD N-VALUE

ATTERBERG LIMITS

P.L. L.L.

MOISTURE CONTENT

SYMBOL	DESCRIPTION	DEPTH FEET	ELEV. FEET	TEST RESULTS (200 400 600 800 PSF / 20 40 60 80 BLOWS/FT. OR %)	SAMPLE NO.	RECOVERY INCHES
			16.1			
	DYKE FILL 0-1.5' Silty sand and gravel 1.5'-11.5' Silt, clayey, weathered, trace fine sand in thin layers, trace organic matter				1	24/24
					2	9/18
					3	24/24
					4	8/18
					5	24/24
		11.5	4.6		6	9/18
	SILT, clayey, trace fine sand in thin layers, roots and some organic matter near top, trace organic matter at depth				7	24/24
		20			8	7/18
					9	24/24
		29.0	-12.9		10	7/18
	SAND, fine to medium, some silt, mostly in thin layers				11	5/18
					12	6/18
		41.5	-25.4			
	End of hole					

APPENDIX II

LABORATORY TEST RESULTS

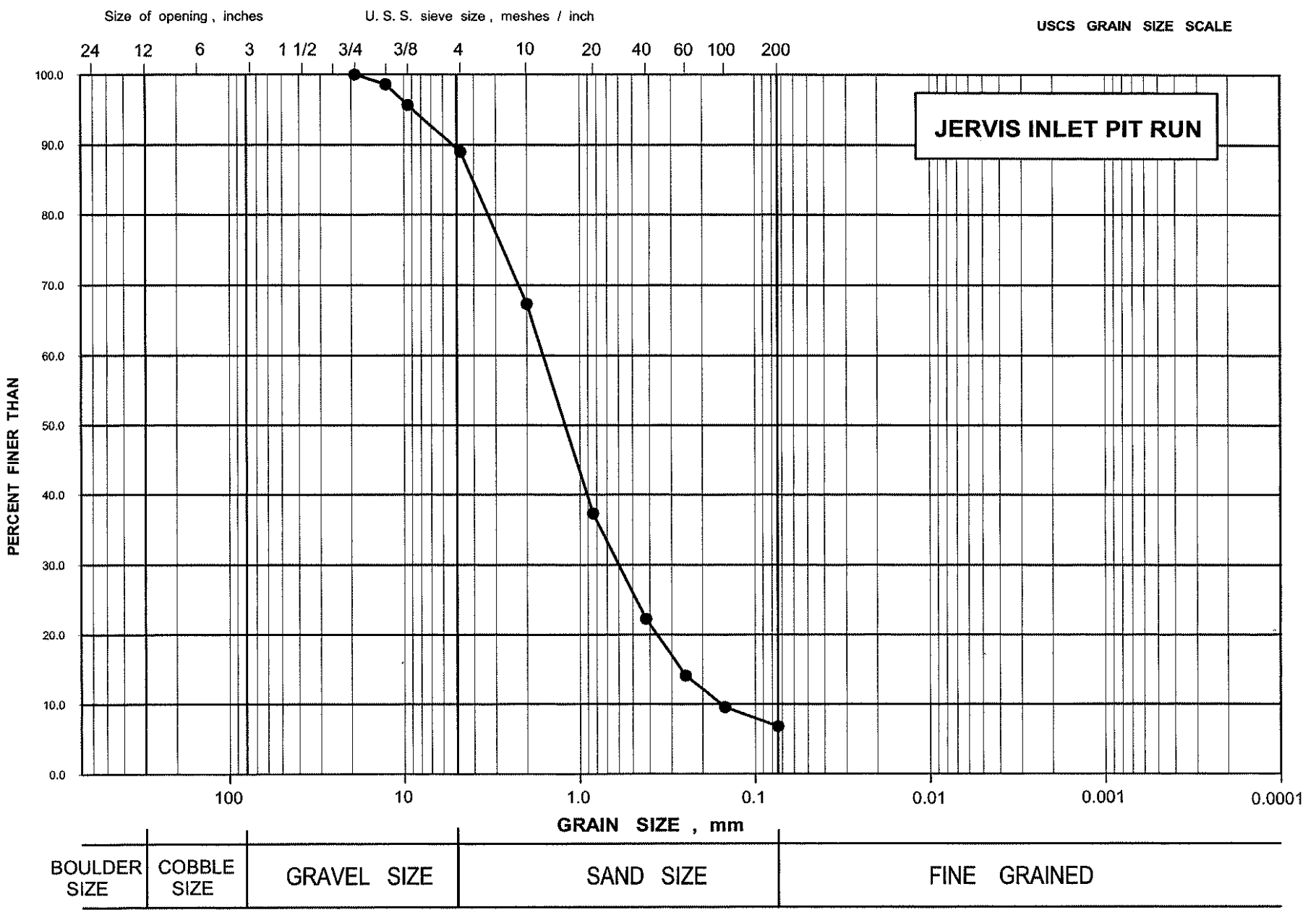
SIEVE ANALYSIS

Project No.	07-1416-0039	Client	Associated Engineering	Sample	Jervis Inlet Pit Run
Sch#	74	Project	Pitt River Dike		March 30, 2007
Lab Work	TM	Location			

1st SIEVING +#4		2nd SIEVING -#4		Wash Sieving - #4	
Weight before sieving		Quarter - #4 (Y/N)	Y	Weight before wash	287.5
Total weight	1547.2	Wash Sieve (Y/N)	Y	Weight after wash	266.1
Total Wt -#4	1376.7	Total Wt of -#4 sieved	287.5	Pan Weight	0.6

Sieve (USS)	Weight Retained	% Retained	Weight Retained	% Retained	% Retained of Total	Diameter (mm)	% Passing
12"	0.0	0.0			0.0	**304.8**	**100.0**
6"	0.0	0.0			0.0	**152.4**	**100.0**
3"	0.0	0.0			0.0	**76.2**	**100.0**
1 1/2 "	0.0	0.0			0.0	**38.1**	**100.0**
1"	0.0	0.0			0.0	**25.4**	**100.0**
3/4"	0.0	0.0			0.0	**19.1**	**100.0**
1/2"	21.6	1.4			1.4	**12.7**	**98.6**
3/8"	45.4	2.9			2.9	**9.50**	**95.7**
#4	103.5	6.7			6.7	**4.76**	**89.0**
#10			70.0	24.3	21.7	**2.00**	**67.3**
#20			96.9	33.7	30.0	**0.84**	**37.3**
#40			48.6	16.9	15.0	**0.42**	**22.3**
#60			26.4	9.2	8.2	**0.25**	**14.1**
#100			14.6	5.1	4.5	**0.149**	**9.6**
#200			9.0	3.1	2.8	**0.074**	**6.8**
-200			22.0	7.7	6.8		

REMARKS :



Project No. 07-1416-0039 Drawn TM Reviewed LL Date 07/03/07	Golder Associates	**GRAIN SIZE DISTRIBUTION**	**Figure**

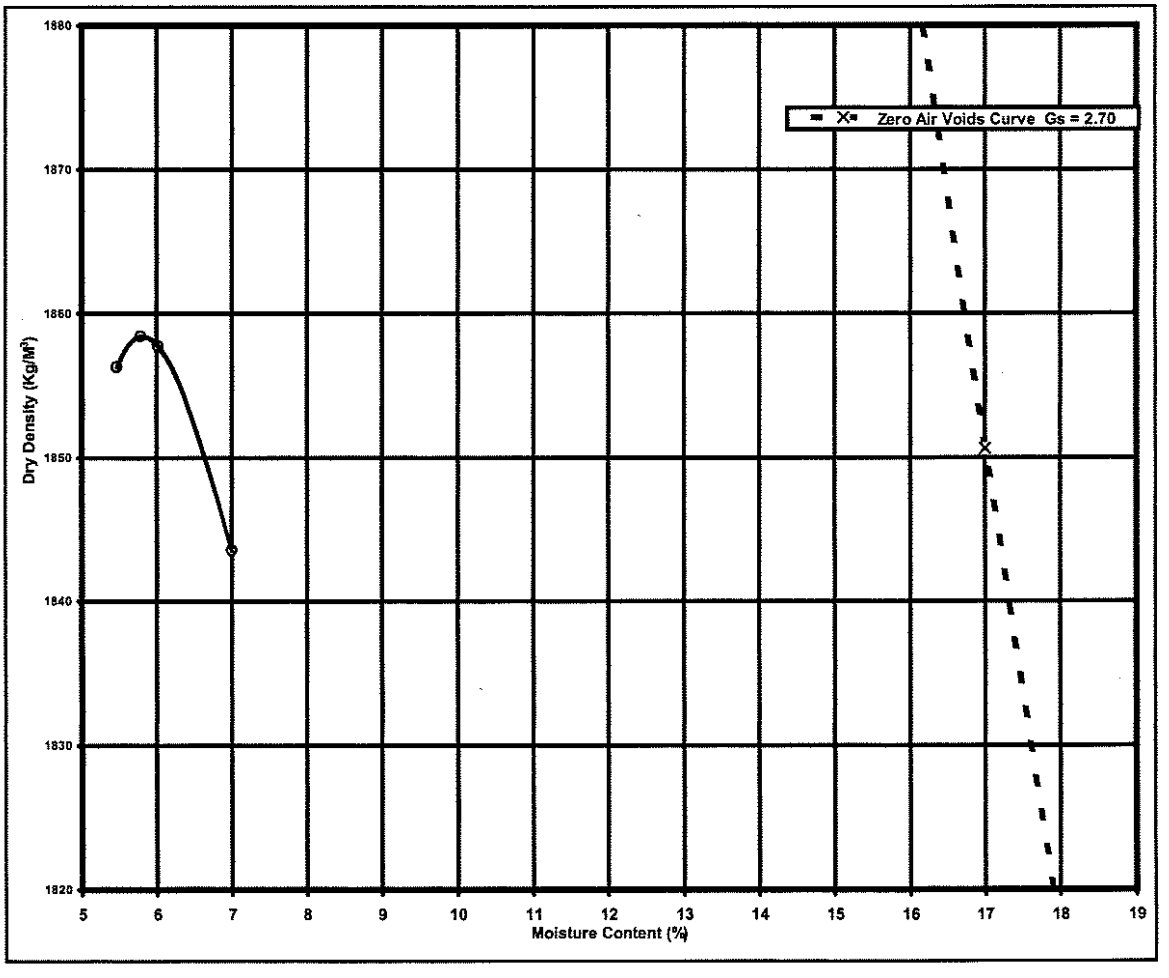
Test Method for Laboratory Compaction Charateristics of Soil

Project #	07-1416-0039	**Sample Identification :**		ASTM D 698-91 Standard Proctor		
Client	Associated Engineering	Sample	Jervis Inlet Pit Run	*Method*	B	
Project	Pitt River Dike		March 30, 2007	*Optimum WC* =	5.8	%
Location				*Max* ρ_{dry} =	1858	Kg/M³

Technician	TM	**Sample Description :**			*ASTM D 4718-87*	
Schedule #	74	Natural Moisture Content = 5.5%			*Correction for oversize particles*	
Proctor Type (S/M)	S			*Optimum WC* =	5.6	%
		Mould Volume =	0.000944 m^3	*Max* ρ_{dry} =	1883	Kg/M³

TRIAL NO.	*1*	*2*	*3*	*4*			*Percent Oversize :*		
WT SOIL WET + MOULD	6109	6117	6120	6123			SCREEN SIZE :	9.50	mm
WEIGHT OF MOULD	4261	4261	4261	4261			*Coarser Fraction*		
WT OF SOIL WET	1848	1856	1859	1862			P_c =	4.3	%
WET DENSITY (Kg/M³)	1958	1966	1970	1973			Gs =	2.70	assumed
DRY DENSITY (Kg/M³)	*1856*	*1858*	*1858*	*1844*			W_c =	1.5	%

CONTAINER NO.							*Finer Fraction*		
WT OF WET SOIL + TARE	643.9	736.9	473.2	714.6			P_f =	95.7	%
WT OF DRY SOIL + TARE	628.5	716.4	457.3	691.7			Gs =	2.70	assumed
WEIGHT OF WATER	15.4	20.5	15.9	22.9			W_f =	5.8	%
TARE WEIGHT	346.8	362.3	193.2	364.8			Zero Air Voids Curve Gs =	2.70	
WEIGHT OF DRY SOIL	281.7	354.1	264.1	326.9			Bulk Gs =	2.70	
MOISTURE CONTENT (	*5.5*	*5.8*	*6.0*	*7.0*			Saturation =	100.0	%



Permeability of Granular Soils (Constant Head)
ASTM D 2434-68 (1993)

Project #	07-1416-0042 Phase 20000			Location	Jervis Inlet Pit Run			Panel No.	4		
Client	Associated Engineering			Sample	Barge Sample			Cell No.	Soiltest		
Project	Dike Upgrades			Depth				Sch No.	132		
Location	Coquitlam										
Dimensions - Initial					**Initial**	**Final**					
D_o	15.24	cm		Wet Wt	5651.7	5975.1	g	**Method of sample preparation**			
H_o	14.77	cm		Dry Wt	5310.9	5310.9	g	Assumed Optimum W% of 7%			
A_o	182.41	cm^2		w	6.4	12.5		Compaction to Est. Standard Proctor Energy			
V_o	2694.5	cm^3		ρ_{dry}	1977	1977	Kg/M^3	**Standard Proctor Compaction**			
Dimensions - After Consolidation				e	0.37	0.37		$\rho_{dry\ Max(Est.)}$	1960	Kg/M^3	
δH_c	0.05	cm		G_s	2.7	2.7	assumed				
H_c	14.73	cm		Saturation	47.4	92.3	%	**Distance between manometers**			
V_c	2686.2	cm^3		Compaction	100.9	100.9	%	L_{man}	---	cm	

Constant Head Permeability Test Data

Test	Head		Head	Flow	Time	Velocity	Gradient			Temp	
No.	H_1	H_2	**h**	**Q**	**t**	**Q/At**	**h/L**	**k**	**Temp**	**Correction**	k_{20}
	cm	cm	cm	cc	min	cm/s		cm/s	C_{deg}	η_t/η_{20}	cm/s
1	61.6	29.0	32.6	423.7	25.0	0.002	2.21	7.0E-04	20.0	0.9995	7.0E-04
2	69.4	29.0	40.4	323.6	25.0	0.001	2.74	4.3E-04	20.0	0.9995	4.3E-04
3	79.4	29.0	50.4	295.9	16.0	0.002	3.42	4.9E-04	20.0	0.9995	4.9E-04
4	99.6	29.0	70.6	605.6	7.0	0.008	4.79	1.6E-03	20.0	0.9995	1.6E-03
5	99.6	29.0	70.6	683.9	12.0	0.005	4.79	1.1E-03	20.0	0.9995	1.1E-03
6	120.4	29.0	91.4	904.7	10.0	0.008	6.21	1.3E-03	20.0	0.9995	1.3E-03
7	120.4	29.0	91.4	676.9	10.0	0.006	6.21	1.0E-03	20.0	0.9995	1.0E-03
8	120.4	29.0	91.4	515.3	10.0	0.005	6.21	7.6E-04	20.0	0.9995	7.6E-04
										Avg k_{20}	**9.3E-04**

Remarks :

Sand & Gravel

Sample as received

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

ASTM C 136

April 5, 2007

Valley Geotechnical Engineering

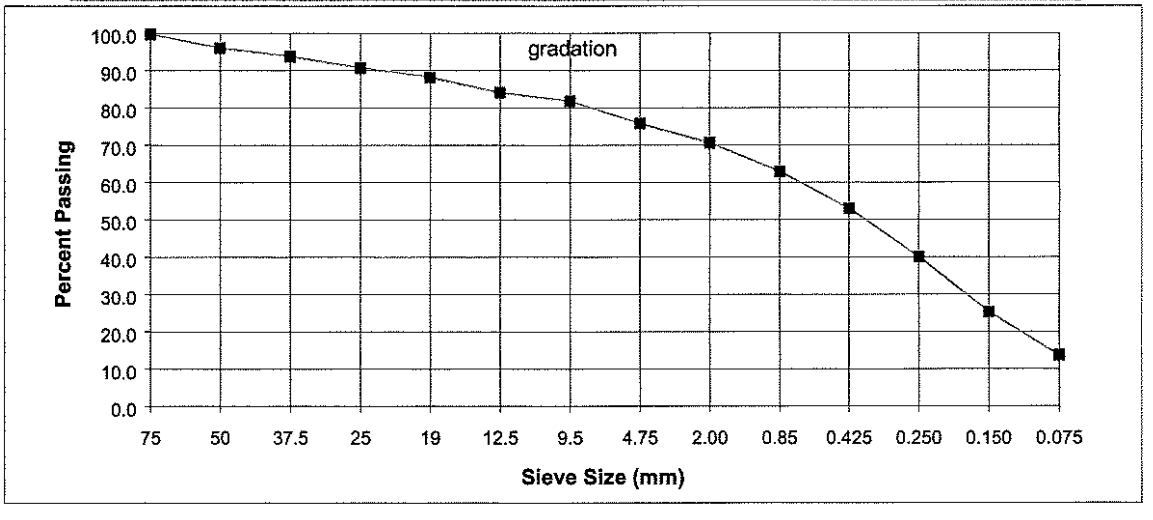
Project number: 07-1416-0039

PROJECT: **Coquitlam Dike**

Sample:	**CEWE Pipeline Rd Pit Run (screened)**

DATE SAMPLED: April 3, 2007 SAMPLED BY: **AL**

SIEVE ANALYSIS				
Sieve Size (mm)	% Retained	% Passing	Individual % Retained (Split values)	
			+ 4.75	- 4.75
75	0.0	100.0	0.0	
50	3.7	96.3	15.3	
37.5	2.3	94.0	9.5	
25	3.1	91.0	12.8	
19	2.6	88.4	10.6	
12.5	4.1	84.4	17.0	
9.5	2.3	82.0	9.7	
4.75	6.0	76.0	25.0	
2.00	5.1	70.9		6.8
0.85	7.7	63.2		10.1
0.425	10.0	53.2		13.2
0.250	12.9	40.3		17.0
0.150	14.7	25.5		19.4
0.075	11.5	14.0		15.2
PAN	13.9			18.3
Total	100.0			



Reported by: S. Sahai Reviewed by: N. Mwitta

Notice: The test data given herein pertain to the sample provided only. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT (12,400 ft-lbf/ft3)

ASTM D698

April 8, 2007

Associated Engineering
Suite 300 - 4940 Canada Way
Burnaby, BC V5G 4M5

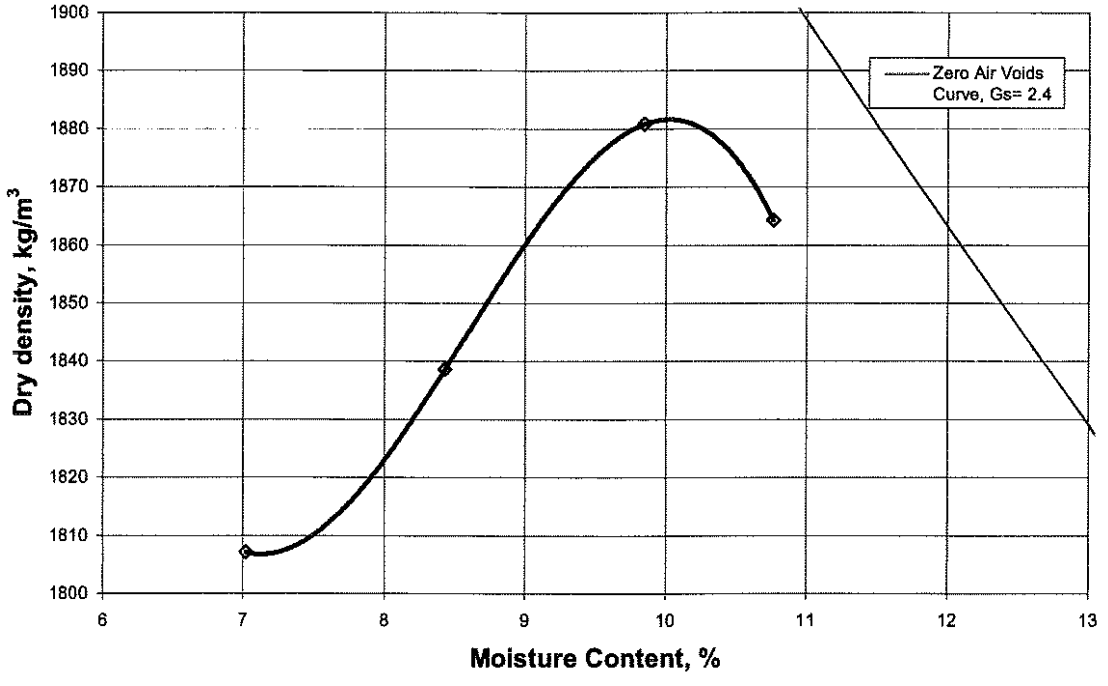
Attention: Mr. Wayne Zhan

		Project No.:	07-1416-0038
Project:	Pitt River Dike	Sampled:	April 3, 2007
Location:	Pitt River Dike	Test:	2
Material Description:	Jervis Inlet Pit Run	Sampled by:	AL
Source:	Coast Meridian	Method:	A

Trial No.	1	2	3	4
Dry Density, kg/m^3	1807	1839	1881	1864
Moisture Content,%	7.0	8.4	9.8	10.8

Maximum Dry Density	**1882.0**	kg/m^3	Gs (assumed)	2.40
Optimum Moisture	**10.0**	%	Oversize	13.0 %
Rock Corrected Dry Density	**1936**	kg/m^3		
Rock Corrected Moisture	**9.0**	%		

Moisture - Density Relationship



Reported by: Satinder Sahai

Reviewed by: N. Mwitta

Reporting of these test results constitutes a testing service only. Interpretation may be provided upon request.

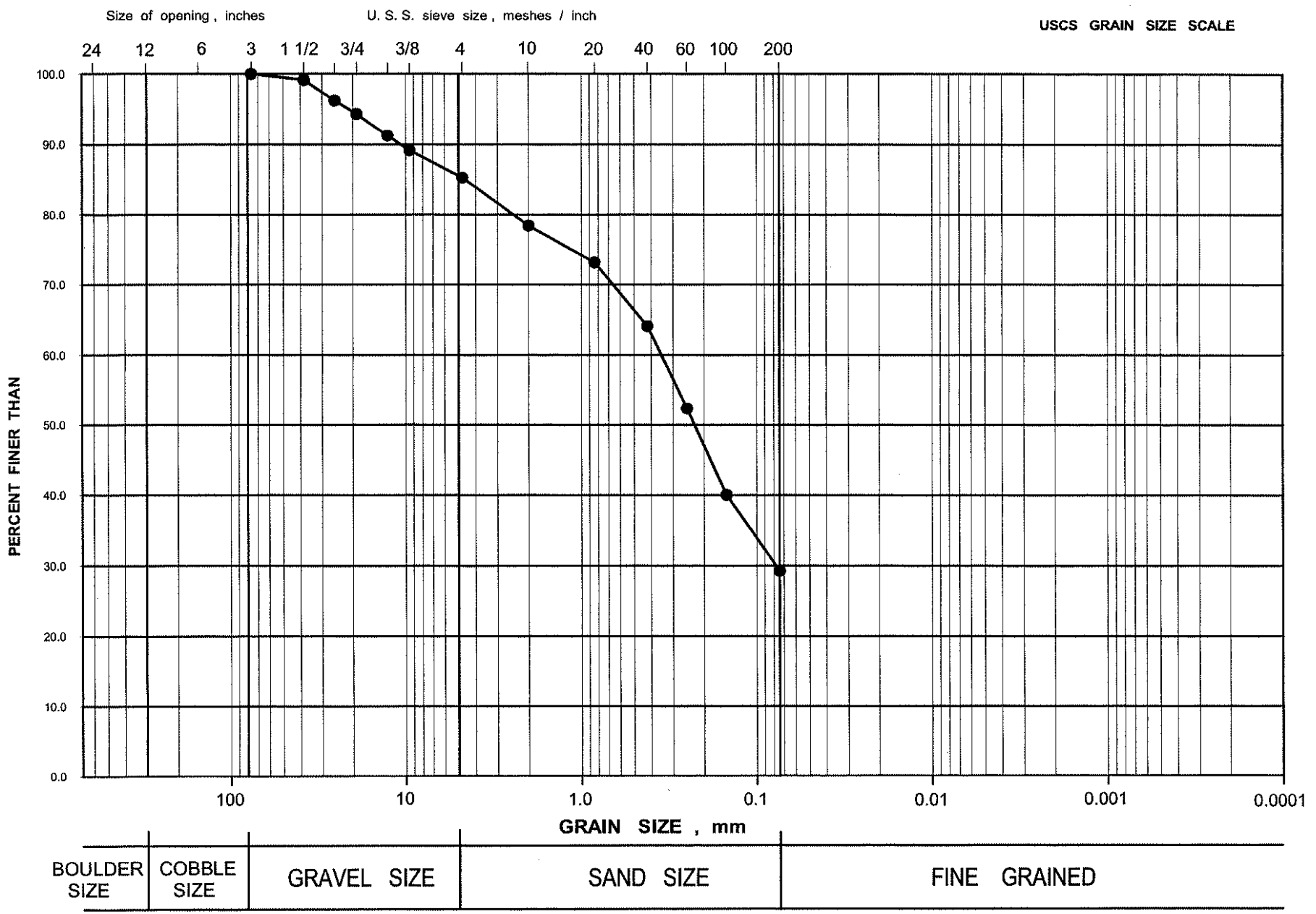
SIEVE ANALYSIS

Project No.	07-1416-0042	Client	Associated Engineering	Location	CEWE Pipeline Road
Sch#	132	Project	Dike Upgrade	Sample	Pit Run (unscreened)
Lab Work	GP	Location	Coquitlam	Depth	Stockpile

1st & 2nd SIEVING		3rd SIEVING -No.4		Wash Sieving -No.4	
Weight before sieving		Quarter - 3/4 (Y/N)	Y	Weight before wash	342.1
Total weight	22973.1	Wash Sieve (Y/N)	Y	Weight after wash	242.5
Total Wt -3/4	20067.0	Total Wt of -No.4 sieved	342.1	Pan Weight	17.2

Sieve (USS)	Weight Retained	% Retained	Weight Retained	% Retained	% Retained of Total	Diameter (mm)	% Passing
12"	0.0	0.0			0.0	**304.8**	**100.0**
6"	0.0	0.0			0.0	**152.4**	**100.0**
3"	0.0	0.0			0.0	**76.2**	**100.0**
1 1/2 "	197.4	0.9			0.9	**38.1**	**99.1**
1"	663.6	2.9			2.9	**25.4**	**96.3**
3/4"	433.2	1.9			1.9	**19.1**	**94.4**
1/2"	668.1	3.3			3.1	**12.7**	**91.2**
3/8"	442.5	2.2			2.1	**9.50**	**89.1**
#4	825.8	4.1			3.9	**4.76**	**85.3**
#10			27.5	8.0	6.9	**2.00**	**78.4**
#20			21.0	6.1	5.2	**0.84**	**73.2**
#40			36.3	10.6	9.0	**0.42**	**64.1**
#60			47.4	13.9	11.8	**0.25**	**52.3**
#100			49.3	14.4	12.3	**0.149**	**40.0**
#200			43.2	12.6	10.8	**0.074**	**29.3**
-200			116.8	34.1	29.1		

REMARKS :



Project No. 07-1416-0042
Drawn GP
Reviewed LL
Date 07/03/07

Golder Associates

GRAIN SIZE DISTRIBUTION

CEWE Pipeline Rd
Pit Run

Measurement of Hydraulic Conductivity of Porous Material
Using a Rigid-Wall, Compaction-Mould Permeameter - ASTM D 5856-95

Project No.	07-1416-0042	**Client :**	Associated Engineering	**Source :**	Cewe
Sch#	132	**Project :**	Dike Upgrades	**Sample :**	Pipeline Road
Lab Work:	RB	**Location:**	Coquitlam		Pit Run (unscreened)
Method:	Method B, Constant Tailwater Pressure				

Dimensions	**Initial**	**After Consolidation**
D (cm) =	10.25	10.25
H (cm) =	7.67	7.67
A (cm^2) =	82.44	82.44
V (cm^3) =	632.2	632.1
Void Ratio =	0.401	0.400

		After Consolidation
Wet Wt (g) =	1333.1	1372.8
Dry Wt (g) =	1218.7	1218.7
w (%) =	9.4	12.6
ρ_{dry} (kg/m^3) =	1928	1928
G_s (assumed) =	2.70	2.70
Saturation (%) =	63.3	85.3
Compaction (%) =	99.5	99.5

Compaction Data

Sample Preparation =	Standard Proctor
Target Compaction Degree =	
$\rho_{max\ dry}$ (kg/m^3) =	1938
Type of Permeameter =	Single Ring Base Plate

Pipette Geometry

Height to base (cm) =	23.2
$a_{pipette}$ (cm^2) =	0.291

Permeability Test Data

Test	Graduated Pipette		Temperature		Applied Pressure to Headwater	Head		Time	Gradient	Hydraulic Conductivity	
No.	h_1 (cm)	h_2 (cm)	T_1 (°C)	T_2 (°C)	(kPa)	h_1 (cm)	h_2 (cm)	Δt (min)	h_{avg}/H_c	k (cm/sec)	k_{20} (cm/sec)
1	39.7	37.3	21.0	21.0	0.0	62.9	60.5	5.0	8.04	3.4E-06	**3.4E-06**
	39.7	34.6	21.0	21.0	0.0	62.9	57.8	11.0	7.87	3.4E-06	**3.4E-06**
	39.7	30.8	21.0	21.0	0.0	62.9	54.0	20.0	7.62	3.4E-06	**3.3E-06**
	39.7	24.9	21.0	21.0	0.0	62.9	48.1	36.0	7.23	3.4E-06	**3.3E-06**
	39.7	19.9	21.0	21.0	0.0	62.9	43.1	52.0	6.91	3.3E-06	**3.2E-06**
	39.7	10.9	21.0	21.0	0.0	62.9	34.1	89.0	6.32	3.1E-06	**3.0E-06**
	39.7	9.5	21.0	21.0	0.0	62.9	32.7	96.0	6.23	3.1E-06	**3.0E-06**
2	39.0	36.8	21.0	21.0	0.0	62.2	60.0	5.0	7.97	3.2E-06	**3.2E-06**
	39.0	34.7	21.0	21.0	0.0	62.2	57.9	10.0	7.83	3.3E-06	**3.2E-06**
	39.0	32.3	21.0	21.0	0.0	62.2	55.5	16.0	7.67	3.2E-06	**3.2E-06**
	39.0	28.9	21.0	21.0	0.0	62.2	52.1	25.0	7.45	3.2E-06	**3.1E-06**
	39.0	25.4	21.0	21.0	0.0	62.2	48.6	35.0	7.23	3.2E-06	**3.1E-06**
	39.0	23.8	21.0	21.0	0.0	62.2	47.0	40.0	7.12	3.2E-06	**3.1E-06**
	39.0	7.7	21.0	21.0	0.0	62.2	30.9	110.0	6.07	2.9E-06	**2.8E-06**
3	38.2	36.7	21.0	21.0	6.9	131.7	130.2	1.0	17.08	5.2E-06	**5.0E-06**
	38.2	35.2	21.0	21.0	6.9	131.7	128.7	2.0	16.98	5.2E-06	**5.1E-06**
	38.2	32.1	21.0	21.0	6.9	131.7	125.6	4.0	16.78	5.4E-06	**5.3E-06**
	38.2	29.0	21.0	21.0	6.9	131.7	122.5	6.0	16.58	5.4E-06	**5.3E-06**
	38.2	24.1	21.0	21.0	6.9	131.7	117.6	10.0	16.26	5.1E-06	**5.0E-06**
	38.2	17.7	21.0	21.0	6.9	131.7	111.2	15.0	15.84	5.1E-06	**5.0E-06**
	38.2	11.1	21.0	21.0	6.9	131.7	104.6	21.0	15.41	4.9E-06	**4.8E-06**
	38.2	6.1	21.0	21.0	6.9	131.7	99.6	26.0	15.08	4.8E-06	**4.7E-06**
										Average k_{20} =	**3.75E-06**

Sample Description Silty SAND, some gravel

Comments

Applied Vertical Stress 33.8 kPa

Permeant Liquid Tap Water

$$k_{20} = \frac{aL}{At} \ln\left(\frac{h_1}{h_2}\right) R_T$$

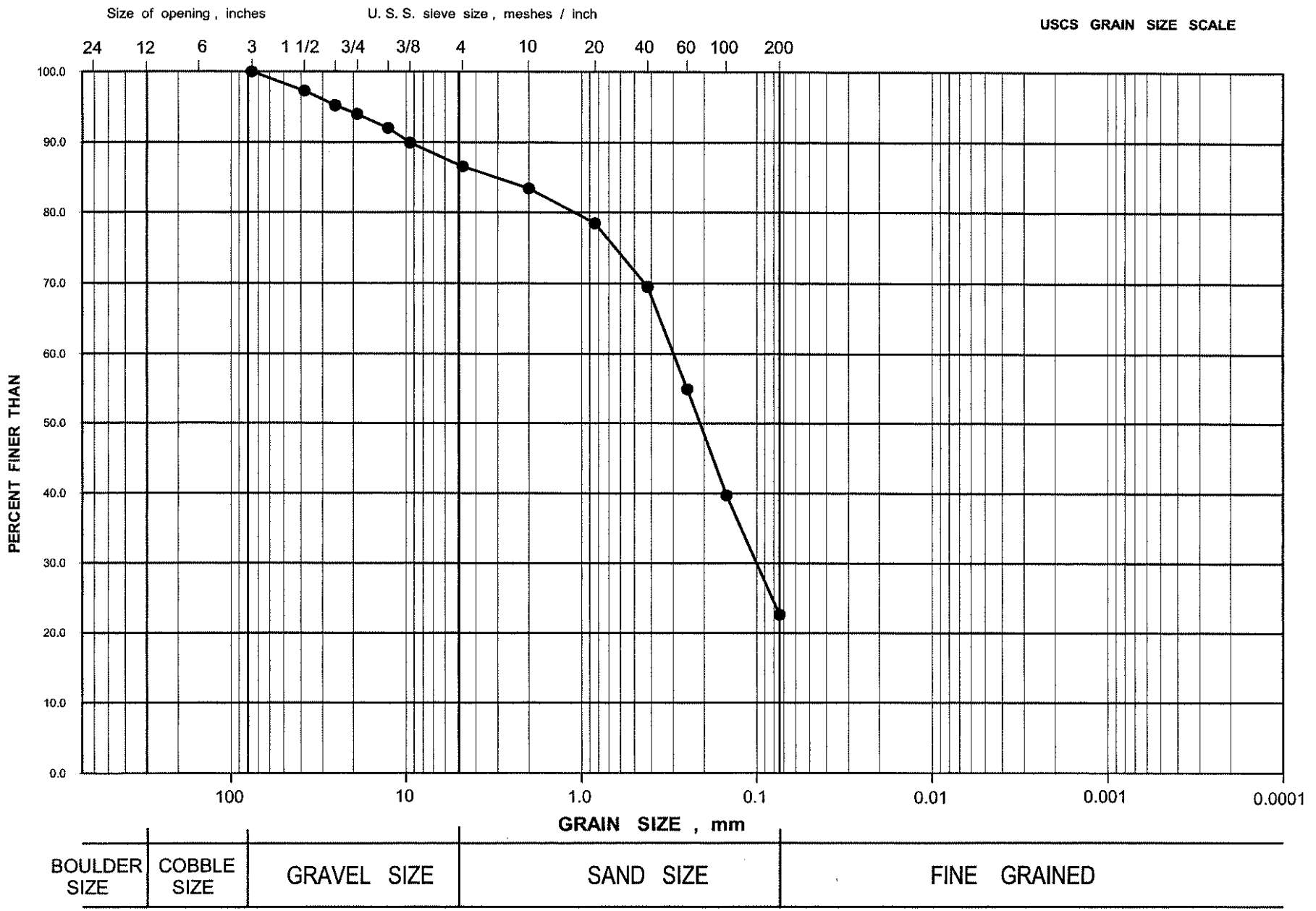
SIEVE ANALYSIS

Project No.	07-1411-0098	**Client**	Associated Engineering	**Type**	Pipeline Rd Pit Run (unscreened)
Sch#	126	**Project**	Urgent Dike Upgrade	**Location**	24m N of Conveyor, on Bank
Lab Work	RB	**Location**	Pitt River	**Depth**	0.0 - 0.2m

1st & 2nd SIEVING		**3rd SIEVING -No.4**		**Wash Sieving -No.4**	
Weight before sieving		Quarter - 3/4 (Y/N)	Y	Weight before wash	228.7
Total weight	16740.4	Wash Sieve (Y/N)	Y	Weight after wash	177.4
Total Wt -3/4	4077.6	Total Wt of -No.4 sieved	228.7	Pan Weight	9.4

Sieve (USS)	Weight Retained	% Retained	Weight Retained	% Retained	% Retained of Total	Diameter (mm)	% Passing
12"	0.0	0.0			0.0	**304.8**	**100.0**
6"	0.0	0.0			0.0	**152.4**	**100.0**
3"	0.0	0.0			0.0	**76.2**	**100.0**
1 1/2 "	452.0	2.7			2.7	**38.1**	**97.3**
1"	343.4	2.1			2.1	**25.4**	**95.2**
3/4"	203.6	1.2			1.2	**19.1**	**94.0**
1/2"	87.2	2.1			2.0	**12.7**	**92.0**
3/8"	91.6	2.2			2.1	**9.50**	**89.9**
#4	144.7	3.5			3.3	**4.76**	**86.6**
#10			8.3	3.6	3.1	**2.00**	**83.4**
#20			13.1	5.7	5.0	**0.84**	**78.5**
#40			23.6	10.3	8.9	**0.42**	**69.5**
#60			38.6	16.9	14.6	**0.25**	**54.9**
#100			40.1	17.5	15.2	**0.149**	**39.7**
#200			45.2	19.8	17.1	**0.074**	**22.6**
-200			60.7	26.5	23.0		

REMARKS :



Project No. 07-1411-0098
Drawn RB
Reviewed LL
Date 07/03/07

Golder Associates

GRAIN SIZE DISTRIBUTION

Road Pit Run (unscreened)

LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT (12,400 ft-lbf/ft3)

ASTM D698

May 18, 2007

Associated Engineering
Suite 300-4940 Canada Way
Burnaby , BC V5G 4M5

Project No.: 07-1416-0038

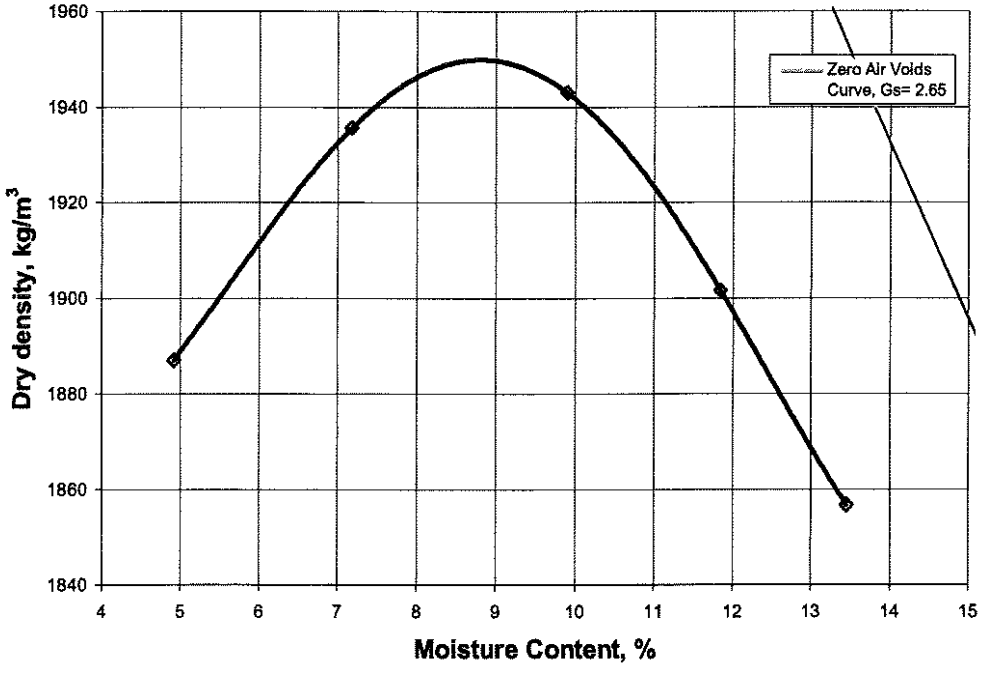
Attention: Mr. Wayne Zhan

Project:	Pitt River Dike	Sampled:	May 17, 2007
Location:	West Side of Pitt River, between bridges	Tested:	May 18, 2007
Material Description:	Sand with mixed gravel	Sampled by:	JP
Source:	Pipeline Road Pit Run (unscreened)	Method:	B
Proposed Use:	Embankment - Emergency Dyke		

Trial No.	1	2	3	4	5
Dry Density, kg/m^3	1887	1936	1943	1857	1902
Moisture Content,%	4.9	7.2	9.9	13.5	11.8

Maximum Dry Density	**1950.0**	kg/m^3	Gs (assumed)	2.65
Optimum Moisture	**8.8**	%	Oversize	18.3 %
Rock Corrected Dry Density	2049	kg/m^3		
Rock Corrected Moisture	7.7	%		

Moisture - Density Relationship



Reported by: Kosei Fukuoka Reviewed by: N. Mwitta

Reporting of these test results constitutes a testing service only. Interpretation may be provided upon request.

LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT (12,400 ft-lbf/ft3)

ASTM D698

April 12, 2007

Associated Engineering
Suite 300 - 4940 Canada Way
Burnaby, BC V5G 4M5

Project No.: 07-1416-0038

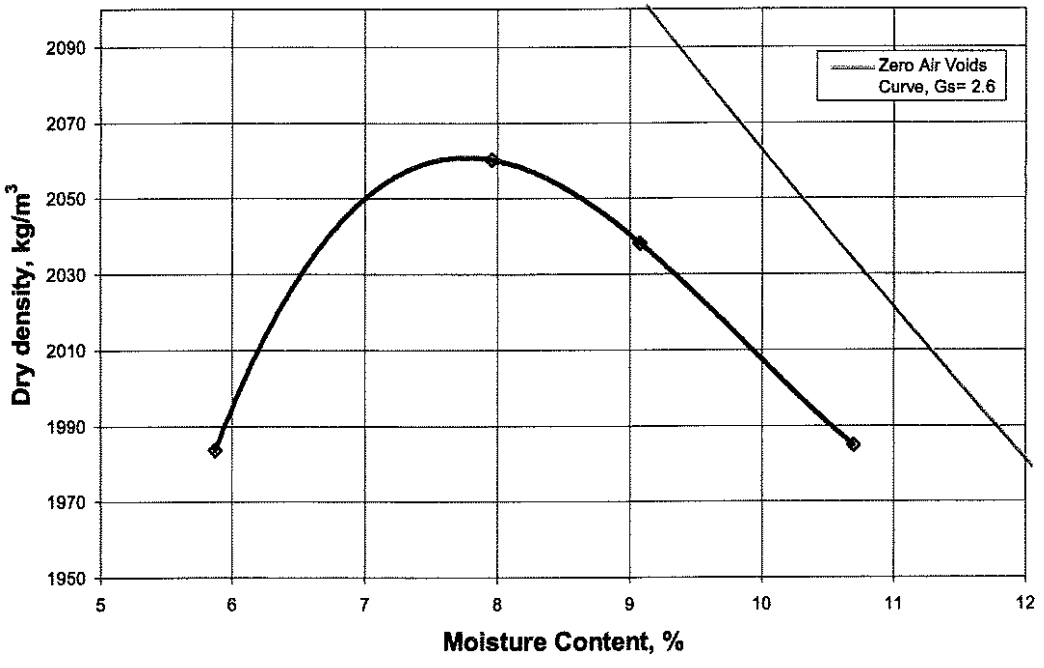
Attention: Mr. Wayne Zhan

Project:	Pitt River Dike	Sampled:	April 11, 2007
Location:	STA 3+ 050	Test:	3
Material Description:	Sand (Brown)	Sampled by:	GANI
Source:	Cewe Pit - Pipeline Road Pit Run (unscreened	Method:	C

Trial No.	1	2	3	4	
Dry Density, kg/m^3	1984	2060	2038	1985	
Moisture Content,%	5.9	8.0	9.1	10.7	

Maximum Dry Density	**2062.0**	kg/m^3	Gs (assumed)	2.60
Optimum Moisture	**7.8**	%	Oversize	10.4 %
Rock Corrected Dry Density	2107	kg/m^3		
Rock Corrected Moisture	7.3	%		

Moisture - Density Relationship



Reported by: Satinder Sahai

Reviewed by: N. Mwitta

Reporting of these test results constitutes a testing service only. Interpretation may be provided upon request.

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE
ASTM C 136

April 5, 2007

Valley Geotechnical Engineering

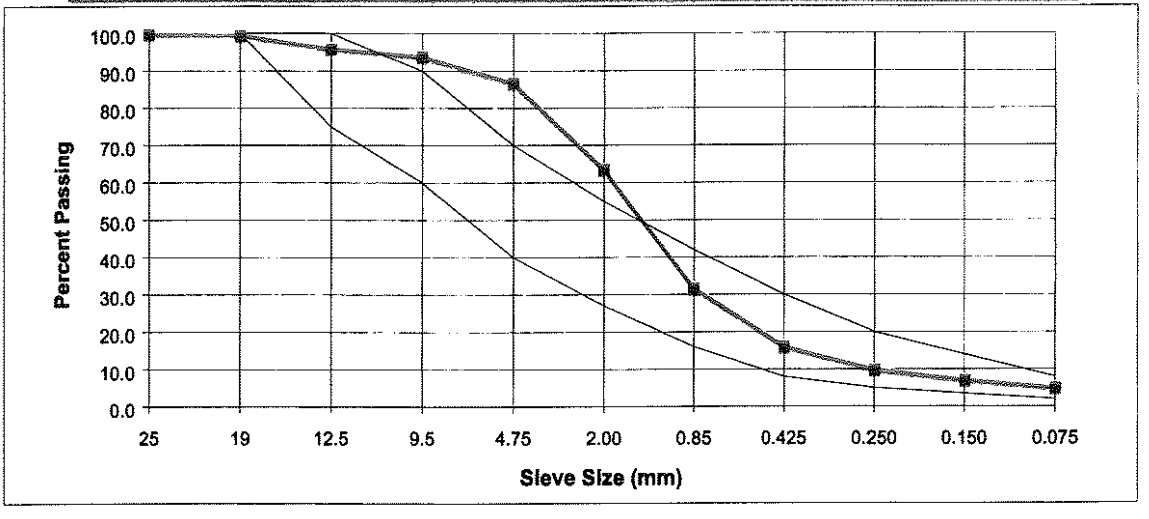
Project number: 07-1416-0039

PROJECT: **Coquitlam Dike**

Sample:	**Jervis Inlet Pit Run**

DATE SAMPLED: April 3, 2007 SAMPLED BY: **AL**

SIEVE ANALYSIS					MMCD, GRANULAR BASE	
Sieve Size (mm)	% Retained	% Passing	Individual % Retained (Split values)			
			+ 4.75	- 4.75		
25	0.0	100.0	0.0			
19	0.3	99.7	2.2		100.0	100.0
12.5	3.5	96.2	26.8		75.0	100.0
9.5	2.2	94.0	16.8		60.0	90.0
4.75	7.1	87.0	54.2		40.0	70.0
2.00	23.2	63.8		26.7	27.0	55.0
0.85	31.8	32.0		36.6	16.0	42.0
0.425	15.7	16.3		18.1	8.0	30.0
0.250	6.1	10.1		7.1	5.0	20.0
0.150	2.8	7.3		3.2		
0.075	2.0	5.3		2.3	2.0	8.0
PAN	5.3			6.0		
Total	100.0					



Reported by: S. Sahai Reviewed by: N. Mwitta

Notice: The test data given herein pertain to the sample provided only. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT (12,400 ft-lbf/ft3)

ASTM D698

April 8, 2007

Associated Engineering
Suite 300 - 4940 Canada Way
Burnaby, BC V5G 4M5

Project No.: 07-1416-0038

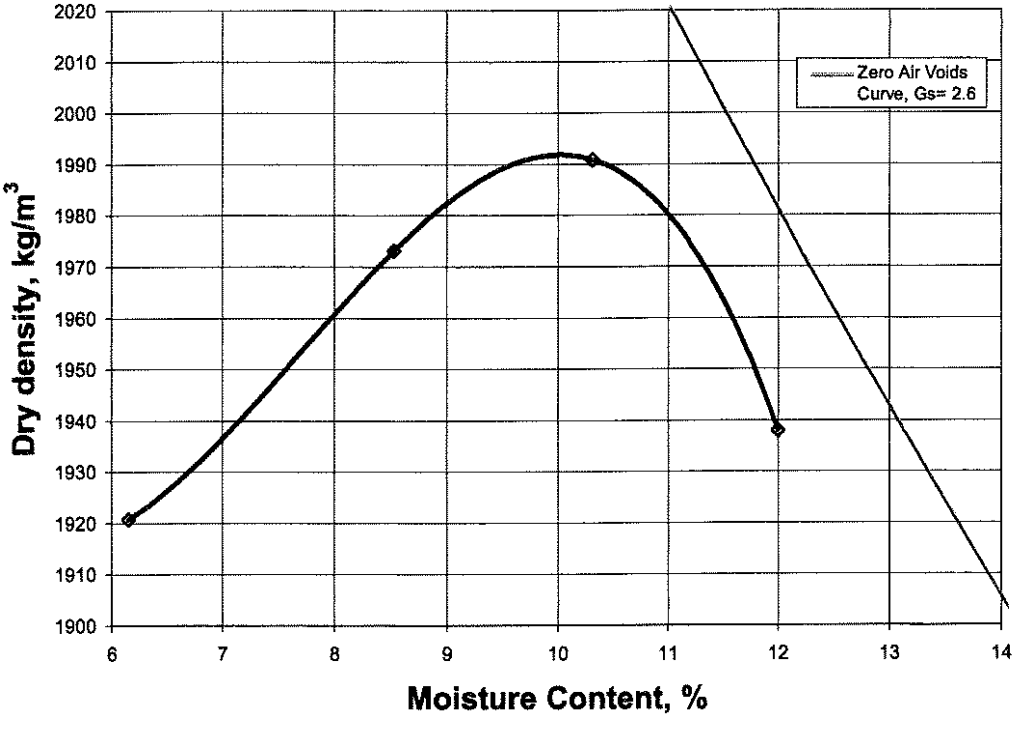
Attention: Mr. Wayne Zhan

Project:	Pitt River Dike	Sampled:	April 3, 2007
Location:	Pitt River Dike	Test:	1
Material Description:	CEWE Pipeline Rd Pit Run (screened)	Sampled by:	AL
Source:	Unknown	Method:	C

Trial No.	1	2	3	4
Dry Density, kg/m^3	1921	1973	1991	1938
Moisture Content,%	6.2	8.5	10.3	12.0

Maximum Dry Density	**1992.0**	kg/m^3	Gs (assumed)	2.60
Optimum Moisture	**10.0**	%	Oversize	11.6 %
Rock Corrected Dry Density	**2047**	kg/m^3		
Rock Corrected Moisture	**9.1**	%		

Moisture - Density Relationship



Reported by: Satinder Sahai

Reviewed by: N. Mwitta

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LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT (12,400 ft-lbf/ft3)

ASTM D698

April 23, 2007

Associated Engineering
Suite 300-4940 Canada Way
Burnaby , BC V5G 4M5

Project No.: 07-1416-0038

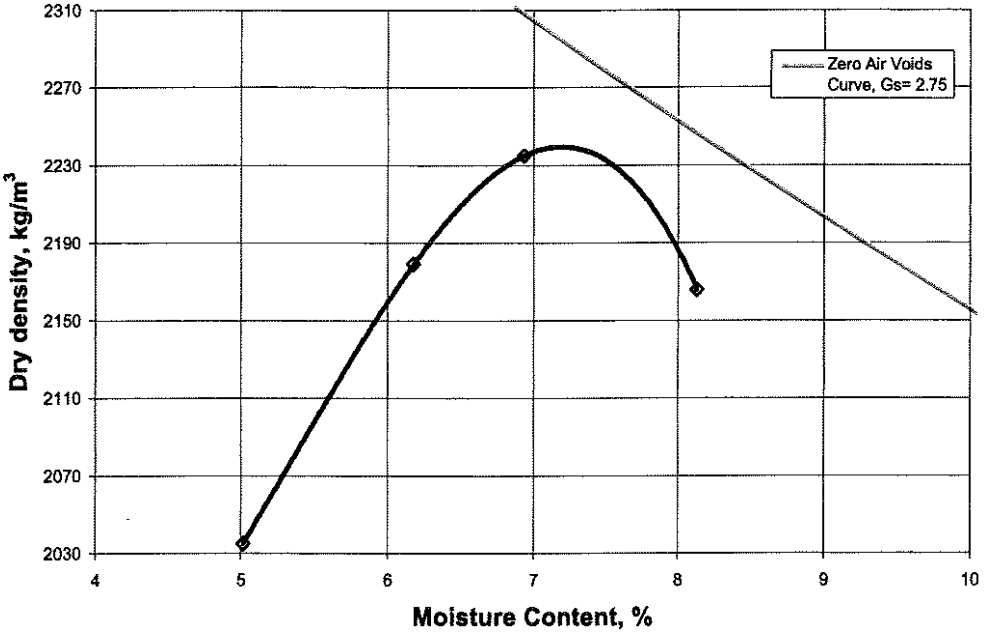
Attention: Mr. Wayne Zhan

Project:	Pitt River Dike	Sampled:	April 19, 2007
Location:	Sta. 0+00-Cedar & Victoria	Test:	1
Material Description:	14 mm road mulch	Sampled by:	AL
Source:	Site	Method:	C

Trial No.	1	2	3	4
Dry Density, kg/m^3	2035	2179	2235	2166
Moisture Content,%	5.0	6.2	6.9	8.1

Maximum Dry Density	**2240.0**	kg/m^3	Gs (assumed)	2.75
Optimum Moisture	**7.3**	%	Oversize	0.0 %

Moisture - Density Relationship



Reported by: Satinder Sahai

Reviewed by: N. Mwitta

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