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Memo: Drainage planning, Tisdale Developments Ltd., Tisdale property, PID 028-270-304.

Att: Paul Turner

On November 9, 2015 Cordilleran reported on land development and stream channel impacts that had occurred at the Tisdale site in 2014, and on subsequent flooding in December 2015 that affected Highway 99. Subsequent to the December 2015 flooding, mitigation measures were implemented by Steve Miles (Tisdale Developments) including cleaning the CN Railway culvert that drains the site. Since that time, Cordilleran is not aware of further flooding problems affecting Highway 99.

On October 13, 2023, Pierre Friele (P. Geo., Cordilleran) visited the site in the company of Paul Turner (Tisdale Developments), Steve Miles (Tisdale Developments), Peter Gordon (Cascadia Consulting) and Lori Bartsch, R. P.Bio., (Chartwell Resource Group Ltd). The purpose of the visit was to review the existing drainage conditions, and provide commentary on future drainage management with respect to site environmental restoration issues.

Observations

The existing drainage has been mapped by Cordilleran (Figure 1). The surface water inflowing to the site comes from two sources:

- 1) From the south, from other's private land located between CN Rail grade and Highway 99. This water source would be from both surface runoff and from subsurface drainage from the toe of Rutherford Creek fan which has been truncated by gravel mining allowing groundwater to daylight.
- 2) From the west and northwest, from dispersed groundwater and a small creek draining off the hillslope above the CN Rail grade. The dispersed hillslope sources are intercepted by the rail grade ditch, then conveyed through the rail grade by a 1200 mm diameter culvert at the southwest end of the property and by seepage at various sites along the length of the Tisdale property. The hillslope creek is conveyed through the rail grade by a 1200 mm diameter culvert at the apex of the eastward curve on the CN rail grade. This creek has formed a debris fan at the foot of slope immediately above the rail grade. The creek on the fan is unconfined and laterally unstable, and has recently shifted southwards from its normal position directly upslope of the culvert. There is evidence of piping erosion that undermines portions of the railway berm. Cordilleran understands that CN has a plan to mitigate seepage and piping erosion. Once completed, less water should reach the Tisdale property.

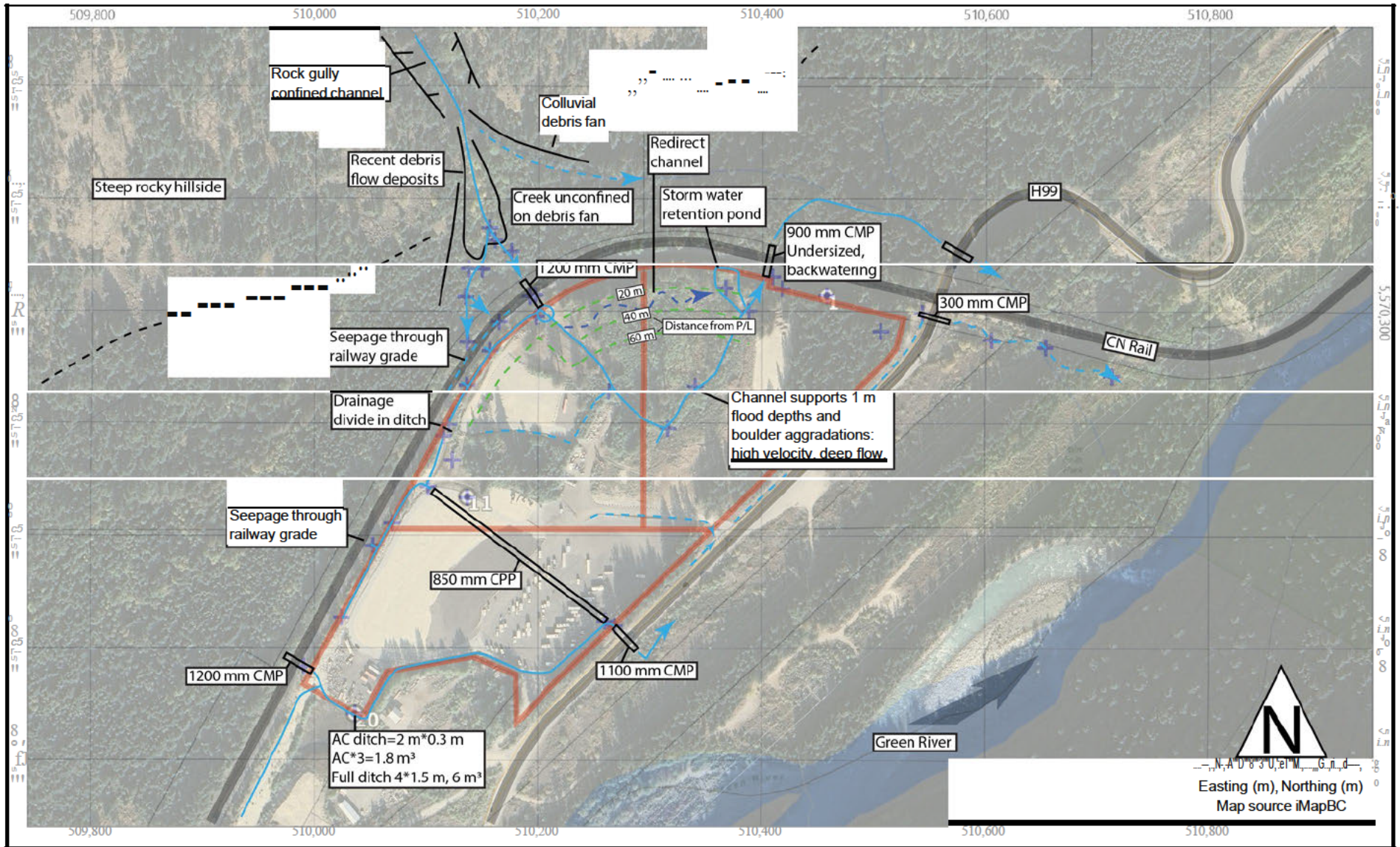


Figure 1. Map of the existing drainage conditions on the Tisdale Developments property, located near Pemberton, BC. The red lines delineate individual properties that make up the Tisdale site discussed in the text. Observations were compiled October 13, 2023.

The surface water outflowing from the site leaves via two culverts:

- 1) An 1100 mm diameter culvert under Highway 99, located about 400 m south of the CN rail crossing on Highway 99. This culvert takes all the incoming water from the adjacent property to the south and from the 1200 mm diameter inflow pipe located at the southwest corner of the site. On the south half of the Tisdale site, this water is managed by a south perimeter ditch and by an 850 mm diameter storm sewer pipe buried under the existing open storage area. The outflowing 1100 mm diameter culvert under Highway 99 has had no reported issues to date.
- 2) A 900 mm diameter culvert through the CN rail grade located ~150 west of the CN rail crossing on Highway 99. This culvert takes the water from seepage through the CN Rail berm and from the 1200 mm diameter culvert conveying the hillslope creek. The outflowing 900 mm diameter culvert was almost fully plugged by debris before the December 2015 flooding incident, but has since been cleaned by Tisdale Developments. However, it continues to backwater streamflow during heavy runoff events, requiring Tisdale Developments to accommodate backwatering by construction of an ephemeral pond that fills and drains slowly after the passage of the rainfall peak. This system appears to be functioning well.

Conclusions

In Cordilleran's opinion, it is not possible to conduct flood frequency analysis to assess the actual required culvert diameters. This is because much of the water entering the site is daylighted from groundwater, so the drainage areas contributing are not representative of the flow volumes experienced. As such, past performance is the best gauge of adequacy.

The drainage conditions on the south half of the property appear to be functioning adequately. However, it is apparent that on the north half of the property, the capacity of the 1200 mm diameter culvert conveying water onto the property is larger than the capacity of 900 mm diameter culvert conveying water off the property. That situation is out of the control of Tisdale Developments, as the inflow and outflow culverts are the responsibility of CN Rail. Assuming CN Rail will be leaving the culverts as is, then the existing inflow/outflow situation must be accommodated as is. The situation will be monitored after CN have completed their work within their right-of-way.

With respect to the existing path of the channel on the north half of the property between the 1200 mm diameter inflow and the 900 mm diameter outflow, it is evident that the channel was artificially created by machine excavation at some time in the past; it flows in a straight line ~200 m southwest to a 90 degree bend, and then ~200 m northwest to the 900 mm diameter outflow culvert. This configuration is not optimal for best use of the site, and it is not optimal from a habitat perspective as the southern riparian area is degraded by clearing and development. Also, if the creek were to remain in this position, then future maximization of land for development would require crossing the creek to access the remainder within the north side of the right-angle jog. This land contains the only mature vegetation on the property and would be partially cleared.

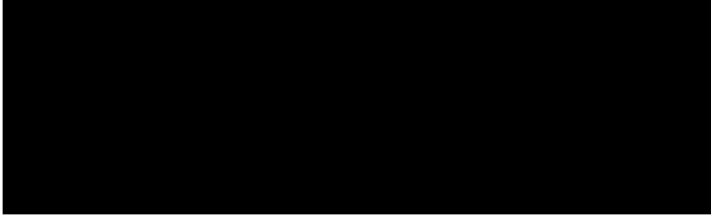
Recommendation

In Cordilleran's opinion, the best future drainage arrangement would be to realign the creek that crosses the north half of the property such that it follows a course through the remaining mature vegetation. This realigned course could be reconstructed to mimic a wandering natural stream planform, and could be done with minimal impact to the natural mature vegetation onsite, so as to provide a mature riparian condition and provide more shading for fish habitat.

Closure

This report was prepared for use by Paul Turner of Tisdale Developments Ltd., including distribution as required for purposes for which the report was commissioned. The report cannot be distributed to other third parties without prior written consent by Cordilleran Geoscience. The work has been carried out in accordance with generally accepted geoscience practice. Judgment has been applied in developing the conclusions stated herein. No other warranty is made, either expressed or implied to our clients, third parties, and any regulatory agencies affected by the conclusions.

Sincerely,



Professional Geoscientist
EGBC Permit to Practice: [Redacted]