Methods and Results for
3D Seismic Ecological Recovery Attribution

TECHNICAL MEMO

Submitted to:

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1.0 BACKGROUND

This technical memo outlines the unique methods and results associated with the mapping of 3D seismic line attributes for ecological recovery. The details in this document expand on the similar approach presented in the report recently completed for the 2D seismic line project which covered the broader NE BC study area. The approach steps that differ from the core procedure described in the report are described below. (Refer to: 2D_SeismicRecoveryMapping_Summary_Report.pdf)

Refer to the BCER_Operational_Database_3D.gdb that accompanies this memo with the feature class (map layer) entitled SEISMIC_LINES_3D_20230418 containing 18,546 records. Each record defines a portion or segment of seismic lines that have been split into segments at visible changes in vegetation cover (as described below). The seismic lines used for this project were sourced from HV1CSeismicLinesMoreCuts file provided by Jacqueline Howard, Environment Management Specialist, BCER, which contained additional attributes primarily derived from VRI polygons.

2.0 METHODS

The following methods describe steps applied to the 3D seismic line mapping.

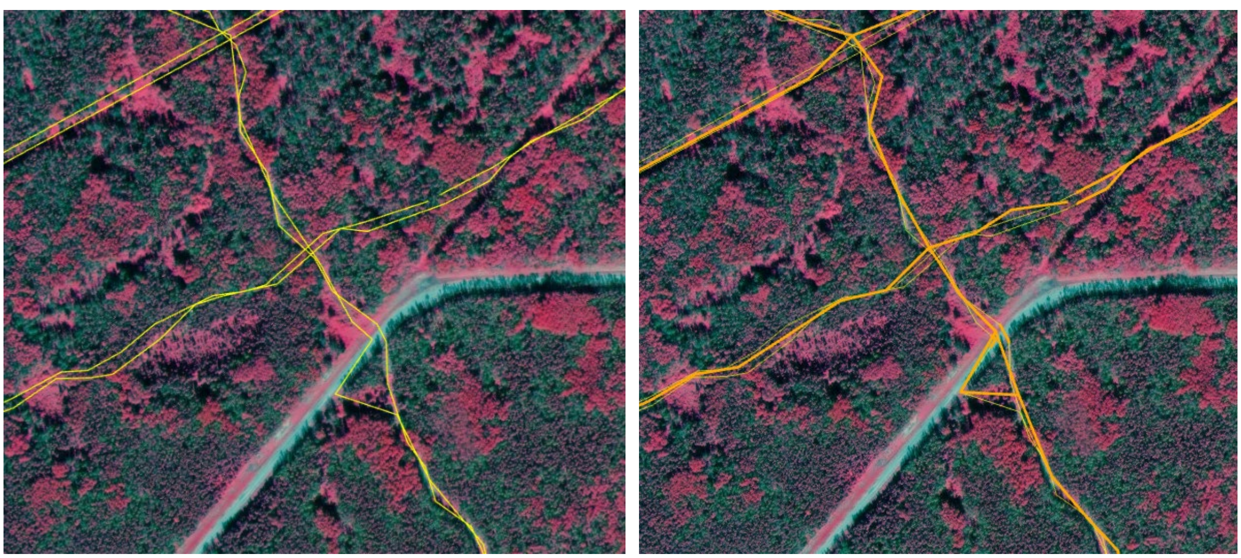
1. Unlike the 2D seismic ecological recovery project, where it was too large a study area, with too many lines to develop an image-based approach to cutline segmentation, this project had smaller extents and lends itself to a more robust segmentation approach. Caslys applied the same techniques as for the 2D lines to merge the line segments into longer lines based on continuous semi-parallel connectivity, which breaks lines that make hard turns, but dissolves line features together where they continue along a relative straight unbroken path. Using these longer lines, we then intersected the cutlines with polygons derived from an automated segmentation routine that was applied to the MAXAR image data. Overall, this approach does not rely on the precision of VRI mapping to define vegetation breaks, but instead uses actual high-resolution imagery that clearly depicts vegetation change and is of the same date as our ecological recovery assessments. We feel that this altered approach is an improvement that is feasible for the 3D cutlines.

Figure 1 – Automatic Segmentation of Cutlines

2. Our review of widths leveraged the actual documented widths of each cutline. Our interpreters were aware of the documented width when assigning width classes and only deviated from those width values when obvious exceptions were visible. The purpose this serves is that when a line appears very close to 3 metres wide, we might see that (for example) a width of 3.8m would be assigned to the class '3-7m' wide, while a documented width of 2.6 metres would be assigned to the 'less than 3m' class. Our team used the imagery to define width classes that were obviously different than the documented values for whatever reason.

3. There were a series of areas where multiple (usually 2 or 3) separate cutlines from the source data represented the same feature in the imagery. Prior to building the final line segments for ecological recovery assessments, geoprocessing was completed to first merge these lines into a single path that represented the cutline location. The task was completed using the 'integrate' function in Esri ArcGIS Pro. The figures below illustrate an example of the output of the function that merged the multiple lines together into a single line. The duplicate lines (shown left) within the source linework follows the same physical cutline noticed within the imagery, and the results of the geoprocessing (right) show the new lines in orange, with the original lines in thinner yellow. Notice an area where the lines deviate from each other to form a triangle near the road. In this area, the linework is far enough apart to be considered different lines, even though we think this specific case may be an artifact of poor digitizing in the original data capture. Regardless, both routes around this triangle have been assessed for ecological recovery.

Figure 2 - Seismic Line Conflation



4. Alternate use classification was performed slightly differently from the 2D assessment. Because of the small study area and relatively compact overlap between seismic lines and alternate use features (cutblock, wildfires, oil and gas infrastructure), alternate use codes were automatically applied to seismic line features that had a relevant overlap with these alternate use source features. All these overlaps were manually reviewed to validate that the attribution was accurate. The selection of the overlaps was performed using the methods explained in the full 2D seismic ecological recovery report, including the use of data comparisons between the seismic line disturbance and the alternate use disturbance.

5. In the original 2D assessments, clustering was used to extrapolate ecological recovery codes across the large dataset, but due to the smaller size of this study area, it was not used, and all line features were manually assessed. While the tiered spatial twinning approach used to develop micro and macro clusters is ideal for large datasets, the time involved to setup and manage this method has diminishing returns. For this evaluation, it was more efficient to remove the overhead of creating clusters and assign interpreters to manually work through all of the records.

6. There was a small section of segments that were provided in the source data but were excluded from the results based on date attributes. A portion of the source data was dated as 2021 seismic lines, but due to the date of the imagery, these lines were not visible and could not be assessed. Any 2021 lines that also had coincident data from other dates were retained. (i.e., an area where a 2009 and a 2021 cutline both follow the same general path the line is retained.)

3.0 DISCUSSION

In general, the photo interpretation confirmed that many 3D lines are less than 3 metres across when cut, and in many cases, the lines appear to have recovered (or never to have been cut). One of the challenges with narrow cutlines is that it can be difficult to see into the shadows in tall forest. All of the challenges with shadow documented for 2D lines are magnified with narrower cutlines. Regardless, there are plenty of useful calls made where we could identify significant recovery of canopy, or cases where canopy has not recovered, or where various alternate uses exist. These results provide useful information to support restoration planning.

4.0 RESULTS

The total dataset consisted of 18,546 line segments; many lines fall under various alternate uses, with the majority (3,462 segments) falling into forestry cutblock disturbances. As well, 1,575 segments we classified as Not Visible (coded NV). Of the 10,043 records recorded as numeric codes with a width and level of tree / shrub canopy, the largest group was classified as less than 3 metres wide with the highest degree of tree canopy (i.e., uniform or continuous coverage; coded as 39) with 3,606 records. The next largest group was also classified less that 3 metres wide, but with patchy to near continuous canopy coverage (coded as 355) and 1,081 records. Only 12 records were classified with a width wider than 7 metres (coded as 7). Unlike the 2D seismic results, most records between 3 and 7 metres wide are closer to 3 metres than they are to 7 metres wide. It is evident from the results and the interpretation process that narrower width lines used in 3D assessments are very commonly attributed with uniform and/or continuous canopy coverage (coded as 9). All results can be found in the accompanying geodatabase in the feature class entitled SEISMIC_LINES_3D_20230418.