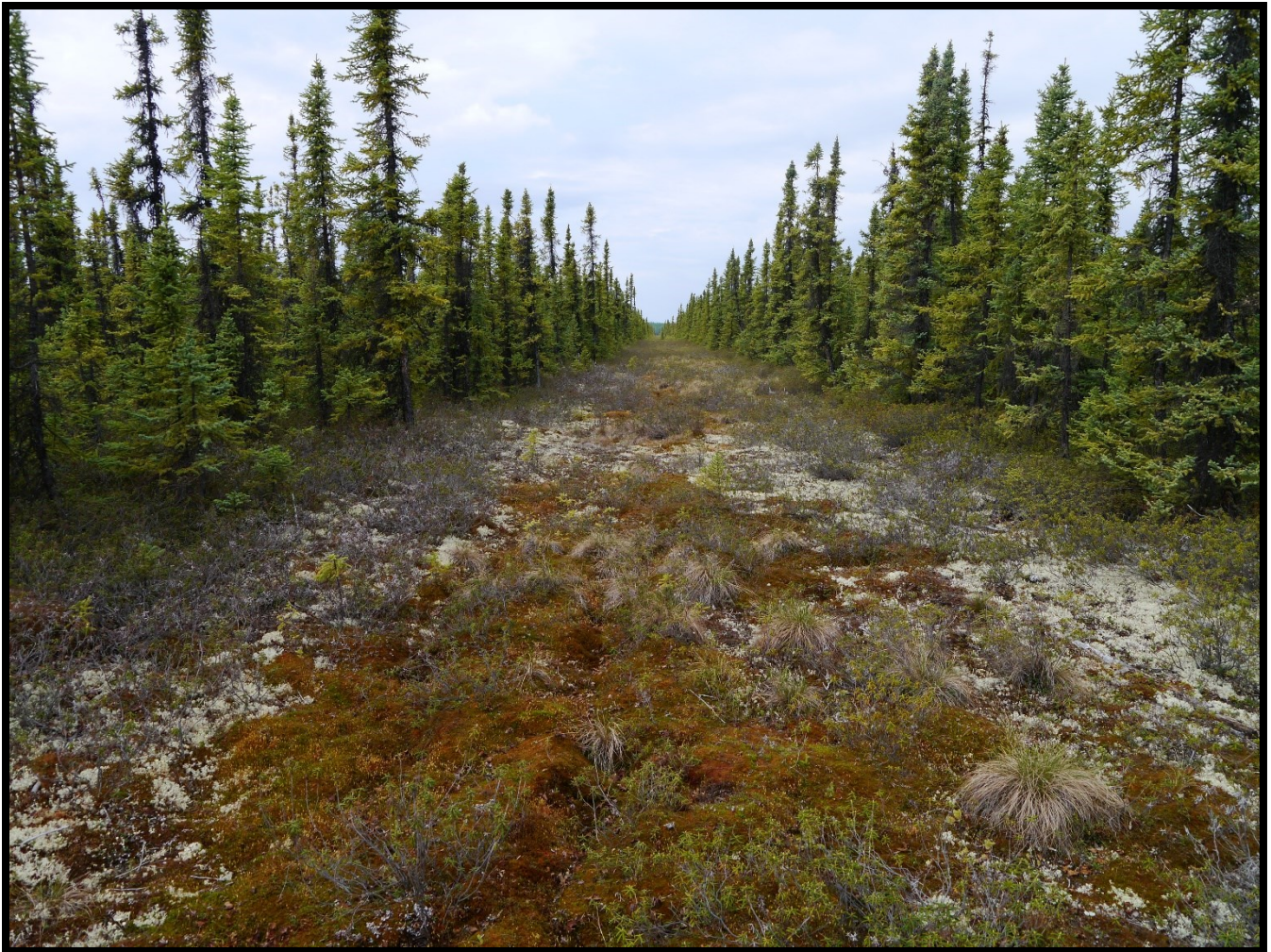


TESTING FUNCTIONAL RESTORATION OF LINEAR FEATURES WITHIN BOREAL CARIBOU RANGE

PHASE I PROGRESS REPORT



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TABLE OF CONTENTS

Project Summary.....	1
Phase Objective.....	1
Site Selection Methods	1
Results.....	2
Discussion.....	6
Going Forward	6
Literature Cited	7
Appendix A: GPS Coordinates	8
Appendix B: Additional Maps.....	10

LIST OF TABLES

Table A 1: GPS coordinates of candidate seismic lines identified during an aerial survey conducted 3 – 4 October 2017 within northeast British Columbia. “X” refers to the Easting coordinate and “Y” refers to the Northing coordinate within the UTM system.....	8
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LIST OF FIGURES

Figure B 1: Candidate seismic lines identified in the Clarke Lake Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.	11
Figure B 2: Candidate seismic lines identified in the Elleh Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.....	12
Figure B 3: Candidate seismic lines identified in the area of the Eskai and South Elleh (61) Roads during an aerial survey conducted 3 - 4 October 2017 in northeast BC.	13
Figure B 4: Candidate seismic lines identified in the area of the SYD and Elleh (61) Roads during an aerial survey conducted 3 - 4 October 2017 in northeast BC.	14
Figure B 5: Candidate seismic lines identified in the SYD Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.....	15
Figure B 6: Candidate seismic lines identified in the Deer River Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.	16
Figure B 7: Candidate seismic lines identified in the Windflower Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.	17
Figure B 8: Candidate seismic lines identified in the Tatoo High Grade Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.	18
Figure B 9: Candidate seismic lines identified in the Fort Nelson caribou core area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.	19
Figure B 10: Candidate seismic lines identified in the Patry Main Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.	20

PROJECT SUMMARY

Linear features such as seismic lines (SLs) and pipelines are believed to be a contributing factor to population declines of boreal caribou, an ecotype of woodland caribou currently listed as *Threatened* under the *Species at Risk Act* and *Red-Listed* in British Columbia. Linear features are thought to increase predator (e.g., wolves and bears) movement rates and assist their movement into caribou habitat, leading to more caribou-predator encounters and increasing rates of caribou predation.

This project will use an innovative control-treatment design to test whether tree-hinging and/or tree-bending can reduce linear feature use by predators. For each treated line, a lure or bait is placed in the center of two treated line segments (~ 200 – 400 m in length). Three remote cameras are then deployed: one at the bait station and the other two within each treated line segment. The center camera records whether a predator reaches the bait station while the other two cameras record whether the animal used the linear feature to reach the bait station. This three-camera and bait design is repeated at untreated sites. If line treatments are effective, predator line use at treated sites should be much lower than at untreated sites.

PHASE OBJECTIVE

For this initial phase of the project, our primary objective was to identify candidate SLs within caribou range for potential inclusion in the study. Statistical analyses in the project's proposal suggested a minimum sample size of 40 SLs (20 treatments and 20 controls). During our reconnaissance flight of the study, we sought to identify substantially more than 40 SLs because some candidate SLs may conflict with stakeholder interests and therefore may not be amenable to treatment.

SITE SELECTION METHODS

To identify candidate SLs, we conducted a helicopter-based aerial survey of six caribou core areas (Capot-Blanc, Clarke, Fort Nelson, Fortune, Kiwigana and Prophet) within northeast BC. These areas were selected due to their proximity to Fort Nelson and because each can be accessed by an all-season road. We identified candidate SLs based on four criteria:

1. The SL intersects with an all-season road to allow ground-based access for deployment of treatments and cameras.
2. The SL has little to no vegetative regeneration thereby being conducive to predator use and movement (Dickie et al. 2017)
3. An adequate supply of timber borders the SL allowing for tree-hinging and/or tree-bending techniques to be utilized.
4. The SL has sufficient length (i.e., ≥ 800 -m) to allow deployment of the three-camera design

Prior to the flight, we conducted GIS analyses to identify potential SLs and increase the efficiency of the survey. For each SL meeting the above selection criteria, we recorded the GPS coordinates of where the

SL intersected the road, the approximate orientation of the SL, and a qualitative assessment of the available timber bordering the line.

RESULTS

We initiated the aerial survey on 3 October 2017 and completed it by the afternoon of the following day. We identified 61 candidate SLs (Fig. 1, Appendix A) within the six caribou core areas. A majority of the lines were clustered around all-season roads in the Clarke core area (Fig. 2) and the western part of the Kiwigana core area (Fig. 3).

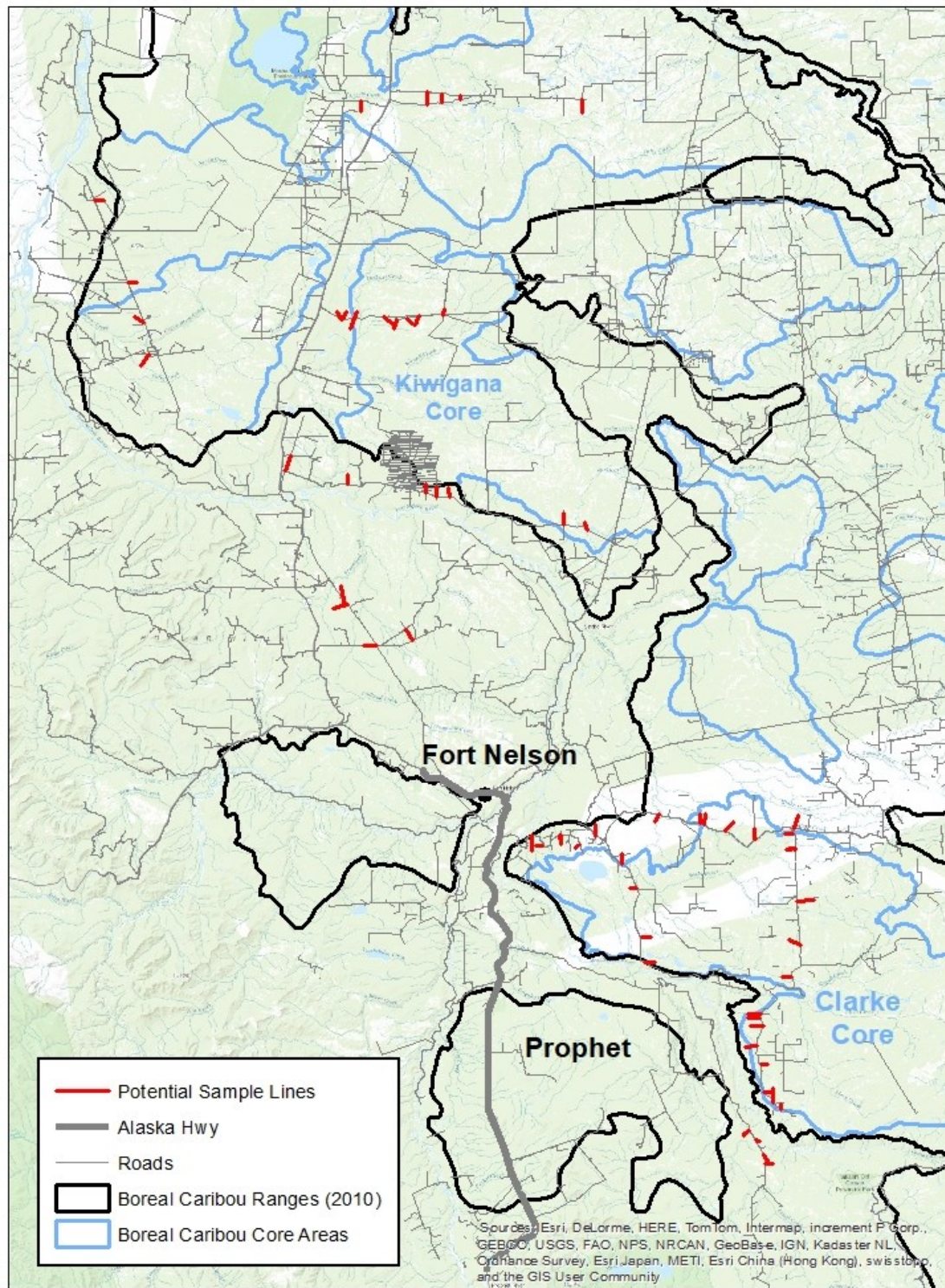


Figure 1: Candidate seismic lines identified during an aerial survey of boreal caribou ranges in northeast BC. The survey was conducted from 3 – 4 October, 2017.

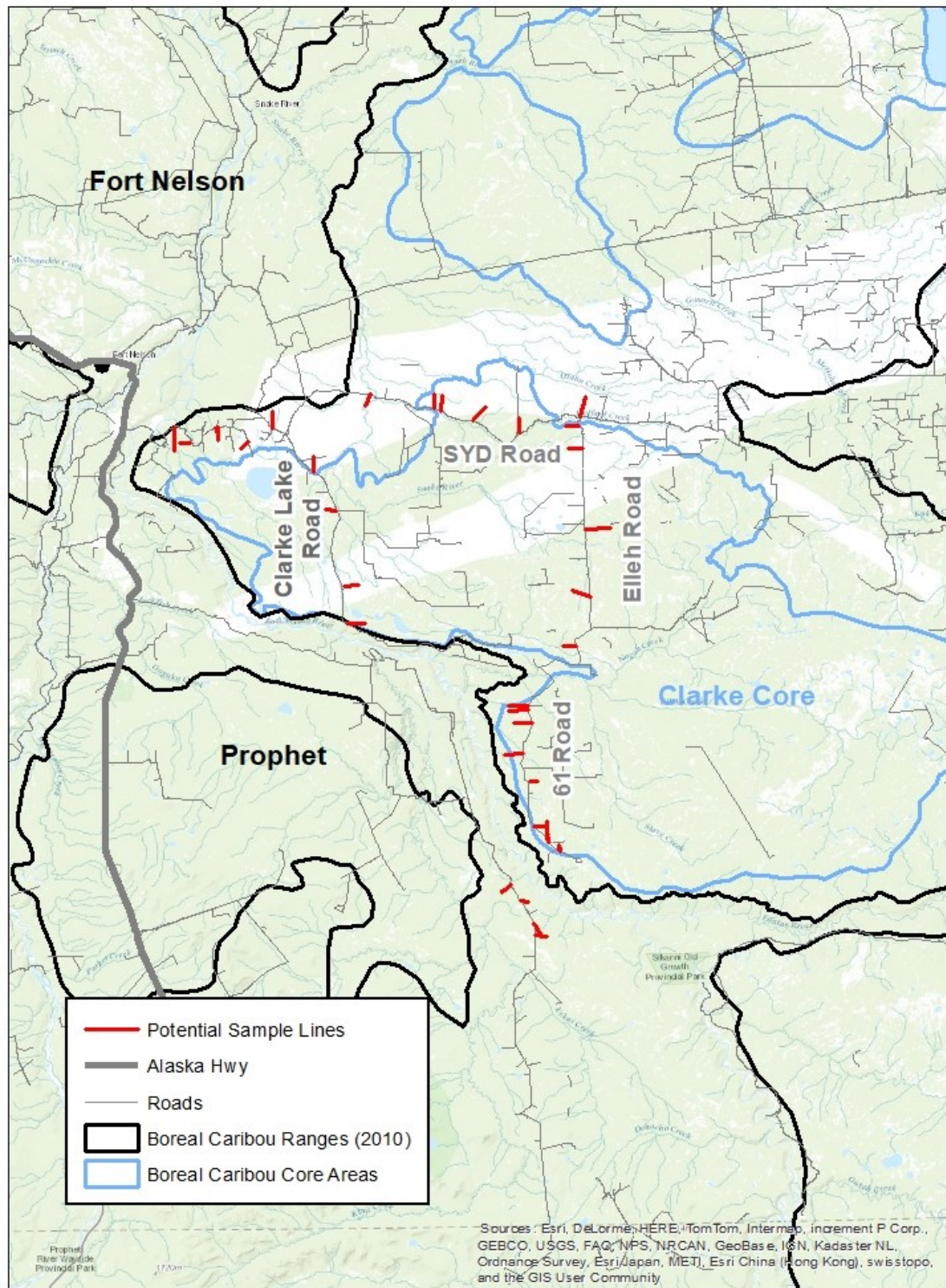


Figure 2: Candidate seismic lines identified in the Clarke core caribou area during an aerial survey conducted on 3 - 4 October, 2017.

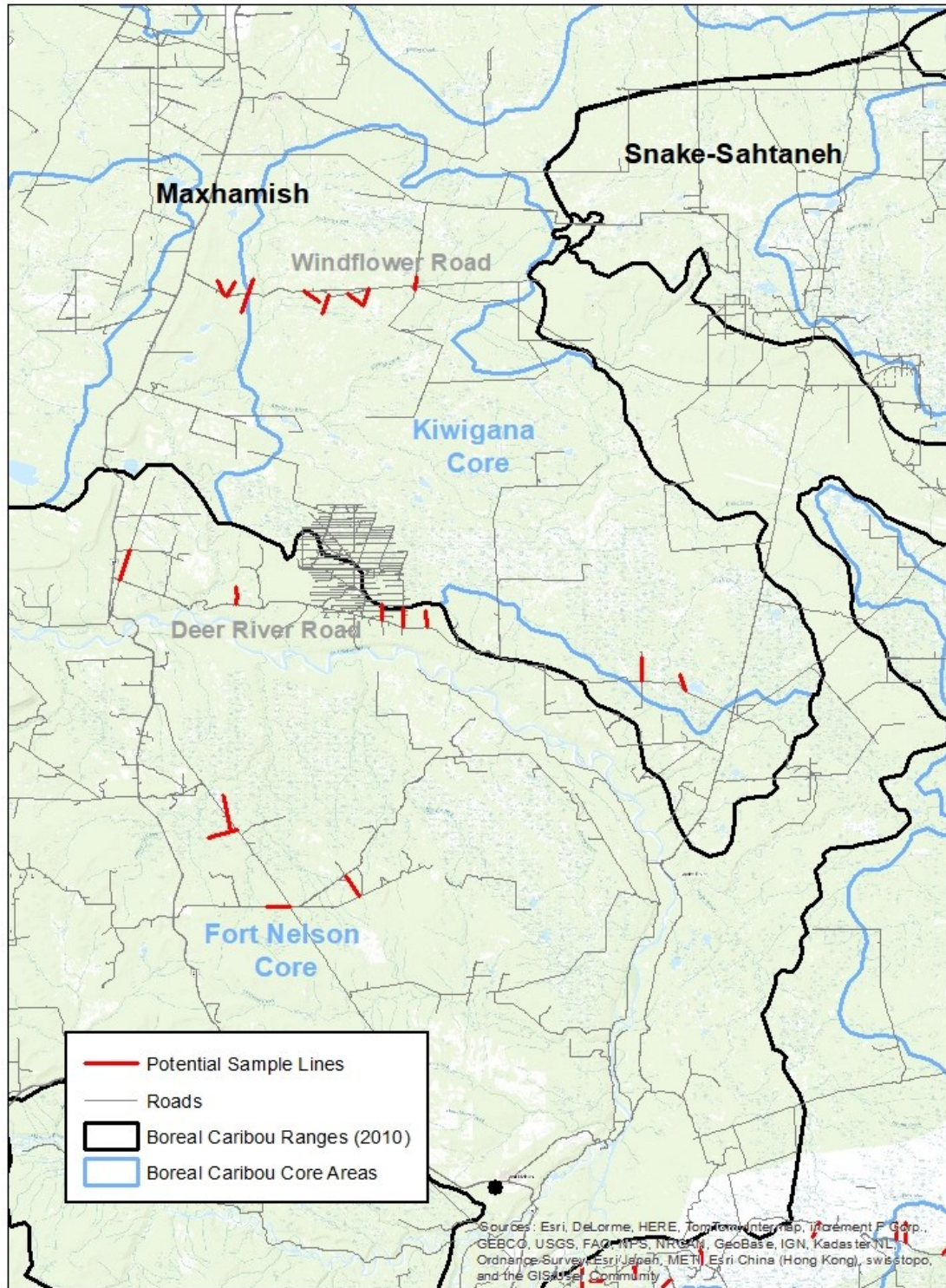


Figure 3: Candidate seismic lines identified in the Kiwigana core caribou area during an aerial survey conducted on 3 - 4 October, 2017.

DISCUSSION

We successfully identified a sufficient pool of candidate SLs from which we can ultimately select a final sample for inclusion in the study. This pool will be circulated to all relevant stakeholders to allow the identification of any SLs that may not be appropriate for restoration treatments; for example, some SLs may be used by trappers to access trap lines. Note that SLs identified as inappropriate for treatment may still be included in the study as controls.

Many of the candidate SLs were located in the Clarke core. Ultimately, selecting many of the SLs from this area may be advantageous because of its relatively close proximity to Fort Nelson and the multiple all-season roads located in the area. The high quantity of candidate SLs in this area likely relates to the fact that it is older in terms of oil and gas exploration compared to more northern areas. From a biological standpoint, the Clarke core may also be advantageous because it has a relatively high abundance of caribou (Culling and Culling 2014) and existing GPS collar data show that at least two wolf packs frequent the area (Culling and Culling 2016).

A further area to consider is the Kiwigana core, in particular areas off the Deer River Road and the Windflower Road (Fig. 3). Similar to Clarke, this area also has a relatively high abundance of caribou, especially in the winter (C. DeMars, *personal observation*). Existing GPS data show at least one wolf pack has historically been situated in the southeast portion of the core. Field surveys conducted off the Windflower Road in 2012 and 2013 also noted wolf scat and sign on SLs, suggesting that this area is likely included in the territory of an additional pack.

GOING FORWARD

With this initial phase of the project completed, the following are updates on other project activities and suggested next steps in the project:

1. GPS coordinates and GPS locations of candidate SLs will be distributed to relevant stakeholders including First Nations to identify potential conflicts.
2. Contractor(s) for treatment deployments: Fort Nelson First Nations (FNFN) has indicated that they have the capacity to deploy the proposed treatments. They have indicated that they will submit a formal proposal by 20 October 2017.
3. Remote cameras: order specifications for the required remote cameras and associated equipment have been submitted to Megan Watters at BC MFLNORD.
4. Potential federal permits for proposed timber removal in spring 2018: Environment and Climate Change Canada (ECCC) has been contacted regarding our proposed project. So far, our inquiry has been passed amongst several people but we have yet to receive any information or answers. We will continue to follow-up with ECCC.
5. Provincial permits for proposed timber removal in spring 2018: To be pursued once we have agreed on the contractor (potentially FNFN) for treatments.

LITERATURE CITED

- Culling, D. E., and B. A. Culling. 2014. BC boreal caribou implementation plan: 2013-2014 field activities progress report. Diversified Environmental Services, Fort St. John, BC.
- Culling, D. E., and B. A. Culling. 2016. BC boreal caribou implementation plan: Year IV 2(015-2016) field activities progress report. Diversified Environmental Services, Fort St. John, BC.
- Dickie, M., R. Serrouya, C. DeMars, J. Cranston, and S. Boutin. 2017. Evaluating functional recovery of habitat for threatened woodland caribou. *Ecosphere* 8:e01936.

APPENDIX A: GPS COORDINATES

Table A 1: GPS coordinates of candidate seismic lines identified during an aerial survey conducted 3 – 4 October 2017 within northeast British Columbia. “X” refers to the Easting coordinate and “Y” refers to the Northing coordinate within the UTM system.

Line ID	LENGTH (m)	START_X	START_Y	MID_X	MID_Y	END_X	END_Y	BEARING	Access Road
1	2383	523785	6511450	523794	6510259	523803	6509067	180	Clarke
2	1076	525494	6509881	524956	6509877	524419	6509873	270	Clarke
3	1337	528349	6510123	528348	6510792	528347	6511460	360	Clarke
4	1013	531405	6509985	531015	6509661	530624	6509338	230	Clarke
5	1729	533943	6511407	533913	6512269	533886	6513133	358	Clarke
6	1610	538210	6506877	538194	6507663	538182	6508468	359	Clarke
7	1140	540533	6502953	539964	6502971	539394	6502990	272	Clarke
8	1425	541344	6495152	542057	6495162	542769	6495172	89	Clarke
9	1791	541638	6491250	542532	6491261	543428	6491263	90	Clarke
10	1239	558470	6464330	557990	6463938	557512	6463544	231	Klua
11	779	559488	6462734	559866	6462640	560244	6462547	104	Klua
12	1207	560881	6460388	561187	6459869	561494	6459349	149	Klua
13	1259	560931	6459114	561559	6459072	562187	6459029	94	Eskai
14	758	563510	6467738	563496	6468112	563486	6468488	358	Elleh
15	2202	562288	6468795	562255	6469883	562230	6470975	358	Elleh
16	1322	560808	6470411	561469	6470394	562129	6470376	92	Elleh
17	900	560410	6474951	560860	6474961	561310	6474966	89	Elleh
18	1978	559805	6477817	558817	6477773	557829	6477730	267	Elleh
19	1921	560682	6481059	559721	6481039	558761	6481018	269	Elleh
20	1921	560224	6482330	559263	6482312	558303	6482295	269	Elleh
21	2036	560341	6482871	559323	6482867	558305	6482862	270	Elleh
22	1437	565255	6488916	564536	6488922	563818	6488927	270	Elleh
22	2041	566665	6494007	565714	6494377	564763	6494747	291	Elleh
23	2622	566119	6500992	567429	6501020	568740	6501048	89	Elleh
25	1500	565852	6509306	565115	6509292	564378	6509289	269	Elleh
26	1375	565429	6511690	564763	6511683	564076	6511674	269	Elleh
27	2068	498898	6541801	497865	6541809	496831	6541818	270	Ft Nelson core
28	2551	494345	6548365	493112	6548041	491878	6547717	255	Ft Nelson core
29	3192	493763	6548212	493476	6549782	493159	6551345	349	Ft Nelson core
30	2016	503631	6544350	504189	6543511	504748	6542671	146	Ft Nelson core
31	1437	532598	6560250	532347	6560923	532096	6561596	340	Deer River
32	2036	528831	6561005	528838	6562023	528844	6563041	0	Deer River
33	1454	510528	6565628	510495	6566354	510461	6567080	357	Deer River
34	1591	508502	6565629	508502	6566425	508503	6567220	0	Deer River
35	1435	506746	6566202	506713	6566918	506679	6567635	357	Deer River
36	1509	494301	6567571	494310	6568324	494304	6569078	0	Deer River

Line ID	LENGTH (m)	START_X	START_Y	MID_X	MID_Y	END_X	END_Y	BEARING	Access Road
37	2657	484334	6569665	484759	6570924	485185	6572183	19	Deer River
38	1309	493286	6593999	492979	6594577	492673	6595155	332	Windflower
39	1399	493503	6593877	493838	6594492	494173	6595106	29	Windflower
40	2981	494704	6592483	495228	6593878	495752	6595273	21	Windflower
41	1698	499965	6594276	500679	6593816	501392	6593356	123	Windflower
42	1646	502185	6593935	501913	6593158	501642	6592381	199	Windflower
43	1549	503721	6594093	504334	6593619	504946	6593145	128	Windflower
44	1555	505617	6594511	505339	6593785	505062	6593058	201	Windflower
45	1079	509514	6594443	509583	6594978	509652	6595513	7	Windflower
46	2255	531718	6629102	531720	6627975	531722	6626848	180	Tatoo
47	721	512324	6629015	512336	6629375	512348	6629735	2	Tatoo
48	1283	509333	6628551	509318	6629192	509302	6629834	359	Tatoo
49	1940	506929	6628297	506907	6629259	506905	6630229	359	Tatoo
50	1621	496496	6628817	496445	6628008	496395	6627199	184	Tatoo
51	1579	453767	6612991	454556	6612984	455345	6612978	90	Patry Main
52	1448	459147	6599825	459861	6599858	460585	6599866	88	Patry Main
53	1854	461759	6593403	460968	6593886	460177	6594370	301	Patry Main
54	2397	462546	6588465	461912	6587447	461278	6586430	212	Patry Main
55	1407	544065	6514932	543750	6514303	543435	6513674	207	SYD
56	1513	550580	6513403	550574	6514160	550567	6514916	360	SYD
57	1676	551338	6513162	551356	6513999	551374	6514837	1	SYD
58	1924	554540	6512171	555217	6512855	555894	6513539	45	SYD
59	1561	559421	6510943	559320	6511701	559280	6512480	355	SYD
60	2146	565675	6512551	565934	6513592	566192	6514633	14	SYD
61	980	528130	6511439	528205	6510983	528287	6510500	170	Clarke

APPENDIX B: ADDITIONAL MAPS

Additional maps of the locations of candidate seismic lines identified during an aerial survey conducted from 3 – 4 October 2017 in northeast British Columbia.

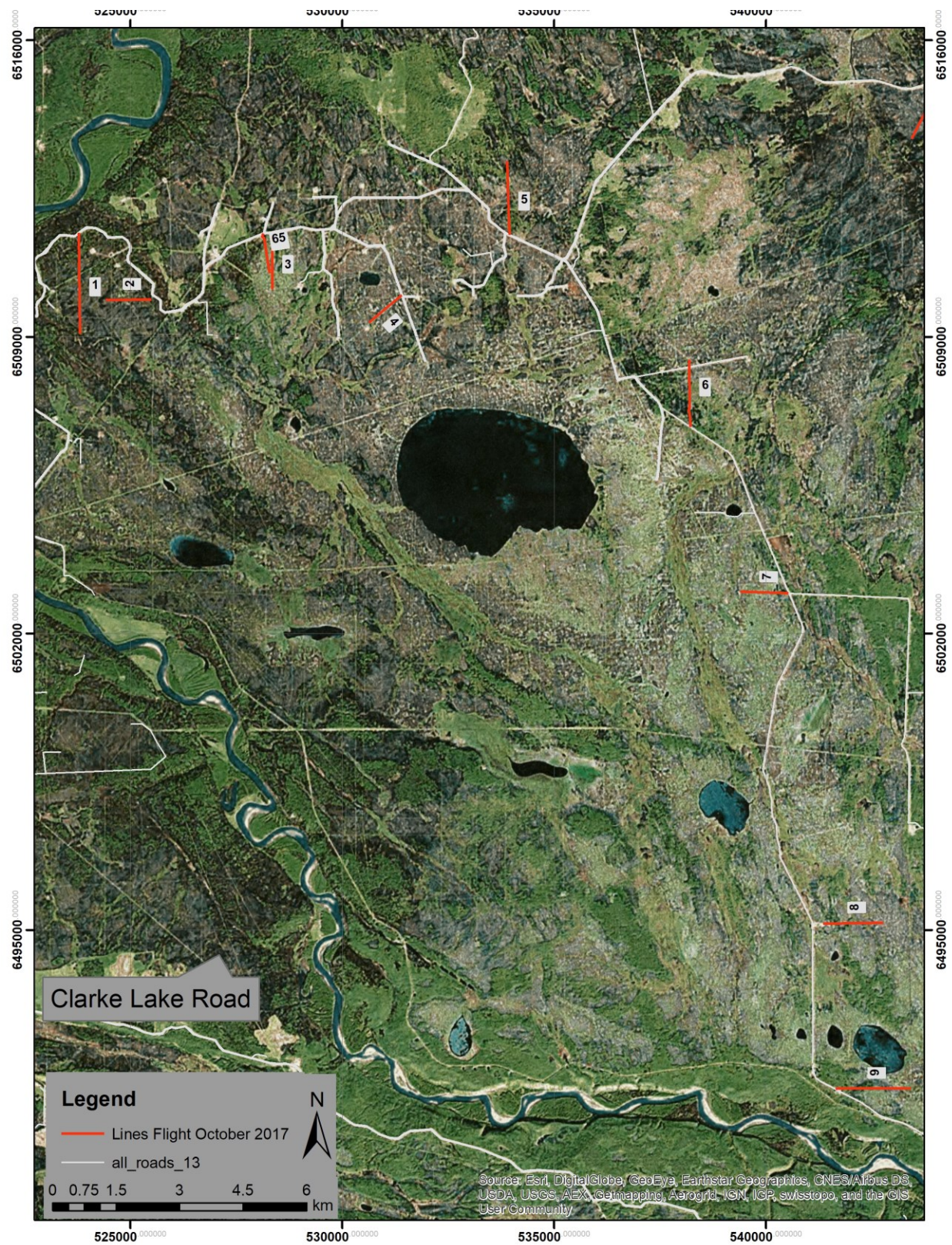


Figure B 1: Candidate seismic lines identified in the Clarke Lake Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.



Figure B 2: Candidate seismic lines identified in the Elleh Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.

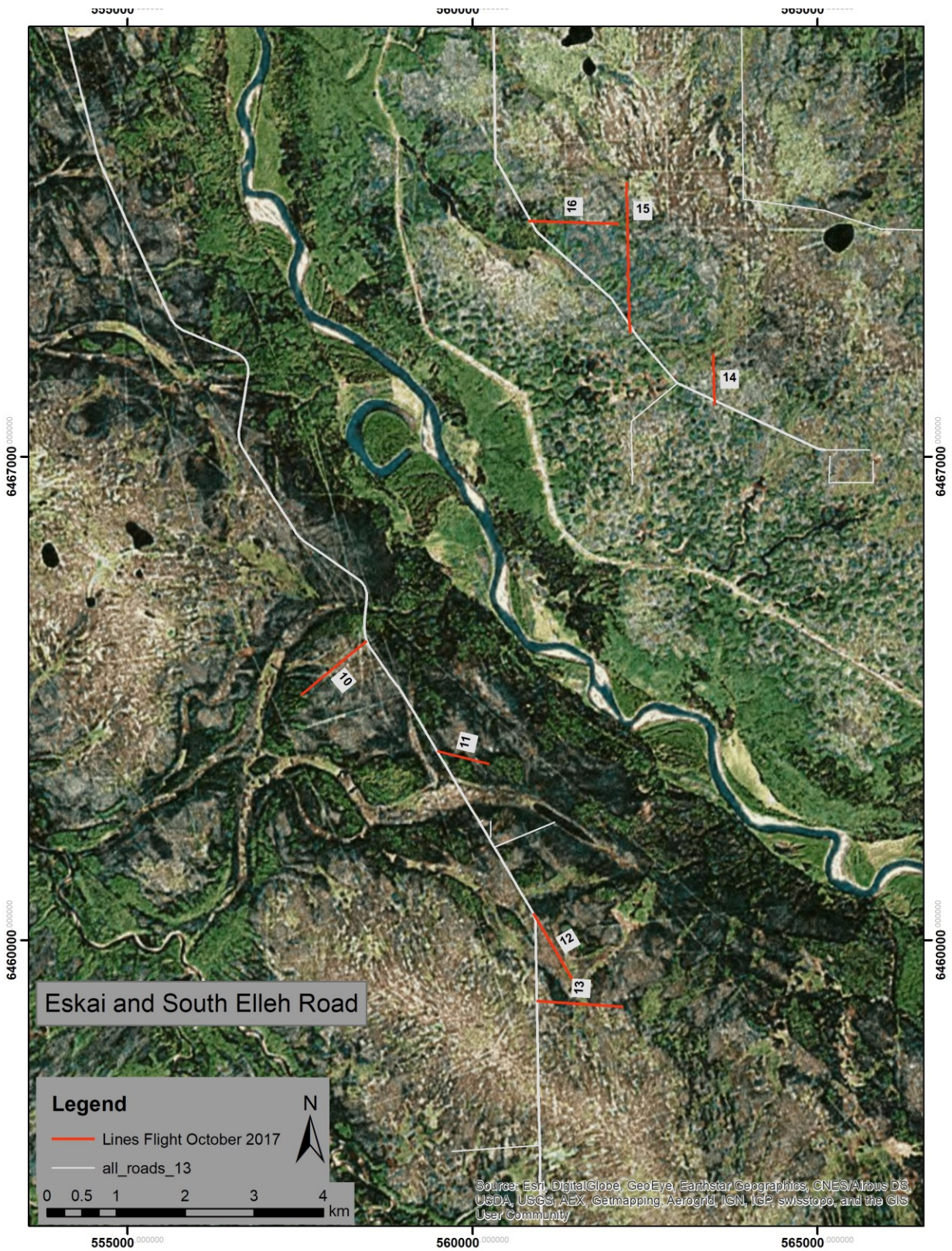


Figure B 3: Candidate seismic lines identified in the area of the Eskai and South Elleh (61) Roads during an aerial survey conducted 3 - 4 October 2017 in northeast BC.

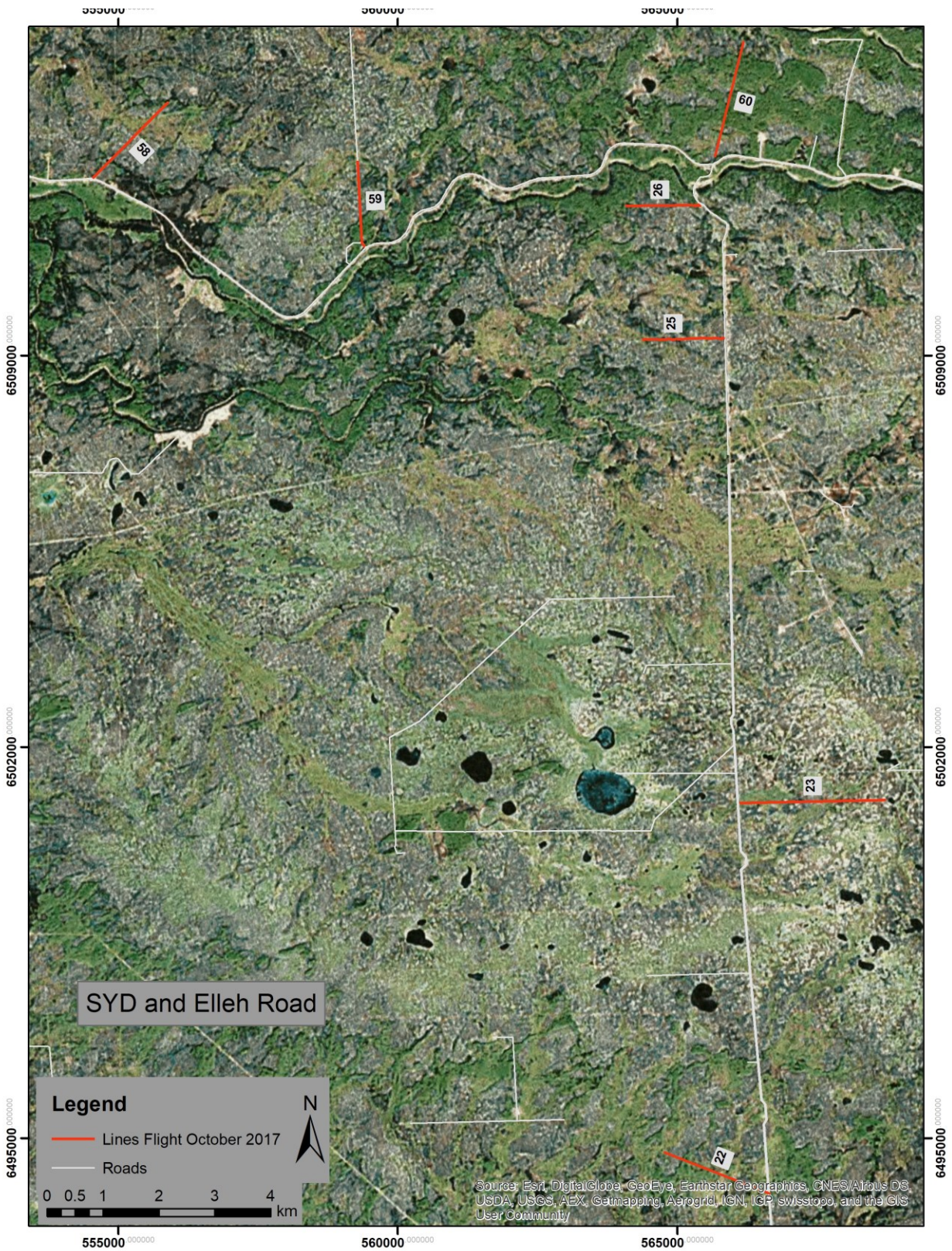


Figure B 4: Candidate seismic lines identified in the area of the SYD and Elleh (61) Roads during an aerial survey conducted 3 - 4 October 2017 in northeast BC.

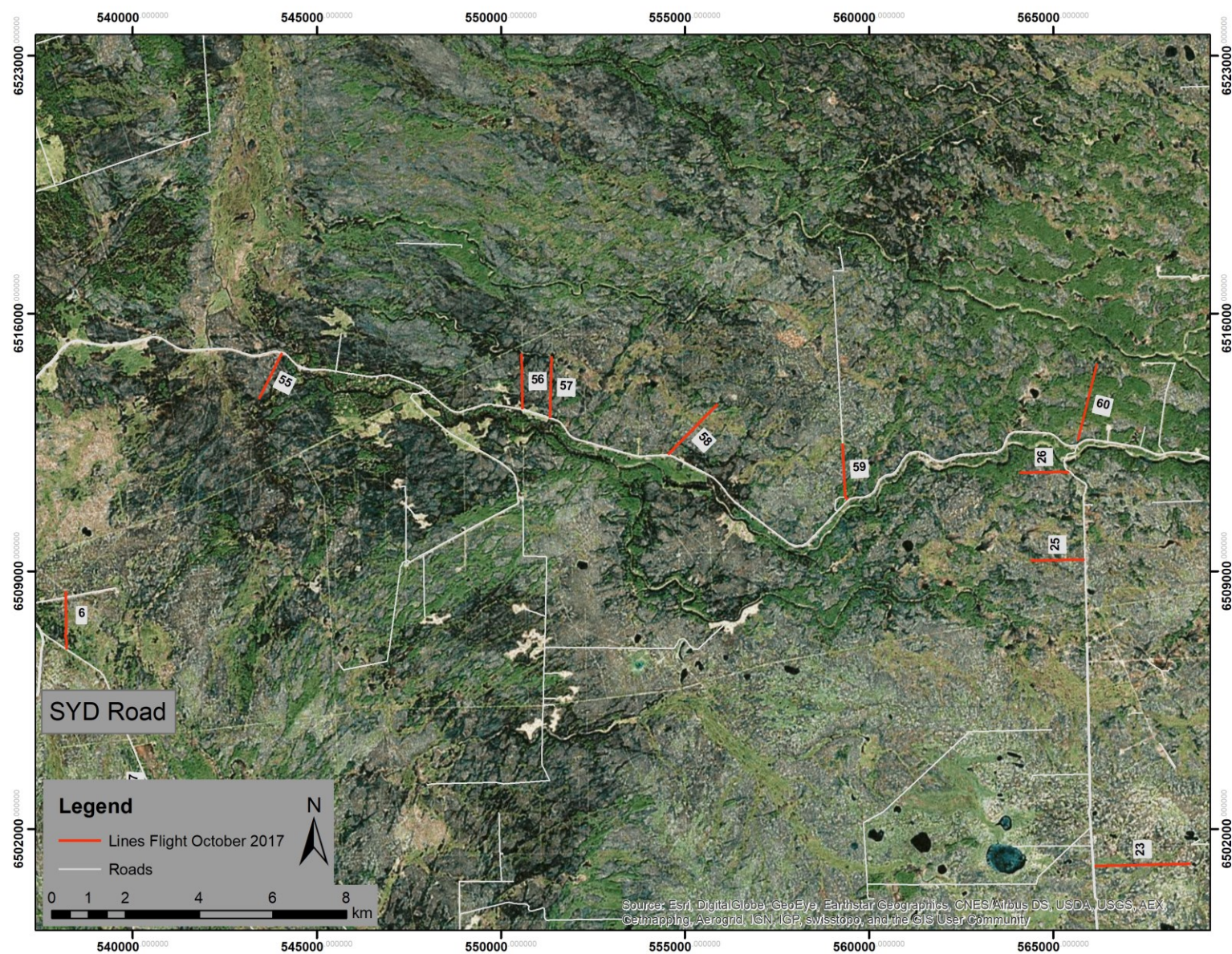


Figure B 5: Candidate seismic lines identified in the SYD Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.

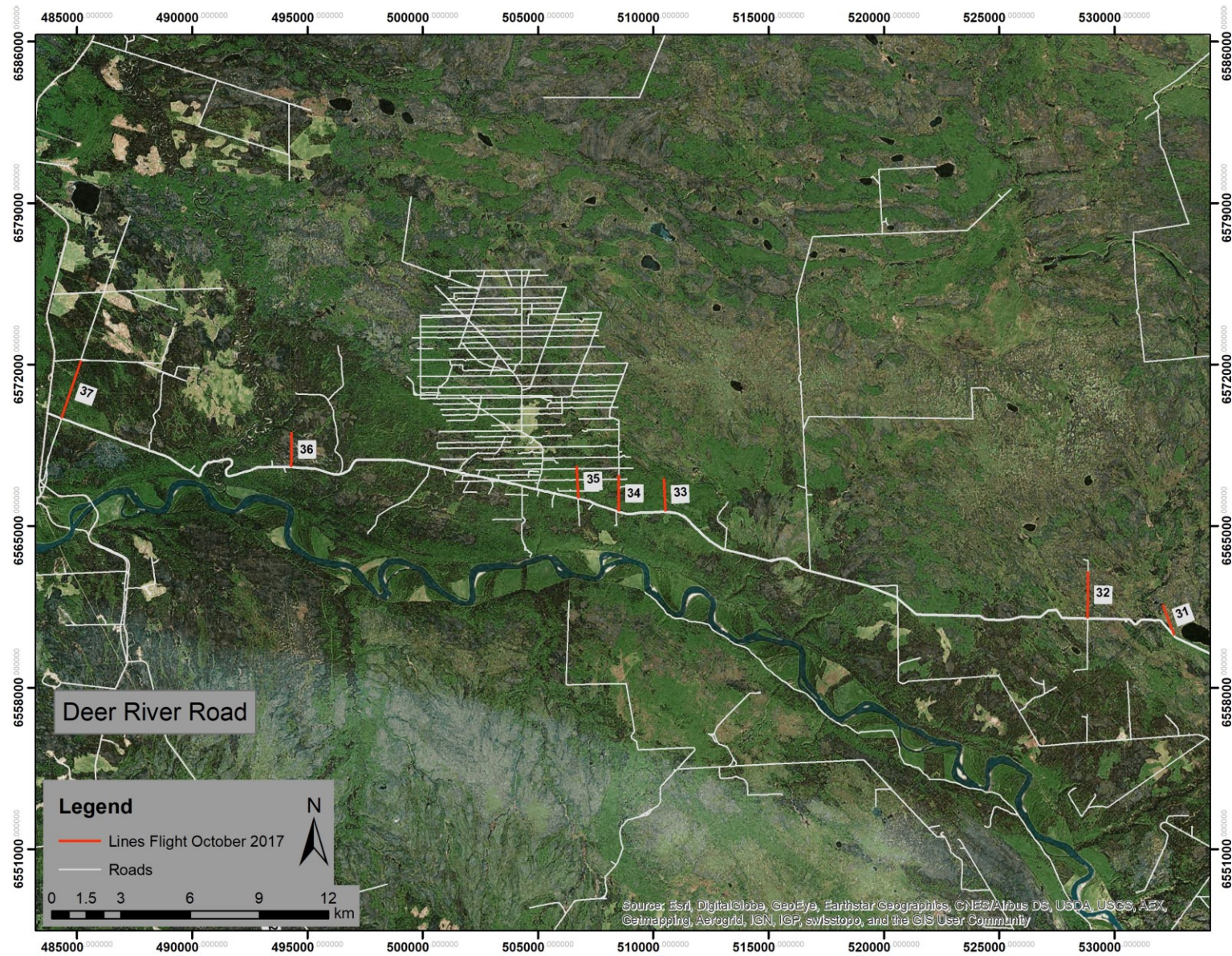


Figure B 6: Candidate seismic lines identified in the Deer River Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.

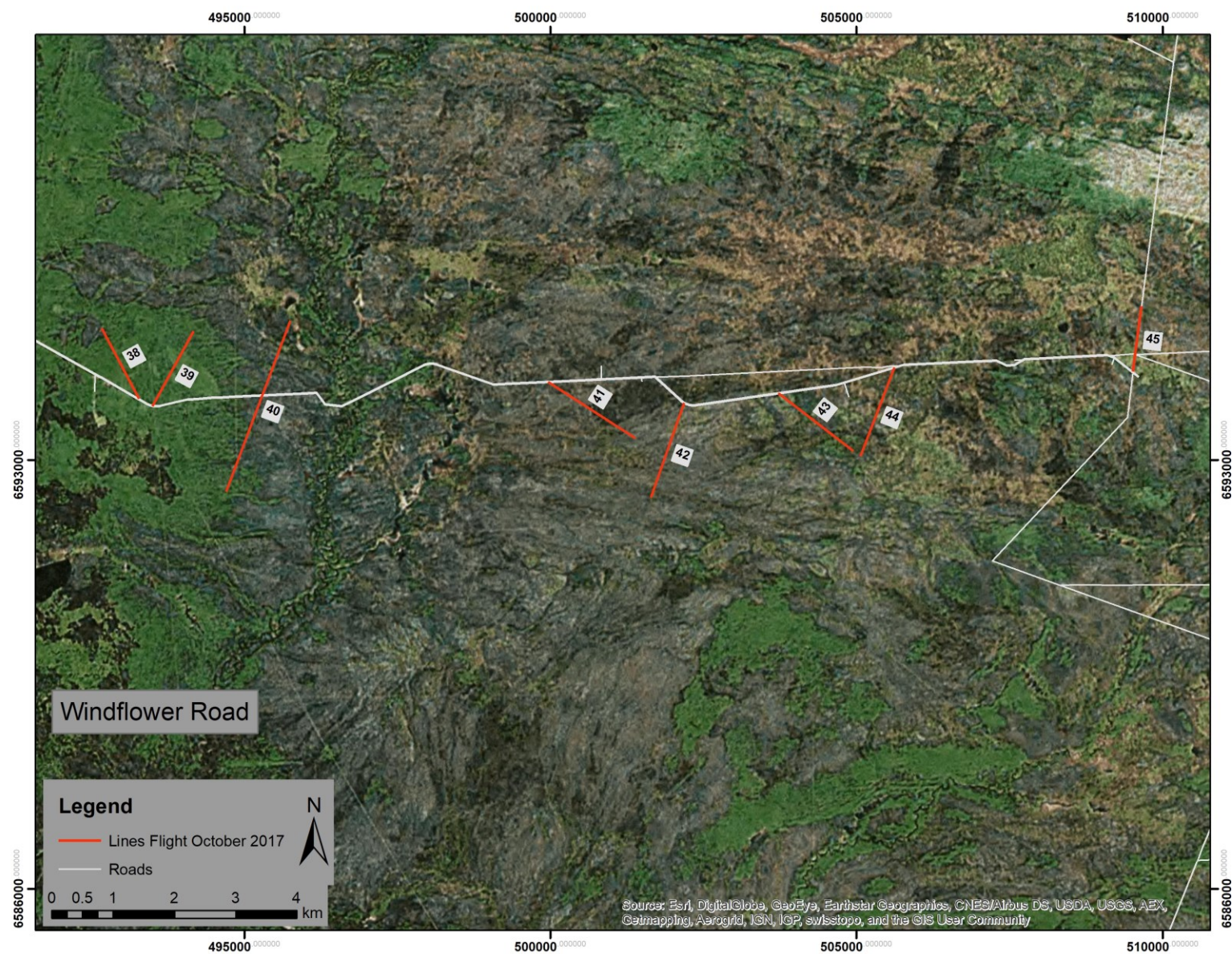


Figure B 7: Candidate seismic lines identified in the Windflower Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.

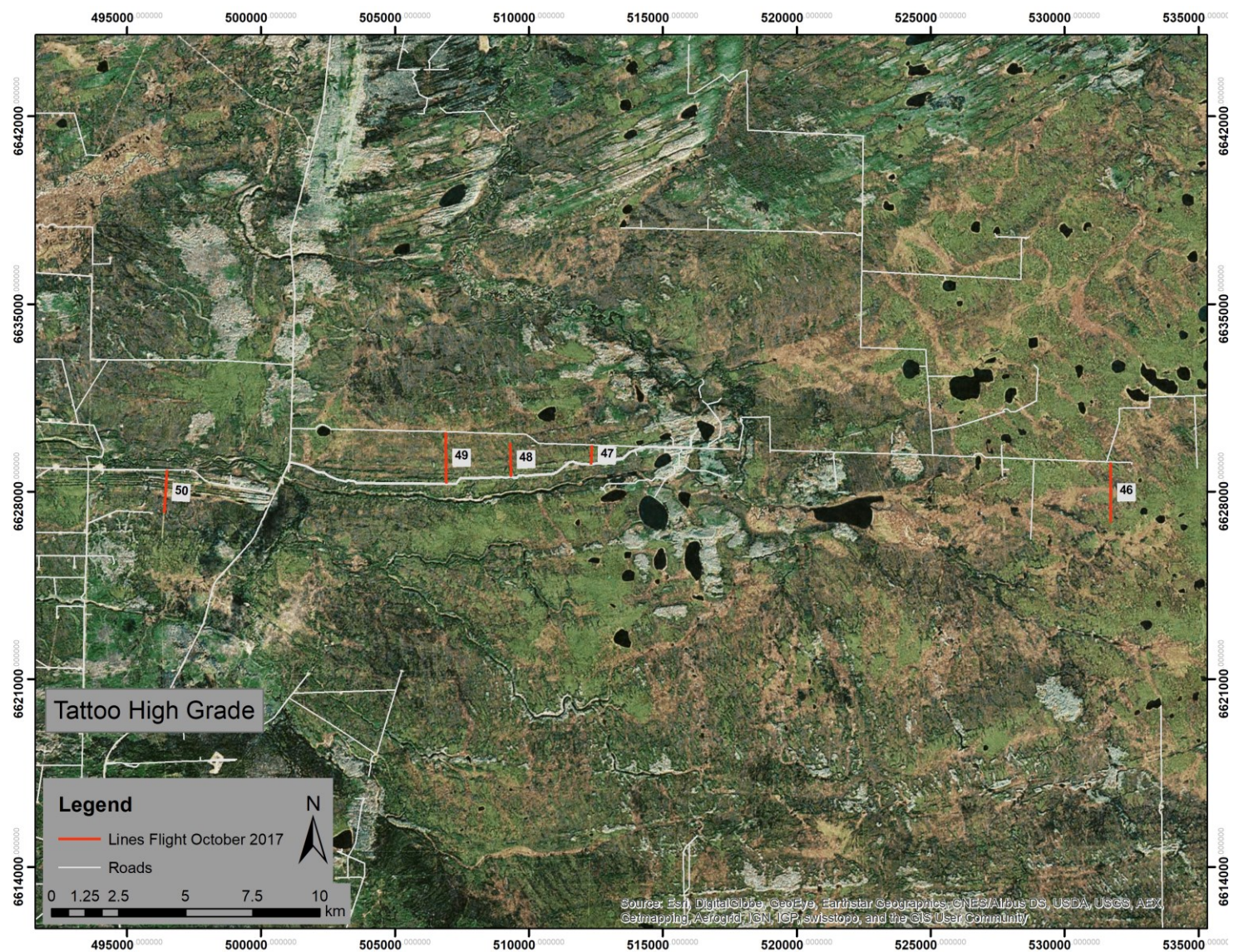


Figure B 8: Candidate seismic lines identified in the Tatoo High Grade Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.

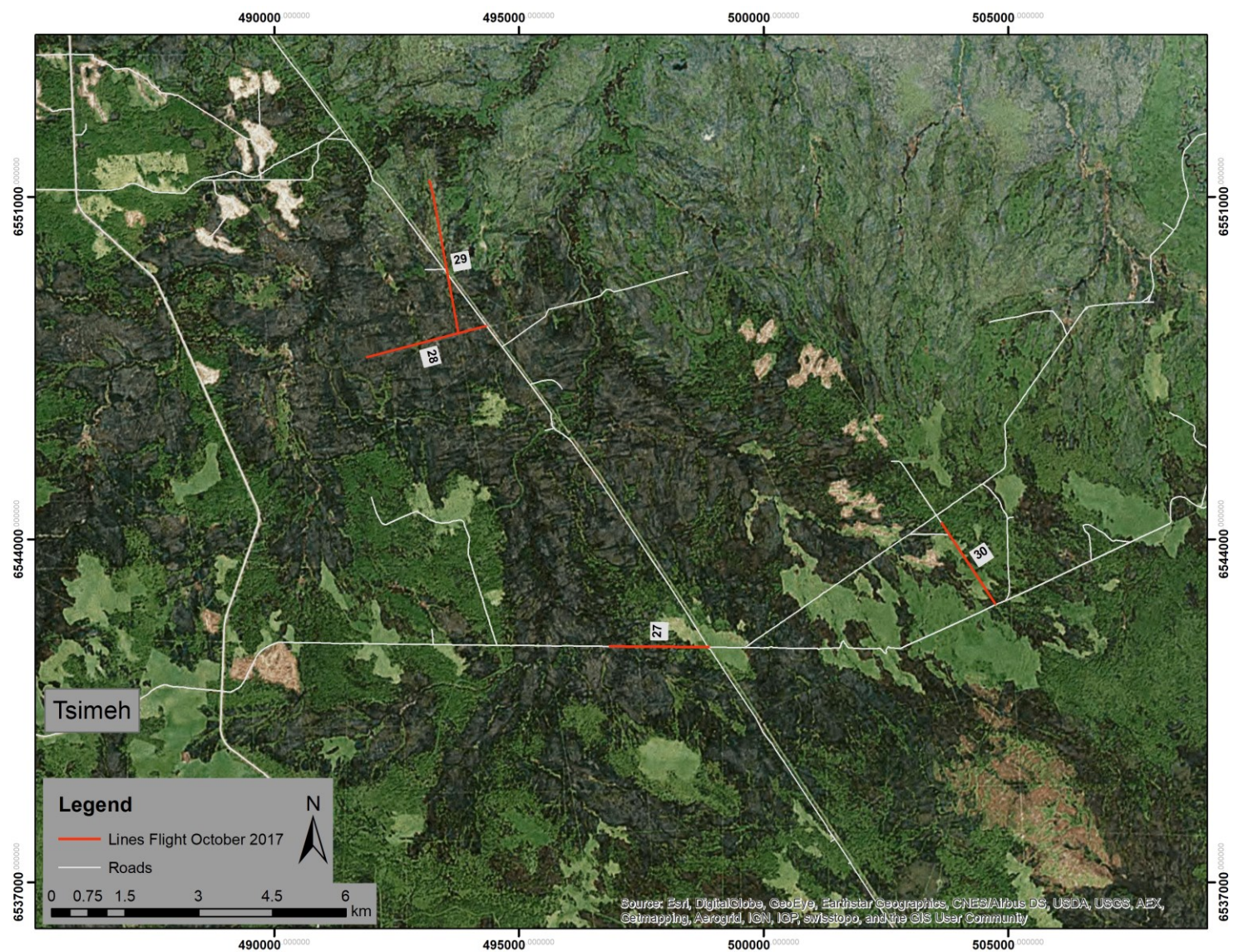


Figure B 9: Candidate seismic lines identified in the Fort Nelson caribou core area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.



Figure B 10: Candidate seismic lines identified in the Patry Main Road area during an aerial survey conducted 3 - 4 October 2017 in northeast BC.