Klohn Crippen Berger

January 7, 2009

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Northwest Territories Energy Corporation
206, 5102 50th Ave
Yellowknife, NT X1A 3S8

By email: dgrabke@nwtec.ca

Mr. Dan Grabke
Director, Business Development

Dear Mr. Grabke:

Taltson Expansion Project
Trudel Creek Erosion Assessment

This report presents our Erosion Assessment for Trudel Creek, as outlined in our June 18, 2008 proposal. This assessment is based on observations made during our site visit and our subsequent office analyses. Supporting information was provided by Cambria Gordon Ltd. and Rescan. This report contains the updated simulated flow regimes for the 36 MW and 56 MW Expansion Projects, provided by Rescan on December 17, 2008.

It has been a pleasure providing consulting engineering services to Northwest Territories Energy Corporation.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

G W Stevenson

Garry W. Stevenson, P.Eng.
Project Manager

Klohn Crippen Berger Ltd. • 500 – 2955 Virtual Way • Vancouver BC V5M 4X6 • CANADA
604.669.3800 t • 604.669.3835 f • www.klohn.com

TABLE OF CONTENTS

PAGE

Tables

TABLE OF CONTENTS
(continued)

PAGE

Figures

APPENDICES

1. INTRODUCTION

Klohn Crippen Berger Ltd. (KCBL) has carried out this assignment as described in our June 18, 2008 proposal. Our proposal was based on Northwest Territories Energy Corporation's Request for Proposal entitled "Taltson Expansion Project, Trudel Creek Erosion Assessment, Scope of Work", dated February 18, 2008, and June 13, 2008 and subsequent emails and discussions.

The following items are addressed in this report:

- Identification of conditions that typically cause bank erosion in Trudel Creek;
- Identification of specific conditions that likely cause the current bank erosion observed in Trudel Creek;
- Identification of timing of erosion on Trudel Creek and an opinion on current erosion rates compared to those of 1965 to 1986;
- Identification and discussion of how the Expansion Project flow regime will change the existing erosion;
- Identification of existing and future deposition zones;
- Identification of how the new flow regime may impact water quality and turbidity levels; and
- Identification of potential parameters and monitoring sites for erosion.

This report is organized into the following sections: Site Visit; Erosion Monitoring Sites; Trudel Creek Hydrology; Trudel Creek Erosion Assessment; and Conclusions and Recommendations.

2. SITE VISIT

2.1 General

A site visit was carried out by our Mr. Rick Rodman, P.Eng. (BC) who joined others from KCBL on July 8, 2008 and left the site on July 10, 2008. The length of Trudel Creek was flown by helicopter during the morning of July 9 and then three previously identified erosion sites were visited. The sites, shown on Figure 2-1 were selected as they were representative erosion sites. These three locations were also selected as erosion monitoring sites, as described in Section 3. Soil samples were collected at each site to assist in characterizing the erosion. Each site is described in the following sections. GPS points for soil samples and erosion monitoring sites are provided in Table 2-1. General and detailed photomosaics of each site are contained in Appendix I. At the time of the site visit the flow in Trudel Creek was approximately 175 m^3/s (personal communication from Tom Vernon).

Table 2-1 GPS Location Points

Location	Easting	Northing
200m Upstream of Monitoring Site 1	478150	6695987
Monitoring Site 2	479761	6694856
Monitoring Site 3	483546	6696710
Sediment Sample RR-1	478207	6695948
Sediment Samples RR-2+3	479841	6694965
Sediment Sample RR-4	483556	6696780

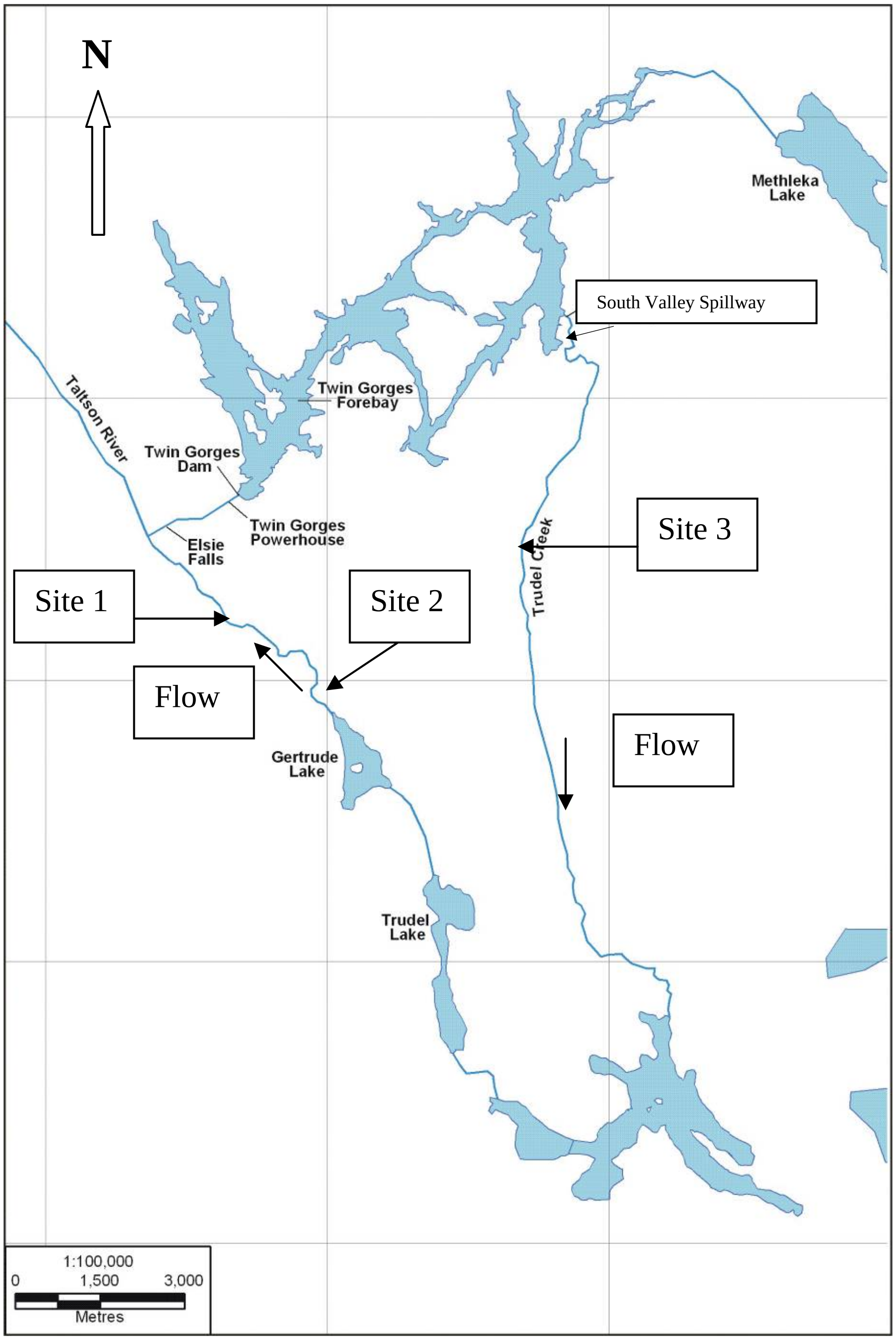


Figure 2-1 Location of Trudel Erosion Monitoring Sites.

(Base figure provided by Rescan)

2.2 Site 1

This site is located on a bend on the left bank of Trudel Creek, looking downstream, see Photo 2.1 and Figures I-1 and I-2 in Appendix I. It consists of a high bank composed of sandy, silt and clay. There are fingers of bedrock outcrops at several locations along the toe of Site 1 that reduce erosion, see Photo 2.2. The upstream portion of Site 1 has toe armouring by cobbles and boulders, see Photo 2.3. The downstream end of Site 1 has high steep sand banks with no toe armouring, see Photo 2.4. There are areas of erodible clay that are being undercut and eroded by surface runoff coming down the slope. There are several mud slide areas that are delivering trees and sediment to the river, see Photo 2.5. These mud slides, created by water draining off the upper slopes, tend to destabilize the banks.

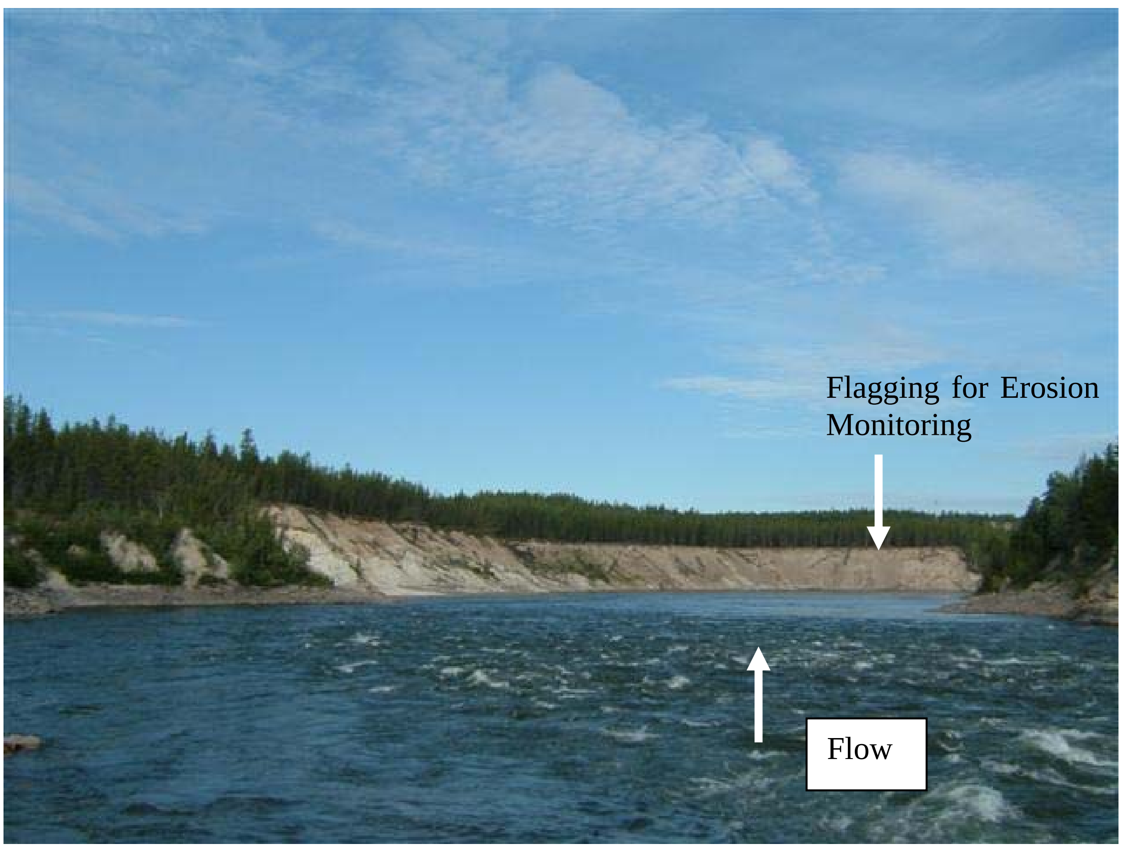


Photo 2.1 Looking downstream at Erosion Site 1 and Erosion Monitoring Site (July 9, 2008).

Photo 2.2 Bedrock outcrops at Site 1 (July 9, 2008).

Photo 2.3 Cobble and boulder toe armouring (July 9, 2008).

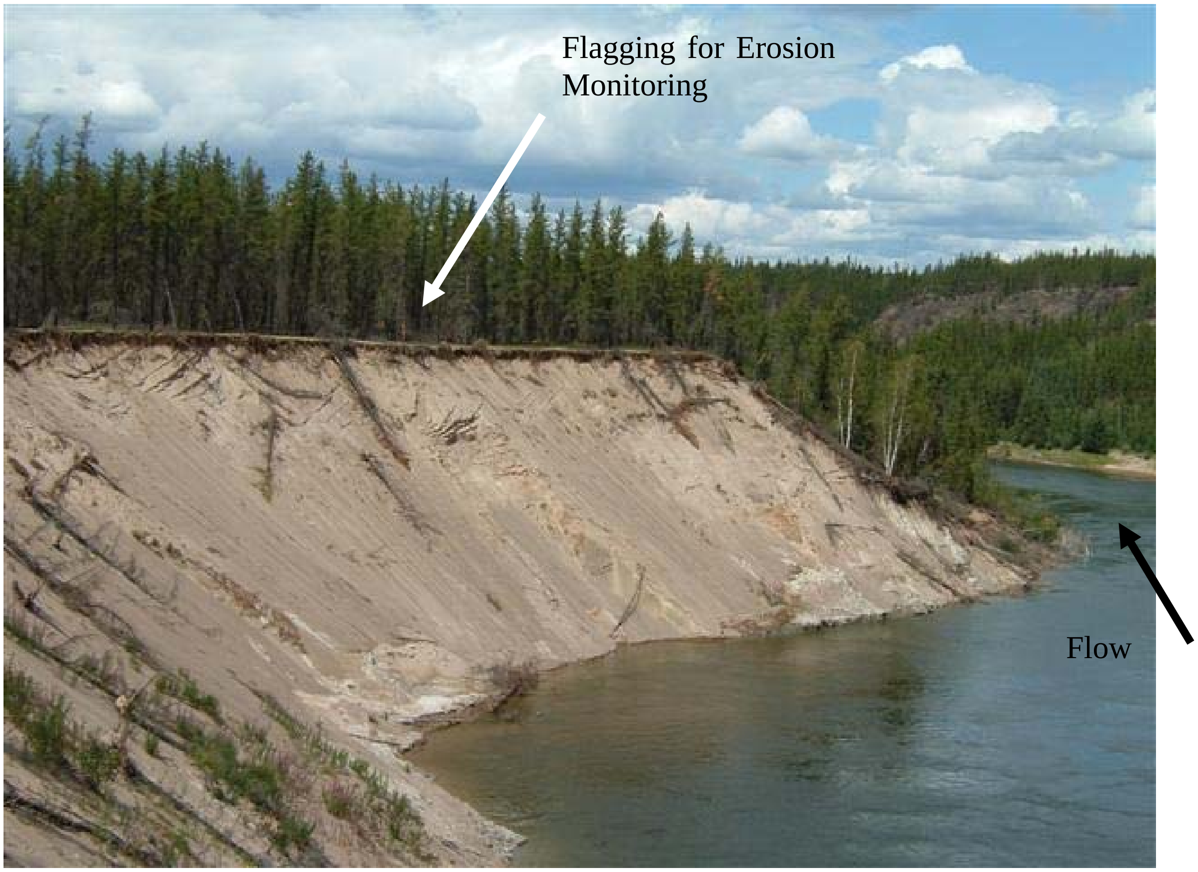
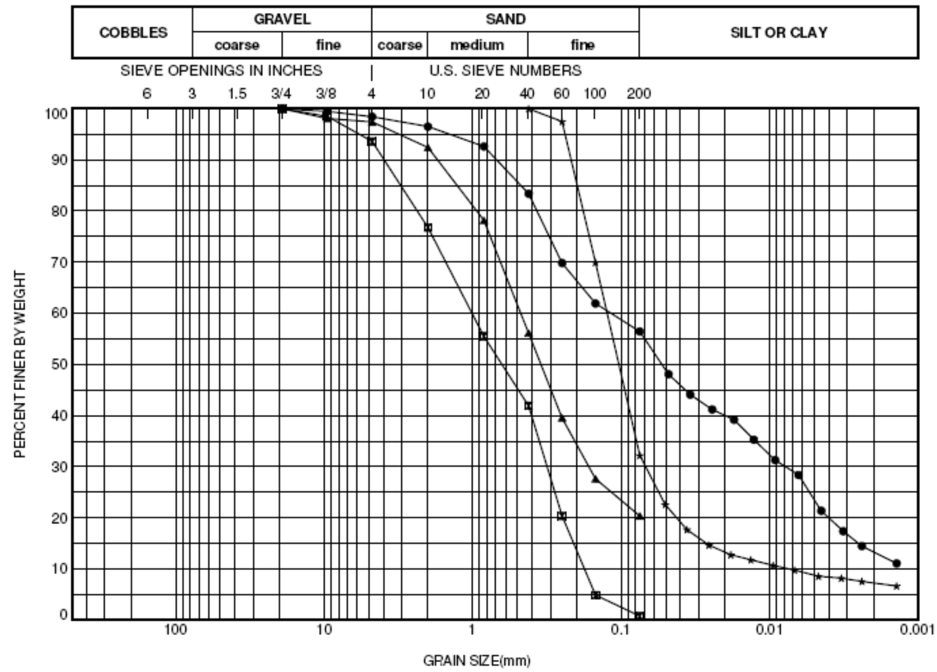


Photo 2.4 Looking downstream at Site 1 where there is no toe armouring (July 9, 2008).

Photo 2.5 One of several mud slides supplying sediment to Trudel Creek at Site 1 (July 9, 2008).

A sample of the bank clay material was taken and a sieve analysis was carried out, see Sample RR-1, on Figure 2-2. This material has 56% fines and 42% sand, and is very erodible. Other areas of this eroding site are mostly composed of sands.

GRAIN SIZE DISTRIBUTION



	HOLE	DEPTH (m)	D85	D60	D50	D15	D10	CU	%GRAVEL	%SAND	%FINES
●	RR-1	0.00	0.474	0.117					1.6	42.0	56.4
⊠	RR-2	0.00	3.054	1.009	0.634	0.209	0.177	5.714	6.4	92.8	0.8
▲	RR-3	0.00	1.273	0.474	0.347				2.6	77.0	20.4
★	RR-4	0.00	0.198	0.124	0.104				0.0	67.8	32.2

	HOLE	SAMPLE	DEPTH (m)	W%	W_L	W_P	PI	REMARKS / SAMPLE DESCRIPTION
●	RR-1		0.00					
⊠	RR-2		0.00					
▲	RR-3		0.00					
★	RR-4		0.00					

CU = COEFFICIENT OF UNIFORMITY = D60/D10 PARTICLE SIZES, e.g. D85, in mm Tested by Wet Sieving Method (ASTM D1140 & D422)

Klohn Crippen Berger

PROJECT NO.: P09363B01
PROJECT: NTEC Talston 2008 Study Program
LOCATION: NWT
FIGURE:
DRAWN BY: NG CHECKED BY: JG

Figure 2-2 Grain Size Analyses Results.

2.3 Site 2

Site 2 is located on the right bank of Trudel Creek approximately 2 km upstream of Site 1, adjacent to a cascade where the river is relatively narrow, see Figures I-3 and I-4. The downstream portion of Site 2 contains a sediment depositional bar and sand bank, see Photo 2.6, while the upstream portion has a steep esker slope consisting of sand and cobbles, see Photo 2.7. High water was estimated to be approximately 2 m higher than the water level during the site visit. High water usually covers the depositional bar, creating a back eddy that flows along the toe of the sand bank. A mud flow also entered into this area, providing additional sediment to the creek. This mud flow has substantially revegetated itself, most likely due to the moisture and north facing aspect of the gully.

Soil Sample RR-2 was taken from sand bank at Site 2. Figure 2-2 shows that this bank is mainly sand, consisting of about 93% sand, 6% gravel and 1% fines. This bank will self armour over a very long period as the sands are washed away. There was evidence of self armouring after significant erosion had occurred. Sample RR-3 was taken at the toe of the bank on the sand bar. This sample has 77% sand and 20% fines, reflective of this lower velocity backwater sediment deposition location.

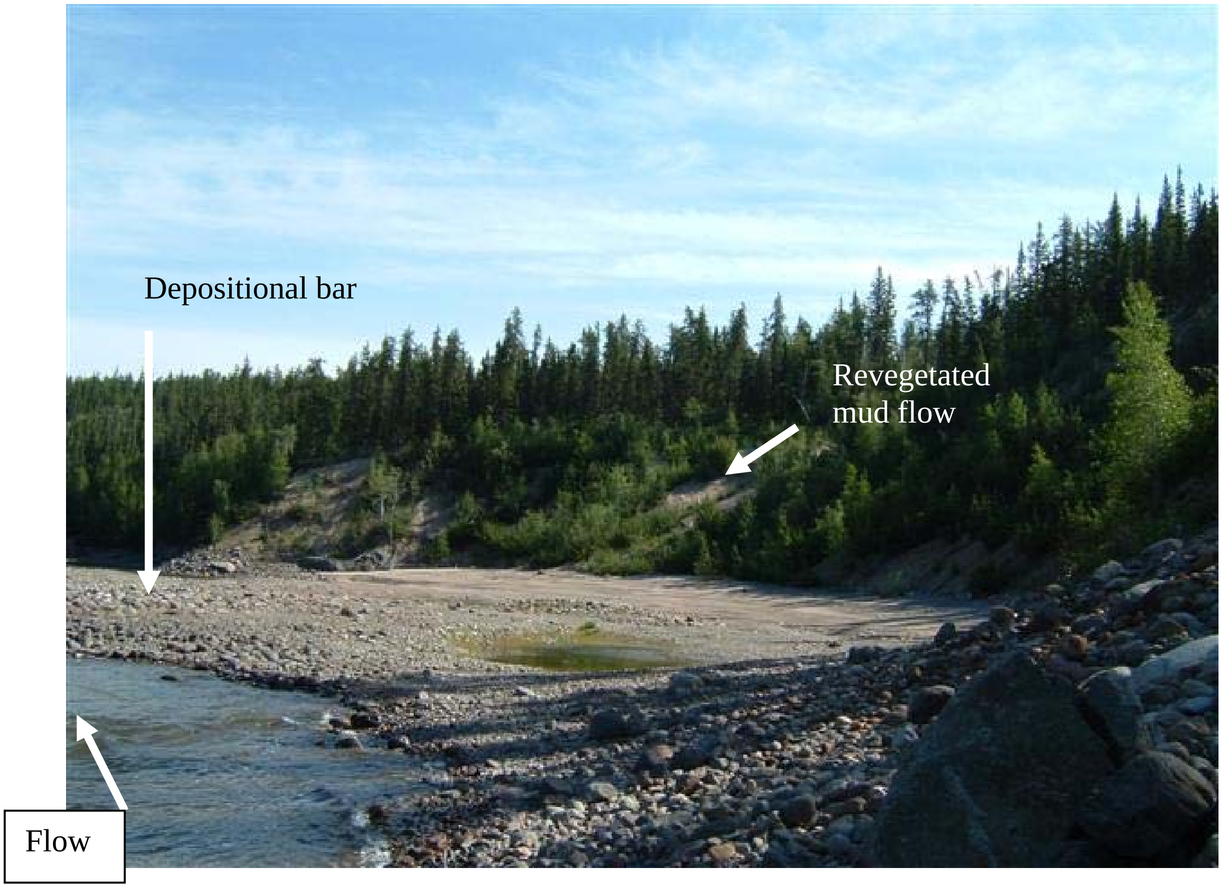


Photo 2.6 Downstream end of Site 2 with depositional bar and eroding bank (July 9, 2008).

The upstream portion of Site 2 had substantially armoured itself over the last 43 years, since the construction of the hydropower plant in 1965. Fallen trees at the top of the slope indicated that some erosion was still taking place at the toe of this slope.

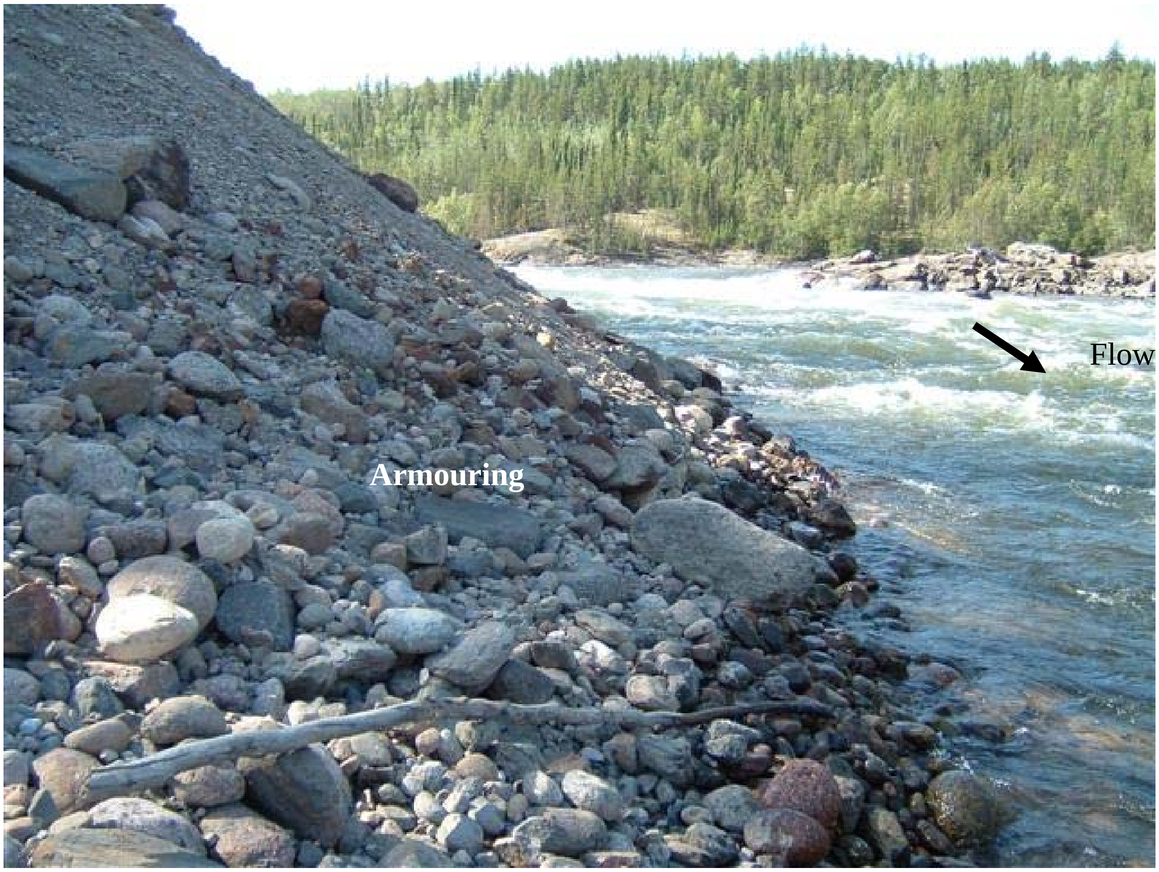


Photo 2.7 Upstream end of Site 2 with eroding esker slope (July 9, 2008).

2.4 Site 3

Site 3 is a low bar on the left bank of Trudel Creek, located approximately 4 km downstream from the South Valley Spillway (SVS), see Photo 2.8 and Figures I-5 and I-6. The bar had not yet been flooded this year and had long grass growing on it. Large pieces of the bank had fallen into the creek and large tension cracks were evident, see Photo 2.9 and Photo 2.10. Soil Sample RR-4 was taken from this bank. This sample has 68% sand and 32% fines, providing some cohesion, as can be seen in Photo 2.10.

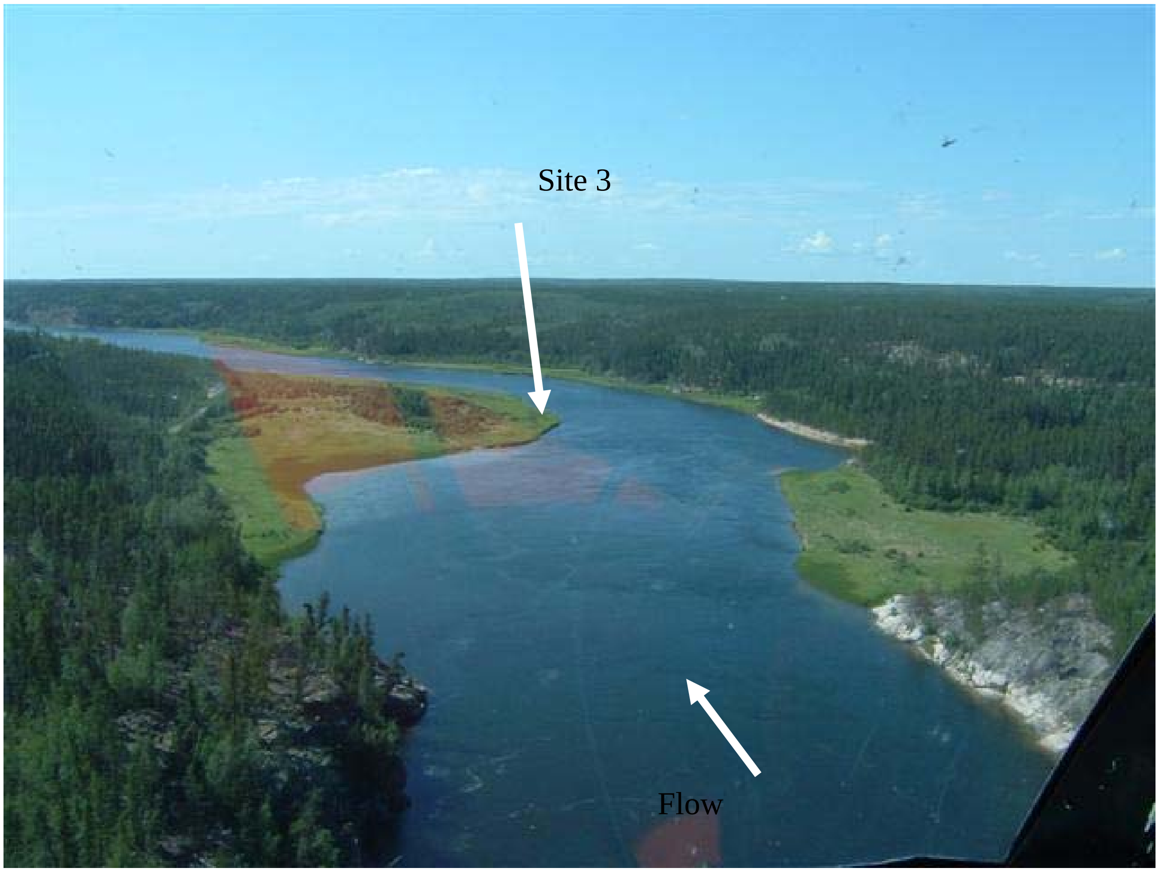


Photo 2.8 Looking downstream at Site 3 (July 9, 2008).

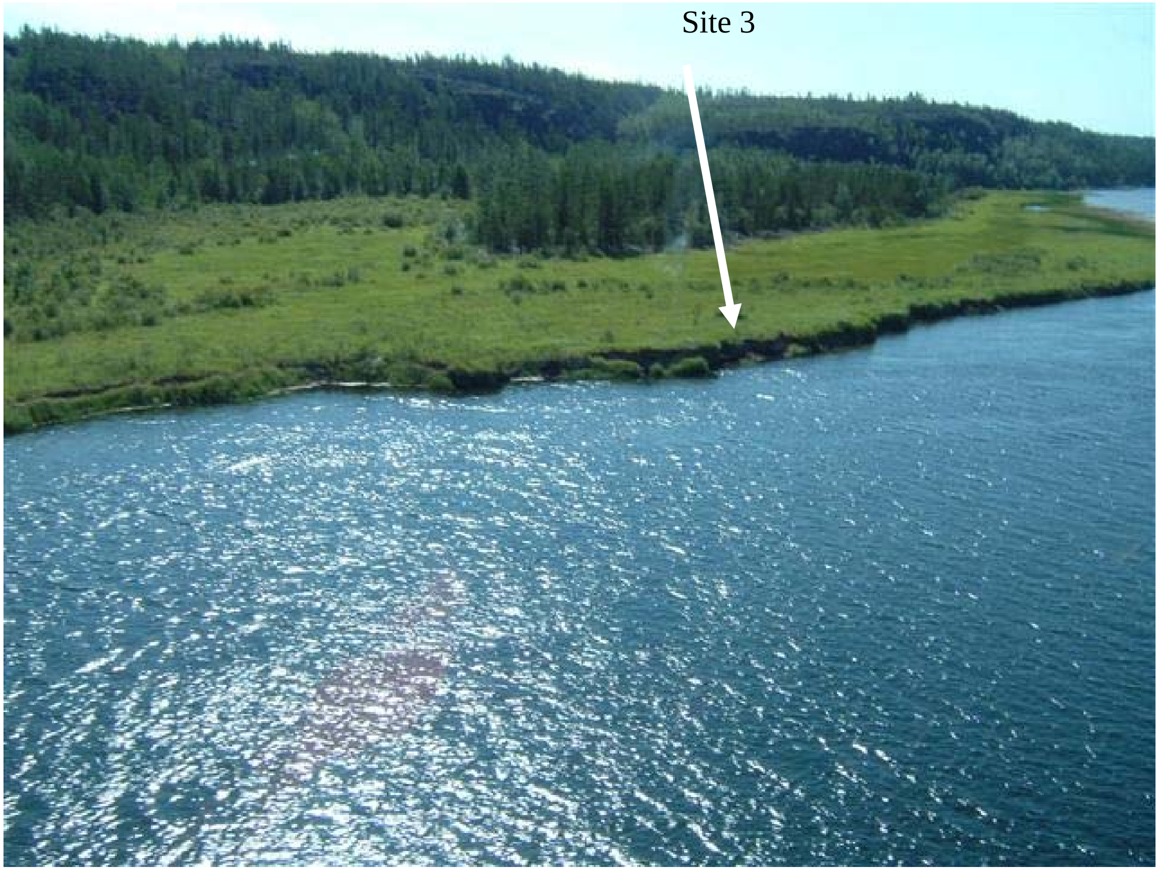


Photo 2.9 Pieces of the low bank falling into the creek (July 9, 2008).

Photo 2.10 Large tension crack at Site 3 (July 9, 2008).

3. EROSION MONITORING SITES

Without precise surveying and permanent bench marks, bank erosion monitoring can be difficult. Photographic documentation can be of some assistance, but is qualitative at best. Installation of a series of markers at the top of an eroding bank can provide an indication of the rate of bank erosion. This method was used to set up the 3 erosion monitoring sites described below and located as shown on Figure 2-1. These monitoring sites were selected since they are representative of the erosion processes that are present in Trudel Creek. Sites 1 and 2 are representative of the erosion that occurs downstream of Unnamed Lake, while Site 3 is representative of the erosion that occurs upstream of Unnamed Lake. These sites should be monitored several times during the year, especially before and after high flow periods. Depending on the progression of the erosion, additional markers may be required. General and detailed photomosaics of each site are contained in Appendix I, Figures I-1 through I-6.

3.1 Site 1

This monitoring site is located at the downstream end of Site 1, see Photo 2.4 and Appendix I, Figures I-1 and I-2. This location was selected as it appeared to be active and there was no armouring of the toe of the slope at the water line. This site is located at the end of a fairly straight reach, with direct impingement of the creek on the toe of the bank. Three trees were flagged so that they could be seen by a hovering helicopter, see Photo 3.1. Orange flagging tape was placed on three trees: one tree on the edge of the top of the slope; one tree 2.6 m from the edge; and one tree 3.6 m from the edge.

Photo 3.1 Looking downstream at erosion monitoring Site 1 (July 9, 2008).

3.2 Site 2

This site is located at the upstream end of Site 2, adjacent to a cascade; and Photo 3.2 and Appendix I, Figures I-3 and I-4. The slope is somewhat armoured along the toe, but is still eroding as demonstrated by the fallen trees. Orange flagging tape was placed on three trees: one tree on the crest of the slope; one tree 1.9 m from the edge; and one tree 4.0 m from the edge. Flagging was also placed on two other trees on the edge of the slope, one upstream and one downstream of the monitoring site.

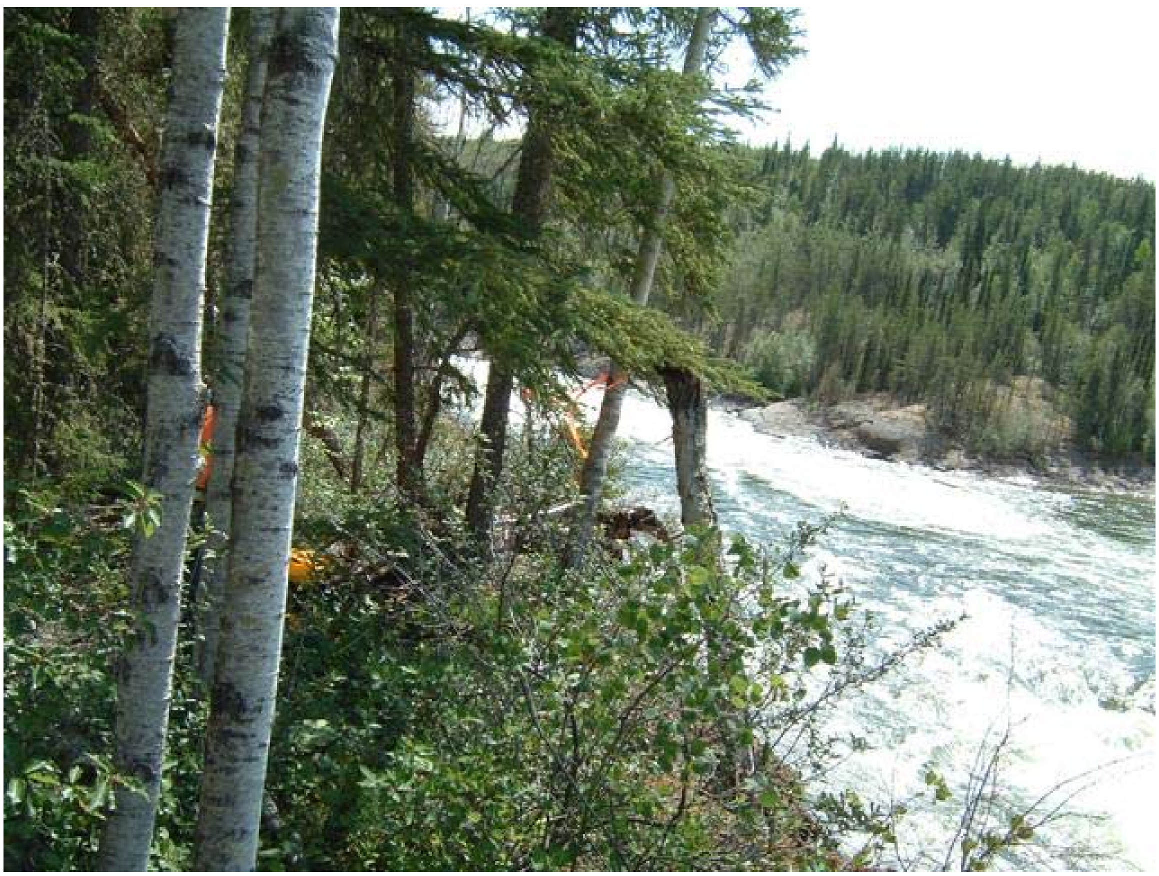


Photo 3.2: Looking upstream at erosion monitoring Site 2 (July 9, 2008).

3.3 Site 3

This site is located at the same location as the previously described Site 3, see Figure 2-1 and Appendix I, Figures I-5 and I-6. Five 1.2 m long reinforcing rods were driven into the ground at 1 m spacing, see Photo 3.3. These markers may need to be lengthened so that they can be seen through the tall grass. Also, 2 m to 2.5 m long rods may be necessary should high flows submerge the area and cause the existing rods to vibrate looser be disturbed by floating debris. The ground appears to be soft enough for the longer rods to be installed.

Photo 3.3 Site 3 with 5 flagged rods at 1.0 m spacing (July 9, 2008).

4. TRUDEL CREEK HYDROLOGY

Review of historical air photos indicates that prior to construction of the power plant in 1965, Trudel Creek was a small meandering creek, possibly with occasional flow from the Taltson River. Figures II-1 to II-3 in Appendix II show Trudel Creek in 1955 prior to development. Two small linear lakes are evident in the air photos along with Trudel and Gertrude Lakes. Unnamed Lake is not covered by these 1955 air photos. Upstream of Trudel Lake, Trudel Creek is quite small, with minor meandering, whereas downstream of Gertrude Lake, Trudel Creek is wider with many meander bends. The creek appears to have had a low energy and a low sediment transport regime. Prior to development, Trudel Creek was isolated from the Taltson River, although there is some evidence that flow may have spilled from Taltson River into Trudel Creek (Rescan 2006). Except for the periodic spills from the Taltson River, Trudel Creek was most likely near to hydrological equilibrium or "in regime" (as described in Section 5.1).

Figure II-4 is a 1980 air photo showing the upstream and downstream portions of the creek. The erosion caused by the high flows is easily seen as the white areas along Trudel Creek. These are the areas that have eroded and are lacking vegetation.

Flow modelling simulations of the post development flow regimes on Trudel Creek have been carried out by Rescan (Cambria Gordon Ltd., 2008 and Rescan 2008b). The results of this modelling are summarized below, along with analyses of high flows. A 13 year period of predicted flows was simulated by Rescan to represent each of the recent Trudel Creek flow regimes: Pine Point Era (1965-1986); Current Era (1986 – present); and future 36 MW and 56 MW Expansion Eras. These predicted flow regimes are shown in Figure 4-1. As can be seen from these figures the predicted Trudel Creek flows for the 36 MW and 56 MW Expansions are much smaller and have somewhat less variability than either of the two other flow regimes.

Collection of flow data from the South Valley Spillway to Trudel Creek commenced in 1987. Previous to this there was no historical flow data for Trudel Creek. The plotted predicted or simulated flows were produced by Rescan using a calibrated HEC-ResSim model of the Taltson basin which was run with the three different operating conditions. The model used a synthetic hydrograph time-series for each input location. The operating conditions for the power plant, in terms of power generation at any given time, were based on data provided by Deze (Rescan, 2008a).

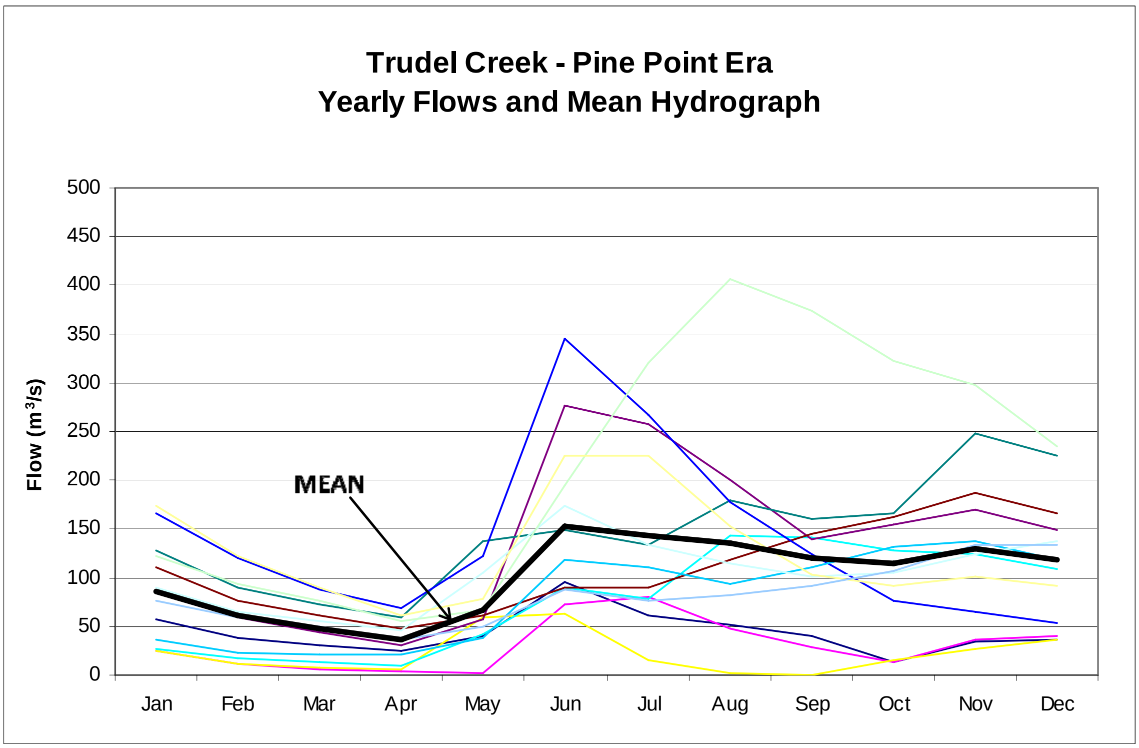


Figure 4-1 Simulated Trudel Creek Flows: Pine Point Era (1965 – 1986) (Data provided by Rescan 2008b)

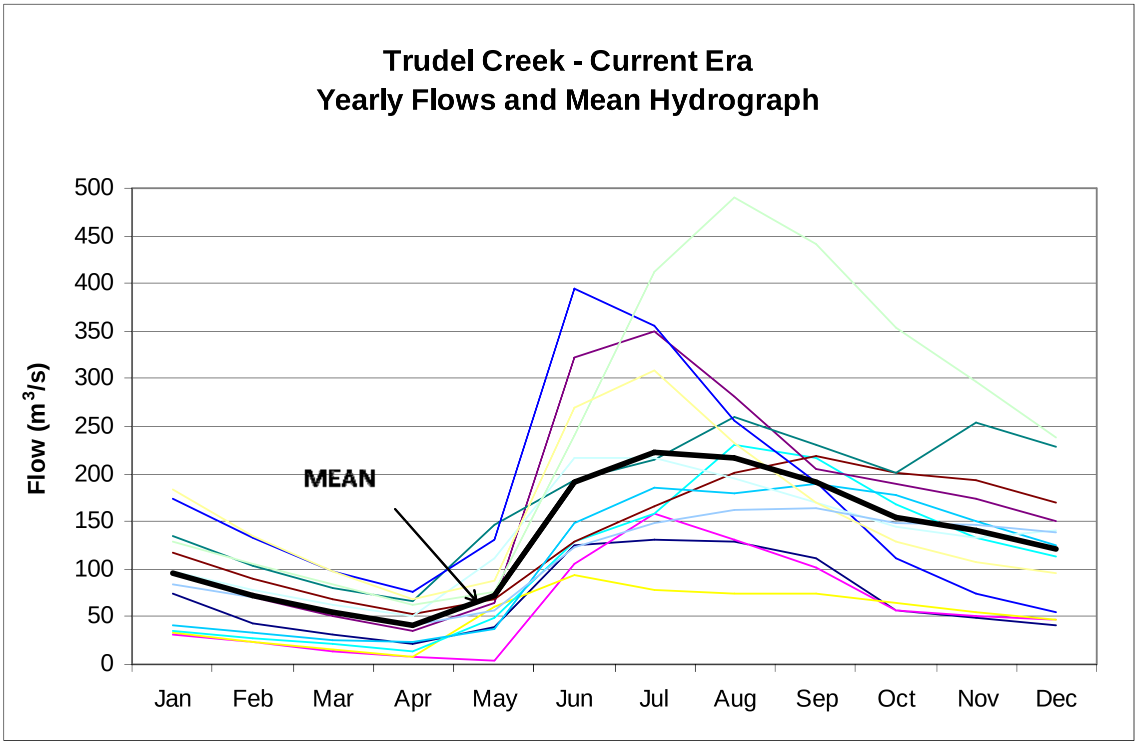


Figure 4-2 Simulated Trudel Creek Flows: Current Era (1986 - Present) (Data provided by Rescan 2008b)

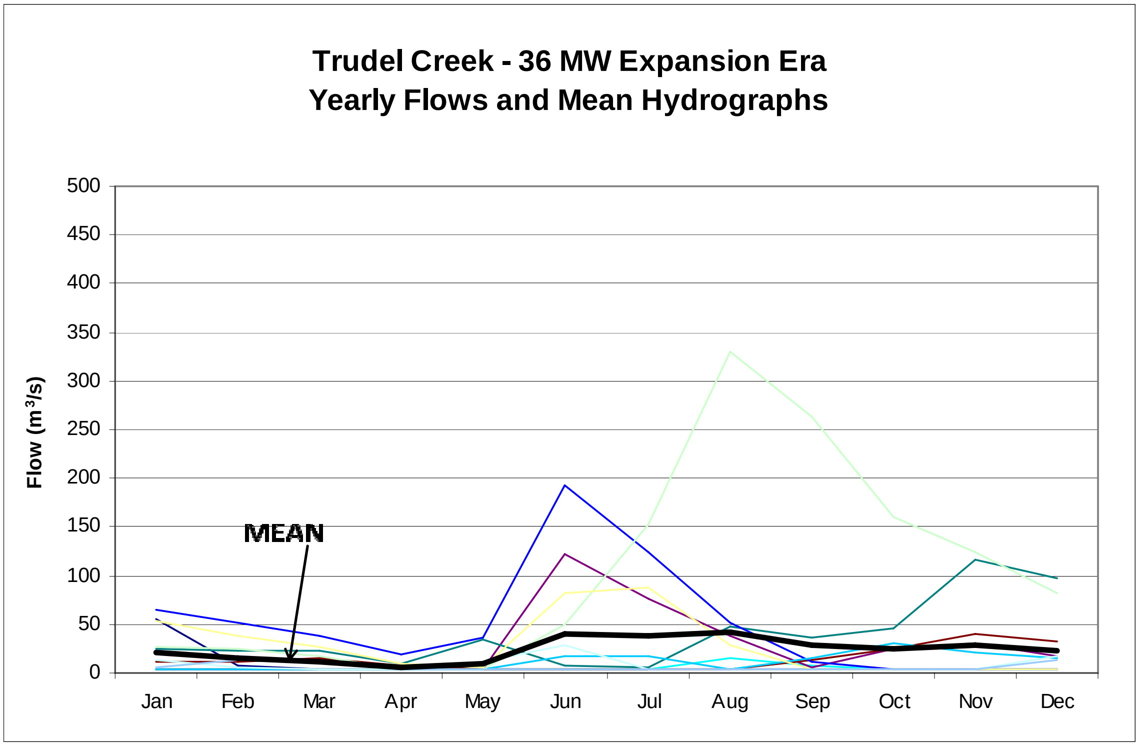


Figure 4-3 Simulated Trudel Creek Flows: Future 36 MW Expansion Era (Data provided by Rescan 2008b)

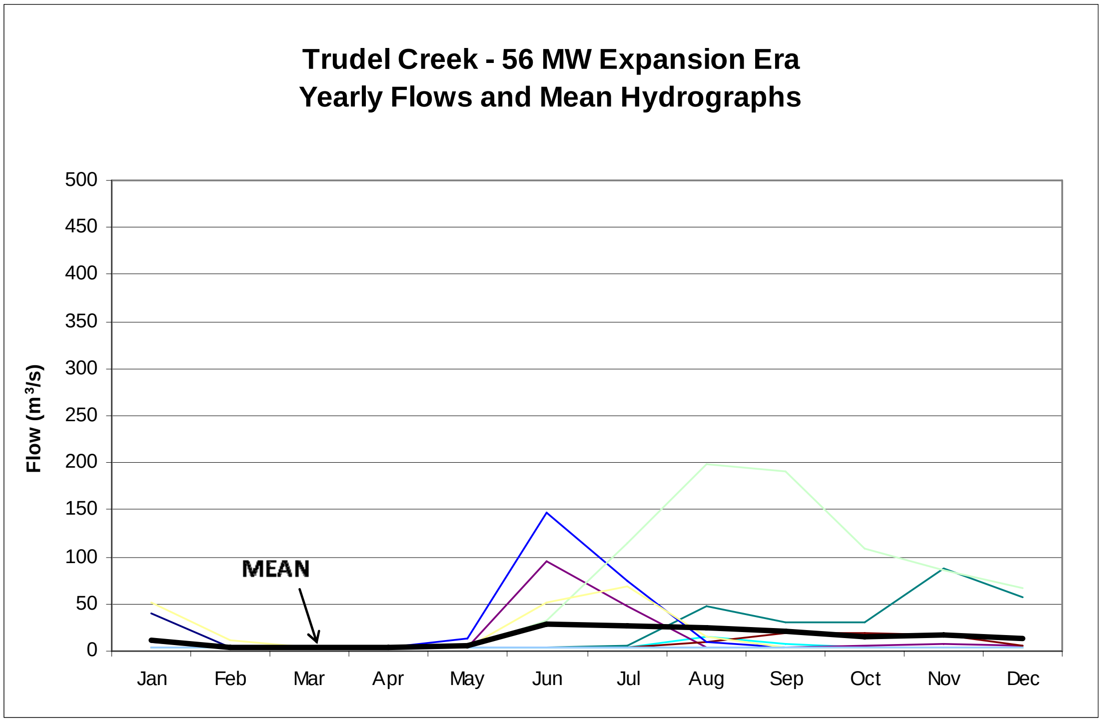


Figure 4-4 Simulated Trudel Creek Flows: Future 56 MW Expansion Era (Data provided by Rescan 2008b)

KCBL has processed the predicted daily flow data to obtain the maximum monthly flows, (see Table 4-1) and maximum annual daily flows (see Table 4-2). These tables also show the expected percentage reduction in flow for the 36 MW and 56 MW Expansion Eras compared to the two previous flow eras. The flow regime for the future 36 MW Expansion Era is predicted to have, on average, monthly flows that are 68% to 74% less than previous monthly flow regimes. Similarly, the predicted maximum daily flows will be reduced 63% to 69% from previous flow regimes. These results are shown graphically in Figure 4-5 and Figure 4-6.

Similarly, the flow regime for the future 56 MW Expansion Era is predicted to have, on average, monthly flows that are 79% to 83% less than previous monthly flow regimes. Similarly, the predicted maximum daily flows will be reduced 73% to 77% from previous flow regimes. These results are shown graphically in Figure 4-5 and Figure 4-6.

Table 4-1 Maximum Monthly Flow by Simulation Year.

	Pine Point (1965-1986)		Current (1986-present)		36MW Expansion		56MW Expansion		% Reduction from			
Simulation Year	Month	Flow (m^3/s)	Month	Flow (m^3/s)	Month	Flow (m^3/s)	Month	Flow (m^3/s)	Pine Pt to 36MW Expansion	Current to 36MW Expansion	Pine Pt to 56MW Expansion	Current to 56MW Expansion
1978	July	96.1	July	131.6	January	55.3	January	40.7	42	58	58	69
1979	July	80.5	July	158.4	June	4.1	June	4.1	95	97	95	97
1980	November	62.7	June	93.6	May	4.1	May	4.1	93	96	93	96
1981	August	142.4	August	230.9	August	15.9	August	14.6	89	93	90	94
1982	June	275.8	June	350.0	June	121.8	June	95.1	56	65	66	73
1983	September	186.6	September	218.7	November	39.6	November	19.4	79	82	90	91
1984	November	248.1	August	259.1	November	115.8	November	87.5	53	55	65	66
1985	June	346.2	June	393.9	June	193.4	June	146.6	44	51	58	63
1986	October	137.4	July	188.5	October	31.3	October	4.2	77	83	97	98
1987	August	174.4	August	217.8	December	28.3	December	4.6	84	87	97	98
1988	August	405.7	August	490.3	August	329.3	August	198.6	19	33	51	59
1989	June	224.6	June	308.3	June	88.2	June	69.3	61	71	69	78
1990	August	134.3	August	164.5	August	12.8	August	4.1	90	92	97	98
Maximum	-	405.7	-	490.3	-	329.3	-	198.6	95	97	97	98
Average	-	193.4	-	246.6	-	80.0	-	53.3	68	74	79	83
Minimum	-	62.7	-	93.6	-	4.1	-	4.1	19	33	51	59

Table 4-2 Maximum Daily Flow by Simulation Year.

	Pine Point (1965-1986)		Current (1986-present)		36MW Expansion		56MW Expansion		% Reduction from			
Simulation Year	Date	Flow (m^3/s)	Date	Flow (m^3/s)	Date	Flow (m^3/s)	Date	Flow (m^3/s)	Pine Pt to 36MW Expansion	Current to 36MW Expansion	Pine Pt to 56MW Expansion	Current to 56MW Expansion
1978	14/06/1978	104.4	14/06/1978	134.3	02/01/1978	97.2	02/01/1978	97.2	7	28	7	28
1979	25/06/1979	96.8	25/06/1979	162.6	24/06/1979	4.1	14/06/1979	4.1	96	97	96	97
1980	27/05/1980	91.4	02/06/1980	109.0	29/05/1980	4.1	08/05/1980	4.1	95	96	95	96
1981	14/08/1981	153.2	14/08/1981	240.2	14/08/1981	22.6	14/08/1981	22.8	85	91	85	90
1982	23/06/1982	322.6	23/06/1982	378.8	16/06/1982	165.6	23/06/1982	142.8	49	56	56	62
1983	18/09/1983	190.6	18/09/1983	223.9	13/11/1983	41.9	17/09/1983	21.7	78	81	89	90
1984	13/11/1984	257.4	21/08/1984	270.9	14/11/1984	123.2	21/08/1984	94.5	52	55	63	65
1985	11/06/1985	375.4	11/06/1985	416.1	10/06/1985	217.2	10/06/1985	170.2	42	48	55	59
1986	06/10/1986	140.0	01/10/1986	199.4	11/10/1986	32.7	04/10/1986	4.2	77	84	97	98
1987	20/07/1987	185.4	20/07/1987	223.1	27/05/1987	38.9	20/05/1987	6.1	79	83	97	97
1988	28/08/1988	412.2	28/08/1988	495.2	28/08/1988	354.3	28/08/1988	244.1	14	28	41	51
1989	13/06/1989	244.1	13/06/1989	318.1	12/06/1989	97.1	13/06/1989	78.6	60	69	68	75
1990	08/08/1990	141.3	08/08/1990	171.5	08/08/1990	23.5	08/08/1990	4.1	83	86	97	98
Maximum	-	412.2	-	495.2	-	354.3	-	244.1	96	97	97	98
Average	-	208.8	-	257.2	-	94.0	-	68.8	63	69	73	77
Minimum	-	91.4	-	109.0	-	4.1	-	4.1	7	28	7	28

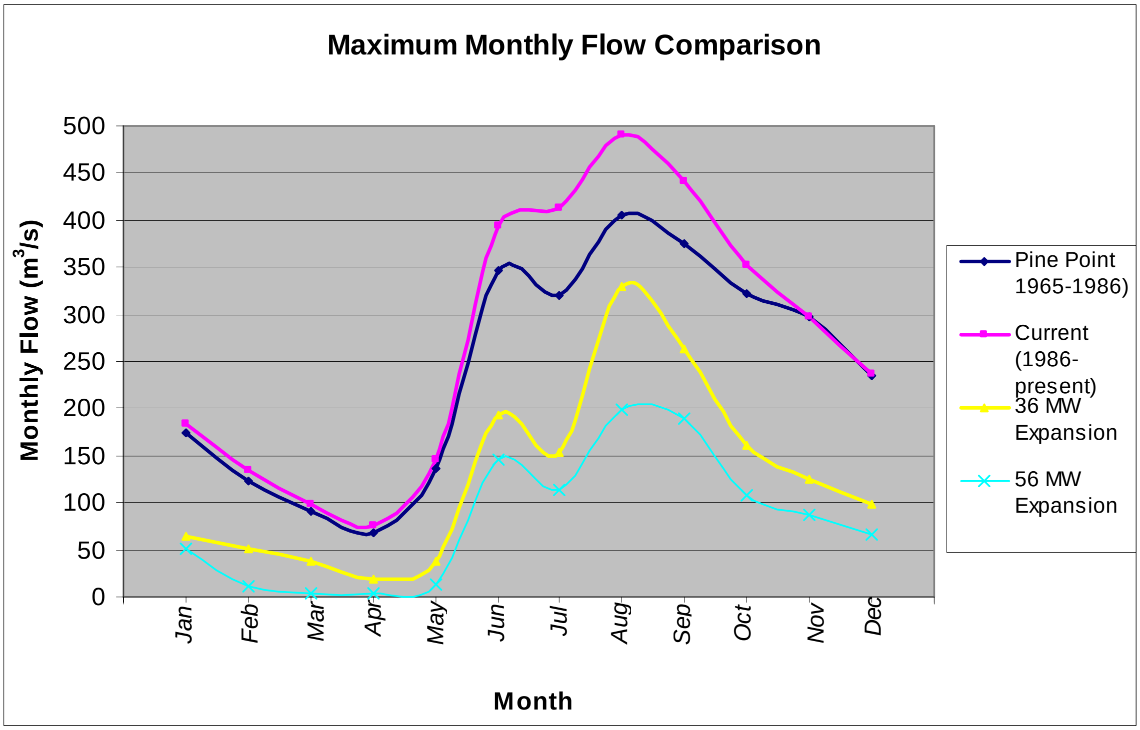


Figure 4-5 Maximum Monthly Flow Comparison

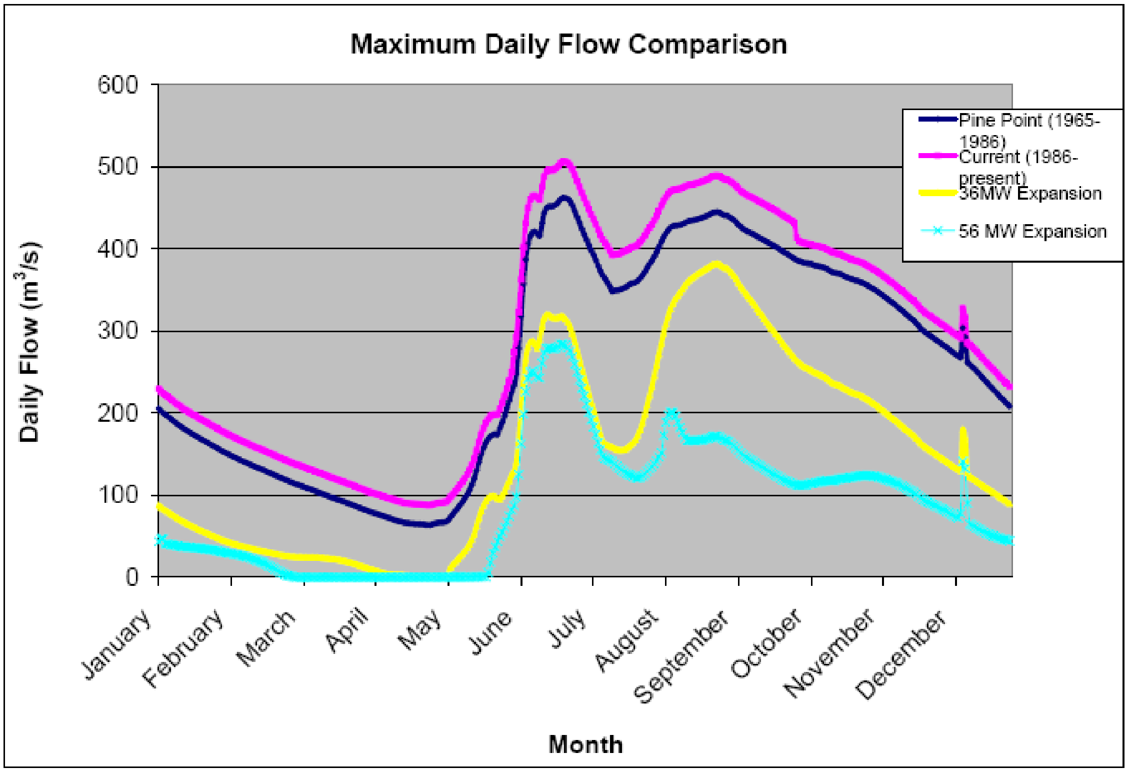


Figure 4-6 Maximum Daily Flow Comparison

The spike in maximum daily flows in December is the result of a high flow event in December 1990. This event is supported by data from the Environment Canada station on the Thoa River (Rescan, 2008a).

5. TRUDEL CREEK EROSION ASSESSMENT

The information and data presented in the previous sections of this report serve to support the following discussions on erosion and erosion processes. Due to the nature of erosion processes and erosion modelling, much of this assessment is qualitative. The basic principle is that the higher the flow, the higher the flow velocity, and the higher the flow velocity the higher the potential for erosion. Similarly low flows result in lower velocities which lead to lower potential for erosion. If the river banks are armoured, changes in flow and velocity will not result in erosion. If the river banks consist of erodible materials, then increases in flow and velocity will result in erosion. Erosion processes resulting from flow changes may require decades to achieve equilibrium.

5.1 Causes of Bank Erosion

The typical cause of bank erosion is a change in a hydrological or geomorphic (e.g. slide into river) condition. Usually, increased flows or bank/slope failures into a river will result in erosion. Once the bank materials self armour the bank, a steady state condition results with little or no erosion. If there are no self armouring materials in the bank, a significant amount of erosion will take place, until the river becomes very wide and disperses its energy. The river is said to be “in regime” and stable when neither erosion nor deposition occur. Climate variations can cause rivers to begin eroding again (due to increases in flows) or start depositing materials (due to decreases in flows). These climatic variations in flow can be caused by many different climatic factors such as: increased rainfall intensities or rapid snowmelt due to high spring temperatures.

Prior to development, Trudel Creek appeared to be a small stable channel. With the introduction of large flows from spillway releases, due to the construction of the hydro power plant, Trudel Creek was no longer in equilibrium, and significant bank erosion occurred. The banks eroded in response to the much higher base flows and the high peak flows.

Sites 1, 2 and 3 represent the range of eroding banks along Trudel Creek. Some of the bank erosion is due to the high flows mobilizing the fine grained bank materials. This has occurred at Sites 1 and 2, which are representative of erosion sites downstream of Unnamed Lake. Site 1 has very little self armouring capability, due to the lack of large rock material, therefore the river has eroded a very wide area with very steep and high banks. Continued erosion is taking place as there is very little regeneration of vegetation at Site 1. There are also some point sources of sediment entering into Trudel Creek in the Site 1 area.

Site 2 has some self armouring capability, evident in the photos of that site. Erosion is still continuing, but its initial rapid rate has reduced. Some of the banks near Site 2 have begun to revegetate.

Site 3 is a former wide floodplain area in a lower gradient reach of Trudel Creek. The introduction of higher base flows and peak flows has created a wide channel within the floodplain. The banks are not self armouring, due to the lack of coarse materials, but the banks have some cohesion. The mechanism of bank erosion appears to be a result of undermining of the floodplain banks. Continued flow against the bank removes sufficient material to cause undermining and tension cracks, resulting in large pieces of bank falling into the creek, not continuously, but episodically. Some of these fallen pieces of bank were evident in the creek. The overbank flood flows are most likely not the primary form of bank erosion in this reach of the creek. Others have mentioned the very plausible scenario of spring breakup of ice causing bank erosion. This mechanism can only be confirmed by first hand observations during spring breakup.

The grain size analyses, presented in Figure 2-2 , are indicative of the erodible fine grain materials that are present along Trudel Creek. Sites 1 and 2 are similar, with high sloping banks that are being eroded at the toe. The sample taken at Site 1 was specifically in an area of the site that contained erodible clay, and so it has 56% fines and some cohesion.

The two samples from Site 2 have no cohesion and lower fines content. The sample from Site 3 contains a higher percentage of fines than Site 2 and has some cohesion. The resulting erosion mechanisms are different at Sites 1 and 2, compared to Site 3. Sites 1 and 2 illustrate steep bank erosion, while Site 3 illustrates bank undercutting with large pieces of bank falling into the creek. All three sites and material types have similar erodibility, but Site 3 is episodic (since pieces of the bank were noted in the creek) while Sites 1 and 2 are continuous.

5.2 Erosion Rates, Past, Present and Future

With the data available at present erosion rates cannot be quantified but can be qualified in relative terms. Detailed mapping of erosion areas and detailed river modelling would be required to determine quantitative erosion rates.

The rate of erosion on Trudel Creek was greatest for several years immediately after construction of the hydro power plant in 1965 due to the dramatic increase in flows. Base flows, monthly flows, and peak flood flows increased dramatically due to the change in hydro power plant operation. It is expected that during the first 5 to 10 years of this new flow regime the rate of erosion was very high. The erosion rate reduced as some of the banks began to self armour and the channel widths increased. It is unlikely that equilibrium was reached in the 21 year period from 1965 to 1986 since the Creek flow regime was significantly changed. That is, some erosion was still taking place in 1986 due to the changed flow regime. Air photo coverage and scales are not in sufficient detail to allow mapping of historical erosion.

The current erosion rates are likely lower than those initially experienced in the 1965 to 1986 period. Erosion is continuing in some areas, since the present maximum monthly and daily flows are on average 17% higher than the 1965 to 1986 period. Field observations of recently fallen trees and actively eroding banks indicates that erosion is still taking place, although the rate of erosion is much reduced from historical rates due to self armouring and widening of the river in some locations. Figure 5-1 shows existing erosion sites identified by Cambria Gordon during previous studies. Some of these sites area also identified on Figures III-1 and III-2, in Appendix III.

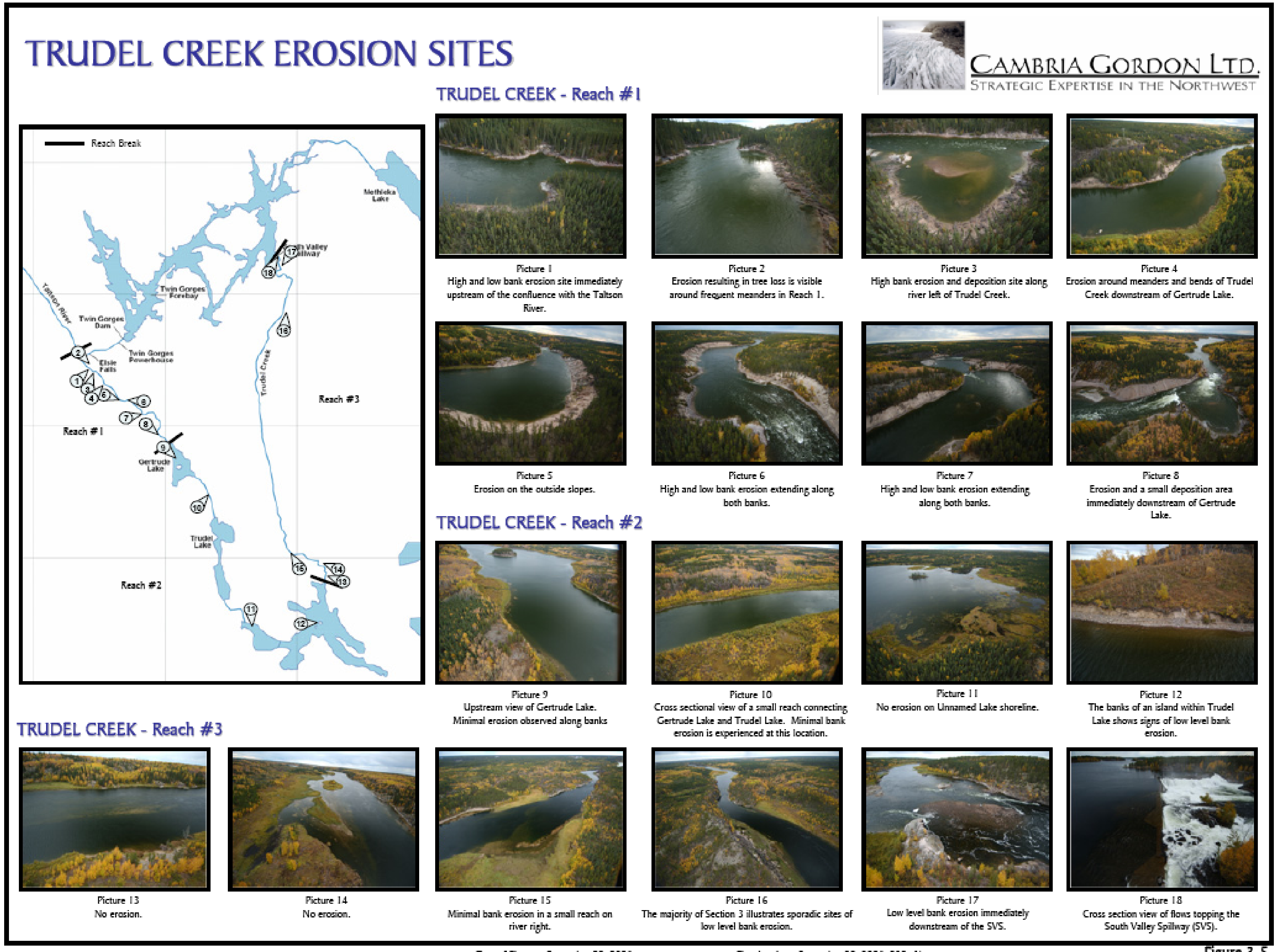


Figure 5-1 Trudel Creek Erosion Sites (Ref: Cambria Gordon 2006)

A review of the 2007 photomosaics was carried out to identify present erosion sites. Nine possible eroding banks were identified and are shown as red dots on Figures III-1 and III -2, in Appendix III. Ground truthing is required to confirm that these are actually eroding sites. The estimated total length of eroding bank is approximately 1,500 m. Low bank erosion, similar to Site 3, and less obvious eroding banks could not be identified on the photomosaics. The Trudel Creek reach downstream of Gertrude Lake contains the highest eroding banks and most frequent occurrence of these banks, characterized by Sites 1 and 2. This is due to the meandering nature of the Creek, the materials through which it passes, and the apparent increase in channel slope. Upstream of Unnamed Lake the erosion sites are mostly low bank erosion sites, similar to Site 3. Figure 5-1 illustrates the range and location of erosion sites along Trudel Creek.

To fully quantify the existing Trudel Creek eroding banks the entire length of Trudel Creek would have to be inspected from a boat. Both banks would need to be mapped at low water, using the photomosaics as a reference and noting GPS locations. This information could then be used to better quantify the existing erosion along the entire length of Trudel Creek.

The 36 MW Expansion flow regime will result in reduced erosion rates compared to the present erosion rates, since peak monthly and peak daily flows will be reduced by 74% and 69%, respectively. The monthly flows affect erosion rates in areas similar to Sites 1 and 3, which have continuous erosion, while the peak daily flows affect erosion rates at all erosion areas. The base flows are also significantly reduced so that the base flows will be contained well within the present wide river channel. Initially this may result in some erosion of fines from former depositional areas. Prediction of this erosion is very difficult and unreliable.

Similarly, the 56 MW Expansion flow regime will also result in reduced erosion rates compared to the present erosion rates, since peak monthly and peak daily flows will be reduced by 83% and 77%, respectively. This further decrease in flows, compared to the 36 MW Expansion will result in a greater reduction in erosion rates than the 36 MW Expansion.

5.3 Depositional Zones

Identification of depositional zones requires a detailed boat and helicopter reconnaissance at high flow to identify back eddy and low flow areas, and at low flow to quantify the sediments in these possible depositional zones, to see if the sediments have been deposited or are armour layers resulting from previous erosion. In the vicinity of the three sites that were visited, observations were made from a helicopter to attempt to identify some of the depositional zones. Based on these observations, historic air photos and the two different scale photomosaics, existing possible depositional zones have been identified. These existing possible depositional zones are shown in Appendix III, Figures III-1 through Figure III-7. As mentioned above, ground truthing is required to confirm these depositional zones and perhaps identify other zones.

Under both Expansion flow regimes, the area of many of the existing sediment depositional zones will be significantly reduced and may be eliminated in some cases due to the reduction in flows. Some of the present depositional zones may not be covered by water. At some locations the lower flows may result in remobilization of deposited sediments. This would occur if a depositional zone was now only partly covered and a back eddy no longer formed over the former depositional zone. Once again, identification and quantification of these areas in advance is nearly impossible, as detailed mapping of the entire river bottom would be required to predict where the reduced discharges from the Expansion flow regimes would actually flow.

5.4 Water Quality and Turbidity

Reference to water quality in this report is from a sediment and turbidity point of view, not a biological or chemical point of view. In general, both Expansion flow regimes should improve the water quality and turbidity. Since the Expansion flow regimes have lower flows than the existing flow regime, the energy and sediment transport power of the river will be reduced. As mentioned in Section 5.3, there may be some isolated zones where erosion of previously deposited sediments could occur. These are expected to be isolated, contributing very little to the sediment load. In general, the transport of fine sediments will be much reduced under both Expansion flow Regimes.

Ongoing turbidity and suspended sediment measurements both indicate low levels of sediment transport. Turbidity measurements should continue to be taken during high flows at several locations along Trudel Creek to provide a baseline for existing conditions. This data can then be compared to future conditions when the flow regime has been modified due to the Expansion Project. At a minimum, turbidity measurements should be taken at the outlet of Trudel Creek and at the inlet to Unnamed Lake. The measurements should be taken as close to the freshet peak flow as possible.

6. CONCLUSIONS AND RECOMMENDATIONS

Sites 1, 2 and 3 were selected and visited during this study. These sites are representative of the various kinds of bank erosion presently occurring along Trudel Creek.

Prior to development of the power plant in 1965, Trudel Creek appeared to be a small, stable channel. With the introduction of large flows from spillway releases, due to the construction of the hydro power plant, Trudel Creek was no longer in equilibrium, and significant bank erosion occurred. The banks eroded in response to the much higher base flows and the high peak flows.

The rate of erosion on Trudel Creek was greatest for several years immediately after construction of the hydro power plant in 1965. It is unlikely that an equilibrium was reached in the 21 year period from 1965 to 1986. The current erosion rates are likely lower than those initially experienced in the 1965 to 1986 period.

Both Expansion flow regimes will result in significantly reduced flows and reduced erosion rates, compared to the present erosion rates. Initially this may result in some erosion of fines from former depositional areas. Prediction of this erosion is very difficult and unreliable and would require a significant amount of field data and mapping.

Existing possible depositional and erosion zones are shown in Appendix III, Figures III-1 through Figure III-7. Ground truthing is required to confirm these zones and perhaps identify other zones which are not evident on the photomosaics.

In general, either Expansion flow regime should improve the water quality (by a reduction in sediment transport) and turbidity. The 56 MW Expansion would result in greater improvements than the 36 MW Expansion.

We recommend that:

- Erosion Sites 1, 2 and 3 be monitored; and
- Turbidity measurements be taken to provide a baseline data base.

This has been an interesting project and we look forward to providing you with consulting services in the future.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

REGISTERED PROFESSIONAL ENGINEER
G.W. STEVENSON
LICENSEE
NWT/NU

Garry W. Stevenson, P.Eng.
Project Manager

PROFESSIONAL
PROVINCE OF
Richard F. Rodman
BRITISH COLUMBIA
ENGINEER

Richard F. Rodman, P.Eng.
Senior Water Resources Engineer

7. REFERENCES

Cambria Gordon Ltd. (2008), “Trudel Creek Fish and Fish Habitat Effects Assessment”, Deze Energy Corporation, Taltson River Hydroelectric Expansion Project, March.

Rescan (2006), “Taltson Hydro Project Trudel Creek Hydrological Assessment”, for Northwest Territories Energy Corporation, Draft, October.

Rescan (2008a), Personal communication from Greg Norton, M.Sc., Hydrologist,.

Rescan (2008b), Emailed data files from Kelli Bergh, MET, B.Sc., Environmental Toxicologist, December 17.

APPENDIX I

Photomosaics Maps of Erosion Monitoring Sites

(FIGURES I-1 TO I-6)

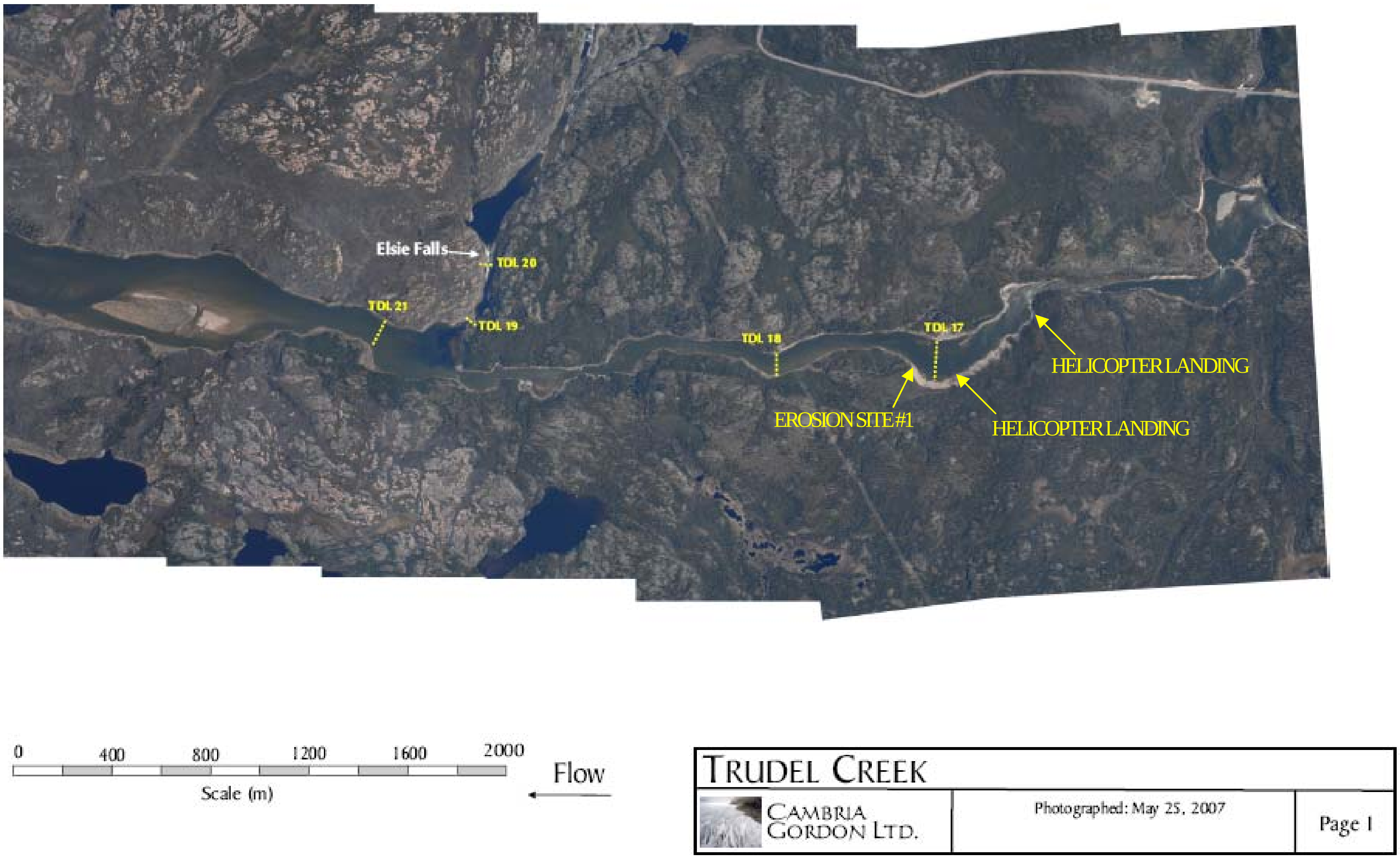


Figure I-1 Site 1 General

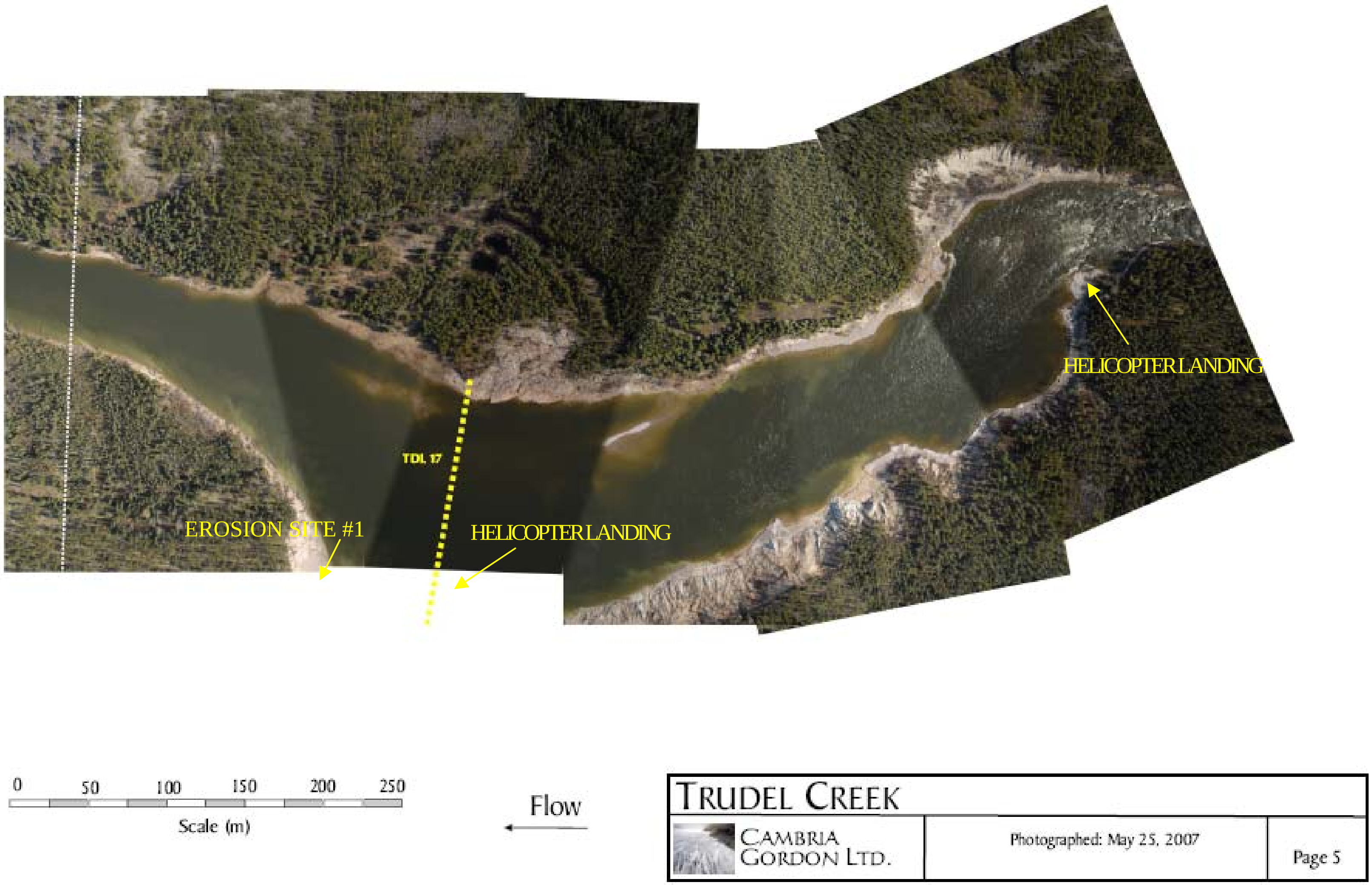


Figure I-2 Site 1 Detail

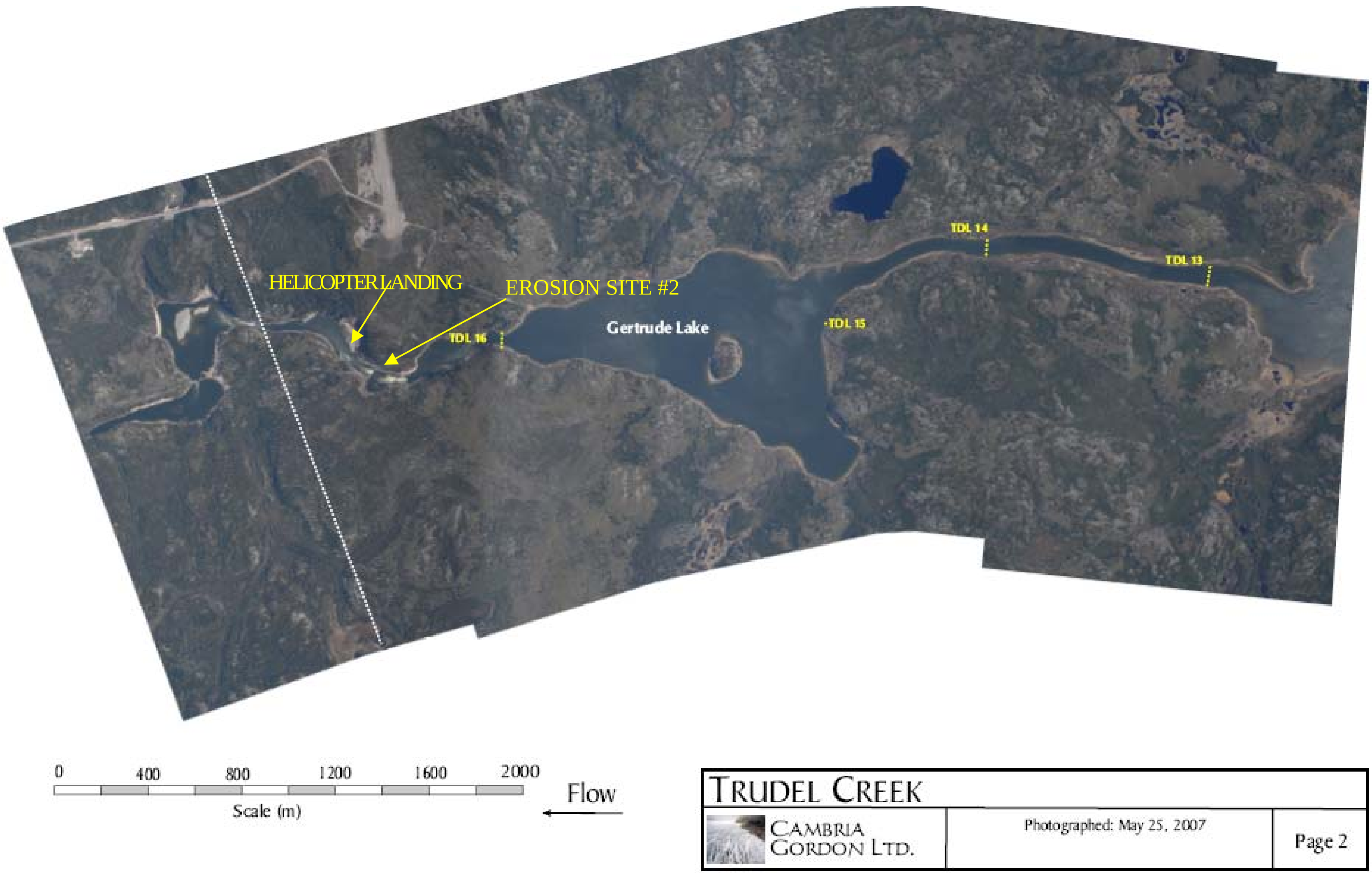


Figure I-3 Site 2 General

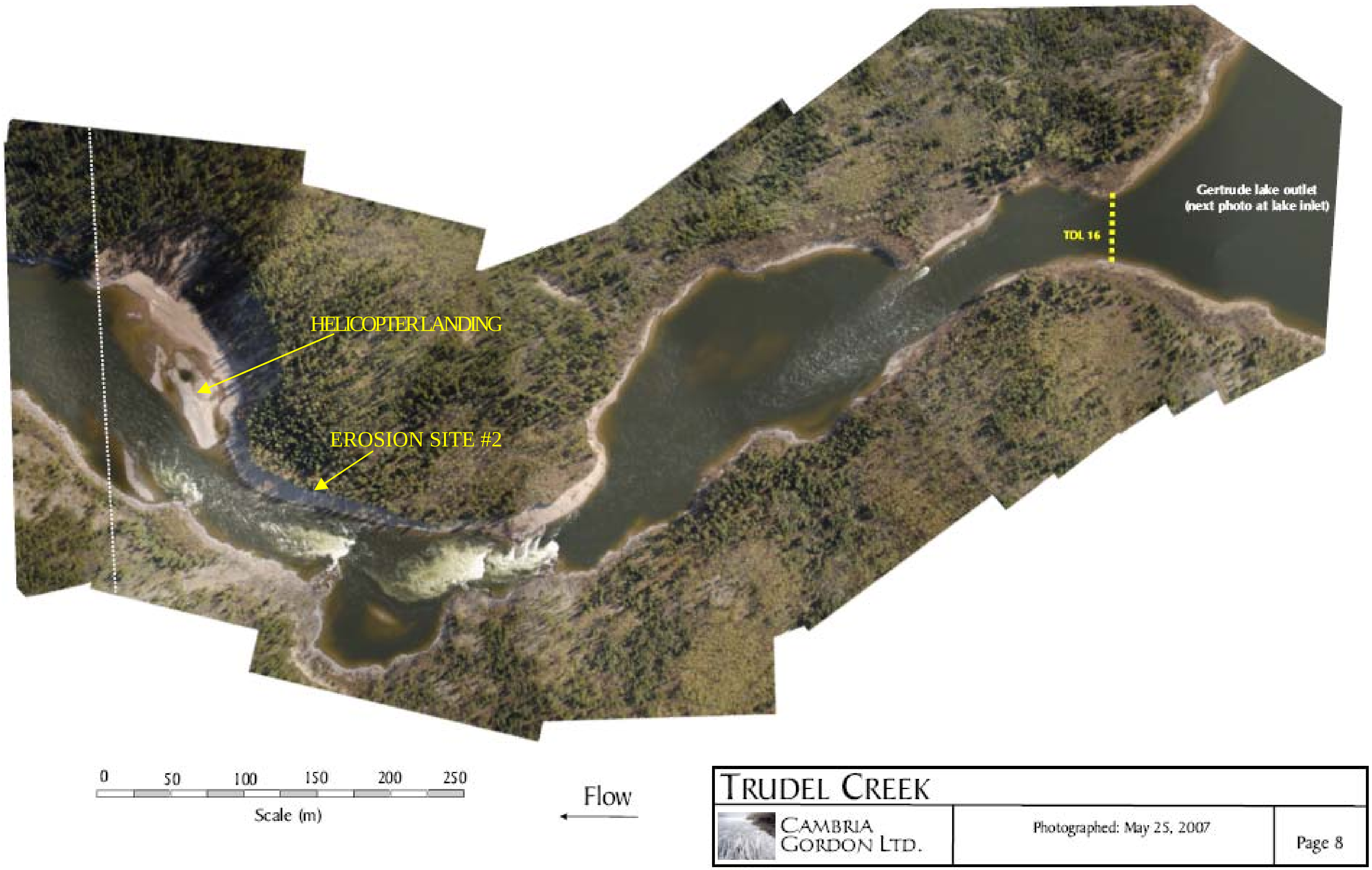


Figure I-4 Site 2 Detail

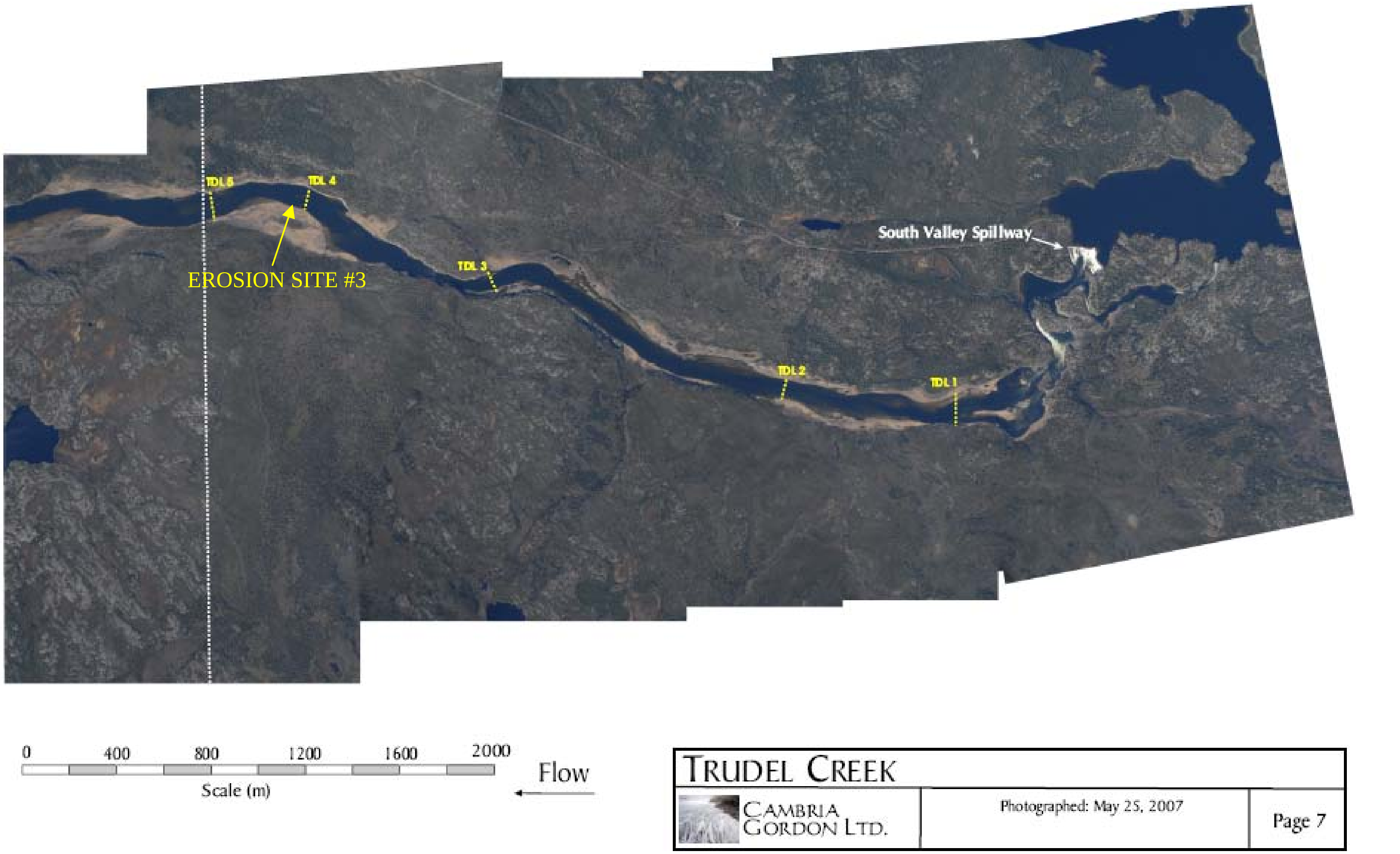


Figure I-5 Site 3 General

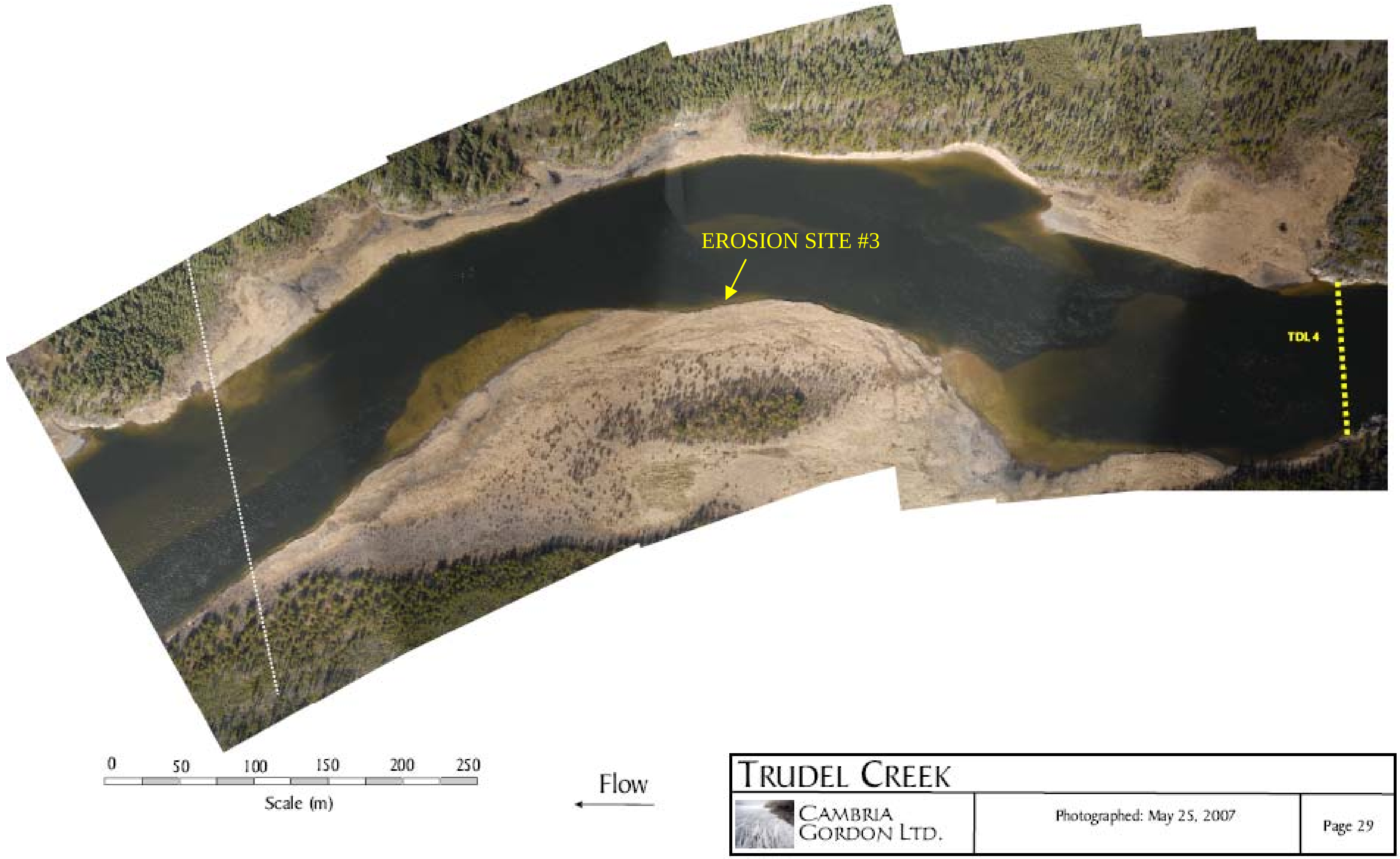


Figure I-6 Site 3 Detail

APPENDIX II

Historical Air Photos

(Figures II-1 to II-4)

CAMBRIA GORDON LTD.	Aerial Photo of Trudel Creek and Twin Gorges Pre-development, August 15, 1955

Figure II-1

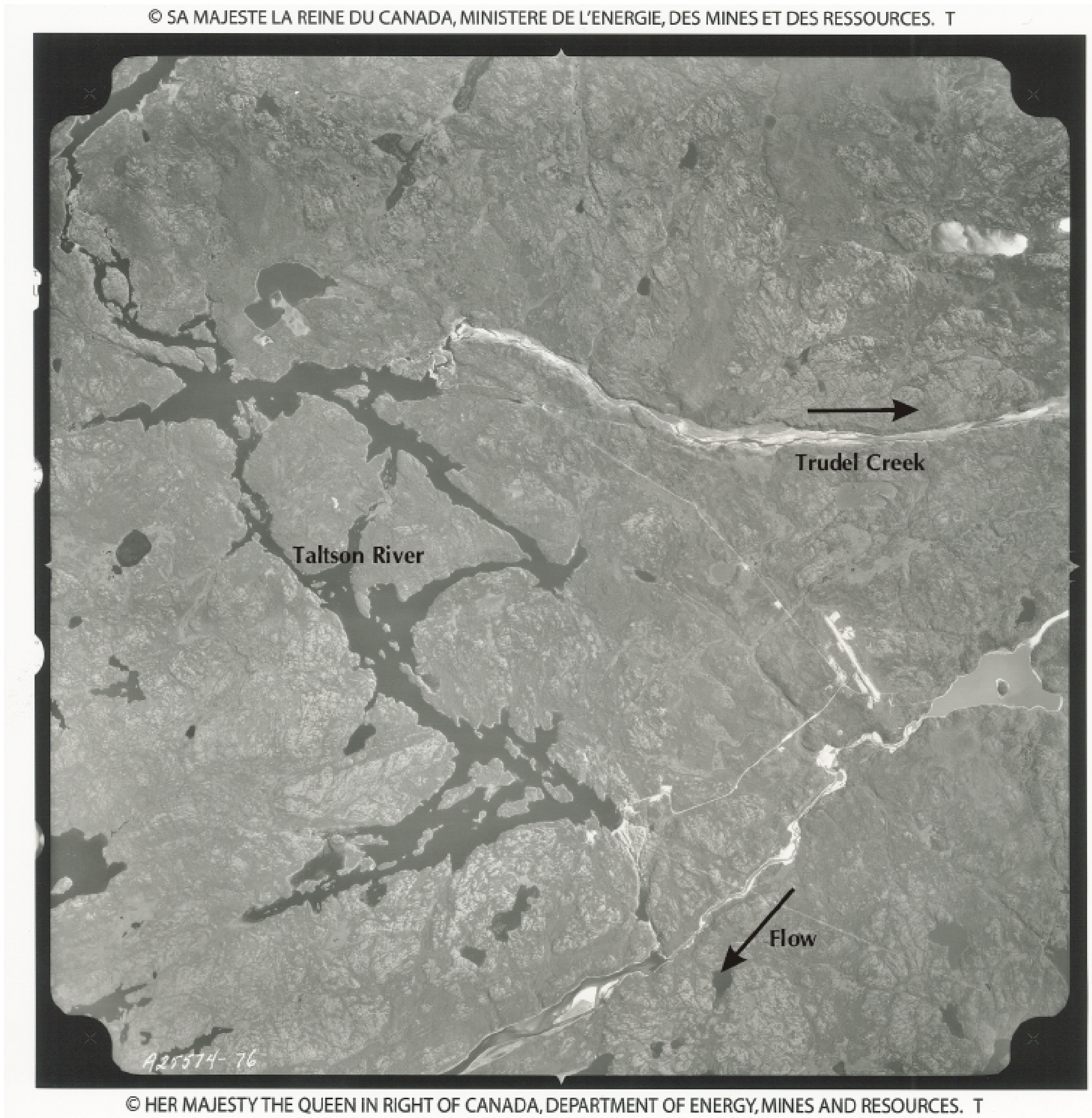
CAMBRIA GORDON LTD.	Aerial Photo of Trudel Creek Pre-development August 1955

Figure II-2

CAMBRIA GORDON LTD.

Aerial Photo of Trudel Creek (Reach 1) Pre-development
August 15, 1955

Figure II-3



CAMBRIA GORDON LTD.

Aerial Photograph of Trudel Creek, South Valley Spillway and Twin Gorges
August 1980

Figure II-4

APPENDIX III

Possible Sediment Depositional and Erosion Zones

(Figures III-1 to III-7)

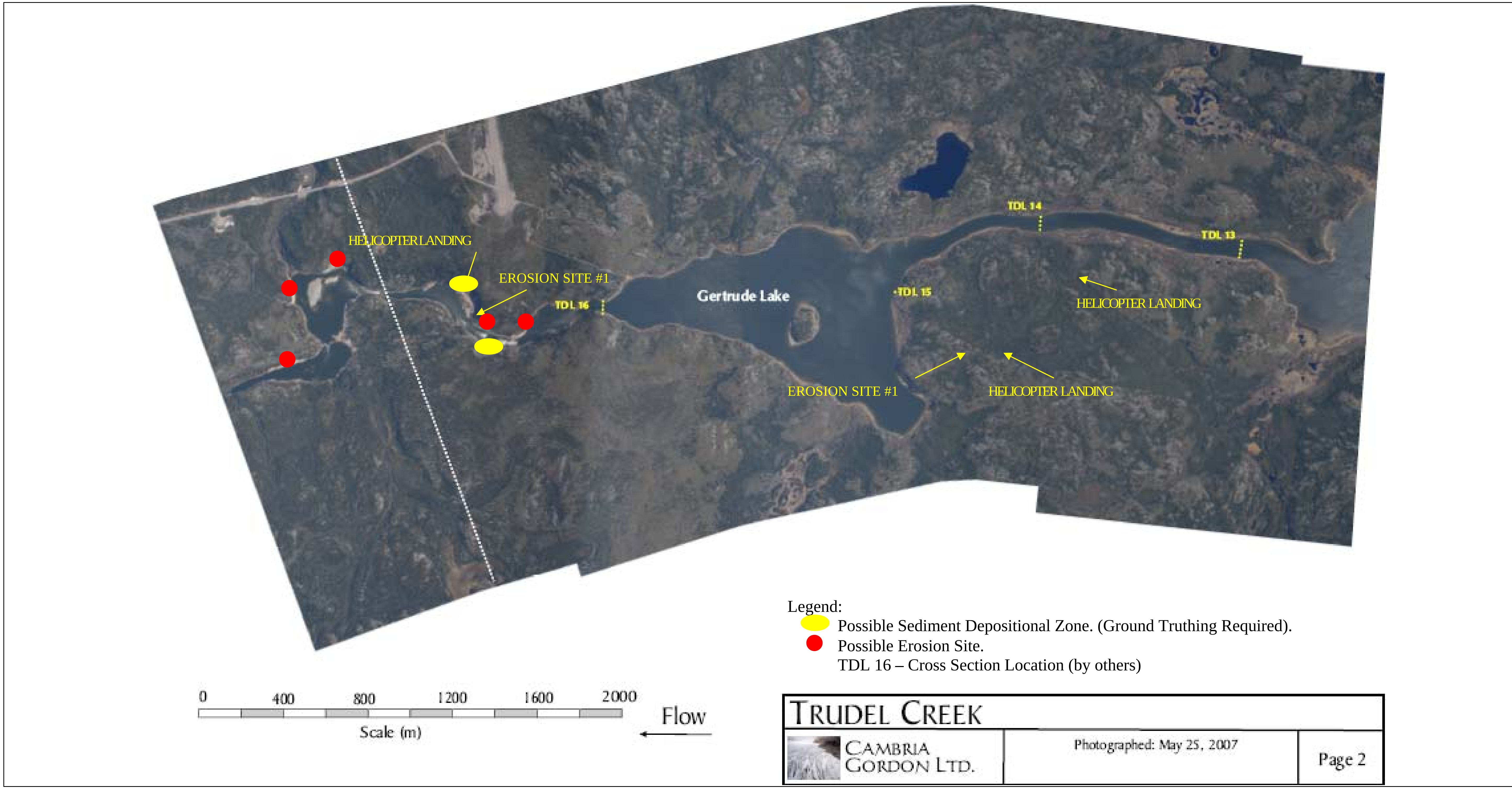

HELICOPTER LANDING
EROSION SITE #1
TDL 16
Gertrude Lake
TDL 15
TDL 14
TDL 13
HELICOPTER LANDING
EROSION SITE #1
HELICOPTER LANDING
Legend:
Possible Sediment Depositional Zone. (Ground Truthing Required).
Possible Erosion Site.
TDL 16 – Cross Section Location (by others)
0
400
800
1200
1600
2000
Scale (m)
Flow
TRUDEL CREEK
CAMBRIA GORDON LTD.
Photographed: May 25, 2007
Page 2

Figure III-1

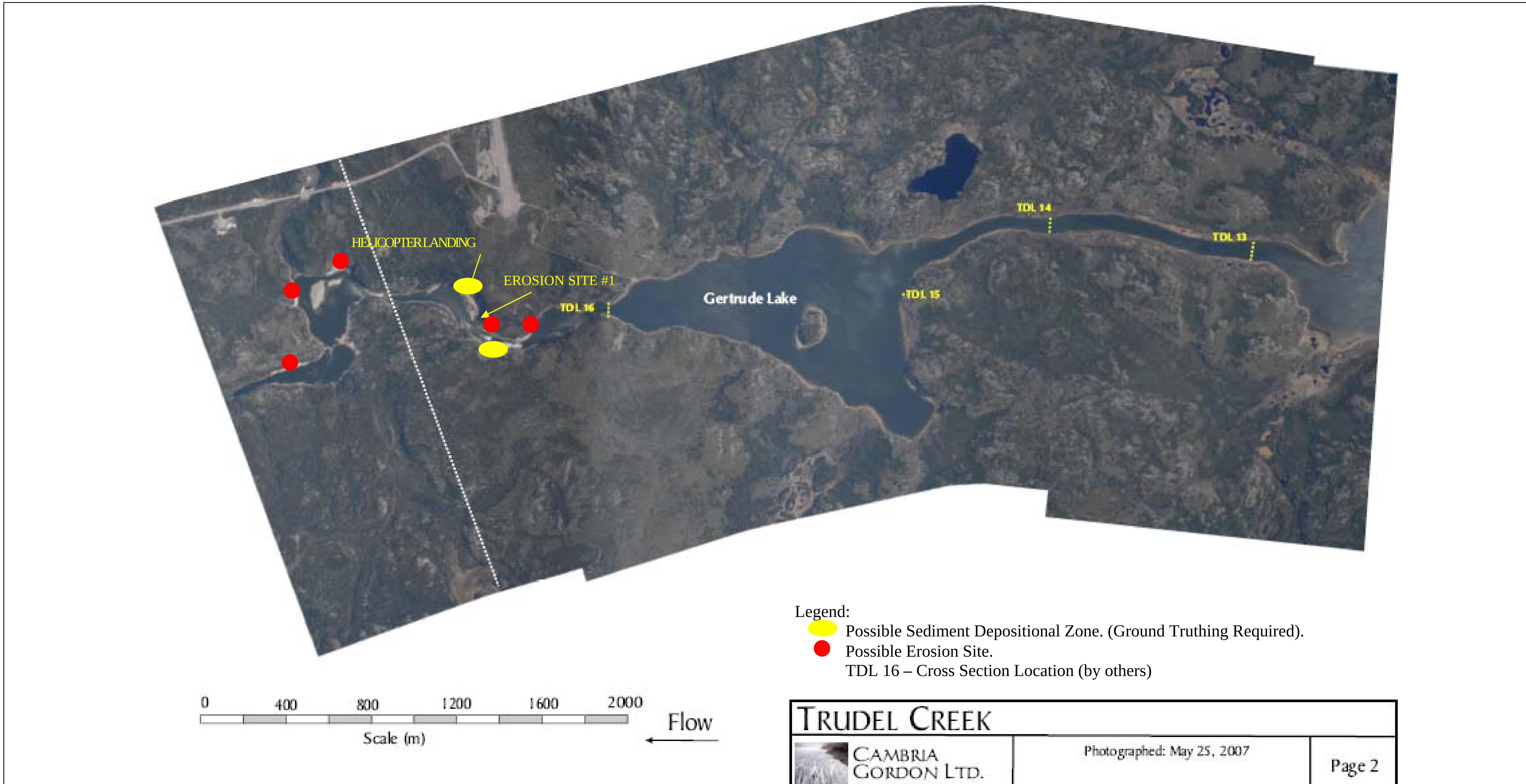
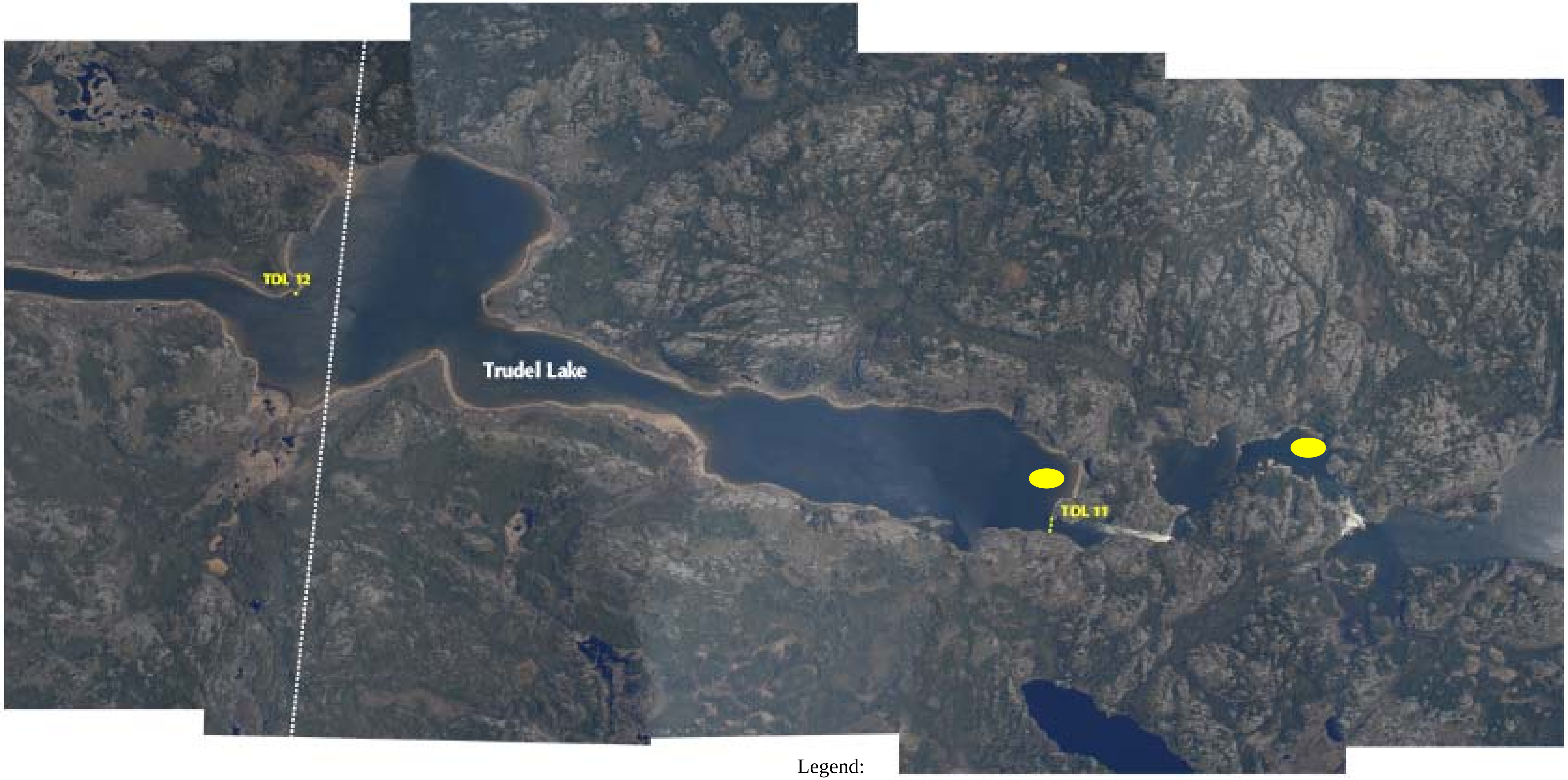

HELICOPTER LANDING
EROSION SITE #1
TDL 16
Gertrude Lake
TDL 15
TDL 14
TDL 13
Legend:
Possible Sediment Depositional Zone. (Ground Truthing Required).
Possible Erosion Site.
TDL 16 – Cross Section Location (by others)
0
400
800
1200
1600
2000
Scale (m)
Flow
TRUDEL CREEK
CAMBRIA GORDON LTD.
Photographed: May 25, 2007
Page 2

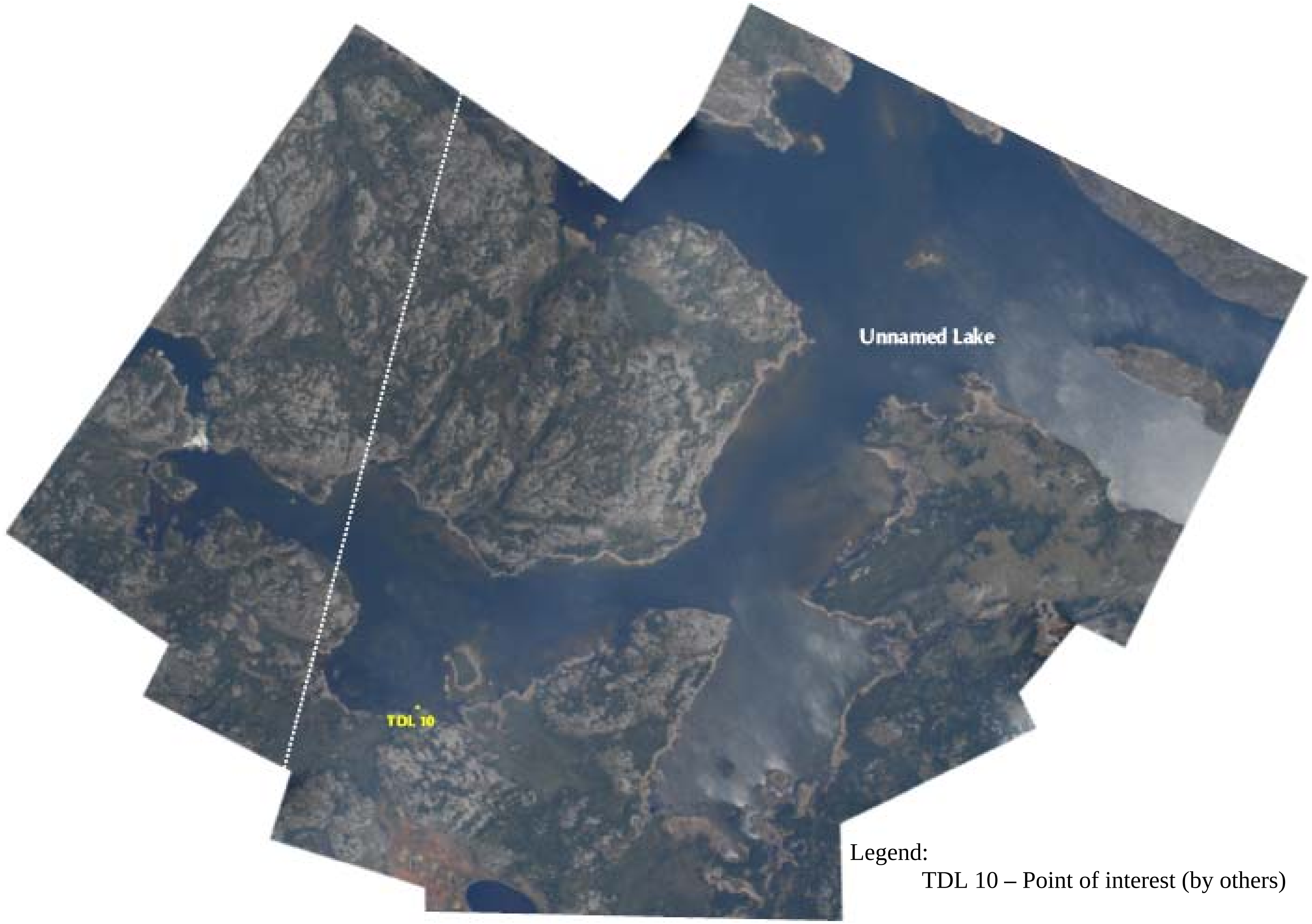
Figure III-2



Legend:
Possible Sediment Depositional Zone. (Ground Truthing Required).
TDL 11 – Cross Section Location (by others)

TRUDEL CREEK		
CAMBRIA GORDON LTD.	Photographed: May 25, 2007	Page 3

Figure III-3



Legend:
TDL 10 – Point of interest (by others)

TRUDEL CREEK		
CAMBRIA GORDON LTD.	Photographed: May 25, 2007	Page 4

Figure III-4

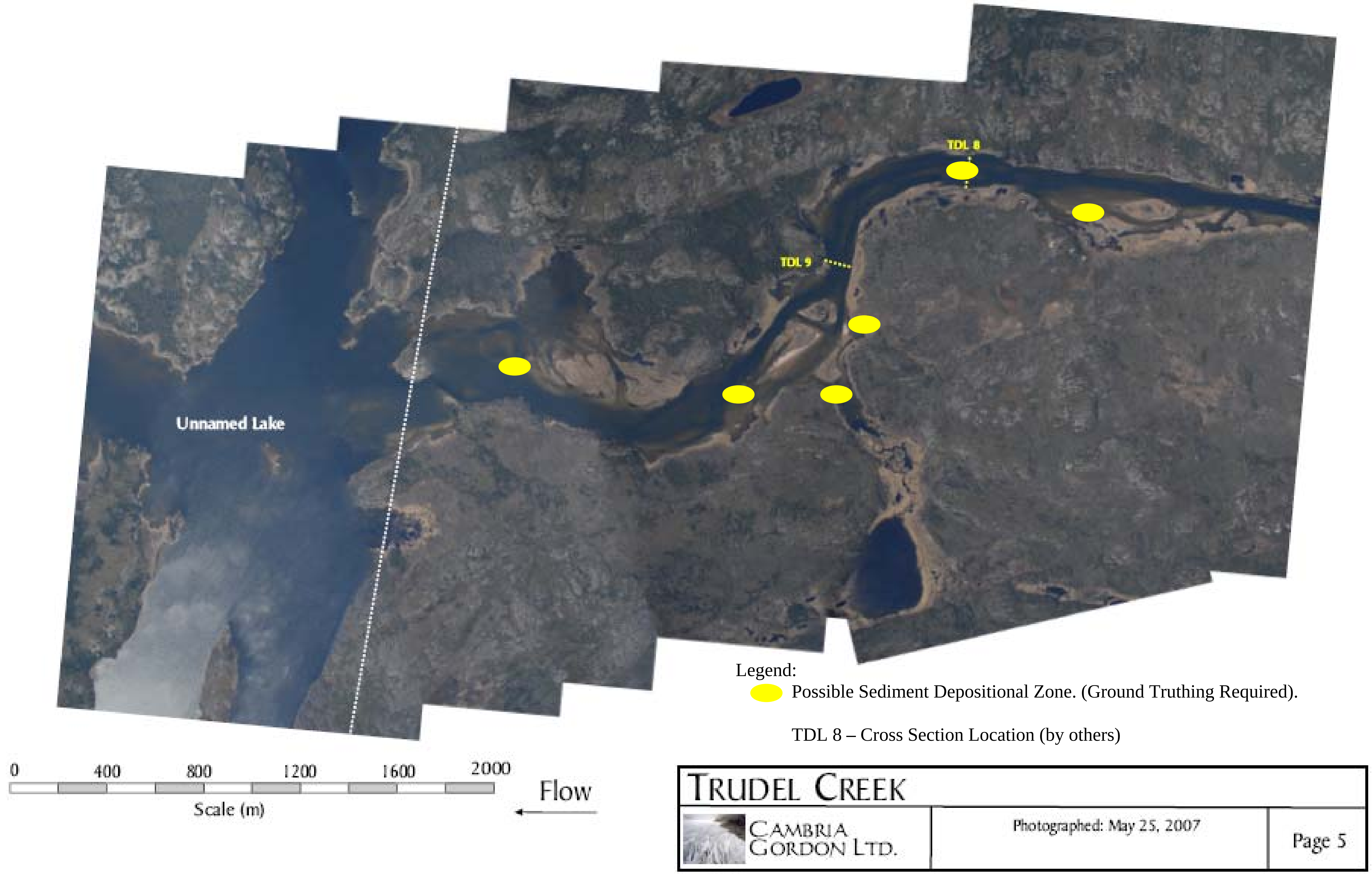
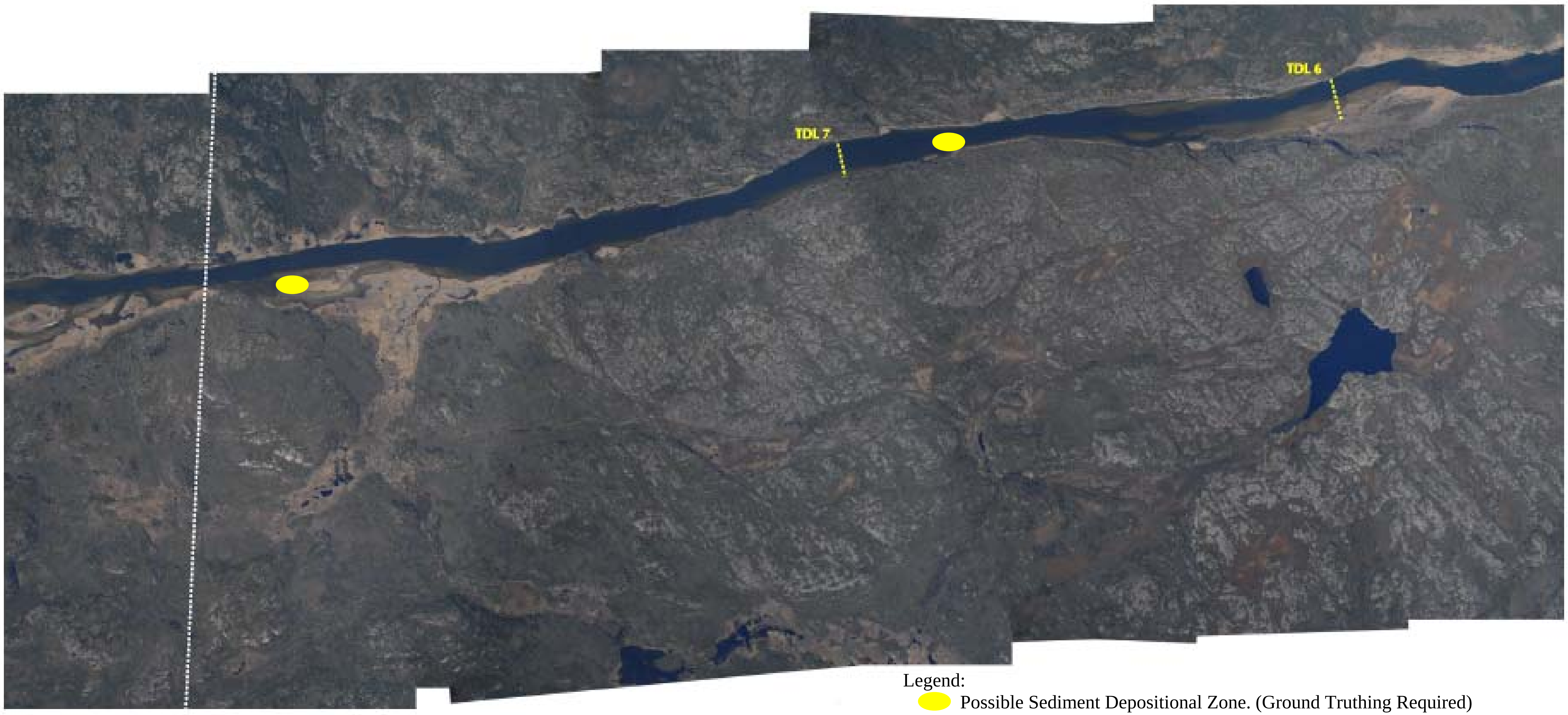

TDL 8
TDL 9
Unnamed Lake
Legend:
Possible Sediment Depositional Zone. (Ground Truthing Required).
TDL 8 – Cross Section Location (by others)
0 400 800 1200 1600 2000
Scale (m)
Flow
TRUDEL CREEK
CAMBRIA GORDON LTD.
Photographed: May 25, 2007
Page 5

Figure III-5



Legend:
Possible Sediment Depositional Zone. (Ground Truthing Required)

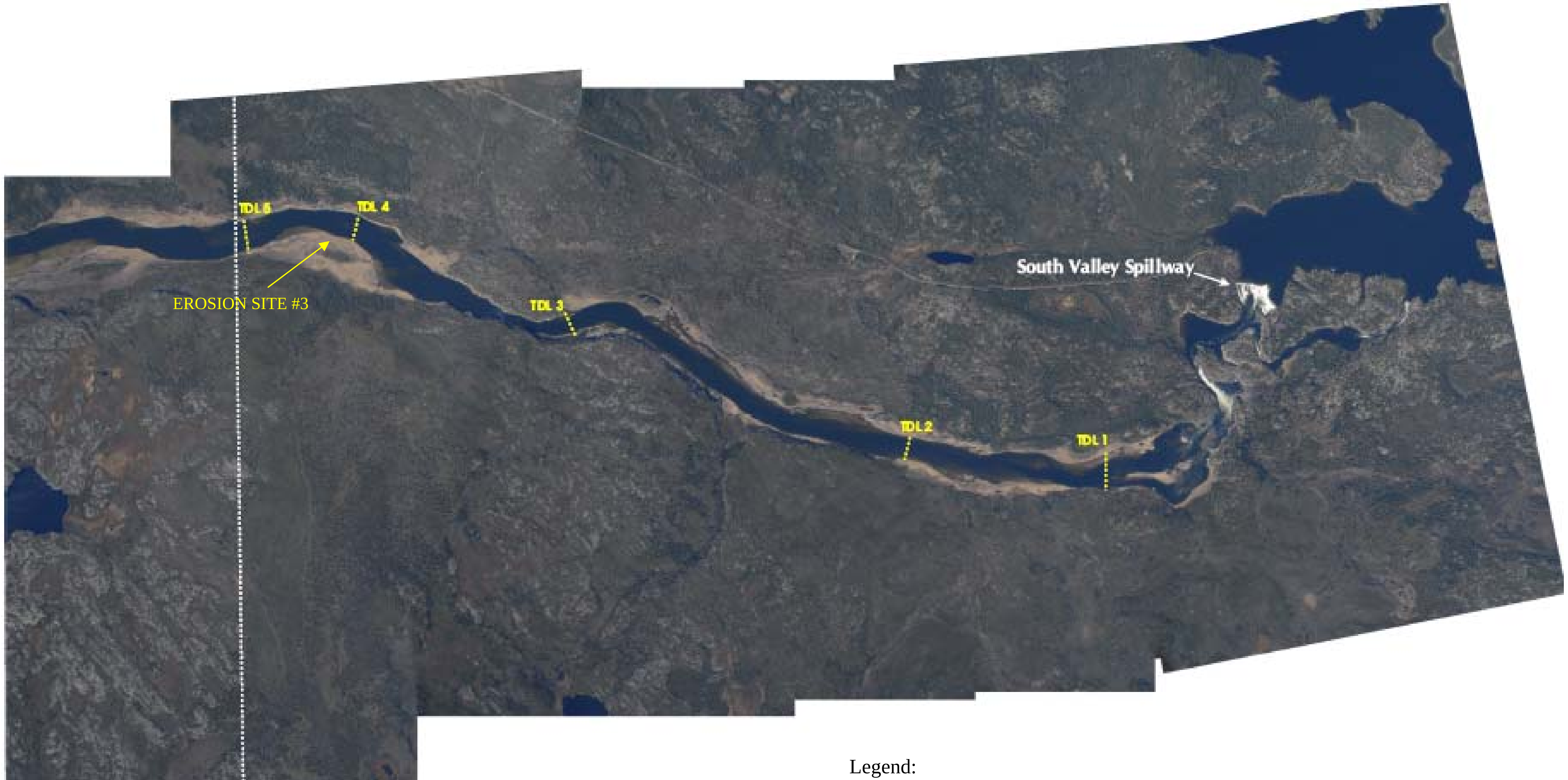
TDL 7 – Cross Section Location (by others)

0 400 800 1200 1600 2000
Scale (m)

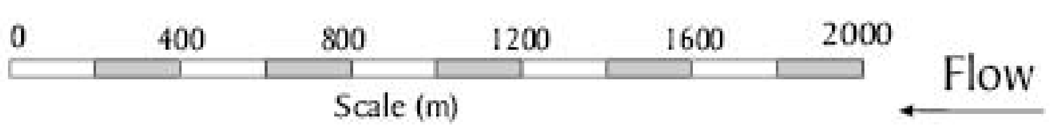
Flow

TRUDEL CREEK		
CAMBRIA GORDON LTD.	Photographed: May 25, 2007	Page 6

Figure III-6



Legend:
TDL 5 – Cross Section Location (by others)



TRUDEL CREEK		
CAMBRIA GORDON LTD.	Photographed: May 25, 2007	Page 7

Figure III-7