

Webequie Supply Road Project

Webequie First Nation

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APPENDIX D-2: WEBEQUIE AGGREGATE SITES

AtkinsRéalis



WSR
WEBEQUIE
SUPPLY ROAD



WEBEQUIE SUPPLY ROAD: JULY 2020 EXPLORATION OF POTENTIAL AGGREGATE DEVELOPMENT SITES

FINAL REPORT

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1 INTRODUCTION

Following from fieldwork completed by our firm in September 2019, this report summarizes July 2020 exploration of potential aggregate development sites along the western, north-south trending section of the proposed Webequie Supply Road (Figs 1,2). Specifically, the sites explored during this field program were referred to in the 2019 work as, from north to south, TP19-02, TP19-09, TP19-10 and TP19-03 (Figs 1,2). No sites along the main east-west trending section of the proposed supply road were explored in July 2020, as the September 2019 fieldwork found there to be limited aggregate potential along that section.

1.1 BOREHOLE DATA

Ten boreholes were drilled as part of the aggregate exploration program for a total of 51.1 m of drilling (Table 1). Drilling methods included hollow stem (HS) or solid stem (SS) auger and BQ coring in bedrock. A basic summary of the materials observed at each borehole is provided in Table 1. Elevations reported in this table are interpolated from the LiDAR ground elevation surface. Boreholes in the table are sorted according to the day of July in which they were completed. Please refer to the official borehole logs provided by SNC-Lavalin for full borehole details.

Table 1 Summary of boreholes drilled as part of aggregate exploration program.

Borehole	Metres				Day	Site	Termination	Material	Drilling method
	Easting	Northing	Elev.	Depth					
WQA1	490301	5862245	198.08	5.2	4,5	TP19-02	Terminated by choice	Sand and gravel\bedrock	HS\BQ
BH20-1	490540	5862412	197.69	2.1	6	TP19-02	Refusal at boulder\bedrock	Till\bedrock	SS
WQA2	488808	5861787	201.02	5.2	7	TP19-02	Terminated by choice	Thick organics\till	SS
WQA4	488976	5857117		7.7	8	TP19-09	Terminated by choice	Till	HS
WQA3	489224	5857493	196.71	5.2	9	TP19-09	Terminated by choice	Sand and gravel	HS
BH20-2	489278	5857978	196.49	4.8	10	TP19-09	Terminated by choice	Sand and gravel	SS
WQA7	488545	5847291		5.0	11	TP19-03	Terminated by choice	Till	SS
WQA5	485494	5852807		6.6	13	TP19-10	Terminated by choice	Sand and gravel	HS
BH20-3	485566	5853161		5.8	13,14	TP19-10	Refusal at boulder\bedrock	Sand and gravel	HS
WQA6	486193	5853367		3.5	16	TP19-10	Terminated due to sand heave	Sand and gravel and till	HS

1.2 HAND AUGER AND SURFACE OBSERVATIONS

Surface and hand augering observations were made to explore beyond borehole locations. Table A1 provides a simple summary of the surface material observed at each of these 189 points. Hand auger holes were drilled with a 2.5-inch diameter auger, with 39 holes drilled for a total of 60.5 m of drilling, with field logs provided in Table B1. Grain size curves for selected samples from the hand auger holes are provided in Appendix C (Figure C1 to Figure C5). JDMA conducted the grain size analyses following ASTM117 and ASTM136 standards at their “Type C” aggregate lab certified by the Canadian Council of Independent Laboratories (CCIL).

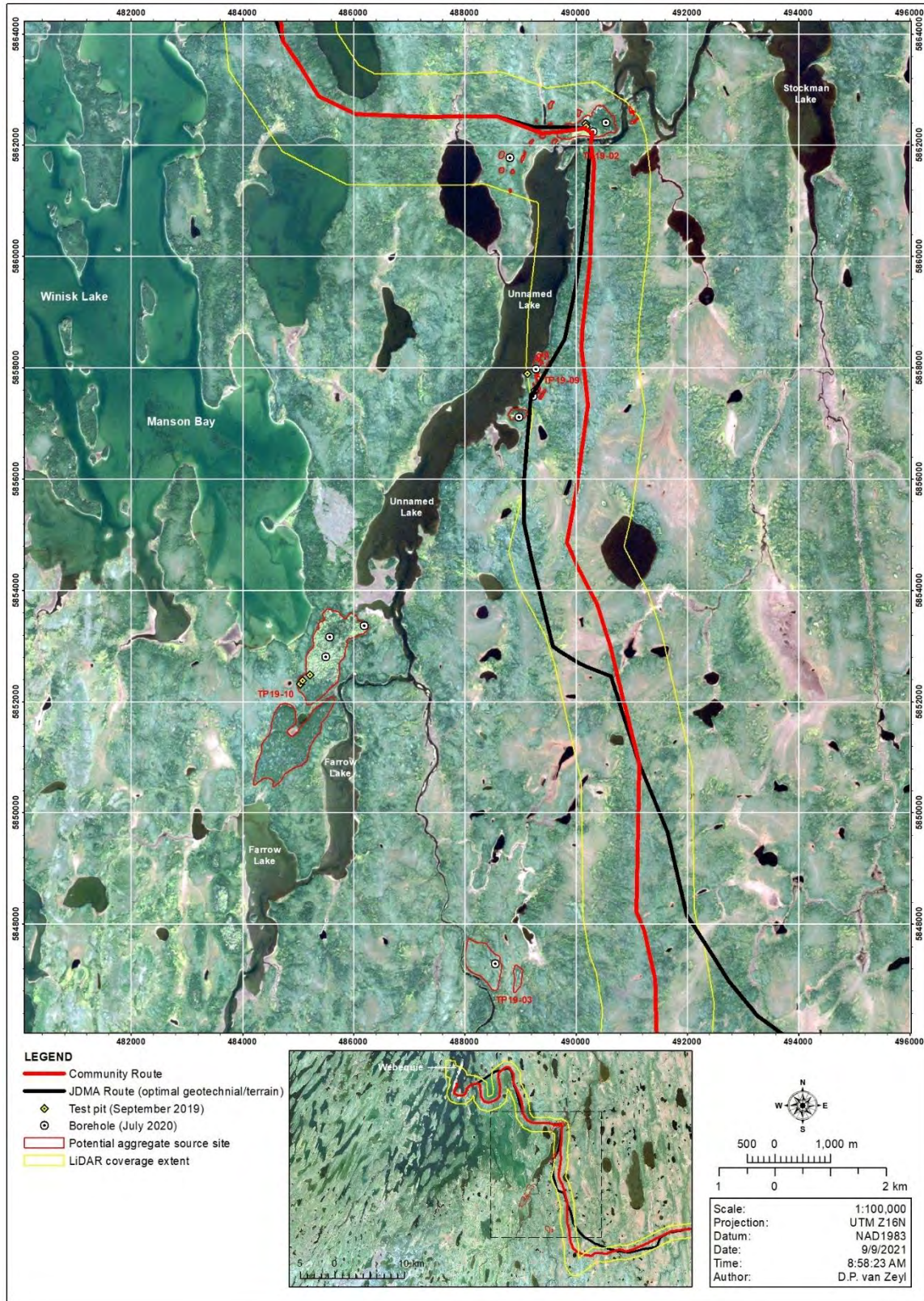


Figure 1 Satellite map showing sites explored in July 2020. Webequie Supply Road.

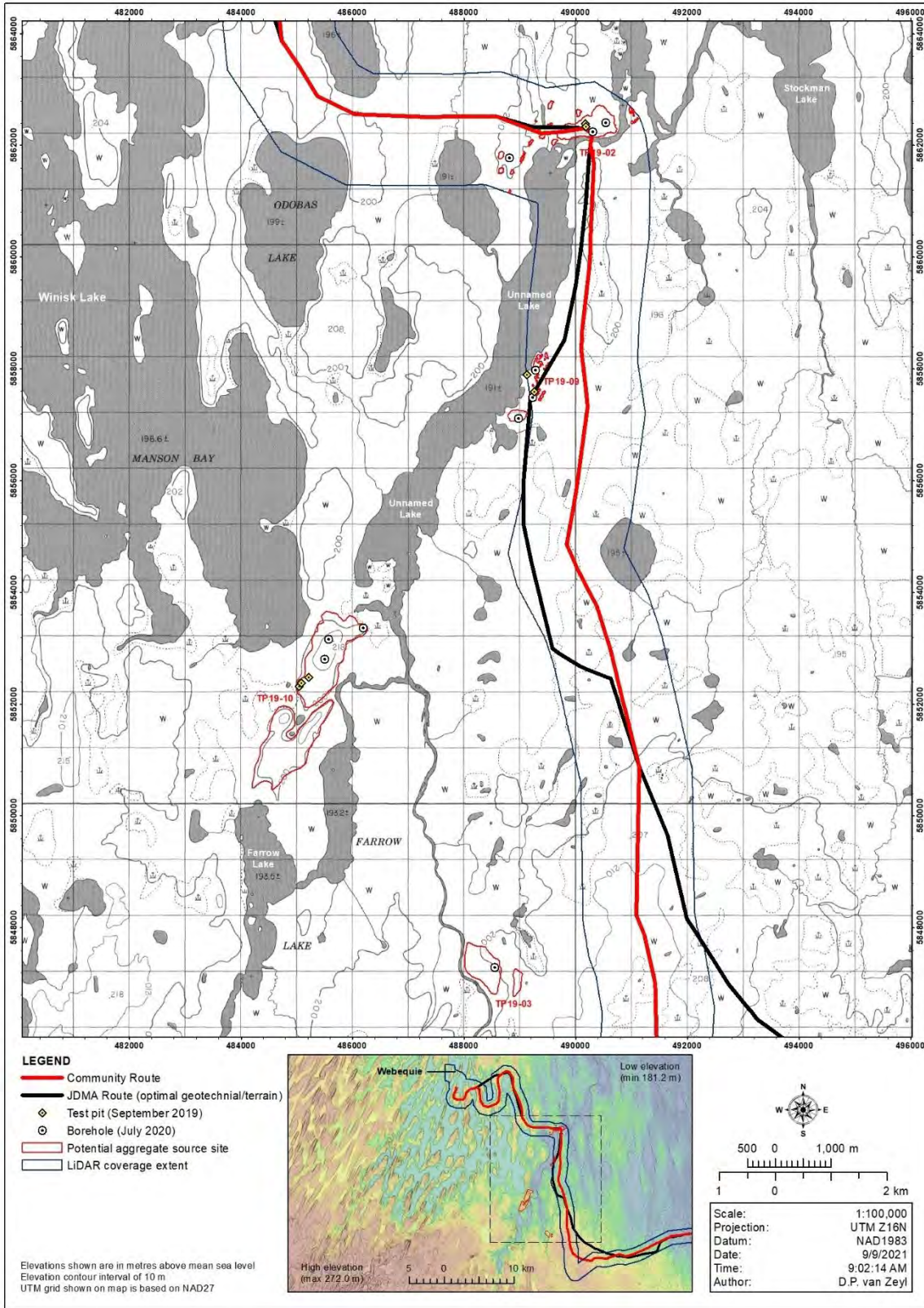


Figure 2 Topographic map showing sites explored in July 2020. Webequie Supply Road.

2 OBSERVATIONS AT TP19-02

This site is situated at the north end of a north-northeast trending unnamed lake (Figs. 1,2). Results for this site are described in three separate areas respectively covered by cross sections A and B, C and D, and E through I (Figure 3). The main part of the site explored in 2019 is situated immediately north of the outlet channel at the north end of the unnamed lake (cross sections E through I). The two additional areas explored this year were identified prior to the fieldwork as being possible locations of shallow bedrock based on the presence of several localized hills and ridges shown hidden beneath the forest canopy by the LiDAR data.

2.1 CROSS SECTIONS A AND B

Several localized hills and north-trending ridges are present in the area covered by cross sections A and B (Figure 4). Given that bedrock is locally at the surface in hill features nearby the cross sections F through I, upon identifying these hills and ridges prior to the July 2020 fieldwork, it was considered possible that bedrock might similarly be close to surface beneath these features.

Hand augering was completed into the four hills along sections A and B and the two hills within 300 m north of section B (Figure 4). Five of the six hills revealed sand and/or gravel as the dominant material beneath organics, while the west hill in section B revealed till (Figure 5, Table 2, Figure 6, Figure 7). In the six auger holes that intersected sand and/or gravel, refusal occurred at depths of 1.32 to 3.60 m, with an average of 2.36 m. The total surface area of the five hills underlain by sand and/or gravel, as shown by the red outlines in Figure 4, is 20,090 m². If the average refusal depth of 2.36 m is applied to this surface area, a volume of sand and/or gravel of 47,412 m³ is obtained.

Cross sections in Figure 5 are drawn to suggest that refusal in the hand auger holes was caused by impact with bedrock. However, no direct evidence was established to confirm whether refusal was in fact related to the top of bedrock. The main purpose of borehole WQA2 was to establish the depth of overburden in the location where overburden was expected to be thickest in the topographic low between hills in section B. Unfortunately, the borehole was terminated prematurely before hitting bedrock. As a result, it is uncertain whether bedrock is present beneath the hills in this area.

In summary, five of the six hilltops explored by hand augering in this area showed roughly 1.32 to 3.60 m of sand and/or gravel at the surface with a possible combined aggregate volume in the order of 40,000 to 50,000 m³ suggested. It is possible that bedrock is present at shallow depth beneath the six hilltops in this area. If bedrock is present beneath the six hilltops, which have a combined surface area of 30,040 m² as delineated in Figure 4, this would represent a reserve of 60,080 to 120,160 m³ of bedrock if depths of 2 to 4 m are applied to the surface area. If bedrock is indeed present at shallow depths beneath these hills, further investigation would have the possibility of identifying a much larger quantity of bedrock than the above suggested values.

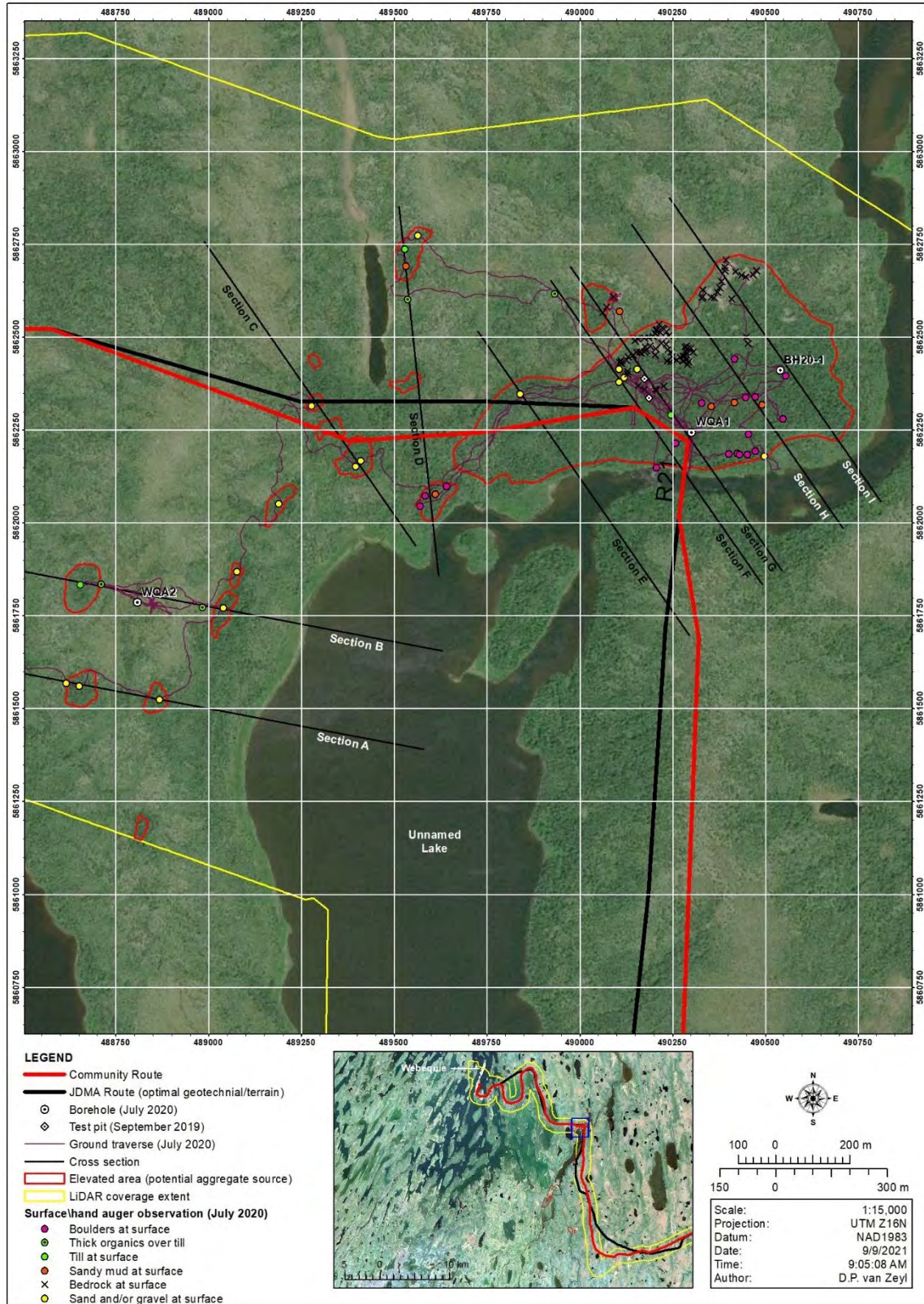


Figure 3 Satellite map showing overview of TP19-02. Webequie Supply Road.

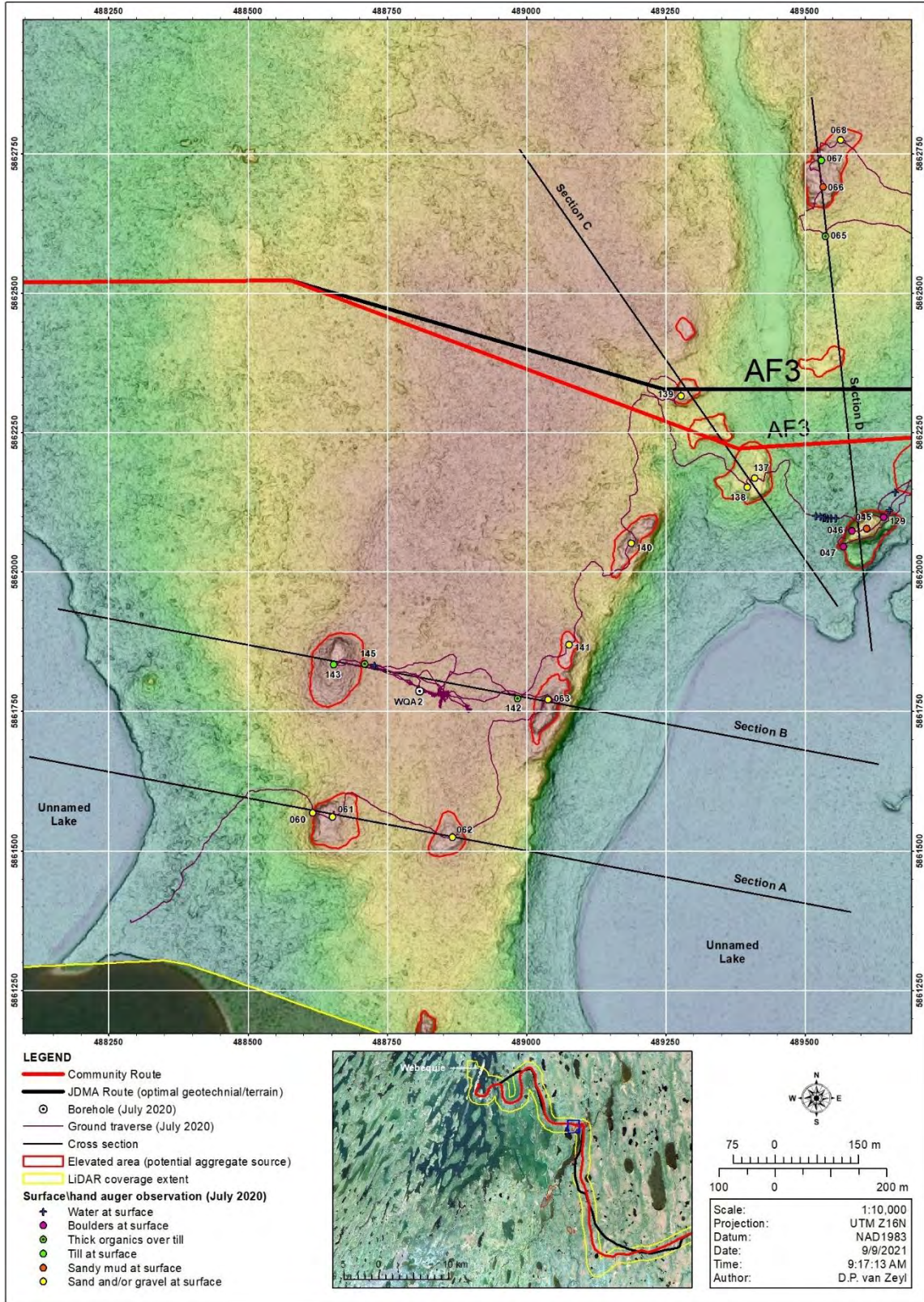


Figure 4 LiDAR map showing west part of TP19-02, Webequie Supply Road.

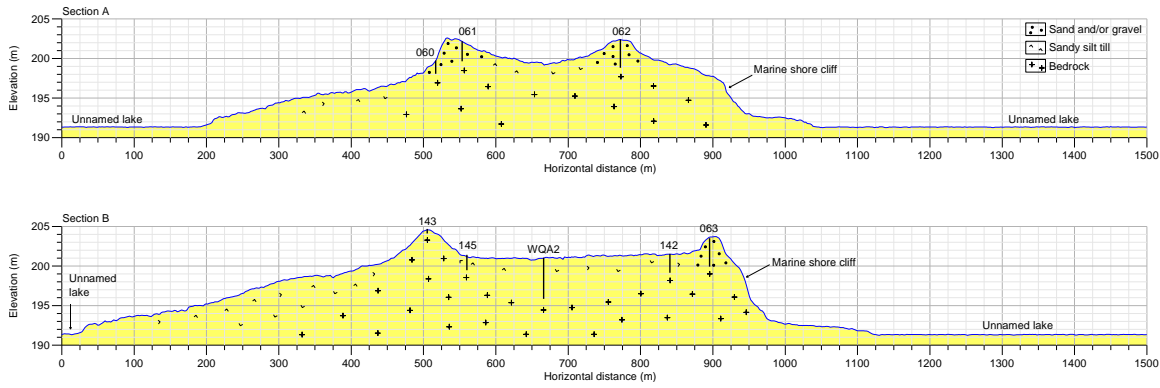


Figure 5 Borehole and hand auger observations plotted onto cross sections A and B.

Table 2 Summary of observations along and near cross sections A and B.

Section	Waypoint	Metres				Materials
		Chainage	Elevation	Depth	Bottom	
A	060	517.1	199.73	1.68	198.05	Organics less than 0.1 m thick over very fine to medium sand, some silt, gravel from 1.35 to 1.40, refusal at 1.68 m
A	061	553.7	202.15	2.53	199.62	Organics less than 0.1 m thick over very fine to fine sand, some coarse sand and gravel, some silt, refusal at 2.53 m
A	062	772.4	202.41	3.60	198.81	Organics less than 0.1 m thick over very fine to medium sand, some coarse sand and gravel, some silt, refusal at 3.6 m
B	143	505.3	204.68	0.59	204.09	Organics 0.19 m thick over till (brownish light grey sandy silt till), refusal at 0.59 m
B	145	560.1	201.39	1.94	199.45	Organics 0.21 m thick over till (brownish light grey sandy silt till), refusal at 1.94 m
B	WQA2	666.3	201.02	5.20	195.82	Organics 1.98 m thick over till (light brown to light grey sandy silt till)
B	142	840.8	201.52	2.39	199.13	Organics 0.85 m thick over till (brownish light grey sandy silt till), refusal at 2.39 m
B	063	895.7	203.49	3.60	199.89	Organics less than 0.1 m thick over very fine to medium sand, some very coarse sand and fine gravel, refusal at 3.6 m
	141		202.21	1.32	200.89	Organics less than 0.1 m thick over fine sand grading down to coarse sand with gravel, refusal at 1.32 m
	140		202.21	1.44	200.77	Organics less than 0.1 m thick over fine to very coarse sand, some fine to coarse gravel, refusal at 1.44 m



Figure 6 Sand and gravel from depth of 0.55 m in auger hole at waypoint 061.



Figure 7 Very fine to very coarse sand from depth of 0.95 m in auger hole at waypoint 063.

2.2 CROSS SECTIONS C AND D

The area covered by cross sections C and D (Figure 4) includes several isolated hill features that are suspected to be locations where bedrock is close to surface. Eight hand auger holes were drilled along and nearby these cross sections (Figure 8, Table 3).

Hand auger holes drilled along section C revealed very fine to very coarse sand to depths of 0.1 to 2.01 m with gravel present in one of the holes. It is suspected that auger refusal at these holes was caused by impact with the top of bedrock.

Hand auger holes in the hill at the top of section D (waypoints 066 through 068) revealed a silt drape covering variable amounts of sand and/or gravel. Auger hole 065 was drilled to determine the thickness of organics and depth to bedrock in a location marginal to the hilltop. The hill at the bottom of section D showed boulders at the surface throughout the hill.

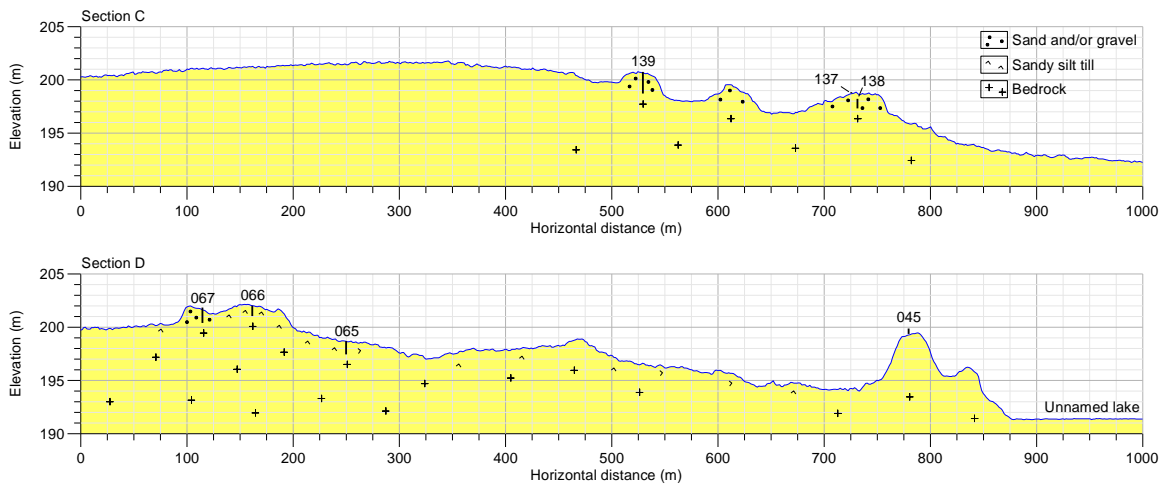


Figure 8 Hand auger observations plotted onto cross sections C and D.

Table 3 Summary of observations along and near cross sections C and D.

Section	Waypoint	Metres				Materials
		Chainage	Elevation	Depth	Bottom	
C	139	529.40	200.72	2.01	198.71	Organics less than 0.1 m thick over very fine to very coarse sand, some gravel, refusal at 2.01 m
C	137	725.80	198.83	0.10	198.73	Organics less than 0.1 m thick over very fine to medium sand, refusal at 0.1 m
C	138	731.50	198.19	0.89	197.30	Organics less than 0.1 m thick over very fine sand, very well sorted, refusal at 0.89 m
D	068		201.28	1.50	199.78	Organics less than 0.1 m thick over light grey silt 0.6 m thick over gravel and very coarse sand, terminated due to sloughing at 1.5 m
D	067	114.70	201.83	1.45	200.38	Organics less than 0.1 m thick over brownish light grey silt over coarse sand and gravel, refusal at 1.45 m
D	066	161.70	202.00	0.98	201.02	Organics less than 0.1 m thick over grey laminated silt over coarse sand and gravel, refusal at 0.98 m
D	065	250.00	198.67	1.25	197.42	Organics 0.45 m thick over brownish light grey sandy silt till, gravelly prior to refusal at 1.25 m
D	045	779.80	199.84	0.50	199.34	Organics less than 0.1 m thick over silt with some very fine sand, coarse sand before refusal at 0.5 m

2.3 CROSS SECTIONS E THROUGH I

The area covered by cross sections E through I is the area of TP19-02 explored in September 2019 (Figure 9). The large red polygon in this area (Figure 9) outlines an area of elevated land where surface materials include bedrock, sand, sand and bouldery gravel, till, and marine sandy mud.

Section E (Figure 10) extends through a sand ridge standing up to 4.5 m above the surrounding terrain. Sand was observed in several locations along the length of this ridge. Hand auger hole 043 drilled in the centre of the ridge revealed fine to very coarse sand with trace fine gravel (Table 4).

Sections F and G (Figure 10) extend through the central part of this complex. Bedrock is exposed along the northwest edge of the complex as well as in a local topographic high northwest of the complex (e.g., waypoint 069). Auger refusal at waypoint 064 on Section F is taken as indicating depth to bedrock in that location. The hand auger hole at waypoint 054 was drilled in the highest part of the sand hill in this complex. The hole showed clayey silt and very fine sand grading down to fine to medium sand with some silt, with bedrock at a depth of 2.98 m. Many locations in the south half of the complex show boulders at the surface. Borehole WQA1 was drilled through a slight topographic high with boulders at the surface. The borehole intersected bedrock at a depth of 2.39 m beneath bouldery sand and gravel.

Variability in materials resting on bedrock within this complex is considerable. The hand auger hole at waypoint 056 intersected marine muds and sandy muds to a depth of 2.35 m, with refusal at 2.35 m taken as the top of bedrock. Borehole BH20-1 intersected sandy silt till to a depth of 2.10 m, with refusal taken as the top of bedrock.

Volume data for the large red polygon shown in Figure 9 is presented in Table 5. In this table, volumes are presented as a function of the depth to which mining is completed. The unnamed lake in this area had its water level in the range of 191.0 to 191.6 m elevation at the time of the LiDAR survey, while the water level was in the range of 190.5 to 190.8 m elevation at the downstream end of the outlet channel. Given these water surface elevations, a conservative estimate of available material has been made by assuming that no mining would be done below 192 m elevation in order to mitigate against potential flooding into the pit. Although it might be possible to mine below that level with special drainage provisions, a more detailed study would be required to confirm the feasibility. Also included in Table 5 are reduced volumes based on assumed percentages of spoil within the complex. It is assumed that the marine sandy muds and perhaps some of the till will represent spoil. In addition, organic material would also contribute to the percentage of spoil within the complex.

Visual examples of sand samples obtained from within this complex are shown for reference in Figure 11 and Figure 12.

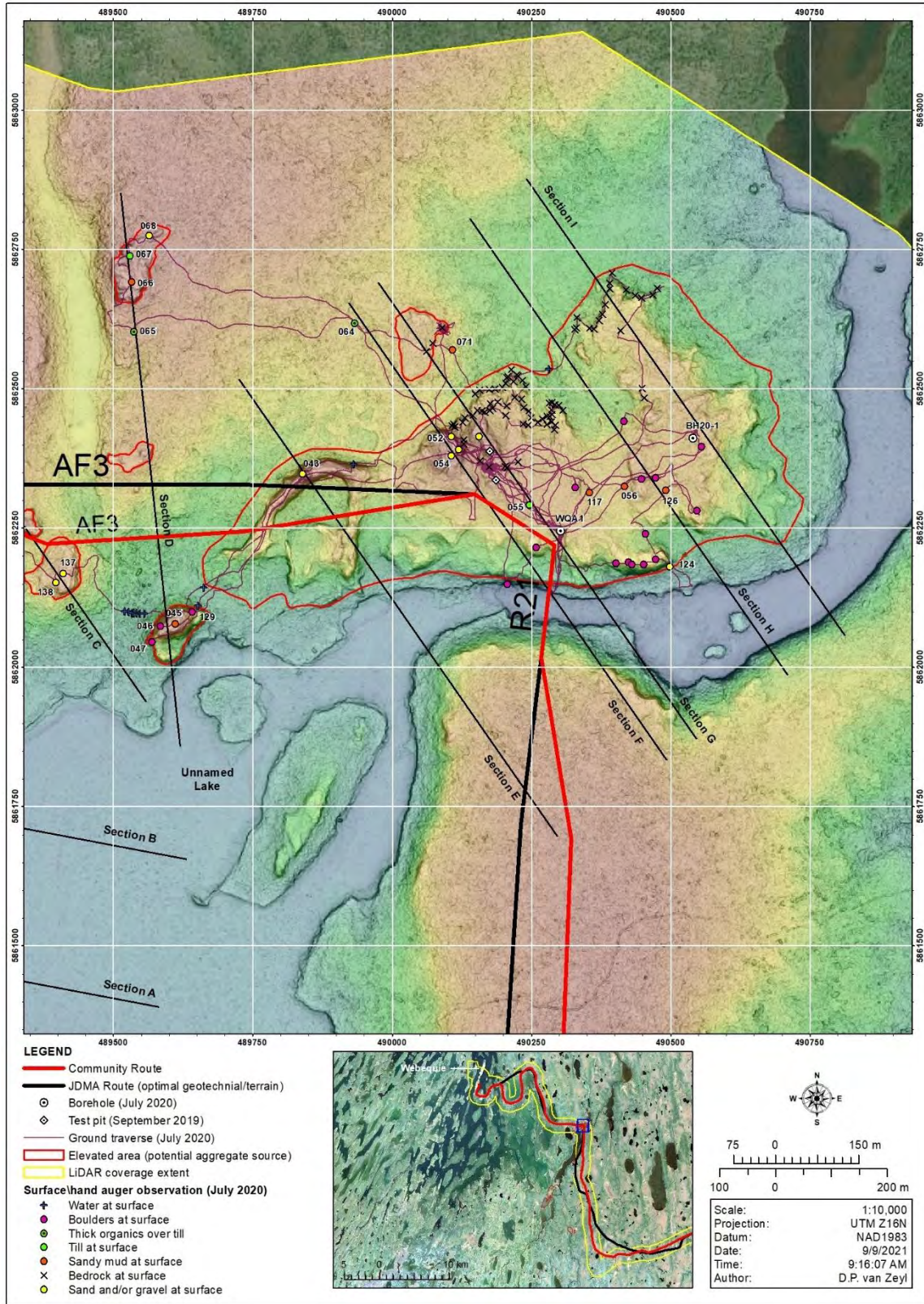


Figure 9 LiDAR map showing east part of TP19-02. Webequie Supply Road.

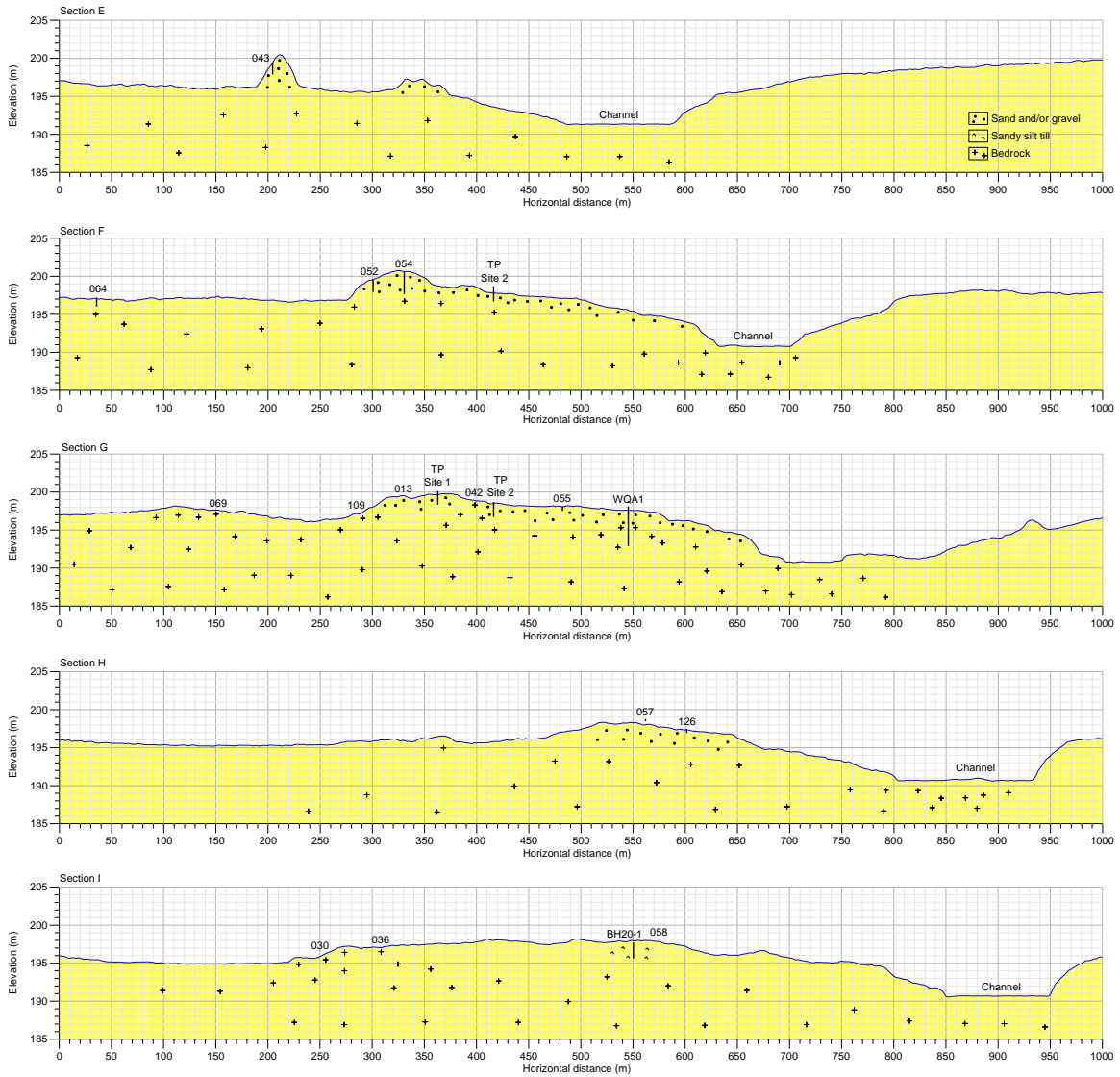


Figure 10 Borehole, hand auger and surface observations plotted onto cross sections E through I.

Table 4 Summary of observations along and near cross sections E through I.

Section	Waypoint	Metres				Materials
		Chainage	Elevation	Depth	Bottom	
E	043	204.40	199.45	1.60	197.85	Fine to very coarse sand, trace fine gravel, terminated by choice at 1.6 m
F	064	035.80	197.19	1.18	196.01	Organics 0.64 m thick over greyish light brown sandy silt till (gravelly at base), refusal at 1.25 m
F	052	300.90	199.51	1.60	197.91	Organics less than 0.1 m thick over silty very fine sand grading downward to fine to medium sand, terminated by choice at 1.60 m
F	054	330.80	200.63	2.98	197.65	Organics less than 0.1 m thick over clayey silt and very fine sand grading down to fine to medium sand, some silt, refusal at 2.98 m
F	TP2	416.30	198.68	2.00	196.68	Organics 0.15 m thick over medium to coarse sand, trace fine gravel, terminated by choice
G	069	151.37	197.75			Bedrock at surface
G	109	291.50	197.38			Bedrock at surface
G	013	327.00	199.68			Fine to medium sand at surface
G	TP1	362.90	200.10	1.80	198.30	Organics 0.15 m thick over medium to coarse sand, trace fine gravel, terminated by choice
G	042	401.80	198.93			Bedrock at surface
G	TP2	416.30	198.68	2.00	196.68	Organics 0.15 m thick over medium to coarse sand, trace fine gravel, terminated by choice
G	055	482.30	198.06	0.55	197.51	Organics 0.15 m thick over gravelly mud, refusal at 0.55 m
G	WQA1	545.50	197.58	5.20	192.38	Organics less than 0.1 m thick over bouldery sand and gravel 2.39 m thick resting on bedrock, terminated by choice at 5.20 m
H	057	562.00	198.76	0.32	198.44	Boulders at surface, refusal at 0.32 m
H	126	601.50	197.44	0.52	196.92	Organics less than 0.1 m thick over silt and very fine sand, refusal at 0.52 m
I	029	262.80	196.83			Bedrock at surface
I	038	320.10	197.26			Bedrock at surface
I	BH20-1	550.50	197.69	2.10	195.59	Organics less than 0.1 m thick over brownish light grey sandy silt till, refusal at bedrock at 2.10 m
I	058	573.70	198.06			Boulders at surface with sand and gravel matrix between boulders

Table 5 Volume table for large red polygon (Figure 9) covered by cross sections E through I.

Lower-bound elevation defining volume (m)	Volume (m ³)	Surface area (m ²)	Volume reduced based on percentage of spoil within complex					
			5%	10%	15%	20%	25%	30%
192	1,764,947	519,714	1,676,700	1,588,452	1,500,205	1,411,958	1,323,710	1,235,463
193	1,276,375	454,126	1,212,556	1,148,738	1,084,919	1,021,100	957,281	893,463
194	857,139	368,261	814,282	771,425	728,569	685,712	642,855	599,998
195	527,977	287,628	501,578	475,179	448,780	422,381	395,983	369,584
196	271,906	203,413	258,311	244,716	231,120	217,525	203,930	190,334
197	101,302	123,408	96,237	91,172	86,107	81,042	75,977	70,912
198	21,519	32,308	20,443	19,367	18,291	17,215	16,139	15,063
199	4,298	6,535	4,083	3,868	3,653	3,438	3,223	3,008
200	462	1,080	439	416	393	370	347	323

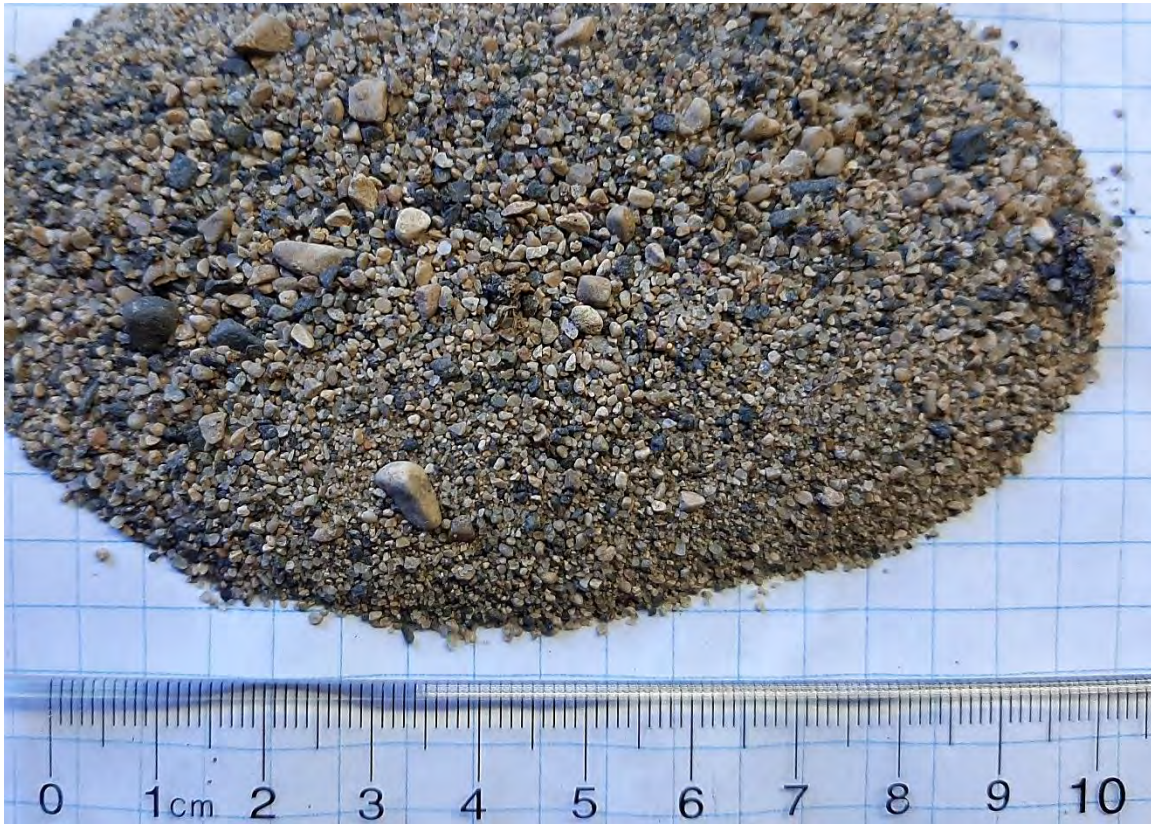


Figure 11 Med. to v.c. sand and fine gravel from depth of 0.50 m in auger hole at waypoint 043.



Figure 12 Fine to medium sand from depth of 2.60 m in auger hole at waypoint 054.

3 OBSERVATIONS AT TP19-09

TP19-09 is represented by a complex of hills rising up from low-relief, generally wet terrain situated along the east shore of the unnamed lake that sits at the west edge of the corridor (Figure 13, Figure 14). The site was explored with two hand-dug test pits in September 2019. As the complex sits at the west edge of the LiDAR coverage, it is uncertain to what extent, if any, the hills containing sand and gravel are present beneath the forest canopy in the area west of the coverage. A large hill west of the coverage was explored in July 2020, but no sand or gravel were found in the locations checked.

The part of the complex within the LiDAR coverage was explored with two boreholes and three main hand auger holes in July 2020 (Figure 14, Figure 15, Table 6). The boreholes encountered sandy gravel that became wet at elevations in the range of 192.0 to 193.3 m. The hand auger hole at waypoint 150, which was located on the same ridge as borehole WQA3, penetrated 3.54 m of sand and gravel that became wet at about 194.2 m elevation. The hand auger hole at waypoint 151 was drilled in the low-relief peatland east of the large hill where WQA3 is located. This auger hole went through 0.48 m of organics and then through 1.0 m of till down to an elevation of 193.3 m. The hand auger hole at waypoint 152 was drilled on a small ridge at the south end of cross section K. The ridge is situated slightly higher up from the lake than the other ridges to the west. Sand and gravel were found with water being found at an elevation of 195.8 m.

A narrow north-south trending discontinuous ridge joins the south part of the complex with its northern counterpart. Several attempts to drill hand auger holes were made in the north part of the complex. However, abundant cobbles and boulders at the surface resulted in auger refusal within 0.25 m in all locations checked. These locations are plotted in Figure 14 as boulders at surface. Borehole BH20-2 was drilled in this northern part of the complex.

Volumes were calculated as a function of the elevation to which mining occurs (Table 7). The volume data are for the portion of the deposit contained within the LiDAR coverage. Volume reductions to account for different percentages of spoil within the complex have also been included in Table 7. Higher percentages of spoil are expected for the lower elevations within the complex, due to the presence of organics and till in the low areas between hills and ridges.

A hill feature located at the top of the drumlinoid ridge centred on the corridor displayed a slightly anomalous morphology in the LiDAR imagery. The site was inspected using hand augering (waypoints 173, 174, Figure 14), but only till was found in the augering. As a result, it was determined that the location is not of interest in terms of aggregate potential.

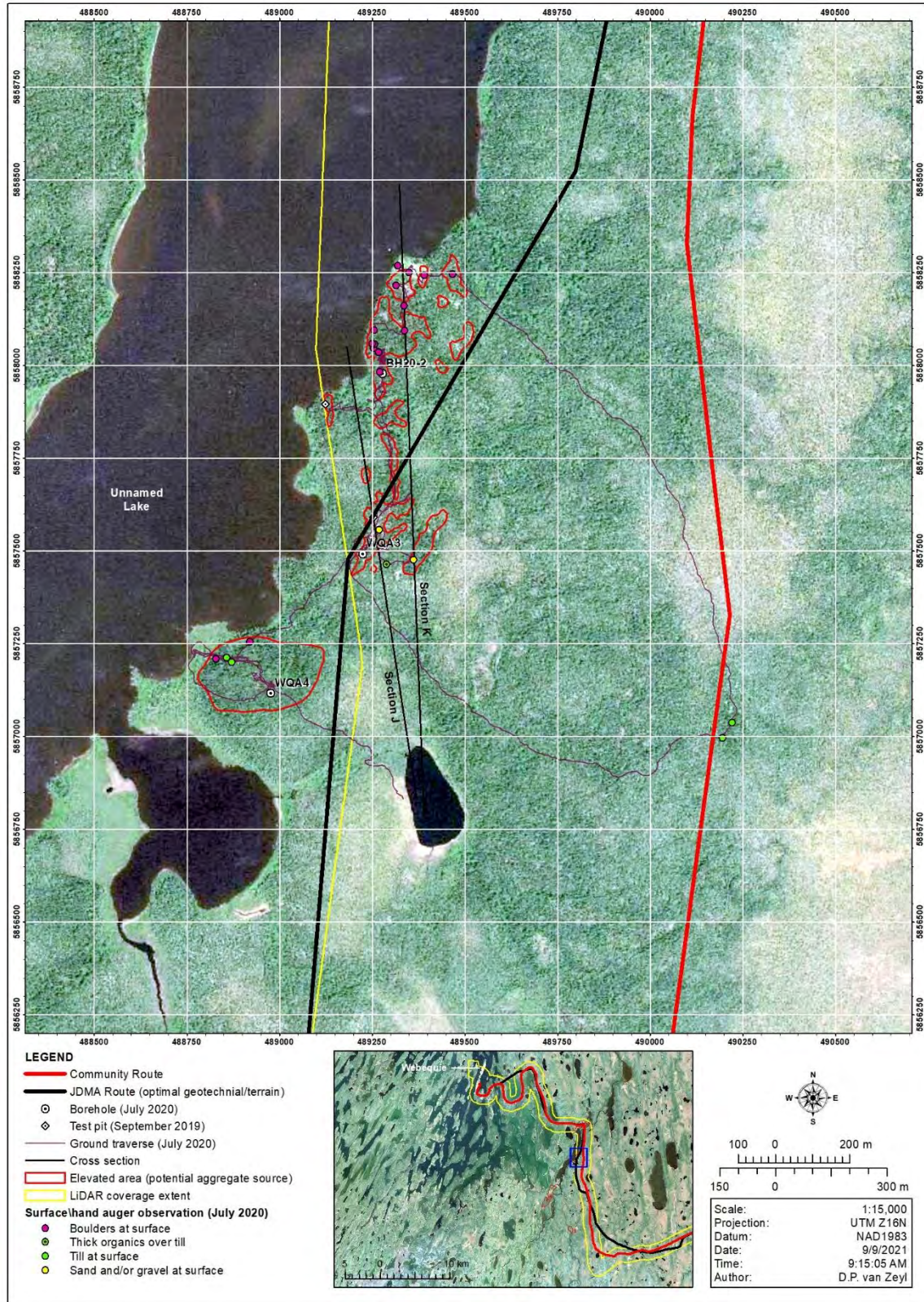


Figure 13 Satellite map showing overview of TP19-09. Webequie Supply Road.

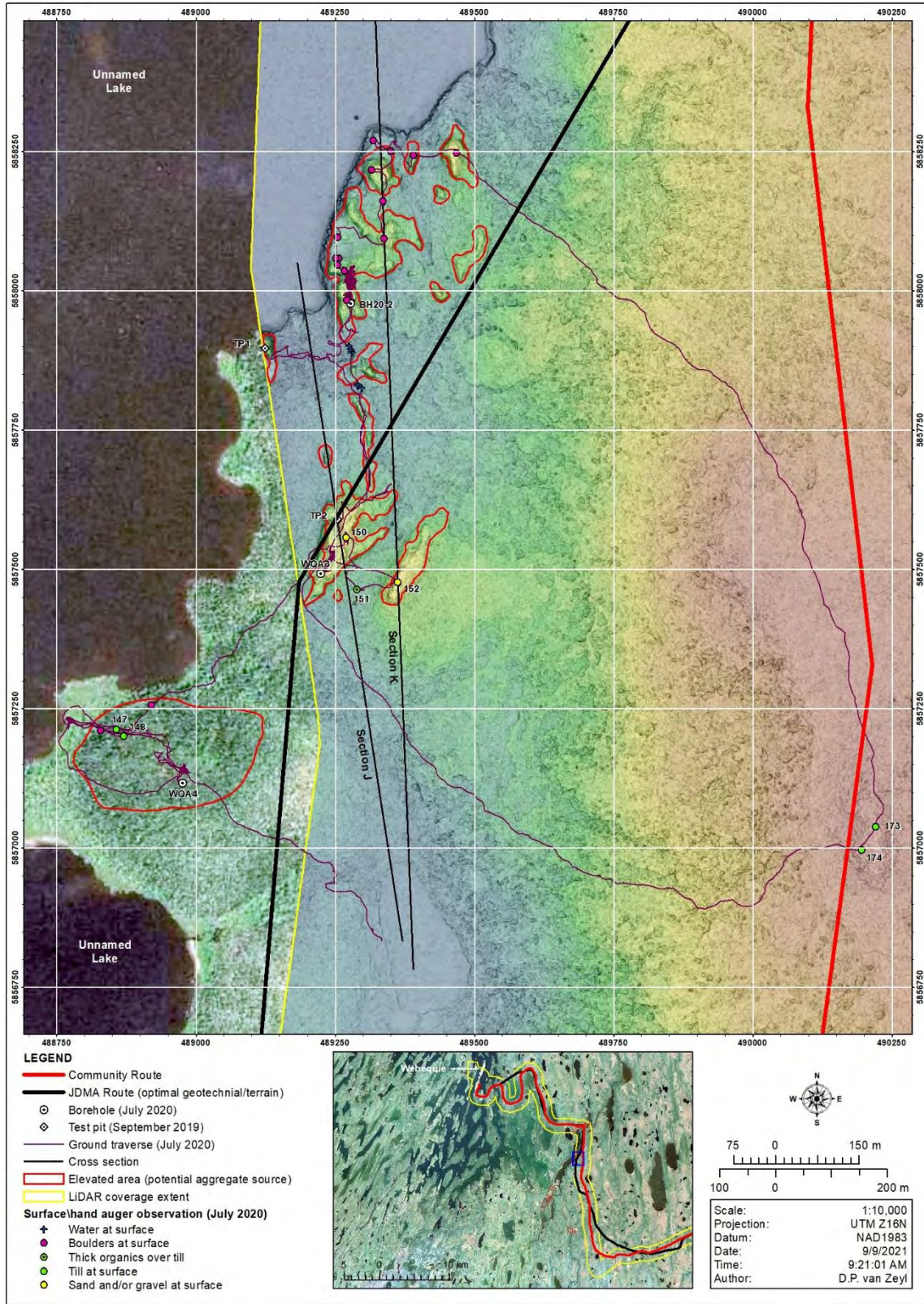


Figure 14 LiDAR map showing the TP19-09 area. Webequie Supply Road.

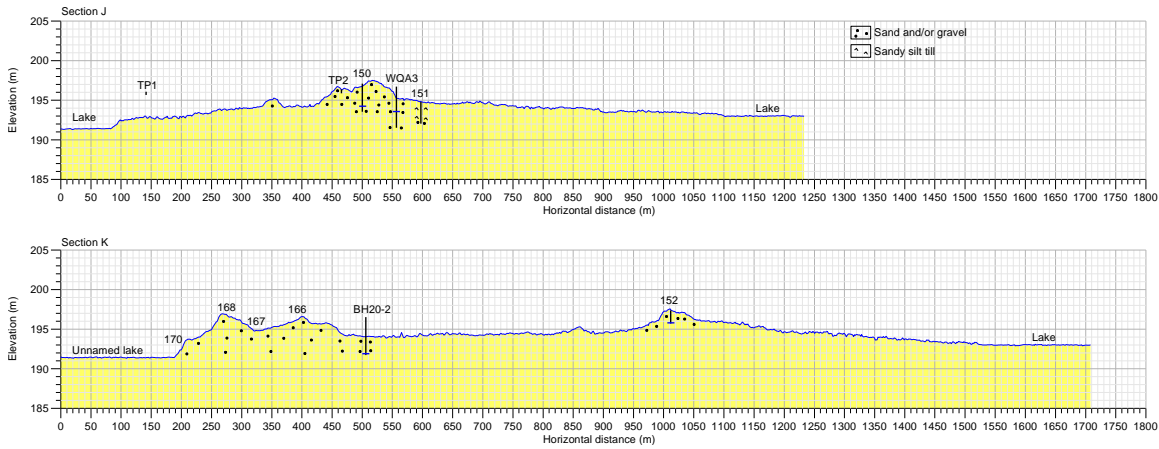


Figure 15 Borehole, hand auger and surface observations plotted onto cross sections A and B.

Table 6 Summary of observations along and near cross sections J and K.

Section	Waypoint	Metres				Materials
		Chainage	Elevation	Depth	Bottom	
J	TP1	141.58	196.04	0.40	195.64	Coarse sand with cobble and boulder gravel
J	TP2	465.76	196.36	0.50	195.86	Medium sand, trace fine gravel
J	150	500.39	197.07	3.54	193.53	Fine to medium sand grading down to very coarse sand and coarse gravel, termination due to sloughing in wet gravel at 3.54 m
J	WQA3	557.06	196.71	5.20	191.51	Sandy gravel, wet at 3.05 m
J	151	597.59	194.78	2.76	192.02	Organics 0.48 m thick over brownish light grey sandy silt till over fine to very coarse sand
K	170	218.24	193.29			Boulders at surface
K	168	270.49	196.08			Boulders at surface
K	167	327.9	194.78			Boulders at surface
K	166	394.35	196.24			Boulders at surface
K	BH20-2	506.26	196.49	4.80	191.69	Sandy gravel, wet at 4.57 m
K	152	1012.08	197.35	1.64	195.71	Fine to very coarse sand, some silt, some fine gravel, wet at 1.52 m
	147			0.42		Silty fine sand with granule and pebble gravel (suspect till), refusal at 0.42 m.
	148			1.90		Silt, some clay, some sand (no gravel) over sandy silt till with granules and pebbles, termination by choice at 1.90 m
	WQA4					Dominantly sandy silt till, minor silty sand

Table 7 Volume table for TP19-09.

Lower-bound elevation defining volume (m)	Volume (m ³)	Surface area (m ²)	Volume reduced based on percentage of spoil within complex					
			5%	10%	15%	20%	25%	30%
192	666,772	264,368	633,433	600,095	566,756	533,418	500,079	466,740
193	409,421	241,273	388,950	368,479	348,008	327,537	307,066	286,595
194	183,891	200,755	174,696	165,502	156,307	147,113	137,918	128,724
195	47,710	62,871	45,325	42,939	40,554	38,168	35,783	33,397
196	9,273	15,189	8,810	8,346	7,882	7,419	6,955	6,491
197	508	2,227	482	457	432	406	381	356

4 OBSERVATIONS AT TP19-10

TP19-10 is a large ridge containing significant sand and gravel resources located west of the corridor (Figure 16). The northeast tip of the ridge, as outlined in Figure 16, is located 3.2 km west of the proposed Webequie Supply Road and would require a river crossing with a bridge span of approximately 55 m. The landform extends toward the south, but no test pits or boreholes were completed outside of the area in Figure 16. LiDAR coverage, unfortunately, does not exist at this site.

The site was explored with three hand-dug test pits in September 2019 (Figure 16). The test pits are located at the south tip of the ridge. The first test pit was dug at the foot of the ridge, where silt with clay was found. The second and third test pits were dug at higher elevations and found medium sand with trace gravel.

Prior to drilling boreholes at this site, reconnaissance of the north and central parts of the ridge was performed. Cobbles and boulders were found at surface in many of the locations checked (Figure 16). Many attempts were made to drill with the hand auger, but auger refusal occurred within 0.25 m in all but one of the attempts. Sand with silt and clay and cobbles and boulders was observed at surface in many of these locations. Till or sandy silt was found at the surface in a few locations.

Three boreholes were drilled at this site in July 2020 (Figure 16). Boreholes WQA5 and BH20-3 were located so as to provide borehole coverage in widely spaced locations along the central part of the ridge. These two boreholes found silty sand and sandy gravel to depths of 6.6 and 5.8 m. The base of the sand and gravel deposit was not reached in either of these two boreholes. The third borehole (WQA6) was drilled at low elevation at the northeast tip of the ridge. This borehole found silt and clay as well as silty sand, but no appreciable sand or gravel.

Volume data have been compiled as a function of the lower elevation to which mining occurs (Table 8). Mining this landform to an elevation of 196 m (covering an area of 923,005 m²) has the potential to provide 12,626,167 m³ of material. Mining to an elevation of 206 m (736,784 m²) would yield 3,813,600 m³ of material. Regional elevation data were used for these calculations, which will include a larger margin of error as compared with the calculations made using LiDAR data at TP19-02 and TP19-09. Volume reductions are included in the table to provide a possible range of volumes that account for various percentages of spoil within the complex. The volume data were computed based on the assumption that the ridge is predominantly composed of sand and gravel with no more than 30% being composed of spoil. Given that boreholes WQA5 and BH20-3 were drilled to depths of less than 7 m, the composition of the ridge is uncertain at depths greater than about 7 m in the centre of the ridge. Based on the available topographic data, the central part of the ridge stands in the order of 25 m high above the surrounding low-relief terrain.



Figure 16 Satellite map showing overview of TP19-10.

Table 8 Volume table for large red polygon (Figure 16) at TP19-10.

Lower-bound elevation defining volume (m)	Volume (m ³)	Surface area (m ²)	Volume reduced based on percentage of spoil within complex					
			5%	10%	15%	20%	25%	30%
196	12,626,167	923,005	11,994,859	11,363,550	10,732,242	10,100,934	9,469,625	8,838,317
198	10,783,714	921,620	10,244,528	9,705,343	9,166,157	8,626,971	8,087,786	7,548,600
200	8,946,810	913,839	8,499,470	8,052,129	7,604,789	7,157,448	6,710,108	6,262,767
202	7,142,285	891,465	6,785,171	6,428,057	6,070,942	5,713,828	5,356,714	4,999,600
204	5,404,120	842,448	5,133,914	4,863,708	4,593,502	4,323,296	4,053,090	3,782,884
206	3,813,600	736,784	3,622,920	3,432,240	3,241,560	3,050,880	2,860,200	2,669,520
208	2,469,039	605,057	2,345,587	2,222,135	2,098,683	1,975,231	1,851,779	1,728,327
210	1,434,406	414,878	1,362,686	1,290,965	1,219,245	1,147,525	1,075,805	1,004,084
212	801,360	245,580	761,292	721,224	681,156	641,088	601,020	560,952
214	410,275	155,452	389,761	369,248	348,734	328,220	307,706	287,193
216	176,443	83,850	167,621	158,799	149,977	141,154	132,332	123,510

5 OBSERVATIONS AT TP19-03

The Ontario Geological Survey had identified this site as a possible location of exposed bedrock. In addition, white moss at the surface in several locations within this site further suggested that bedrock may be at the surface or at shallow depth at this site prior to the July 2020 fieldwork (Figure 17). Upon field exploration, no bedrock was found at surface in the areas of white moss examined on the ground, and no exposed bedrock was found during the flight approach to the site.

Three hand auger holes were completed in two of areas of white moss (Figure 17). The first auger hole (at waypoint 175) was completed in the same location as the borehole that was later drilled at this site (WQA7). Silt and fine sand with some clay was found to a depth of 1.20 m. Below that, silt and clay with some gravel and some sand was found to a depth of 1.75 m, with auger refusal at a cobble/boulder. The borehole in this same location found sandy silt till to a depth of 5.0 m.

The other two hand auger holes were drilled in another area of white moss located about 125 m north-northwest of the borehole. Auger refusal occurred at a depth of 1.50 m in one of these holes (waypoint 181), while refusal had not occurred after drilling to a depth of 2.0 m in the other.

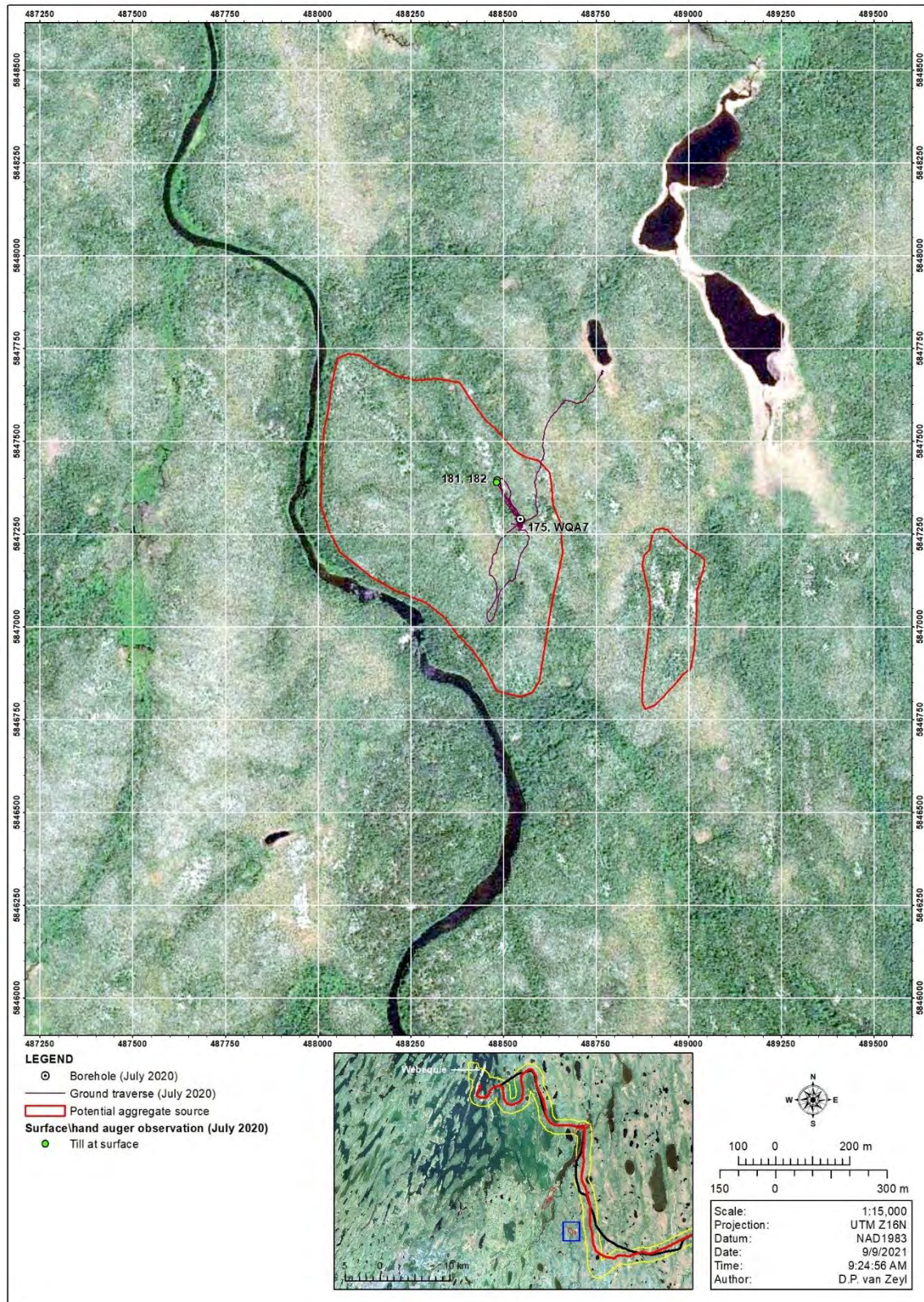


Figure 17 Satellite map showing overview of TP19-03.

6 SUMMARY

The aggregate exploration program in July 2020 collected data and observations in four locations along the western north-south trending section of the proposed Webequie Supply Road (TP19-02, TP19-09, TP19-10, TP19-03). The field program included ten boreholes for a total of 51.1 m of drilling and 39 hand auger holes for a total of 60.5 m of drilling. In addition, surface observations were made in many locations to extend the exploration program beyond drilling locations.

The part of TP19-02 explored in September 2019 is represented by an area of elevated land where a wide range of surface materials are present, including bedrock, sand, sandy gravel, till and marine sandy muds. The combined volume of borrow and bedrock aggregate expected to be feasible to mine at this location is estimated as 500,000 to 1,000,000 m³. In addition to this part of the site, which is covered by cross sections E through I, two additional areas were identified during the July 2020 program. The area covered by cross sections A and B is expected to host a sand and gravel reserve in the order of 40,000 to 50,000 m³ spread out among five hills. Beneath these five hills and one other, a bedrock reserve in the order of at least 60,000 to 120,000 m³ is expected to be present and feasible to mine, though absolute confirmation that bedrock is present beneath these hills has not yet been obtained. Additional sand and gravel and bedrock reserves are present in similar hill and ridge landforms covered by cross sections C and D. Reserves estimated here are lower than what was estimated in earlier desktop studies. The main reason for the reduction in estimated volume is due to better definition of the aggregate landforms with the LiDAR DEM and field exploration results. In the earlier study an assumed uniform thickness was simply applied over the entire area of the glaciofluvial landform and bedrock. In terms of bedrock volumes, the actual volume will be much higher; however, the amount of bedrock that can be extracted in practical terms will be largely dependent on pit development constraints as the bedrock will extend to great depths.

The main area of TP19-09 is included within the LiDAR coverage and was explored in September 2019. The area represents a complex of hills rising from generally wet, low-relief terrain along the east margin of the unnamed lake in this location. The complex is divided into north and south components by a narrow, discontinuous ridge. The south component shows generally clean sand and sandy gravel, whereas the north component shows cobbles and boulders present at the surface covering sandy gravel. The sand and gravel reserve expected to be feasible to mine at this site is estimated as 150,000 to 500,000 m³. This estimate is consistent with an earlier estimate of 292,500 m³ based on desktop studies.

TP19-10 is a large ridge located from 3.2 to 5.9 km west of the nearest point on the centre of the proposed road corridor. Test pits from September 2019 and boreholes and surface observations from July 2020 indicate a significant reserve of sand and gravel at this site. The volume of sand and gravel expected to be feasible to mine at this site, based on regional elevation data, is in the

order of 4,000,000 to 8,000,000 m³, assuming that the entire ridge consists of sand and gravel with some accounting for varying percentages of spoil. This estimate is consistent with an earlier estimate of 6,675,000 m³ based on desktop studies.

TP19-03 was a site that had been identified as a possible location where bedrock was exposed at the surface or at shallow depth beneath white moss. No bedrock was found at surface or to a depth of 5.0 m based on the July 2020 observations.

SNC-Lavalin estimates that the material requirements for construction of the road include:

Earth Excavation	1,361,685 m ³
Fill	1,551,009 m ³
Gravel Base	1,296,922 m ³

The material reserves examined and quantified from the information gathered in this assessment are considered adequate to meet the preliminary engineering estimates of material requirements to construct the road.

While the projected aggregate quantities needed on an annual basis for the life-cycle of the road remain to be determined, a permanent source of material to maintain the road is likely to be associated with TP19-02 or TP19-10. TP19-02 offers the prospect of quarrying bedrock while TP19-10 has significant quantities of granular material. Provided a bridge is constructed to access the material at TP19-10, this location has the potential to deliver the quantities of maintenance material for the life-cycle of the road.

7 CLOSURE

Statements contained in this report are strictly intended for use by SNC-Lavalin Inc. to assist in their planning of construction of the proposed Webequie Supply Road. Statements or data in this report are not intended for third party use.

Information and interpretations made in this report are made based on information collected at the locations examined. Examination of additional sites or further examination of the sites already visited may reveal conditions that differ from those observed or interpreted. Further investigation should be completed before making critical decisions based on the information presented.

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APPENDIX A – SURFACE AND HAND AUGER OBSERVATION POINTS

Table A1 Surface and hand auger observation points.

ID	Waypoint	Type	Observation	Day of July	Site	Metres (UTM Zone 16N, NAD83)		Elevation (m asl)	
						Easting	Northing	GPS	LIDAR
1	009	Surface	Bedrock at surface	2	TP19-02	490206	5862358	193.6	198.88
2	010	Surface	Boulders at surface	2	TP19-02	490207	5862150	186.7	191.09
3	012	Surface	Bedrock at surface	2	TP19-02	490174	5862360	198.4	198.93
4	013	Surface	Sand and/or gravel at surface	2	TP19-02	490156	5862415	197.2	199.68
5	014	Surface	Bedrock at surface	2	TP19-02	490161	5862460	196.5	198.10
6	015	Surface	Bedrock at surface	2	TP19-02	490177	5862474	196.7	197.58
7	016	Surface	Bedrock at surface	2	TP19-02	490190	5862477	196.8	198.04
8	017	Surface	Bedrock at surface	2	TP19-02	490206	5862470	196.9	198.14
9	018	Surface	Bedrock at surface	2	TP19-02	490220	5862485	196.6	198.06
10	019	Surface	Bedrock at surface	2	TP19-02	490218	5862514	195.6	197.17
11	020	Surface	Bedrock at surface	2	TP19-02	490208	5862523	195.7	195.91
12	021	Surface	Bedrock at surface	2	TP19-02	490226	5862524	194.4	195.71
13	022	Surface	Bedrock at surface	2	TP19-02	490328	5862607	194.5	195.66
14	023	Surface	Bedrock at surface	2	TP19-02	490331	5862610	195.0	195.95
15	024	Surface	Bedrock at surface	2	TP19-02	490332	5862629	194.5	195.49
16	025	Surface	Bedrock at surface	2	TP19-02	490354	5862610	196.0	196.58
17	026	Surface	Bedrock at surface	2	TP19-02	490363	5862608	196.4	196.80
18	027	Surface	Bedrock at surface	2	TP19-02	490372	5862623	196.2	196.92
19	028	Surface	Bedrock at surface	2	TP19-02	490378	5862634	196.6	197.46
20	029	Surface	Bedrock at surface	2	TP19-02	490382	5862652	196.3	196.83
21	030	Surface	Bedrock at surface	2	TP19-02	490391	5862680	195.4	196.11
22	031	Surface	Bedrock at surface	2	TP19-02	490391	5862690	195.4	196.21
23	032	Surface	Bedrock at surface	2	TP19-02	490395	5862709	194.4	195.06
24	033	Surface	Bedrock at surface	2	TP19-02	490420	5862678	195.5	195.54
25	034	Surface	Bedrock at surface	2	TP19-02	490436	5862668	195.8	196.13
26	035	Surface	Bedrock at surface	2	TP19-02	490448	5862664	196.0	196.07
27	036	Surface	Bedrock at surface	2	TP19-02	490468	5862669	196.1	195.94
28	037	Surface	Bedrock at surface	2	TP19-02	490476	5862681	194.6	194.81
29	038	Surface	Bedrock at surface	2	TP19-02	490410	5862605	196.4	197.26
30	039	Surface	Bedrock at surface	2	TP19-02	490449	5862502	196.0	197.57
31	040	Surface	Bedrock at surface	2	TP19-02	490453	5862484	195.5	197.27
32	041	Surface	Bedrock at surface	2	TP19-02	490226	5862369	193.8	198.31
33	042	Surface	Bedrock at surface	2	TP19-02	490203	5862361	193.6	198.93
34		Surface	Boulders at surface	2	TP19-02	490258	5862216		197.28
35		Water	Water ponded at surface	2	TP19-02	490281	5862536		195.20
36		Surface	Bedrock at surface	2	TP19-02	490090	5862610		198.34
37		Surface	Sand and/or gravel at surface	2	TP19-02	490119	5862392		200.71
38	043	Auger	Sand and/or gravel at surface	3	TP19-02	489839	5862348	195.3	199.45
39	044	Water	Water ponded at surface	3	TP19-02	489661	5862144	185.0	194.13
40	045	Auger	Sandy mud at surface	3	TP19-02	489611	5862079	195.8	199.84
41	046	Surface	Boulders at surface	3	TP19-02	489584	5862074	196.4	198.43

ID	Waypoint	Type	Observation	Day of July	Site	Metres (UTM Zone 16N, NAD83)		Elevation (m asl)	
						Easting	Northing	GPS	LIDAR
42	047	Surface	Boulders at surface	3	TP19-02	489569	5862046	194.1	196.46
43	048	Water	Water ponded at surface	3	TP19-02	489651	5862111	192.3	194.59
44	049	Water	Water ponded at surface	3	TP19-02	489931	5862365	191.4	196.17
45	050	Surface	Organics at surface	3	TP19-02	490075	5862448	193.6	196.86
46	051	Surface	Bedrock at surface	3	TP19-02	490107	5862434	190.2	196.81
47	052	Auger	Sand and/or gravel at surface	3	TP19-02	490106	5862415	197.2	199.51
48	053	Surface	Bedrock at surface	3	TP19-02	490129	5862409	194.8	198.97
49	054	Auger	Sand and/or gravel at surface	3	TP19-02	490106	5862381	202.6	200.63
50	055	Auger	Gravelly mud at surface	3	TP19-02	490246	5862292	200.8	198.06
51	056	Auger	Sandy mud at surface	3	TP19-02	490418	5862325	202.3	197.33
52	057	Auger	Boulders at surface	3	TP19-02	490448	5862338	205.6	198.76
53	058	Surface	Boulders at surface	3	TP19-02	490556	5862396	206.5	198.06
54	059	Surface	Boulders at surface	3	TP19-02	490416	5862443	204.8	196.07
55	060	Auger	Sand and/or gravel at surface	4	TP19-02	488615	5861569	199.9	199.73
56	061	Auger	Sand and/or gravel at surface	4	TP19-02	488651	5861562	201.5	202.15
57	062	Auger	Sand and/or gravel at surface	4	TP19-02	488867	5861525	202.5	202.41
58	063	Auger	Sand and/or gravel at surface	4	TP19-02	489039	5861771	204.5	203.49
59	064	Auger	Thick organics over gravelly mud	5	TP19-02	489933	5862619	194.6	197.19
60	065	Auger	Thick organics over gravelly mud	5	TP19-02	489536	5862603	195.5	198.67
61	066	Auger	Sandy mud at surface	5	TP19-02	489532	5862692	202.8	202.00
62	067	Auger	Gravelly mud at surface	5	TP19-02	489529	5862739	206.5	201.83
63	068	Auger	Sand and/or gravel at surface	5	TP19-02	489563	5862775	205.4	201.28
64	069	Surface	Bedrock at surface	5	TP19-02	490061	5862567	194.6	197.75
65	070	Surface	Bedrock at surface	5	TP19-02	490073	5862582	194.7	197.42
66	071	Auger	Sandy mud at surface	5	TP19-02	490108	5862570	194.4	196.59
67	072	Surface	Bedrock at surface	5	TP19-02	490149	5862491	193.1	196.25
68	073	Surface	Bedrock at surface	5	TP19-02	490157	5862498	192.5	196.21
69	074	Surface	Bedrock at surface	5	TP19-02	490174	5862499	192.8	196.59
70	075	Surface	Bedrock at surface	5	TP19-02	490185	5862501	192.9	196.48
71	076	Surface	Bedrock at surface	5	TP19-02	490198	5862503	192.2	196.48
72	077	Surface	Bedrock at surface	5	TP19-02	490204	5862511	191.9	196.12
73	078	Surface	Bedrock at surface	5	TP19-02	490205	5862521	191.6	196.00
74	079	Surface	Bedrock at surface	5	TP19-02	490214	5862535	190.7	195.82
75	080	Surface	Bedrock at surface	5	TP19-02	490224	5862526	190.3	195.63
76	081	Surface	Bedrock at surface	5	TP19-02	490234	5862515	190.4	195.71
77	082	Surface	Bedrock at surface	5	TP19-02	490240	5862505	190.8	195.79
78	083	Surface	Bedrock at surface	5	TP19-02	490232	5862483	191.5	196.80
79	084	Surface	Bedrock at surface	5	TP19-02	490237	5862467	190.8	196.98
80	085	Surface	Bedrock at surface	5	TP19-02	490246	5862461	190.5	196.83
81	086	Surface	Bedrock at surface	5	TP19-02	490249	5862449	191.3	197.14
82	087	Surface	Bedrock at surface	5	TP19-02	490262	5862440	191.4	196.68
83	088	Surface	Bedrock at surface	5	TP19-02	490270	5862447	190.6	196.59

ID	Waypoint	Type	Observation	Day of July	Site	Metres (UTM Zone 16N, NAD83)		Elevation (m asl)	
						Easting	Northing	GPS	LIDAR
84	089	Surface	Bedrock at surface	5	TP19-02	490278	5862451	190.7	196.54
85	090	Surface	Bedrock at surface	5	TP19-02	490283	5862450	190.1	196.79
86	091	Surface	Bedrock at surface	5	TP19-02	490287	5862455	190.4	196.95
87	092	Surface	Bedrock at surface	5	TP19-02	490286	5862463	190.1	196.80
88	093	Surface	Bedrock at surface	5	TP19-02	490282	5862475	189.6	196.23
89	094	Surface	Bedrock at surface	5	TP19-02	490287	5862476	189.6	196.51
90	095	Surface	Bedrock at surface	5	TP19-02	490292	5862472	189.4	196.31
91	096	Surface	Bedrock at surface	5	TP19-02	490299	5862471	189.6	195.78
92	097	Surface	Bedrock at surface	5	TP19-02	490306	5862462	189.0	196.16
93	098	Surface	Bedrock at surface	5	TP19-02	490286	5862441	190.6	196.84
94	099	Surface	Bedrock at surface	5	TP19-02	490293	5862435	190.5	197.22
95	100	Surface	Bedrock at surface	5	TP19-02	490291	5862427	190.7	197.42
96	101	Surface	Bedrock at surface	5	TP19-02	490278	5862436	190.1	196.87
97	102	Surface	Bedrock at surface	5	TP19-02	490245	5862435	190.3	197.16
98	103	Surface	Bedrock at surface	5	TP19-02	490236	5862437	191.2	198.08
99	104	Surface	Bedrock at surface	5	TP19-02	490204	5862453	190.4	197.82
100	105	Surface	Bedrock at surface	5	TP19-02	490180	5862465	190.0	197.58
101	106	Surface	Bedrock at surface	5	TP19-02	490175	5862462	189.9	197.72
102	107	Surface	Bedrock at surface	5	TP19-02	490166	5862459	190.7	197.97
103	108	Surface	Bedrock at surface	5	TP19-02	490153	5862462	190.2	197.81
104	109	Surface	Bedrock at surface	5	TP19-02	490145	5862453	189.9	197.76
105	110	Surface	Bedrock at surface	5	TP19-02	490131	5862448	190.1	197.38
106	111	Surface	Bedrock at surface	5	TP19-02	490126	5862440	189.6	197.86
107	112	Surface	Bedrock at surface	5	TP19-02	490113	5862432	189.3	198.17
108	113	Surface	Bedrock at surface	5	TP19-02	490110	5862438	188.7	196.96
109	114	Surface	Bedrock at surface	5	TP19-02	490128	5862401	192.0	199.09
110	115	Surface	Bedrock at surface	5	TP19-02	490158	5862372	191.2	198.34
111	116	Surface	Boulders at surface	5	TP19-02	490329	5862323	193.7	198.25
112	117	Auger	Sandy mud at surface	5	TP19-02	490354	5862314	198.5	197.44
113	119	Surface	Boulders at surface	5	TP19-02	490402	5862187	200.5	196.02
114	120	Surface	Boulders at surface	5	TP19-02	490424	5862189	200.9	196.80
115	121	Surface	Boulders at surface	5	TP19-02	490430	5862186	200.9	196.40
116	122	Surface	Boulders at surface	5	TP19-02	490452	5862185	200.7	196.80
117	123	Surface	Boulders at surface	5	TP19-02	490473	5862194	200.0	197.17
118	124	Auger	Sand and/or gravel at surface	5	TP19-02	490498	5862181	196.0	193.46
119	125	Surface	Boulders at surface	5	TP19-02	490455	5862240	196.2	195.77
120	126	Auger	Sandy mud at surface	5	TP19-02	490492	5862319	202.5	197.44
121	127	Surface	Boulders at surface	5	TP19-02	490548	5862282	200.4	197.76
122	128	Surface	Boulders at surface	5	TP19-02	490473	5862341	197.1	197.72
123	129	Surface	Boulders at surface	6	TP19-02	489641	5862100	187.5	196.92
124	130	Water	Water ponded at surface	6	TP19-02	489555	5862097	186.1	193.60
125	131	Water	Water ponded at surface	6	TP19-02	489547	5862097	186.4	193.79

ID	Waypoint	Type	Observation	Day of July	Site	Metres (UTM Zone 16N, NAD83)		Elevation (m asl)	
						Easting	Northing	GPS	LIDAR
126	132	Water	Water ponded at surface	6	TP19-02	489541	5862098	186.7	193.68
127	133	Water	Water ponded at surface	6	TP19-02	489536	5862098	186.7	193.66
128	134	Water	Water ponded at surface	6	TP19-02	489533	5862098	187.0	194.20
129	135	Water	Water ponded at surface	6	TP19-02	489527	5862100	186.7	193.95
130	136	Water	Water ponded at surface	6	TP19-02	489520	5862101	186.8	193.80
131	137	Auger	Sand and/or gravel at surface	6	TP19-02	489410	5862169	194.4	198.83
132	138	Auger	Sand and/or gravel at surface	6	TP19-02	489396	5862153	195.9	198.19
133	139	Auger	Sand and/or gravel at surface	6	TP19-02	489278	5862317	197.3	200.72
134	140	Auger	Sand and/or gravel at surface	6	TP19-02	489188	5862053	197.1	202.21
135	141	Auger	Sand and/or gravel at surface	6	TP19-02	489076	5861870	204.8	202.21
136	142	Auger	Thick organics over gravelly mud	6	TP19-02	488983	5861773	201.3	201.52
137	143	Auger	Gravelly mud at surface	6	TP19-02	488654	5861835	204.8	204.68
138	144	Water	Water ponded at surface	6	TP19-02	488727	5861833	202.4	201.13
139	145	Auger	Thick organics over gravelly mud	6	TP19-02	488710	5861836	203.4	201.39
140	146	Surface	Boulders at surface	7	TP19-09	488829	5857211	199.9	
141	147	Auger	Gravelly mud at surface	7	TP19-09	488857	5857214	200.1	
142	148	Auger	Gravelly mud at surface	7	TP19-09	488870	5857201	199.6	
143	149	Surface	Boulders at surface	8	TP19-09	488920	5857257	203.2	
144	150	Auger	Sand and/or gravel at surface	8	TP19-09	489269	5857558	201.9	197.07
145	151	Auger	Thick organics over gravelly mud	8	TP19-09	489288	5857464	201.5	194.78
146	152	Auger	Sand and/or gravel at surface	8	TP19-09	489362	5857478	204.2	197.35
147	153	Water	Water ponded at surface	8	TP19-09	489297	5857826	194.0	193.96
148	154	Water	Water ponded at surface	8	TP19-09	489291	5857830	194.7	193.99
149	155	Water	Water ponded at surface	8	TP19-09	489290	5857832	195.4	194.14
150	156	Water	Water ponded at surface	8	TP19-09	489289	5857832	194.5	194.08
151	157	Water	Water ponded at surface	8	TP19-09	489280	5857890	194.6	193.38
152	158	Water	Water ponded at surface	8	TP19-09	489277	5857896	194.6	193.45
153	159	Water	Water ponded at surface	8	TP19-09	489274	5857902	194.1	193.44
154	160	Surface	Boulders at surface	8	TP19-09	489270	5857984	201.5	196.55
155	161	Surface	Boulders at surface	8	TP19-09	489267	5858037	200.0	195.75
156	162	Surface	Boulders at surface	8	TP19-09	489254	5858047	199.9	195.63
157	163	Surface	Boulders at surface	8	TP19-09	489257	5858059	199.7	194.98
158	164	Surface	Boulders at surface	8	TP19-09	489251	5858059	199.1	194.71
159	165	Surface	Boulders at surface	8	TP19-09	489254	5858096	198.4	194.63
160	166	Surface	Boulders at surface	8	TP19-09	489338	5858095	201.5	196.24
161	167	Surface	Boulders at surface	8	TP19-09	489336	5858161	195.5	194.78
162	168	Surface	Boulders at surface	8	TP19-09	489315	5858217	192.0	196.08
163	169	Surface	Boulders at surface	8	TP19-09	489350	5858251	192.2	194.39
164	170	Surface	Boulders at surface	8	TP19-09	489319	5858271	191.7	193.29
165	171	Surface	Boulders at surface	8	TP19-09	489391	5858244	188.3	195.06
166	172	Surface	Boulders at surface	8	TP19-09	489467	5858248	194.6	197.06
167	173	Auger	Gravelly mud at surface	8	TP19-09	490221	5857039	196.2	203.28

ID	Waypoint	Type	Observation	Day of July	Site	Metres (UTM Zone 16N, NAD83)		Elevation (m asl)	
						Easting	Northing	GPS	LIDAR
168	174	Auger	Gravelly mud at surface	8	TP19-09	490195	5856997	202.2	202.52
169	175	Auger	Gravelly mud at surface	10	TP19-03	488548	5847290	254.1	
170	181	Auger	Gravelly mud at surface	11	TP19-03	488483	5847396	201.8	
171	182	Auger	Gravelly mud at surface	11	TP19-03	488482	5847391	201.3	
172	184	Surface	Boulders at surface	11	TP19-10	486255	5853408	192.7	
173	185	Surface	Sandy mud at surface	11	TP19-10	486201	5853351	192.3	
174	186	Surface	Boulders at surface	11	TP19-10	486078	5853309	197.6	
175	187	Surface	Boulders at surface	11	TP19-10	485979	5853245	195.0	
176	188	Surface	Gravelly mud at surface	11	TP19-10	485877	5853193	197.3	
177	189	Auger	Sand and/or gravel at surface	11	TP19-10	485735	5853156	218.2	
178	190	Surface	Sand and/or gravel at surface	11	TP19-10	485532	5853158	211.5	
179	191	Surface	Gravelly mud at surface	11	TP19-10	485622	5853302	200.4	
180	192	Surface	Sand and/or gravel at surface	11	TP19-10	485562	5852903	208.5	
181	193	Surface	Sand and/or gravel at surface	11	TP19-10	485522	5852816	211.5	
182	195	Surface	Sand and/or gravel at surface	11	TP19-10	485599	5852953	219.6	
183	196	Surface	Sand and/or gravel at surface	11	TP19-10	485653	5853116	220.1	
184	197	Surface	Sand and/or gravel at surface	11	TP19-10	485959	5853358	207.3	
185	198	Surface	Boulders at surface	12	TP19-10	486097	5853456	197.1	
186	199	Surface	Sand and/or gravel at surface	12	TP19-10	486026	5853318	200.8	

APPENDIX B – HAND AUGER LOGS

Table B1 Hand auger logs.

Waypoint	Site	From	To	Description	Day of July
043	TP19-02			Hole in crest of sand ridge where sand is seen at surface throughout	3
043	TP19-02	0.00	0.12	Organics	3
043	TP19-02	0.12	1.60	Fine to very coarse sand, trace fine gravel, moist, light grey	3
043	TP19-02			Terminated due to only one auger extension available during traverse	3
045	TP19-02			Hole on summit of hill feature with boulders present throughout surface	3
045	TP19-02	0.00	0.14	Organics	3
045	TP19-02	0.14	0.50	Sandy silt, some clay, coarse sand near bottom of hole	3
045	TP19-02			Auger refusal at bedrock or cobble\boulder	3
052	TP19-02			Hole on flank of sand hill	3
052	TP19-02	0.00	0.12	Organics	3
052	TP19-02	0.12	1.60	Silty very fine sand grading downward to fine to medium sand, light grey, moist	3
052	TP19-02			Terminated due to only one auger extension available during traverse	3
054	TP19-02	0.00	0.10	Organics	3
054	TP19-02	0.10	0.40	Clayey silt and very fine sand, moist, light grey	3
054	TP19-02	0.40	2.98	Fine to medium sand, silty, moist, light grey, wet at bottom, no gravel	3
054	TP19-02			Auger refusal at bedrock or cobble\boulder (highly suspect bedrock)	3
055	TP19-02			Hole on flat floor of conifer stand	3
055	TP19-02	0.00	0.15	Organics	3
055	TP19-02	0.15	0.55	Silt, clay and very fine sand, wet, trace gravel	3
055	TP19-02			Auger refusal at bedrock or cobble\boulder	3
056	TP19-02			Hole in flat floor of zone in stand of conifers	3
056	TP19-02	0.00	0.15	Organics	3
056	TP19-02	0.15	1.15	Silt and very fine sand, some clay, wet	3
056	TP19-02	1.15	2.35	Silty clay, highly plastic, wet, firm to stiff, laminated, buff light grey, water at 1.15 m	3
056	TP19-02			Auger refusal at bedrock or cobble\boulder (highly suspect bedrock)	3
057	TP19-02			Hole on slight hill standing above flat plain, boulders at surface on small hill	3
057	TP19-02	0.00	0.10	Organics	3
057	TP19-02	0.10	0.32	Sandy silt, some clay	3
057	TP19-02			Auger refusal at bedrock or cobble\boulder	3
058	TP19-02			Hole on slight hill with boulders at surface	3
058	TP19-02	0.00	0.12	Organics	3
058	TP19-02	0.12	0.20	Gravel matrix between boulders, pebbles and granules	3
058	TP19-02			Auger refusal at bedrock or cobble\boulder	3
060	TP19-02			Hole drilled on west slope of hill	4
060	TP19-02	0.00	0.08	Organics	4
060	TP19-02	0.08	1.35	Very fine to medium sand, some silt, wet, light grey	4
060	TP19-02	1.35	1.40	Gravel and very coarse sand, wet	4
060	TP19-02	1.40	1.68	Very fine to medium sand, some gravel, wet, light grey	4
060	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	4
061	TP19-02			Hole drilled on low-relief summit of hill	4
061	TP19-02	0.00	0.08	Organics	4
061	TP19-02	0.08	2.53	Silt and very fine to fine sand, some coarse sand and gravel, wet, light grey	4

061	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	4
062	TP19-02			Hole drilled on low-relief summit of hill	4
062	TP19-02	0.00	0.05	Organics	4
062	TP19-02	0.05	3.60	Fine to medium sand, coarse sand with gravel, wet, light grey	4
062	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	4
063	TP19-02			Hole drilled on crest of north-trending hill/ridge	4
063	TP19-02	0.00	0.05	Organics	4
063	TP19-02	0.05	3.60	Very fine to medium sand, coarse to very coarse sand with fine gravel, silty zones, moist	4
063	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	4
064	TP19-02			Hole in peatland between rock exposures to north and south	5
064	TP19-02	0.00	0.60	Organics, water saturated	5
064	TP19-02	0.60	1.18	Greyish light brown sandy silt till, wet	5
064	TP19-02			Auger refusal at bedrock or cobble\boulder (highly suspect bedrock)	5
065	TP19-02			Peatland south of hill feature	5
065	TP19-02	0.00	0.45	Organics, water saturated	5
065	TP19-02	0.45	1.25	Greyish light brown sandy silt till, wet, gravel at base	5
065	TP19-02			Auger refusal at bedrock or cobble\boulder (highly suspect bedrock)	5
066	TP19-02			Hole on low-relief hilltop in mossy floored conifer stand	5
066	TP19-02	0.00	0.05	Organics	5
066	TP19-02	0.05	0.98	Light grey laminated silt with coarse sand and gravel at base	5
066	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	5
067	TP19-02			Hole on low-relief hilltop in mossy floored conifer stand	5
067	TP19-02	0.00	0.05	Organics	5
067	TP19-02	0.05	0.60	Greyish light brown sandy silt, moist	5
067	TP19-02	0.60	1.35	Light grey silt, seems laminated, no gravel apparent	5
067	TP19-02	1.35	1.45	Coarse sand and gravel	5
067	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	5
068	TP19-02			Hole on narrow ridge at northeast tip of hilltop, sand and gravel seen at surface	5
068	TP19-02	0.00	0.05	Organics	5
068	TP19-02	0.05	0.65	Brownish light grey silt (not sure if till or laminated mud)	5
068	TP19-02	0.65	1.50	Granule to pebble gravel and very coarse sand, wet	5
068	TP19-02			Terminated due to sloughing in gravel	5
071	TP19-02			Hole in peatland between rock exposures to north and south	5
071	TP19-02	0.00	0.10	Organics, water saturated	5
071	TP19-02	0.10	0.60	Very fine to fine very well sorted sand, which grades down into laminated silt	5
071	TP19-02	0.60	0.70	Laminated grey silt with orange streaks, wet	5
071	TP19-02			Auger refusal at bedrock or cobble\boulder (highly suspect bedrock)	5
117	TP19-02			Hole in low-relief zone between boulder ridges	5
117	TP19-02	0.00	0.05	Organics	5
117	TP19-02	0.05	0.90	Brownish light grey silt with very fine sand	5
117	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	5
126	TP19-02			Hole within low-relief surface within moss floored conifer stand	5
126	TP19-02	0.00	0.10	Organics	5
126	TP19-02	0.10	0.52	Silt and very fine sand, moist	5

126	TP19-02			Auger refusal at bedrock or cobble\boulder	5
137	TP19-02			Hole on hilltop on mossy floor of conifer stand	6
137	TP19-02	0.00	0.10	Silt with very fine sand, some gravel, oxidized, moist	6
137	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	6
138	TP19-02			Hole on hilltop on mossy floor of conifer stand	6
138	TP19-02	0.00	0.10	Organics	6
138	TP19-02	0.10	0.89	Very fine sand, very well sorted, moist	6
138	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	6
139	TP19-02			Hole on hilltop on mossy floor of conifer stand	6
139	TP19-02	0.00	0.20	Organics	6
139	TP19-02	0.20	2.01	Sand ranging from very fine to very coarse, locally contains gravel	6
139	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	6
140	TP19-02			Hole on north trending ridge	6
140	TP19-02	0.00	0.10	Organics	6
140	TP19-02	0.10	1.00	Coarse gravel, pebbles, granules	6
140	TP19-02	1.00	1.44	Dominantly fine sand, but gravel present locally	6
140	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	6
141	TP19-02			Hole on north trending ridge	6
141	TP19-02	0.00	0.05	Organics	6
141	TP19-02	0.05	1.32	Fine sand grading down to very coarse sand with gravel, moist	6
141	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	6
142	TP19-02			Hole in peatland west of rock ridge	6
142	TP19-02	0.00	0.85	Organics and peat, water saturated	6
142	TP19-02	0.85	1.44	Brownish light grey sandy silt till, some granules and pebbles	6
142	TP19-02	1.44	1.60	Coarse gravel	6
142	TP19-02	1.60	2.39	Light grey sandy silt till	6
142	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	6
143	TP19-02			Hole on hilltop on mossy floor of conifer stand	6
143	TP19-02	0.00	0.19	Organics	6
143	TP19-02	0.19	0.59	Thin layer of silt over sandy silt till	6
143	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	6
145	TP19-02			Hole in peatland east of hill	6
145	TP19-02	0.00	0.21	Organics and peat, water saturated	6
145	TP19-02	0.21	1.94	Started as silt, went into brownish light grey sandy silt till, then into soupy very fine sand facies, then went back to till, then went to gravelly till facies	6
145	TP19-02			Auger refusal at bedrock or cobble\boulder (suspect bedrock)	6
147	TP19-09			Hole on slight ridge above step in slope	7
147	TP19-09	0.00	0.08	Organics	7
147	TP19-09	0.08	0.42	Silty fine sand with granule and pebble gravel, moist	7
147	TP19-09			Auger refusal at bedrock or cobble\boulder (suspect cobble\boulder)	7
148	TP19-09			Hole in local flat spot in general low-relief zone in lower part of hill feature	7
148	TP19-09	0.00	0.10	Organics	7
148	TP19-09	0.10	1.50	Silt, some clay, some sand, brownish light grey to light grey, moist	7
148	TP19-09	1.50	1.90	Sandy silty till, some pebbles, moist	7
148	TP19-09			Terminated due to absence of aggregate	8

150	TP19-09			Hole on crest of hill in pine stand with open mossy floor with sand at surface	8
150	TP19-09	0.00	0.05	Organics	8
150	TP19-09	0.05	2.34	Fine sand to medium sand, rare coarse sand, very well sorted, no gravel, moist	8
150	TP19-09	2.34	3.54	Fine to very coarse sand with fine to coarse gravel, wet at 2.91 m	8
150	TP19-09			Terminated due to sloughing in wet gravel	8
151	TP19-09			Hole in peatland east of sand ridge	8
151	TP19-09	0.00	0.48	Saturated organics and peat (water table within 10 cm of surface)	8
151	TP19-09	0.48	1.48	Brownish light grey sandy silt till, generally limited gravel, wet	8
151	TP19-09	1.48	2.76	Fine to coarse sand, wet	8
151	TP19-09			Terminated due to sufficient information gathered from auger hole	8
152	TP19-09			Hole on small ridge east of main ridge. Mossy-floored conifer stand	8
152	TP19-09	0.00	0.05	Organics	8
152	TP19-09	0.05	1.64	Fine to medium sand zones, silty zones, very coarse sand to fine gravel zones, wet at 1.52 m	8
152	TP19-09			Terminated due to sufficient information gathered from auger hole	8
173	TP19-09			Hole on summit of drumlinoid ridge in moss-floored conifer stand	8
173	TP19-09	0.00	0.08	Organics	8
173	TP19-09	0.08	0.75	Reddish light brown silt and clay with rare granules and pebbles	8
173	TP19-09			Auger refusal at bedrock or cobble\boulder (suspect cobble\boulder)	8
174	TP19-09			Hole on summit of drumlinoid ridge in moss-floored conifer stand	8
174	TP19-09	0.00	0.10	Organics	8
174	TP19-09	0.10	3.07	Light grey to red silt and clay with trace granules and pebbles, wet below 1.5 m	8
174	TP19-09			Terminated due to not hitting rock or aggregate	8
175	TP19-03			Hole in low-relief spot with white moss on surface	11
175	TP19-03	0.00	0.08	Organics	11
175	TP19-03	0.08	1.20	Silt and very fine sand, some clay, moist, reddish light grey	11
175	TP19-03	1.20	1.75	Silt and clay, some gravel, some sand, moist, reddish light grey	11
175	TP19-03			Auger refusal at bedrock or cobble\boulder (suspect cobble\boulder)	11
181	TP19-03			Hole in low-relief spot with white moss on surface	11
181	TP19-03	0.00	0.10	Organics	11
181	TP19-03	0.10	1.50	Silt and very fine sand, some clay, moist, reddish light grey, wet at 1.4 m	11
181	TP19-03			Auger refusal at bedrock or cobble\boulder (suspect cobble\boulder)	11
182	TP19-03			Hole in low-relief spot with white moss on surface	11
182	TP19-03	0.00	0.10	Organics	11
182	TP19-03	0.10	1.90	Silt and very fine sand, some clay, moist, reddish light grey, wet at 1.4 m	11
182	TP19-03			Terminated due to not hitting rock or aggregate	11
189	TP19-10			Hole in conifer stand on plateau above steep slope	11
189	TP19-10	0.00	0.10	Organics	11
189	TP19-10	0.10	0.60	Gravelly mud with sand	11
189	TP19-10			Auger refusal at bedrock or cobble\boulder (highly suspect cobble\boulder)	11

APPENDIX C – GRAIN SIZE CURVES FROM SELECTED SAMPLES

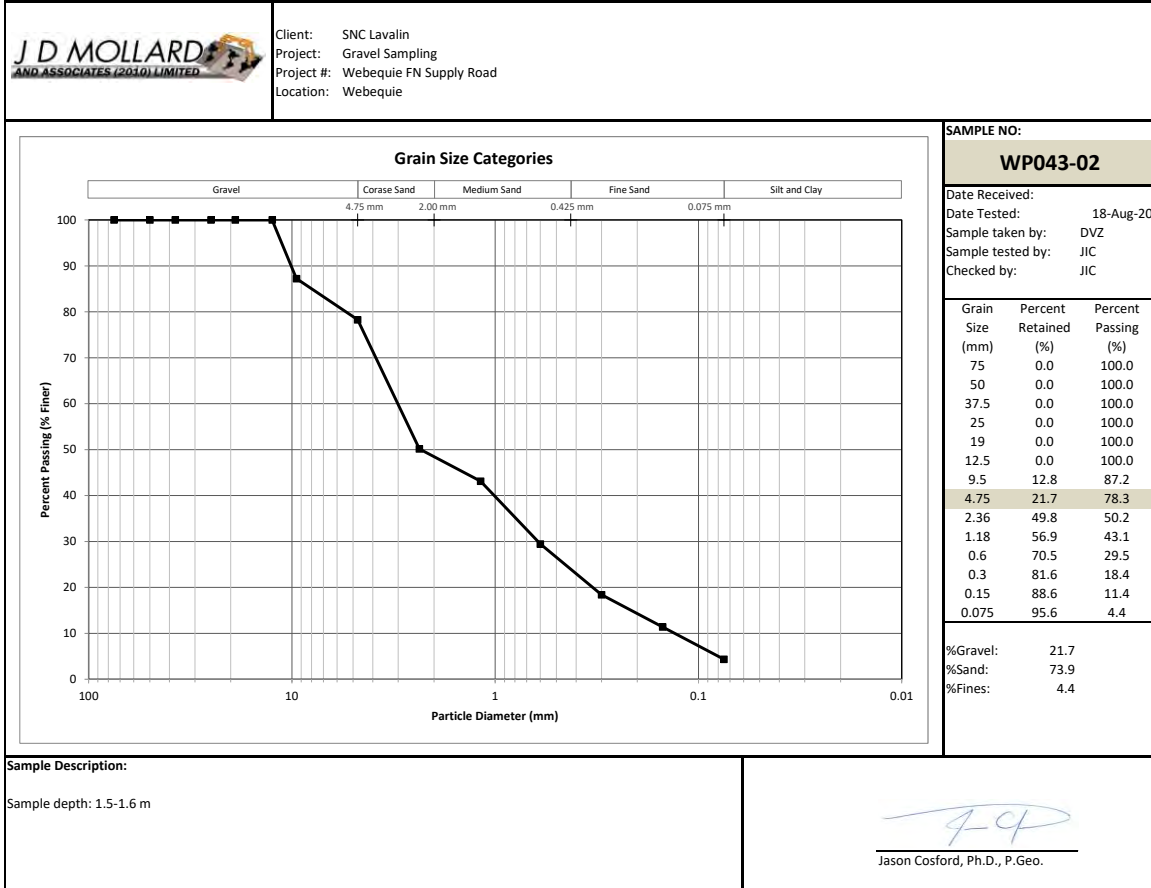


Figure C1 Grain size curve for sample WP043-02.

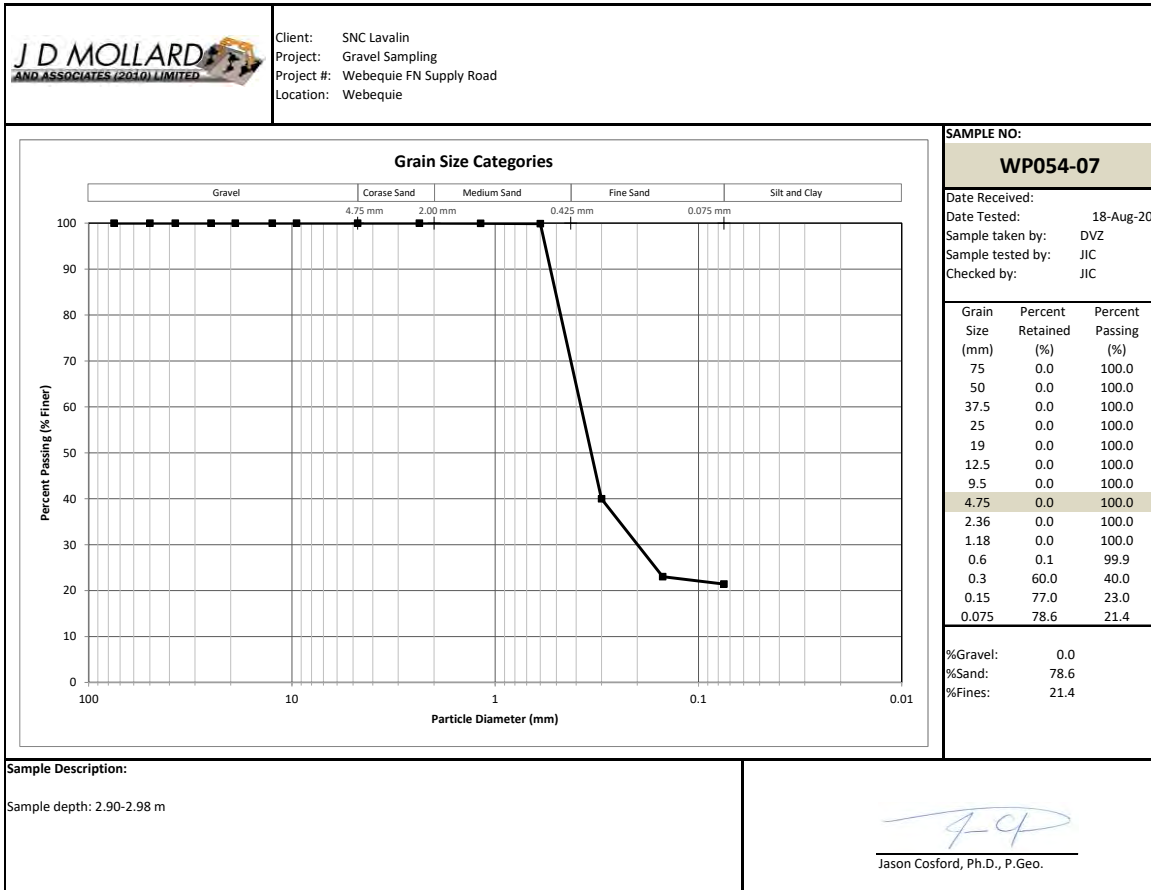


Figure C2 Grain size curve for sample WP054-07.

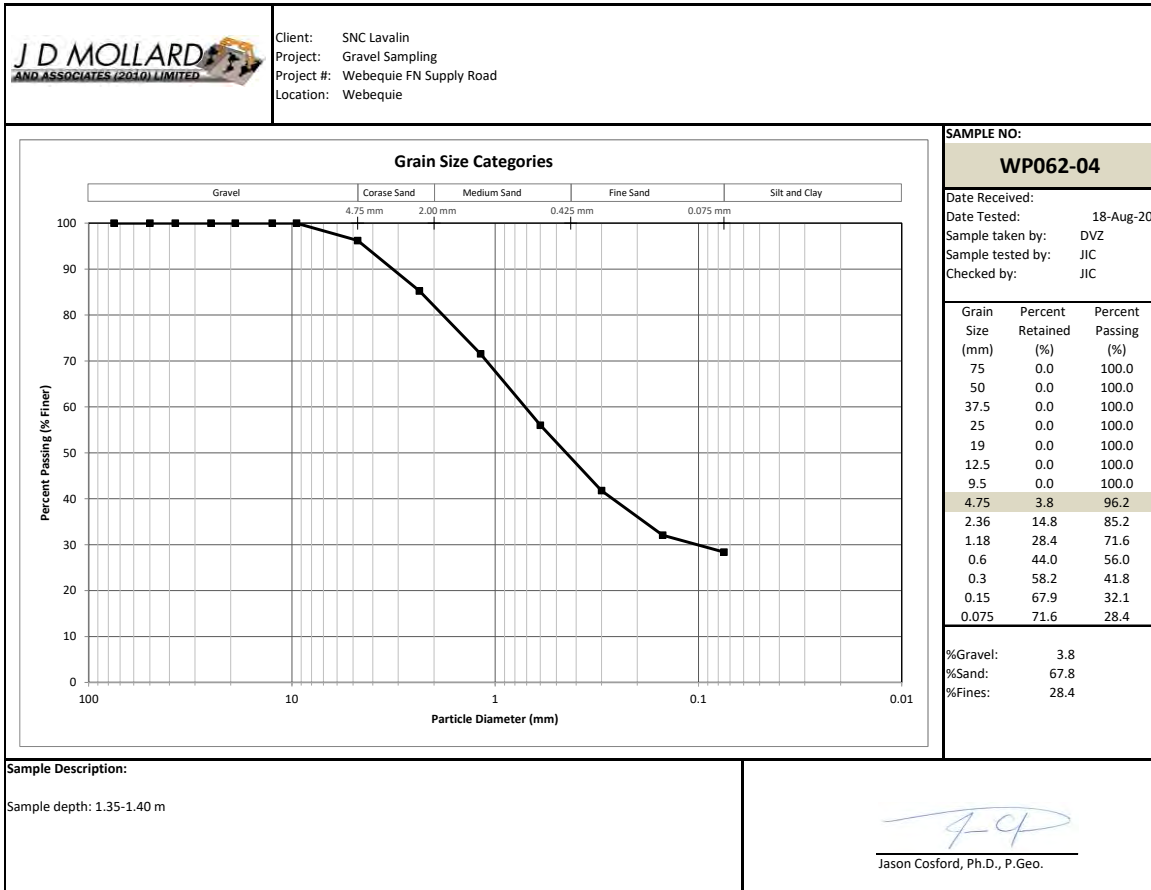


Figure C3 Grain size curve for sample WP062-04.

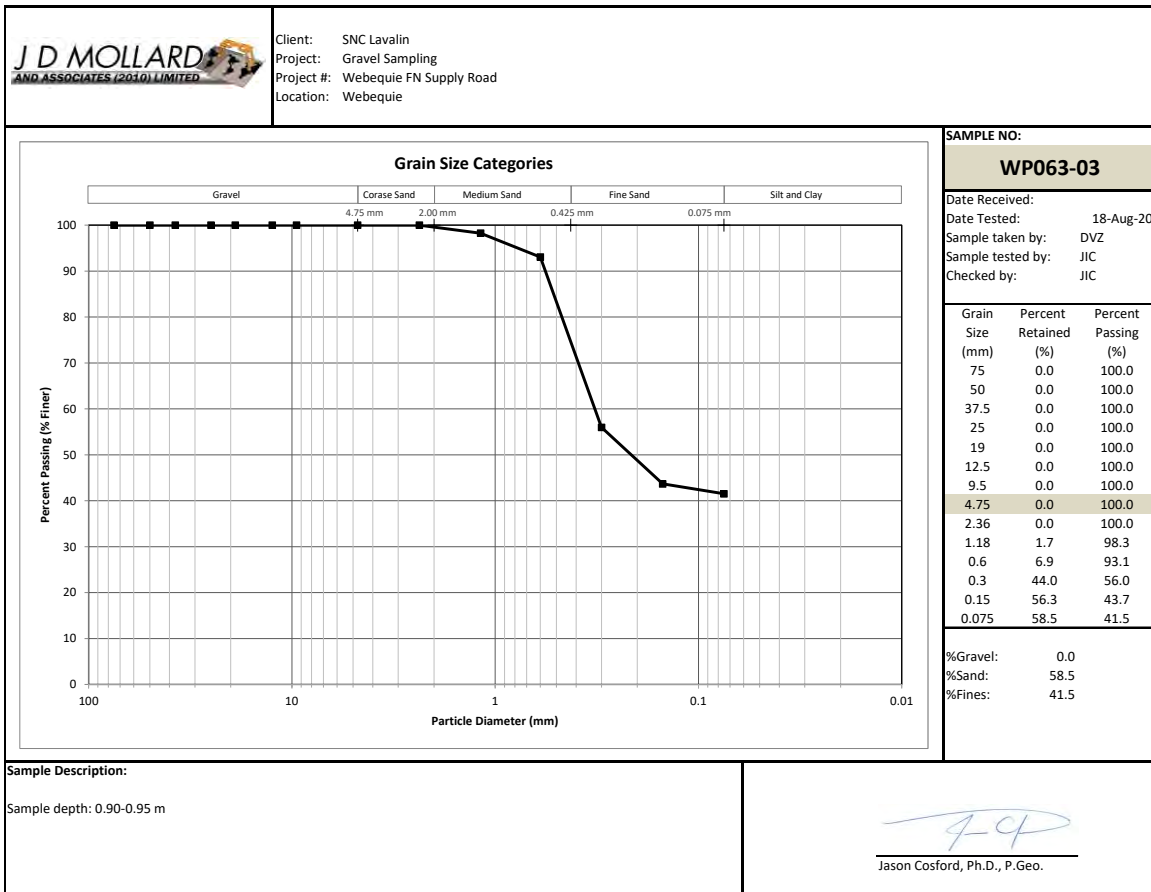


Figure C4 Grain size curve for sample WP063-03.

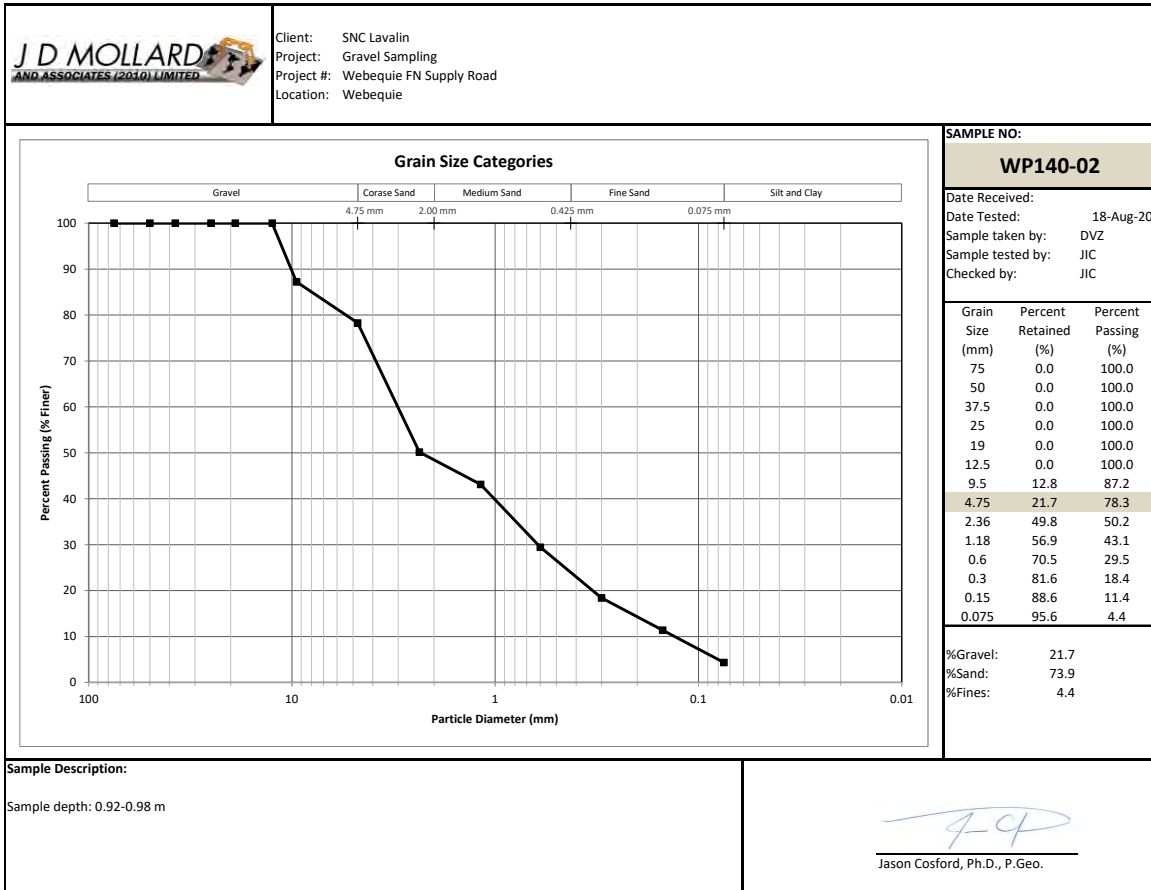


Figure C5 Grain size curve for sample WP140-02.