# Jumbo Glacier Resort Master Plan

# Appendix 5-A

## Route Study and Proposed Road Upgrading

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# ROUTE STUDY REPORT

# FOR

# JUMBO GLACIER RESORT

# ACCESS ROADS

**2111 01243-1**

Prepared By:

McElhanney Consulting Services Ltd.

13160 - 88 Avenue

Surrey, British Columbia

V3W 3K3

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The information contained in this report has been prepared based on our review and discussions with you and should not be used or relied upon by any other person or organization without the written consent of McElhanney Consulting Services Ltd.

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# 1.0 BACKGROUND

The purpose of this route study is to provide the requested additional information on the access roads to the proposed Jumbo Glacier Resort, in support of the Project Report submitted to the Province.

In 1995, McElhanney Consulting Services Ltd. (MCSL) prepared a report entitled "Preliminary Access Evaluation Report", which evaluated the present condition of the existing access road in the Jumbo Creek valley. That report also addressed issues of current and future use of the access road, projected traffic volumes, and provided preliminary estimates to improve the road.

In December 1996, the Environmental Assessment Office released their "Draft Project Report Specifications", which were later amended to their final form in May 1998. These Project Report Specifications (PRS) further identified information required by the Proponent to support their project submission.

Since that time, numerous meetings have occurred with local interest groups and approval authorities, which has resulted in the need to provide additional information and clarifications in support of the PRS review. The PRS also requires the Proponent to evaluate the existing Toby Creek road from Panorama Resort to the Mineral King Mine. This section of road was not addressed in the original report prepared by McElhanney. The site location and existing access roads are shown on Figure 1.

Currently, access to the proposed resort is provided by the Toby Creek road from Panorama Resort to the Mineral King Mine site, where access is further continued along the Jumbo Creek Forest Service Road (FSR). The existing road conditions vary throughout its length, from what one could classify as a good Low Volume Road to an average gravel logging road in some sections.

Currently there are several creek crossings along the road varying from steel girder bridges with timber decks to steel pipe culverts for smaller crossings. Generally, the crossings are in good condition relative to the purpose they are serving. Several of the

structures have been load-rated, by others, and the limits vary from 10 tons to 60 tons. During completion of the route study, a site visit was conducted and the general conditions and functionality of each crossing were examined. With any new road alignment, selecting safe, functional and environmentally-friendly crossing locations will allow the route study to progress around numerous fixed points, namely the crossing locations.

The operational speed of the existing road varies, but would generally be classified as 50 kph, with several sections where this speed is not achievable for safe operation due to limited vision and narrowness of the roadway.

The proposed resort development will create added traffic volumes along these roadways, and therefore some improvements will be required to provide a safe and functional facility for all users.

The main focus of this route study was to investigate the design criteria listed in the PRS and to determine the functionality of achieving these criteria.

The route study generally focussed on the existing routes within both the Toby Creek valley and Jumbo Creek valley. Within these two valleys, current or recently deactivated routes exist on both sides of the creeks.

This allows the option of selecting alignments that extend the access from Panorama to the proposed resort site without crossing to the opposite side of the drainage, and this is the selected option by the Proponent for the Jumbo Creek drainage. The selection of the optimum alignment in the Toby Creek drainage should be made at the detailed study state, but an alignment that follows the north side of the drainage from Panorama to the Mineral King Mine is also feasible, eliminating all bridges.

# 2.0 SCOPE

The intent of this report is to identify road alignment options which give some consideration to the requested design criteria and speed, while providing a safe and functional access route for all users and at the same time balancing the overall costs of providing the improvements.

In order to limit the environmental impacts on the surrounding area, the route studies were focused along the existing access corridors which included the Toby Creek road, Jumbo Creek FSR and the abandoned FSR around the Mineral King Mine site.

The "Final Project Report Specifications" for the Environmental Assessment Report identified six key areas to be addressed in this report.

## 2.1 SECTION E.6(B) GENERAL PUBLIC USE OF THE ACCESS ROAD

*"In the project report:*

1. *The proponent must present a preliminary access management plan.*

2. *As a basis for its reporting under specification #1, the proponent must hold discussions with relevant government agencies (e.g. MoT, MoF and MELP), with affected First Nations, and with other interested parties, including the local heli-ski operator, the local guide / outfitter, affected trapline holders, snowmobiling interests, hunting and fishing interests, and other identified users of the area (if any). (Note – if any of the identified parties is unwilling to engage in these discussions, it is sufficient for the proponent to note this in the project report.)"*

   In response to this requirement, MCSL, along with the Proponent, met with representatives from the Ministry of Transportation (MoT), Ministry of Environment, Lands and Parks (MELP), and had discussions with Ministry of Forests (MoF) staff. These groups confirmed their individual needs and requirements, which are addressed in greater detail later in this report. All existing accesses will be

maintained. The Proponent will be reporting separately on their discussion with the other interested parties.

## 2.2 E.6(C) ACCESS ROAD UPGRADING REQUIREMENTS

***"Traffic Volumes***

*1. In order to confirm the appropriate level of design for the access road at each stage of resort development, the proponent, in the project report, must provide, for each stage of the project, any updates of its earlier traffic forecast and trip-generation analysis, to ensure that current forecasts reflect all proposed land uses and activities at the resort.*

***Route Study (with Possible Site Impact Analysis)***

*2. Based on the detailed traffic forecast and trip-generation analysis referred to in specification #1, the proponent must present the findings of:*

*either a route study and needs analysis or site impact analysis (SIA) for the Toby Creek road from the Panorama ski resort to the Mineral King minesite; and*

*a route study and needs analysis for the Jumbo Creek forest road from the Mineral King minesite to the proposed resort centre.*

*(Note - The proponent's studies for the access road must cover the entire access road from the Panorama ski resort to the Jumbo Glacier project site).*

*3. The route study (with SIA, if conducted) must be carried out by qualified consultants according to terms of reference which are satisfactory to MoT, and is to be performed in sufficient detail that:*

*the access road location and design for each phase of the resort development is established on a preliminary basis;*

*initial costing of road upgrading requirements will be possible; and*

*the necessary impact assessment of the access road for the EA process can be accomplished, especially with respect to impacts on fish and fish habitat (for the purposes of determining whether or not there is a CEAA trigger - see also section H.1).*

*4. Assuming that the traffic volume estimates contained in Table 1, page 3-1 of McElhanney's December 1995 report are confirmed as a result of updating that analysis (per specification #1), the route study (with SIA, if conducted) referred to in specification #2 is to be guided by the following target road design standards:*

*For Phase One, stages 1 and 2 - Rural Minor Road to Rural Collector Undivided (RCU) standards - minimum design speed - 80 kph;*

*For Phase Two, stages 1 to 3 - Rural Major Road to RCU standards - minimum design speed - 80 kph; and*

*For Phase Three - Rural Secondary Highway to RCU standards - minimum design speed - 90 kph.*

*5. The minimum design speeds cited in specification #4 for each design standard are simply target expectations for the design of the access road for each phase of project development, and* ***it is not necessary to attain road locations and designs which achieve these design speeds at all costs****. The project committee will consider lower design speeds in clearly defined sections of the route where there is a good case to modify road geometry requirements either to accommodate difficult topography or to mitigate impacts on environmentally sensitive terrain (e.g. riparian zones). The route study (with SIA, if conducted) is the key to determining and negotiating any reduction in the target standards which may be warranted for sound environmental, technical or financial reasons.*

*6. Notwithstanding specification #3, the project committee, on the advice of MoT, reserves the right to amend the target road design standards for the proponent's route study (with SIA, if conducted) if either of the following circumstances arises prior to the*

*submission of the proponent's project report and its acceptance for formal detailed review:*

*the applicable provincial road design standards are amended by MoT; or*

*updating of the existing traffic analysis by the proponent (per specification #1) leads to revised traffic volume projections which are significantly different from those presented in McElhanney's December 1995 report*.

*7. The proponent's route study (with SIA, if conducted) must comply with the basic methodology which has been developed and agreed upon in consultations between MoT and the proponent's access road consultant, McElhanney. The key areas of concern which the studies must address include:*

*geotechnical;*

*hazards;*

*traffic;*

*environmental;*

*forestry;*

*socio-community;*

*heritage and aboriginal;*

*mining; and*

*engineering*.

*8. During the implementation of the route study (with SIA, if conducted), the proponent is expected to consult with MoT staff on the details of the approach, as well as with staff of other relevant agencies (including MELP, MoF, DFO and RDEK).*

***Bridge Design***

*9. For the Toby Creek and Jumbo Creek access roads, proposals for incremental bridge improvements which are appropriate to each stage of resort development must be addressed in the project report. The intent is to link required bridge standards to the scheduling of required ski resort development approvals, based on projected traffic volumes.*

***Provision of Parking***

10. In the project report, the proponent must include information on the provision being made for parking for all purposes at the resort, including planned parking capacity and the potential locations of any proposed off-site parking areas (e.g. in the vicinity of the Mineral King minesite)."

Items 1 through 9 are addressed in detail in the Section 3 of this Route Study. The parking provisions of the resort are addressed in the Master Plan.

Preliminary Investigations

Traffic volumes originally presented in the MCSL 1995 Traffic Analysis Report were reviewed to confirm that they accurately reflect projected added traffic volumes resulting from each phase of the Jumbo Glacier Alpine Resort development. We have included updated traffic volume projections within this report. Since the 1995 report, the demand for ski opportunities in B.C. has increased at an average of 8% per year. This does not change the traffic projections for design of the roadway system but may perhaps accelerate the phased construction of all the facilities at the resort. The roadway needs to be designed to deal with peak traffic demands.

Design Criteria

As a means to address the target design speeds listed in the PRS, we firstly examined an alignment that would provide a 50 kph design speed consistent with the requirements of a subdivision road as defined in Section 14 of the MoT Highway

Design Manual for Rural Local Undivided Roads. From there we looked at the feasibility of upgrading this alignment to meet the targeted 80 kph design speed. We did not attempt to evaluate a 90 kph design speed as the 80 kph evaluation confirmed that excessive cuts and fills would be required.

It became very evident that the feasibility of achieving an 80 kph design speed along this corridor was not only impractical, but in some areas almost impossible within the parameters of this development. The main challenge with achieving a consistent 80 kph design speed resulted from the numerous vertical alignment variations, although there were some sections where tight horizontal curves were also identified, which, similarly, resulted in a reduction in speed through these curves. Vertical cuts in excess of 20 metres would be required in some locations, which in our opinion, and considering the sensitive nature of this valley, did not offer sufficient benefits to offset the environmental impacts created.

The details of the route selection, design considerations, risk assessments and environmental impacts are discussed later in this report.

## 2.3 E.6(D) AVALANCHE HAZARD ALONG THE ACCESS ROAD

"*1. The November 30, 1995 and May 18, 1997 detailed avalanche assessments which have been produced by the proponent's consultant, P. Schaerer of Stetham & Associates, for the highway corridor from the Panorama ski resort to the proposed Jumbo Glacier resort, must be included in the project report, and the findings in these reports fully integrated with the access road route study (with SIA, if conducted) which is required under specification E.6(C)#2.*

*2. The avalanche management program reporting requirements identified in conditional specification C.3#2 apply to the access road also, and on the same terms.*"

*"If the long-term assessment required in specification #1 identifies significant avalanche hazard in the vicinity of any road, ski lift or ski run, the proponent, in the project report, must present a conceptual operations plan for monitoring avalanche hazards to protect*

*those sites for public safety purposes. This plan must include emergency preparedness, emergency response, avalanche monitoring/reporting, avalanche control and safety. For project components where minimal hazard is present, operations planning can be left to the CASP process at the permitting stage."*

The Ministry of Transportation provides avalanche monitoring and control programs on public roads in the province and would monitor and control the access roads. Avalanche control equipment will also be available at the resort along with road clearing equipment to supplement the equipment used by MoT if necessary. Provisions to accommodate the users of the resort during avalanche control must be included in the emergency response plan created for the resort development. This work is normally part of the rdequirements at the Master Development Agreement stage between the Province and the Proponent. The detailed area Sefety Plan is filed with the Province prior to start of operations. The reports and information provided by Peter Schaerer during site visits and project consultations are the basis of the Master Plan and of this route sudy.

For the purposes of this route study, we considered locations of existing avalanche paths and the advise of Peter Schaerer in determining route locations.

## 2.4 E7(L) REGIONAL TRANSPORTATION INFRASTRUCTURE

*"1. In the project report, the proponent must present specific transportation data which include estimates of daily trip generation by automobile, truck, bus and air for all of the resort's operational functions, including maintenance/support purposes.*

*2. The proponent must provide estimates of the seasonal patterns of public highway traffic associated with the project, noting any increases in traffic volumes resulting from resort development. In part, this reporting item is intended to enable Parks Canada to assess the effects of any incremental traffic on Kootenay National Park.*

*3. The proponent, in its project report, must provide an assessment of the potential demand which the resort is expected to place on local and regional transportation*

*systems, the resulting impacts on transportation infrastructure (including local air traffic infrastructure, notably Fairmont Airport), and any significant accompanying congestion, noise or safety impacts.*

*4. To contribute towards the reporting required for section E.8, above, in the project report, the proponent must provide some analysis of any significant potential incremental costs of the project's transportation needs for parties other than the resort's own management."*

It is expected that the Jumbo Glacier Resort will cater to skiers worldwide and therefore, if service will be provided, some will access the site by way of airplane to Fairmount Airport, then travel to the site by tour bus ranging in capacity from 10 to 40. The majority of the users of the resort will travel to the site by personal vehicle or tour bus using Highway 95. As reported by MCSL in the 1995 report, Highway 95 experiences peak daily traffic volumes during the summer months. The two-way average annual daily traffic (AADT) on Highway 95 is approximately 8100. The daily traffic reduces to approximately 3000 in February, the time when the resort demand is at its peak. It is estimated that the Jumbo Glacier Resort would result in a winter AADT of 1875 at the 20 year horizon projection. Therefore, the AADT on Highway 95, with Jumbo Glacier Resort operating at peak demand in February, would be approximately 4875 , or 60 % of the current average usage during the summer months. It is not realistic to assume that all vehicles accessing the site will also access Highway 95. For example, some users will likely travel from Invermere and Panorama Resort. However, the worst case scenario demonstrates that Highway 95 has sufficient capacity to service the Jumbo Glacier Resort during the winter months.

## 2.5 PROJECT REPORT SPECIFICATIONS – E.7(M)

"*1. The proponent must provide cost estimates generated as a result of the route study (with site impact analysis, if any) conducted under specifications E.6(C)#2 to #9 with respect to upgrading, operating and maintaining the access road between the Panorama*

*ski resort and the project site. Cost data must be broken down by phase of resort development.*"

This route study includes order-of-magnitude cost estimates based on the preliminary alignments generated using existing available mapping and contour information. A summary of the cost estimates for a 50 kph route and an 80 kph route are discussed in Section 6 of this report.

The cost estimates based on unit costs per kilometre of road result in a calculationof $312,162 for a design speed of 50 kph and of $724,594 for a design speed of 80 kph.. However, MoT has been considering for some years a revised construction standard for destination mountain resorts, which would translate into lower construction costs, without significant additional maintenance costs or safety risk, more similar to the European model of mountain roads than to the American model. A comparison with the Kicking Horse Mountain Resort road construction, without bridges and without the cost of the 40km/hr switchback, would also indicate that a construction cost of $ 200,000 for a paved two lane road according to current standards would be feasible.

It would be premature to speculate on what works would be attributable to each phase of the resort development as approximately 50% of the route is currently under the control and jurisdiction of the Ministry of Transportation. It is not known what portion of the work would be provided by the Province and what costs would be borne by the Proponent. The BCTFA, which is no longer in existence, had indicated to the Proponent that an arrangement similar to the one utilized for Kicking Horse Mountain Resort, where the cost of the road is paid for with a user charge on the lift tickets would be available for this project also. Further discussions would be required prior to establishment of a phased construction plan.

## 2.6 PROJECT REPORT SPECIFICATIONS – H.1

*"The proponent must provide the following information, analysis and commitments in the project report in order to satisfy DFO's requirements under the federal Fisheries Act:*

*1. Detailed descriptions of the existing fisheries resource values of Jumbo Creek which could potentially be affected by the proposed works or activities, identifying the species of fish which frequent the stream, fish habitat use during all life cycle stages (e.g. spawning, rearing and overwintering habitat), and riparian habitat. In part, this information has been supplied by the proponent in its application (Volume 2, section 4.2.2, Aquatic Resources, and section 4.3, Potential Environmental Concerns; and Volume 5, Appendix P – see reports Late Summer Fisheries and Wildlife Reviews (November 1992) and Jumbo Valley Resort Development - Aquatic Resources (December 1993)). However, in order to allow DFO to determine whether or not a section 35(2) authorisation under the Fisheries Act will be required for any aspect of project development, the following must be included in the project report:*

- *completion of reporting on the objectives cited in these last two reports (per specification D.3(A)#1);*
- *the further baseline information identified in section D.3(A) of these specifications (Fisheries Resources); and*
- *other information noted in these specifications with respect to water quality issues, water management and water supply, access road upgrading and waste management (see references in specification #3)."*

The route analysis respected the desire to prevent the placement of embankment fill within 30 metres of the existing streams. If stream crossings are required, culverts and bridges will be designed and constructed to allow fish passage, where needed. Works "in or about" a stream will only be constructed with appropriate approvals and within the approved fisheries window time limits. A sedimentation control plan will be developed during the detailed design phase to ensure deleterious materials do not enter the streams and tributaries. It also appears that bridge locations will be accessible from earlier forestry roads from both sides, making possible most of the work without creek disturbance. However, the current proposal for the route alignment for the improved Jumbo Creek road will not require the construction or relocation of any bridges.

The aquatic resource information referenced during completion of this route study was provided in the reports submitted in 1992 and 1993.

Permits will be required for works in or about a stream related to the installation of culverts and construction of bridges. The attached alignment plans in Appendix A identify stream crossings where fish passage may be required.

# 3.0 ROUTE STUDY

The Toby Creek road access is currently operated and maintained by MoT. This is a gravel road and is approximately 18 km in length from Panorama Resort to the Mineral King Mine site. The Jumbo Creek FSR is a gravel logging road maintained by the MoF and is approximately 18 km in length from the Mineral King Mine site to the proposed resort. Each of these two sections of roadway was evaluated separately to determine what improvements would be necessary to provide a safe access to the proposed Jumbo Glacier Resort.

The study was completed using existing topographic information created from TRIM data at 1:20,000 with 20 metre contour intervals. Following several earlier site visits, including one with MOT staff, a recent site visit was also completed in October 2000 to review the existing conditions of the roadway.

Additional mapping and engineering work will be required to further define and detail the extent of the recommended upgrade works for each phase of the proposed development. At this stage of the project, sufficient information, from existing mapping combined with ground reconnaissance, was available to assess the impacts of the proposed access road.

## 3.1 GEOTECHNICAL

As indicated in the earlier report submitted in 1995, the physical characteristics of the area are described in MELP Resource Analysis Branch Bulletin 15 (1980).

Consistent with mountain terrain in the Purcell Mountain Range, the area consists of bedrock, sedimentary and metamorphic rock, and colluvial soils.

It is expected that generally favourable soil and rock properties exist in the area to allow roadway construction. This is confirmed by site visits by Golder Associates engineers. Till occurs on the lower to intermediate valley sides and is expected to be a dense, silt-

sand and bouldery soil. Tills are likely highly erodible when disturbed. The till may be suitable for common fill when placed and compacted under controlled conditions.

The valley floor, consisting of alluvial/ colluvial fans, provides a source of granular construction materials and reasonable subsurface drainage. Further detailed investigations will be required to fully examine the potential borrow pit sites for suitable material for sub-base materials and potential production sites for base gravels and for subsequent production of asphalt aggregates.

The construction of Toby Creek road and Jumbo Creek FSR utilized fill and gravel surfacing materials available from the immediate area. It should be noted that these two roads differ in their construction procedures, as the level of roadway structure for a Forest Service Road differs considerably from a Rural Local Undivided Roadway.

Due to the proximity of the existing roads to exposed bedrock, realignment to improve horizontal curves or vertical grades will be extremely difficult to attain and costly to construct to attain the desired 80 kph design speed.

## 3.2 HAZARDS

The existing roads have several risk factors that must be considered in providing improved access to the proposed Jumbo Glacier Alpine Resort. These known risks are common and expected when travelling in mountainous terrain.

The hazards discussed below are generally the result of the alpine environment, which must be considered in establishing year-round access to the resort. These hazards can be separated into seasonal hazards as well as year-round hazards.

The access roads to the site are subject to snow, avalanches, landslides, debris flows, flooding, and frost heaves, as is typical of many mountain roads. No additional assessment of these hazards has been made nor has any cost been assigned to mitigation works that may be required, except that the alignments chosen are the ones that provide the best avoidance of the affected areas. In particular, the chosen route

around the Mineral King Mine tailings offers the avoidance of the most significant area of potential difficulty at the entry into the Jumbo Creek drainage. Records available from MoT indicate no significant problems in the past twenty years.

The hazards associated with avalanches are discussed in detail in the reports prepared by Peter Schaerer, which have been submitted to the EA Office and are included in the Project Registry, and in verbal comments to the Proponent's consultants. He recommends that avalanche control work be completed by trained safety personnel and notes that some road closures will be necessary during high season hazard, resulting in the need to accommodate all visitors to the resort area for the duration of the road closures. He recommends against placing the road in cut through avalanche areas and suggests wider ditches may be required in areas with steep cut slopes. The details would be incorporated into the detailed roadway design for each section of the access road. For the purpose of this route study, avalanche paths were mapped and considered during the preliminary route selection. It soon became apparent that completely avoiding all existing avalanche paths was impractical and unnecessary. Therefore, we focused our work on selecting an alignment that attempts to avoid the major avalanche paths, and where crossing remaining existing avalanche paths was more practical, we strove to select alignments that provide the most feasible long-term solution with respect to maintenance and operations. During the detailed design phase of the project further investigation and design will be required to address these areas; this may involve adjusting the alignment slightly to ensure cuts are avoided, further addressing maintenance and an information signing plan to prevent users of the road from stopping in these areas and alerting them to the potential hazards.

Rock falls appear to be the most common landslide hazard to occur in areas with exposed steep cliffs. The preliminary investigations confirm there is no evidence of imminent large landslides in the area. Where the proposed alignment passes through areas of rock cut, further detailed investigations will be required to confirm cut slopes and address any requirements for rock bolting and scaling. The chosen alignments,

however, avoid the steep sections of the valley, minimizing potential risks and reducing the amount of work required.

Debris flows and floods must be considered at all bridge crossings. The migration of cobbles and boulders and forest litter could result in stream blockages at culverts or bridge crossings. Entrainment works and catchment basins may be needed at some locations to protect the constructed infrastructure. The need for these entrainment facilities would be addressed during the detailed design of proposed crossings.

All bridge crossings will be designed to accommodate the 1:100 year return period flood, with a 1.5 metre clearance to the underside of the girder or navigation clearances whichever is greater. For bridge crossings with debris flow potential, we will also investigate the use of pre-cast concrete for girders for the ultimate crossing configuration as their smooth bottoms prevent debris from getting caught on the underside of the structure . However, the final choice of route alignment for the Jumbo creek drainage should avoid the need to construct any new bridges or to relocate existing ones.

Due to the varying types of soils observed throughout the length of the access road, it is likely that deep frost penetration in the finer moist soils could result in frost heaving along some sections of the roadway. This potential problem will be addressed in greater detail while preparing the Stormwater Management Plan and roadway structure composition during detailed design.

## 3.3 TRAFFIC

MCSL completed preliminary traffic projections in 1995 and prepared a report detailing these projections. Traffic projections were again updated in June 2003 to reflect a reduction in the number of beds (6252, including 5502 tourist beds and 750 employee beds), maximum design lift capacity (approximately 16,000 ph) and maximum Comfortable Carrying Capacity or Skiers At One Time (approximately 10,000 SAOT) . As indicated in the original report, traffic volumes will increase with each successive stage of development of the resort. With increased traffic, improvements to the existing road access would be required. This route study concentrated on finding solutions to the

roadway alignment upon full build-out of the resort. Consideration should be given to staged construction to meet the needs of each phase as the resort develops.

Access to this development is provided by Highway 95, which is a two-lane facility that runs north and south through the Rocky Mountain trench and connects to Invermere by way of Athalmar road through to Panorama. The access route between Panorama and Jumbo Glacier Resort is the focus of this report. The traffic projections and possible staging of developments are similar to those detailed in the 1995 report. Projected traffic volumes are based on a correlation between existing traffic volumes at surveyed ski resorts as well as the respective numbers of beds provided and overall lift capacity.

The following is a summary of the approximate traffic volumes at the completion of each of the three phases of development.

**TABLE 1**
**TRAFFIC VOLUMES**

| | Phase 1 | Phase 2 | Phase 3 |
|---|---|---|---|
| P.M. Inbound (vph) | 160 | 290 | 500 |
| P.M. Outbound (vph) | 50 | 100 | 170 |
| A.M. Inbound (vph) | 60 | 120 | 200 |
| A.M. Outbound (vph) | 190 | 350 | 600 |

The above referenced traffic projections represent weekend traffic during the busiest ski seasons, typically in February. Weekday traffic volumes will be considerably less. For comparison, the 1993/1994 seasonal distribution of skier visits in B.C. are tabulated below by month.

**Distribution of Skier Visits**

| MONTH | PERCENTAGE |
|---|---|
| November | 1.6% |
| December | 15.2% |
| January | 23.1% |
| February | 32.1% |
| March | 27.1% |
| April | 0.9% |
| Total | 100.0% |

Average Daily Traffic calculations are as follows:

**20 Year Projections**

| Parameter | Unit | | | | Value | |
|---|---|---|---|---|---|---|
| Winter skier visits, Yr 15 (150 days = 41%) | Vw | | | | 500,411 winter visits | |
| Summer skier visits, Yr 15 (215 days = 59%) | Vs | | | | 184,294 summer visits | |
| Winter ratio - PM peak hour / ADT | kw | | | | 0.25 | |
| Summer ratio - PM peak hour / ADT | ks | | | | 0.12 | |
| February PM peak hour 2-way volume ( vph) | PMw | | | | 600 vph | |
| February Average Daily Traffic (ADT) | FEBadt = PMw / kw | | | | 2,400 ADT (February) | |
| Monthly Winter Traffic | No. of days | Proportion | MADT | Factor, F | Total Monthly Winter Traffic | |
| Dec | 31 | 15% | 1136 | 1.3 | Mdec | 46,895 |
| Jan | 31 | 23% | 1727 | 1.1 | Mjan | 58,894 |
| Feb | 28 | 32% | 2,400 | 1.0 | Mfeb | 67,200 |
| Mar | 31 | 27% | 2026 | 1.0 | Mmar | 62,811 |
| Nov/Apr | 29 | 3% | 187 | 3.0 | Mn-a | 16,136 |
| Total | 150 | 100% | | | Total | 251,936 |
| Winter Traffic (150 days) | Wt | | | | 251,936 | vehicles in 150 days |
| **Winter ADT** | **Wadt = Wt / 150** | | | | **1,680** | **ADT (winter)** |
| Average daily winter skier visits | Aw = Vw / 150 | | | | 3,336 | daily winter visits |
| Average daily summer skier visits | As = Vs / 215 | | | | 857 | daily summer visits |
| **Summer ADT** | **Sadt = As/Aw *PM** | | | | **432** | **ADT (summer)** |
| Summer PM peak hour 2-way volume ( vph) | PMs = ks * Sadt | | | | 52 | vph |
| **AADT (Average Annual Daily Traffic)** | **AADT = 0.41(Wadt) * 0.59(Sadt)** | | | | **943** | **AADT** |

MADT = Monthly Average Daily Traffic

Total Monthly Winter Traffic = No. of days x MADT x F

Note: Factor F accounts for high proportion of sevice/employee vehicles during off-peak montl

In addition to the traffic projections listed above, it is expected that some minor additional traffic generation will result from logging trucks and other non-skiing recreational uses in the area. These other incidental uses are considered to fall within the traffic range projections listed in this report. It must be noted that the proposed project may have a greater than normal tour bus component, a factor that would reduce traffic calculations if confirmed.

The projected phasing of improvement works has not been provided as a work program and cost sharing arrangements have not been finalized. However, it is assumed that the first phase of construction would be within the Jumbo Creek valley section, to improve the FSR to a similar standard as the Toby Creek road, utilizing existing alignments.

## 3.4 ENVIRONMENTAL

Environmental impacts associated with the proposed access relate to the potential for erosion of exposed cut and fill sections during and after construction, and the migration of silt-laden water to the fish bearing streams of Jumbo and Toby Creeks and their tributaries during peak storms or run-off conditions during the spring snow melt. Snow storage along and adjacent to ditches will be considered during detailed design. To reduce the effects of storm run-off, the access road will have a small drainage ditch on the cut side of the valley slope and numerous culverts discharging at the bottom of the fill slopes. This will reduce the effects of erosion caused by large volumes of water cascading down steep slopes. In addition, tree removal and clearing will be restricted to areas where sight improvements are required. This will generally be located in areas where tight horizontal curves are located in order to improve sight distances.

Siltation and sediment control plans will be developed during detailed design to protect the water quality in the existing streams during construction.

Where steep slopes occur near the existing streams, cuts and fills will be kept to a minimum. This will result in a reduction of the proposed access road operating speed.

The area has numerous wildlife species which are encountered along the length of the access roads. For the safety of the animals and vehicle operators, it is important to reach a balance where the operating speed of the road is adequate to allow for animals to safely cross the route. There is a trade-off for animal /user safety and the environment. To provide increased sight lines, rights-of-way would require additional tree removal with further impacts on the environment. The need to balance safety with the environmental consequences will be addressed at detailed design. Where safe stopping sight distances cannot be provided for the posted speed, additional signage will be required to limit the operating speed to a safe speed for the conditions encountered.

All slopes exposed during construction will be hydroseeded to assist in revegetation to reduce the effects of erosion. Current design does not appear to generate any large exposed slopes, but if detailed topography were to show differently and if large exposed slopes are required, additional erosion control will be investigated during detailed design to determine whether terracing mats or other erosion protection measures should be implemented.

## 3.5 FORESTRY

The two existing roadways provide the primary access to support the forest industry in the area. The proposed improvements to Jumbo Creek road and Toby Creek road will not have any detrimental effect on the current logging industry. Currently, portions of Jumbo Creek FSR are used by logging trucks with two-way radios to allow direct communications between the drivers on this narrow roadway.

Accesses to new areas will have to be reviewed individually to ensure safe intersection locations are selected. As indicated in Section 3.2, it is expected that load restrictions will continue to ensure the integrity of the road is maintained.

Based on discussions with MOF, the minimal amount of proposed logging will have little effect on the roadway.

As indicated earlier, some additional right-of-way clearing will be required to improve sight distances along the existing roadway.

## 3.6 SOCIO-COMMUNITY

The socio-community issues are addressed by the Proponent's other consultants in the appropriate sections of the Master Plan and of the Project Report.

## 3.7 HERITAGE AND ABORIGINAL

The heritage issues and aboriginal concerns are expected to be addressed by the Proponent's other consultants on the basis of the archaeological and traditional use study and of the socio economic study that are being prepared with the assistance of the First Nations.

## 3.8 MINING

Although the area has experienced mining operations in the past, this proposed resort is planned as a destination resort and is intended to take advantage of the existing natural environment. There are no current plans to develop any mining operations in the Jumbo Creek valley. Any future mining operations that include access from Toby Creek road will have some impact on that section of roadway. We have assumed that proponents for any future mine site development would be required to address their access requirements at that time.

Similar discussion on future access locations and load restrictions may apply, as discussed in Section 3.5 above.

## 3.9 ENGINEERING

Roadway

The report submitted in 1995 addressed the access road from the Mineral King Mine site up Jumbo Creek FSR to the proposed alpine resort site. The proponent was asked to

expand their review to also include the Toby Creek road from the Panorama Ski Resort to the Mineral King Mine site. At the present time, MoT maintains the Toby Creek road and MoF maintains the Jumbo Creek FSR for logging purposes and local recreational needs. MoF has expressed an interest in closing the Jumbo Creek FSR in the absence of logging operations and until the project start in order to eliminate maintenance costs. However, this would impact the heli-ski operator, which depends on summer truck access to refuel the supply tank located in the Jumbo Creek valley near the confluence of jumbo and Leona Creek.

MoT has requested that the proponent look at upgrading both sections of roadway to an ultimate 90 kph design speed when Phase 3 is completed. They also requested a target road design standard equal to a Rural Collector Undivided (RCU) with a design speed of 80 kph.

It is recognized that attaining the desired design speed in alpine environments could result in significant impacts on the existing land form and at significant costs. The Final Project Report Specification E.6(C) 5. states *"**It is not necessary to attain road locations and designs which achieve these design speeds at all costs. The Project Committee will consider lower design speeds in clearly-defined sections of the route where there is a good case to modify road geometry requirements, either to accommodate difficult topography or to mitigate impacts on environmentally-sensitive terrain.**"* At the present time, it has not been determined whether MoT will ultimately maintain the Jumbo Creek road or whether the road will be maintained by the Proponent with provision for public right of access.

The route alignments reviewed in this report do not distinguish between public or private operation of the roadway. The safety requirements remain the same as these roads will be publicly accessible. During the route study review it became evident that significant roadway realignment would be required to attain an 80 kph design speed along the entire 37 km length of access from Panorama to the proposed resort site. The requirement to provide a 90 kph design speed road would create increased horizontal curves from 250 m to 300 m and the K values for sag would increase from 32 to 40 and

crest from 50 to 90, as specified in MoT's Design Manual for Rural Collector Undivided Roads.

The scale of topographic mapping allows an order of magnitude evaluation of the anticipated bulk excavation and fill requirements necessary to attain either a 50 kph or 80 kph design speed throughout the entire length of roadway. Eight alternative alignments were developed and evaluated to establish the order-of-magnitude works associated with each alternative.

Crossings

At this stage of the development, crossing locations were investigated only to determine the number and approximate length of bridge structures that might be required, as well as providing minimal culvert requirements. At this stage of the project, Toby Creek and Jumbo Creek were assumed to be fish-bearing creeks and tributaries were assessed based on bank-to-bank width and creek gradient from crossing location to a point 100 metres upstream to determine their ability to allow fish movement. The attached plans in Appendix A identify stream crossings where fish passage may be required.

Along with the road alignment, a phased construction procedure for the crossings was investigated. The existing structures were inspected, and as-built records were obtained from MoF. A review of the as-builts was completed to determine the suitability of the structure to be re-used on this project. Where new culvert crossings are required, the culverts will be installed to their ultimate configuration. The bridges, however, will be able to operate as single lane facilities, with appropriate signage and sight distances for the initial phase of the project development. If new crossings were proposed, and no suitable structure is available on the existing alignment, we would propose to construct ultimate width foundations with pre-cast concrete girders installed to provide single-lane access until such time as the resort development warrants an additional lane. However, the current plan does not foresee the need for new crossings.

# 4.0 ROUTE SELECTION AND ALTERNATIVES

## 4.1 GENERAL

Eight alternative alignments were analysed to determine the optional alignment and grade for the proposed access to Jumbo Glacier Resort from Panorama Resort. The routes were developed using TRIM data at a scale of 1:20,000 with 20 metre contour intervals. The data was derived from map sheets 82k: 037, 038, 039, 047, 048 and 049 using ARCINFO software.

Appendix A shows the preferred alignment and profile for each of the selected 50 kph and 80 kph design speeds detailed in this report. The alternative alignments are shown for information purposes and would be considered further during detailed design.

The TRIM data showed the existing watercourse and forestry road locations. Additional information on the location of stream crossings was provided by MOF and digitised onto the existing map sheets. The cross-sectional area of each road was not sufficiently detailed; therefore the earthworks were not adjusted to account for the cuts and fills completed during construction of the existing roadways. The order-of-magnitude earthwork volumes would remain consistent for each alignment studied. In areas where the existing roadway is ultimately utilized, some reduced earthworks would result and will be quantified during detailed design.

Avalanche mapping was superimposed on the base mapping to assist in determining the risks associated with avalanches and debris flows.

## 4.2 ALIGNMENT OPTIONS

The eight alternative alignments were developed along the entire route from the Panorama Resort to the proposed resort site. The established design criteria for these routes were based on MoT's Highway Engineering Design Manual for Rural Local Undivided Roads, Section 14.

The alternative alignments were developed to determine optimal cut and fill requirements and to avoid hazardous areas, wherever possible. Detailed design would include a review of the alternatives developed to minimize disruption to the natural environment. This study confirms that alternatives exist to meet the goals and objectives of providing access to the resort.

Every effort has been made to utilize the existing roadway alignment to minimize the effects of construction on the natural environment. Where it was necessary to deviate from the existing alignment, every effort was made to re-join the existing alignment as quickly as possible.

Eight options were developed using the design controls as follows:

- Three alignments were developed with design speed criteria for both horizontal and vertical control at 50 kph.
- One alignment was developed using an 80 kph design speed for the horizontal control and 50 kph design speed for vertical control. This option was developed to determine an alignment that could be developed in phases which could initially be constructed to 50 kph vertical controls and improved over time by adjusting the vertical alignments only. The horizontal controls would be built to the ultimate during initial development.
- Four alignments were developed with design speed criteria for both horizontal and vertical control at 80 kph.

All route alignments were developed with a maximum grade of 8% due to the frequency of use of minimum radius horizontal curves.

The initial evaluations also considered partial re-alignment along the north side of Toby Creek. Current considerations have brought back to life this solution as bridge upgrading or new bridge construction are no longer proposed.The major differences between the 50 kph and 80 kph design criteria is the requirement for the minimum horizontal curve radius to increase from 75 metres to 250 metres and the K factor for vertical curves to increase from 11 to 50 for crest and from 12 to 32 for sag curves, as

specified in MoT's Highway Engineering Design Manual for Rural Local Undivided Roads. These increased curve radii result in a significant increase in the cut and waste of excess excavated material.

In alpine environments, the existing ground can change abruptly from a gentle valley slope to near-vertical rock walls. The existing road was developed to provide access to the area while respecting the existing site conditions. Bridges have been installed along the roadway to bypass major topographically challenging and environmentally-sensitive areas.

Attempts have been made to bypass major avalanche areas as well as the existing mine tailing site. For the 50 kph design criteria, all routes generally follow the same alignment for the majority of its length with only minor horizontal and vertical variations. The only area where the 50 kph alignments vary significantly is from station 60+00 to 130+00 along the Jumbo Creek section. Keeping the alignment on the north side of Jumbo Creek avoids several avalanche areas.

As can be expected in mountainous terrain, the vertical alignment of the road is often the controlling criteria, which restrict the speed of the facility. It is recommended that cuts be avoided where crossing an avalanche area is unavoidable.

It is difficult to develop a road profile which provides adequate sight distances to attain the desired 80 kph design speed without significantly affecting the natural environment and significant additional construction costs. As indicated above, we developed one alignment that provides horizontal alignment improvements to meet the 80 kph design speed; however, the vertical alignment continues to restrict the overall speed to 50 kph. The resulting horizontal improvements, alone, at six locations along the Toby Creek section of the road, do not improve the overall operating speed of 50 kph throughout this section of roadway.

Significant horizontal alignment improvements would also be required for the Jumbo Creek section in order to attain the 80 kph design speed. Again, these horizontal improvements alone would not improve the overall safe operating speed for the facility.

As indicated in Section 3.9, the increased horizontal and vertical design controls for a 90 kph alignment would add significant earthworks and costs to construct and have considerable additional impact on the environment over and above the significant impacts associated with an 80 kph alignment.

Four optional route alignments were developed to determine the extent of work that would be required to provide an access route that would meet MoT's 80 kph desired design speed requirement. These routes have significant impact on the existing environment as the vertical curve adjustment would result in reconstruction of numerous sections of the roadway.

The alignments attempt to utilize the existing Toby Creek roadway wherever possible. Significant sections of the existing roadway would require either horizontal or vertical adjustments, or both, to meet the 80 kph requirements, resulting in extensive cuts and fills. The Jumbo Creek section would require reconstruction of the majority of the existing FSR in the valley.

It is very evident from our analysis that the feasibility of achieving an 80 kph design speed along this corridor was not only impractical, but in some areas almost impossible within the parameters of this development. The main challenge with achieving a consistent 80 kph design speed are the numerous vertical alignment variations, although there were some sections where tight horizontal curves were also identified, which, similarly, resulted in a reduction in speed through these curves. Vertical cuts in excess of 20 metres would be required, which in our opinion, and considering the sensitive nature of this valley, did not offer sufficient benefits to offset the environmental impacts created.

The information used to make our assessments was not intended nor sufficiently accurate or complete to make a detailed recommendation on a final alignment location. Further design will be required to refine the choice of the recommended alignment.

## 4.3 CROSS-SECTION

All roadway improvements were based on a typical 8 metre wide finished grade (a 7 metre road with 0.5 metre shoulders), with a 1 metre deep V-shaped ditch on the cut side of the road, with 1.5 H:1.0 V cut and fill slopes to meet the existing ground. It is assumed that the roadways would be capped with suitable gravel surface material manufactured from borrow pits in the vicinity of the proposed roadworks. It is recognized that slopes steeper than 1.5 H:1.0 V would be provided where existing soil conditions warrant, i.e. rock excavation. Consideration of rock bolting, etc., will be reviewed as discussed in Section 3.9.

It is assumed that adequate drainage improvements can be provided along the proposed alignments, with culvert crossings provided at all low points along the access profile. The cross-section of the ditch will have to be modified during detailed design to accommodate siltation control and weathering of the exposed surfaces as well as the need to accommodate snow storage.

Maintenance turnarounds and chain on/off area may also be required, although existing locations near Panorama and near the Mineral King Mine may suffice. It may also be desireable to provide passing or climbing lanes in some sections due a lack of passing opportunities or long sections of steep grade. No allowances have been included in this study or the associated cost estimates for these types of facilities.

## 4.4 BRIDGES

Along the Jumbo Creek section of the proposed access road there are five single-lane bridges provided and maintained by MOF. We were provided with MOF's most recent bridge inspection reports and confirm that all structures were installed within the last ten years. We are not aware of whether the steel bridges were installed new or relocated from other sites. The evaluation of the quality and structural integrity of the existing bridges was considered to be beyond the scope of this route study. Two of the structures were replaced in 2000. The load rating is 10 tonnes and up. It is not expected that these bridges would require further upgrading during the initial phase of

development other than an improved running surface. Widening or replacement of all five bridges would be completed during the final Phase, but it is now expected that this will not be necessary as the chosen alignment will not require further use of these bridges . If the alignment is shifted to the north side of Jumbo Creek, between stations 60+00 and 130+00, bridges #N2-177, 178 and 179 would be used for construction access.

The following is a summary of the bridge evaluation for Jumbo Creek valley:

### 4.4.1 Existing Bridge at 1.3 km on Jumbo FSR Structure No. N2-060

- Single lane;
- Constructed in 1990;
- The existing bearing is treated fir;
- 14000 mm span;
- Portable twin steel girder superstructure with a timber deck;
- Timber abutment wall;
- There are no as-built drawings;
- Reviewed inspections done in 1998 and 1996 done for MOF and as-built sheet;
- The design vehicle was Ministry of Forests L-60;
- Foundation is steel bin wall;
- Cursory load rating using CAN/CSA-S6-88 for the girders only to a CS-600 truck;
- It is possible to use the existing structure until demands warrant upgrading to two lanes, as long as the vertical and horizontal alignments do not dictate a larger span;
- Upgrade to two lanes can make use of the existing structure without a great amount of disruption to traffic;
- Preliminary investigation indicates that the existing bridge can be incorporated into a new structure and meet the intent of the current bridge design code with some minor rehabilitation;
- We have no information on the foundation capacity or the hydraulic capacity of the present crossing;

- The following is a list of deficiencies with respect to the current MoT Bridge Standards:
  - The railing has a lower height than specified in MoT Bridge Manual and S6 and possible strength deficiencies;
  - Transitional barriers are lacking;
  - The timber bearing needs upgrading; and
  - It lacks full depth bearing stiffeners.
- The proposed sequence to upgrade the bridge to two lanes using the existing steel and designing for composite action with the use of precast concrete deck panels is as follows:
  - Construct the new foundation and girder near the existing bridge and place precast deck with temporary barriers;
  - Divert traffic onto the new bridge;
  - Remove the timber deck and shift existing girders to the new location and place precast deck; and
  - Remove the temporary barriers and install longitudinal compression seal between the two separate deck panels.

#### 4.4.2 Existing Bridge at 6.5 km on Jumbo FSR Structure No. N2-177

- Single lane;
- Constructed in 1995;
- The existing bearing is treated timber and serves as the foundation;
- 21100 mm span;
- Portable twin steel girder superstructure with a timber deck;
- Timber abutment wall;
- There are no as-built drawings;
- Reviewed inspections done in 1998 for MOF and as-built sheet;
- The design vehicle was Ministry of Forests L-45;
- Cursory load rating using CAN/CSA-S6-88 for the girders only, to approximately 85% of a CS-600 truck;

- It is possible to use the existing structure until demands warrant upgrading to two lanes as long as the vertical and horizontal alignments do not dictate a larger span;
- Upgrade to two lanes can make use of the existing structure without a great amount of disruption to traffic;
- Preliminary investigation indicates that the existing bridge can be incorporated into a new structure and meet the intent of the current bridge design code with some minor rehabilitation;
- We have no information on the foundation capacity or the hydraulic capacity of the present crossing;
- The following is a list of deficiencies with respect to the current MoT Bridge Standards:
  - The railing has a lower height than specified in MoT Bridge Manual and S6 and possible strength deficiencies;
  - Transitional barriers and barrier flare are lacking;
  - The timber bearing needs upgrading; and
  - It lacks full depth bearing stiffeners.
- The proposed sequence to upgrade the bridge to two lanes using the existing steel and designing for composite action with the use of precast concrete deck panels is as follows:
  - Construct new foundation and girder near the existing bridge and place precast deck with temporary barriers;
  - Divert traffic onto the new bridge;
  - Remove the timber deck and shift existing girders to the new location and place precast deck; and
  - Remove the temporary barriers and install longitudinal compression seal between the two separate deck panels.

#### 4.4.3 Existing Bridge at 8 km Earl Grey Creek on Jumbo FSR Structure No. N2-178

- Single lane;
- Constructed in 1998;
- The existing bearing is treated timber;

- 10300 mm span;
- Portable twin steel girder superstructure with a timber deck;
- Timber abutment wall;
- The foundation is concrete lock block;
- There are no as-built drawings;
- Reviewed inspections done in 1998 for MOF and as-built sheet;
- The design vehicle was Ministry of Forests L-100;
- The design truck is 40% heavier than CS-600; therefore no load rating was completed;
- It is possible to use the existing structure until demands warrant upgrading to two lanes as long as the vertical and horizontal alignments do not dictate a larger span;
- Upgrade to two lanes can make use of the existing structure without a great amount of disruption to traffic;
- Preliminary investigation indicates that the existing bridge can be incorporated into a new structure and meet the intent of the current bridge design code with some minor rehabilitation;
- We have no information on the foundation capacity or the hydraulic capacity of the present crossing;
- The following is a list of deficiencies with respect to the current MoT Bridge Standards:
  - The railing has a lower height than specified in MoT Bridge Manual and S6 and possible strength deficiencies;
  - Transitional barriers and barrier flare are lacking;
  - The timber bearing needs upgrading; and
  - It lacks full depth bearing stiffeners.
- The proposed sequence to upgrade the bridge to two lanes using existing steel and designing for composite action with the use of precast concrete deck panels is as follows:
  - Construct the new foundation and girder near the existing bridge and place precast deck with temporary barriers;
  - Divert traffic onto the new bridge;

- Remove the timber deck and shift existing girders to the new location and place precast deck; and
- Remove temporary barriers and install longitudinal compression seal between the two separate deck panels.

#### 4.4.4 Existing Bridge at 13.8 km on Jumbo FSR Structure No. N2-180

- Existing 9.9 m log stringer designed to 10 tons only;
- Replaced in summer 2000;
- As-constructed information is not available.

#### 4.4.5 Existing Bridge at 15.3 km on Jumbo FSR Structure No. N2-181

- Existing 12 m log stringer replaced with a temporary steel portable bridge;
- There is no information on the portable bridge;
- This portable bridge was replaced in the summer of 2000; load rated 10 tonnes.

#### 4.4.6 Toby Creek Road

The bridge structures along Toby Creek road have not been analyzed to determine their load capacity and suitability as these structures will be owned and maintained by MoT. The existing bridges are single lane structures with approach restrictions due to existing horizontal and vertical curve restrictions. A phased improvement program will require discussions with MoT as to proposed timing of construction and cost.

## 4.5 SURFACE TREATMENT

This route study assumes the subgrade will be capped with suitable base gravel from sources along the proposed route.

The travelled surface, consisting of two 3.5 m wide lanes with 0.5 m wide shoulders, would be covered with a 150 mm thick layer of well-graded granular material similar to that which currently exists along the Toby Creek road section. Surfacing the roadways with an asphaltic concrete mixture was considered to be beyond the scope of this route alignment study, but may be warranted in the future.

The Proponent considers the winter season the primary season, and in light of this consideration paving the roadway in the initial phases would not represent a priority.

## 4.6 SIGNAGE

Due to the numerous horizontal and vertical alignment restrictions expected, the route will require the placement of curve advisory signs and speed reduction signage throughout its length. Narrow, single lane bridges would also require adequate signage to provide safe usage of the installed structures.

The posting of the maximum allowable speed signs for the facility, with speed reduction signage at all locations where the posted speed cannot be safely maintained, is an important element of this route study report. MCSL recognizes that the desired design speed of 80 kph and 90 kph will not be attained during the initial development of the resort facilities or in the foreseeable future of the proposed resort development project.

A traffic control gate may be required with radio-controlled access, similar to those employed for forestry operations, during development construction, subject to the other uses (logging, mining, etc.) of the road at the time.

# 5.0 PROJECT PHASING

The successful development and operation of the Jumbo Glacier Alpine Resort relies on having a safe reliable access route to the site that is useable year-round.

As indicated earlier in this report, the access roads will be classified as Rural Local Undivided Roads, as defined in MoT's Highway Engineering Design Manual. Currently, Toby Creek road from Panorama to the Mineral King Mine site is maintained by MoT as a gravel road, with portions restricted to single lane access primarily at bridge structures. Jumbo Valley FSR is constructed and maintained to a lesser standard and operates as a logging road, with two-way radio communications between the primary users of the facility, although recreational users frequently utilize the road without radio communications as logging operations are sporadic and mostly inactive past the first kilometers of road.

## 5.1 PHASE I ROAD IMPROVEMENTS

The Proponent proposes to improve the existing Jumbo Creek FSR to provide construction access and allow access to the ski area and day lodge. The following works are proposed:

- Removal of brush and trees to improve sight distance;
- Upgrade ditching to improve drainage;
- Gravel surfacing in areas of poor subgrade;
- Repair of structures where required; and
- Signing improvements.

**Phase 1 Stage 1**
**Traffic Volumes (VPH) and Estimated Cost**

| | Lift CCC | Bed Units | Ph. 1, Stg 1 Volumes | Estimated Cost |
|---|---|---|---|---|
| A.M. Inbound (vph)<br>A.M. Outbound (vph) | 1,690 | 682 | 110<br>40 | **$500,000** |
| P.M. Inbound (vph)<br>P.M. Outbound (vph) | | | 40<br>130 | See section 6 for cost estimate details |

**Phase 1 Stage 2**
**Traffic Volumes (VPH) and Estimated Cost**

| | Lift CCC | Bed Units | Ph. 1, Stg 2 Volumes | Estimated Cost |
|---|---|---|---|---|
| A.M. Inbound (vph)<br>A.M. Outbound (vph) | 2,730 | 1,446 | 170<br>60 | n/a |
| P.M. Inbound (vph)<br>P.M. Outbound (vph) | | | 70<br>210 | n/a |

## 5.2 PHASE II ROAD IMPROVEMENTS

The Proponent proposes to upgrade the Jumbo Creek FSR to a Rural Local Undivided Road at the time of subdivision of fee simple parcels.

Phase II would see a detailed design of the proposed Jumbo Creek road from the Mineral King Mine site to the resort site. The design would identify a Phase II construction program that would see the route constructed to subgrade at a 50 kph design speed. Bulk excavation and construction of the drainage works associated with subgrade construction would be included.

The subgrade would be capped with 150mm of suitable gravels along the length of Jumbo Valley. Improvements to the existing bridge structures, as deemed necessary to attain the 50 kph design speed, would be completed during this phase of construction.

However, it may be more cost effective and it is part of the current plan to eliminate the crossings and stay on the North side of Jumbo Creek for the entire distance. This would require the construction of approximately 2 km of new road. Road signage would be provided and installed.

The Proponent would finalize discussions with MoT on improvements and funding options on the Toby Creek portion of the road according to the prevailing Government policy. It appears that a formula whereby a user pay concept is utilized, with the cost of the road repaid with charges on the lift tickets, in a similar fashion to Kicking Horse Mountain Resort and other ski areas in B.C., will be a likely conclusion. At this time, the MoT indicate that it would become responsible for operation and maintenance of the Jumbo Valley road.

**Phase 2**
**Traffic Volumes (VPH) and Estimated Cost**

| | Lift CCC | Bed Units | Phase 2 Volumes | Estimated Cost |
|---|---|---|---|---|
| A.M. Inbound (vph)<br>A.M. Outbound (vph) | 4,979 | 2,080 | 310<br>105 | **$6,000,000** |
| P.M. Inbound (vph)<br>P.M. Outbound (vph) | | | 130<br>380 | See section 6 for cost estimate details |

## 5.3 PHASE III

The Jumbo Creek road would be completed as a graveled road and may eventually be paved. This would be completed when warranted or as required by the Proponent or the Approving Officer. It is anticipated that the paving would be completed over two years and would occur when funding is available.

**Phase 3**
**Traffic Volumes (VPH) and Estimated Cost**

| | CCC | Bed Units | Phase 3 Volumes | Estimated Cost |
|---|---|---|---|---|
| A.M. Inbound (vph)<br>A.M. Outbound (vph) | 9,009 | 3,979 | 500<br>170 | **$3,600,000** |
| P.M. Inbound (vph)<br>P.M. Outbound (vph) | | | 200<br>600 | |

The cost of gravel and paving is based on 300mm granular base and 75mm of asphalt. The warrant to add passing and climbing lanes, if desired, would need to be assessed at these volumes, but as the proposed design speed and traffic cost load it appears unlikely.

## 5.4 PHASING OPTIONS

It may be determined during detailed design that some sections of the Jumbo Valley road can be completed in their entirety rather than construct the works to subgrade only. The staging of construction would ensure the continued use of the Jumbo Creek FSR by current users of the facility.

It is proposed that the Jumbo Creek FSR remain under the control and jurisdiction of the Proponent until the road meets the standards established for a Rural Local Undivided Road. This would ensure that unauthorized access could be controlled for the safety of all users.

It is possible that access to the site during the initial stages of development would be provided by the Proponent using buses and other transport vehicles beyond the Mineral King Mine site.

A suggested phasing schedule has been provided. However, further discussion will be required before a final phasing plan can be developed.

# 6.0 COST ESTIMATES

As indicated earlier, eight alternative alignment options were evaluated as part of this route selection study.

The cost estimates detailed below are based on existing available mapping and contours at 20 m vertical spacing. No detailed geotechnical evaluations were completed and it was assumed, based on earlier geotechnical evaluations, that the materials generated during excavation could be used as embankment fill. It is also assumed that suitable gravel sources will be available adjacent to the alignment.

The estimates provided should be considered order-of-magnitude costs for comparison purposes only. These estimates should have a substantial contingency, for example a 25% contingency allowance added at this preliminary stage, because the route studies were completed without the benefit of detailed engineering, geotechnical, or hydrographic survey information. We caution that the quantity take-off could be significantly over or under the values shown and do not include an allowance for rock excavation costs, which are rated as improbable. Therefore, the estimates at this stage are not intended to represent the actual total cost, but only a potential order of magnitude based on preliminary information. However, the relative cost of a 50 kph versus an 80 kph design speed will likely remain the same. In other words, the cost of providing an 80 kph design speed will be approximately 2.1 times the cost of constructing a 50 kph design speed road.

It should also be noted that the estimates include the upgrading of both Toby Creek road and Jumbo Valley road to either 50 kph or 80 kph. However, the majority of the expenditure in each case would be for the improvements to the Jumbo Creek FSR.

Table 2 details the cost estimates for both a 50 kph design speed route and an 80 kph design speed route based on 18km of road improvements.

## TABLE 2 – CONSTRUCTION COST ESTIMATES

| Construction Cost Estimate - Phase I<br>Intermittent Improvements to Jumbo Creek FSR | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Item** | **Description** | **Unit** | **Quantity** | **Unit Cost** | **Total** |
| | | | | | |
| 1 | Mobilization/Demobilization | LS | 1 | $45,000 | $45,000 |
| 2 | Ditching | LS | 1 | $50,000 | $50,000 |
| 3 | Clearing Sight Lines | Ha | 7 | $40,000 | $280,000 |
| 4 | Surface Works | Ls | 1 | $50,000 | $50,000 |
| 5 | Engineering & Construction Administration | LS | 15% | | $64,000 |
| | **Total Estimate** | | | | **$500,000** |

| Construction Cost Estimate - Phase II<br>Design Speed - 50 kph Jumbo Creek Road 18km | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Item** | **Description** | **Unit** | **Quantity** | **Unit Cost** | **Total** |
| | | | | | |
| 1 | Mobilization/Demobilization | LS | 1 | $86,000 | $86,000 |
| 2 | Bulk Excavation/ Subgrade construction | m3 | 450,000 | $6 | $2,700,000 |
| 3 | Drainage | LS | 1 | $400,000 | $400,000 |
| 4 | Structures | m2 | 1,550 | $1,000 | $1,550,000 |
| 5 | Surface Works | m3 | 27,000 | $20 | $540,000 |
| 6 | Engineering & Construction Administration | LS | 15% | | $792,000 |
| | **Total Estimate** | | | | **$6,000,000** |
| **Note: Toby Creek Road would cost approximately $2,970,000 to attain 50 kph design speed Panorama to Mineral King Mine (18km)** | | | | | |

| Construction Cost Estimate<br>Design Speed – 80 kph Jumbo Creek Road 18km | | | | | |
|---|---|---|---|---|---|
| **Item** | **Description** | **Unit** | **Quantity** | **Unit Cost** | **Total** |
| 1 | Mobilization/Demobilization | LS | 1 | $165,000 | $165,000 |
| 2 | Bulk Excavation/ Subgrade construction | m3 | 1,500,000 | $6 | $9,000,000 |
| 3 | Drainage | LS | 1 | $370,000 | $370,000 |
| 4 | Structures | m2 | 1,400 | $1,000 | $1,400,000 |
| 5 | Surface Works | m3 | 32,400 | $20 | $648,000 |
| 6 | Engineering & Construction Administration | LS | 15% | | $1,738,000 |
| | **Total Estimate** | | | | **$13,500,000** |
| **Note: Toby Creek Road would cost approximately $8,032,000 to attain 80 kph design speed Panorama to Mineral King Mine (18km)** | | | | | |

Although alternative alignments were considered in this route selection study and would be considered during detailed design, we have provided a representative cost estimate for comparative purposes. For example, one of the 80 kph alignments requires twice the volume of excavation of the alignment shown, and would not likely be considered during detailed design. Therefore, we did not prepare cost estimates for this option. It is likely that the added cost of excavation would add an additional 50% to the cost of the 80 kph alignment detailed in this report.

As shown in Table 2, the estimated costs, excluding contingencies, to improve Jumbo Creek FSR to a 50 kph design speed would average $6,577,000 for the 18 km of roadway, or $365,400 per km. The cost to upgrade this road to an 80 kph design speed would average $13,810,000, or $767,200 per km. It should be noted that the Toby Creek sections would add an additional $2,970,000 for the 50 kph design speed, or an additional $8,032,000 to attain an 80 kph design speed.

For discussion purposes, our preliminary estimates based on the approved standards by MoT indicate that a 50 kph design speed facility for the Jumbo Creek section would cost approximately $365 K per km to construct, while an 80 kph design speed facility would cost approximately $767 K per km to construct. For the Toby Creek section, the approximate cost is calculated at $165 K per km at 50 kph design speed, and at $446,222 at 80 kph design speed.

The cost estimates provided above, are to construct the roadways to a gravel standard road. If the roads were to be paved at a future time to current MoT standards, it may cost an additional $200 K per km to place 300mm of gravel and 75mm of pavement on the road. However, it should be noted that similar sections of road for the access to Kicking Horse Mountain Resort, excluding the cost of the switchback, have in fact been constructed for approximately $200 K per km, including paving.

# 7.0 CONCLUSIONS & RECOMMENDATIONS

This route study does not provide a detailed recommended alignment, but only the best alternative as the planned alternative at this stage of the design process. The information available is not sufficiently accurate or complete to determine the best location, design details or estimate the costs. It was undertaken to determine the most feasible design speed and to recommend options to be taken forward to the design of the route.

Based on the level of information available to complete this route selection study, we can confirm that construction of MoT's desired 90 kph design speed access road would be very disruptive to the natural environment and would have a prohibitive cost associated with construction. An 80 kph design speed access route for Jumbo Creek road can be provided, again with considerable disruption to the natural environment and at a cost of approximately $13.81 M.

The volumes of traffic associated with this development would ultimately require the access requirements for a Rural Collector Undivided Road, as defined by MoT's Highway Engineering Design Manual. This requirement would be reviewed based on future standards established at the time and revised accordingly.

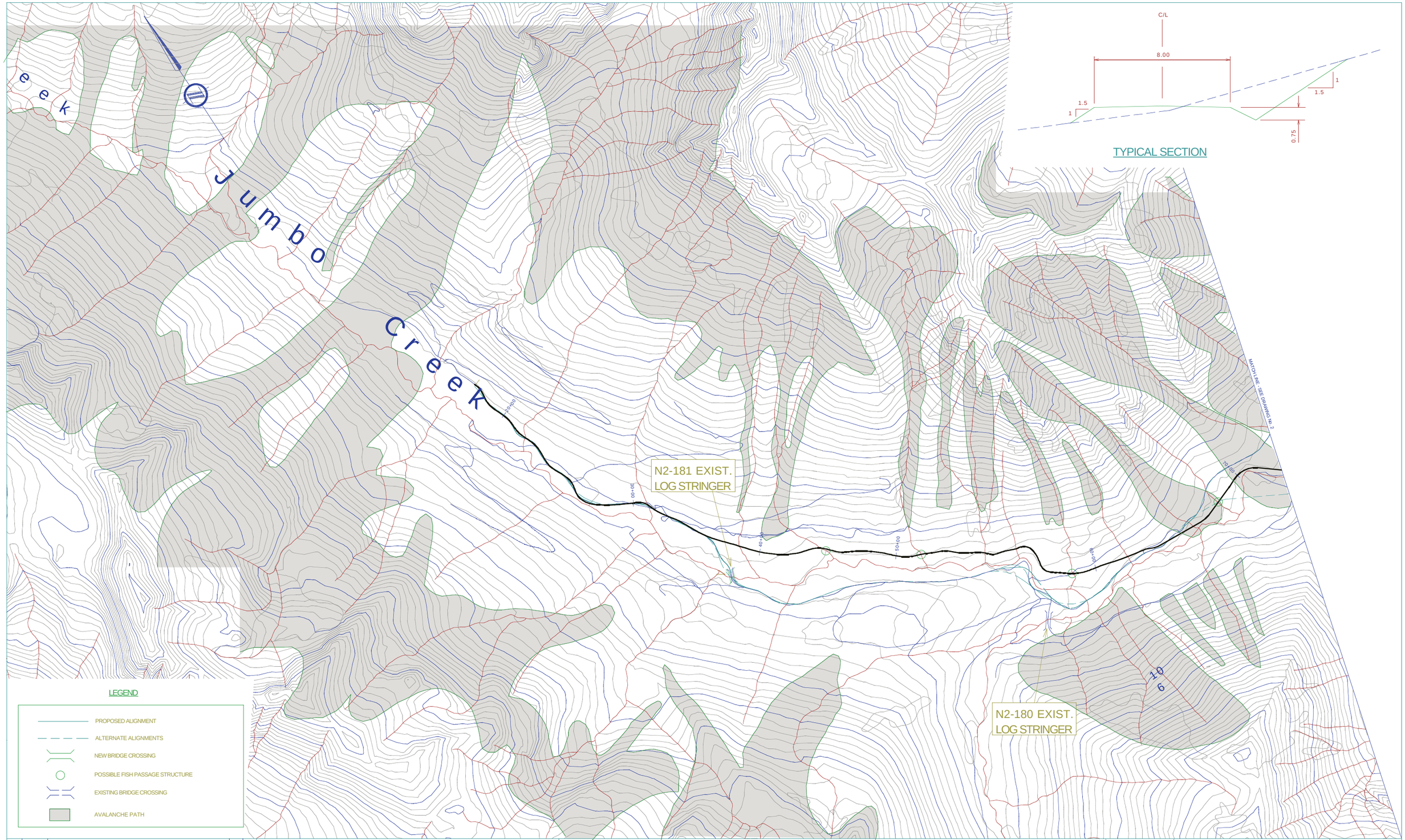
We would recommend that the access requirements for the proposed Jumbo Glacier Resort be confirmed using a maximum 50 kph design speed and, where horizontal or vertical constraints dictate, that some small sections of further speed reductions be permitted to provide access around or near environmentally-sensitive areas. We would further recommend that any cost sharing arrangements and a phased construction schedule be deferred until the Proponent and the other Agencies have agreed on the project scope for the access roads and further design details have been defined. Road improvement costs will be reduced by the selection of the route on the North side of the drainage, eliminating the need to rebuild bridges. We have also confirmed with Peter Schaerer that the avalanche protection measures would not require any snow sheds or

special measures other than avalanche monitoring and prevention, which he estimates in the range of $25,000 per year for the road from Panorama to the resort.

We understand that MoT is looking at modified road standards for mountain roads to tourist resorts. The viability of new developments of this type would be significantly improved if engineering standards for the main access road were similar to FSR requirements for the initial stages of the project. Future improvement could then be linked to the development growth, development revenue and the actual traffic volumes. A progressive standard of this type would help to reduce the huge financial burden and risk placed on a proponent at the beginning of a project regardless of the financing source, and would ultimately same money to the public.

# APPENDIX A

## ROUTE SELECTION AND PROFILES
## 50 KPH AND 80 KPH

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| 1 | 03 JUL 03 | ALIGNMENT TO ELIMINATE CROSSINGS ADDED. | H.S. | R.P. |

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PHEDIAS PROJECT MANAGEMENT CORPORATION

JUMBO GLACIER RESORT

PLAN - 50 km/h DESIGN

Scale 0 1 : 20,000 500m

Drawn | Designed

P.W. / P.U. | Job No. 2111-01243-1

Approved | Date AUGUST 2003

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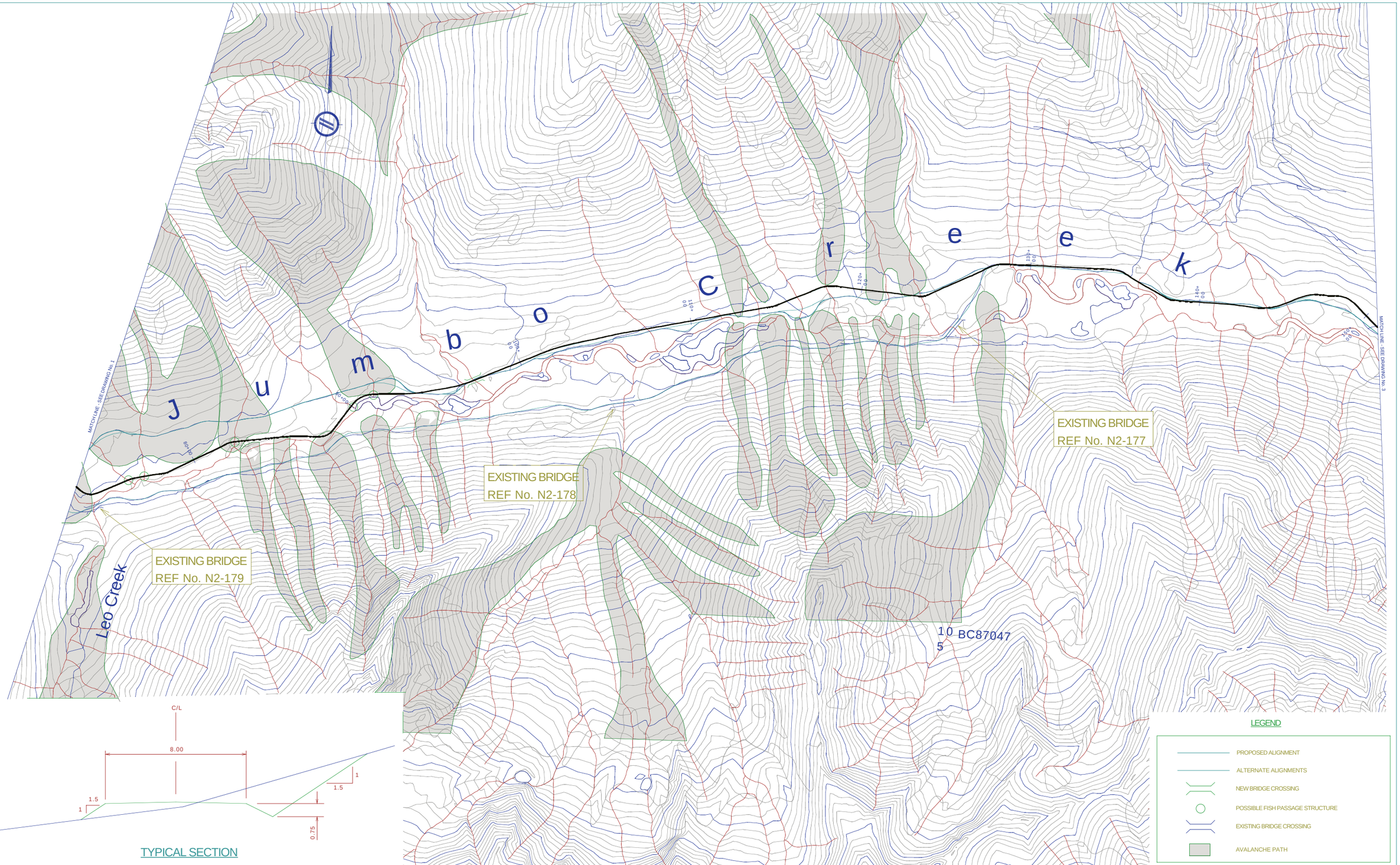


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Scale 0 1 : 20,000 500m

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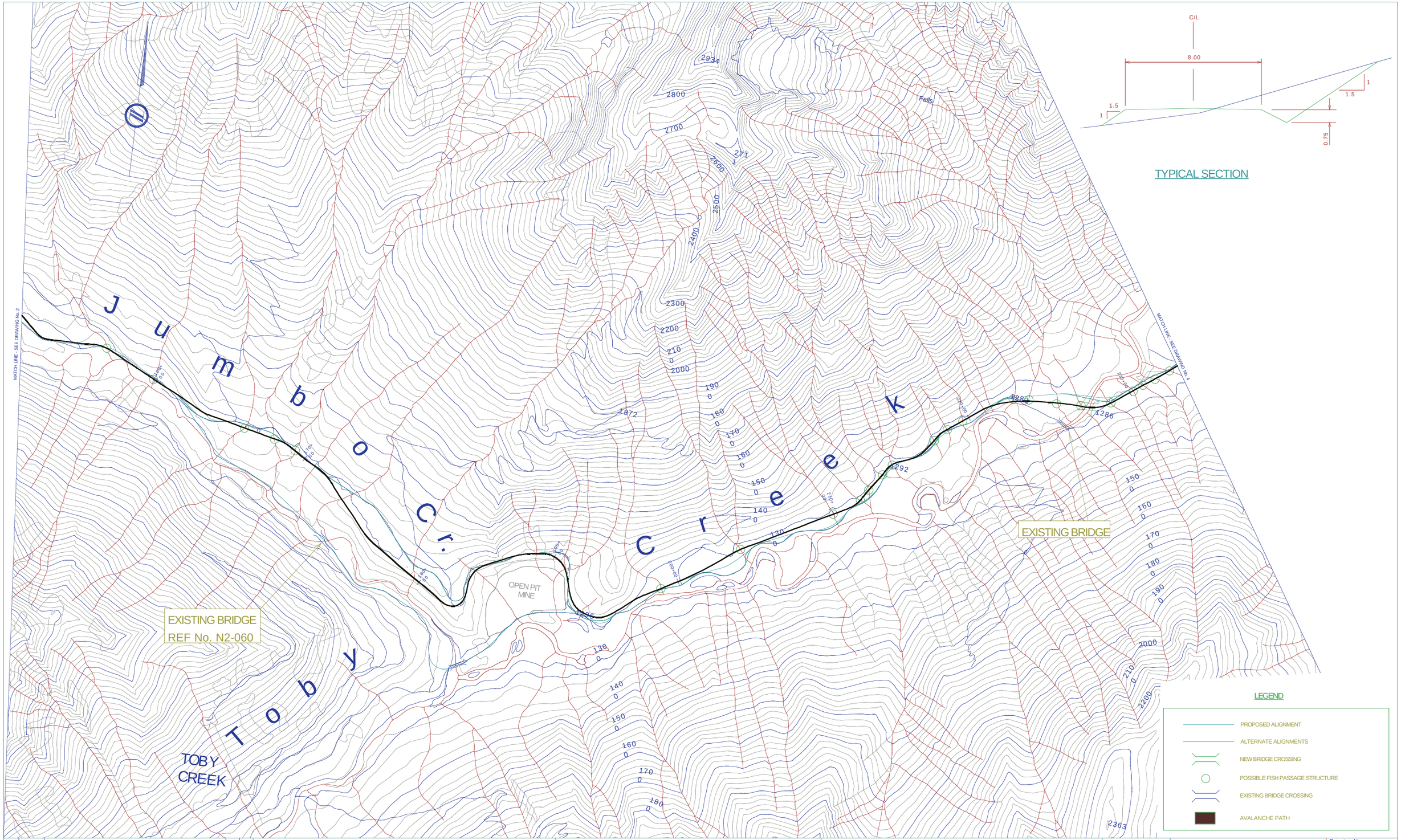


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Scale 0 1 : 20,000 500m

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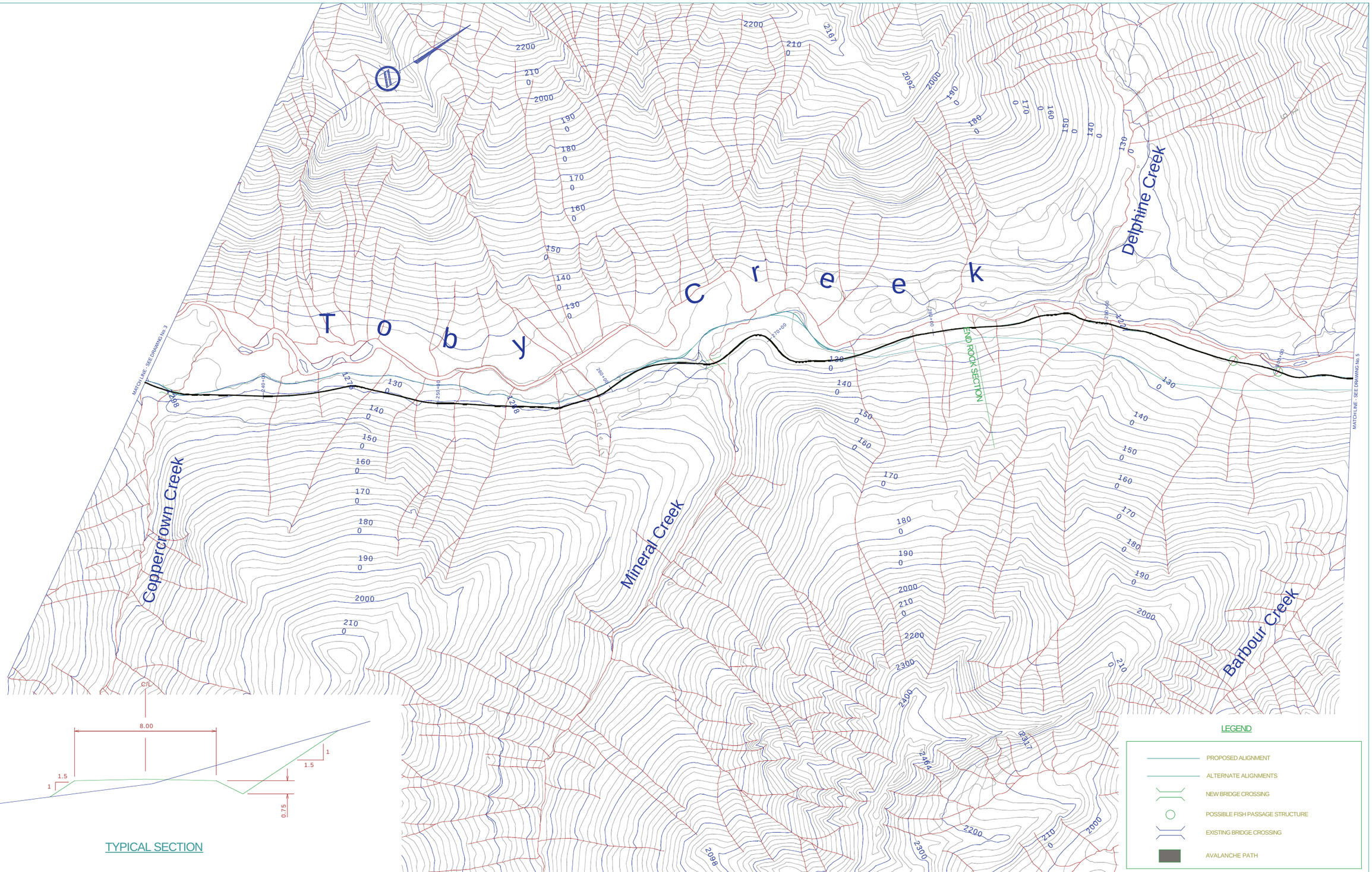


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PLAN - 50 km/h DESIGN

Scale 0 1 : 20,000 500m

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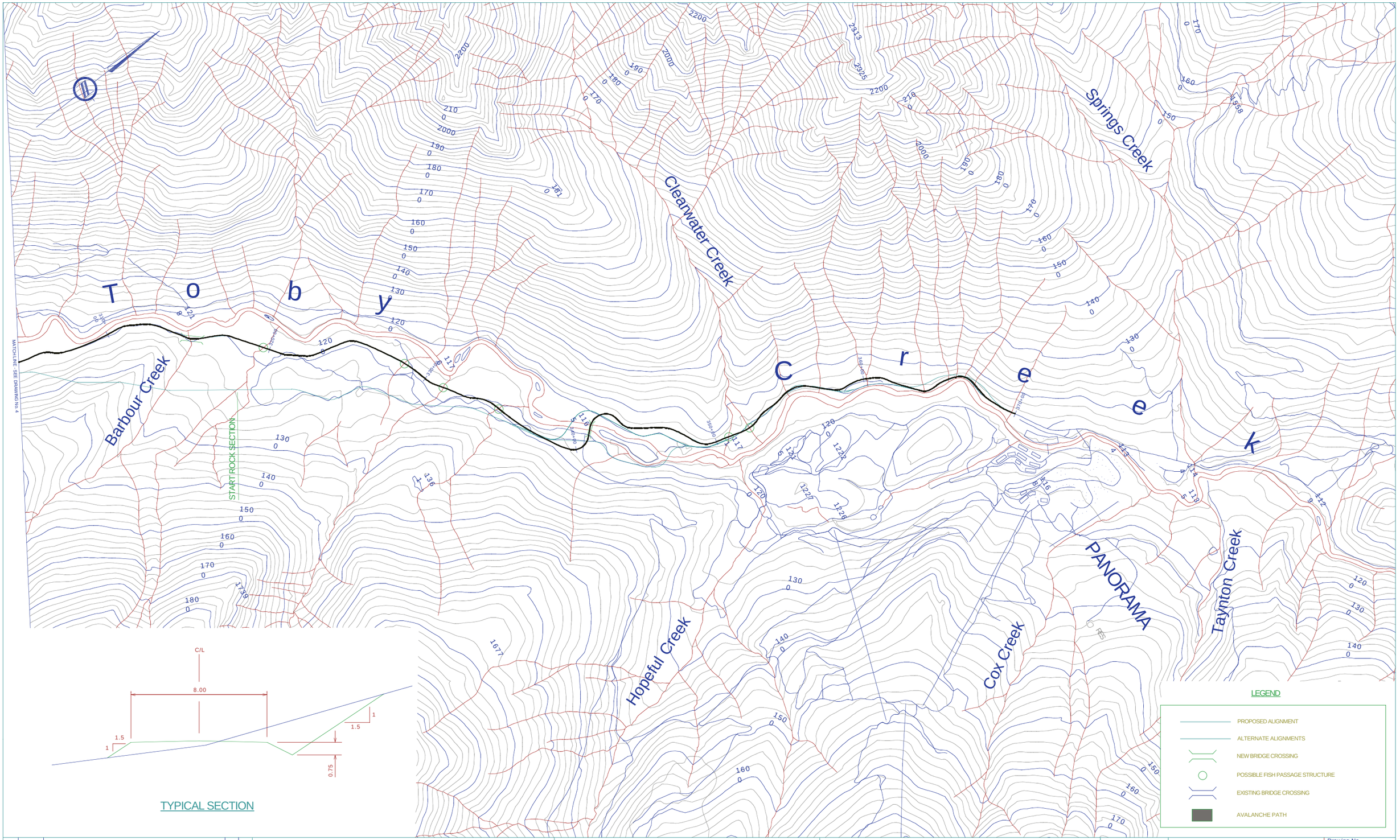


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PLAN - 50 km/h DESIGN

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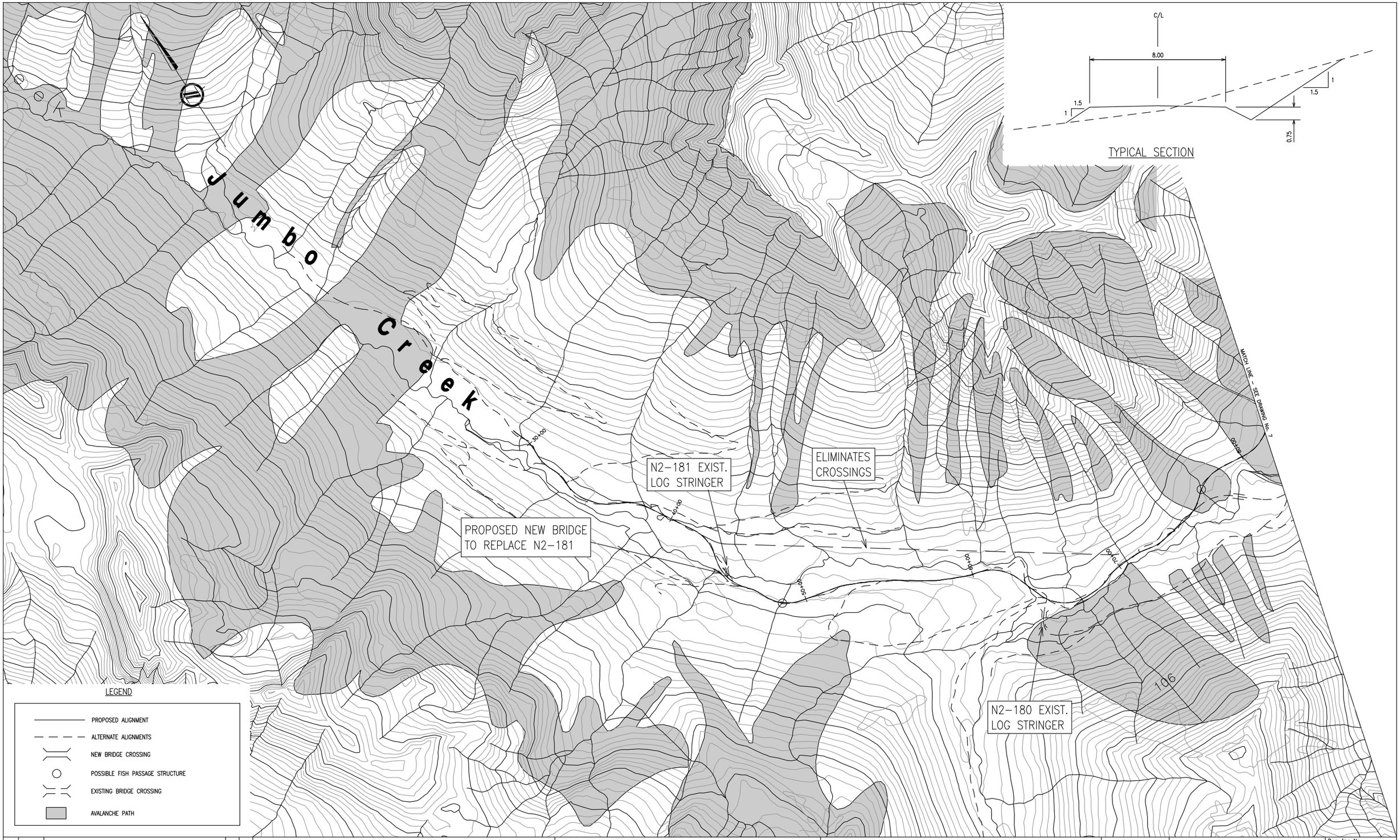


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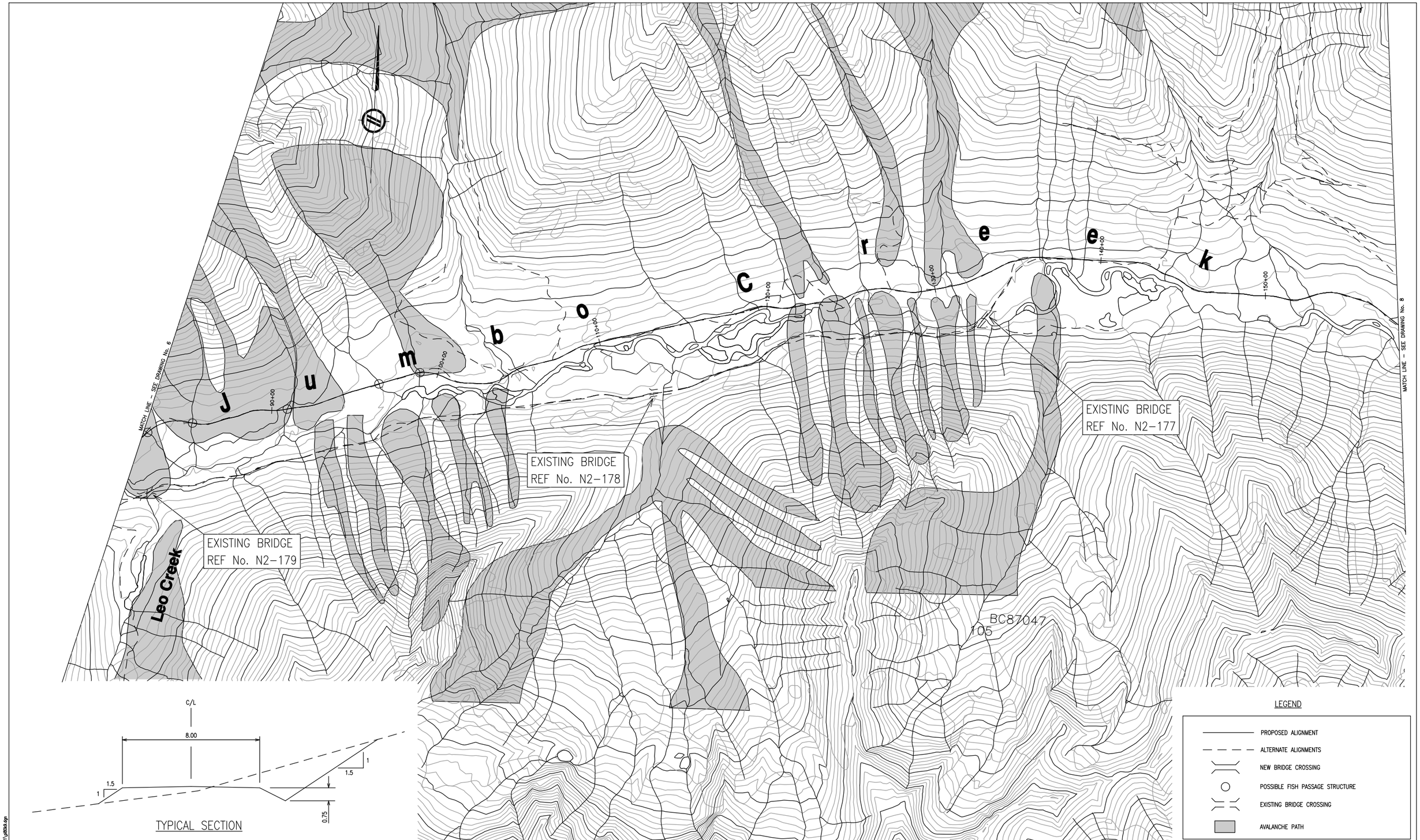


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PLAN - 80 km/h DESIGN

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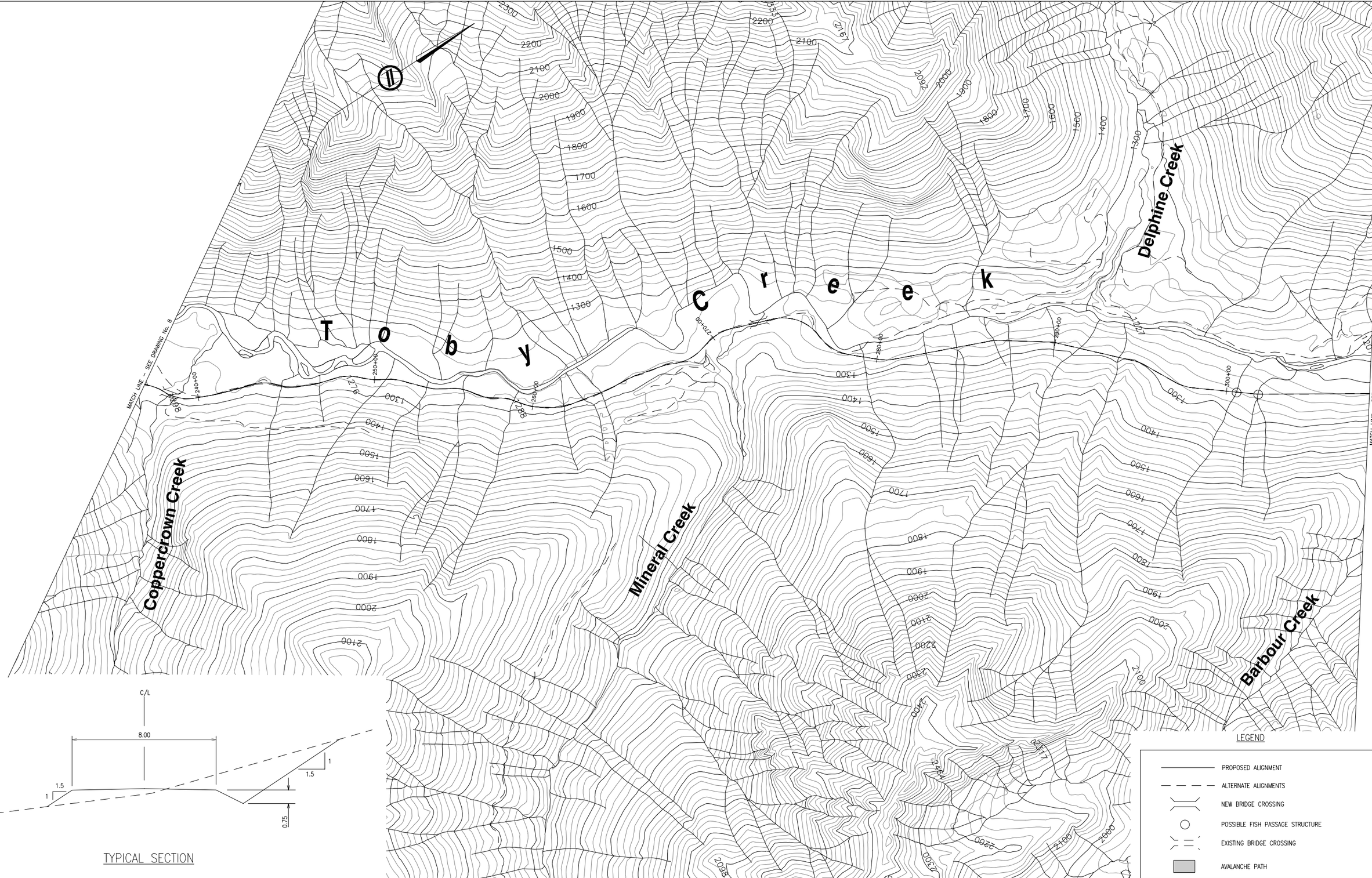


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PLAN - 80 km/h DESIGN

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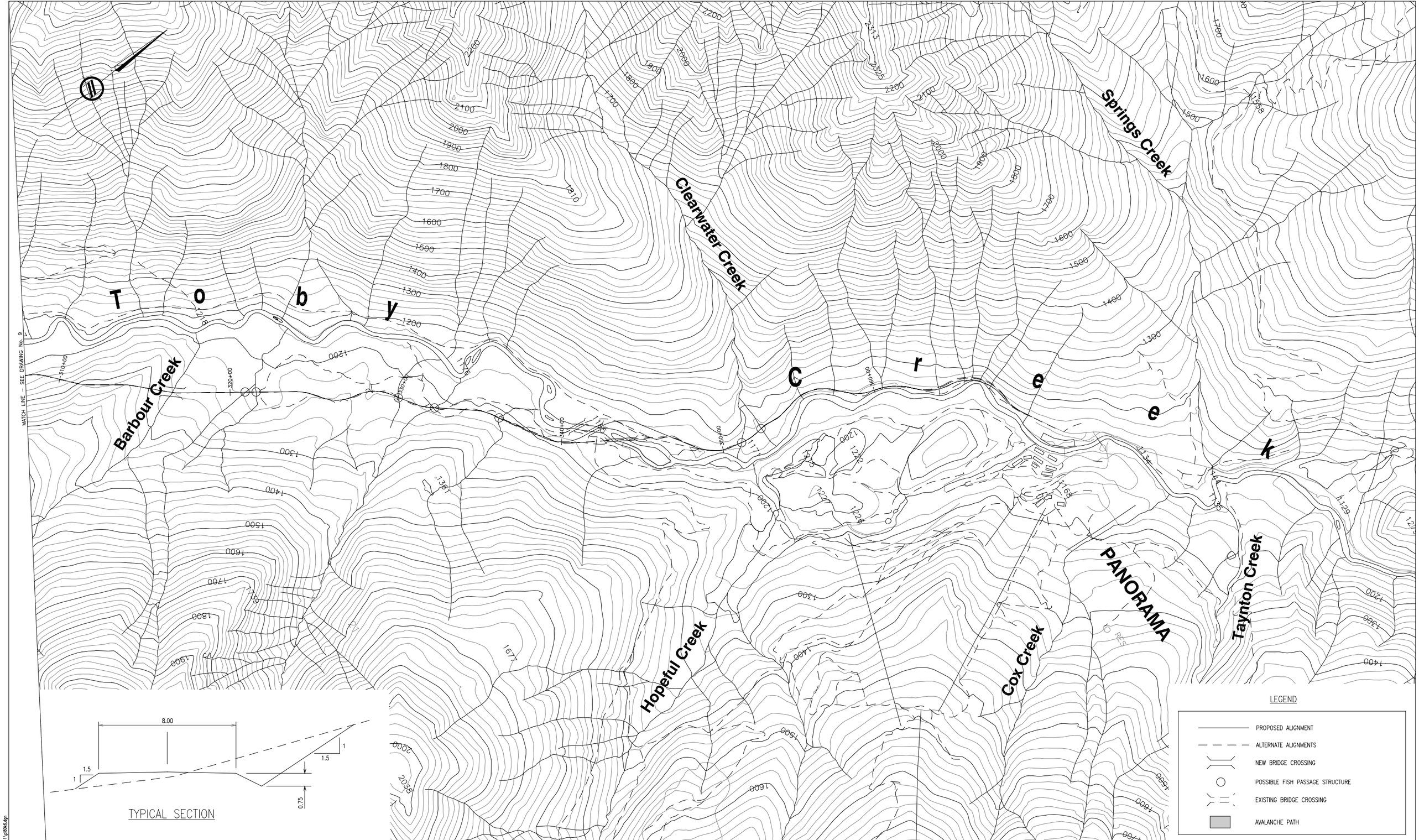


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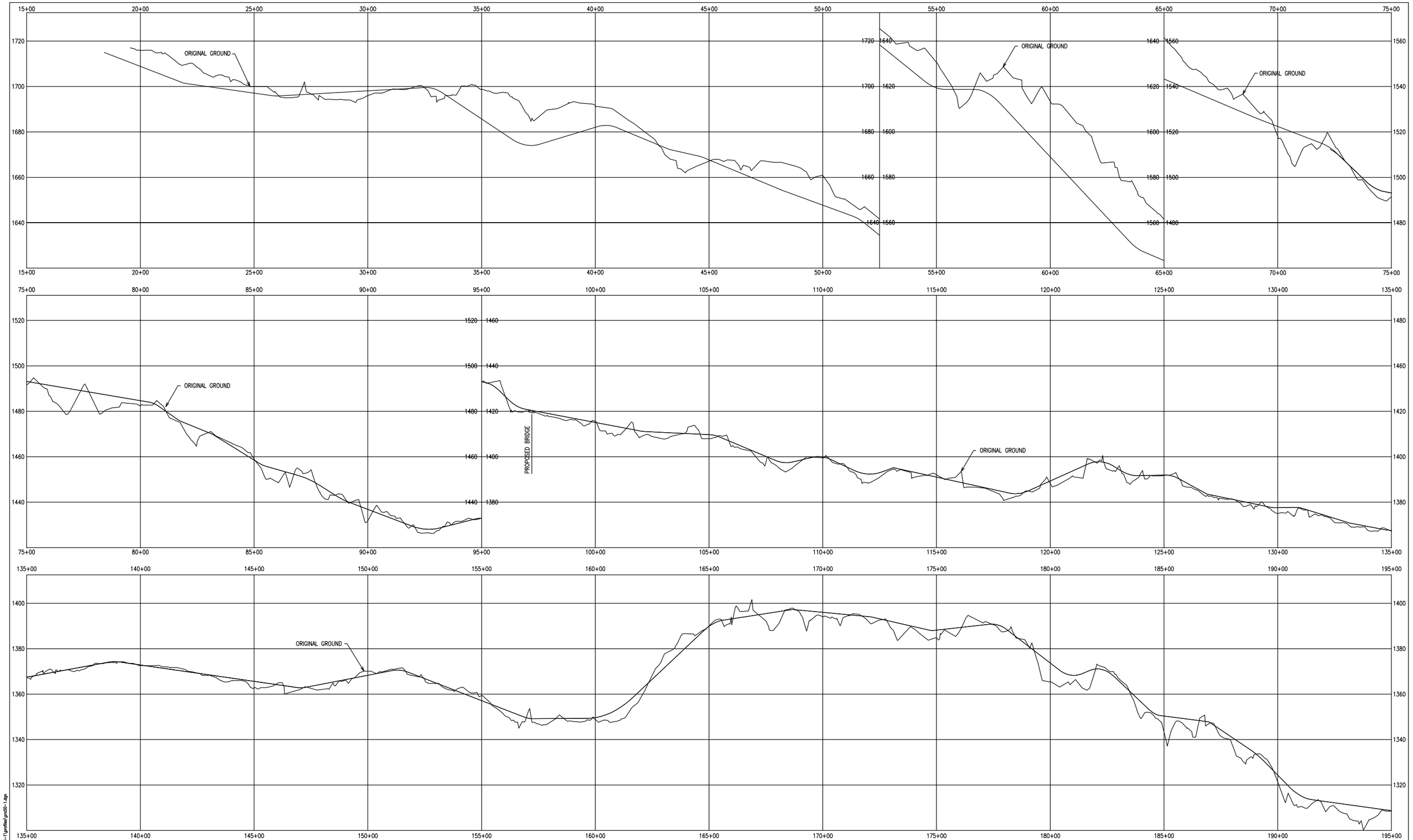


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JUMBO GLACIER ALPINE RESORT
PROFILE – 50 km/h DESIGN
STA. 15+00 to STA. 195+00

Scale 0 HORIZ. 1 : 7500 500m
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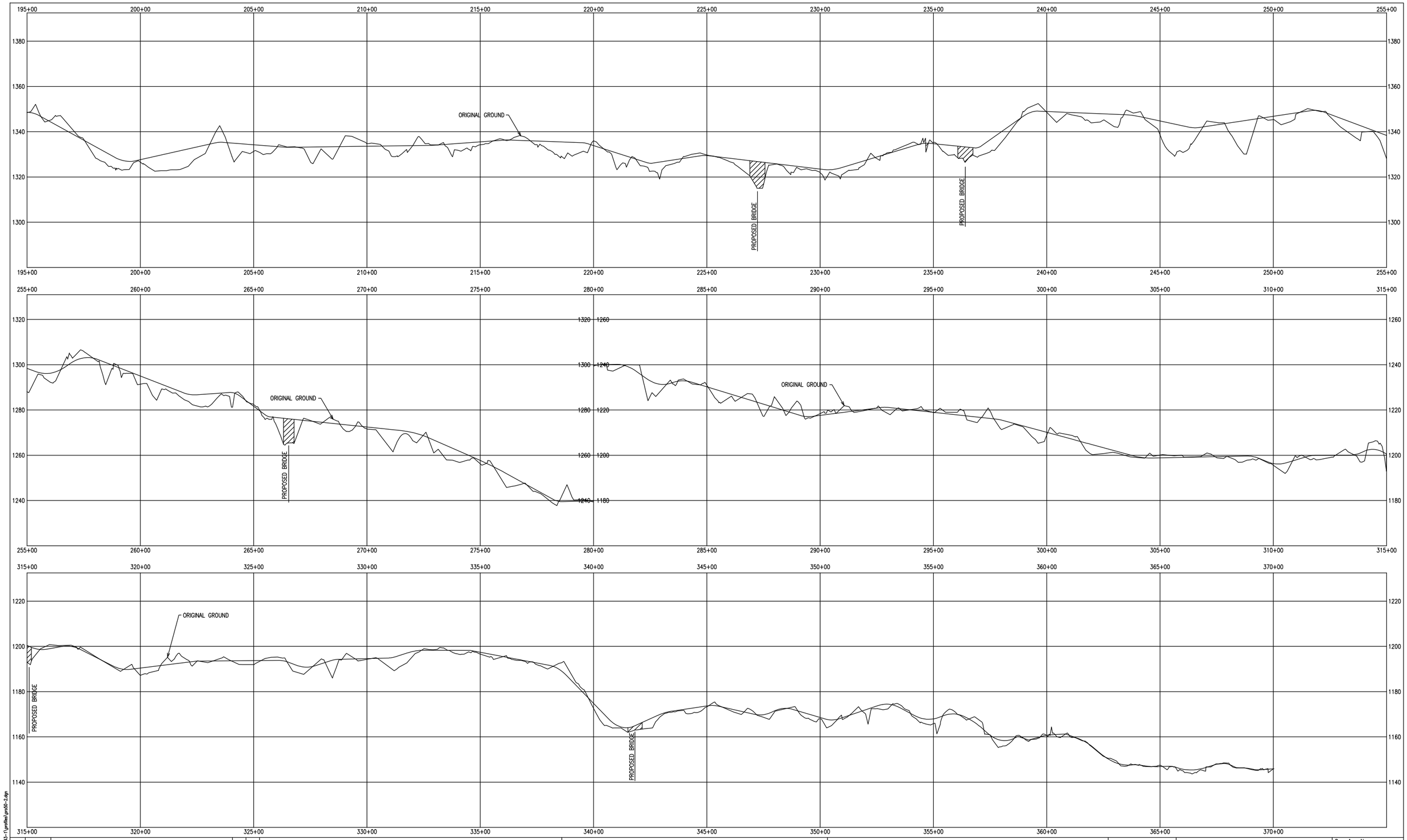


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JUMBO GLACIER ALPINE RESORT
PROFILE – 50 km/h DESIGN
STA. 195+00 to STA. 370+00

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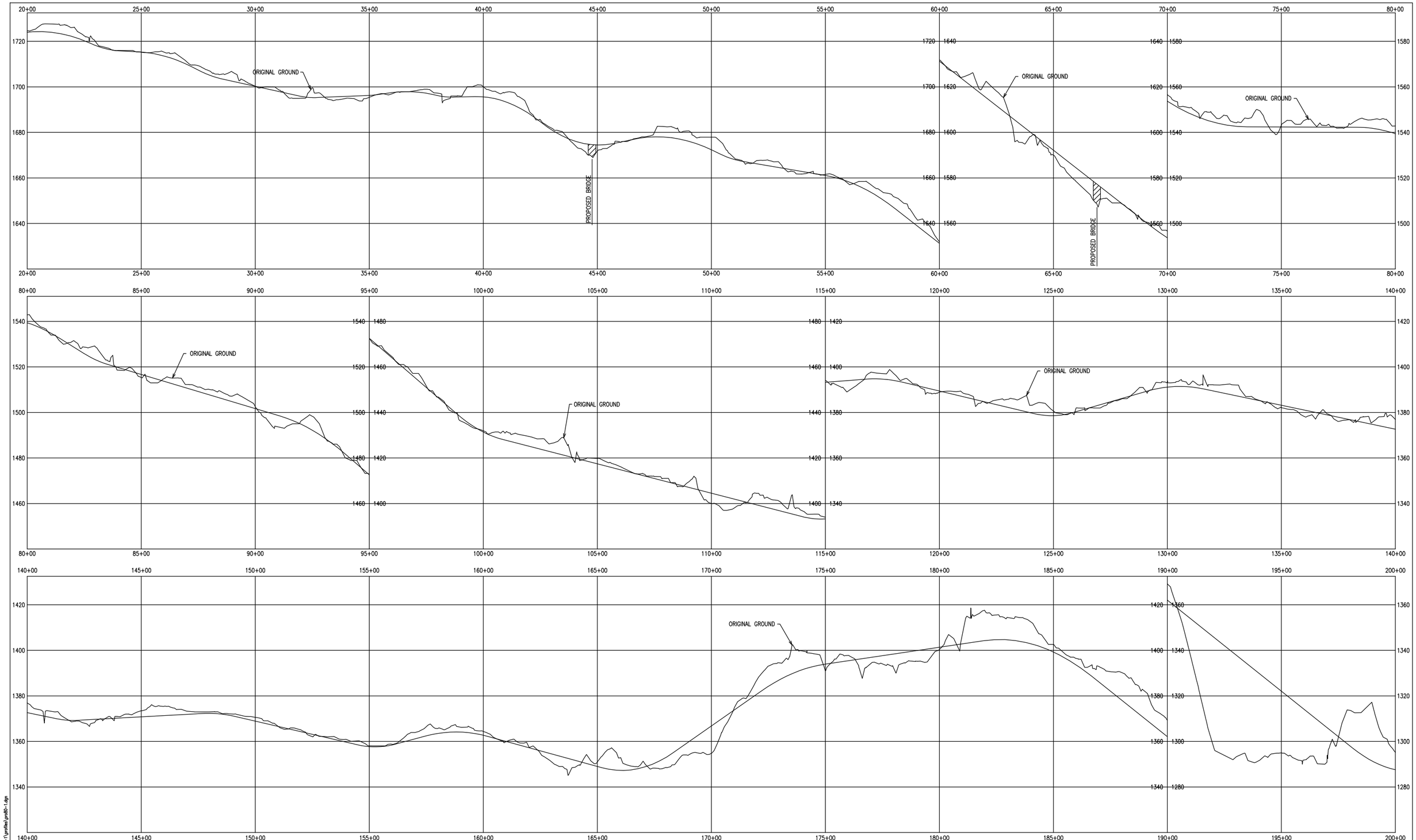


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JUMBO GLACIER ALPINE RESORT
PROFILE – 80 km/h DESIGN
STA. 20+00 to STA. 200+00

Scale 0 HORIZ. 1 : 7500 500m
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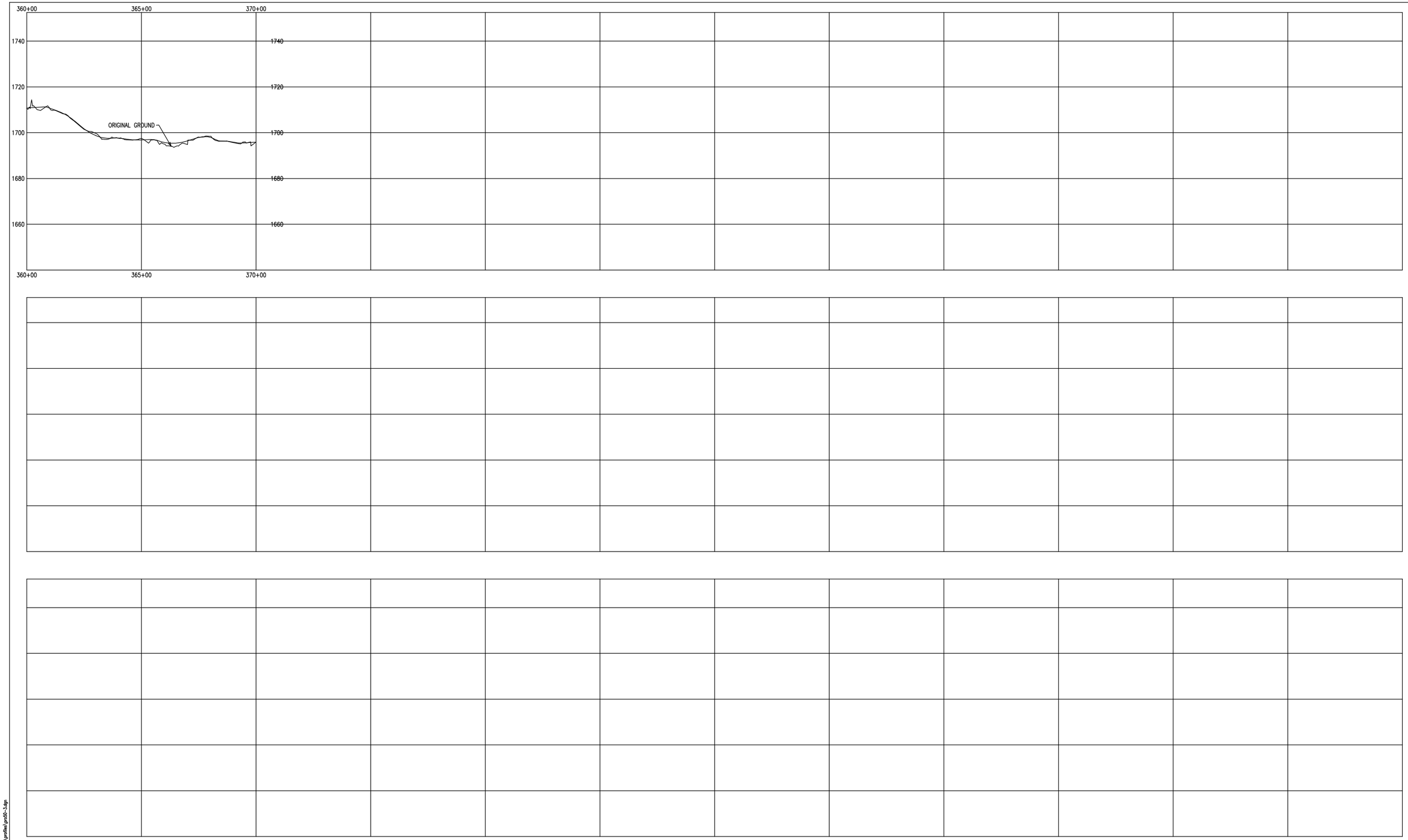


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JUMBO GLACIER ALPINE RESORT
PROFILE – 50 km/h DESIGN
STA. 360+00 to STA. 370+00

Scale 0 HORIZ. 1 : 7500 500m
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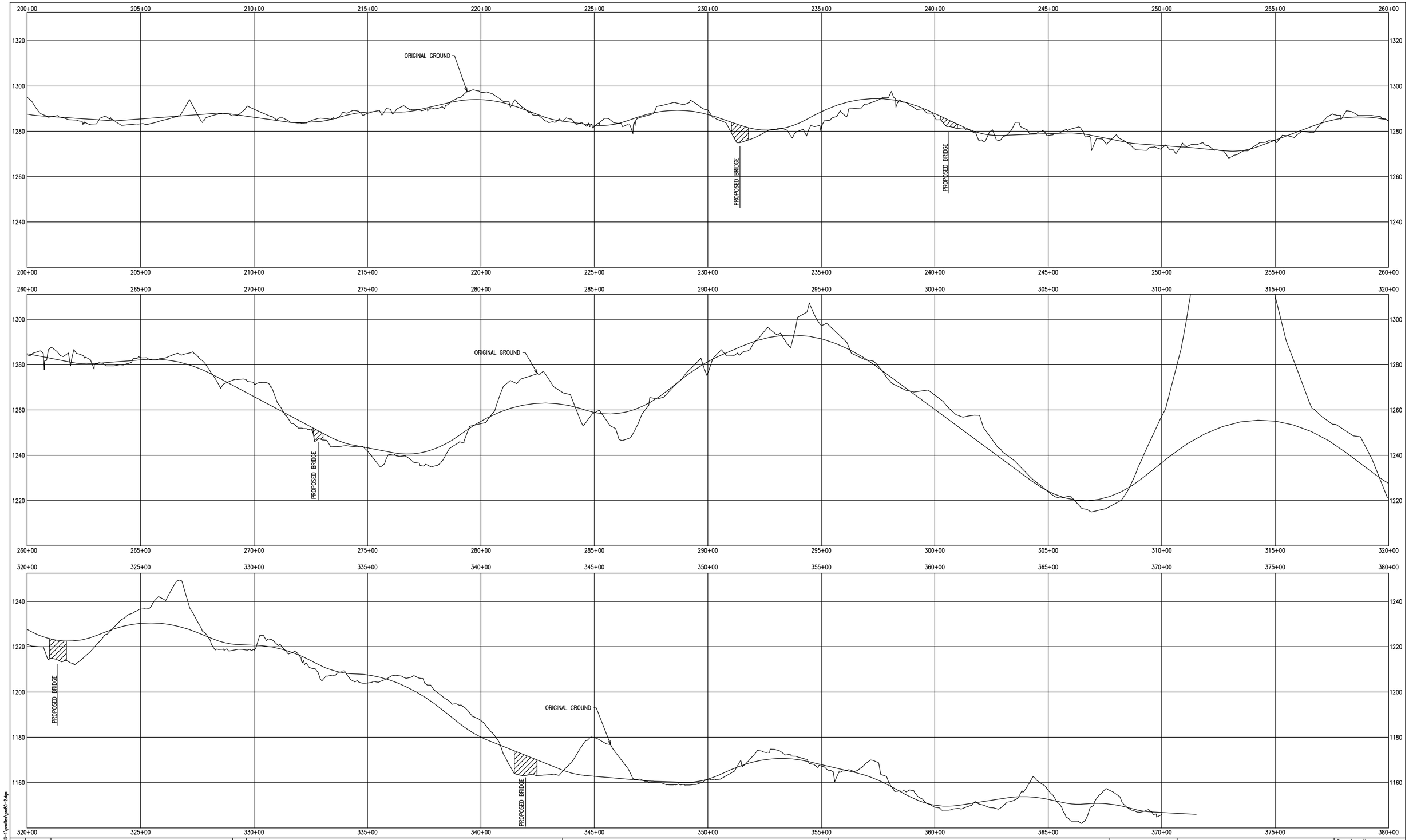


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JUMBO GLACIER ALPINE RESORT
PROFILE – 80 km/h DESIGN
STA. 200+00 to STA. 370+00

Scale 0 HORIZ. 1 : 7500 500m
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