Independent Expert Engineering Investigation and Review Panel

Report on Mount Polley Tailings Storage Facility Breach

Appendix D: ATTACHMENT D1

Attachment D1: Thurber Logs of KCB Sonic Holes
Appendix D
Attachment 1
Thurber Logs of KCB Sonic Holes
## Hole Location Summary

<table>
<thead>
<tr>
<th>Hole Number</th>
<th>Northing (m)</th>
<th>Easting (m)</th>
<th>Elevation (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH14-01</td>
<td>5819872</td>
<td>595248</td>
<td>931.3</td>
</tr>
<tr>
<td>SH14-01A</td>
<td>5819869</td>
<td>595252</td>
<td>931.2</td>
</tr>
<tr>
<td>SH14-02</td>
<td>5819957</td>
<td>595204</td>
<td>932.9</td>
</tr>
<tr>
<td>SH14-02A</td>
<td>5819957</td>
<td>595207</td>
<td>932.9</td>
</tr>
<tr>
<td>SH14-03</td>
<td>5819941</td>
<td>595130</td>
<td>932.5</td>
</tr>
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<td>SH14-04</td>
<td>5819908</td>
<td>595109</td>
<td>932.2</td>
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<td>SH14-05</td>
<td>5819918</td>
<td>595195</td>
<td>937.1</td>
</tr>
<tr>
<td>SH14-05A</td>
<td>5819920</td>
<td>595193</td>
<td>937.2</td>
</tr>
<tr>
<td>SH14-06</td>
<td>5819917</td>
<td>595180</td>
<td>937.5</td>
</tr>
<tr>
<td>SH14-07</td>
<td>5819899</td>
<td>595055</td>
<td>931.7</td>
</tr>
<tr>
<td>SH14-08</td>
<td>5819889</td>
<td>595167</td>
<td>947.6</td>
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<tr>
<td>SH14-08A</td>
<td>5819887</td>
<td>595170</td>
<td>947.6</td>
</tr>
<tr>
<td>SH14-09</td>
<td>5819911</td>
<td>595145</td>
<td>938.0</td>
</tr>
<tr>
<td>SH14-10</td>
<td>5819965</td>
<td>595148</td>
<td>932.2</td>
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<tr>
<td>SH14-11</td>
<td>5819995</td>
<td>595168</td>
<td>931.0</td>
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<tr>
<td>SH14-11B</td>
<td>5819992</td>
<td>595169</td>
<td>931.2</td>
</tr>
<tr>
<td>SH14-12</td>
<td>5819842</td>
<td>595297</td>
<td>930.8</td>
</tr>
<tr>
<td>SH14-13</td>
<td>5819770</td>
<td>595405</td>
<td>933.1</td>
</tr>
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<td>SH14-14</td>
<td>5819936</td>
<td>595096</td>
<td>930.1</td>
</tr>
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<td>SH14-15</td>
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<td>930.2</td>
</tr>
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<td>SH14-16</td>
<td>5819973</td>
<td>595076</td>
<td>930.2</td>
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<td>SH14-17</td>
<td>5819998</td>
<td>595090</td>
<td>929.6</td>
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<td>SH14-18</td>
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<td>594883</td>
<td>942.8</td>
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<td>594862</td>
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<td>SH14-22A</td>
<td>5819984</td>
<td>595120</td>
<td>930.0</td>
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</table>
SYMBOLS AND TERMS
FOR SOIL DESCRIPTION SHOWN ON LOGS

BASIC SOIL SYMBOLS

<table>
<thead>
<tr>
<th>Predominant Material</th>
<th>Secondary Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAVEL</td>
<td>gravely to some gravel</td>
</tr>
<tr>
<td>SAND</td>
<td>sandy to some sand</td>
</tr>
<tr>
<td>SILT</td>
<td>silty to some silt</td>
</tr>
<tr>
<td>CLAY</td>
<td>clayey to some clay</td>
</tr>
<tr>
<td>PEAT / ORGANICS</td>
<td>some organics</td>
</tr>
<tr>
<td>Undifferentiated</td>
<td></td>
</tr>
<tr>
<td>BEDROCK</td>
<td></td>
</tr>
<tr>
<td>ORGANIC SILT</td>
<td></td>
</tr>
<tr>
<td>FILL / DEBRIS</td>
<td></td>
</tr>
</tbody>
</table>

SYMBOL VARIATIONS - EXAMPLES

(1)

PROPORTION OF MINOR COMPONENTS BY WEIGHT

<table>
<thead>
<tr>
<th>Minor Component</th>
<th>Weight Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>and</td>
<td>35 - 50%</td>
</tr>
<tr>
<td>y / ey</td>
<td>20 - 35%</td>
</tr>
<tr>
<td>some</td>
<td>10 - 20%</td>
</tr>
<tr>
<td>trace</td>
<td>0 - 10%</td>
</tr>
</tbody>
</table>

DENSITY OF GRANULAR SOILS

<table>
<thead>
<tr>
<th>Description</th>
<th>SPT N ((^{(4)}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Loose</td>
<td>0 - 4</td>
</tr>
<tr>
<td>Loose</td>
<td>4 - 10</td>
</tr>
<tr>
<td>Compact</td>
<td>10 - 30</td>
</tr>
<tr>
<td>Dense</td>
<td>30 - 50</td>
</tr>
<tr>
<td>Very Dense</td>
<td>&gt; 50</td>
</tr>
</tbody>
</table>

CONSISTENCY OF COHESIVE SOILS

<table>
<thead>
<tr>
<th>Description</th>
<th>Undrained Shear Strength (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Soft</td>
<td>&lt; 12</td>
</tr>
<tr>
<td>Soft</td>
<td>12 - 25</td>
</tr>
<tr>
<td>Firm</td>
<td>25 - 50</td>
</tr>
<tr>
<td>Stiff</td>
<td>50 - 100</td>
</tr>
<tr>
<td>Very Stiff</td>
<td>100 - 200</td>
</tr>
<tr>
<td>Hard</td>
<td>&gt; 200</td>
</tr>
</tbody>
</table>

CLASSIFICATION BY PARTICLE SIZE

<table>
<thead>
<tr>
<th>Name</th>
<th>Size Range ((^{(3)}))</th>
<th>U.S. Standard Sieve Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulders</td>
<td>&gt; 200</td>
<td>8 inch</td>
</tr>
<tr>
<td>Cobble</td>
<td>75 - 200</td>
<td>3 inch 8 inch</td>
</tr>
<tr>
<td>Gravel: coarse</td>
<td>19 - 75</td>
<td>0.75 inch 3 inch</td>
</tr>
<tr>
<td>Gravel: fine</td>
<td>5 - 19</td>
<td>No. 4</td>
</tr>
<tr>
<td>Sand: coarse</td>
<td>2 - 5</td>
<td>No. 10</td>
</tr>
<tr>
<td>Sand: medium</td>
<td>0.4 - 2</td>
<td>No. 40</td>
</tr>
<tr>
<td>Sand: fine</td>
<td>0.075 - 0.4</td>
<td>No. 200</td>
</tr>
<tr>
<td>Fines: silt</td>
<td>0.002 - 0.075</td>
<td>-</td>
</tr>
<tr>
<td>Fines: clay</td>
<td>&lt; 0.002</td>
<td>-</td>
</tr>
</tbody>
</table>

PENETRATION TESTS

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Cone Penetration</td>
<td>![Diagram]</td>
</tr>
<tr>
<td>Standard Penetration</td>
<td>![Diagram]</td>
</tr>
<tr>
<td>Becker Closed Casing</td>
<td>![Diagram]</td>
</tr>
<tr>
<td>Becker Open Casing</td>
<td>![Diagram]</td>
</tr>
<tr>
<td>Bounce Chamber Pressure</td>
<td>![Diagram]</td>
</tr>
</tbody>
</table>

1. Only selected examples of the possible variations or combinations of the basic symbols are illustrated.
2. USCS refers to group symbols as defined by the Unified Soil Classification System. Soil descriptions related to fines and secondary materials are based on particle size where lab testing was completed by Thurber and visual and tactile field behaviour of samples where lab testing was not completed by Thurber.
3. Approximate metric conversion.
**LOCATION:** See Fig. 209  
E 595248, N 5819872

**TOP OF HOLE ELEV:** 931.3 m

**METHOD:** Sonic

**DRILLING CO.:** Mud Bay Drilling Ltd.

**INSPECTOR:** CHS

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**CLIENT:** Mount Polley Independent Expert Engineering Investigation and Review Panel

**PROJECT:** Mount Polley Tailings Dam Breach

**DATE:** September 25, 2014

**FILE NO.:** 15-3-280

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### LOG OF TEST HOLE - MT POLLEY 15-3-280 KCB.GPJ  THURBER BC.GDT  1/7/15- THURBER BC.GLB

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>PENETRATION (blows/300 mm)</th>
<th>WATER CONTENT (%)</th>
<th>WATER LEVEL</th>
<th>SAMPLES</th>
<th>UNDRAINED SHEAR STRENGTH (kPa)</th>
<th>GRAIN SIZE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>Plastic</td>
<td>Liquid</td>
<td></td>
</tr>
<tr>
<td>20-200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Limit</td>
<td>Liquid</td>
</tr>
</tbody>
</table>

**COMMENTS**

Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-01 and KCB laboratory testing for further information.

Nominal sonic core diameter 100 mm

Top of UPPER TILL

Refer to SH14-01A preferentially for redrill of interval 0 to 12.5 m.

Start of RSCPT14-01 at approx. 2.8 m

**SOIL DESCRIPTION**

Grey, moist, angular GRAVEL with some sand and a trace of silt. (Fill)

Firm to stiff, grey-brown, moist, sandy SILT with some gravel and traces of clay, wood fragments and organics. (Possible weathered ablation/moraine till)

Very stiff to hard, brown, moist, sandy SILT with some gravel and a trace of clay. (Possible ablation/moraine till)
No structure evident in disturbed sample from 6.4 to 11.3 m. See SH14-01A for more detailed soil description.

Very stiff to hard, brown, moist, sandy SILT with some gravel and a trace of clay. (Possible ablation/moraine till)

Firm to stiff, grey, moist, sandy SILT with some clay and trace to some gravel and trace cobbles to 125 mm diameter. (Possible ablation/moraine till) - some zones with some sand and clayey (possible disturbed glaciolacustrine)

Vibrating Wire Tip C at 9.4 m.
No structure evident in disturbed sample from 6.4 to 11.3 m. See SH14-01A for more detailed soil description.

Possible Top of LOWER TILLS (Lower Basal Till)

Refusal of RSCP14-01 at approx. 12.0 m

Firm to stiff, grey, moist, sandy SILT with some clay and trace to some gravel and trace cobbles to 125 mm diameter. (Possible ablation/moraine till) - some zones with some sand and clayey (possible disturbed glaciolacustrine)

Very stiff to hard, grey, moist, sandy SILT with some gravel and a trace of clay. (Basal till)
**SOIL DESCRIPTION**

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Very stiff to hard, grey, moist, sandy SILT with some gravel and a trace of clay. (Basal till)</td>
</tr>
<tr>
<td>16</td>
<td>Dense, grey, moist, silty, fine SAND. (Possible glaciofluvial)</td>
</tr>
<tr>
<td>17</td>
<td>Dense (inferred), brown, wet, sub-angular to angular GRAVEL and SAND with a trace to some silt. (Possible glaciofluvial)</td>
</tr>
<tr>
<td>18</td>
<td>Very dense (frangible), brown, moist, silty fine SAND to SILT and fine SAND. (Possible glaciofluvial)</td>
</tr>
<tr>
<td>19</td>
<td>Very dense / hard, brown, moist, sandy SILT to silty SAND mixtures with some gravel and a trace of clay. (Basal till)</td>
</tr>
</tbody>
</table>

- grey below 17.4 m

**LOCATION:** See Fig. 209

**E 595248, N 5819872**

**TOP OF HOLE ELEV:** 931.3 m

**METHOD:** Sonic

**DRILLING CO.:** Mud Bay Drilling Ltd.

**INSPECTOR:** CHS

**CLIENT:** Mount Polley Independent Expert Engineering Investigation and Review Panel

**PROJECT:** Mount Polley Tailings Dam Breach

**DATE:** September 25, 2014

**FILE NO.:** 15-3-280
### Soil Description

Hard, dark grey, dry to moist, angular gravelly sandy SILT with a trace of clay. (Possible brecciated basalt bedrock)

### Comments

**LOCATION:** See Fig. 209
**ELEVATION (m):** 911

**TOP OF HOLE ELEV:** 931.3 m

**METHOD:** Sonic

**DRILLING CO.:** Mud Bay Drilling Ltd.

**CLIENT:** Mount Polley Independent Expert Engineering Investigation and Review Panel

**PROJECT:** Mount Polley Tailings Dam Breach

**DATE:** September 25, 2014

**FILE NO.:** 15-3-280
Hard, dark grey, dry to moist, angular gravelly sandy SILT with a trace of clay. (Possible brecciated basalt bedrock)

- angular gravel (probable basalt boulder) from 27.1 to 27.7 m
**SOIL DESCRIPTION**

Hard, dark grey, dry to moist, angular gravelly sandy SILT with a trace of clay. (Possible brecciated basalt bedrock)

- some clay to clayey from 33.8 to 35.3 m
Hard, dark grey, dry to moist, angular gravelly sandy SILT with a trace of clay. (Possible brecciated basalt bedrock)

Very dense/hard, dark grey, dry to moist, angular GRAVEL, SAND and SILT. (Possible brecciated basalt bedrock)

Very dense (inferred), friable, dark grey, dry to moist, silty, sandy, angular GRAVEL. (Possible brecciated basalt bedrock)

- silt, sand and gravel of basalt-like origin with occasional white vein-like streaks of quartz or plagioclase feldspar
Vibrating Wire Tip A at 43.9 m.

Very dense (inferred), friable, dark grey, dry to moist, silty, sandy, angular GRAVEL. (Possible brecciated basalt bedrock) - silt, sand and gravel of basalt-like origin with occasional white vein-like streaks of quartz or plagioclase feldspar

End of hole at KCB instruction. Test hole left cased pending instrumentation installation completed September 27. Vibrating wire piezometers installed September 27 at 9.4 m (Tip C), 16.5 m (Tip B) and 43.9 m (Tip A) and test hole grouted.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-01 and KCB laboratory testing for further information.

Poor recovery for the first 1.8 m.

Top of UPPER TILL

Nominal sonic core diameter 100 mm

Start of RSCPT14-01 at approx. 2.8 m

Re-drill to sample interval which with disturbed recovery at SH14-01.

Grey, moist, angular GRAVEL with some sand and a trace of silt. (Fill)

Firm to stiff, grey-brown, moist, sandy SILT with some gravel and traces of clay and organics. (Possible ablation/moraine till)

Very stiff to hard, brown, moist, sandy SILT with some gravel and traces of clay and cobbles. (Possible ablation/moraine till)
**SOIL DESCRIPTION**

**Top of UPPER GLU**
- Cvane at 9.0 m is 20 to 30 kPa (Cvane is Torvane)

**Top of LOWER TILLS (Lower Basal Till)**
- Firm to stiff, grey, moist to wet, sandy SILT with some gravel and traces of clay and cobbles. (Possible ablation/moraine till)
  - grey below 6.1 m
  - firm to stiff below 6.4 m

**Firm, grey, moist sandy SILT with some gravel and traces of clay and cobbles. (Basal till)**
- some clay from 9.5 to 9.6 m

**COMPMENTS**

**ELEVATION (m)**
- 922
- 923
- 924
- 925
- 926

**LOG OF TEST HOLE**

**LOCATION:** See Fig. 209
- E 595252, N 5819869

**TOP OF HOLE ELEV:** 931.2 m

**METHOD:** Sonic

**DRILLING CO.:** Mud Bay Drilling Ltd.

**INSPECTOR:** CHS

**CLIENT:** Mount Polley Independent Expert Engineering Investigation and Review Panel

**PROJECT:** Mount Polley Tailings Dam Breach

**DATE:** September 25, 2014

**FILE NO.:** 15-3-280
Refusal of RSCPT14-01 at approx. 12.0 m

Firm, grey, moist sandy SILT with some gravel and traces of clay and cobbles. (Basal till)
- very stiff to hard below 10.1 m

- sandy silt to fine sand and silt from 11.0 to 12.5 m

End of hole at KCB instruction. Test hole backfilled with bentonite chips upon completion.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-02 and KCB laboratory testing for further information.

Grey-brown, moist, sandy, sub-angular to angular GRAVEL to 75 mm diameter with a trace of silt. (Rockfill debris)

Nominal sonic core diameter 100 mm

Poor recovery from 3.4 to 4.9 m, drill bit blocked by wood. Refer to SH14-02A preferentially for redrill.

Firm to stiff, grey-brown, moist SILT with some sand and fibrous organics, trace to some gravel and clay and a trace of wood fragments. (Possible stripping material - till-like fill)

- 75 mm diameter wood fragment (possible small log), crossing perpendicular to core axis
**SOIL DESCRIPTION**

- **Firm to stiff, grey-brown, moist SILT with some sand and fibrous organics, trace to some gravel and clay and a trace of wood fragments. (Possible stripping material - till-like fill)**

- **Very stiff to hard, grey-brown, moist, sandy SILT with some gravel and trace to some clay. (Possible weathered ablation/moraine till)**

**END OF HOLE**

End of hole due to poor recovery. Test hole grouted to base of fill upon completion. Moved to SH14-02A.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-02 and KCB laboratory testing for further information.

Nominal sonic core diameter 140 mm

Cvane is Torvane

Red/grey/brown, moist, sandy, sub-angular to angular GRAVEL to 76 mm in diameter with a trace of silt. (Rockfill)

Dark brown, moist to wet, fibrous ORGANICS and WOOD fragments (sticks). (Possible stripping waste - fill)

Stiff to very stiff, grey-brown, moist SILT with some sand and a trace to some sub-rounded, gravel to 50 mm in diameter and clay. (Possible till-like fill)

- firm to stiff below 4.6 m
- 25 mm diameter pocket of clean medium sand at 4.7 m
Sample fell out of core barrel during retrieval from 9.4 to 11.0 m. Recovered during next run with significant disturbance.

Start of RSCPT 14-02 at approx. 9.4 m

Vibrating Wire Tip B at 9.4 m.

Very stiff to hard, grey-brown, moist, sandy SILT with some gravel to gravelly and a trace of cobbles to 100 mm diameter. (Possible ablation/moraine till)

- stiff to very stiff with cobbles to 125 mm in diameter below 6.4 m

- firm to stiff and grey below 7.9 m

Sample fell out of core barrel during retrieval from 9.4 to 11.0 m. Recovered during next run with significant disturbance.
Sample fell out of core barrel during retrieval from 9.4 to 11.0 m. Recovered during next run with significant disturbance.

Top of UPPER GLU

Cvane at 11.5 m is 30 to 35 kPa

Firm to stiff (highly disturbed), grey, moist, sandy SILT with some gravel to gravelly and a trace of cobbles to 100 mm diameter. (Possible ablation/moraine till)

Top of LOWER TILLS (Lower Basal Till)

Cvane at 12.5 m is 25 kPa

Firm, grey, moist SILT with some clay to clayey and a trace to some gravel and a trace of sand. (Glaciolacustrine) - massive, no apparent structure

Initial refusal of RSCPT14-02 at approx. 13.7 m

Very stiff to hard, grey, moist SILT with some clay and a trace to some sand and a trace of gravel to 40 mm diameter. (Glaciolacustrine)

(Top of Lower GLU)

Very dense, grey, moist SAND and SILT with some sub-rounded to rounded gravel to 75 mm diameter and a trace of clay. (Basal till)

(Top of Glaciofluvial)

Dense, brown, wet, silty, fine SAND with a trace of gravel to 75 mm diameter. (Possible glaciofluvial)
Restart of RSCPT14-02 at approx. 15.0 m Vibrating Wire Tip A at 15.5 m.

Refusal of RSCPT14-02 at approx. 16.6 m Top of WEAK BEDROCK

Dense, brown, wet, silty, fine SAND with a trace of gravel to 75 mm diameter. (Possible glaciofluvial)
- a 50 mm thick layer of wet SAND and GRAVEL with a trace to some silt at 15.2 m

Dense, brown, wet, fine to medium SAND with some silt. (Possible glaciofluvial)

Dense, brown, wet, silty, fine SAND to fine SAND and SILT. (Possible glaciofluvial)

Very stiff to hard, brown/red/green SILT with some gravel and sand and a trace of clay. (Basal till)

Very dense (inferred), red/brown/orange, moist, silty sub-angular to angular SAND and GRAVEL (Possible brecciated volcanic bedrock).
- gravel to 13 mm diameter, very friable, weak to moderately strong of basalt like with oxidation staining
- white vein-like structure perpendicular to core axis up to 10 mm thick

Very dense (inferred), grey, dry to moist, silty, fine SAND with traces of medium to coarse sand and sub-rounded to sub-angular gravel to 13 mm diameter. (Possible poorly cemented sandstone bedrock)
- white vein-like structures
Gravel fragments are moderately strong but friable.

Very dense (inferred), grey, dry to moist, silty, fine SAND with traces of medium to coarse sand and sub-rounded to sub-angular gravel to 13 mm diameter. (Possible poorly cemented sandstone bedrock)

Very dense (inferred), dark grey, dry to moist SAND and sub-angular to angular GRAVEL to 13 mm diameter with a trace to some silt. (Possible brecciated volcanic bedrock)
- sand and gravel particles of basalt-like origin
- remnants of vein-like structure crosses at 20.7 m

Very dense (inferred), light grey, dry to moist, silty, fine to medium SAND. (Possible poorly cemented sandstone)

Very dense / hard, dark grey, dry to moist, angular gravelly silty SAND. (Possible brecciated volcanic bedrock)
- gravel, sand and silt matrix are sub-angular to angular of basalt like origin

End of hole at KCB instruction. Vibrating wire piezometers installed at 9.4 m (Tip B) and 15.5 m (Tip A) and test hole grouted.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-03 and KCB laboratory testing for further information.

Nominal sonic core diameter 140 mm from 0 to 29.3 m

Grey, moist to wet, angular GRAVEL with some sand and traces of silt and cobbles to 100 mm diameter. (Rockfill)
Boundary between fill and foundation at 5.0 m.

Top of UPPER TILL

Start of RSCPT14-03 at approx. 5.3 m

- fragments of non-woven geotextile at 5.0 m
- Stiff to very stiff, grey/brown, moist, sandy SILT with some gravel to 50 mm diameter, and a trace of clay. (Possible ablation/moraine till)
- grey below 7.0 m
- stiff below 7.3 m
- firm to stiff below 7.9 m
<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>PENETRATION</th>
<th>WATER CONTENT (%)</th>
<th>WATER LEVEL</th>
<th>SAMPLES</th>
<th>UNDRAINED SHEAR STRENGTH (kPa)</th>
<th>GRANULOMETRY</th>
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</thead>
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<td>Liquid</td>
<td>Undisturbed</td>
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</tbody>
</table>

**COMMENTS**

Firm to stiff, grey, moist, sandy SILT with some gravel to 50 mm diameter, and a trace of clay. (Possible ablation/moraine till)

- 50 mm thick layer of silty sand with some gravel at 14.0 m

- Very stiff, grey, friable, moist to wet SILT with some clay and fine sand and occasional fragments (less than 5 mm long) of compressed (coal-like) organics. (Glaciolacustrine)

- Very Stiff to hard, grey, moist, sandy SILT with some sub-rounded to sub-angular mixed origin gravel to 40 mm in diameter and a trace of clay. (Basal till)

- bedding folded downhole into parabolic structures with concave downward curvature, at steepest (50 mm form core axis) bedding is approximately 60° to horizontal from 13.0 to 13.3 m (possible drill disturbance)

- bedding is tilted dipping at 30 to 50° from horizontal from 11.7 to 11.8 m

- from 13.0 to 13.6 m, core perimeter shaved off during drilling/extrusion, resulting core diameter is 100 mm for 140 mm I.D. barrel

- 100 mm thick layer with some sub-rounded to sub-angular mixed origin gravel to gravelly to 40 mm in diameter at 14.8 m

- laminations could be peeled apart 'booking' at sandy partings

Top of LOWER TILLS (Lower Basal Till)

Very Stiff to hard, grey, moist, sandy SILT with some sub-rounded to sub-angular mixed origin gravel to 40 mm in diameter and a trace of clay. (Basal till)

Very Stiff, grey, friable, moist to wet SILT with some clay and fine sand and occasional fragments (less than 5 mm long) of compressed (coal-like) organics. (Glaciolacustrine)

- 100 mm thick layer with some sub-rounded to sub-angular mixed origin gravel to gravelly to 40 mm in diameter at 14.8 m

- 50 mm thick layer of silty sand with some gravel at 14.0 m

- bedding folded downhole into parabolic structures with concave downward curvature, at steepest (50 mm form core axis) bedding is approximately 60° to horizontal from 13.0 to 13.3 m (possible drill disturbance)

- bedding is tilted dipping at 30 to 50° from horizontal from 11.7 to 11.8 m

- from 13.0 to 13.6 m, core perimeter shaved off during drilling/extrusion, resulting core diameter is 100 mm for 140 mm I.D. barrel

- 100 mm thick layer with some sub-rounded to sub-angular mixed origin gravel to gravelly to 40 mm in diameter at 14.8 m

- laminations could be peeled apart 'booking' at sandy partings
**SOIL DESCRIPTION**

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>WATER CONTENT (%)</th>
<th>WATER LEVEL</th>
<th>GRANULOMETRY</th>
<th>PENETRATION (blows/300 mm)</th>
<th>Comments</th>
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<td>20</td>
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</tbody>
</table>

- **Top of Glaciofluvial**
- Very stiff, grey, friable, moist to wet SILT with some clay and fine sand and occasional fragments (less than 5 mm long) of compressed (coal-like) organics. (Glaciolacustrine)

- Stiff to very stiff, grey, moist, thinly laminated, clayey SILT to CLAY interbedded with partings of fine sand. (Glaciolacustrine)
  - bedding is undulating amplitude approx. 25 mm
  - alternating laminations are dark grey/black, organic odour, and a trace of organic silt below 18.4 m
  - contact at 18.6 m is undulating

- Compact to dense (inferred), grey, wet, fine SAND and SILT, coarsening downward. (Possible glaciofluvial)
  - grading to fine to medium sand with some silt at 18.7 m

- Compact to dense (inferred), grey, wet, silty, fine SAND to fine SAND and SILT, interbedded with black laminations with organic odour. (Possible glaciofluvial)
  - bedding is deformed with concave upward curvature with peak slightly off center of core axis from 19.4 to 20.0 m (possible drill disturbance)
Refusal of RSCPT14-03 at approx. 20.6 m

Top of WEAK BEDROCK

Very stiff to hard, grey with green, purple, orange, red staining/weathering, dry to moist, clayey SILT with traces of sand and gravel. (Possible fine volcanic ash tuff bedrock)
- weathering horizons surrounding gravel particles
- trace white streaks (possible weathering by-product or weathered remnants of veins)
- stiff to very stiff with some sand below 23.5 m

- silty SAND to sandy SILT with a trace of quartz vein fragments below 24.7 m, with pockets of olive green and red staining

Compact to dense (inferred), grey, wet, silty, fine SAND to fine SAND and SILT, interbedded with black laminations with organic odour. (Possible glaciofluvial)

Refusal of RSCPT14-03 at approx. 20.6 m

Compact to dense (inferred), grey, wet SAND with a trace of sub-rounded gravel to 13 mm diameter. (Possible glaciofluvial)

Compact to dense (inferred), grey, wet, silty, fine SAND with a trace of organic silt and organic odour. (Possible glaciofluvial)

Compact to dense (inferred), grey, wet, gravelly SAND to SAND and GRAVEL with a trace of silt. (Possible glaciofluvial)

Compact to dense (inferred), grey, wet, silty fine SAND with organic odour. (Possible glaciofluvial)
- fine sand and silt below 21.6 m

Compact to dense (inferred), grey, wet SAND with a trace of organic silt and organic odour. (Possible glaciofluvial)
Nominal sonic core diameter 100 mm below 29.3 m

- Very stiff to hard, grey with green, purple, orange, red staining/weathering, dry to moist, clayey SILT with traces of sand and gravel. (Possible fine volcanic ash tuff bedrock)
  - zone of purple SAND with a trace to some silt and a trace of white angular quartz vein fragments from 25.3 to 25.5 m

Very stiff to hard, grey-green, dry to moist, clayey SILT with traces of sand and sub-angular basalt gravel to 50 mm diameter. (Possible fine volcanic ash tuff bedrock)

- hard below 29.3 m with no gravel
Very stiff to hard, grey-green, dry to moist, clayey SILT with traces of sand and sub-angular basalt gravel to 50 mm diameter. (Possible fine volcanic ash tuff bedrock)

Hard, grey with light green, rusty red, and white and black streaks, dry to moist SILT with some sand and sub-rounded to sub-angular gravel to 50 mm diameter of meta-basalt like origin and a trace of clay. (Possible fine volcanic ash tuff bedrock)

Very dense (inferred), light grey, dry to moist, silty, fine to medium SAND to SILT and SAND with a trace to some sub-angular to sub-rounded coal fragments to 13 mm diameter and some red and green alteration staining of matrix. (Possible poorly cemented sandstone bedrock)

Very stiff, green with purple and white staining/streaking, dry to moist, fine sandy SILT with a trace to some sub-rounded to sub-angular gravel to 13 mm diameter and a trace of clay. (Possible fine volcanic ash tuff bedrock)

Very stiff to hard, grey, dry to moist SILT with some clay with green and white streaks/fine mineralization. (Possible fine volcanic ash tuff bedrock)
**SOIL DESCRIPTION**

**COMMENTS**

**Very stiff to hard, grey, dry to moist SILT with some clay with green and white streaks/fine mineralization. (Possible fine volcanic ash tuff bedrock)**

**Hard with very stiff zones, dark grey-green, moist SILT with some angular to sub-rounded gravel to 25 mm diameter and a trace to some sand and a trace of clay. (Possible brecciated volcanic bedrock)**
- matrix is pervasively stained green
- gravel is medium strong, reddish black moderately strong basalt like

**Hard (friable), light grey, dry to moist, fine sandy SILT with traces of fine gravel, medium to coarse sand with black vein-like streaks and red secondary alteration colour. (Possible brecciated volcanic bedrock)**

**Hard, grey, moist SILT with some fine sand to sandy, some sub-angular to angular basalt gravel to 25 mm diameter and a trace of clay. (Possible brecciated volcanic bedrock)**

**Very dense (inferred), grey, dry to moist, silty, fine SAND to fine SAND and SILT with some sub-angular to angular basalt gravel and a trace to some medium to coarse sand. (Possible brecciated volcanic bedrock)**
Very dense (inferred), grey, dry to moist, silty, fine SAND to fine SAND and SILT with some sub-angular to angular basalt gravel and a trace to some medium to coarse sand. (Possible brecciated volcanic bedrock)

Very dense (inferred), friable, dark grey/black, dry to moist, sandy, sub-angular to angular GRAVEL to 50 mm diameter. (Probable brecciated volcanic bedrock)
- gravel of moderately strong basalt like origin with no visible structure, alteration or veins.
- localized zones of silt and sand with some gravel
Very dense (inferred), friable, dark grey/black, dry to moist, silty, sandy, sub-angular to angular GRAVEL to 50 mm diameter. (Probable brecciated volcanic bedrock)
- gravel of moderately strong basalt like origin with no visible structure, alteration or veins.
- localized zones of silt and sand with some gravel

- a 100 mm intact basalt cobble at 47.7 m

End of hole at KCB instruction. Test hole sounded through casing upon completion to 47.8 m. Slope inclinometer installed and test hole grouted.
**Note:** Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-04 and KCB laboratory testing for further information.

Nominal sonic core diameter 140 mm from 0 to 18.6 m

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**SOIL DESCRIPTION**

Open HDPE pipe standing vertically installed through rockfill access road during construction to facilitate drilling.

Grey-brown, moist to wet, cobbly, sandy, angular to sub-angular GRAVEL to 100 mm diameter with some silt. (Rockfill)
Grey-brown, moist to wet, cobbly, sandy, angular to sub-angular GRAVEL to 100 mm diameter with some silt. (Rockfill)
- with some reddish grey silty sand (tailings debris) present below 4.9 m

Stiff, grey-brown, moist, sandy SILT with some sub-rounded to sub-angular gravel to 75 mm in diameter with a trace of clay. (Possible ablation/moraine till)
- very stiff to hard below 5.8 m

Very dense (inferred) silt and sand (brittle) from 8.4 to 9.5 m
**TOP OF HOLE ELEV:** 932.2 m

**METHOD:** Sonic

**DRILLING CO.:** Mud Bay Drilling Ltd.

**INSPECTOR:** CHS

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**SOIL DESCRIPTION**

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>PENETRATION (blows/300 mm)</th>
<th>WATER CONTENT (%)</th>
<th>WATER LEVEL</th>
<th>SAMPLES</th>
<th>UNDRAINED SHEAR STRENGTH (kPa)</th>
<th>GRAIN SIZE (%)</th>
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<tbody>
<tr>
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</tbody>
</table>

**COMMENTS**

- Very stiff to hard, grey-brown, moist, sandy SILT with some sub-rounded to sub-angular gravel to 75 mm in diameter with a trace of clay. (Possible ablation/moraine till)

- Firm, grey, with trace to some clay below 11.3 m

- Compact (inferred), grey, moist to wet, silty SAND with some gravel and a trace of clay. (Possible ablation/moraine till)

- Firm (inferred), grey, moist to wet, clayey SILT to CLAY with traces of sand and fine gravel. (Glaciolacustrine)

- Dense/stiff to very stiff, grey, moist, sandy SILT to SILT and SAND with some sub-rounded to rounded gravel to 50 mm diameter and a trace of clay. (Basal till)

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**LOG OF TEST HOLE - MT POLLEY 15-3-280 KCB.GPJ THURBER BC.GDT 1/7/15 - THURBER BC.GLB**
Refusal of RSCPT14-04 at approx. 17.2 m

Nominal sonic core diameter 100 mm below 18.6 m

Stiff to very stiff, grey, moist, thinly laminated, clayey SILT to CLAY interbedded with fine sand partings. (Glaciolacustrine)
- bedding dips at 35 to 45° to horizontal
- zone about 50 mm thick where no bedding apparent at 15.4 m
- below 15.4 m, bedding reverses to 20 to 30° from horizontal in opposite orientation to that above

Compact to dense (inferred), grey, wet, thinly laminated, silty, fine to medium SAND interbedded with firm to stiff silt. (Possible glaciofluvial)
- bedding is deformed with peak near centre of core axis (possibly due to drill action) and limbs dipping at 20 to 30° to horizontal by core perimeter (concave downward)
- loose (disturbed), grey, moist SAND with trace to some silt from 16.1 to 16.3 m

Compact to dense (inferred), brown, wet, sandy rounded to sub-angular GRAVEL to 75 mm diameter and a trace of silt. (Possible glaciofluvial)

Compact to dense (inferred), thickly laminated, fine to medium SAND with trace silt interbedded with compact (brittle) fine SAND and SILT. (Possible glaciofluvial)
- 15 mm average bed thickness

Compact to dense (inferred), brown with reddish staining (possible oxidization), wet, sandy, sub-rounded to sub-angular GRAVEL to 50 mm diameter with a trace of silt. (Possible glaciofluvial)
- gravel is altered/weathered, mixed origins

Very dense (inferred), purple to pink, moist, sandy, sub-rounded to angular GRAVEL to 75 mm diameter, with some silt. (Possible till fragment)

Compact to dense (inferred), brown, wet, fine to medium SAND with some silt to silty. (Possible glaciofluvial)
**SOIL DESCRIPTION**

- **Top of Lower Basal Till**
  - Very dense, purple to pink, moist, sandy, sub-rounded GRAVEL to 100 mm diameter, with some silt. (Basal till)

- **Driller infers weathered rock below 21.3 m**
- **Top of WEAK BEDROCK**
  - Dense (inferred), brown, moist to wet, gravelly to 25 mm diameter SAND with a trace to some silt. (Possible glaciofluvial)
  - Very dense (inferred), purple to pink, dry to moist, SAND with some angular friable gravel to 25 mm diameter. (Possible weathered igneous bedrock)
  - Texture suggests highly weathered, moderately strong meta-igneous (monzonite) rock
  - No apparent structure or discontinuities visible
  - Sand grains may be phenocrysts with pervasive (potassic) alteration
  - 75 mm diameter, very strong (R5) green meta-igneous xenolith, possible chloritic alteration at 22.0 m

**COMMENTS**

- No Recovery

**PROJECT:** Mount Polley Tailings Dam Breach

**DATE:** September 30 and October 1, 2014

**FILE NO.:** 15-3-280
Hard, greenish grey with dark red sub-vertical banding, dry to moist, sandy SILT with some gravel. (Possible weathered igneous bedrock)
- pervasive alteration
- gravel particles are pinkish grey meta-igneous
- dark red bands are very stiff silt with some clay (possible shear indicator)

End of hole at KCB instruction. Test hole sounded through casing upon completion to 26.2 m. Slope inclinometer installed and test hole grouted.
Drill casing and core barrel became fused at 2 m. Test hole abandoned, moved to SH14-05A.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-05 and KCB laboratory testing for further information.

RSCPT14-05 located approx. 7 m from SH14-05A.

SH14-05 was abandoned at 2 m due to equipment malfunction.

Nominal sonic core diameter 140 mm

Top of UPPER TILL

Cvane is Torvane

Grey, moist, angular GRAVEL to 75 mm diameter with some sand and a trace of silt. (Rockfill)

Firm, dark brown/grey, moist, organicy SILT with some sand and traces of sub-rounded gravel to 25 mm diameter, clay and wood (sticks). (Possible weathered glaciolacustrine)

Firm, grey/brown, moist, sandy SILT with some sub-angular to rounded gravel to 75 mm diameter and a trace to some clay. (Possible ablation/moraine till)

- trace of organics and oxidation staining above 3.4 m

- stiff to very stiff below 3.7 m
Stiff to very stiff, grey/brown, moist, sandy SILT with some sub-angular to rounded gravel to 75 mm diameter and a trace to some clay. (Possible ablation/moraine till)

- firm to stiff below 5.5 m
- grey below 6.4 m
- firm below 7.9 m
- firm to stiff below 9.4 m
- occasional sub-rounded cobbles to 150 mm in diameter

LOCATION: See Fig. 209
E 595193, N 5819920

TOP OF HOLE ELEV: 937.2 m

CLIENT: Mount Polley Independent Expert Engineering Investigation and Review Panel

PROJECT: Mount Polley Tailings Dam Breach

DATE: October 3, 2014

FILE NO.: 15-3-280

METHODOLOGY:
- Sonic

DRILLING CO.: Mud Bay Drilling Ltd.

INSPECTOR: CHS

SOIL DESCRIPTION:
- Stiff to very stiff, grey/brown, moist, sandy SILT with some sub-angular to rounded gravel to 75 mm diameter and a trace to some clay. (Possible ablation/moraine till)

- firm to stiff below 5.5 m
- grey below 6.4 m
- firm below 7.9 m
- firm to stiff below 9.4 m
- occasional sub-rounded cobbles to 150 mm in diameter
**SOIL DESCRIPTION**

Start of RSCPT14-05 at approx. 13.2 m

Vibrating Wire Tip C at 13.7 m

Firm to stiff, grey, moist, sandy SILT with some sub-angular to rounded gravel to 75 mm diameter and a trace to some clay. (Possible ablation/moraine till)
Top of UPPER GLU

Cvane at 15.5 m is 25 kPa across bedding and 18 kPa parallel to bedding

Cvane at 15.7 m is 50 kPa across bedding, and 40 kPa peak / 10 kPa remolded parallel to bedding

Vibrating Wire Tip B at 15.8 m

Top of LOWER TILLS (Lower Basal Till)

Refusal of RSCTPT14-05 at approx. 17.6 m

Firm, grey, moist, clayey SILT with some sand and a trace to some gravel. (Glaciolacustrine)
- at 15.1 and 15.2 m layers of undulating thinly laminated CLAY interbedded with fine sand partings 25 and 75 mm thick respectively

Firm, grey, moist, clayey SILT to CLAY interbedded with occasional fine sand partings. (Glaciolacustrine)

Firm, grey, moist SILT with some sand gravel and clay. (Transition from glaciolacustrine to till)

Very dense, grey/brown, dry to moist, gravelly to 75 mm diameter, silty SAND. (Basal till)

Very stiff to hard, grey, moist, thinly laminated clayey SILT to CLAY with occasional fine sand partings. (Glaciolacustrine)
- bedding is irregular, sub-horizontal

Very dense, brown, dry to moist, sub-angular to rounded gravelly to 50 mm diameter, silty SAND. (Basal till)
Vibrating Wire Tip A at 20.7 m

Top of WEAK BEDROCK

Very dense, brown, dry to moist, sub-angular to rounded gravelly to 50 mm diameter, silty SAND. (Basal till)

- fine sand and silt below 21.3 m

Very stiff, red/orange/purple/brown, moist, sandy SILT with some sub-rounded to sub-angular gravel, a trace of clay and pervasive oxidation staining. (Basal till)

- gravel particles friable down to 10 mm diameter
- sand and gravel of basalt like origin

Very dense (inferred), dark grey-black, moist to dry, silty, angular SAND with some fine, angular gravel and a trace of clay. (Possible brecciated volcanic bedrock)

- dry and gravelly to 50 mm diameter below 23.2 m
Very dense (inferred), dark grey-black, moist to dry, silty, angular SAND with some fine, angular gravel and a trace of clay. (Possible brecciated volcanic bedrock)

- gravel particles friable down to 10 mm diameter
- sand and gravel of basalt like origin

End of hole at KCB instruction. Vibrating wire piezometers installed at 13.7 m (Tip C), 15.8 m (Tip B) and 20.7 m (Tip A) and test hole grouted.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-06 and KCB laboratory testing for further information.

Nominal sonic core diameter 140 mm from 0 to 20.1 m

Cvane is Torvane

Grey, moist GRAVEL with traces of sand, silt and angular cobbles to 150 mm diameter. (Rockfill)
Grey, moist GRAVEL with traces of sand, silt and angular cobbles to 150 mm diameter. (Rockfill)

- some sand and silt below 6.4 m

Very stiff to hard, grey/brown, moist, sub-rounded gravelly SILT with some sand, a trace of clay and cobbles to 150 mm diameter. (Possible ablation/moraine till)

- at 8.7 m, two horizontal discontinuities within the till about 75 mm apart along the core axis, smooth to rough-undulating-tight, subtle striations, anisotropic roughness

- stiff to very stiff below 9.4 m
Top of UPPER GLU

Cvane across
bedding is 30 to 40
kPa and 15 to 20
kPa parallel to
bedding at 14.5 m

Stiff to very stiff, grey/brown, moist, sub-rounded gravelly SILT with some sand, a trace of clay and occasional cobbles to 150 mm diameter. (Possible ablation/moraine till)

- gradual transition to grey below 11.0 m

- firm below 11.9 m

- sandy below 13.9 m

- at 14.2 m, 25 mm thick zone of thinly laminated clayey SILT to CLAY with fine sand partings, bedding folded/undulating

Firm, grey, moist, thinly laminated, clayey SILT to CLAY interbedded with fine sand partings and a trace of gravel. (Glaciolacustrine)

- beds typically curving concave upward with occasional horizontal beds (possible drill disturbance)
Firm, grey, moist, thinly laminated, clayey SILT to CLAY interbedded with fine sand partings and a trace of gravel. (Glaciolacustrine)
- 75 mm thick pocket of firm till like material at 14.6 m
- bedding chaotic with open and tight folds of varying width and positions relative to core axis, several recumbent folds with hinge line perpendicular to core axis from 14.6 to 15.8 m (possible shear zone)
- bedding curved and folded with overall concave upward below 15.8 m

Very dense / very stiff, grey, moist, sandy SILT to fine SAND and SILT with some sub-rounded to rounded gravel to gravelly to 75 mm diameter and a trace of clay. (Basal till)

Very dense / very stiff, grey-brown, moist, gravelly SILT and SAND with traces of sub-angular to sub-rounded cobbles to 100 mm diameter and oxidation staining. (Possible glaciofluvial or till)
### Soil Description

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<th>Elevation (m)</th>
<th>Comments</th>
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<tbody>
<tr>
<td>937.5</td>
<td>Nominal sonic core diameter 100 mm below 20.1 m</td>
</tr>
<tr>
<td>21.2</td>
<td>Refusal of RSCPT14-06 at approx. 20.2 m</td>
</tr>
<tr>
<td></td>
<td>Compact to dense (inferred), brown, moist, silty, fine SAND with some sub-angular to sub-rounded gravel to 50 mm diameter and a trace of medium to coarse sand. (Possible glaciofluvial)</td>
</tr>
<tr>
<td>21.8</td>
<td>Hard, brown with weathering, dry to moist, SILT with some sand and a trace of angular to sub-rounded gravel to 6 mm diameter. (Basal till)</td>
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<td>- gravel particles are weathered meta-basalt like</td>
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<td></td>
<td>- very stiff pocket at 21.8 m</td>
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<td></td>
<td>- sandy and a trace of clay from 21.9 to 22.6 m</td>
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<tr>
<td>22.6</td>
<td>Some gravel to gravelly to 50 mm diameter below 22.6 m</td>
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<tr>
<td>913</td>
<td>Very dense, dark grey, dry to moist, silty SAND with some gravel and white alteration speckled throughout. (Basal till)</td>
</tr>
</tbody>
</table>
**Location:** See Fig. 209  
E 595180, N 5819917

**Top of Hole Elev:** 937.5 m

**Method:** Sonic

**Drilling Co.:** Mud Bay Drilling Ltd.

**Inspector:** CHS

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**Comments:**

**Soil Description:**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Comments</th>
</tr>
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<tbody>
<tr>
<td>25</td>
<td>Very dense, dark grey, dry to moist, silty SAND with some gravel and white alteration speckled throughout. (Basal till) - white and green alteration/weathering from 25.0 to 25.5 m</td>
</tr>
<tr>
<td>26</td>
<td>Hard, grey with red and green streaks of alteration/weathering, dry to moist, clayey SILT with traces of sand and sub-angular fine gravel. (Possible fine volcanic ash tuff bedrock) - with faint sub-horizontal lineations (possible bedding) - green is primary colour below 26.5 m</td>
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<tr>
<td>27</td>
<td>Hard, grey with green, red and yellow, dry to moist SILT with some sand, sub-angular to angular gravel to 6 mm diameter and clay. (Possible brecciated volcanic bedrock) - gravel particles are of weathered basalt like origin, weathering/alteration in coloured bands and halos, no apparent structure - occasional discontinuous slickensided surfaces</td>
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**Client:** Mount Polley Independent Expert Engineering Investigation and Review Panel

**Project:** Mount Polley Tailings Dam Breach

**Date:** October 4, 2014

**File No.:** 15-3-280
Hard, grey with green, red and yellow, dry to moist SILT with some sand, sub-angular to angular gravel to 6 mm diameter and clay. (Possible brecciated volcanic bedrock)
**SOIL DESCRIPTION**

Hard, grey with green, red and yellow, dry to moist SILT with some sand, sub-angular to angular gravel to 6 mm diameter and clay. (Possible brecciated volcanic bedrock)

End of hole at KCB instruction. Test hole sounded through casing upon completion to 35.7 m. Slope inclinometer installed and test hole grouted.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-07 and KCB laboratory testing for further information.

Grey, wet, angular GRAVEL with some sand and silt. (Rockfill - drill access road)

Nominal sonic core diameter 140 mm between 1.5 and 17.1 m

Loose to compact (inferred), red/brown/grey, moist to wet, silty, fine SAND. (Tailings debris)

Top of UPPER TILL

Very stiff, grey/brown, moist, sandy SILT to SAND and SILT with some clay and sub-rounded to rounded gravel to gravelly to 80 mm diameter. (Possible weathered ablation/moraine till)

- grey, wavy seam approximately parallel to core axis infilled with firm silt between 2.7 to 3.0 m

- very stiff to hard below 3.0 m

(Open HDPE pipe installed vertical through rockfill drill access road.)
Very stiff to hard, grey/brown, moist, sandy SILT to SAND and SILT with some clay and sub-rounded to rounded gravel to gravelly up to 80 mm diameter. (Possible weathered ablation/moraine till)
- grey, mottled brown with trace pockets which are oxidized/stained red brown below 5.3 m
- very stiff, trace cobbles below 5.8 m
- 50 mm thick zone with thin clayey silt laminations across half core diameter, undulating and dipping steeply at 6.8 m
- stiff below 7.9 m
- 50 mm thick sub-horizontal layer of soft to firm, bluish grey, fine gravelly SILT with some clay and a trace of sand at 8.7 m
- 10 mm thick sub-horizontal layer of soft to firm, bluish grey, fine gravelly SILT with some clay and a trace of sand at 9.4 m
Top of LOWER TILLS (Lower GLU) at 12.2 m.

Stiff, grey/brown, moist, sandy SILT to SAND and SILT with some clay and sub-rounded to rounded gravel to gravelly to 80 mm diameter. (Possible ablation/moraine till)

Stiff, bluish grey, clayey SILT to CLAY with faint thinly laminated bedding undulating 40 to 60° from horizontal with a trace of fine sand partings. (Glaciolacustrine)

Very dense, reddish brown, moist, silty SAND and GRAVEL with a trace of compressed partly decomposed organics and pervasive oxidation. (Possible weathered basal till or glaciofluvial)

- 3 mm thick sub-horizontal layer of red/brown (oxidized), wet SAND at 13.1 m

- 3 mm thick sub-horizontal layer of pinkish-brown (oxidized), wet SAND at 14.0 m

Top of WEAK BEDROCK

Refusal of RSCPT14-07 at approx. 14.2 m

Very stiff to hard, pinkish dark grey, moist, sandy SILT and sub-angular to angular meta-igneous GRAVEL with a trace of clay. (Possible weathered igneous bedrock)
Nominal sonic core diameter 100 mm below 17.1 m

Very stiff to hard, pinkish dark grey, moist, sandy SILT and sub-angular to angular meta-igneous GRAVEL with a trace of clay. (Possible weathered igneous bedrock)

- 5 mm thick layer of purplish grey, wet, fine to medium SAND layer at 17.4 m

- 5 mm thick layer of purplish grey, wet, fine to medium SAND layer at 18.3 m
Very stiff to hard, pinkish dark grey, moist, sandy SILT and sub-angular to angular meta-igneous GRAVEL with a trace of clay. (Possible weathered igneous bedrock)

End of hole at KCB instruction. Test hole sounded through casing upon completion to 20.3 m (Tip B) and 12.2 m (Tip A) and test hole grouted.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-08 and KCB laboratory testing for further information.

Nominal sonic core diameter 140 mm between 1.5 and 29.3 m.

cvane is torvane

Grey/brown, angular GRAVEL and COBBLES with some sand, a trace of silt and occasional boulders to 1.0 m diameter. (Rockfill)
Grey/brown, angular GRAVEL and COBBLES with some sand, a trace of silt and occasional boulders to 1.0 m diameter. (Rockfill)
Grey/brown, angular GRAVEL and COBBLES with some sand, a trace of silt and occasional boulders to 1.0 m diameter. (Rockfill)
Grey/brown, angular GRAVEL and COBBLES with some sand, a trace of silt and occasional boulders to 1.0 m diameter. (Rockfill)

- some clumps of stiff to very stiff, grey/brown SILT with some sand and a trace of gravel (Possible rockfill and till fill mixture) from 15.5 to 17.0 m

- possible boulder from 17.0 to 18.0 m

- some sand and a trace to some silt below 18.0 m
<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>PENETRATION (blows/300 mm)</th>
<th>WATER CONTENT (%)</th>
<th>WATER LEVEL</th>
<th>SAMPSELLS</th>
<th>UNDRAINED SHEAR STRENGTH (kPa)</th>
<th>GRAIN SIZE (%)</th>
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</table>

**SOIL DESCRIPTION**

- Fragment of non-woven geotextile at 20.1 m

- Very stiff, grey/brown, moist SILT with some sand to sandy, some sub-rounded gravel to 25 mm diameter and traces of roots and fine organics. (Possible weathered ablation/moraine till)

- Very stiff, grey/brown with speckled orange/red mottling, moist, clayey SILT to CLAY with a trace to some fine sand. (Possible weathered glaciolacustrine)
  - Stiff below 20.7 m
  - Firm with folded thin laminations interbedded with fine sand partings and several apparently discontinuous slickensided clay surfaces below 20.9 m

- Stiff, grey/brown, moist, sandy SILT with some sub-angular to rounded gravel to gravelly, trace to some clay, and traces of partially decomposed organics and cobbles to 100 mm diameter. (Possible ablation/moraine till)
  - Very stiff to hard with no organics below 21.3 m

- Stiff below 23.2 m

- Firm to stiff, grey, moist, thinly laminated CLAY interbedded with fine sand partings. (Glaciolacustrine)
  - Bedding undulating

- Soft (disturbed), grey-brown, moist SILT with some sand, clay and sub-rounded to rounded gravel to 75 mm diameter. (Possible ablation/moraine till)

- Stiff to very stiff, grey, moist, sandy SILT with some gravel. (Possible ablation/moraine till)
Drill loss inferred from 25.9 to 28.0 m (See SH14-08A)

LOWER TILLS (Lower Basal Till)

Refusal of RSCPT14-08 at approx. 28.9 m

Nominal sonic core diameter 100 mm below 29.3 m

Very dense, grey, moist SAND and SILT with some gravel to gravelly and trace of clay. (Basal till)

- cored a minimum 150 mm long green, meta-igneous cobble at 29.3 m

Stiff to very stiff, grey, moist, sandy SILT with some gravel. (Possible ablation/moraine till)

Dense (inferred), grey, moist SAND and SILT with some gravel to gravelly and trace of clay. (Possible ablation/moraine till)

- very soft (disturbed) zone at 25.9 m

(No recovery)
Very dense, grey, moist SAND and SILT with some gravel to gravelly and trace of clay. (Basal till)

Very dense (inferred), grey, moist SAND with some silt to silty and some sub-angular to rounded gravel to 50 mm diameter. (Basal till)

- a trace of gravel from 31.1 to 31.4 m

Hard, grey/brown, moist SILT with some sand and sub-rounded to rounded gravel to 75 mm diameter. (Basal till)

- 25 mm thick layer of wet, gravelly SAND at 32.6 m

- fine sandy SILT with a trace to some gravel below 33.4 m
  - two 5 mm thick layers of silty, fine SAND approximately 25 mm apart at 33.5 m

Dense (inferred), dark grey, moist to wet, silty, fine SAND with a trace of black organic staining and odour of decomposition. (Possible glaciofluvial)

- very stiff to hard, dark grey, moist, thinly laminated SILT interbedded with fine sand partings including a trace of black organics from 34.6 to 34.75 m

Bedding overall curvature concave downward.

With a closed fold - almost chevron - about 10 mm wide limb to limb near one edge of core with peak of fold pointing downhole.

(Top of Glaciofluvial)
**SOIL DESCRIPTION**

**TOP OF HOLE ELEV:** 947.6 m

**LOCATION:** See Fig. 209

**CLIENT:** Mount Polley Independent Expert Engineering Investigation and Review Panel

**PROJECT:** Mount Polley Tailings Dam Breach

**DATE:** October 6 and 7, 2014

**FILE NO.:** 15-3-280

**METHOD:** Sonic

**DRILLING CO.:** Mud Bay Drilling Ltd.

**INSPECTOR:** CHS

**LOCATION:** E 595167, N 5819889

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>PENETRATION (blows/300 mm)</th>
<th>WATER CONTENT (%)</th>
<th>WATER LEVEL</th>
<th>SAMPLES</th>
<th>UNDRAINED SHEAR STRENGTH (kPa)</th>
<th>GRAN SIZE (%)</th>
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</table>

**COMMENTS**

- **Dense (inferred), dark grey, moist to wet, fine SAND with a trace of black organic staining and odour of decomposition. (Possible glaciofluvial)**

- **Soft/loose (likely heavily drill disturbed), dark grey, moist to wet, fine SAND and SILT with some gravel to gravelly. (Till-like)**

- **Very dense (inferred), purplish brown with oxidation, dry to moist, gravelly silty SAND. (Basal till)**

- **Very stiff to hard, grey, moist, gravelly sandy SILT with a trace of clay. (Basal till)**

- **- two 25 mm thick layers of brown, wet, gravelly SAND and a trace to some silt at 37.5 and 37.6 m**

- **- cobble at least 125 mm diameter at 38.7 m**
**SOIL DESCRIPTION**

- **Top of WEAK BEDROCK**
- Hard, greenish dark grey, dry to moist, gravelly, sandy SILT. (Basal till)
- Hard SILT with traces of gravel, sand and clay below 41.7 m
- Hard, grey, dry to moist clayey SILT to CLAY. (Possible fine volcanic ash tuff bedrock)

**COMMENTS**

- Very dense (inferred), grey, dry to moist, gravelly silty SAND. (Basal till)
**SOIL DESCRIPTION**

- Hard (brittle), grey-green, dry to moist clayey SILT to CLAY.
  (Possible fine volcanic ash tuff bedrock)
  - gradually grades to light greyish green by 45.4 m

- Very stiff to hard, dark reddish brown, moist, clayey SILT with a trace to some sand and sub-rounded gravel from 46.9 to 47.1 m

- Light green, with occasional discontinuous irregular smooth to polished surfaces (possible slickensides) below 47.4 m

- Very stiff from 48.7 to 49.0 m
Sample fell out of core barrel during retrieval from 50.9 to 53.9 m. Recovered during next run with significant disturbance.

Hard (brittle), greyish light green, dry to moist, clayey Silt to Clay with occasional irregular smooth to polished surfaces.

(Possible fine volcanic ash tuff bedrock)

- 100 mm thick gravely zone, sub-angular to angular meta-volcanic particles (possibly chloritic basalt) at 51.2 m
- some fine sand to fine sandy and trace of clay below 51.3 m
- trace to some fine sand below 51.8 m
- 100 mm thick gravely zone, sub-angular to angular meta-volcanic particles at 52.1 m
- white vein or infilled crack like structures (possibly calcite)
- some fine sand to fine sandy from 53.5 to 53.9 m (increased brittleness)
- some clay to clayey and a trace fine sand below 53.9 m
- stiff to very stiff from 54.6 to 55.2 m
Hard (brittle), greyish light green, dry to moist, clayey Silt to Clay with occasional irregular smooth to polished surfaces. (Possible fine volcanic ash tuff bedrock)

- 100 mm thick layer of very dense, green, olive, purple, brown, dry to moist, silty, fine SAND at 55.2 m

- reddish brown streaks of weathering/staining from 55.5 to 56.4 m

- some sand to fine sandy and a trace of clay below 56.7 m

Hard (brittle), dark grey/black with greenish grey matrix and reddish brown streaks, dry to moist Silt with some sub-angular to angular gravel of meta-volcanic origin and a trace to some sand. (Possible brecciated volcanic bedrock)
End of hole at KCB instruction. Test hole sounded through casing upon completion to 60.0 m. Vibrating wire piezometers installed at 22.9 m (Tip C), 24.1 m (Tip B) and 34.7 m (Tip A) and test hole grouted.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-08 and KCB laboratory testing for further information.

Cvane is Torvane

KCB instructed driller to quickly drill to 24.7 m, discarding any heavily washed/disturbed recovery. Re-drill to sample interval 24.7 to 29.3 m which was not recovered at SH14-08.
<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>PENETRATION (blows/300 mm)</th>
<th>WATER CONTENT (%)</th>
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<td>20</td>
<td>Blows/300 mm</td>
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**COMMENTS**: (No recovery)

**SOIL DESCRIPTION**

**LOCATION**: See Fig. 209  
E 595170, N 5819887

**TOP OF HOLE ELEV**: 947.6 m

**METHOD**: Sonic

**DRILLING CO.**: Mud Bay Drilling Ltd.

**INSPECTOR**: CHS

**CLIENT**: Mount Polley Independent Expert Engineering Investigation and Review Panel

**PROJECT**: Mount Polley Tailings Dam Breach

**DATE**: October 8, 2014

**FILE NO.**: 15-3-280
LOCATION: See Fig. 209  
E 595170, N 5819887

TOP OF HOLE ELEV: 947.6 m

METHOD: Sonic

DRILLING CO.: Mud Bay Drilling Ltd.

INSPECTOR: CHS

CLIENT: Mount Polley Independent Expert Engineering Investigation and Review Panel

PROJECT: Mount Polley Tailings Dam Breach

DATE: October 8, 2014

FILE NO.: 15-3-280

LOG OF TEST HOLE - MT POLLEY 15-3-280 KCB.GPJ  THURBER BC.GDT 1/7/15- THURBER BC.GLB

COMMENTS

(No recovery)
### Log of Test Hole - Mt. Polley 15-3-280 KCB.GPJ  THURBER BC.GDT  1/7/15- THURBER BC.GLB

#### Table of Soil Properties

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Penetration (blows/300 mm)</th>
<th>Water Content (%)</th>
<th>Water Level</th>
<th>Undrained Shear Strength (kPa)</th>
<th>Grain Size (%)</th>
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#### Comments

(No recovery)

#### Soil Description

See Fig. 209

- **Location:** E 595170, N 5819887
- **Client:** Mount Polley Independent Expert Engineering Investigation and Review Panel
- **Project:** Mount Polley Tailings Dam Breach
- **Date:** October 8, 2014
- **File No.:** 15-3-280
- **Drilling Co.:** Mud Bay Drilling Ltd.
- **Inspector:** CHS

#### Additional Information

- **Penetration (blows/300 mm):**
- **Water Content (%):**
- **Water Level:** Plastic, Liquid
- **Undrained Shear Strength:** Peaking, Remolding
- **Grain Size (%):** Passing #4 sieve, Passing #20 sieve

#### Diagram

The diagram shows the elevation and depth for various sections of the hole, indicating the penetration and water content at different depths. The comments section notes that there was no recovery at certain depths.
Start of RSCPT14-07 at approx. 21.2 m

Firm (likely drill disturbed), grey, moist, sandy, gravelly SILT with a trace to some clay. (Possible ablation/moraine till)
Top of UPPER GLU
Cvane at 26.5 m is 70 kPa across bedding and 50 kPa parallel to bedding.

Top of LOWER TILLS (Lower Basal Till)

Refusal of RSCPT14-08 at approx. 28.9 m

Top of UPPER GLU Cvane at 26.5 m is 70 kPa across bedding and 50 kPa parallel to bedding.

Stiff, grey-brown, moist, thinly laminated CLAY interbedded with fine sandy partings with several apparently discontinuous slickenside surfaces parallel and perpendicular to bedding. (Glaciolacustrine)

Soft to firm (likely drill disturbed), grey-brown, moist, gravelly, sandy SILT with some clay and trace cobbles up to 100 mm diameter. (Till-like)

- stiff to very stiff/dense, SAND and SILT with a trace to some clay below 27.3 m (Basal till)

- hard/very dense below 27.9 m

End of hole at KCB instruction. Test hole backfilled with bentonite chips up to 18.3 m with cuttings and slough above.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to KCB laboratory testing for further information.

Nominal sonic core diameter 140 mm to 20.1 m

Cvane is Torvane

- pockets of stiff, sandy SILT with some sub-rounded gravel (Till like fill) from 3.3 to 7.9 m

- wet below 4.9 m
Grey/brown, angular GRAVEL and COBBLES with some sand and silt and occasional boulders to 1.0 m in diameter including pockets of stiff, sandy silt. (Rockfill)

- fragment of non-woven geotextile at 9.8 m
Stiff to very stiff, grey/brown with orange/red mottling and black streaks, moist, laminated SILT with some fine sand and a trace of organics. (Possible weathered glaciolacustrine)

- 75 mm thick layer of soft, wet SILT and fine SAND at 10.3 m
- stiff below 10.4 m

Firm to very stiff (variable), grey-brown, moist, sandy SILT to SAND and SILT with some sub-rounded gravel to 50 mm in diameter and a trace to some clay. (Possible weathered ablation/moraine till)

- gradual transition to grey at 13.7 m (not weathered)

- firm to stiff, gravelly SAND and SILT below 14.0 m
Top of UPPER GLU: Cvane at 18.0 m is 40 to 50 kPa both parallel and across bedding.

Top of LOWER TILLS (Lower Basal Till):
- 50 to 75 mm thick layer (disturbed) of silty SAND and CLAY at 18.3 m
- Very stiff to hard, grey, moist, sandy SILT with some clay and sub-angular to rounded gravel to gravelly. (Basal till)

Firm to stiff, grey, moist, gravelly SAND and SILT with trace to some clay. (Possible ablation/moraine till)

- from 16.6 to 17.1 m moist, with trace to some gravel and 3 fractures on smooth fine sandy surfaces with thin clayey silt lamination below the sandy surface. Fractures shaped as paraboloids, concave upward with peak near parallel with core axis (possibly drill induced)
- firm below 17.1 m

Firm to stiff, grey, moist, thinly laminated silty CLAY interbedded with fine to medium sand laminations and partings. (Glaciolacustrine)
- bedding curved or folded in varying degrees from 30 to 60° from horizontal, concave upward.

Very stiff to hard, grey, moist, sandy SILT with some clay and sub-angular to rounded gravel to gravelly. (Basal till)
- hard below 19.7 m
Nominal sonic core diameter 100 mm from 20.1 to 61.6 m

Very stiff to hard, grey, moist, sandy SILT with some clay and sub-angular to rounded gravel to gravelly. (Basal till)

- fine sandy SILT to fine SAND and SILT with some gravel and a trace to some medium to coarse sand from 20.9 to 21.5 m

- trace to some gravel below 21.5 m

Hard, grey, dry to moist, thinly laminated CLAY with occasional fine sand laminations and partings. (Glaciolacustrine)
- laminations are undulating, sub-horizontal
- occasional discontinuous slickensided surfaces

- very stiff to hard, clayey silt to clay with more regular interbedding with fine sand partings below 23.5 m
- 50 mm thick layer of dense (inferred), wet, fine sand and silt at 23.7 m

- occasional black laminations containing partially decomposed fine organics below 24.0 m

Dense (inferred), dark grey, wet, fine to coarse SAND with a trace to some silt. (Possible glacioluvial)

Compact to dense (inferred), dark grey, wet, silty, fine SAND with a trace of fine organics, organic decomposition odour. (Possible glacioluvial)
Compact to dense (inferred), dark grey, wet, silty, fine SAND with a trace of fine organics, organic decomposition odour. (Possible glaciofluvial)

- soft, black, thin laminations of fine sandy SILT with traces of organics and clay interbedded with fine sand laminations, between 25 and 25.6 m depth. Bedding folded concave upward reversing to concave downward with axis near core perimeter, with sand layer between reversal of apparent folding.

Dark grey, wet, sub-rounded to rounded gravelly to 25 mm in diameter SAND with a trace to some silt. (Possible glaciofluvial)

Dense (inferred), dark grey, wet, fine SAND with some silt to silty and a trace of black fine organic streaks, organic decomposition odour. (Possible glaciofluvial)

Stiff to very stiff, yellowish brown with black and pink/purple streaks, moist, sandy SILT with a trace to some sub-rounded to rounded fine gravel and a trace of clay. (Till)

Very stiff to hard, purplish grey, dry to moist SILT with a trace to some clay. (Possible fine volcanic ash tuff bedrock)

- sporadic faint undulating sub-horizontal planar features (possible bedding or laminations or a function of core breaking)

- greenish grey below 29.1 m
Very stiff to hard, greenish grey, dry to moist SILT with a trace to some clay. (Possible fine volcanic ash tuff bedrock)

- white, irregular vein-like structures, possible calcite infilled at 30.5 m
- 2 mm thick layer of glossy black coal like seam at 30.8 m
- 150 mm thick layer of black, angular gravel to 40 mm in diameter of basalt like origin (possible drill crushed cobble) at 31.1 m
- 100 mm thick zone of white, irregular vein-like structures, possible calcite infilled at 31.2 m
Very stiff to hard, greenish grey, dry to moist SILT with a trace to some clay. (Possible fine volcanic ash tuff bedrock)

- firm, moist with some clay to clayey from 37.2 to 37.5 m (possibly drill disturbed)

- 175 mm of angular basalt fragments up to 60 mm in diameter (possible drill broken weathered cobble) at 37.5 m

- light grey with black sub-horizontal streaks (possible bedding marker or weathering), dry to moist, with a trace of clay below 37.6 m

- greenish grey, with a trace to some clay below 38.7 m

- approximately 300 mm of sub-angular to angular GRAVEL friable to 40 mm maximum diameter, basalt-like origin at 39.3 m (possible drill broken weathered boulder)
**SOIL DESCRIPTION**

- Very stiff to hard, greenish grey, dry to moist Silt with a trace to some clay. (Possible fine volcanic ash tuff bedrock)
- 150 mm thick zone with diffuse white powdery speckling and some coarse crystals (possible calcite) at 41.0 m
- hard, fractures along horizontal curvilinear planes
- blocky, a trace of clay from 41.1 to 41.5 m
Very stiff to hard, greenish grey, dry to moist SILT with a trace to some clay. (Possible fine volcanic ash tuff bedrock)

- approximately 200 mm of angular gravel sized basalt fragments at 46.9 m (possible drill broken weathered boulder)

- frequent discontinuous slicksided surfaces in opposing planes, ranging from 40 to 60° from horizontal, noted from 48.2 to 49.7 m

- slickenside undulating at about 60° to horizontal at 49.7 m
Very stiff to hard, greenish grey, dry to moist SILT with a trace to some clay. (Possible fine volcanic ash tuff bedrock)
Very stiff to hard, greenish grey, dry to moist SILT with a trace to some clay. (Possible fine volcanic ash tuff bedrock)

- 450 mm thick zone with diffuse white powdery speckling (possible calcite) at 55.5 to 56.0 m

- dark grey below 56.0 m

- dark grey, angular SAND and GRAVEL of basalt-like origin from 57.8 to 58.2 m (possible drill broken boulder)

- greenish dark grey, with some sub-rounded to angular gravel to 25 mm diameter of basalt-like origin below 58.2 m
Hard (brittle-blocky), greenish dark grey, dry to moist, SILT with some clay and sub-rounded to rounded basalt gravel up to 25 mm diameter.
(Possible Fine Ash Tuff - Very Weak Bedrock)
- occasional discontinuous slickensided surfaces in opposing planes ranging 40 to 60° from horizontal from 59.9 to 60.5 m

Hard, greenish dark grey, dry to damp (drill disturbed), sub-rounded to sub-angular GRAVEL friable to 25 mm maximum diameter and SILT with some sand.
(Possible brecciated volcanic bedrock)
- gravel particles of basalt-like and coarse sandstone origin.

End of hole at KCB instruction. Test hole sounded through casing upon completion to 61.7 m.
Slope inclinometer installed to bottom of hole and test hole grouted.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-10 and KCB laboratory testing for further information.

Nominal sonic core diameter 140 mm between 0 and 17.1 m

Cvane is Torvane

Grey/brown, angular GRAVEL and COBBLES with some sand, a trace of silt and occasional boulders to 0.5 m in diameter. (Rockfill debris)

Grey, angular GRAVEL and red/brown, fine SAND and SILT. (Mixture of rockfill and tailings debris)

Poor recovery in tailings debris.

Top of UPPER TILL
**Soil Description**

Very stiff, grey-brown speckled with orange/red (oxidation), moist SILT with some sand to sandy, a trace to some sub-rounded to rounded gravel to 25 mm in diameter and a trace of clay. (Possible weathered ablation/moraine till)

- firm to stiff without oxidation below 6.7 m
Top of UPPER GLU

Cvane is 45 to 60 kPa, parallel and perpendicular to bedding respectively.

Initial refusal of RSCPT14-10 at 12.5 m

Top of LOWER TILLS (Lower Basal Till)

Firm to stiff, grey-brown, moist SILT with some sand to sandy, a trace to some sub-rounded to rounded gravel to 25 mm in diameter and a trace of clay. (Possible ablation/moraine till)

- 20 mm thick bed of silty clay with some fine sand at 12.2 m

Dense (inferred), grey, moist, silty SAND and GRAVEL with a trace of cobbles to 125 mm in diameter. (Basal till)

- very stiff SILT with some sand and gravel and a trace of clay from 13.4 to 13.7 m
- silty SAND with some gravel to gravelly from 13.7 to 14.0 m
- dense (inferred), purplish/orange brown, moist SAND and SILT with some sub-angular to rounded gravel to gravelly (weathered/oxidized) from 14.0 to 14.6 m
- very stiff, reddish brown SILT with some sand and gravel and a trace to some clay 14.6 to 15.4 m
RSCPT14-10 restarted at approx. 15.2 m (Top of Lower Glu)

Cvane is 125 to 150 kPa, parallel and perpendicular to bedding respectively.

(Top of Glaciofluvial)
Refusal of RSCPT14-10 at approx. 16.3 m

Nominal sonic core diameter 100 mm from 17.1 to 26.5 m

Driller notes relatively hard drilling below 18.6 m

Very stiff, reddish brown, moist Silt with some sand and gravel, trace to some clay and a trace of cobbles to 125 mm in diameter. (Basal till)

Very stiff, grey, moist, thinly laminated clayey silt to CLAY interbedded with fine sand partings with a trace of fine organics with decomposed organic odour. (Glaciolacustrine)
- bedding appears sinusoidally folded, overall sub-horizontal with two upward peaks and one downward peak within 140 mm sonic core
- about 20% of laminations are black with fine organics

Dense (interred), grey, moist to wet, silty, fine SAND (Possible glaciofluvial).

Very stiff, orange-brown, moist Silt with some sand and a trace of sub-rounded gravel. (Basal till)
- zone of silty, fine sand from 16.5 to 16.6 m

- variable mixtures of fine sandy Silt to silty fine SAND with seams of stiff, orange-brown, clayey silt to clay 2 to 5mm thick below 17.0 m

- very stiff to hard below 17.7 m

Hard, light grey with dark grey streaks and white calcite like alteration, dry to moist, fine sandy Silt to fine SAND and Silt with a trace of sub-angular gravel. (Basal till)
Top of WEAK BEDROCK

Hard, light grey with dark grey streaks and white calcite like alteration, dry to moist, fine sandy SILT to fine SAND and SILT with a trace of sub-angular gravel. (Basal till)

Hard, dark grey, dry to moist, fine sandy SILT with some sub-rounded to rounded basalt-like gravel and a trace of clay and possible calcite alteration. (Basal till)

Very dense (inferred), dark greenish grey, dry to moist, sub-angular to angular SAND and fine GRAVEL with frequent bands/layers 1 to 4 mm thick of very stiff, dark red-brown silt with a trace of clay. (Possible brecciated volcanic bedrock)

Hard, dark grey, dry to moist with black and green highlights SILT with some sub-angular to angular basalt-like gravel. (Possible brecciated volcanic bedrock)

- 150 mm thick layer of very dense (inferred), silty, fine SAND at 24.1 m

Hard, dark red/purple/brown, dry to moist SILT with some angular gravel (basalt and altered/metamorphic) and a trace to some clay. (Possible brecciated volcanic bedrock)
Hard, dark red/purple/brown, dry to moist SILT with some angular gravel (basalt and altered/metamorphic) and a trace to some clay. (Possible brecciated volcanic bedrock)

Very dense (inferred), dark grey with purplish weathering, interlocking angular GRAVEL (moderately strong meta-basalt like) to 50 mm diameter with traces of silt and clay between stones. (Possible brecciated volcanic bedrock) - heavily disturbed by drill action

End of hole at KCB instruction. Test hole sounded through casing upon completion to 26.5 m. Test hole grouted to base of fill with bentonite chips and cuttings above.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-11 and KCB laboratory testing for further information.

Cvane is Torvane
See also SH14-11B for 0 to 14 m.

Top of UPPER TILL

Grey/brown, angular GRAVEL and COBBLES with some sand and boulders to 0.5 m in diameter and a trace of silt. (Rockfill debris)

Loose red/brown angular, gravelly, fine SAND and SILT. (Mixture of rockfill and tailings debris)

Loose to compact, grey, angular GRAVEL and COBBLES with some sand, silt, and boulders to 0.5 m in diameter. (Rockfill)

Stiff to very stiff, brown mottled grey SILT with some sand, gravel and clay. (Possible weathered ablation/moraine till)
- some gravel fragments friable and weathered
- 100 mm thick layer of brown, moist organic SILT with some fibrous organics at 2.1 m
- sandy below 2.6 m

Very stiff, grey mottled brown, moist, sandy, rounded gravelly to 60 mm in diameter SILT with a trace of clay. (Possible ablation/moraine till)
Start of RSCPT14-11 at approx. 5.6 m

No recovery. Drill action suggests relatively soft conditions. Following completion moved and attempted to redrill interval (SH14-11A) - also with no recovery due to cobble blocking bit.

Refer to SH14-11B for 0 to 14 m.

Cvane at 8.8 m is 52 kPa

Top of LOWER TILLS

Very dense/hard, grey, moist to wet, fine SAND and SILT with some gravel to gravelly and traces of clay and tan to red particles 3 to 4 mm diameter. (Possible glaciofluvial or till)

Firm to stiff, grey, moist to wet, sandy, rounded gravelly to 60 mm in diameter SILT with a trace of clay. (Possible ablation/moraine till)

Very stiff, grey mottled brown, moist, sandy, rounded gravelly to 60 mm in diameter SILT with a trace of clay. (Possible ablation/moraine till)

(No recovery)
Refusal of RSCPT14-11 at approx. 10.6 m

Top of WEAK BEDROCK

Very dense/hard, grey, moist to wet, fine SAND and SILT with some gravel to gravelly and traces of clay and tan to red particles 3 to 4 mm diameter. (Possible glaciofluvial or till)
- 140 mm diameter cobble at 10.4 m

- dark grey to grey below 14.3 m
- some clay from 14.9 to 15.5 m
Very dense, dark grey to grey, silty, angular gravelly to 20 mm in diameter SAND with some 1 to 2 mm thick banding/bedding and a trace of mica (biotite and muscovite). (Possible brecciated volcanic bedrock)

Very dense, dark grey to black, folded band comprised of silt and clay 5 to 7 mm thick at 16.1 m

Very dense, dark grey to black, angular gravelly SAND with some silt to silty and some clay. (Possible brecciated volcanic bedrock) - rock fragments generally appear to be meta-sedimentary or basalt

Light grey, moist, angular granitic SAND and GRAVEL. (Possible weathered igneous bedrock intrusion)

Very dense, dark grey to black, angular gravelly SAND with some silt to silty and some clay. (Possible brecciated volcanic bedrock) - sand and gravel consist of meta-sedimentary or basalt origin
Very dense, dark grey to black, angular gravelly SAND with some silt to silty and some clay.
(Possible brecciated volcanic bedrock)
- sand and gravel consist of meta-sedimentary or basalt origin

End of hole at KCB instruction. Test hole grouted upon completion to 2.1 m depth with cuttings backfill from 0 to 2.1 m.

Following completion, SH14-11A drilled about 2 m away in attempt to recover lost interval at 7 m. Core barrel bit blocked with cobble, no recovery. Refer to SH14-11B.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-11 and KCB laboratory testing for further information.

See also SH14-11B for 0 to 14 m.

Nominal sonic core diameter 140 mm between 0 and 14.0 m

Cvane is Torvane

Top of UPPER TILL

SOIL DESCRIPTION

- Grey-brown, moist, angular GRAVEL with some sand to sandy and trace to some silt and trace cobbles up to 100 mm in diameter. (Rockfill debris)
- Very stiff, grey, moist, gravelly SILT with some sand and trace of clay. (Till-like debris)
- Grey, wet, silty angular GRAVEL with some sand and lumps of stiff silt. (Rockfill/till mixture - possible debris)
- Soft, dark brown, moist to wet, fibrous PEAT and WOOD. Wood fragments up to 25 mm diameter and 150 mm long. (Possible debris)
- Soft to firm, grey-brown - mottled orange (oxidized), moist SILT with trace to some clay and traces of sand, gravel, and organics. (Weathered till-like - possible debris)
- Soft, reddish brown with grey, moist to wet, fine sandy SILT with some sub-angular gravel to gravelly. (Possible tailings and rockfill mixture - debris)
- Soft, grey-brown, moist to wet, SILT with some sand and gravel to gravelly (sub-rounded) and trace of clay. (Disturbed till)
- Very stiff to hard, grey-brown, moist, sandy SILT with some gravel to gravelly and trace of clay. (Possible ablation/moraine till)
Top of LOWER TILLS (Glaciofluvial)

Start of RSCPT14-11 at approx. 5.6 m

Cvane decreases gradually from 150 kPa to 70 kPa from 5.6 to 7 m

- stiff below 5.6 m with gradual softening downwards to stiff to firm by 7 m
- gradual transition to grey downwards

- bluish-grey-brown and trace to some clay below 9.6 m

Very stiff to hard, grey-brown, moist, sandy SILT with some gravel to gravelly and trace of clay. (Possible ablation/moraine till)
Top of Lower Basal Till

Refusal of RSCPT14-11 at approx. 10.6 m

Top of WEAK BEDROCK

End of hole at KCB instruction. Test hole grouted upon completion to base of fill with cuttings backfill above.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to KCB laboratory testing for further information.

Top of UPPER TILL at 0.8 m
Cvane at 1.7 m is 77 kPa
Cvane is Torvane

Grey/brown SAND and GRAVEL with some silt and clay and a trace of cobbles. (Fill)

Stiff, brown, moist, sandy, rounded gravelly SILT with some clay and cobbles. (Possible ablation/moraine till)

- cobble at least 150 mm diameter at 2.0 m
- a trace of partially decomposed oxidized rock fragments at 3.7 m
- very stiff to hard below 4.1 m
- a trace of partially decomposed oxidized rock fragments at 4.6 m
**LOG OF TEST HOLE - MT POLLEY 15-3-280**

**HOLE NO.** SH14-12

**LOCATION:** See Fig. 209  
E 595297, N 5819842

**TOP OF HOLE ELEV.:** 930.8 m

**METHOD:** Sonic

**DRILLING CO.:** Mud Bay Drilling Ltd.

**INSPECTOR:** BSP

**CLIENT:** Mount Polley Independent Expert Engineering Investigation and Review Panel

**PROJECT:** Mount Polley Tailings Dam Breach

**DATE:** October 15, 2014

**FILE NO.:** 15-3-280

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**SOIL DESCRIPTION**

VW piezometer  
Tip B at 7.6 m.

- Very stiff to hard, brown, moist, sandy, rounded gravelly Silt with some clay and cobbles.  
(Possible ablation/moraine till)
- Partially decomposed, weathered schist cobble at 5.2 m
- Gradual transition to grey at 8 m
- 50 to 100 mm thick layer of medium to coarse sand at 9.3 m
- 130 mm diameter rounded cobble at 9.4 m
Top of LOWER TILLS (Lower Basal Till)

- Very stiff to hard, grey, moist, sandy, rounded gravelly SILT with some clay and cobbles. (Possible ablation/moraine till)

- Hard/very dense, grey, moist, rounded gravelly SILT and SAND with a trace to some clay and a trace of cobbles. (Basal till)

- sandy below 13.7 m

- 200 mm thick layer of silty, sandy GRAVEL at 14.8 m
VW piezometer
Tip A at 15.2 m.
(Top of Lower Basal Till)

Firm/compact (likely disturbed), grey, moist, friable, fine SAND and SILT with a trace to some fine rounded gravel to 40 mm in diameter. (Possible glaciofluvial)

Hard, grey, moist, sandy, rounded gravelly SILT with a trace to some clay and a trace of oxidized gravel and partially decomposed gravel to 10 mm diameter. (Basal till)

- brown between 19.0 and 19.7 m
- cored minimum 300 mm diameter boulder
Very dense, dark grey, moist, silty, angular gravelly SAND with some clay. (Possible brecciated volcanic bedrock)
- sand and gravel likely of meta-sedimentary or basalt origin

End of hole at KCB instruction. Vibrating wire piezometers installed at 7.6 m (Tip B) and 15.2 m (Tip A) and test hole grouted.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-13 and KCB laboratory testing for further information.

Cvane is Torvane

Grey/brown SAND and GRAVEL with some silt and clay and a trace of cobbles. (Fill)

Boulder, at least 300 mm diameter.

Hard, brown, moist, rounded to sub-angular gravelly fine SAND and SILT with a trace to some clay and a trace of oxidation staining. (Possible ablation/moraine till)

- a trace of partially decomposed schist gravel to 50 mm diameter at 2.9 m

- brown grading to grey between 4.9 and 6.7 m
Hard, brown, moist, rounded to sub-angular gravelly fine SAND and SILT with a trace to some clay and a trace of oxidation staining.
(Possible ablation/moraine till)

- grey below 6.7 m
- a trace of partially decomposed rock fragments at 7.2 m
- 100 mm diameter rounded cobble at 7.3 m

Hard, brown, moist, silty, fine to medium SAND with some coarse sand and rounded to sub-rounded gravel to gravelly, and a trace of clay and cobbles.
(Possible ablation/moraine till)
Possible top of LOWER TILLS (Lower Basal Till)

Initial refusal of RSCPT14-13 at approx. 10.9 m

RSCPT14-13 restarted at approx. 13.9 m

Very stiff, grey, moist, rounded to sub-angular gravelly SILT and fine SAND with some clay and traces of friable partially decomposed rock fragments and cobbles. (Basal till)

- fine sandy SILT to SAND and SILT below 12.2 m

- 70 mm thick layer of silty SAND and GRAVEL at 14.2 m
Cvane at 17.8 m is 130 kPa
Cvane at 18.9 m is 42 kPa

Hard, grey, moist, sandy SILT with some clay and sub-rounded gravel to 70 mm in diameter. (Basal till)
- friable layering between 15.2 and 15.5 m

Stiff, grey, moist, clayey SILT to CLAY with a trace of fine sand. (Glaciolacustrine)
- bedding is undulating with some polished surfaces

Dense (inferred), dark grey to black, moist, fine SAND and SILT with slight organic odour. (Possible glaciofluvial)
Cvane at 20.1 m is 42 kPa

Cvane at 21.6 m is 40 kPa

Cvane at 22.3 m is 42 kPa

RSCPT14-13 refusal at approx. 23.0 m

Firm, grey, moist to wet, fine sandy SILT. (Possible glaciofluvial)

Dense (inferred), grey, moist, rounded, gravelly, silty SAND with some clay and a trace of cobbles. (Basal till - possible eroded fragment)

- rounded cobble to 130 mm in diameter at 22.9 m

Dense (inferred), grey, moist to wet, silty SAND and rounded GRAVEL with a trace to some clay. (Possible glaciofluvial)

Dense (inferred), brown, moist to wet, fine to medium SAND with some silt and a trace of mica. (Possible glaciofluvial)
**SOIL DESCRIPTION**

- **Dense (inferred)**, brown, moist to wet, fine to medium SAND with some silt and a trace of mica. (Possible glaciofluvial)

- **Hard, grey, moist, sandy, rounded gravelly SILT with some clay and a trace of cobbles to 100 mm diameter. (Basal till)**

- reddish brown below 29.0 m
Top of bedrock not encountered within depth of investigation. Refer to VW11-10 for possible bedrock elevation.

End of hole at KCB instruction. Test hole grouted upon completion to base of fill with cuttings backfill above.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-14 and KCB laboratory testing for further information.

**SOIL DESCRIPTION**

- Top of UPPER TILL
- Grey/brown, sandy, cobbly GRAVEL and red/brown, silty fine to medium SAND. (Mixture of rockfill and tailings - drill access road)
- Reddish brown, silty, fine to medium SAND. (Tailings debris)
- Very stiff to hard, brown/tan, sandy, rounded gravelly SILT with a trace to some clay and traces of oxidized and partially decomposed gravel. (Possible weathered ablation/moraine till)
- Very stiff below 3.6 m
Very stiff, brown/tan, sandy, rounded gravelly SILT with a trace to some clay and traces of oxidized and partially decomposed gravel. (Possible weathered ablation/moraine till)
- trace of organic rootlets at 5.3 m
- 70 mm thick layer of SAND and GRAVEL with some silt and a trace of clay at 5.5 m
- grey below 6.1 m
- softens downward from very stiff to firm
- rounded cobble to 140 mm in diameter at 9.3 m
- firm at 9.4 m
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<tr>
<th>DEPTH (m)</th>
<th>PENETRATION (blows/300 mm)</th>
<th>WATER CONTENT (%)</th>
<th>WATER LEVEL</th>
<th>USCS SAMPLES</th>
<th>USCS SAMPLES</th>
<th>UNDRAINED SHEAR STRENGTH (kPa)</th>
<th>GRAIN SIZE (%)</th>
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**LOG OF TEST HOLE - MT POLLEY 15-3-280**

**LOCATION:** See Fig. 209  
E 595096, N 5819936

**TOP OF HOLE ELEV:** 930.1 m

**CLIENT:** Mount Polley Independent Expert Engineering Investigation and Review Panel

**PROJECT:** Mount Polley Tailings Dam Breach

**DATE:** October 16, 2014

**FILE NO.:** 15-3-280

**METHODOLOGY:** Sonic

**INSPECTOR:** Mud Bay Drilling Ltd.

**DRILLING CO.:** Mud Bay Drilling Ltd.

**INSPECTOR:** Mud Bay Drilling Ltd.

**ELEVATION (m):**

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<th>ELEVATION (m)</th>
<th>PENETRATION (blows/300 mm)</th>
<th>WATER CONTENT (%)</th>
<th>WATER LEVEL</th>
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**SOIL DESCRIPTION:**

- **Top of UPPER GLU**
  - Firm to stilly, greenish grey, moist, laminated CLAY with some laminations of fine sand and a trace of fibrous organics. (Glaciolacustrine)
  - bedding is deformed

- **Top of LOWER TILLS (Lower Basal Till)**
  - Hard, grey, moist, sandy SILT with some clay and sub-rounded gravel. (Basal till)

- **Top of Lower GLU**
  - Very stiff, grey, moist, laminated CLAY with some 1 to 4 mm thick laminations of fine sand. (Glaciolacustrine)
  - bedding is wavy/undulating

- **Top of Glaciofluvial**
  - Dense (inferred), grey, wet, silty, clayey SAND and GRAVEL. (Possible glaciofluvial)

- **Refusal of RSCPT14-14 at approx. 14.0 m**
  - Dense (inferred), grey, wet SAND and sub-angular to rounded GRAVEL with some silt. (Possible glaciofluvial)
Dense (inferred), grey, wet SAND and sub-angular to rounded GRAVEL with some silt. (Possible glaciofluvial)

Hard, reddish brown, moist, subrounded gravelly SAND and SILT with some clay and a trace of cobbles. (Basal till)

Hard (friable), grey, moist, sandy SILT with some gravel. (Basal till)
- undulating brown layer 5 mm thick at 17.2 m

Hard, grey, moist, fine sandy CLAY with white vein-like structures. (Possible fine volcanic ash tuff bedrock)
- blocky, friable with no apparent bedding
**SOIL DESCRIPTION**

- **20.0 m**
  - Hard, grey, moist, fine sandy CLAY with white vein-like structures. (Possible fine volcanic ash tuff bedrock)
  - blocky, friable with no apparent bedding

- **21.0 m**
  - brown to grey mottled with some gravel between 21.3 and 21.6 m

- **22.0 m**
  - fractured rock/possible boulder between 22.3 and 22.6 m
  - grey-brown below 22.9 m
  - grey below 23.3 m

- **23.0 m**

- **24.0 m**

- **25.0 m**

End of hole at KCB instruction. Test hole sounded through casing upon completion to 23.6 m. Test hole grouted to surface.
**LOCATION:** See Fig. 209
E 595104, N 5819959

**TOP OF HOLE ELEV:** 930.2 m

**METHOD:** Sonic

**DRILLING CO.:** Mud Bay Drilling Ltd.

**INSPECTOR:** BSP

**CLIENT:** Mount Polley Independent Expert Engineering Investigation and Review Panel

**PROJECT:** Mount Polley Tailings Dam Breach

**DATE:** October 17, 2014

**FILE NO.:** 15-3-280

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### SOIL DESCRIPTION

**Top of UPPER TILL**
- Very stiff to hard, brown to mottled grey, sandy, rounded gravelly SILT with some clay and oxidation.
- (Possible weathered ablation/moraine till)
- 120 mm diameter rounded cobble at 3.0 m

**Grey, wet SAND and GRAVEL with some silt and a trace of clay, and some red/brown, silty SAND.**
- (Mixture of rockfill and tailings).

**Reddish brown-grey, silty fine to medium SAND.**
- (Tailings debris)

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**Note:** Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-15 and KCB laboratory testing for further information.

Cvane is Torvane

---

**Note:** Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-15 and KCB laboratory testing for further information.

Cvane is Torvane
Cvane at 7.9 m is 50 kPa
Top of UPPER GLU
Cvane at 8.4 m is 30 kPa
Cvane at 9.4 m is 35 kPa

Very stiff to hard, grey, sandy, rounded gravelly SILT with some clay and oxidation. (Possible ablation/moraine till)
- firm to stiff below 5.8 m
- 1 mm thick sand parting at 8.0 m

Firm, brown to grey, moist to wet, laminated CLAY with some thin laminations of fine sand and a trace of rounded gravel to 20 mm diameter. (Glaciolacustrine)
- laminations are 1 to 3 mm thick between 8.1 and 8.4 m
- sandy at 8.4 m
- 10 to 15 mm thick layers of SAND and GRAVEL at 8.5 and 8.6 m

- laminations are 1 to 3 mm thick with partings of fine sand between 9.8 and 10.1 m
Top of LOWER TILLS (Lower GLU)

Cvane at 10.9 m is 85 kPa

- stiff to very stiff below 10.9 m

Cvane at 14.0 m is 105 kPa

- sub vertical (approximately 70 degrees below horizontal) parting with some sand at 12.5 m

Cvane at 14.6 m is 90 kPa

- 150 mm diameter cobble partially cored at 14.0 m
- greenish grey with some indistinct vertical to subvertical structure at 14.0 m
- sub vertical, distorted layers of fine to medium sand at 14.3 m
- bedding becomes sub-horizontal with grey, fine sand partings 3 to 5 mm thick between 14.3 and 15.5 m

Firm, grey, moist, laminated CLAY with some thin laminations of fine sand and a trace of rounded gravel to 20 mm diameter. (Glaciolacustrine)
- bedding is faint, distorted and generally not horizontal
- sub vertical (approximately 70 degrees below horizontal) parting with some sand at 12.5 m
- 150 mm diameter cobble partially cored at 14.0 m
- greenish grey with some indistinct vertical to subvertical structure at 14.0 m
- sub vertical, distorted layers of fine to medium sand at 14.3 m
- bedding becomes sub-horizontal with grey, fine sand partings 3 to 5 mm thick between 14.3 and 15.5 m
Cvane at 17.1 m is 65 kPa

Refusal of RSCPT14-15 at approx. 18.8 m

Stiff, grey, moist, fine sandy SILT with a trace to some clay, a trace of subangular gravel to 20 mm diameter, and a slight organic odour. (Possible glaciofluvial)

Dense (inferred), grey, wet, silty, fine to medium SAND with a slight organic odour. (Possible glaciofluvial)

Very dense/very stiff to hard, reddish brown to tan mottled grey and green, angular to subangular gravelly, SILT and SAND with some clay. (Basal till)
Top of WEAK BEDROCK

Very dense/very stiff to hard, reddish brown to tan mottled grey and green, angular to subangular gravelly, SILT and SAND with some clay. (Basal till)

Hard, green mottled brown, moist, sandy, angular to subrounded gravelly SILT with some clay. (Possible brecciated volcanic bedrock) - with reddish brown sub-horizontal banding

End of hole at KCB instruction. Test hole grouted to surface upon completion.
Note: This log is based on visual observations during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-16 and KCB laboratory testing for further information.

Top of UPPER TILL

Start of RSCPT14-16 at approx. 2.3 m

Grey, grading to red where washed, SAND and angular GRAVEL with some cobbles and boulders. (Rockfill - Drill access road)

Reddish brown, silty, fine to medium SAND. (Tailings debris)

Very stiff, brown mottled grey, moist, sandy, rounded gravelly SILT with some clay. (Possible weathered ablation/moraine till)

- 100 mm diameter rounded cobble at 2.7 m

- grey (unweathered) below 3.3 m

Firm, brown mottled grey, moist, sandy, rounded gravelly SILT with some clay. (Possible ablation/moraine till)
Top of LOWER TILLS (Lower Basal Till)

- 5 mm thick undulating layer of light grey, fine sandy silt with some clay at 6.4 m
  - becoming stiff below 7.0 m
  - 5 mm thick undulating layer of light grey, fine sandy silt at 7.0 m
  - grades to silt and fine sand with some rounded gravel and clay below 7.3 m

Very stiff to hard, grey, moist, fine sandy SILT with some rounded gravel. (Basal till)

- grading finer downward with gradual transition to glaciolacustrine

- trace oxidization on gravel fragments at 9.8 m
### Soil Description

**Top of Lower GLU (12.5 m):**
- Very stiff to hard, grey, moist, clayey SILT to CLAY with some fine sand, a trace of rounded gravel to 20 mm diameter. (Glaciolacustrine)
- Occasional polished surfaces (slickensides) and faint horizontal to subvertical bedding below 10.7 m
- Traces of rounded gravel and organics (charcoal) below 11.6 m

**Probable top of Lower Basal Till (13.2 m):**
- Very stiff to hard, brown mottled grey, moist SILT with some clay and sand. (Glaciolacustrine)

**Refusal of RSCP414-16 at approx. 12.5 m:**
- Probable core loss between 12.5 and 12.8 m

**Boulder (cored and broken by drill action):**
- Boulder (cored and broken by drill action).

**Very stiff, orange-brown with yellow, moist, sandy, gravelly SILT with some clay and a trace of cobbles. (Basal till):**
- With significant pervasive oxidation and alteration (possibly from parent material)

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**Inserts:**
- **Top of Lower GLU:** E 595076, N 5819973
- **TOP OF HOLE ELEV:** 930.2 m
- **METHOD:** Sonic
- **DRILLING CO.:** Mud Bay Drilling Ltd.
- **INSPECTOR:** BSP
- **CLIENT:** Mount Polley Independent Expert Engineering Investigation and Review Panel
- **PROJECT:** Mount Polley Tailings Dam Breach
- **DATE:** October 17 and 18, 2014
- **FILE NO.:** 15-3-280
- **LOCATION:** See Fig. 209
- **ELEVATION (m):**
  - 920
  - 919
  - 918
  - 917
  - 916

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**SOIL DESCRIPTION**

**PRIMARY SEMIQUALITATIVE CLASSIFICATION:**

- **USCS:**
  - Plastic: Liquid Limit
  - Remolded: Plastic Limit
  - Undisturbed: Remolded Limit
  - Disturbed: Liquid Limit

**SAMPLING:**

- **SAMPLES:**
  - Grab Sample
  - Tube Sample
  - No Recovery

**SAMPLE WETTED:**

- **GRAIN SIZE (%):**
  - Undisturbed
  - Disturbed

**Penetration: (blows/300 mm):**

- **PET (m):**
  - 20 40 60 80 100 120 140 160 180 200

**WATER CONTENT (%):**

- **WATER LEVEL:**
  - Plastic
  - Liquid

**UNDRAINED SHEAR STRENGTH (kPa):**

- **SAMPLES:**
  - Peak
  - Residual
  - Pocket Pen

**GRAIN SIZE (%):**

- Passing #4 sieve
- Passing #200 sieve
- Passing #400 sieve
Top of WEAK BEDROCK

Hard, bluish green mottled grey-brown, clayey SILT to CLAY with some sand and gravel.
(Possible fine volcanic ash tuff bedrock)

Hard, reddish brown, dark gray to black, mottled greenish sandy, gravelly SILT with some clay.
(Possible brecciated volcanic bedrock)
Hard, reddish brown, dark grey to black, mottled greenish sandy, gravelly SILT with some clay. (Possible brecciated volcanic bedrock)

- with some reddish brown and green sub-horizontal banding

- 130 mm diameter rounded volcanic cobble at 21.0 m

Very dense (inferred), grey, moist, silty fine SAND with traces of clay and coal. (Possible poorly cemented sandstone bedrock)

End of hole at KCB instruction. Test hole sounded through casing upon completion to 23.4 m. Slope inclinometer installed and test hole grouted to surface.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-17 and KCB laboratory testing for further information.

SOIL DESCRIPTION

- Grey, wet SAND and GRAVEL with some silt, some cobbles, and a trace of boulders. (Rockfill - drill access road)

- Red-brown, wet, silty fine to medium SAND. (Tailings debris)

- 5 mm thick layer of grey SAND and SILT at 1.5 m

- Hard, grey, moist, sandy, gravelly SILT with some clay and cobbles. (Possible ablation/moraine till)

- Firm to stiff below 3.7 m
Top of UPPER GLU

Top of LOWER TILLS (Lower Basal Till)

Top of Lower GLU

Firm to stiff, grey, moist, sandy, gravelly SILT with some clay and cobbles.
(Possible ablation/moraine till)

Stiff, grey, moist CLAY with some fine sand and a trace of rounded gravel to 40 mm diameter.
(Glaciolacustrine)
- faintly laminated in zones with some horizontal layers to 4 mm thickness
- 100 mm thick layer of SAND, SILT and CLAY at 5.7 m
- 130 mm diameter rounded cobble at 6.1 m

Hard, grey, moist SILT and fine SAND with some clay and rounded gravel to gravelly. (Basal till)
- 100 mm thick layer of sandy, clayey silt to clay with a faint polished surface (possible slickenside) at 6.7 m

Dense (inferred), grey, wet, silty SAND and GRAVEL with some clay.
Hard, grey, moist, clayey SILT with some fine sand and rounded gravel and with faint polished surfaces. (Glaciolacustrine)
- some 5 to 30 mm thick layering at 30 degrees to horizontal
- some horizontal bedding below 9.1 m
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>10</td>
<td>Initial refusal of RSCPT14-17 at approx. 11.3 m</td>
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<tr>
<td>11</td>
<td>Restart of RSCPT14-17 at approx. 11.9 m</td>
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<td>12</td>
<td>(Top of Glacioluvial)</td>
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<td>13</td>
<td>(Top of Lower Basal Till)</td>
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<td>14</td>
<td>Refusal of RSCPT14-17 at approx. 14.0 m</td>
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</tbody>
</table>

- Hard, grey, moist SILT and fine SAND with traces of clay and rounded gravel to 25 mm diameter. (Glaciolacustrine) - bedding not apparent
- Hard, grey, moist, laminated clayey SILT with some fine sand in partings and a trace of rounded gravel to 30 mm. (Glaciolacustrine) - fine sand partings spaced at 50 to 100 mm - 100 mm diameter rounded cobble at 11.9 m
- Becoming very stiff, with some dark grey to black laminations containing trace fine organics below 13.1 m
- Dense (inferred), grey, wet, silty fine to medium SAND. (Possible glaciofluvial)
- Dense (inferred), grey, wet, fine to coarse SAND with a trace to some silt. (Possible glaciofluvial)
- Dense (inferred), grey, wet SAND and GRAVEL with some silt. (Possible glaciofluvial)
- Disturbed (inferred very stiff to hard), brown to grey, sandy, gravelly SILT with a trace of cobbles. (Basal till)
Top of WEAK BEDROCK

- 130 mm diameter rounded cobble at 15.5 m

Very dense (inferred), black, moist, silty angular SAND and GRAVEL with a trace of clay. (Possible brecciated volcanic bedrock)
- gravel and matrix of basalt-like origin

Hard, dark grey to black, moist, friable, sandy, subrounded to subangular gravely SILT with some clay. (Possible brecciated volcanic bedrock)
- gravel and matrix of basalt-like origin

Disturbed (inferred very stiff to hard), brown to grey, sandy, gravelly SILT with a trace of cobbles. (Basal till)
Hard, dark grey to black, moist, friable, sandy, subrounded to subangular gravelly Silt with some clay. (Possible brecciated volcanic bedrock) - gravel and matrix of basalt-like origin

End of hole at KCB instruction. Test hole grouted to surface upon completion.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-18 and KCB laboratory testing for further information. Nominal sonic core diameter 140 mm between 0 and 11.0 m.

**SOIL DESCRIPTION**

- **Top of UPPER TILL**
  - Start of RSCPT14-18 at approx. 3.8 m
  - Grey-brown, moist, angular sandy GRAVEL with trace of silt. (Fill for drill access road)

- **Loose to compact (inferred), reddish brown, moist, silty fine SAND. (Tailings debris)**

- **Very stiff, grey-brown, moist, sandy SILT with some rounded to angular gravel and traces of clay and cobbles (Mixture of till-fill and rockfill debris)**
  - with pockets of tailings at 3.2 and 3.7 m (slide debris)

- **Stiff to very stiff, grey-brown, moist SILT with some sand to sandy, some gravel, trace to some clay and traces of roots, fibrous organics and cobbles to 125 mm diameter:**
  - (Possible weathered ablation/ moraine till)
  - firm from 4.0 to 5.2 m
**SOIL DESCRIPTION**

Stiff to very stiff, grey-brown, moist SILT with some sand to sandy, some gravel, trace to some clay and traces of roots, fibrous organics and cobbles to 125 mm diameter.

(Possible weathered ablation/moraine till)

- stiff to very stiff with some gravel to gravelly below 7.9 m depth

- firm below 8.8 m depth

- very stiff to hard, grey, gravelly below 6.2 m depth
**Location:** See Fig. 209  
**E 595016, N 5820025**

**Top of Hole Elev:** 934.8 m  
**Method:** Sonic  
**Drilling Co.:** Mud Bay Drilling Ltd.  
**Inspector:** CHS

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Penetration (blows/300 mm)</th>
<th>Water Content (%)</th>
<th>Water Level</th>
<th>Samples</th>
<th>Undrained Shear Strength (kPa)</th>
<th>Grain Size (%)</th>
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**Comments:**
- Top of Lower Tills (Lower Basal Till)
- Nominal sonic core diameter 100 mm between 11.0 and 25.0 m
- Refusal of RSCP14-18 at approx. 11.8 m
- Very stiff, grey, moist, sandy SILT with some gravel to gravelly, trace to some clay and traces of cobbles to 125 mm diameter. (Basal till)
- Two zones (each about 50 mm thick) of grey, moist to wet, fine to medium SAND with some silt to silty and trace of gravel with oxidation, at 10.7 and 10.9 m depth
- Very stiff/dense (brittle), moist to wet, SILT and fine SAND to fine sandy SILT with traces of clay and fine black organics. (Possible glaciofluvial)
- Generally massive with trace sub-horizontal laminations containing organics
- Dense (inferred), grey, moist to wet, sandy GRAVEL and SILT. (Possible till fragment)
- Dense (inferred), light brown, wet, silty fine SAND to fine SAND and SILT. (Possible glaciofluvial)
- Dense (inferred), grey-brown, wet, sandy GRAVEL to 75 mm diameter, with trace to some silt. (Possible glaciofluvial)
- Stiff/dense (inferred), light brown, wet, fine sandy SILT to silty fine SAND with some irregular seams of fine to medium sand to 25 mm thick. (Possible glaciofluvial)
- Dense (inferred), brown, moist to wet, fine to medium SAND with trace to some silt. (Possible glaciofluvial)
- Pocket of stiff, sandy SILT with some gravel (Till-like) from 14.3 to 14.5 m depth
- With trace zones of soft, fine sandy SILT with trace gravel and fine black organics with slight organic odour below 14.5 m
Dense (inferred), grey-brown, moist, fine sandy SILT to SILT and fine SAND with some gravel to 75 mm diameter.
- very stiff/dense zone, 100 mm thick at 15.4 m

Very stiff to hard, grey-brown with reddish oxidation, moist, gravelly sandy SILT to GRAVEL, SILT and SAND with traces of clay and cobbles up to 100 mm diameter. (Basal till)
- gravel is sub-rounded to rounded
- very dense (inferred), silty sand and gravel, no oxidation below 16.2 m

- purplish brown matrix below 16.8 m
- very dense (inferred), purple, gravelly sand with some silt to silty below 17.4 m

Very stiff to hard, purplish brown with green and red bands up to 10 mm thick (undulating sub-horizontal), dry to moist SILT with trace to some gravel, sand and clay. (Possible brecciated volcanic bedrock)
- gravel particles are sub-rounded to sub-angular, to 50 mm diameter, greenish black meta-volcanic
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<tr>
<th>DEPTH (m)</th>
<th>PENETRATION (blows/300 mm)</th>
<th>WATER CONTENT (%)</th>
<th>WATER LEVEL</th>
<th>SAMPLES</th>
<th>UNDRAINED SHEAR STRENGTH (kPa)</th>
<th>GRAIN SIZE (%)</th>
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- Very stiff to hard, purplish brown with green and red bands up to 10 mm thick (undulating sub-horizontal), dry to moist SILT with trace to some gravel, sand and clay. (Possible brecciated volcanic bedrock)
  - with some slickensides up to 1 square cm in sub-horizontal planes

- Hard, reddish brown with green highlights, moist, fine to medium sandy SILT to SAND and SILT. (Possible brecciated volcanic bedrock)
  - gravel particles are sub-angular to rounded, to 25 mm diameter, of meta-volcanic origin
  - with frequent undulating sub-horizontal colour bands (banded), green-purple-red/brown all of same apparent gradation

- greenish grey with red highlights below 22.1 m depth

- Hard, dark grey with black, green and red zones and streaks, dry to moist, fine gravelly SILT with some sand and trace of clay. (Possible brecciated volcanic bedrock)
Artesian groundwater flow noted flowing from 7" casing at 11.0 m when 6" casing removed (on order of 1.5 to 3 m head).

About 0.5 hours following initial grouting artesian flow resumed at 10 to 20L/min. Returned and successfully regrouted with heavier mix.

End of test hole at KCB instruction. Test grouted to surface upon completion.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-19 and KCB laboratory testing for further information.

Nominal sonic core diameter 140 mm between 0 and 11.0 m

Grey-brown, moist, sandy angular GRAVEL with trace of silt. (Road fill)

Stiff to very stiff, grey-brown, moist, sandy SILT with some gravel to gravelly and traces of roots, fine organics and oxidation. (Possible weathered ablation/moraine till)

Dense to very dense (inferred), grey-brown, moist, silty SAND to SILT and SAND with some gravel. (Possible ablation/moraine till)
Restart of RSCPT14-19 at approx. 6.2 m

Refusal of RSCPT14-19 at approx. 7.0 m

- Dense to very dense (inferred), grey-brown, moist, silty SAND to SILT and SAND with some gravel. (Possible ablation/moraine till)

- Very stiff to hard, grey, moist, sandy SILT with some gravel to gravelly. (Possible ablation/moraine till)

- 50 to 75 mm thick seam of fine to medium SAND with a trace to some silt, irregular sub-horizontal, at 6.9 m

- 25 mm seam of fine to medium SAND with trace to some silt, irregular sub-horizontal, at 7.5 m

- Very dense (inferred), grey, moist, silty SAND with some gravel. (Possible ablation/moraine till)
Nominal sonic core diameter 100 mm below 11.0 m

Top of LOWER TILLS (Glaciofluvial)

- Very dense (inferred), grey, moist, silty SAND with some gravel. (Possible ablation/moraine till)
- Hard, dark grey, gravelly SILT with some sand to sandy. (Possible ablation/moraine till)
- Very stiff to hard, grey-brown, moist, gravelly SILT with some sand to sandy. (Basal till) - oxidation at 13.1 m depth
- 100 mm thick zone of brown, wet, fine to medium SAND with some silt and gravel at 13.3 m

Compact to dense (inferred), light grey/brown, moist to wet, fine SAND and SILT with some gravel with trace fine to medium sand seams to 5 mm thick. (Possible glaciofluvial)

Compact to dense (inferred), brown, wet, gravelly, fine to coarse SAND with a trace to some silt. (Possible glaciofluvial)

Compact to dense (inferred), brown, moist to wet, silty fine to medium SAND with some gravel to gravelly. (Possible glaciofluvial)
**SOIL DESCRIPTION**

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>COMMENTS</th>
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<tbody>
<tr>
<td>15</td>
<td>Very stiff to hard, grey-brown, moist, gravelly SILT with some sand to sandy. (Basal till)</td>
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<tr>
<td>16</td>
<td>Very hard, purple-brown, dry to moist, gravelly SILT to SILT and GRAVEL with some sand to sandy and trace to some clay. (Basal till)</td>
</tr>
<tr>
<td>17</td>
<td>Very dense (frangible), dry to moist, purple mottled greenish grey, angular sandy GRAVEL with some silt and trace to some clay. (Possible brecciated volcanic bedrock)</td>
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</tbody>
</table>

- gravel particles are purplish grey meta-volcanic
  - trace of white, vein-like structures at 19.5 m

**LOG OF TEST HOLE - MT POLLEY 15-3-280**

**LOCATION:** See Fig. 209
E 594883, N 5820042

**TOP OF HOLE ELEV:** 942.8 m

**METHOD:** Sonic

**DRILLING CO.:** Mud Bay Drilling Ltd.

**INSPECTOR:** CHS

**CLIENT:** Mount Polley Independent Expert Engineering Investigation and Review Panel

**PROJECT:** Mount Polley Tailings Dam Breach

**DATE:** October 20, 2014

**FILE NO.:** 15-3-280

**LOCATION:**

**ELEVATION (m):** 924 925 926 927

**COMMENTS:**

- gravel particles to 40 mm diameter, sub-angular
  - generally matrix supported, with no apparent structure (massive)
Very dense (friable), dry to moist, purple mottled greenish grey, angular sandy GRAVEL with some silt and trace to some clay. (Possible brecciated volcanic bedrock) - gravel particles are purplish grey meta-volcanic

End of test hole at KCB instruction. Test hole grouted to surface upon completion.
**Note:** Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to KCB laboratory testing for further information.

Nominal sonic core diameter 140 mm between 0 and 26.2 m

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>PENETRATION (blows/300 mm)</th>
<th>WATER CONTENT (%)</th>
<th>WATER LEVEL</th>
<th>SABLES</th>
<th>UNDRAINED SHEAR STRENGTH (kPa)</th>
<th>GRAIN SIZE (%)</th>
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</table>

**SOIL DESCRIPTION**

Grey-brown, moist, angular GRAVEL with some sand to sandy and trace to some silt, and trace cobbles up to 100 mm diameter. (Downstream dam shell- rockfill)

- Sharp colour break, grey below 3.5 m (possible lift or stage boundary)
- Sharp colour break, grey-brown below 4.3 m (possible lift or stage boundary)
- Sharp colour break, brown and with some silt below 2.6 m (possible lift or stage boundary)
- Typically minus 25 mm crushed material with trace oversize
Grey-brown, moist, angular GRAVEL with some sand to sandy and trace to some silt. (Possible transition zone)
- typically minus 25 mm crushed material with trace oversize
- trace woodwaste (stick) at 5.2 m depth
- sharp colour break, grey below 5.3 m (possible lift or stage boundary)

Grey-brown, moist, angular GRAVEL with some sand to sandy and some silt to silty. (Possible filter zone)
- typically minus 25 mm crushed material with trace oversize
- sharp colour break, grey below 7.9 m (possible lift or stage boundary)
Contact is irregular at 10.2 m

- Very stiff, gravelly with some sand to sandy below 11.0 m

- 100 mm thick soft zone at 13.9 m (possibly drill disturbance)

- 15 mm thick zone of wet, silty sand and gravel at 14.0 m (possible drill segregation)
SOIL DESCRIPTION

Very stiff / dense, grey-brown, moist, gravelly sandy SILT to SAND and SILT. (Till fill core)
- 15 mm thick zone of wet, silty sand and gravel at 14.0 m (possible drill segregation)

Very stiff to hard, grey-brown with oxidization, moist SILT with some sand and gravel and a trace of clay. (Till fill core)
- sandy below 17.4 m
- 25 mm thick layer of stiff, grey, sandy SILT to SILT and SAND with trace of clay at approximately 19.1 m
- trace of woodwaste at 19.4 m
Very stiff to hard, grey-brown with oxidization, moist, sandy SILT with some gravel and a trace of clay. (Till fill core)

Hard, dark grey with brown mottling, moist SILT with some sand and gravel and a trace of clay. (Till fill core)

- brown zones, each less than 100 mm thick, centered at about 22.9 and 23.0 m
- sharp transition to brown with trace oxidation below 23.5 m (possible lift or stage boundary)
- minor trace of grass, thin roots and fibrous organics at 23.5 m
- minor trace of grass, thin roots and fibrous organics at 24.2 m
- 150 mm thick grey zone at 24.4 m
- very stiff below 24.7 m
Nominal sonic core diameter 100 mm below 26.2 m

Top of UPPER TILL

Very stiff, brown, moist SILT with some sand and gravel and a trace of clay. (Till fill core)

- 50 mm thick grey zone at 25.5 m

Compact to dense (inferred), brown, wet, angular GRAVEL with some sand and trace to some silt. (Possible upstream toe-drain)

Very stiff, grey-brown, moist SILT with some sand and trace to some gravel and clay. (Possible ablation/moraine till)

- trace irregular surfaces less than 1 mm thick infilled with grey fine sand and silt and partially decomposed fibrous organics (possible infilled dessication cracks) from 28.8 to 29.9 m

- some gravel to gravelly below 29.6 m
Very stiff, grey-brown, moist SILT with some gravel to gravelly, some sand and trace to some clay. (Possible ablation/moraine till)

Very dense, grey, moist, SAND and SILT with some gravel to gravelly and trace of clay. (Possible ablation/moraine till)
Very dense, grey, moist, SAND and SILT with some gravel to gravelly and trace of clay.
(Possible ablation/moraine till)

- 10 mm thick sub-horizontal irregular seam of fine to medium SAND with trace to some silt at 38.3 m depth

Compact to dense (inferred), dark grey, wet, fine to medium SAND with some silt to silty.
(Possible glaciofluvial)
Compact to dense (inferred), grey-brown, wet, gravelly SAND with some silt. (Possible glaciofluvial)

Very stiff, grey-brown with pockets of oxidation, moist, sandy SILT with some gravel to gravelly and trace of clay. (Basal till)

Very stiff, purplish brown, moist, gravelly, sandy SILT with trace of clay. (Basal till)

Very stiff, grey, moist, gravelly SILT with some sand and trace to some clay. (Basal till)
**Soil Description**

- **Very stiff, grey, moist, gravelly Silt with some sand and trace to some clay.** (Basal till)

- **Hard, grey, moist, gravelly Silt with some sand and a trace of clay.** (Basal till)
  - Gravel particles are rounded to sub-angular, mixed origin

- **Hard, reddish brown with greenish grey in bands, dry to moist, sandy Silt with some gravel to gravelly and trace of clay.** (Possible brecciated volcanic bedrock)
  - Gravel particles to 50 mm diameter, ranging from angular to rounded, meta-basalt like

**GEOLOGICAL LOG**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>COMMENTS</th>
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<tbody>
<tr>
<td>45-46</td>
<td>Top of WEAK BEDROCK</td>
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**Table of Soil Properties**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Penetration (blows/300 mm)</th>
<th>Water Content (%)</th>
<th>Undrained Shear Strength (kPa)</th>
<th>Grain Size (%)</th>
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**Notation**

- **O** Disturbed
- **●** Undisturbed
- **Plastic Liquid Limit**
- **USCS Grab Sample**
- **USCS Tube Sample**
- **No Recovery**
- **Remolded Peak**
- **Residual**
- **Pocket Pen**
- **Passing #200 sieve**
- **Passing #4 sieve**
Hard, reddish brown with greenish grey bands, dry to moist, sandy SILT with some gravel to gravelly and trace of clay. (Possible brecciated volcanic bedrock)

- greenish grey bands, very dense (inferred) silt and fine sand (texture resembles fine meta-igneous rock) at 50.0 m

- 100 mm thick layer of reddish brown, wet, angular to sub-angular GRAVEL with some silt and trace to some clay at 51.2 m

Hard, reddish brown with greenish grey bands, dry to moist SILT with some sub-rounded gravel and a trace to some sand and clay. (Possible brecciated volcanic bedrock)

- sub-rounded cobble shaped pocket consisting of very dense (inferred), dark grey, SAND with some silt at 53.3 m (may be crystals in decomposed cobble)

End of test hole at KCB instruction. Test hole sounded through casing upon completion to 54.0 m. Vibrating wire piezometers installed at 51.8 m (Tip A), 39.9 m (Tip B) and 35.1 m (Tip C) and test hole fully grouted up to 10.2 m upon completion.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-21 and KCB laboratory testing for further information.

Note RSCPT14-21 located approx. 55 m to southeast. Start of RSCPT14-21 at 0 m in till fill core.

Nominal sonic core diameter 140 mm between 0 and 35.4 m

Grey, moist, angular GRAVEL with some sand and a trace to some silt and cobbles to 125 mm diameter. (Downstream dam shell - rockfill)

- grey/brown below 0.9 m (possible lift/stage boundary)

- grey below 2.3 m (possible lift/stage boundary)
Grey, moist, angular GRAVEL with some sand and a trace to some silt and cobbles to 125 mm diameter. (Downstream dam shell - rockfill)

Brown, moist, silty SAND and GRAVEL to sandy GRAVEL with some silt. (Downstream dam shell - rockfill)
- gravel is angular to sub-angular and to 75 mm diameter
- colour change may indicate lift/stage boundary

Grey, dry to moist, angular GRAVEL with some sand and a trace to some silt and cobbles to 125 mm diameter. (Downstream dam shell - rockfill)

- some silt below 5.8 m
Grey, dry to moist, angular GRAVEL with some sand and a trace to some silt and cobbles to 125 mm diameter. (Downstream dam shell - rockfill) - possible pinkish grey boulder at 11.6 m (shattered by drill)

Greenish grey-brown, dry to moist, silky SAND and GRAVEL. (Downstream dam shell - rockfill) - gravel is angular to rounded and to 75 mm diameter (possible lift/stage boundary)

Brown, moist, sandy, angular GRAVEL with some silt and cobbles to 100 mm diameter. (Downstream dam shell - rockfill) (possible lift/stage boundary)
Brown, moist, sandy, angular GRAVEL with some silt and cobbles to 100 mm diameter. (Downstream dam shell - rockfill) (possible lift/stage boundary)

- grey-brown, dry to moist, with a trace to some silt below 15.4 m

- grey, moist to wet, with some silt and a trace of clay below 17.1 m

- dry to moist, no clay below 19.5 m
Grey, dry to moist, sandy, angular GRAVEL with some silt and cobbles to 100 mm diameter. (Downstream dam shell - rockfill)
**LOCATION:** See Fig. 209  
E 595304, N 5819760

**TOP OF HOLE ELEV:** 968.9 m

**METHOD:** Sonic

**DRILLING CO.:** Mud Bay Drilling Ltd.

**INSPECTOR:** CHS

**CLIENT:** Mount Polley Independent Expert Engineering Investigation and Review Panel

**PROJECT:** Mount Polley Tailings Dam Breach

**DATE:** October 23 and 24, 2014

**FILE NO.:** 15-3-280

### Soils Table

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>PENETRATION (blows/300 mm)</th>
<th>WATER CONTENT (%)</th>
<th>WATER LEVEL</th>
<th>USCS SAMPLES</th>
<th>UNDRAINED SHEAR STRENGTH (kPa)</th>
<th>GRAIN SIZE (%)</th>
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</table>

**COMMENTS:** Grey, dry to moist, sandy, angular GRAVEL with some silt and cobbles to 100 mm diameter.  
(Downstream dam shell - rockfill)

- brown moist below 26.2 m (possible lift/stage boundary)
Brown, moist, sandy angular GRAVEL with some silt and cobbles to 150 mm diameter. (Downstream dam shell - rockfill)

Pinkish grey-brown, moist to wet, silty SAND and angular GRAVEL to 20 mm diameter. (Possible transition / filter zones)

Stiff, grey-brown, moist SILT with some sand and sub-rounded gravel to 25 mm diameter and a trace of clay. (Till fill core)

- some discontinuous smooth, faintly striated surfaces (possible slickensides) in approximately parallel planes to the stratigraphic contact above from 32.6 to 33.2 m

- very stiff to hard below 32.9 m
Nominal sonic core diameter 100 mm below 35.4 m

Top of UPPER TILL

- Very stiff to hard, fine sandy SILT to fine SAND and SILT with some gravel to 50 mm diameter and traces of medium to coarse sand. (Till fill core)

- 20 mm thick layer of thinly laminated, stiff, moist SILT with a trace to some clay and fine sand at 38.1 m

- 20 mm thick layer of compact (inferred), moist, silty fine SAND at 38.3 m

- grey below 38.4 m

(Contact is bluish grey silt horizon, 1 mm thick)

Very stiff, brown with oxidization, moist, gravelly SILT with some sand and traces of clay and fibrous organics.

(Possible weathered ablation/moraine till
- with irregular, sub-vertical, surfaces infilled with stiff, light grey, silt (possible infilled desiccation cracks or rootlets)

Very stiff, brown with oxidization, moist, gravelly SILT with some sand and traces of clay and fibrous organics.

(Possible weathered ablation/moraine till
- with irregular, sub-vertical, surfaces infilled with stiff, light grey, silt (possible infilled desiccation cracks or rootlets)
Possible fragments of UPPER GLU

Vibrating Wire Tip C at 40.8 m.

Possible fragment of UPPER GLU

Vibrating Wire Tip B at 43.6 m.

Very stiff to very stiff, grey, moist, fine sandy SILT with some gravel to gravelly with thinly laminated zones with trace of clay and no gravel.
(Possible ablation/moraine till)

- 100 mm thick laminated zone deformed concave upward (open folds) at 39.9 m

- 100 mm thick laminated zone with an overturned fold (limbs at 30 and 60° upward from horizontal in same direction) at 40.5 m

- 100 mm thick laminated zone with an overturned fold (limbs at 60 and 80° upward from the horizontal in opposite orientation to fold at 40.5 m) at 40.8 m

Very stiff, grey-brown, moist, gravelly, sandy SILT with a trace of cobbles to 100 mm diameter and trace pockets of soft, grey silt with some clay.
(Possible ablation/moraine till)

Dense (inferred), grey-brown, moist to wet, silty SAND and GRAVEL to 75 mm diameter.
(Possible ablation/moraine till)

- gravelly, silty sand below 43.3 m

- rough, undulating sand surfaces dipping at about 30° to horizontal at 43.4 and 43.5 m

Very stiff to hard, grey-brown, moist, sandy SILT with some sub-rounded gravel to 75 mm diameter to gravelly and a trace of clay.
(Possible ablation/moraine till)

- 35 mm thick layer of thinly laminated, stiff, clayey silt interbedded with fine sand partings, beds deformed concave upward with 0 to 30° dip from horizontal. Lower surface of laminated zone is blackish grey, possibly with fine organics at 44.2 m
(possible glaciolacustrine fragment)
**SOIL DESCRIPTION**

**Comments:**

- Very stiff to hard, grey-brown, moist, sandy Silt with some sub-rounded gravel to 75 mm diameter to gravelly and a trace of clay. (Possible ablation/moraine till)

- 1 mm thick upward curved layer (resembling 3D paraboloid, possible drill disturbance) consisting of firm, bluish grey, moist, clayey silt at 47.9 m

- Approximately 75 mm thick layer of compact to dense (inferred), grey, wet, fine to medium SAND with a trace to some gravel and silt at 48.0 m

**Possible top of LOWER TILLS (Lower Basal Till):**

- Compact to dense (inferred), grey, wet SAND and sub-angular to rounded GRAVEL to 50 mm diameter with a trace to some silt.

- Very stiff to hard, grey-brown, moist, sandy Silt with some sub-rounded to rounded gravel to 75 mm diameter and a trace of clay. (Basal till)
**SOIL DESCRIPTION**

- Very dense (inferred), grey-brown, dry to moist, silty, fine SAND with some gravel to gravelly, a trace to some medium to coarse sand, and a trace of cobbles to 100 mm diameter. (Basal till)

- Approximately 75 mm thick layer of grey, wet, sand and gravel with a trace to some silt at 51.4 m
**SOIL DESCRIPTION**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>56.4</td>
<td>Very dense (inferred), grey-brown, dry to moist, silty, fine SAND with some gravel to gravelly, a trace to some medium to coarse sand, and a trace of cobbles to 100 mm diameter. (Basal till)</td>
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<tr>
<td>57</td>
<td>Dense (inferred), grey-brown, moist, silty, fine to medium SAND with some gravel. (Possible glaciofluvial) - coarsens downward</td>
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<tr>
<td>58</td>
<td>Dense (inferred), dark grey, wet, fine to medium SAND with some silt and odour of organic decomposition. (Possible glaciofluvial) - fine to coarse sand with a trace to some silt below 57.0 m (coarsening downward) - 1 mm thick layer of black organic silt apparently folded sinusoidally at 57.2 m with silty fine sand below</td>
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<tr>
<td>59</td>
<td>Dense (inferred), dark grey, moist, fine SAND and SILT to fine sandy SILT with some sub-angular to rounded gravel to 50 mm diameter to gravelly and a trace to some medium to coarse sand, with odour of organic decomposition (no organics visible). (Possible glaciofluvial)</td>
</tr>
<tr>
<td>60</td>
<td>Hard/very dense (inferred), grey-brown with greenish zones, dry to moist, sub-rounded to rounded gravelly, silty SAND to sandy SILT with traces of cobbles to 100 mm diameter and clay, with oxidation. (Basal till)</td>
</tr>
</tbody>
</table>
**SOIL DESCRIPTION**

- Very dense (inferred), grey brown with oxidation, moist to wet, SAND and GRAVEL with some silt to silty. (Basal till)

- 100 mm thick layer with diffused precipitated carbonate mineral within silt matrix (likely calcite, vigorous reaction to acid) at 61.3 m

- 25 mm thick oxidized layer, reddish-orange at 62.2 m

- 25 mm thick oxidized layer, reddish-orange at 62.6 m

- a trace to some silt from 63.1 to 63.6 m

- a trace to some silt from 64.0 to 64.2 m
Very dense (inferred), grey brown with oxidation, moist to wet, SAND and GRAVEL with some silt to silty. (Basal till)
- 50 mm thick layer with trace to some silt at 65.2 m
- a trace to some silt below 65.7 m

Hard, reddish brown/bluish grey, moist, sandy gravelly SILT. (Basal till)
- gravel particles are rounded to sub-angular, to 75 mm diameter

Very dense (inferred), dark grey with reddish brown zones and streaks, dry to moist, silty, angular SAND and GRAVEL to 25 mm diameter with a trace of clay. (Possible brecciated volcanic bedrock)
- gravel particles are meta-basalt like, in some zones interlocking as if brecciated cobbles
- frequent irregular sub-vertical to vertical, 70° to 90°, streaks of very stiff, dark red, clayey silt (like gouge, possible infilled shears), ranging from 1 to 5 mm thick

Very dense (inferred), red mottled grey, angular SAND with some silt and traces of clay and angular gravel to 50 mm diameter. (Possible weathered igneous bedrock)
**SOIL DESCRIPTION**

Very dense (inferred), red mottled grey, angular SAND with some silt and traces of clay and angular gravel to 50 mm diameter. (Possible weathered igneous bedrock)

Very dense (inferred), grey, dry to moist, angular GRAVEL with a trace to some angular sand and silt and a trace of clay.
- gravel particles are meta-basalt like, to 25 mm diameter
- generally clast supported

End of test hole at KCB instruction. Test hole sounded through casing upon completion to 72.4 m. Vibrating wire piezometers installed at 56.4 m (Tip A), 43.6 m (Tip B) and 40.8 m (Tip C) and test hole fully grouted up to 22 m upon completion with bentonite chips and drill cuttings above.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-22 and KCB laboratory testing for further information.

Grey, moist to wet, angular, sandy GRAVEL with a trace to some silt and a trace of cobbles to 125 mm diameter. (Rockfill - drill access road)

Loose to compact (inferred), reddish grey-brown, wet, silty, fine SAND. (Tailings debris)

Very stiff, grey-brown, moist, sub-rounded to rounded gravelly to 75 mm diameter SILT with some sand to sandy and a trace of clay. (Possible ablation/moraine till)
Cvane at 7.8 m is 45 kPa
Cvane at 7.9 m is 55 kPa
(sand particles may be skewing results)

Firm to stiff with soft zones, grey, moist, sub-rounded to rounded gravelly to 75 mm diameter SILT with some sand to sandy and a trace of clay. (Possible ablation/moraine till)

- firm with trace to some clay below 7.3 m

No recovery.
(Driller notes pushing a cobble/small boulder ahead of the bit)
No recovery. (Driller notes pushing a cobble/small boulder ahead of the bit)

End of hole due to poor recovery. Test hole grouted upon completion. Continued drilling at SH14-22A.
Note: Field log of test hole based on visual observation during drilling completed by KCB. No samples were obtained by Thurber for confirmatory laboratory testing. Density/consistency/strength descriptions are based on field observations of highly disturbed samples. Refer to RSCPT14-22 and KCB laboratory testing for further information.

KCB instructed driller to quickly drill to 4.9 m, discarding any heavily washed/disturbed recovery. Re-drill to sample interval which was not recovered at SH14-22. Nominal sonic core diameter 140 mm

Cvane is Torvane

Start of RSCPT14-22 at approx. 3.9 m

Drilled out. (No recovery)
UPPER TILL

Cvane at 7.8 m is 35 kPa to 45 kPa

Top of UPPER GLU

Cvane at 8.7 m is 40 kPa

Cvane at 9.3 m is 40 kPa

Cvane at 9.6 m is 20 kPa

Soft to firm, with stiff zones, grey, moist, gravelly SILT with some sand and a trace to some clay. (Possible ablation/moraine till)

Soft to firm, grey, moist SILT with some gravel, sand, and clay. (Possible ablation/moraine till)

- 40 mm thick layer of firm CLAY at 7.8 m
- firm below 7.9 m
- 15 to 20 mm thick layer of soft CLAY at 8.1 m
- 15 to 20 mm thick layer of soft CLAY at 8.2 m
- 15 to 20 mm thick layer of soft CLAY at 8.4 m

Firm to stiff, grey, moist, thinly laminated clayey SILT to CLAY interbedded with fine sand partings and trace beds of clay to 20 mm thick (Glaciolacustrine)

- bedding generally deformed with concave upward curvature (possible drill disturbance) with occasional sections with low amplitude undulating bedding
Cvane at 10.2 m is 60 kPa

Top of LOWER TILLS (Lower Basal Till)
- Firm to stiff, grey, moist, thinly laminated clayey SILT to CLAY interbedded with fine sand partings and trace beds of clay to 20 mm thick (Glaciolacustrine)
- 100 mm thick layer without structure (massive) with some fine to coarse sand (till-like texture) at 10.4 m
- With faint structure visible in discontinuous zones (11.0, 11.3, 12.8, and 13.9 m depth)
- Thin laminations, deformed in highly variable orientations (chaotic) including concave upward and downward curvature, steep tilting of beds and wave folding
- Between zones with visible structure, deposit is massive or structure not readily apparent (note absence of fine sand partings which serve as bedding marker in upper glaciolacustrine deposit)

Very stiff, greenish grey, moist SILT with some sub-angular to rounded gravel to 40 mm diameter and a trace to some sand and clay. (Basal till)

Very stiff, grey, moist, clayey SILT to CLAY with traces of sand and sub-rounded to rounded gravel to 75 mm diameter. (Glaciolacustrine)

Very stiff, grey, moist, clayey SILT to CLAY with some organic silt in black laminations and some fine sand thin laminations and partings, with organic decay odour. (Glaciolacustrine)

Very stiff, interbedded grey and black, moist, thinly laminated clayey SILT to CLAY with some organic silt in black laminations and some fine sand thin laminations and partings, with organic decay odour. (Glaciolacustrine)

Compact (inferred), dark grey, moist to wet, silty, fine SAND with traces of organic silt and organic decomposition odour. (Possible glaciofluvial)
Sample fell out of core barrel during retrieval from 16.8 to 17.4 m. Recovered during next run with significant disturbance.

Refusal of RSCPT14-22 at approx. 18.4 m.

Top of WEAK BEDROCK

Compact to dense (inferred), interbedded dark grey and black, moist to wet, thinly laminated fine SAND and SILT with some organic silt in black laminations and organic decomposition odour. (Possible glaciofluvial)
- bedding is deformed with overall curvature concave downward (possible drill disturbance) and also undulating

Compact (inferred), grey, moist to wet SAND with a trace to some silt and fine rounded gravel. (Possible glaciofluvial)

Compact (inferred), grey, moist to wet, fine SAND with some silt to silty. (Possible glaciofluvial)
- possibly thinly bedded (very faint)

Compact (inferred), grey, moist to wet SAND with some sub-rounded gravel to 25 mm in diameter and a trace of silt. (Possible glaciofluvial)

Compact (inferred), grey, wet, fine to medium SAND with a trace of silt. (Possible glaciofluvial)

Compact (inferred), grey, wet SAND with some fine rounded gravel. (Possible glaciofluvial)

Compact (inferred), dark grey, moist to wet, fine SAND and SILT with traces of clay and sub-rounded gravel to 25 mm diameter. (Possible glaciofluvial)

Hard/very dense, dark grey, dry to moist SILT and angular SAND and GRAVEL. (Possible eroded bedrock fragment)

Compact (inferred), dark grey, moist to wet, sub-rounded to rounded gravelly to 25 in diameter SAND with a trace of silt. (Possible glaciofluvial)

Hard/very dense, dark grey, dry to moist, silty angular SAND to SAND and SILT with a trace to some fine gravel. (Possible brecciated volcanic bedrock)
- coarse particles are of consistent dark grey basalt-like origin
Drill is rattling, as with weak rock

Hard/very dense, dark grey, dry to moist, silty angular SAND to SAND and SILT with a trace to some fine gravel. (Possible brecciated volcanic bedrock)

- angular gravelly SAND with some silt and a trace of clay, clast supported with interlocking angular particles (possible un-brecciated zone) from 20.4 m to 22.6 m

End of test hole at KCB instruction.
Test hole grouted to surface upon completion.