Karst Potential Assessment Lower Salisbury Face

For

Cooper Creek Cedar Ltd.

Introduction:

As a response to local concerns, Mr. B. Kestell of Cooper Creek Cedar requested W. Halleran P. Geo of Apex Geoscience Consultants Ltd. to find out if Karst Terrain was either present within the area of the proposed development or could possibly be impacted by the proposed development. If during the review, significant Karst Topography was discovered, a Karst Vulnerability Assessment would be conducted by qualified personnel.

The Karst Inventory Standards and Vulnerability Assessment Procedures for British Columbia describes three distinct levels for conducting karst inventories and vulnerability assessments.

1) the reconnaissance-level inventory (typically at 1:250 000 map scale);

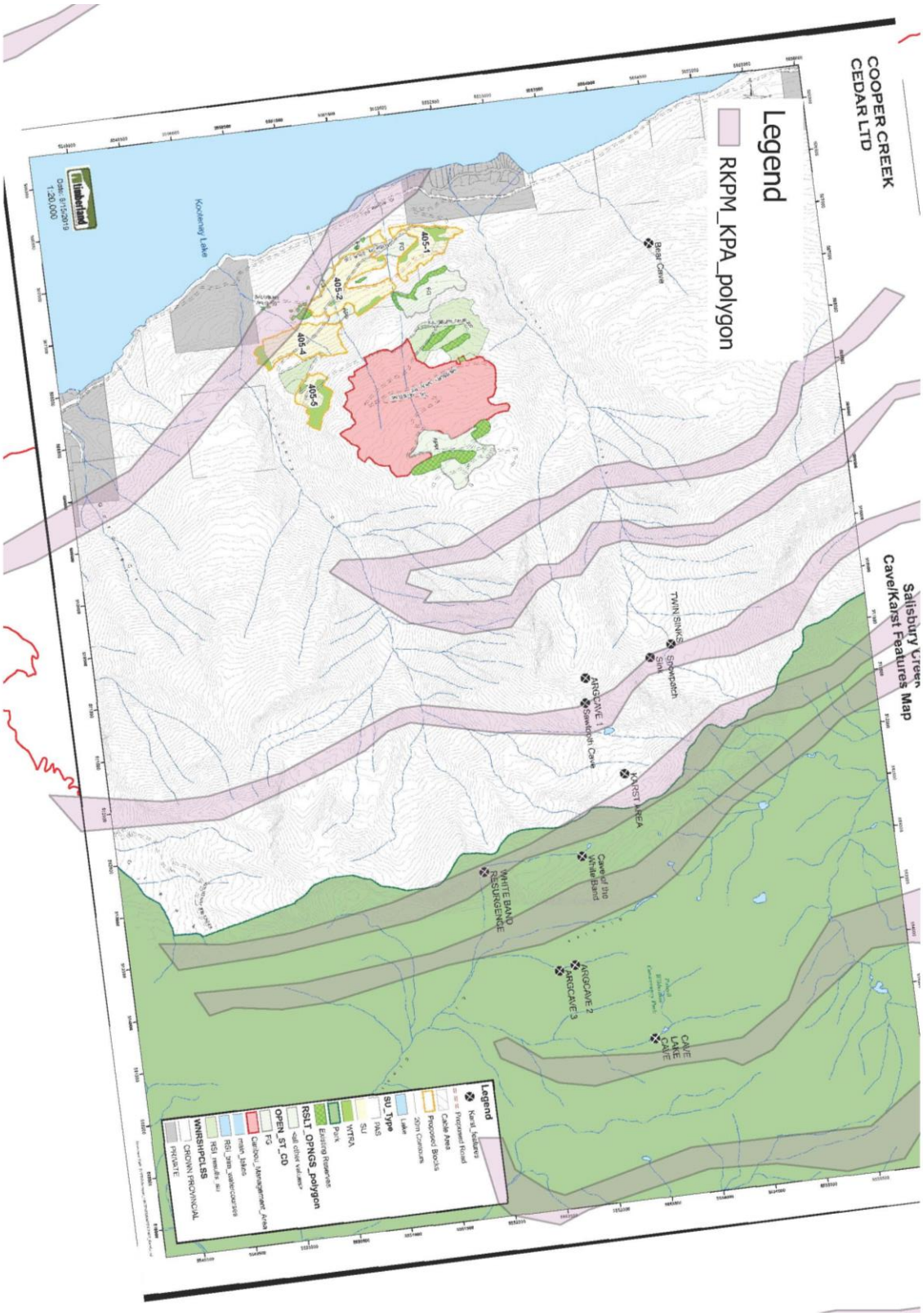
2) the planning-level inventory and vulnerability potential mapping (typically at 1:20 000 or 1:50 000 map scales1); and

3) the karst field assessment2 (KFA) and vulnerability assessment (typically at 1:5000 or 1:10 000 map scales).

Office Review.

Potential Karst Areas shapefile, as delineated by the government reconnaissance level potential mapping, was downloaded and plotted on 1:50,000 scale map (figure #1). Known karst features and cave locations (as provided by CCC) are plotted on figure #1 as well. The areas delineated as areas of karst potential and areas of known Karst features correspond with the Badshot/Mohican Limestone. Apart from the southwest corner (405-2,4), the proposed development is outside the area deemed to have potential for Karst development. This satisfies the 1st level of assessment as described in the Standards.

Figure 1 Karst Potential Areas



The Salisbury Area was field assessed as part of the 2004 report, *Karst Inventory and Karst Assessments for East Kootenay Lake Region-B.C. Timber Sales, Kootenay Business*, completed by Tim Stokes of Terra Firma Geoscience Services. Mr. Stokes reported that there were no Karst features, and minimal possibility of karsts due to limited extent of carbonate units, in the area of the proposed CP 405 development. Mr. Stokes rated the area underlying the reconnaissance delineated Karst Potential Area in the southwest corner (405-2,4) as having a Low Karst Vulnerability Potential due to the thick surficial deposits overlying the southwest corner. (This would satisfy the 2nd and 3rd level of assessment according to the Standards)

After Mr. Kestell was informed of the results of the office review, he requested that Apex Geoscience conduct a field review to confirm the Terra Firma Geosciences Services conclusions.

Methodology

On Sept 24 and 25 2019, W. Halleran P. Geo geologically mapped the area, carbonate units were gpsed and plotted on lidar imagery. The strike trace of the units was traversed to locate any dissolution and/or karst features. Preliminary results were communicated to Paul Griffiths for confirmation of the conclusions.

Observations:

Geology:

The proposed development area is predominately underlain by the Lardeau Formation. In this area this formation is an interbedded sequence of Phyllite (schist) and Quartzite with occasional thin beds of carbonates. Carbonate beds are discrete zones that pinch out along strike, either by thinning out or interfingering with phyllite (and to a lesser extent Quartzite). The carbonate beds are usually less than 2m thick. There is local variability in the strike (folding and convolutions) but the strike is generally ~170^{o}, with very steep (subvertical ~80^{o}) westerly dip. This Formation is stratigraphically above the Badshot Limestone (which is up to 100's meters thick), but the sequence is repeated due to thrust faulting.

Glacial scouring of the slope selectively removed the phyllite leaving the Quartzite as small ridges. Flutes were formed along strike, sub-parallel to the slope contours. The quartzite units likely act as an aquitard to downward flowing ground water, and as barriers for downslope flowing surface water.

Geological mapping of the project area located seven, less than 2m thick, carbonate units (Figure #2). The bands varied from limestone (~90% carbonate) to interbedded micritic phyllite (~ 40% carbonate). These units were walked along the strike projection to locate any karst features. The carbonate units are often located within the flutes formed by the scoured phyllite.

Within road cuts, the limestone units displayed some dissolution along jointing planes. The interbedded units showed preferential dissolution along limey beds.

Two areas of small pits (Area #1 and #2) that could possibly be sinkholes were located. The features were small and closed off (filled with soil), both areas were in dry swales (no flowing streams). No other features were noted along strike of the other carbonate units.

Area #1 (site Kar 39 to 40): This site was mis plotted by the layout crew at site Kar 16 (when I met them in the field). The sinkhole at Kar 39 is 2m wide, 2m deep and 4m across. There are two small sinkholes in a "wet" area, (devil's club) at station 40, the holes are about 1m wide and 3m long (elongated along jointing -likely fracture crevasse). The sinkholes are filled with forest floor, limestone is exposed on the sides. The two sinkholes are contained in a 10m radius area. Flags were hung 1 tree length away from the perimeter.

Area #2: (Kar 58): At this location the limestone bed becomes wider and forms a bit of a rise on the west. Just off the rise is a sharp sinkhole, 2m deep, 2m wide (north south) and 5m long (east west). The bottom of the hole is filled with forest floor, when a branch was pushed into the bottom it was stopped by roots and no soil was brought up. Limestone is exposed on the south side. This sinkhole appears to be at the head of a swale, the swale was followed out to boundary with no further features noted.

Conclusion:

I agree with Mr. Stokes assessment that there is no potential for significant karst due to the limited extent of the carbonate units. The possible sink holes (areas #1 and #2) do not have significant surface water flowing into them and appear to be closed off limiting the possible impacts of timber harvesting. When this information was communicated to P. Griffiths, he agreed that Apex's conclusions were reasonable.

Recommendations:

A perimeter, marked by flagging, was hung one tree length away from the possible sinkhole areas. To avoid any impact to the possible sinkholes and for operator safety it is recommended that there a “no machine zone” 1 tree length from edge of the features as delineated by the flagging is implemented.

Respectfully Submitted,
Apex Geoscience Consultants Ltd.

Will Halleran

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Figure 2: Carbonate units strike trace