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# Lorne Township Property Assessment Report

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May 4, 2017



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## **Introduction**

A small geophysical program consisting of surface UREM and borehole UREM on a historical diamond drillhole drilled in 1959 was completed on patented land of the Lorne township property over the summer of 2016. The program was designed to test the potential of the southern extension of the Worthington Offset at depth near the surveyed borehole.

## **Property**

### ***Location and Access***

The property on which the work was carried out is located approximately 45 km west-southwest of Sudbury, 5 km northeast of Nairn Centre, north of Highway 17 and south of the Spanish River (Figure 1). The work area can be accessed from Highway 17 West to Bell Road then by ATV along a private trail (Figure 2). Access to use the trail, which crosses private property, was obtained from the surface owner.

### ***Property Status***

The work was completed on patented land held by Vale on Lot 9, Concession 6 of Lorne Township. The property identification number (PIN) is 73395-0220 (Figure 3).

## **Exploration Program**

The 2016 work program on the Lorne township property included historical borehole location, dummy probing, access trail cutting, borehole geophysics, surface geophysics and collar surveying. An expenditure summary is provided in Appendix I.

### ***Locating and dummy probing historical diamond drillholes***

At the end of May 2016, three historical collars, all AXT size drilled in 1959 by Vale (formerly Inco), were located and dummy probed to identify any open holes for possible downhole geophysics. Only one of the three holes, BH16609-0, was found to be open to a depth of 265.5 m. The other two holes were blocked at or very near surface.

### ***Access trail cutting***

Several days were spent cutting the access trail to the work area shown in Figure 2 and Figure 3. The access trail was required to facilitate getting the geophysical equipment to the borehole via ATV.

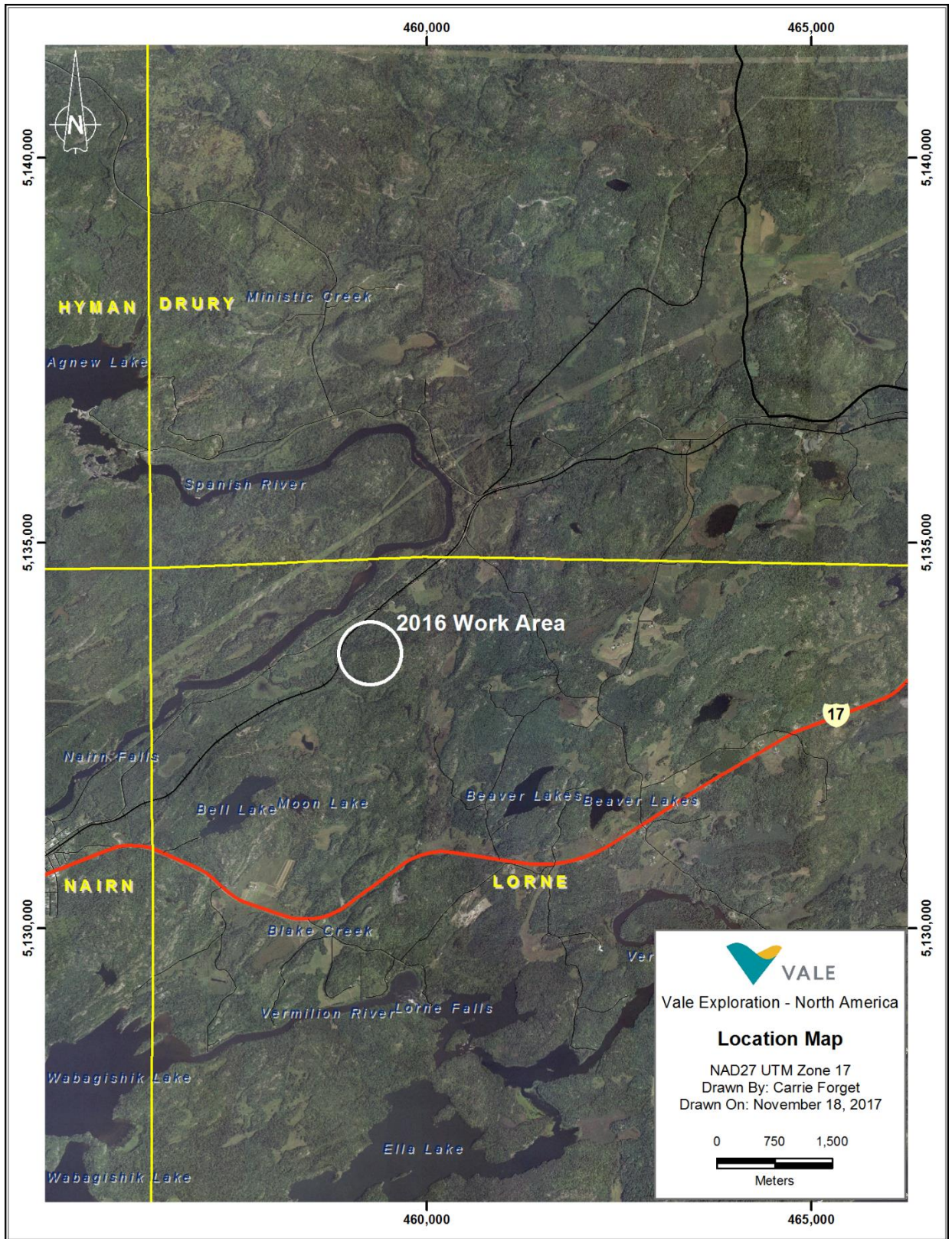


Figure 1. The Lorne property is located in Lorne Township near the town of Nairn, west of Sudbury.



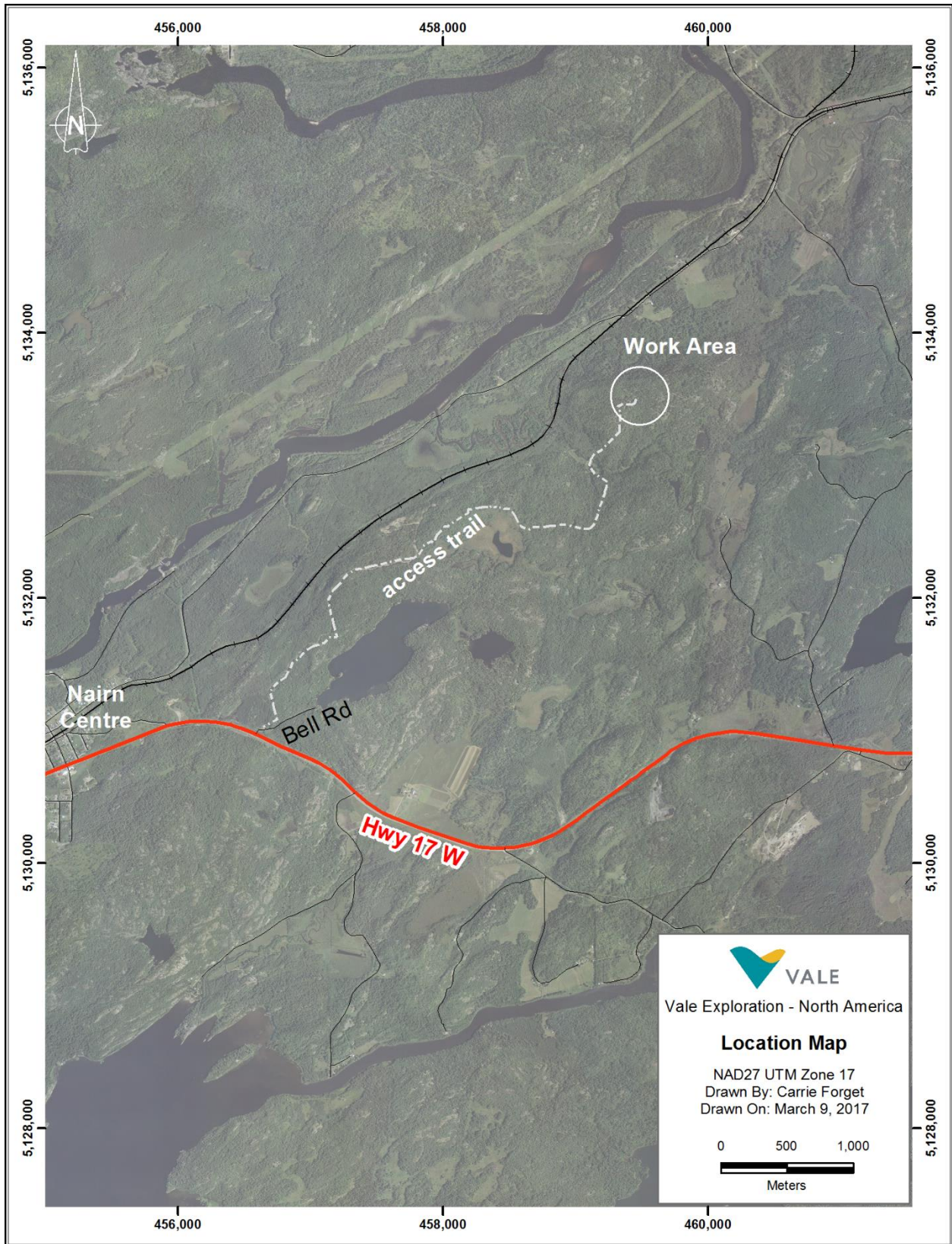


Figure 2. Access to the Lorne Township property.



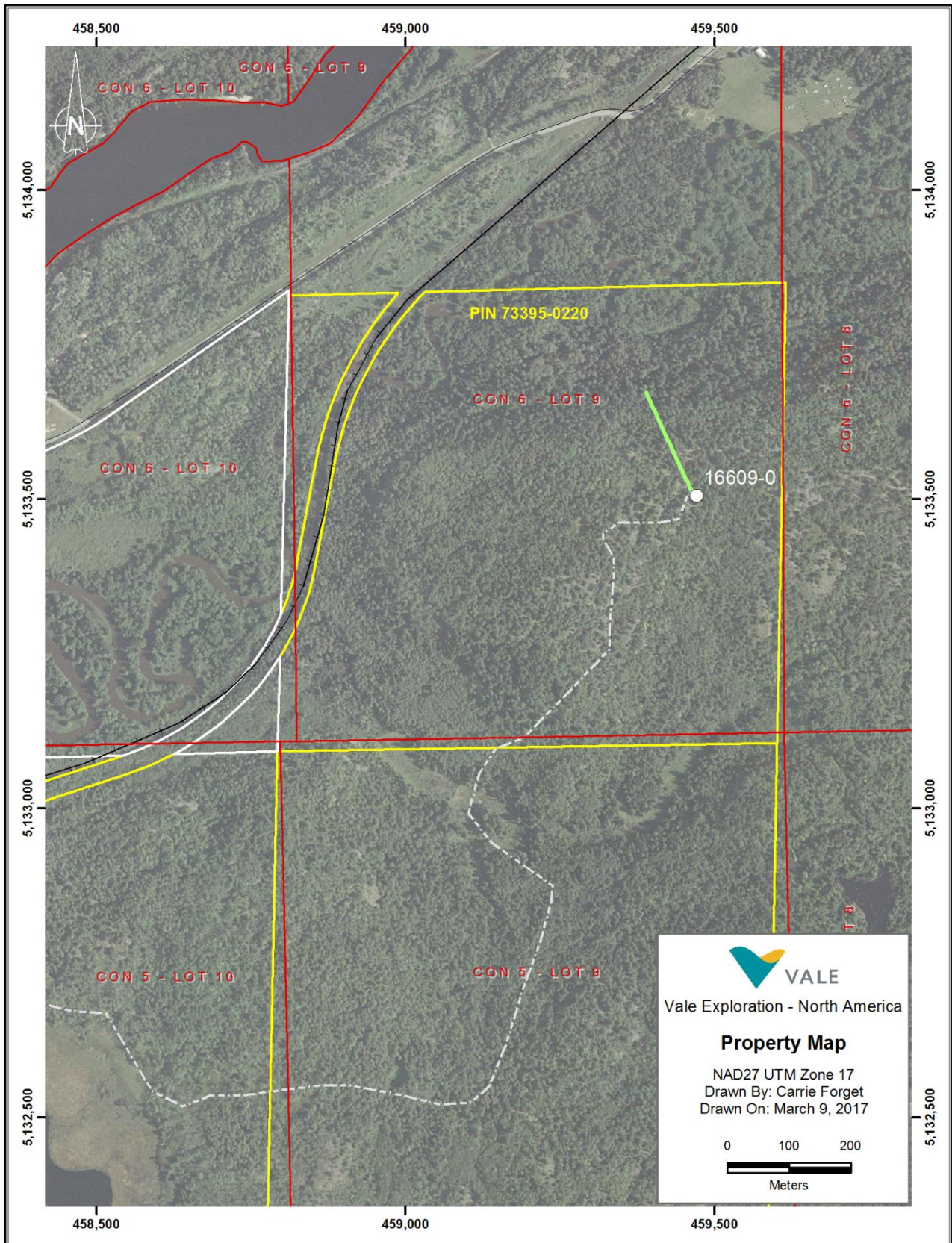


Figure 3. Historic hole BH16609-0 is located in Lorne Township, Lot 9, Concession 6, on patent PIN 73395-0220.

## ***Geophysics***

### ***BH-UREM***

A borehole geophysical UREM survey was completed at the end of June 2016 to explore for conductivity around borehole 16609-0 and assess the exploration potential of the Worthington Offset in the surrounding area. The survey was performed using the Universal Receiver Electromagnetic system (UREM), which was developed by and is proprietary to Vale. The survey transmitter output a 100% duty-cycle square wave at 30.25 Hz, while the downhole receiver was a single component (up the hole) magnetic coil. This configuration allows for the system to detect both weak and extremely strong conductors. To properly process this type of data, it was also required to survey in the location of the borehole collar with a differential GPS and to determine the borehole trajectory with a gyroscopic survey. The data is reduced to 10 channels per station, with Channel 10 being the earliest time and Channel 1 the latest time. Channels 2 through 10 and normalized by subtracting the Channel 1 response and dividing by the calculated total primary field, while Channel 1 is reduced by subtracting the calculated primary field in the receiver direction, and then dividing by the total primary field. This method of data reduction results in the removal of geometrical errors and of the effects of local magnetic bodies from Channels 10 to 2, while any response that is observed solely in Channel 1 could be due to either geometrical errors, magnetic bodies, or the presence of extremely good conductors (Figure 4).

Down-hole profiles from the survey are included in Appendix III.

### ***Surface UREM***

A surface UREM survey was completed at the end of June 2016 to explore for conductivity in the near surface in the vicinity of borehole 16609-0 and assess the exploration potential of the Worthington Offset in the surrounding area. The survey was performed using the Universal Receiver Electromagnetic system (UREM), which was developed by and is proprietary to Vale. The survey transmitter output a 100% duty-cycle square wave at 30.25 Hz, while the surface receiver was a single vertical component magnetic coil. This configuration allows for the system to detect both weak and extremely strong conductors. To properly process this type of data, it was also required to survey in the location of each UREM station with an accurate GPS. The data is reduced to 10 channels per station, with Channel 10 being the earliest time and Channel 1 the latest time. Channels 2 through 10 and normalized by subtracting the Channel 1 response and dividing by the calculated total primary field, while Channel 1 is reduced by subtracting the calculated primary field in the receiver direction, and then dividing by the total primary field. This method of data reduction results in the removal of geometrical errors and of the effects of local magnetic bodies from Channels 10 to 2, while any response that is observed solely in Channel 1 could be due to either geometrical errors, magnetic bodies, or the presence of extremely good conductors (Figure 4).

Along the line profiles showing the results of the surface UREM survey is included in Appendix IV.



## Conclusions & Recommendations

Final interpretation of the BH-UREM results indicated two very small, moderately conductive bodies that were intersected by the drillhole. Both conductors correspond to the presence of sulphides in the borehole. The conductors both appear to be smaller than 25 m x 25 m, and the data shows no indications of a larger conductive system in the vicinity of the borehole.

Final interpretation of the surface UREM results indicate a series of very small, moderately conductive bodies that are very close to surface. These conductors appear to be extremely shallow and very small in size (less than 25 m x 25 m), and do not show correlation from line to line. The Channel 1 response observed on the lines has data that shows large spikes in the observed response. These responses do not show any line to line correlation, and are interpreted to be caused by geometrical errors related to inaccurate positioning of both the loop and the receiver stations as the GPS signal was erratic during the survey.

Based on geological information and geophysical interpretations, follow-up is not recommended at this time.

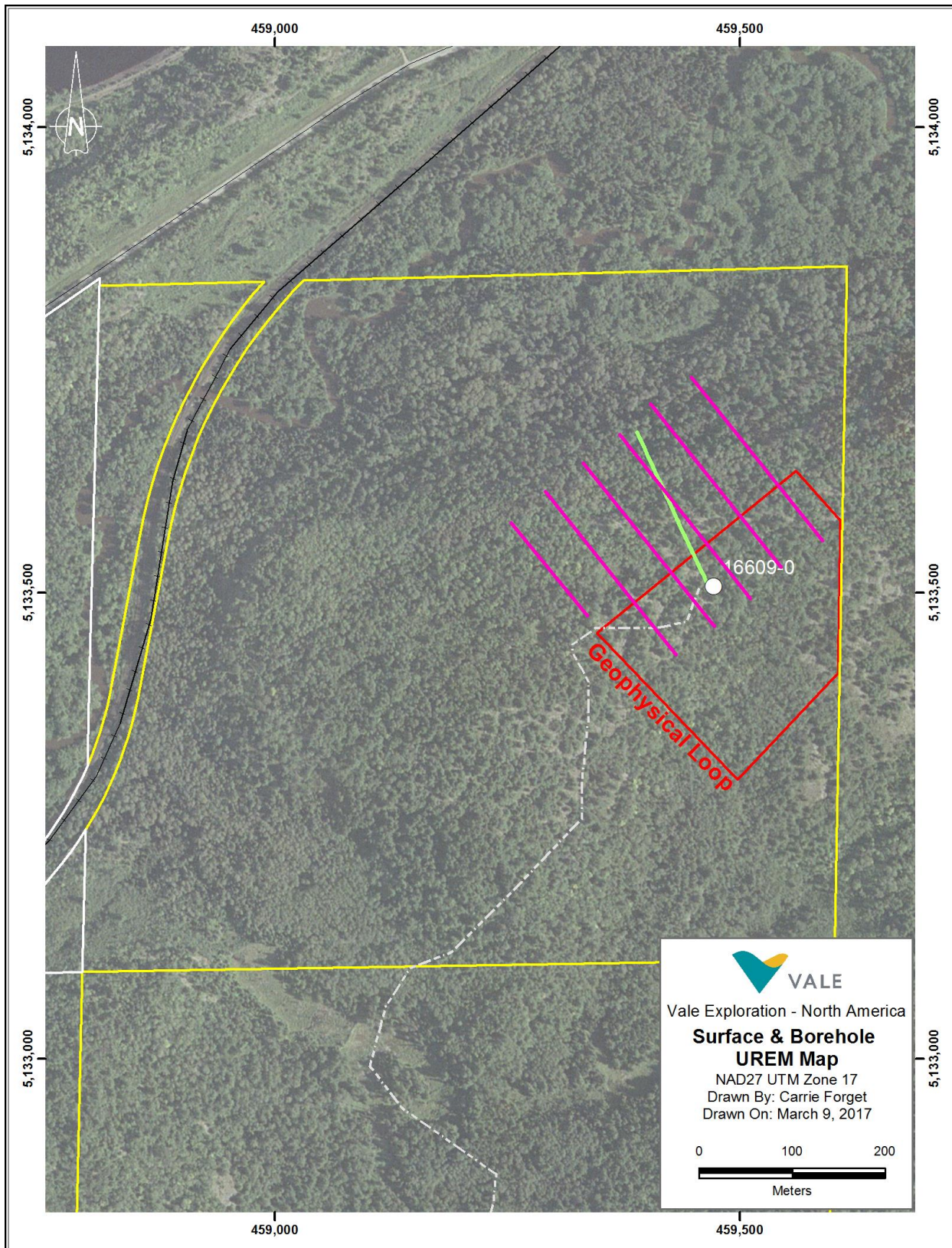


Figure 4. The location of geophysical loop, shown in red, was used for the small surface UREM survey (survey lines shown in pink) and the borehole UREM survey (drillhole trace projected to surface shown in green).

## References

*Placeholder*



## Statement of Qualifications

## Statement of Qualifications

I, Carrie Forget of 1081 Soloy Drive, Sudbury, Ontario hereby certify that:

1. I am registered as a Professional Geoscientist with the Association of Professional Geoscientists of Ontario with registration number 1695.
2. I am a 2005 graduate of Carleton University in Ottawa with a Bachelors of Science degree in Geology.
3. I have practiced my profession continuously since 2005.
4. I am currently employed as a Project Geologist with Vale Exploration - North America in Copper Cliff, Ontario.
5. I am the co-author of this report.



Carrie Forget, P.Ge

March 20, 2017

## Statement of Qualifications

I, Sean Dickie of 1694 Madison Avenue, Sudbury, Ontario, hereby certify that:

1. I am registered as a Professional Geoscientist with the Association of Professional Geoscientists of Ontario with registration number 1755.
2. I am a 2005 graduate of McMaster University in Hamilton with a Bachelor of Science degree in Earth and Environmental Science.
3. I have practiced my profession continuously since 2005.
4. I am currently employed as an Area Geophysicist with Vale Exploration – North America in Copper Cliff, Ontario.
5. I am the co-author of this report.



Sean Dickie, P. Geo

May 4, 2017



**Appendix I – Summary of Expenditures**

<b>Item</b>	<b>Man Days</b>	<b>Time Period</b>	<b>Daily Rate</b>	<b>Total Cost</b>
Compilation & Logistics	8	April 1 to July 15, 2016	\$500	\$4,000
Historic hole location, Access cutting & Dummy probing	19	May 26 to June 23, 2016	\$250	\$4,750
Loop deployment, BH-UREM, Surface UREM, Loop retrieval	9	June 27 to June 29, 2016	\$250	\$2250
Collar and directional survey	3	July 12, 2016	\$250	\$750
Geophysical Interpretation	2	July 15, 2016	\$500	\$1,000
<b>Total Expenditures</b>				<b>\$12,750</b>

## ***Appendix II – Collar Coordinates, Gyroscope Survey Data, Loop Coordinates and Station Coordinates***

All coordinates are in NAD27 UTM Zone 17

### **Borehole 16609-0 Collar Coordinates**

X	Y	Z	Depth (m)
459465.47	5133508.71	287.12	266.70

### **Borehole 16609-0 Gyroscopic**

DEPTH	AZIMUTH	DIP
0	334.47	-49.56
3.05	334.37	-49.55
6.1	334.48	-49.52
9.14	334.46	-49.53
12.19	334.49	-49.48
15.24	334.53	-49.46
18.29	334.54	-49.43
21.34	334.55	-49.4
24.38	334.59	-49.38
27.43	334.64	-49.39
30.48	334.63	-49.31
33.53	334.68	-49.26
36.58	334.78	-49.19
39.62	334.37	-49.1
42.67	334.44	-49.12
45.72	334.45	-49.09
48.77	334.55	-49.04
51.82	334.37	-48.8
54.86	334.48	-48.69
57.91	334.49	-48.56
60.96	334.55	-48.52
64.01	334.58	-48.46
67.06	334.6	-48.37
70.1	334.63	-48.38
73.15	334.66	-48.35
76.2	334.68	-48.31
79.25	334.76	-48.32
82.3	334.79	-48.27

85.34	334.75	-48.21
88.39	334.66	-48.2
91.44	334.8	-48.16
94.49	334.83	-48.16
97.54	334.92	-48.17
100.58	334.88	-48.09
103.63	334.93	-48.09
106.68	334.91	-48.06
109.73	335	-48.12
112.78	334.88	-48.17
115.82	334.91	-48.05
118.87	334.95	-48.05
121.92	335.02	-47.96
124.97	335.11	-48
128.02	335.16	-47.9
131.06	335.19	-47.94
134.11	335.26	-47.64
137.16	335.23	-47.47
140.21	335.24	-47.44
143.26	335.21	-47.28
146.3	335.26	-47.25
149.35	335.25	-47.17
152.4	335.5	-47.34
155.45	335.22	-47.19
158.5	335.27	-47.21
161.54	335.25	-47.18
164.59	335.27	-47.15
167.64	335.36	-46.95
170.69	335.41	-46.72
173.74	335.36	-46.55
176.78	335.32	-46.46
179.83	335.28	-46.4
182.88	335.43	-46.35
185.93	335.42	-46.3
188.98	335.5	-46.25
192.02	335.58	-46.05
195.07	335.53	-46
198.12	335.56	-46
201.17	335.56	-45.83
204.22	335.58	-45.7
207.26	335.47	-45.4
210.31	335.45	-45.61
213.36	335.62	-45.33



216.41	335.4	-45.42
219.46	335.4	-45.24
222.5	335.47	-45.25
225.55	335.42	-45.3
228.6	335.54	-45.12
231.65	335.57	-44.84
234.7	335.57	-44.89
237.74	335.54	-44.82
240.79	335.69	-44.78
243.84	335.72	-44.74
246.89	335.52	-44.64
249.94	335.65	-44.74
252.98	335.55	-44.7
256.03	335.56	-44.49
259.08	335.69	-44.44
262.13	335.77	-44.46
262.98	335.68	-44.52
265.42	335.68	-44.52

## Lorne Loop 1 Coordinates

X	Y	Z
459558.3	5133628	264.563
459564.5	5133620	274.789
459581	5133604	286.104
459609	5133577	286.229
459609.4	5133563	283.551
459607.1	5133537	284.472
459609.4	5133499	293.105
459606.8	5133439	293.019
459607	5133417	291.302
459607.3	5133417	287.827
459601.6	5133403	290.293
459587.5	5133392	286.959
459575.4	5133380	280.834
459557.5	5133359	276.902
459557.7	5133359	277.517
459543.8	5133347	274.593
459526.7	5133333	275.917
459516.6	5133319	260.628
459499.9	5133305	256.278
459490.3	5133313	257.255
459472.5	5133324	263.679
459465.9	5133336	256.814
459455.2	5133350	258.075
459445.5	5133356	258.501
459433	5133369	259.672
459415.9	5133383	270.28
459393.2	5133407	276.257
459374.4	5133426	279.497
459363	5133441	283.293
459348.9	5133455	285.077
459365	5133479	286.758
459389.3	5133498	284.265
459407.5	5133517	285.006
459420.2	5133525	285.052
459414.4	5133516	289.776
459432.7	5133521	285.932
459436.1	5133528	281.677
459444.2	5133539	280.513
459461.1	5133550	279.972
459472.4	5133562	282.293

459489	5133575	281.089
459497.9	5133583	281.891
459507	5133590	279.491
459530.3	5133608	270.358
459547.8	5133620	267.327
459558.3	5133628	275.468



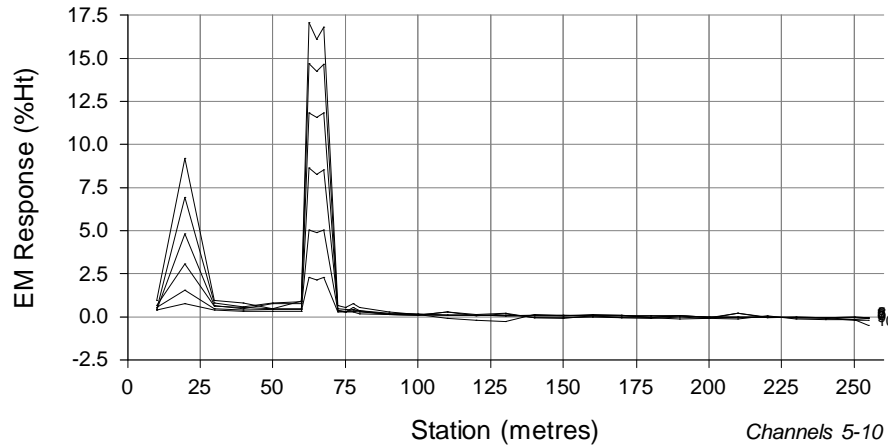
## Surface UREM Station Coordinates

X	Y	Z	LINE	STATION
459332.3	5133477	290	0	25
459316.5	5133497	290	0	50
459300.8	5133516	290	0	75
459285.1	5133536	290	0	100
459269.3	5133555	290	0	125
459253.6	5133575	290	0	150
459434.1	5133431	290	50	-75
459418.3	5133451	290	50	-50
459402.6	5133470	290	50	-25
459371.1	5133509	290	50	25
459355.4	5133528	290	50	50
459339.7	5133548	290	50	75
459323.9	5133567	290	50	100
459308.2	5133587	290	50	125
459292.5	5133606	290	50	150
459472.9	5133463	290	100	-75
459457.2	5133482	290	100	-50
459441.4	5133502	290	100	-25
459410	5133540	290	100	25
459394.2	5133560	290	100	50
459378.5	5133579	290	100	75
459362.8	5133599	290	100	100
459347	5133618	290	100	125
459331.3	5133638	290	100	150
459511.8	5133494	290	150	-75
459496	5133514	290	150	-50
459448.8	5133572	290	150	25
459433.1	5133591	290	150	50
459401.6	5133630	290	150	100
459385.9	5133650	290	150	125
459370.2	5133669	290	150	150
459550.6	5133526	290	200	-75
459534.9	5133545	290	200	-50
459519.2	5133564	290	200	-25
459487.7	5133603	290	200	25
459472	5133623	290	200	50

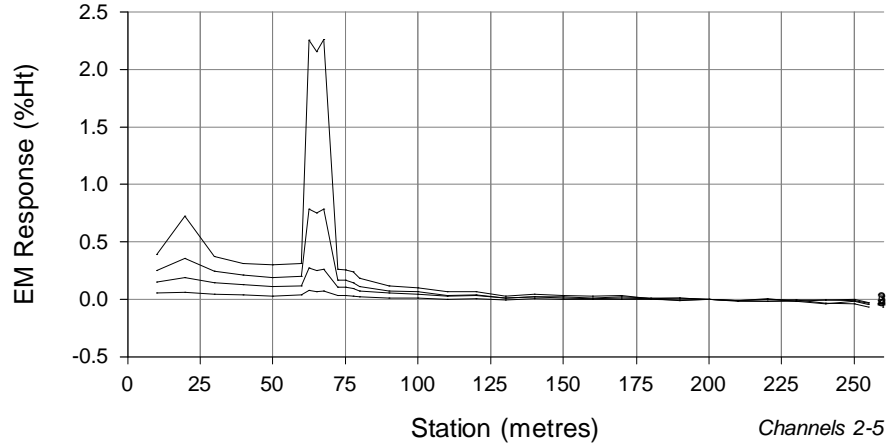
459456.2	5133642	290	200	75
459440.5	5133662	290	200	100

***Appendix III – Borehole UREM Profile***

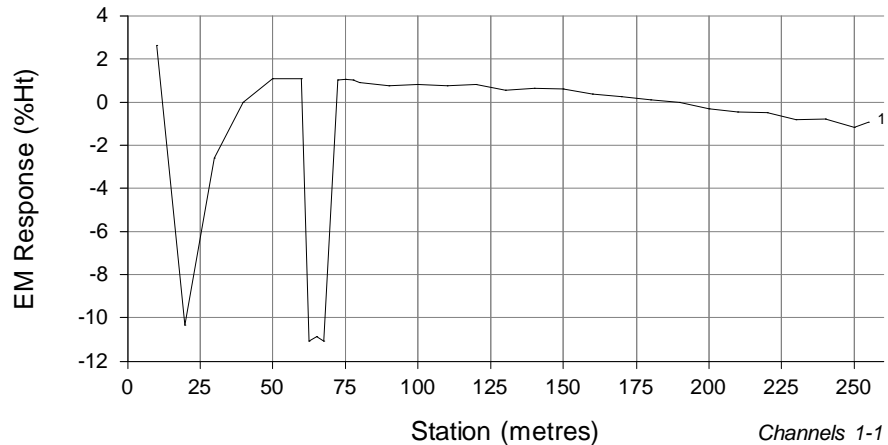
### Channels 5 - 10



### Channels 2 - 5



### Channel 1



#### WINDOW TIMES (ms): Start End From the start of the Ramp

1	: 11.31, 15.00	6	: 2.000, 2.828
2	: 8.000, 11.313	7	: 1.414, 2.000
3	: 5.656, 8.000	8	: 1.000, 1.414
4	: 4.000, 5.656	9	: 0.7070, 1.0000
5	: 2.828, 4.000	10	: 0.5000, 0.7070

#### SURVEY PARAMETERS

Configuration : Downhole  
Station Spacing : 2.5-10.0 m

#### RECEIVER

Receiver : UR  
Frequency : 30.25  
Component : A  
Rx Coil : ANT 23

#### TRANSMITTER

Transmitter : Techron  
Loop : Lorne Loop 1  
Tx Current : 7 A  
On Time : 16.5289 ms  
Off Time : 0 ms

Lorne Prospect  
Downhole EM Survey  
PROFILES OF  
EM RESPONSE  
Line 16609-0

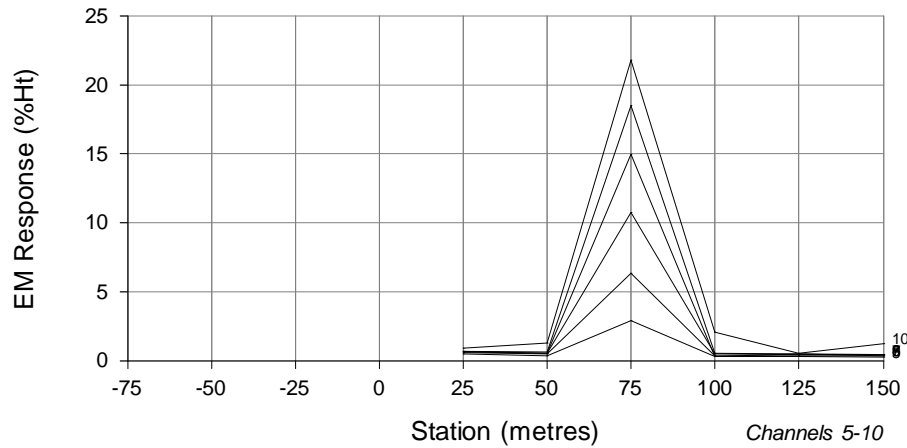
Drawn : May 4, 2017

Job No. : N/A



***Appendix IV – Surface UREM Profiles***

### Channels 5 - 10



### WINDOW TIMES (ms): Start End From the start of the Ramp

1	: 11.31, 15.00	6	: 2.000, 2.828
2	: 8.000, 11.313	7	: 1.414, 2.000
3	: 5.656, 8.000	8	: 1.000, 1.414
4	: 4.000, 5.656	9	: 0.7070, 1.0000
5	: 2.828, 4.000	10	: 0.5000, 0.7070

### SURVEY PARAMETERS

Configuration : Fixed Loop  
Station Spacing : 25 m

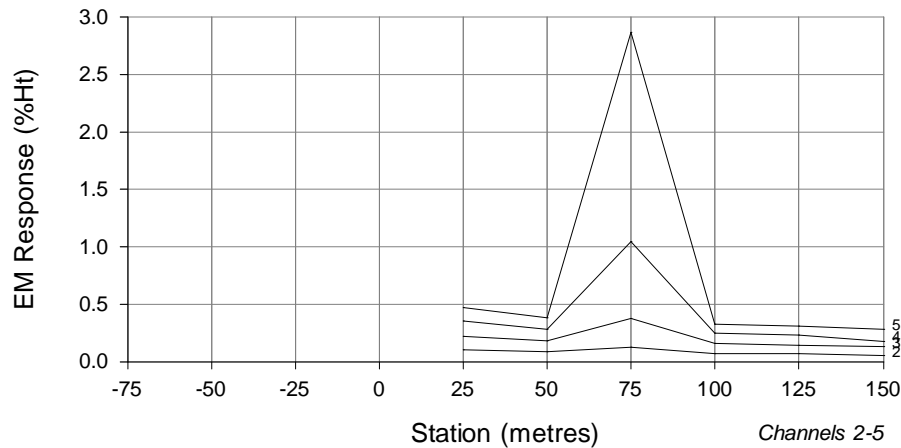
### RECEIVER

Receiver : UR  
Frequency : 30.25  
Component : Z  
Rx Coil : ANT 3

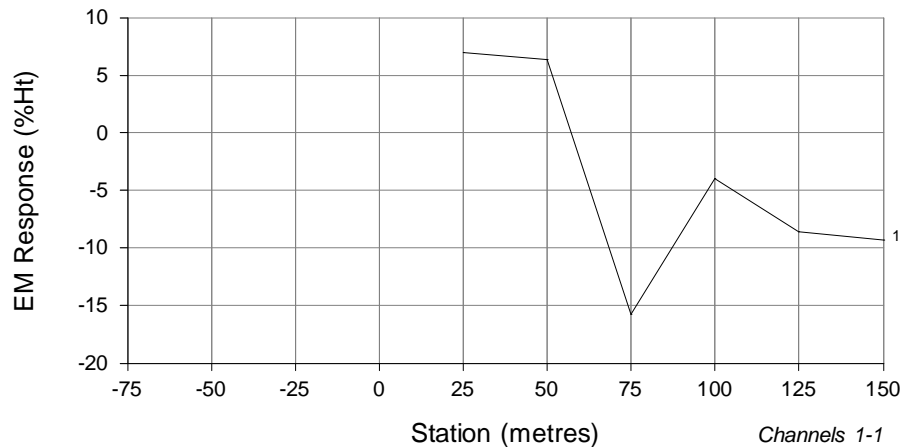
### TRANSMITTER

Transmitter : Techron  
Loop : Lorne Loop 1  
Tx Current : 7 A  
On Time : 16.5289 ms  
Off Time : 0 ms

### Channels 2 - 5



### Channel 1

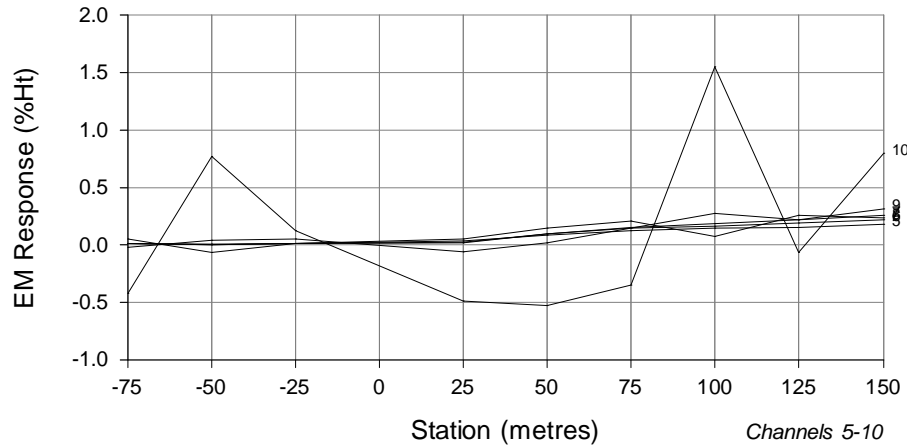


Lorne Prospect  
Fixed Loop EM Survey  
PROFILES OF  
EM RESPONSE  
Line 0

Drawn : May 4, 2017

Job No. : N/A

### Channels 5 - 10



#### WINDOW TIMES (ms): Start End From the start of the Ramp

1	: 11.31, 15.00	6	: 2.000, 2.828
2	: 8.000, 11.313	7	: 1.414, 2.000
3	: 5.656, 8.000	8	: 1.000, 1.414
4	: 4.000, 5.656	9	: 0.7070, 1.0000
5	: 2.828, 4.000	10	: 0.5000, 0.7070

#### SURVEY PARAMETERS

Configuration : Fixed Loop  
Station Spacing : 25-50 m

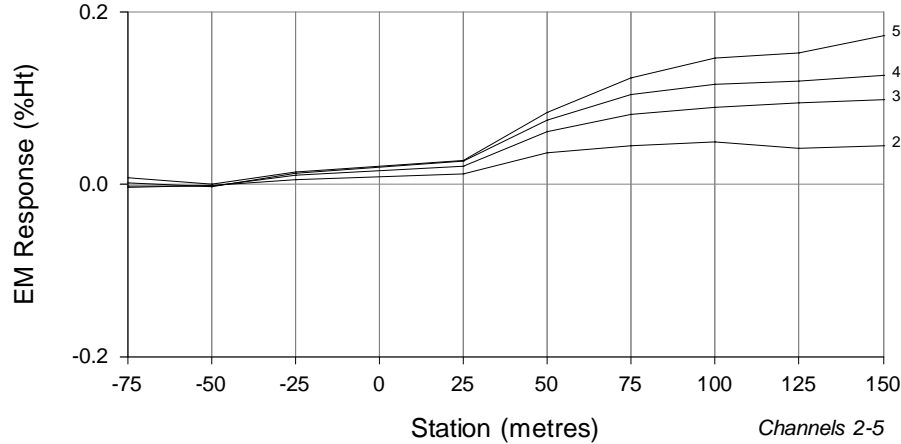
#### RECEIVER

Receiver : UR  
Frequency : 30.25  
Component : Z  
Rx Coil : ANT 3

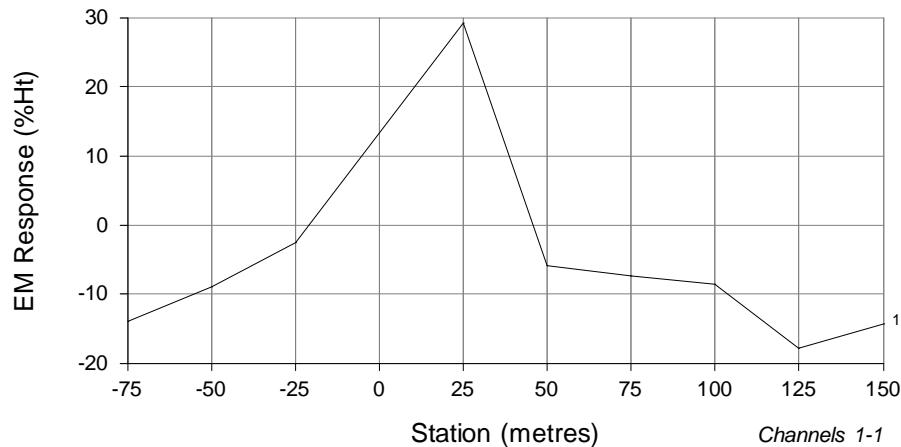
#### TRANSMITTER

Transmitter : Techron  
Loop : Lorne Loop 1  
Tx Current : 7 A  
On Time : 16.5289 ms  
Off Time : 0 ms

### Channels 2 - 5



### Channel 1

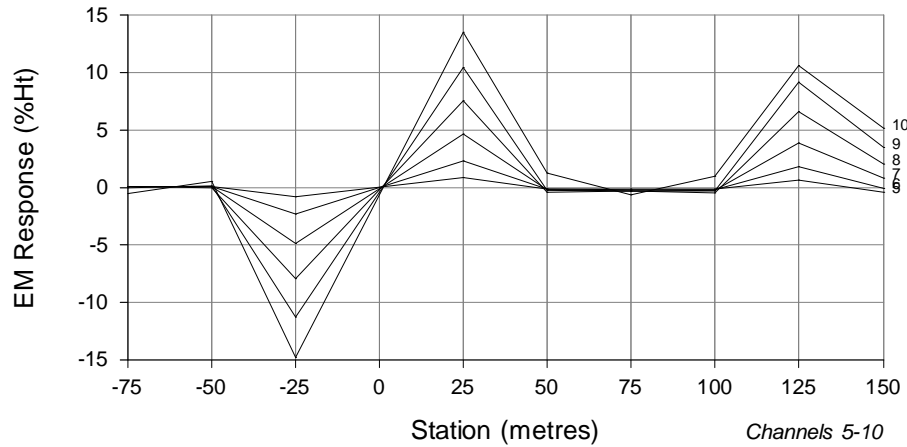


Lorne Prospect  
Fixed Loop EM Survey  
PROFILES OF  
EM RESPONSE  
Line 50

Drawn : May 4, 2017

Job No. : N/A

### Channels 5 - 10



#### WINDOW TIMES (ms): Start End From the start of the Ramp

1	: 11.31, 15.00	6	: 2.000, 2.828
2	: 8.000, 11.313	7	: 1.414, 2.000
3	: 5.656, 8.000	8	: 1.000, 1.414
4	: 4.000, 5.656	9	: 0.7070, 1.0000
5	: 2.828, 4.000	10	: 0.5000, 0.7070

#### SURVEY PARAMETERS

Configuration : Fixed Loop  
Station Spacing : 25-50 m

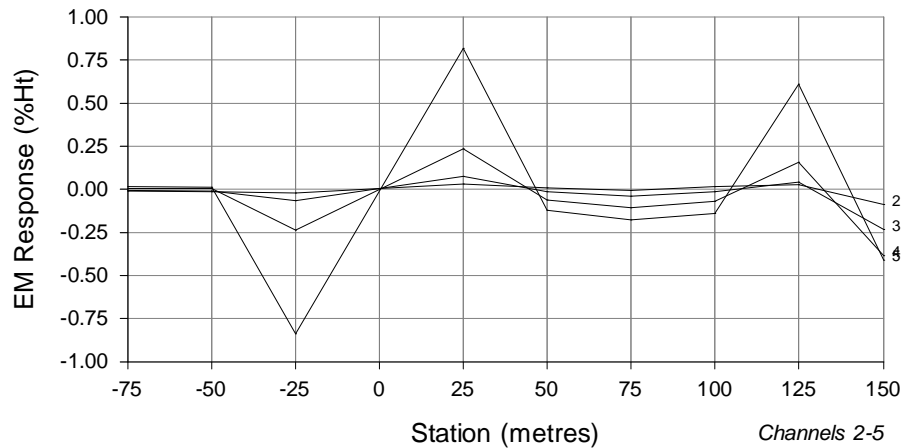
#### RECEIVER

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Frequency : 30.25  
Component : Z  
Rx Coil : ANT 3

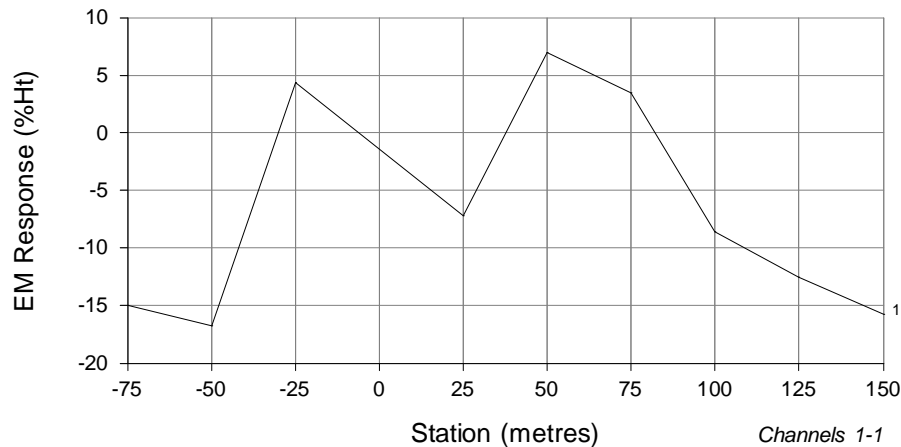
#### TRANSMITTER

Transmitter : Techron  
Loop : Lorne Loop 1  
Tx Current : 7 A  
On Time : 16.5289 ms  
Off Time : 0 ms

### Channels 2 - 5



### Channel 1

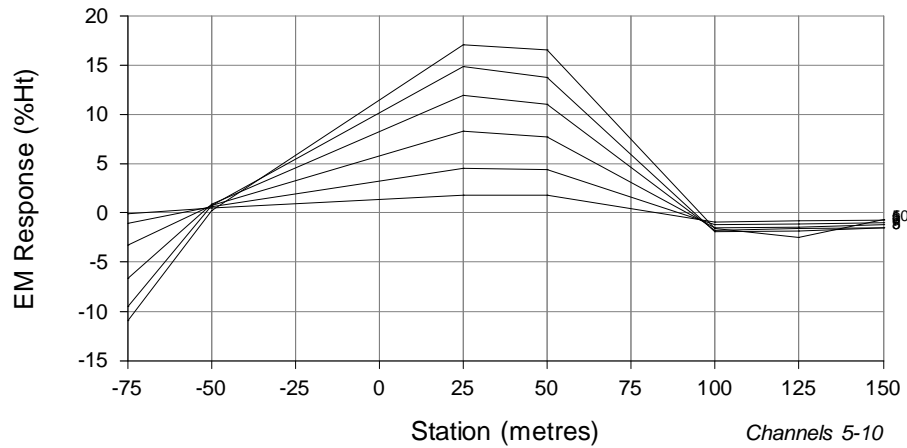


Lorne Prospect  
Fixed Loop EM Survey  
PROFILES OF  
EM RESPONSE  
Line 100

Drawn : May 4, 2017

Job No. : N/A

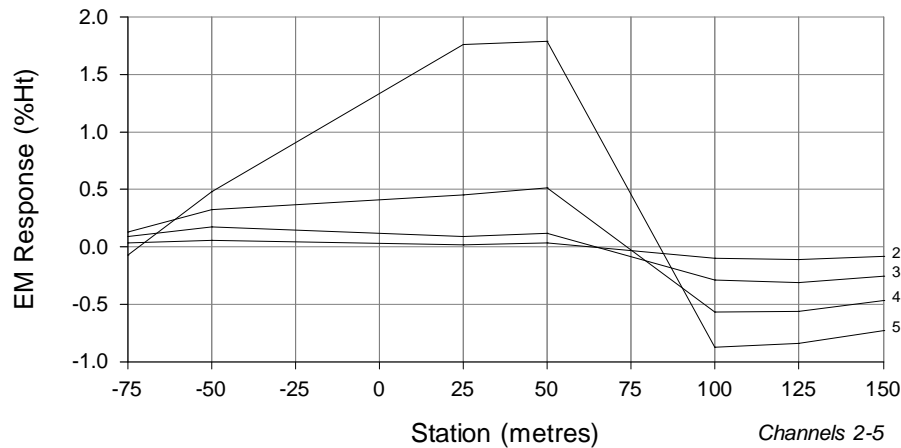
### Channels 5 - 10



#### WINDOW TIMES (ms): Start End From the start of the Ramp

1	: 11.31, 15.00	6	: 2.000, 2.828
2	: 8.000, 11.313	7	: 1.414, 2.000
3	: 5.656, 8.000	8	: 1.000, 1.414
4	: 4.000, 5.656	9	: 0.7070, 1.0000
5	: 2.828, 4.000	10	: 0.5000, 0.7070

### Channels 2 - 5



#### SURVEY PARAMETERS

Configuration : Fixed Loop  
Station Spacing : 25-75 m

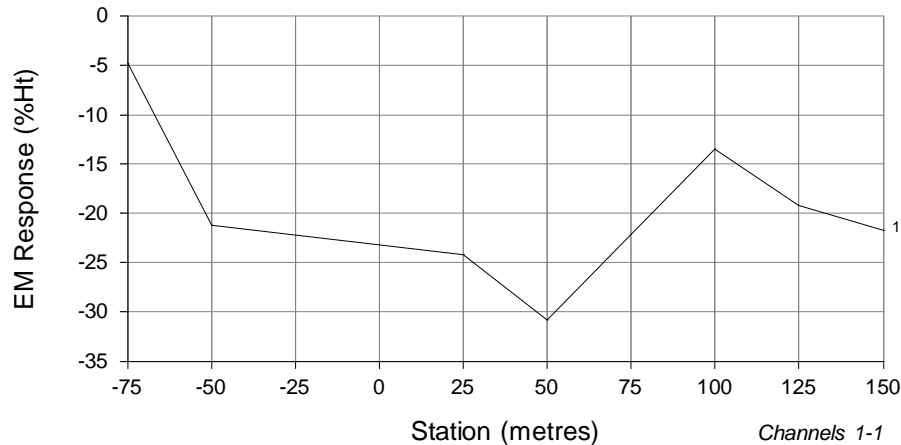
#### RECEIVER

Receiver : UR  
Frequency : 30.25  
Component : Z  
Rx Coil : ANT 3

#### TRANSMITTER

Transmitter : Techron  
Loop : Lorne Loop 1  
Tx Current : 7 A  
On Time : 16.5289 ms  
Off Time : 0 ms

### Channel 1

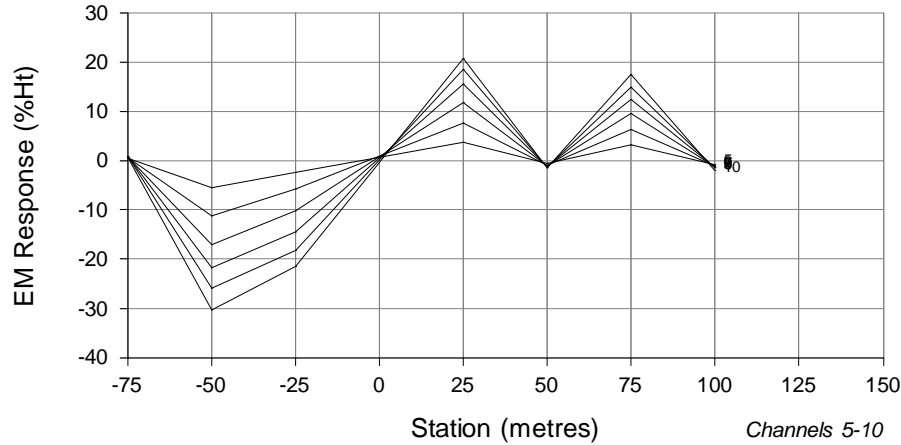


Lorne Prospect  
Fixed Loop EM Survey  
PROFILES OF  
EM RESPONSE  
Line 150

Drawn : May 4, 2017

Job No. : N/A

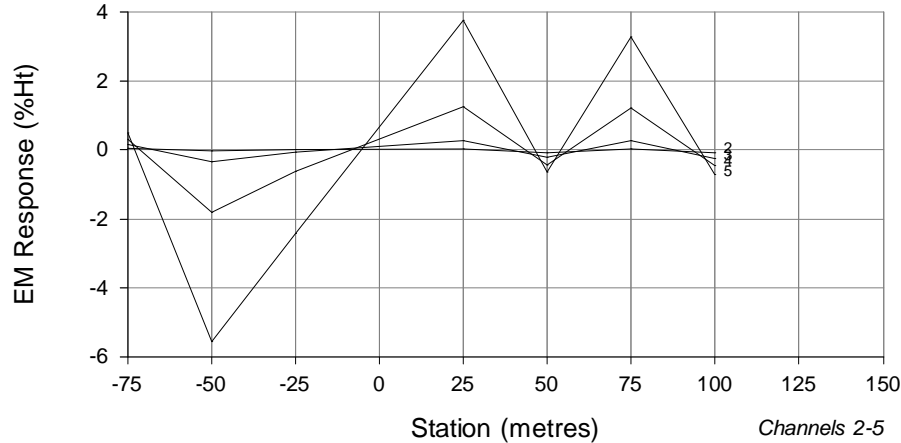
### Channels 5 - 10



### WINDOW TIMES (ms): Start End From the start of the Ramp

1	: 11.31, 15.00	6	: 2.000, 2.828
2	: 8.000, 11.313	7	: 1.414, 2.000
3	: 5.656, 8.000	8	: 1.000, 1.414
4	: 4.000, 5.656	9	: 0.7070, 1.0000
5	: 2.828, 4.000	10	: 0.5000, 0.7070

### Channels 2 - 5



### SURVEY PARAMETERS

Configuration : Fixed Loop  
Station Spacing : 25-50 m

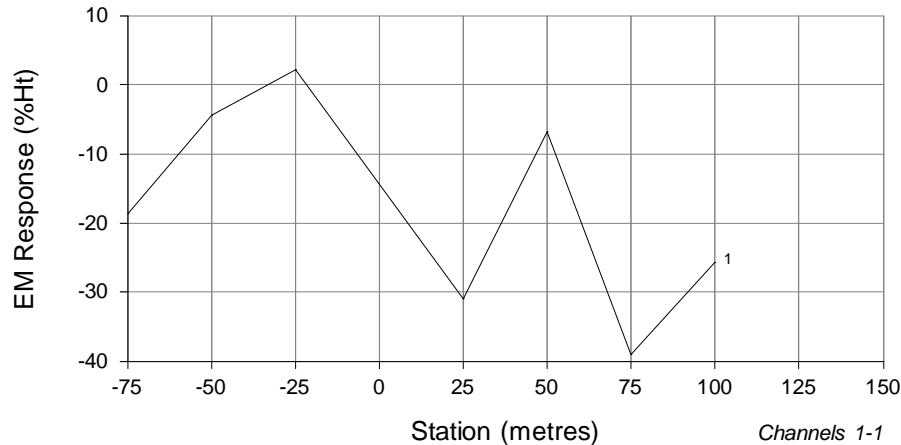
### RECEIVER

Receiver : UR  
Frequency : 30.25  
Component : Z  
Rx Coil : ANT 3

### TRANSMITTER

Transmitter : Techron  
Loop : Lorne Loop 1  
Tx Current : 7 A  
On Time : 16.5289 ms  
Off Time : 0 ms

### Channel 1



Lorne Prospect  
Fixed Loop EM Survey  
PROFILES OF  
EM RESPONSE  
Line 200

Drawn : May 4, 2017

Job No. : N/A