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GALORE CREEK PROJECT MEMORANDUM

To:	**NovaGold Resources Inc.**	**Doc. No:**	
Attention:	**Dean Lindsay**	**CC:**	
From:	**L. Wilchek / J. Brash / I. Bruce**	**Date:**	**14 Nov 2006**
Subject:	**Galore Creek – Tailings Dam Geologic Conditions - Update**		
No. of Pages (including this page): 30		**Project No:**	**0386-003-04**

As part of the on-going detailed design of the proposed Galore Creek tailings facility for NovaGold Resources Inc. (NovaGold), BGC Engineering Inc. (BGC) has prepared an update of the geological interpretation and engineering geological conditions of the tailings dam foundations. This memo describes the lithological units mapped in the tailings dam area, spatial relationships of the lithological units, character of the lithological contacts, local structural rock mass fabric, and major structural features (e.g. faults), including orientations and character.

1.0 BACKGROUND

The tailings facility at Galore Creek requires a cross-valley tailings dam, located approximately 7 km north of the Central Pit (or mid valley), for the retention of water and mill process tailings (BGC, 2006a). An orthophoto of the dam site with the main and starter dam outlines is shown on Drawing 01. The proposed dam is a rockfill structure with an impervious (i.e. clay till) central core and a bituminous geomembrane liner (Coletanche liner) on the upstream face. The proposed dam cross-section is shown on Drawing 02. It is intended that the starter dam will be constructed to a crest elevation of 560 m (or dam height of 152 m) to provide sufficient storage capacity for two years (or 24 months) of tailings solids production and water inflows for a 19 month period. The dam will be raised in a downstream direction to an ultimate elevation of 683 m; the maximum height of the dam above the current creek level will be approximately 275 m. The final downstream face of the dam has been designed with a final slope of 1.7H:1V; the final upstream face of the dam is design at a slope of 2.5H:1V. These dimensions and materials are shown on Drawing 01. Immediately downstream of the ultimate toe, a seepage collection system will be constructed to intercept seepage out of the pond (Drawing 02).

2.0 BGC GEOTECHNICAL SITE INVESTIGATIONS

2.1 2004 & 2005 GEOTECHNICAL INVESTIGATIONS

Geological and engineering characterization of the sub-surface soil and rock within Galore valley has been on-going by BGC and NovaGold since 2004. For prefeasibility level designs of the tailings facility, plant site, and open pits, geotechnical investigations were completed between June and October 2004. A total of 9 geotechnical boreholes were drilled, 13 piezometers were installed, and 6 seismic refraction lines were completed throughout the valley. The results of these investigations are presented in BGC's prefeasibility level design report entitled "Waste and Water Management – Prefeasibility Geotechnical Report' dated February 9, 2005 (BGC, 2005).

The following year (June to October 2005), an additional 47 geotechnical boreholes were drilled, 73 piezometers were installed, 13 test pits were excavated, and 7 seismic refraction lines were completed in the valley for feasibility level geotechnical designs. Of these investigations, 6 holes were drilled and 3 seismic lines were completed within the ultimate tailings dam footprint. In addition, airphoto interpretation of the dam site was completed by BGC. Limited mapping of the dam site was completed by NovaGold geologist D. Smithson. Two condemnation holes were also drilled by NovaGold on the east abutment. The results of the 2005 investigations are summarized in two engineering reports "Feasibility – Geotechnical and Hydrogeological Site Investigation Report" issued 28 April 2006 and "Waste and Water Management – Feasibility Geotechnical Report" issued 21 April 2006 (BGC, 2006a & BGC, 2006b). External reviewers indicated this program was sufficient for feasibility level.

The feasibility report identified areas requiring additional investigations. Also, questions raised by regulators required additional investigations. The program outlined below was undertaken to provide this additional data.

2.2 2006 GEOTECHNICAL INVESTIGATIONS

As part of final design, additional field investigations comprising 39 geotechnical boreholes with, 47 piezometers and 110 test pits were completed within the Galore valley between June and October 2006. Twelve of the holes were drilled and 14 of the pits were excavated within the tailings dam footprint and spillway. In addition, photogrammetry mapping was carried out by J. Mathis, P.Eng. and geologic outcrop mapping was completed throughout the summer by various BGC engineers, and C. Leitch, P. Eng., a sub-consultant to BGC. Limited mapping of the dam site was completed by NovaGold geologist S. Close. Two holes were also drilled by NovaGold on the west abutment for condemnation purposes. The results of these 2006 investigations will be fully presented to NovaGold under separate cover in late November or early December 2006.

Table 1 summarizes investigations completed around the proposed tailings dam area over the last three years. Drawing 03 provides a summary of the borehole locations and Drawing 04 provides a summary of the test pit locations.

Table 1. Summary of Geotechnical Investigations for Galore Tailings Dam

Investigations	2005	2006	Total	Comments
Drilling (BGC and NovaGold)	8[1]	14[1]	22 holes	Refer to Drawing 03.
Test pit excavations	-	14	14 test pits	Refer to Drawing 04.
Piezometers	11	19	30	Standpipe piezometers and four vibrating wires in PC06-19 and PC06-21.
Packer Tests	16	72	88	Completed during drilling.
Falling/Rising Head Tests	5	10	15	Completed in standpipe piezometers
Grout Test	-	1	1	Grout test completed in DH-BGC06-20
Seismic refraction surveys	3	-	3 lines	Refer to Drawing 04.
BGC outcrop mapping	-	-	-	Refer to Drawing 05.
Photogrammetry mapping	-	-	-	Refer to Drawing 05.

1. Totals include NovaGold exploration holes.

A total of 22 holes (18 geotechnical holes & 4 exploration holes), 14 test pits, and 3 seismic refraction lines have been completed within the tailings dam footprint and spillway. In addition, 30 piezometers have been installed, 88 packer tests and 15 falling and rising head tests have been conducted. Lastly, a grout test was conducted in DH-BGC06-20.

3.0 GALORE TAILINGS DAM GEOLOGY

3.1 FEASIBILITY LEVEL - GEOLOGIC INTERPRETATION

Previous work (BGC, 2006a), indicated the following:

- *'Under the entire dam footprint, the overburden varies in thickness from zero (exposed bedrock) to a maximum of 55 m…'*
- *'Thin fluvial deposits lie in the valley bottom with till, undifferentiated glacial deposits, and/or colluvium on the abutments.'*
- *'The overburden is underlain by highly fractured 'broken' rock which underlies less fractured 'stick' rock…*'

- *'Bedrock is either an intrusive breccia or volcanic sediments. Limestone underlies a portion of the downstream toe of the dam.'*

- *'Faults have been identified within the waste containment area. A single steeply dipping normal fault runs almost perpendicular to the Main Tailings Dam (or Main Fault). The fault is narrow, appears relatively impervious and not considered a significant detriment to the dam integrity. Similarly, a healed mylonite zone is located high on the right abutment.'*

- *'The dam has been located so that the contact between the limestone to the north and intrusive breccia to the south is located under a portion of the ultimate downstream dam shell.'*

- *'The inferred fault strikes approximately east-west and is thought have a vertical dip. The exact location of this contact is important to the proposed tailings dam. The dam footprint is currently set so the till core is south of the contact…The contact runs parallel to the dam alignment, and therefore will not pose any seepage problems.'*

Additional investigations were recommended to:

- Improve characterization of the overburden and rock in the dam foundation.

- Improve characterization of the Main Fault, the mylonitic thrust fault on the right abutment, and the limestone contact.

3.2 FINAL DESIGN LEVEL - GEOLOGIC INTERPRETATION

BGC completed the recommended additional drilling and mapping under the tailings dam during the summer and fall of 2006. The additional data collected has provided confirmation of and elaboration of the geologic model at the site.

3.2.1 Geology Overview

Mapping of geology specific to the proposed tailings dam footprint by others, as well as NovaGold and BGC has been difficult due to limited exposure of bedrock. However, based on the 2006 drilling, test pit excavations, and mapping, the following updated interpretation has been prepared. This work is ongoing and a senior level review of the data is scheduled in the near future.

The overburden thickness beneath the main tailings dam has been reinterpreted based on the 2006 field investigations (Drawing 06). Overburden was generally found to be thinner than expected.

3.2.2 Lithological Units

Six lithological units (3 major units & 3 minor units) have been identified around the tailings dam area:

Major lithological units:

1. Volcaniclastic sediments
2. Limestone
3. Quartz monzonite

Minor lithological units:

4. Syenite dykes
5. Argillite & quartzite (in limestone contact zone)
6. Mafic dykes

The majority (80%) of the bedrock underlying the dam consists of volcaniclastic sediments – as shown in plan view on Drawing 07 and in the geologic cross sections perpendicular and parallel to the dam - Drawing 08 and Drawing 09. Limestone occurs north of the impervious dam core, under a portion of the downstream shell. The intrusive quartz monzonite is visible at the surface along the proposed final spillway alignment. Syenite, argillite, quartzite and the mafic dykes are minor lithological units. Syenite dykes are visible on the plan map - Drawing 07. Small mafic dykes are shown in the drillholes on the cross-sections - Drawing 08 and Drawing 09. Argillite and quartzite exist at surface at the limestone contact and in drill core PC06-019 within the limestone unit - Drawing 07.

A brief description of each of these units follows.

Lithologic Unit 1 - Volcaniclastic Sediments

Volcaniclastic sediments were observed in surface outcrops and in most of the drill core. The volcaniclastic sediments are typically dark to light green with a fine grained chlorite groundmass. The rock is typically medium strong (R3) and slightly weathered. The rock mass has a Geological Strength Index (GSI) rating[1] of 40 to 70. Extensive chlorite, epidote, and plagioclase feldspar alteration exists within the rockmass. Epidote occurs predominantly on joint surfaces, in veins, and within and around clasts and phenocrysts. The dominant joint set is near vertical and is spaced at 0.02 m to 0.5 m. The average RQD for this rock type is 25% to 30%. Calcite,

[1] GSI ratings range from 10 = extremely poor rock mass to 100 = intact rock.

chlorite, epidote, and iron oxides commonly occur as joint infill. Small faults exist with gouge and crushed rock infill. Mafic dykes up to 1 m thick and syenite dykes up to 20 m thick are common.

This unit has been variously identified as: crystal-lithic tuff, or resedimented volcanic or epiclastic rocks (Leitch, 2006); orthoclase bearing volcanics, diamictite, conglomerate, resedimented porphyritic mafic volcanic, mafic volcanic (NovaGold, 2005, 2006); and undivided volcanics and sediments (Logan, 1994).

Lithologic Unit 2 - Limestone

The limestone unit varies from dark grey to white with areas of recrystallization (Grant, 1964) and zones of marble. Bedding is identified as bands of darker grey. Convoluted bedding can be seen both in drill core and outcrop in the dam area. Minor folding and faulting of bedding is common. The limestone is very strong (R5) and fresh to moderately weathered in outcrop and in core. The average RQD for this rock type is 55% to 60%. Discontinuity surfaces vary in roughness and hematite is sometimes observed. Localized areas of intense garnet alteration and small intervals of volcanics commonly occur within the rock. Argillite and quartzite beds were described by NovaGold at surface and in drill core collected by BGC.

Limestone in the general area is karstic. However only minor evidence of karst has been revealed at the dam footprint by mapping. Photo 1 shows the first appearance of limestone in the valley bottom. Photo 2 shows solution widening (up to 1 m wide) of vertical joints in the steep limestone cliffs. Small cavities (up to 1 m across) are also noted on vertical limestone faces near drillhole PC06-019 (Photo 3). No large solution voids or caverns have been observed in surface limestone outcrops within the dam footprint.

Holes DH-BGC06-06 and PC06-019 were drilled specifically to characterize the limestone. Borehole DH-BGC06-06, located on the west abutment and near the downstream toe of the ultimate dam, intersected approximately 155 m of limestone. Borehole PC06-019, located in the valley bottom, drilled through approximately 140 m of limestone. No large voids or other dissolution features were intersected in either hole. Recovery of core limestone for both holes was 97% (although evidence of strong karst development was not present, the dam has been sited to ensure the impervious core is located upstream of any limestone units – Drawing 07).

Lithologic Unit 3 - Quartz Monzonite

A quartz monzonite is present at the surface near the spillway and has been identified in boreholes DH-BGC06-12 and DH-BGC06-14. This unit was also intersected at depth in boreholes PC06-019 and DH-BGC06-06. The rock is strong to very strong (R4 to R5) and is fresh to slightly weathered. At surface, three near orthogonal joint sets form blocks with minor iron staining on the joints. Typical joint spacing is 0.4 m to 1 m. The average RQD for this rock

type is 60% to 65%. At depth, calcite and quartz occur as veins and joint infill. Iron oxide can occur as joint infill or as minor alteration. The rockmass is of good quality with a GSI rating of 70 to 80. In general, the rock has a peppered appearance with medium to coarse black, grey, white and green grains. It has an equigranular texture with some banding caused by zones of epidote, potassic, and hematite alteration. The mineral composition of the rock is predominantly plagioclase and orthoclase with chlorite altered horneblende, quartz, and minor magnetite.

This mineralogy of this unit varies and has been classified by NovaGold at various times as a granodiorite and granite.

Lithologic Unit 4 - Syenite

Syenite was observed in surface outcrops, typically as dykes 1 m to 20 m wide, and in borehole DH-BGC06-13. The rockmass is typically highly fractured, and slightly weathered. Depending on the degree of alteration, the strength of the syenite ranges from weak (R2) to strong (R4). The contacts of the syenite dykes with the host volcaniclastic sediments are locally faulted, with some xenoliths observed in the syenite. The syenite dykes are generally flat to steeply dipping with variable strikes. Outcrops of syenite are blocky to shattered with GSI ratings from 50 to 70. This rock is a pink to purplish grey with a grain size varying from fine grained to porphyritic. In general, fine to coarse grains of tablular potassium feldspar occur in a fine grained hematite altered groundmass.

Lithologic Unit 5 - Argillite and Quartzite

Argillite and quartzite exist at surface at the limestone contact and at depth in PC06-019 within the limestone unit. The argillite is light pinkish grey and fine grained. The texture of the rock has been destroyed by intense garnet alteration. The rock is slightly weathered and medium strong (R3). Epidote and iron oxide staining is noted on joint surfaces with calcite commonly occurring as veins and infill.

The quartzite is light greenish grey and is largely composed of recrystallized quartz. This rock occurs at depth in PC06-019 in the vicinity of a fault zone and is fractured with evidence of healed faulting and shearing throughout. The rock is slightly weathered and medium strong (R3). Calcite veins and iron oxide joint infill are noted throughout the unit.

Lithologic Unit 6 - Mafic Dykes

Mafic dykes are observed in all the rock units in various drill holes (i.e. DH-BGC06-01 and 06). The dykes are typically less than 3 m wide, are black to dark green and fine grained. They are typically massive and may be porphyritic with pale “ghost” feldspar phenocrysts. The rock is medium strong (R3) and slightly weathered. Dykes may be chlorite and epidote altered with calcite veining.

3.2.3 Contact Relationships

Limestone/Volcaniclastic Contact

Geologic mapping and additional drilling in 2006 has improved our interpretation of the contact between the limestone and volcaniclastic sediments as it relates to the tailings dam. Drilling has confirmed that the contact is located under a portion of the downstream shell – as shown in Drawing 07 and Drawing 08. Limestone is located north of the impervious core. The location of the contact is similar to that presented in BGC's feasibility study (BGC, 2006a), with slight adjustments based on recent mapping by BGC and C. Leitch.

As proposed in 2005, the contact is still considered to be a fault, likely normal and dipping to the southeast at approximately 60° to 65° - as shown in Drawing 08. The limestone, volcaniclastic sediments, argillite, and quartzite are observed to interfinger along the contact; based on surface mapping, this contact zone is approximately 35 m wide. A more detailed description of this fault contact is provided in Section 4.2.2.

Quartz Monzonite/Limestone Contact

The Jurassic quartz monzonite unit is younger than the surrounding Permian limestone and Triassic volcaniclastic sediments. In drill holes DH-BGC06-06 and PC06-019, the contact between the quartz monzonite unit and the overlying limestone is located along the Main Fault structure – as shown in the cross section in Drawing 08. The lack of intense marbleization in the limestone near this contact also implies that the limestone was faulted into place above the quartz monzonite.

Strong chlorite, epidote, and carbonate alteration exists within the quartz monzonite in the vicinity of the fault. This can result in a dark green, fine grained appearance as the alteration destroys the intrusive texture. Alteration lessens away from the contact.

4.0 STRUCTURAL GEOLOGY

4.1 OVERALL STRUCTURAL FABRIC

Four families of joints and faults have been identified through structural mapping at the tailings dam site. The structures tend to follow the patterns summarized below:

1. North trending faults, dipping to the east and west at 43° ± 32°

2. Northwest trending faults, dipping to the northeast and southwest at 56° ± 29°

3. Northeast trending faults, dipping to the southeast and northwest at 65° ± 30°

4. West trending faults, dipping to the north and south at 61° ± 29°.

In addition to these, one north trending reverse fault was also measured dipping at 50° to the west.

These four families of minor faults and joints occur frequently and some parallel major structural features as part of larger fault zones. This results in the closely jointed and highly fractured nature of the bedrock that is responsible for the geomorphology of the Galore Creek valley. Specifically, the scree slopes on the right dam abutment are caused by the interaction of these fault families intersecting at close spacing. This creates a highly fractured rockmass that is released along fault planes as Galore Creek erodes the toe of the slope. Petrographic analysis conducted in drill core from DH-BGC05-04 (BGC, 2006b) showed signs of shearing and micro-fractured fabric, consistent with a rockmass within the "zone of influence" of faulting.

4.2 MAJOR FAULTS

Two fault zones initially recognized from 2004 and 2005 mapping and air photo interpretation were further characterized in 2006. No new structures have been identified.

1. **Main Fault** - A normal fault (or fault zone), dipping to the southwest (210°) at approximately 45° to 55° is interpreted to intercept the east abutment as shown on Drawing 07. This feature, initially recognized as being the main fault in Galore Creek valley, can be up to 43 m wide with areas of clay-rich gouge, intense shearing and brecciation. A mylonitic shear zone encountered in DH-BGC05-03 is considered to be a portion of the main fault. This structure parallels the northwest trending family of minor faults and joints.

2. **Limestone Fault** – A fault contact between limestone and volcaniclastic sediments striking roughly northeast (approx. 55°) dips to the southeast at approximately 60° to 65°. This feature parallels the family of west trending minor faults and joints.

Drawing 07, Drawing 08, and Drawing 09 show the interpreted location of each of these structures in plan and/or cross section. Due to the intense faulting in this area, offsets along each of these major structures may exist. The descriptions below are based on the interpretation of a single plane through observed data.

4.2.1 Main Fault

The Main Fault is a normal fault striking to the southeast across the east abutment – Refer to Drawing 07, Drawing 08, and Drawing 09. This fault was thought to be located near the valley bottom, but was not intersected in any of the 2005 drillholes. In 2006, a deep inclined borehole (PC06-021) was drilled in the valley bottom, trending northeast (approximately perpendicular to the assumed strike of the Main Fault). This borehole, PC06-021, as well as PC06-019 and DH-BGC06-06 all intersected a major fault at depth, which is now interpreted as the 'Main Fault'. Extrapolation of the trend of the fault plane from three boreholes (PC06-19, PC06-21, and DH-BGC06-06) up the valley slope intersects the mylonite zone located in DH-BGC05-03 (Drawing 09). The Main Fault is now also thought to include the mylonitic shear zone observed in DH-BGC05-03.

Table 2 summarizes the depths and descriptions of the 'Main Fault' in 2005 and 2006 boreholes.

Table 2. Main Fault Identified in 2006 Boreholes

Hole ID	Depth Range of Fault (m)	Thickness (m)	Description of Fault
PC06-019	197.4 - 209.1	11.7	1 m of hematite and clay rich gouge overlying greenish grey, weak to very weak, sheared and brecciated fine grained rock fragments with areas of sheared weak rock.
PC06-021	261.6 – 285.8	22.6	Several areas of dark reddish grey, weak, hematite rich gouge within a sheared and altered rock unit overlie 5.5 m of limestone and 0.5 m of soft, black, clay rich gouge and breccia. This overlies greenish grey, weak, sheared and brecciated, rock fragments and areas of sheared rock.
DH-BGC06-06	167.5 -173.3	5.8	Dark grey, brown and yellow, very weak, sheared and brecciated, hematite rich clay gouge and rock fragments with areas of sheared weak rock.
DH-BGC05-03	27.4 – 70.1	42.7	Dark grey, brown and yellow, very weak, sheared, brecciated, mylonitic, hematite rich clay gouge and rock fragments with areas of sheared weak rock.

Based on these drillholes and outcrop mapping, this fault trend has been refined so that it has an approximate 45° to 55° dip with a dip direction of 210° orientation in the vicinity of the tailings dam. This fault is 6 m to to 43 m wide based on boreholes DH-BGC06-06 and DH-BGC05-03. It is typically defined by zones of clay-rich gouge up to 1 m thick, overlying weak, intensely sheared rock. The country rock above and below the zones specified in Table 2 shows shear textures and minor faulting also. Photo 4 and Photo 5 show examples of the main fault in core

The fault is considered to be relatively impervious. Packer testing has been conducted within the main fault in boreholes DH-BGC06-06, PC06-19, PC06-21, and DH-BGC05-03. Packer testing results for intervals in the main fault zone are summarized in Table 3. Hydraulic conductivity of the clay rich gouge and shear zones of the main fault ranges from 10^{-7} m/s to 10^{-9} m/s.

Table 3. Packer Test Data from Main Fault Zone

Hole ID	Test Interval			Vertical depth to midpoint (m)	Estimated Hydraulic Conductivity (m/s)
	From (m)	To (m)	Interval (m)		
DH-BGC06-06	159.7	172.0	12.2	165.9	1E-08
PC06-19	176.9	196.4	19.5	169.1	2E-08
	193.4	202.4	9.0	179.3	2E-08
	206.9	216.6	9.7	191.9	2E-07
PC06-21	249.9	264.9	15.0	233.2	6E-09
	264.9	279.9	15.0	246.8	2E-08 (Note1)
	279.9	288.8	8.9	257.7	1E-07
DH-BGC05-03	23.8	46.9	23.1	35.4	5E-08
	46.9	64	17.1	55.5	8E-09
	63.8	70.1	6.3	67.0	3E-08

Notes:
1. Very little data collected for these tests; results are suspect.

The fault runs perpendicular to the main dam centerline and does not daylight at the toe of the existing slope. This fault is therefore considered to have limited to no impact on the stability of the dam. In addition, the fault is located high on the east abutment and dips at a relatively steep angle (45° - 55°) towards the southwest.

In terms of seepage out of the impoundment, the main fault is oriented parallel to the direction of seepage, however, based on the estimates of hydraulic conductivity, this feature does not represent a high hydraulic conductivity flow path under the dam. Seepage calculations have accounted for the presence and permeability of this structure.

4.2.2 Limestone Fault

The contact between the limestone to the north and volcaniclastic sediments to the south is located under the downstream toe of the ultimate tailings dam shell is interpreted to be a fault zone – as discussed in Section 3.2.3 above. This faulted contact was observed at the surface in the valley bottom and in PC06-019 at the top of this borehole. Based on surface mapping, this fault zone is not a discrete feature but is up to 35 m thick and dips approximately 60° to 65° to the southeast – Refer to Drawing 07. The fault trend varies, but in general trends northeast similar to the family of minor faults trending to the northeast (Refer to Section 4.1).

Within this fault zone, the limestone is observed to interfinger with volcaniclastic sediments, metamorphosed argillites, and intense white, heavily garnet altered marble. This interfingering may be due to splay faulting along the contact or the influence of other prominent fault sets in the area. Photo 7 shows an example of interfingering of the limestone / volcaniclastic fault contact in the valley bottom.

Although this faulted contact occurs under the downstream shell, its impact on the stability of the dam is likely none because of its orientation – the limestone fault dips at 60° to 65° in an upstream direction. The fault is not considered to be detrimental to dam stability. In terms of increased seepage out of the impoundment, this feature does not represent a high hydraulic conductivity flow path under the dam. Packer testing in the fault zone indicates it has a similar hydraulic conductivity to the underlying limestone unit. The contact also runs parallel to the dam that will limit seepage.

4.3 LIMESTONE OUTLIERS

South of the limestone fault contact, limestone outliers are observed at the surface and in various drillholes. In Drawing 07, there is small limestone outcrop on the western slopes above the ultimate dam crest. In October 2005, NovaGold geologist D. Smithson noted limestone fragments in a shear zone in the valley bottom near the tailings dam – Refer to Photo 8 and Photo 9. Limestone was also observed in borehole PC06-021 at the bottom of the hole (276.5 m to 282 m), likely a part of the main fault. All limestone outliers are likely due to fault splays off the major faults (i.e. main fault or limestone fault contact) that have brought in fragments of limestone from the north; none are considered to be continuous limestone bodies.

5.0 HYDROGEOLOGY

5.1 WATER LEVELS

Around the tailings dam site, the groundwater table is near surface and typically artesian at depth in the bedrock. Groundwater levels measured in August 2006 from standpipe piezometers are show on Drawing 08 and Drawing 09.

Artesian conditions exist in a total of six boreholes beneath the main tailings dam footprint: PC06-019, PC06-021, DH-BGC05-03, DH-BGC05-04, DH-BGC05-15, DH-BGC06-03. These are shown with head levels above the ground surface on Drawing 10. In general, artesian head levels between 2 m and 33 m (i.e. meters of water above the ground surface) are measured in the volcaniclastic sediments from 0 to 70 m depth. Below 70 m, artesian head levels from 22 m to 72 m are measured.

Water levels in the limestone were measured by the piezometers installed in boreholes DH-BGC06-06 and PCO6-019. In DH-BGC06-06, two standpipe piezometers are installed with completion zones at 58 m and 66 m from the ground surface. The water levels for the upper and lower piezometers were measured as 30 m and 26 m below the ground surface, indicating upward flow. In PC06-19, the two vibrating wire piezometer installed at 46 and 91 m depth were both artesian. The water levels for the upper and lower piezometers were measured as 44 and 59 m above the ground surface, indicating upward flow.

5.2 PACKER TESTING

Seventy-two packer tests (constant head, rising head, falling head, and shut-in tests) were completed in the twelve 2006 geotechnical holes within the tailings dam footprint: DH-BGC06-01, 02, 03, 04, 06, 10, 12, 13, 14, 20; PC06-019, PC06-021. Estimates of bedrock hydraulic conductivity were calculated from these tests and are summarized in Table 4.

Table 4. 2006 Hydraulic Conductivities for Main Lithologic Units

Lithology	Range of Hydraulic Conductivity (m/s)
Volcaniclastic	10^{-6} to 10^{-9} m/s
Limestone	10^{-6} to 10^{-9} m/s
Quartz monzonite	10^{-7} to 10^{-10} m/s

6.0 IMPACTS OF KARSTIC LIMESTONE ON TAILINGS DAM STABILITY & SEEPAGE

Karst in the form of crevices or small caves has been observed in the canyon downstream of the proposed dam. No large voids or caverns have been identified in the limestone to the north of the dam core during the 2004, 2005 or 2006 investigations. This karst, if it were present under the dam, could allow seepage to escape the impoundment. Although karst can be sealed with grout, NovaGold has chosen to place the impervious core of the tailings dam and grout curtain approximately 100 m upstream of the limestone / volcaniclastic fault contact. This will provide hydraulic closure and prevent water from seeping out of the impoundment through karst.

References:

BGC, 2005. Galore Creek – Waste and Water Management – Prefeasibility Geotechnical Report. Prepared for NovaGold Resources Inc. Project No. 0386-001-60. Issued February 9, 2005.

BGC, 2006a. Galore Creek Project, British Columbia. Waste and Water Management – Feasibility Geotechnical Report. FINAL. Prepared for NovaGold Resources Inc. Project No. 0386-002-20. Issued 21 April 2006.

BGC, 2006b. Galore Creek Project, British Columbia – Feasibility – Geotechnical and Hydrogeological Site Investigation Report. FINAL. Prepared for NovaGold Resources Inc. Project No. 0386-002-20. Issued 28 April 2006.

PHOTOGRAPHS

DRAWINGS

Photo 1. Looking downstream (north) at limestone under footprint of tailings dam.
June 13, 2005

Photo 2. Joint in limestone with solution widening.
October 2006

Photo 3. Karstic voids / cavities in limestone near tailings dam.
June 13, 2005

Photo 4. Interfingering along limestone - volcanic contact in valley bottom.
June 2005

Photo 5. Gouge in borehole PC06-019. Main Fault.
June 30, 2006

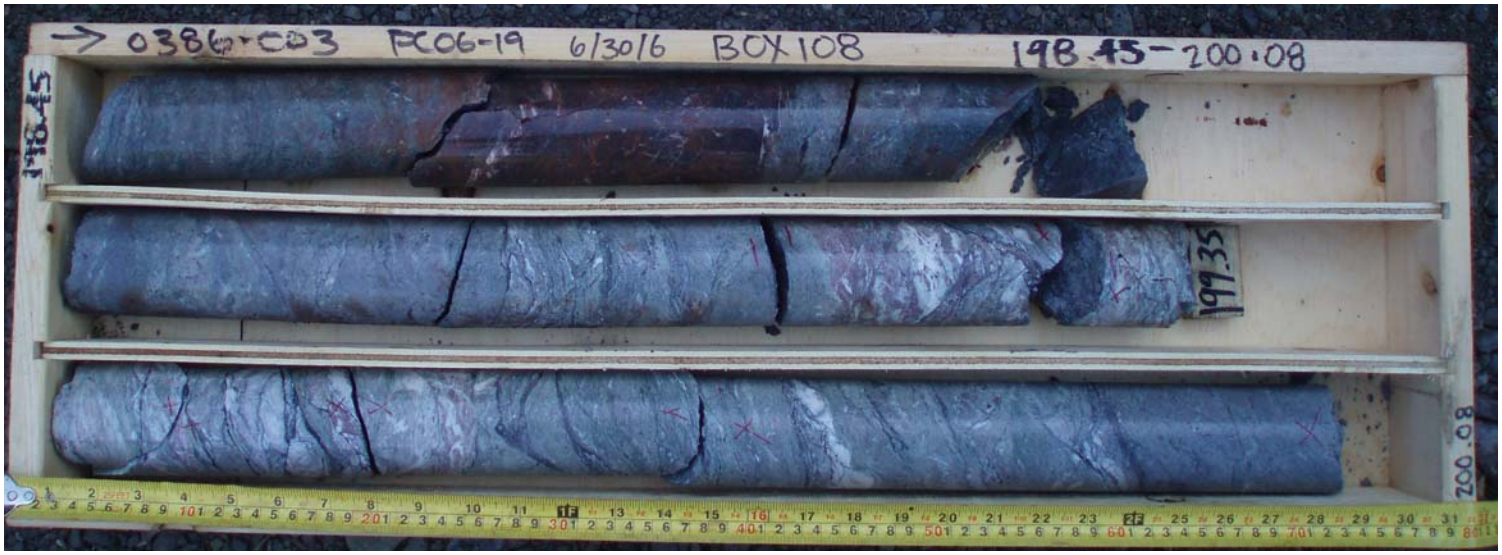
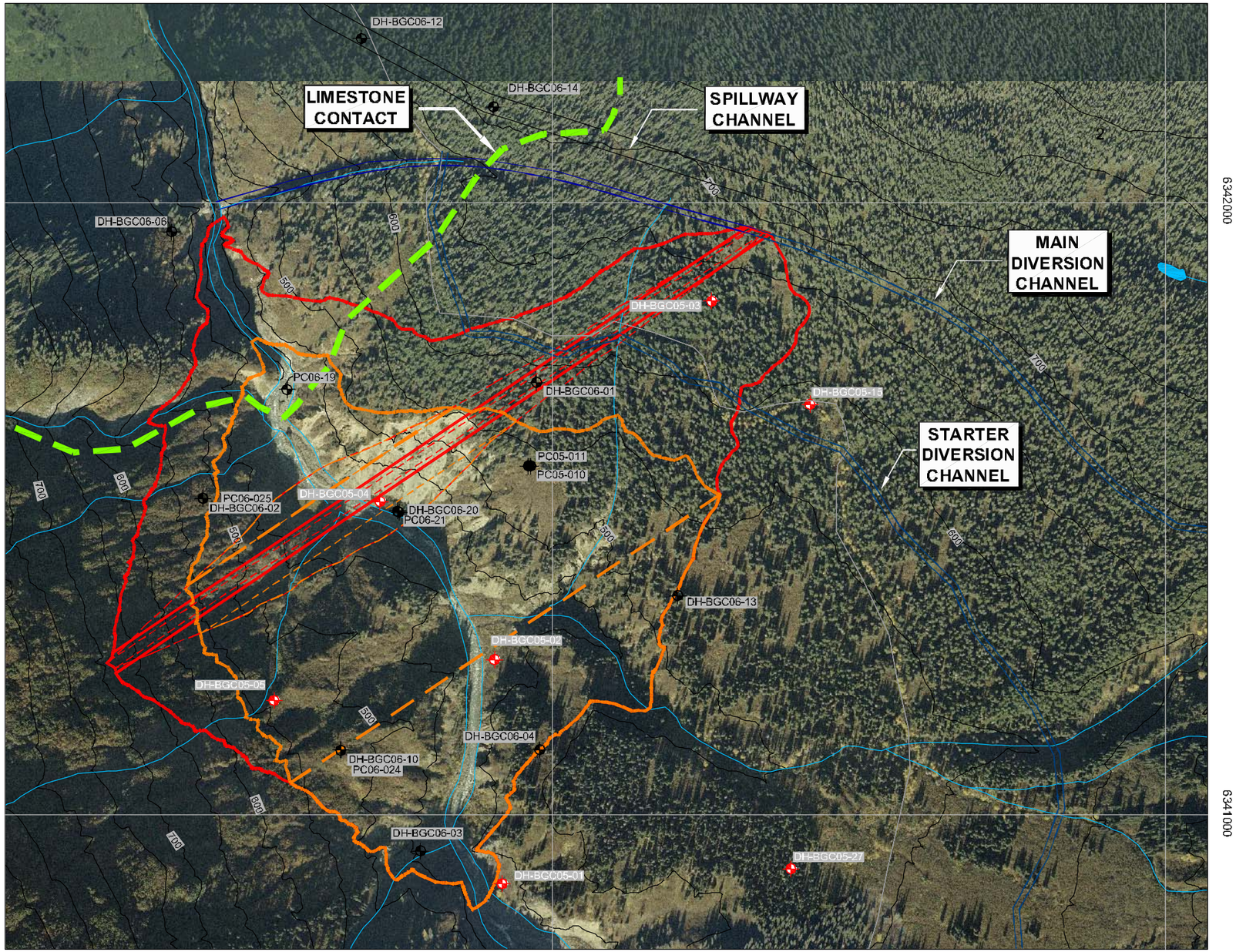


Photo 6. Gouge and shear texture in borehole PC06-019. Main Fault.
June 30, 2006

Photo 7. Gouge and shear texture in borehole DH-BGC05-03. Mylonitic Shear Zone.
June 2005

Photo 8. Shear zone contains limestone fragments in gouge - valley bottom
NovaGold Mapping: P-Dam-6-60; Photo Date: 11 October 2005

Photo 9. Shear zone contains limestone fragments in gouge - valley bottom
NovaGold Mapping: P-Dam-6-61; Photo Date: 11 October 2005



N

NOTES:
1. CONTOURS BASED ON 2004 EAGLE MAPPING TOPOGRAPHY.
2. DH-BGC06-02 AND PC06-025 OCCUPY SAME LOCATION.
3. DH-BGC06-10 AND PC06-024 OCCUPY SAME LOCATION.
4. PC05-010 AND PC05-011 OCCUPY SAME LOCATION.

Scale 1:7500

150 0 150 300 450

meters

LEGEND

- BGC 2005 DRILL HOLES
- BGC 2006 DRILL HOLES
- NOVAGOLD/HMM DRILL HOLES
- ULTIMATE DAM FOOTPRINT
- STARTER DAM FOOTPRINT
- IMPERVIOUS CORE - ULTIMATE
- IMPERVIOUS CORE - STARTER
- HATCH DIVERSION CENTRELINE
- REDEVELOPED KENNECOTT ROAD

JTM NAD 83 ZONE 9
CONTOUR INTERVAL 50M

DRAWINGS TO BE READ WITH BGC REPORT ENTITLED "TAILINGS DAM - GEOLOGIC CONDITIONS MEMO", DATED NOV, 2006.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	1:7500
DATE:	NOV 2006
DRAWN:	CJT
DESIGNED:	JB\LAW
CHECKED:	LAW
APPROVED:	IGB

PROFESSIONAL SEAL:

DRAFT

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: NovaGold Resources Inc.

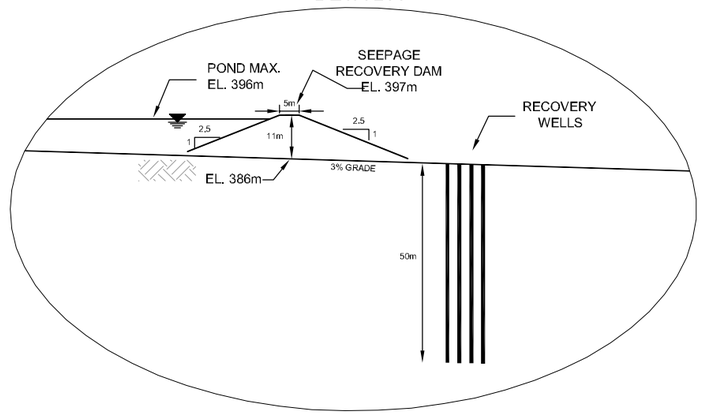
PROJECT: GALORE CREEK - BASIC ENGINEERING

TITLE: TAILINGS DAM - ORTHOPHOTO

PROJECT No.:	DWG No.	REV.:
0386-003	01	0

X:\Projects\0386\dwg\Feasibility\0386-002-20 004 MAIN_DAM.dwg Layout: GEOMEMO Plt: Date Nov 14 06 Time: 1:36 PM

DETAIL A



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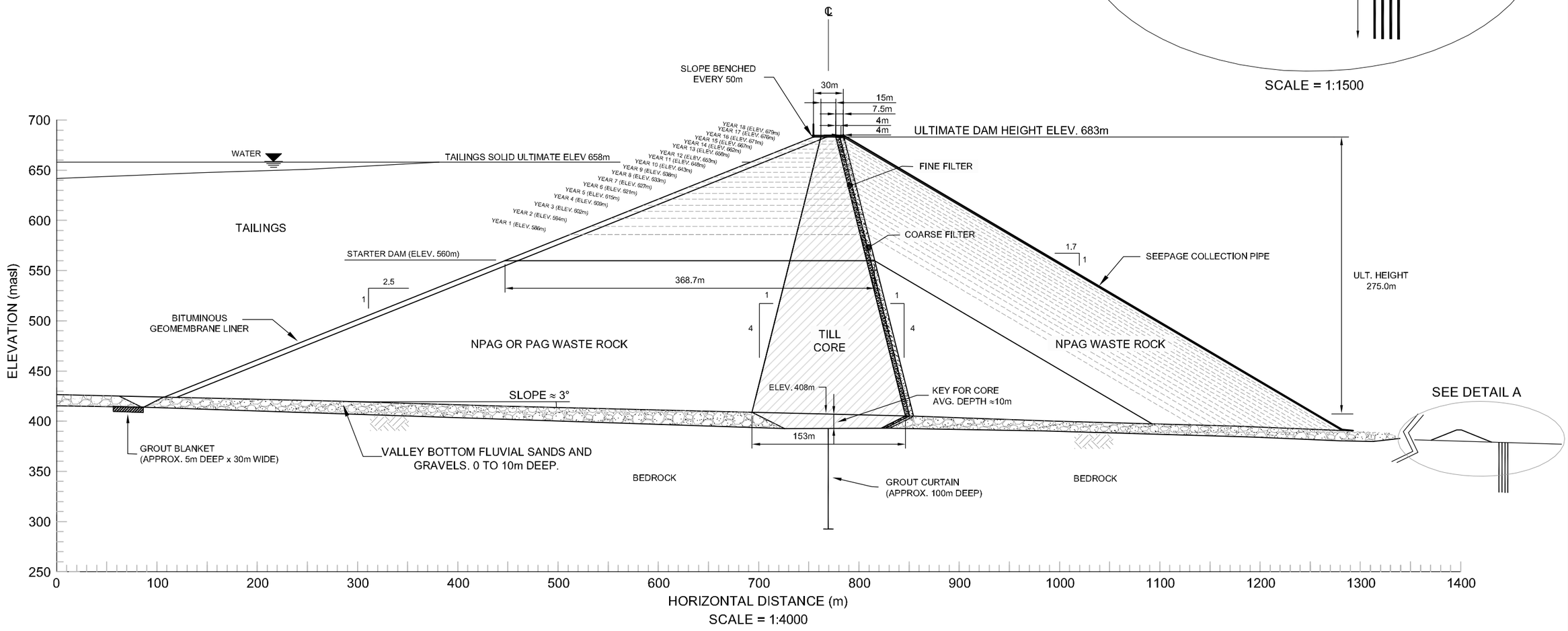

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DRAWINGS TO BE READ WITH BGC REPORT ENTITLED "TAILINGS DAM - GEOLOGIC CONDITIONS MEMO", DATED NOV, 2006.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	1:4000
DATE:	NOV 2006
DRAWN:	CJT
DESIGNED:	JB\LAW
CHECKED:	LAW
APPROVED:	IGB

PROFESSIONAL SEAL:

DRAFT

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

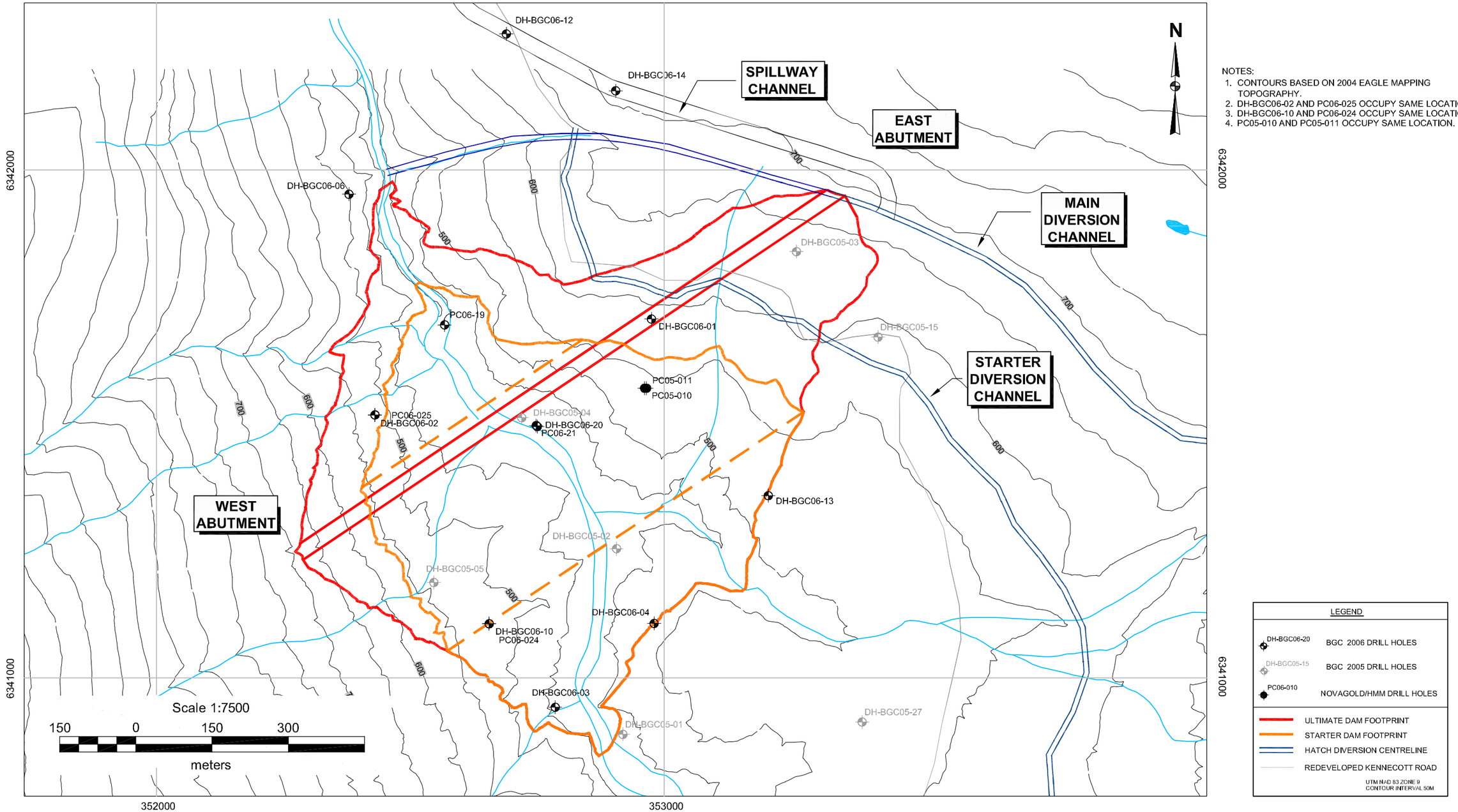
CLIENT: NovaGold Resources Inc.

PROJECT: GALORE CREEK - FEASIBILITY STUDY

TITLE: TAILINGS DAM DESIGN - TYPICAL CROSS-SECTION

PROJECT No.:	DWG No.	REV.:
0386-002-20	02	0

X:\Projects\0386\dwg\Feasibility\0386-002-20 005 Dam XSection_MODIFIED.dwg Layout: TAILSMEMO Plot Date Nov 14 06 Time: 1:37 PM



NOTES:
1. CONTOURS BASED ON 2004 EAGLE MAPPING TOPOGRAPHY.
2. DH-BGC06-02 AND PC06-025 OCCUPY SAME LOCATION.
3. DH-BGC06-10 AND PC06-024 OCCUPY SAME LOCATION.
4. PC05-010 AND PC05-011 OCCUPY SAME LOCATION.

DRAWINGS TO BE READ WITH BGC REPORT ENTITLED "TAILINGS DAM - GEOLOGIC CONDITIONS MEMO", DATED NOV, 2006.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	1:7500
DATE:	NOV 2006
DRAWN:	CJT
DESIGNED:	JB\LAW
CHECKED:	LAW
APPROVED:	IGB

PROFESSIONAL SEAL:

DRAFT

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: NovaGold Resources Inc.

PROJECT: GALORE CREEK - BASIC ENGINEERING

TITLE: TAILINGS DAM - DRILLHOLES 2005 AND 2006

PROJECT No.:	DWG No.	REV.:
0386-003	03	0

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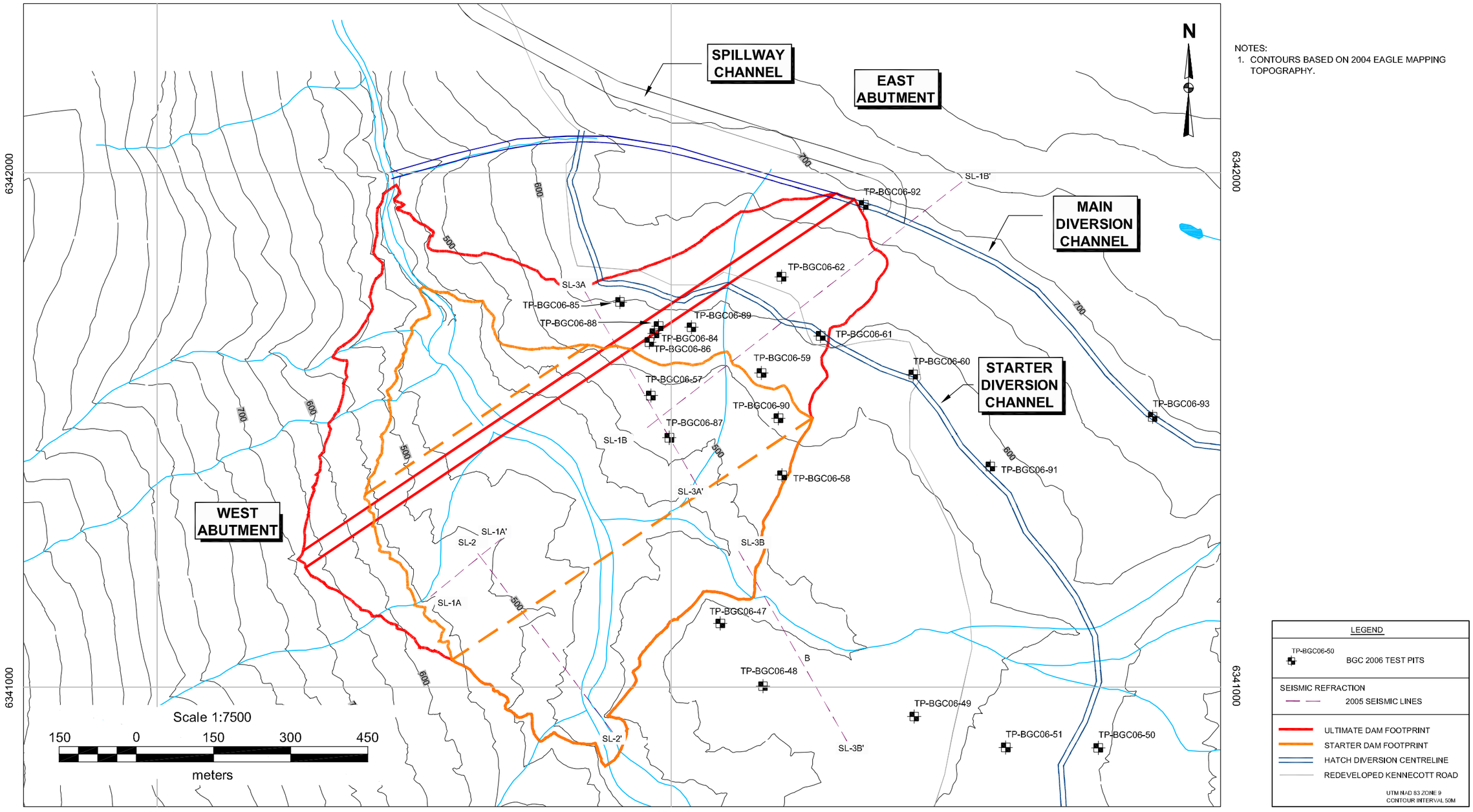

DRAWINGS TO BE READ WITH BGC REPORT ENTITLED "TAILINGS DAM - GEOLOGIC CONDITIONS MEMO", DATED NOV, 2006.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	1:7500
DATE:	NOV 2006
DRAWN:	CJT
DESIGNED:	LAW
CHECKED:	LAW
APPROVED:	IGB

PROFESSIONAL SEAL:

DRAFT

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: NovaGold Resources Inc.

PROJECT: GALORE CREEK - BASIC ENGINEERING

TITLE: TAILINGS DAM - BGC TEST PITS 2006 AND SEISMIC LINES

PROJECT No.:	DWG No.	REV.:
0386-003	04	0

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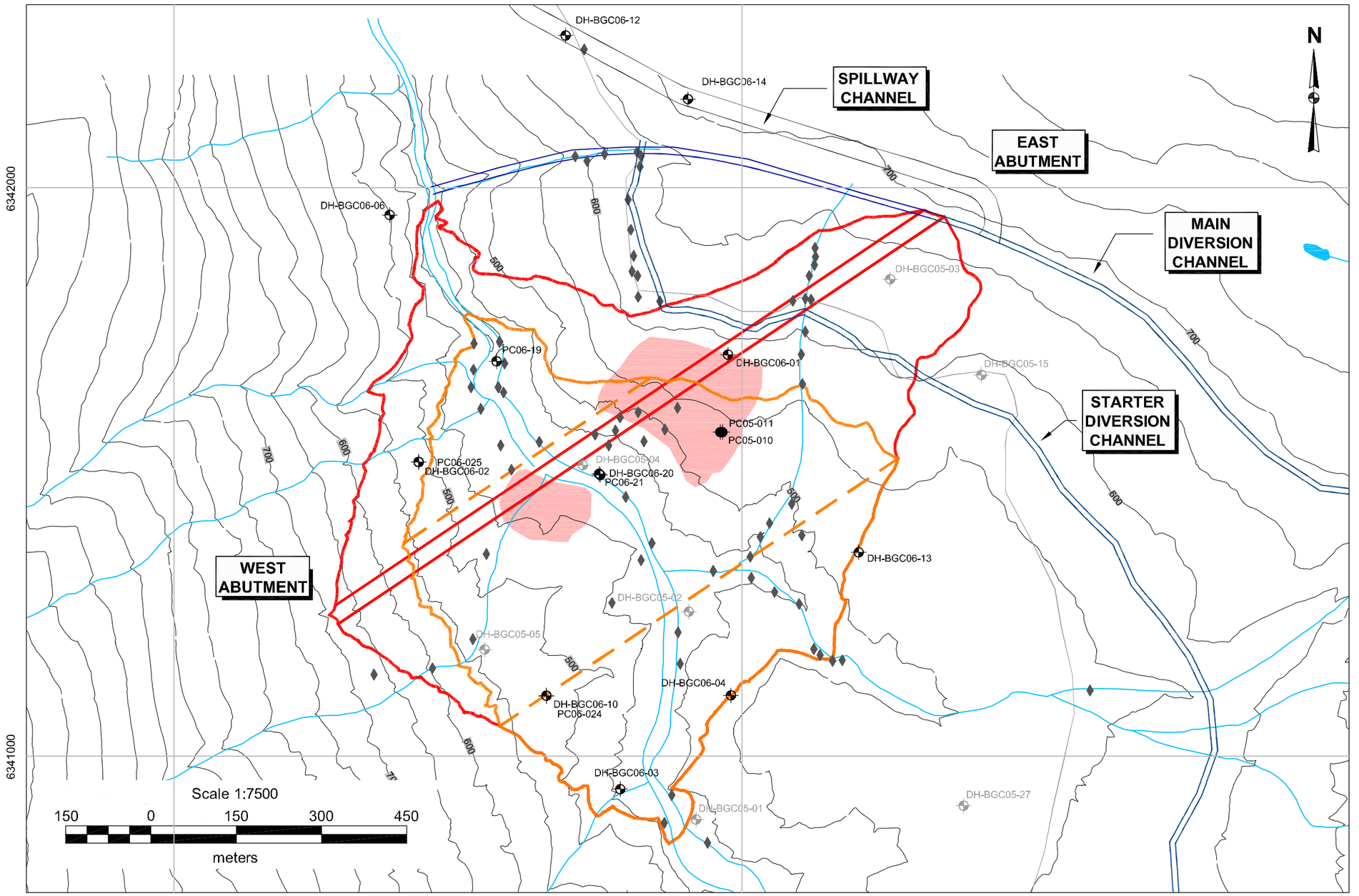

NOTES:
1. CONTOURS BASED ON 2004 EAGLE MAPPING TOPOGRAPHY.
2. DH-BGC06-02 AND PC06-025 OCCUPY SAME LOCATION.
3. DH-BGC06-10 AND PC06-024 OCCUPY SAME LOCATION.
4. PC05-010 AND PC05-011 OCCUPY SAME LOCATION.

LEGEND

- DH-BGC06-20 — BGC 2006 DRILL HOLES
- DH-BGC05-15 — BGC 2005 DRILL HOLES
- PC06-010 — NOVAGOLD/HMM DRILL HOLES
- ULTIMATE DAM FOOTPRINT
- STARTER DAM FOOTPRINT
- HATCH DIVERSION CENTRELINE
- REDEVELOPED KENNECOTT ROAD
- BGC OUTCROP MAPPING- ROCK
- BGC PHOTOGRAMMETRY AREAS

UTM NAD 83 ZONE 9
CONTOUR INTERVAL 50M

DRAWINGS TO BE READ WITH BGC REPORT ENTITLED "TAILINGS DAM - GEOLOGIC CONDITIONS MEMO", DATED NOV, 2006.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	1:7500
DATE:	NOV 2006
DRAWN:	CJT
DESIGNED:	JB\LAW
CHECKED:	LAW
APPROVED:	IGB

PROFESSIONAL SEAL:

DRAFT

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: NovaGold Resources Inc.

PROJECT: GALORE CREEK - BASIC ENGINEERING

TITLE: TAILINGS DAM - BGC ROCK OUTCROPS AND PHOTOGRAMMETRY AREAS

PROJECT No.:	DWG No.	REV.:
0386-003	05	0

X:\Projects\0386\dwg\Feasibility\0386-002-20 004 MAIN_DAM.dwg Layout: GEOMEMOS Plot Date: Nov 14 06 Time: 1:39 PM

352000

353000

6342000

6341000

N

SPILLWAY CHANNEL

EAST ABUTMENT

MAIN DIVERSION CHANNEL

STARTER DIVERSION CHANNEL

WEST ABUTMENT

DH-BGC06-12
DH-BGC06-14
DH-BGC06-06
DH-BGC05-03
PC06-19
DH-BGC06-01
DH-BGC05-15
PC05-011
PC05-010
PC06-025
DH-BGC06-02
DH-BGC05-04
DH-BGC06-20
PC06-21
DH-BGC06-13
DH-BGC05-02
DH-BGC05-05
DH-BGC06-04
DH-BGC06-10
PC06-024
DH-BGC06-03
DH-BGC05-01
DH-BGC05-27

500
600
700

Scale 1:7500

150 0 150 300 450

meters

NOTES:

1. CONTOURS BASED ON 2004 EAGLE MAPPING TOPOGRAPHY.
2. OVERBURDEN THICKNESS INTERPRETED FROM BGC AND NOVAGOLD / EXPLORATION HOLES, SEISMIC REFRACTION SURVEY RESULTS, OUTCROP MAPPING AND AIR PHOTO INTERPRETATION.
3. DH-BGC06-02 AND PC06-025 OCCUPY SAME LOCATION.
4. DH-BGC06-10 AND PC06-024 OCCUPY SAME LOCATION.
5. PC05-010 AND PC05-011 OCCUPY SAME LOCATION.

LEGEND

DH-BGC05-05 BGC 2005 DRILL HOLES

DH-BGC06-20 BGC 2006 DRILL HOLES

PC06-010 NOVAGOLD/HMM DRILL HOLES

INTERPRETED OVERBURDEN THICKNESS

- 0-5m
- 5-10m
- 10-20m
- 20-30m
- 30-40m
- 40-50m
- 50m+

- ULTIMATE DAM FOOTPRINT
- STARTER DAM FOOTPRINT
- IMPERVIOUS CORE - ULTIMATE
- IMPERVIOUS CORE - STARTER
- HATCH DIVERSION CENTRELINE
- REDEVELOPED KENNECOTT ROAD

UTM NAD 83 ZONE 9
CONTOUR INTERVAL 50M

DRAWINGS TO BE READ WITH BGC REPORT ENTITLED "TAILINGS DAM - GEOLOGIC CONDITIONS MEMO", DATED NOV, 2006.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	1:7500
DATE:	NOV 2006
DRAWN:	CJT
DESIGNED:	JB\LAW
CHECKED:	LAW
APPROVED:	IGB

PROFESSIONAL SEAL:

DRAFT

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: NovaGold Resources Inc.

PROJECT: GALORE CREEK - BASIC ENGINEERING

TITLE: TAILINGS DAM - OVERBURDEN THICKNESS

PROJECT No.:	DWG No.	REV.:
0386-003	06	0

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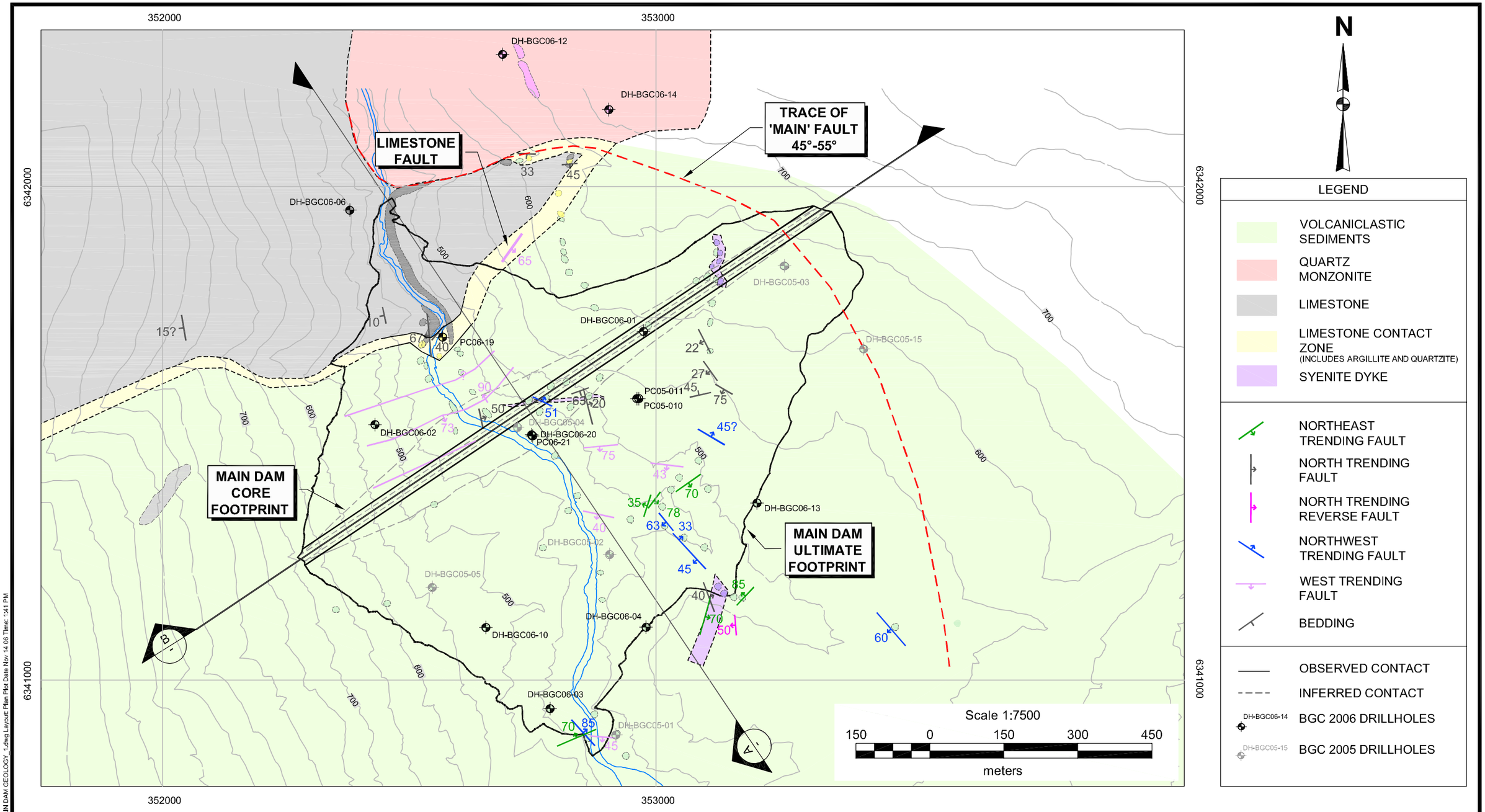

DRAWINGS TO BE READ WITH BGC REPORT ENTITLED "TAILINGS DAM - GEOLOGIC CONDITIONS MEMO", DATED NOV, 2006.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	1:7500
DATE:	NOV 2006
DRAWN:	CJT
DESIGNED:	JB\LAW
CHECKED:	LAW
APPROVED:	IGB

PROFESSIONAL SEAL:

DRAFT

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: NovaGold Resources Inc.

PROJECT: GALORE CREEK - BASIC ENGINEERING

TITLE: GEOLOGY PLAN

PROJECT No.:	DWG No.	REV.:
0386-002-20	07	0

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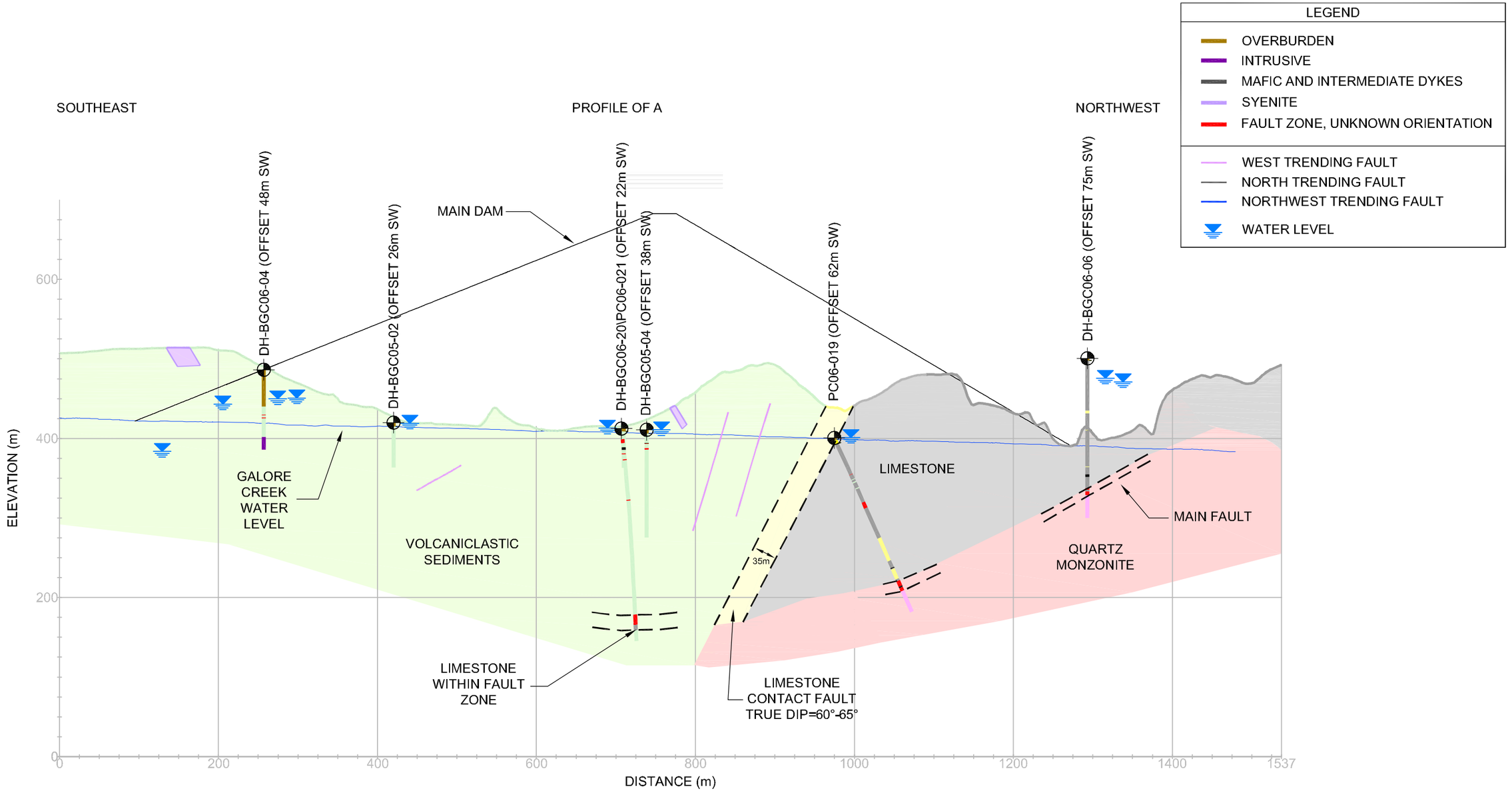

DRAWINGS TO BE READ WITH BGC REPORT ENTITLED "TAILINGS DAM - GEOLOGIC CONDITIONS MEMO", DATED NOV, 2006.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	1:5000
DATE:	NOV 2006
DRAWN:	CJT
DESIGNED:	JB\LAW
CHECKED:	LAW
APPROVED:	IGB

PROFESSIONAL SEAL:

DRAFT

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: NovaGold Resources Inc.

PROJECT: GALORE CREEK - BASIC ENGINEERING

TITLE: CROSS-SECTION A-A'

PROJECT No.:	DWG No.	REV.:
0386-003	08	0

X:\Projects\0386\003\dwg\Main Dam\BGC - MAIN DAM GEOLOGY_1.dwg Layout: SECTION_A Plot Date: Nov 14 06 Time: 2:21 PM

SOUTHWEST

PROFILE OF B

NORTHEAST

LEGEND

- OVERBURDEN
- INTRUSIVE
- MAFIC AND INTERMEDIATE DYKES
- SYENITE
- FAULT ZONE, UNKNOWN ORIENTATION
- WEST TRENDING FAULT
- NORTH TRENDING FAULT
- NORTHWEST TRENDING FAULT
- WATER LEVEL

ELEVATION (m)

900
700
500
300
100

0 200 400 600 800 1000 1200 1400 1600 1758

DISTANCE (m)

MAIN TAILINGS DAM ULTIMATE CREST ELEV. 683m

DH-BGC06-02 (OFFSET 142m NW)

GALORE CREEK

DH-BGC05-04 (OFFSET 23m SE)
DH-BGC06-20\PC06-021 (OFFSET 54m SE)

PC05-011 (OFFSET 111m SE)
PC05-010 (OFFSET 111m SE)

DH-BGC06-01 (OFFSET 4m SE)

DH-BGC05-03 (OFFSET 53m SE)

VOLCANICLASTIC SEDIMENTS

MYLONITIC SHEAR ZONE
TRUE DIP 30°-50°

MAIN FAULT
TRUE DIP=45°-55°

LIMESTONE WITHIN FAULT ZONE

DRAWINGS TO BE READ WITH BGC REPORT ENTITLED "TAILINGS DAM - GEOLOGIC CONDITIONS MEMO", DATED NOV, 2006.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	1:5000
DATE:	NOV 2006
DRAWN:	CJT
DESIGNED:	JB\LAW
CHECKED:	LAW
APPROVED:	IGB

PROFESSIONAL SEAL:

DRAFT

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: NovaGold Resources Inc.

PROJECT: GALORE CREEK - BASIC ENGINEERING

TITLE: CROSS-SECTION B-B'

PROJECT No.:	DWG No.	REV.:
0386-002-20	09	0

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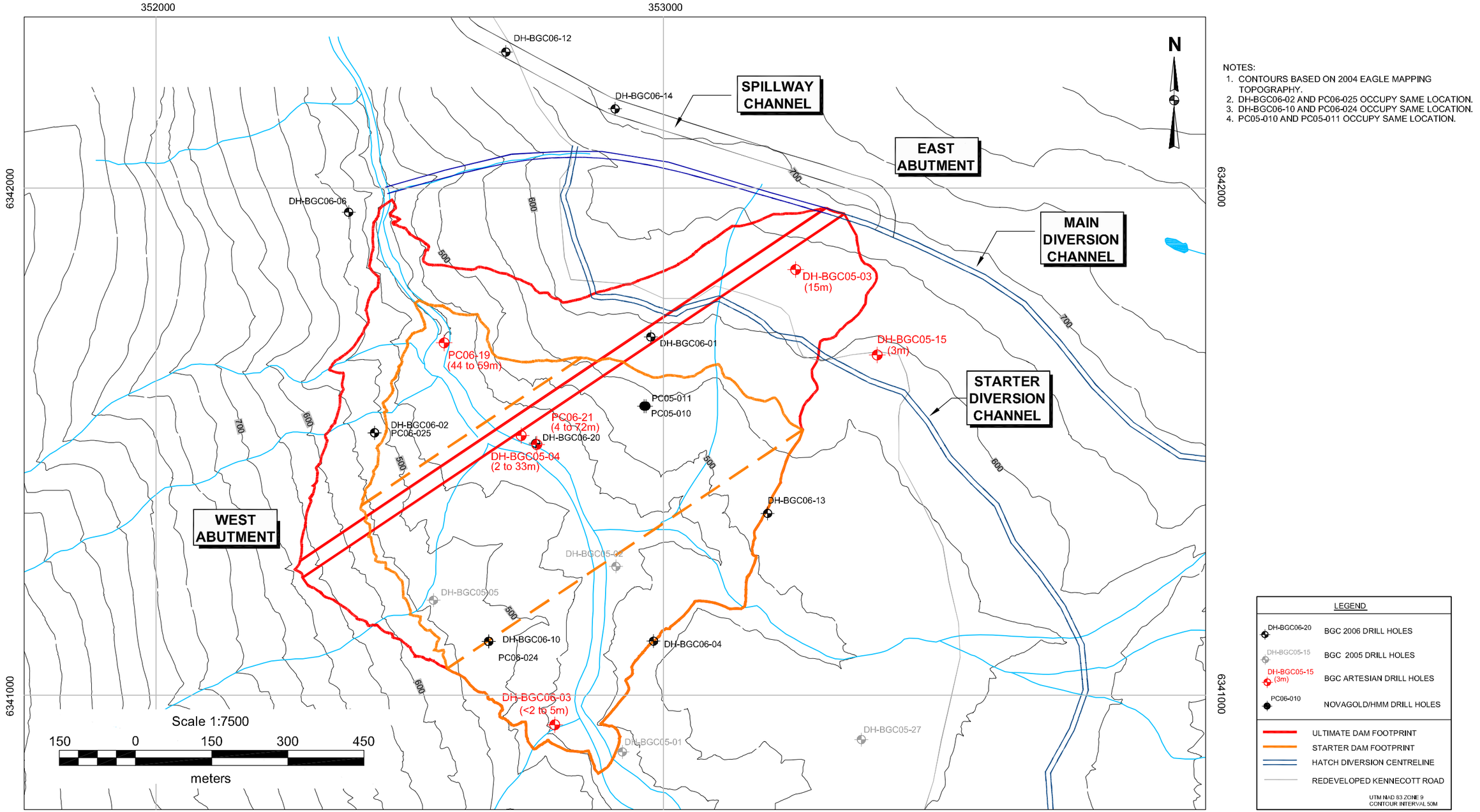

NOTES:
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2. DH-BGC06-02 AND PC06-025 OCCUPY SAME LOCATION.
3. DH-BGC06-10 AND PC06-024 OCCUPY SAME LOCATION.
4. PC05-010 AND PC05-011 OCCUPY SAME LOCATION.

LEGEND

- DH-BGC06-20 — BGC 2006 DRILL HOLES
- DH-BGC05-15 — BGC 2005 DRILL HOLES
- DH-BGC05-15 (3m) — BGC ARTESIAN DRILL HOLES
- PC06-010 — NOVAGOLD/HMM DRILL HOLES
- ULTIMATE DAM FOOTPRINT
- STARTER DAM FOOTPRINT
- HATCH DIVERSION CENTRELINE
- REDEVELOPED KENNECOTT ROAD

UTM NAD 83 ZONE 9
CONTOUR INTERVAL 50M

DRAWINGS TO BE READ WITH BGC REPORT ENTITLED "TAILINGS DAM - GEOLOGIC CONDITIONS MEMO", DATED NOV, 2006.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	1:7500
DATE:	NOV 2006
DRAWN:	CJT
DESIGNED:	JB\LAW
CHECKED:	LAW
APPROVED:	IGB

PROFESSIONAL SEAL:

DRAFT

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: NovaGold Resources Inc.

PROJECT: GALORE CREEK - BASIC ENGINEERING

TITLE: TAILINGS DAM - ARTESIAN HOLES

PROJECT No.:	DWG No.	REV.:
0386-003	10	0

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