

Interior Engineering Cost Estimate Procedures


Effective: July 1, 2021

Prepared By:

ECE Procedures Working Group

(North and South Area Timber Pricing)

Approved By:



June 24, 2021

Allan W. Bennett, RPF

Date

Director, Timber Pricing Branch

New 2021 Engineering Cost Estimate Procedures

Document Change Log

The July 1, 2021, *Engineering Cost Estimate (ECE) Procedures* has been updated. Changes by section as compared to the 2020 *ECE Procedures* are:

Section	Description
O	<ul style="list-style-type: none">• Clarified the rental period for portable platforms.• Clarified PST charges for portable platform rentals.
R	<ul style="list-style-type: none">• Clarified the intend of Forwarding Roads.• Added the requirement to provide supporting documents and rationale if requested.

Table of Contents

1.0 Administration	2
2.0 Engineering Cost Estimates	4
3.0 Submission Standards	7
Item A: Road Construction - Long Term Primary Access Roads	11
Item B: Road Construction - Uphill Side Slopes exceeding 50 Percent.....	12
Item C: Road Construction - Rock exceeding 50 Percent	13
Item D: IAM ECE Item Road Construction - Terrain Class IV or V	14
Item E: Road Construction - End Haul	15
Item F: Road Construction - Overland.....	17
Item G: Bridge Installations.....	19
Item H: Bridge Maintenance or Upgrade.....	25
Item I: Road Reactivation	28
Item J: Road Reconstruction	29
Item K: Road Upgrade	30
Item L: Road Surfacing - Placement of Stabilizing Material	32
Item M: Culvert Installations	33
Item N: Road Surfacing - Placement of Specialized Materials	35
Item O: Road Surfacing - Portable Platforms	36
Item P: Special Structures	38
Item Q: Road Construction - Road Group 1	41
Item R: Forwarding Roads.....	43
Item S: Blasting Rock within Tabular Road Sections	44
Appendix 1: Definitions.....	45
Appendix 2: Supervision and Certification Costs.....	47
Appendix 3: Calculation of Slope Percent for an ECE Road Section	49
Appendix 4: Calculation of Rock Percent for a Road Section.....	51
Appendix 5: References	53

1.0 Administration

1.1 Authority

These procedures have been approved by the Director of Timber Pricing Branch. The Interior Appraisal Manual (IAM) requires that these procedures, as updated from time to time, be followed for the submission of an ECE in an appraisal or reappraisal.

When a discrepancy is identified between the IAM and these Procedures, the IAM will prevail. The Regional Timber Pricing Staff will provide clarification in these situations.

1.2 Purpose

The purpose of this document is to identify the requirements for all ECEs in the Interior. This includes:

1. The submission standards required in an appraisal or reappraisal;
2. The supporting information that may be required by regional timber pricing staff or district engineering staff;
3. The ECEs that require 30-day notification to district engineering staff; and
4. The ECEs that require review by regional timber pricing staff prior to a stumpage rate determination.

1.3 Application

These procedures are applicable to development projects that require ECEs in an appraisal or reappraisal.

1.4 Licensees' (including BCTS) Roles and Responsibilities

1. Ensure the cost effectiveness of their engineered development costs;
2. Ensure their ECE submissions are reasonable for the site conditions, consistent with the IAM and meet the requirements outlined in these procedures; and
3. Provide additional supporting information where the aspects of the project are beyond the normal experience for the type of project in the district and/or as requested by district engineering staff or regional timber pricing staff in order to complete the review of an ECE and determination of a stumpage rate.
4. BCTS must include in the Electronic Commerce Appraisal System (ECAS) an appropriate level of submission content as described in each of the specific ECE items within this document.

1.5 District & Regional Engineering Roles and Responsibilities

1. Review bridge and major culvert upgrades on Forest Service Roads (FSRs);
2. Provide advice on engineering practices, site conditions, productivities or specific engineering projects;
3. Provide advice to regional timber pricing staff on the eligibility of complex structures;
4. Assist with the ongoing updates to these procedures as necessary; and
5. Provide assistance to timber pricing staff in the review of ECE submissions.

1.6 Regional Timber Pricing Roles and Responsibilities

1. Provide advice to licensees on the eligibility of ECE items;
2. Review requests for and approve equipment rates for any equipment not listed in Appendix I of the IAM;
3. Consider and determine changes to the list of eligible Special and Complex Structures as outlined in these Procedures;
4. Identify training needs for district staff; and
5. Provide interpretation on the eligibility of a specific project as requested by District staff.

2.0 Engineering Cost Estimates

2.1 Engineering Cost Estimates

A development project ECE may be used in an appraisal or reappraisal of a cutting authority if the holder of the cutting authority incurred or will incur that kind of cost.

Development projects that do not qualify for tabular, or fall under the specific ECE items in these procedures, may also be eligible items. A professional rationale statement must be provided for these unique situations.

Items that are otherwise considered part of other tenure obligation adjustment (TOA) costs, or part of the costs represented in the MPS Final Estimated Winning Bid, are not eligible items in an ECE.

2.2 Forest Management Administration Items

The IAM includes activities which are considered to be part of Forest Management Administration costs and are directly related to the supervision and administration of those activities. Additional items related to an ECE project, which are considered as forest management administration costs that should not be included in the ECE are:

1. Emergency transportation vehicles and first aid attendants;
2. Stream assessments for the determination of stream class for operating areas;
3. Supervisor or monitoring by an R.P.Bio. or Environmental Monitor;
4. General bridge supervisor (non-complex structures);
5. Any environmental protection works except those specifically listed in section 2.5.

2.3 Road Management Items

Items normally covered under Road Management in the IAM, if specifically required as part of the ECE project/item, can be included in the ECE. Sufficient information should be documented to justify the inclusion in the ECE of any items normally covered under Road Management in the IAM.

For example, grass seeding to mitigate erosion during the ECE project is a legitimate cost to include with construction. Grass seeding as a separate activity is considered part of the road management cost estimate. Grass seeding cannot be submitted as a stand-alone item.

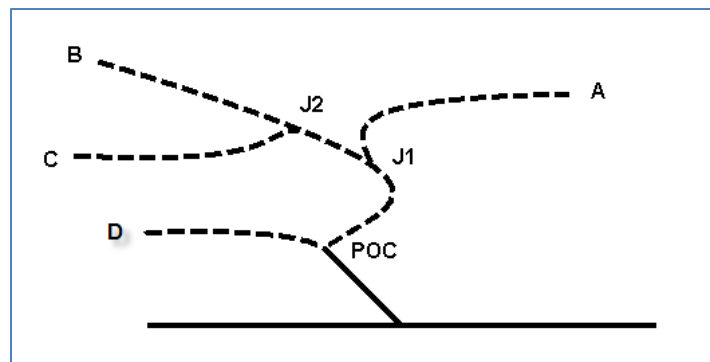
2.4 Projects on Roads Tenured to a different Licensee

Where the licensee (licensee A) holding the road permit does not foresee harvesting in an area, and where a second licensee (licensee B) does intend to conduct operations, licensee B may claim an ECE for an upgrade or reconstruction ECE.

In the case of a second licensee submitting an ECE, a copy of the road use agreement or sufficient documentation must be available. The road use agreement or documentation must clearly show that permission has been given to licensee B by licensee A (road permit holder) to conduct the engineered development works. Licensee A will not be able to claim the costs of the works conducted by licensee B (on licensees' behalf) on future cutting authorities.

2.5 Combo Roads

A licensee may submit a section of new subgrade construction as a “combo” road. A combo road is a section of road with at least 20% of the length made up of ECE eligible sections. To qualify as a section of combo road, it must be measured from a Point of Commencement (POC) to a Point of Termination (POT) or a road junction to a POT (i.e. road junctions are not considered a POT for the purposes of this definition). Examples of potential combo road configurations are illustrated below.



Combo Road Examples – POC to A, B, or C; POC to D; J1 or J2 to a POT.

2.6 Eligible Costs (Generally accepted costs in an ECE)

The following items are considered to be in addition to forest management administration and may be submitted as part of an ECE:

1. Traffic control where justified based on traffic (public and/or industrial), location and nature of the road works;
2. Site surveys and the production of a geometric road design;
3. Terrain Stability Field Assessment (TSFA) and reports (i.e. Measures to maintain slope stability) completed by a Qualified Registered Professional (QRP) where required for the ECE;
4. Site specific Environmental Management Plans (when submitted with the ECE);

5. Stream diversion or isolation works where required as part of the approvals by Ministry of Environment or Fisheries and Oceans Canada, or by a Professional Engineer as part of the design;
6. Multiple handling of right-of-way timber when required (i.e. single heading construction);
7. Stumpage for log culverts when the timber has been scaled and billed. Costs to transport the logs from the mill yard to the site may also be included. Note: Stumpage is not an acceptable cost for on-site materials derived from the road right-of-way; and
8. Costs for grade staking or slope staking may be included where tight survey control is required or recommended by the designer.

2.7 Ineligible Costs

The following items are not acceptable in an ECE (list is not complete – other items may be ineligible):

1. Harvesting operations (i.e. Felling, skidding, yarding, bucking, sorting);
2. Landing construction, rehabilitation and reconstruction (excluding end haul);
3. Pest control;
4. All post logging treatments;
5. Contractor overhead and profit, fringe benefits;
6. Three metre knockdown;
7. Lop and scatter;
8. Landing burning (includes fireguards);
9. Roadside debris piling and disposal;
10. Skid and back spar trail construction and rehabilitation/slashing; and
11. Slashing.

3.0 Submission Standards

3.1 Methods for Determining Engineering Cost Estimates

There are four methods for determining ECEs:

1. QRP estimate (excludes BCTS);
2. Detailed Calculation;
3. Tendered Contract (excludes BCTS); and
4. Tabular Value.

3.1.1 Qualified Professional Estimate

A licensee representative submitting an ECE in an appraisal may choose to submit a development project as a QRP estimate.

These types of estimates are for projects that have not been started (pre-construction) at the time of the submission in ECAS. A QRP estimate is appropriate for common projects that have project costs in the same area.

3.1.2 Detailed Calculation

A licensee representative submitting an ECE in an appraisal may choose to submit a development project as a Detailed Calculation.

3.1.2.1 Pre-Construction

When the development work has not been completed prior to the time of a submission of an appraisal in ECAS, the detailed calculation must be based on the estimate of volumes included in a geometric road design, or in the case of drainage and other structures, site specific plans and/or designs.

Sources of equipment productivity include Chapter 3 of the 1993 *BC Ministry of Forests Engineering Manual*, manufacturer productivity guides, and the *North Area Productivity Estimating Guide* (January 27, 2010).

Equipment and labour rates from the IAM Appendix I must be used where available. Alternatively, the Blue Book matching the IAM Cost Base may be used for equipment that is not listed in Appendix I. Cost estimates for materials may be sourced from local quotes.

The level of the survey completed should be consistent with the complexity of the project and the level of detail required for the calculation of volumes. For example, for road construction through rock (>50%), a higher level of survey is required than for reconstruction of tabular roads. For bridges and major culverts, the level of site survey is outlined in the *Stream Crossing Guidelines*.

3.1.2.2 Post-Construction

When the development work has been completed prior to the time of the submission of the appraisal or reappraisal in ECAS, the detailed calculation must be based on the actual equipment type and hours worked, hours in labour or professional services, materials and costs.

Equipment and labour rates from the IAM Appendix I must be used where available. Alternatively, the Blue Book matching the IAM Cost Base may be used for equipment that is not listed in Appendix I.

3.1.3 Tendered Contract (Arm's Length Competitive Bids)

The licensee has the option of submitting the results of an arm's length competitive bid process as an ECE for a specific project or a portion of a project. The contract and results used in an appraisal or reappraisal must meet the provisions outlined in the IAM. The tendered contract must not include items that are ineligible.

3.1.4 Tabular Values

3.1.4.1 IAM Cost Tables and Formulas

Cost estimate information (such as for tabular bridges, tabular culverts or stabilizing material formulas), equipment and labour rates must be used for cost estimates unless the project qualifies for a detailed ECE, or a tendered contract as per the IAM.

3.1.4.2 Road Reactivation Cost Estimates

The FLNRORD *Road Reactivation Cost Estimate Template* for this type of work may be required. Refer to Item I – Road Reactivation for more information.

3.1.4.3 Road Group 1

Item Q in these procedures must be used to estimate tabular road costs in road group 1.

3.2 General ECE Submission Requirements

All submissions must include a project summary containing the following:

1. ECE item (IAM section 4.3.6) under which the project/section(s) qualifies;
2. A description of project and/or section works in sufficient detail to confirm eligibility for inclusion in the ECE submission;
3. ECE project identified by road name or number, location and crossing names for structures;
4. ECE project location shown and highlighted on the appraisal map; and
5. ECE cost base year (refer to the Cost Year located on the first page of the effective IAM).

For a BCTS submissions the following details may also be required:

1. Equipment used, equipment rates, productivity, hours, labour costs material costs by project phase, including freight, applicable tax, mob and de-mob costs;
2. Volumes of material by soil type in bank cubic meters (m³) where earthworks form part of the ECE item;
3. Professional prescriptions or reports when prepared and form an integral part of the design or ECE;
4. An economic life cycle comparison of road or structures;
5. A copy of the legal survey;
6. Justification for multiple handling of right-of-way timber when required (i.e. single heading construction); and
7. For log culverts, stumpage paid (ONLY when the timber has been scaled and billed). Cost of transportation from the mill yard to the site can be included. Stumpage will not be an acceptable cost on-site for materials derived from the road right-of-way.

Additional supporting information may be required and is detailed in each of the specific ECE items within these procedures.

ECE Documentation Requirement				
ECE Method	Planned/Original ADS		¹ Ministry Review	
	Pre-Construction /Development	Post-Construction /Development	Project <\$25,000	Project \$25,000 or more
Qualified Professional Estimate	Based on experience, internal cost tracking of a “reasonable” cost for the project. Limited supporting documentation.	Not applicable. A Detailed Calculation or a Tendered Contract is required.	Physical evidence or documentation as per the IAM requirements. Bid amount and confirmation of either: A limited tender with 3 or more bids received and lowest bid was awarded or A public (advertised) tender and lowest bid awarded.	Full documentation as per the IAM requirements. Bid amount and confirmation of either: A limited tender with 3 or more bids received and lowest bid was awarded or A public (advertised) tender and lowest bid awarded.
Detailed Calculation	Estimate of hours, equipment & rates, materials, labour, prof. service costs.	Actual hours, equipment & rates, materials, labour, prof. service costs. or Actual linear/piece rate contract - only for road reconstruction, reactivation or upgrade projects <\$25,000.		
Tendered Contract	Bid amount and confirmation of either: A limited tender with 3 or more bids received and lowest bid was awarded or A public (advertised) tender and lowest bid awarded.			
Tabular Values	Project meets tabular criteria in the IAM (N/U Bridges, Culverts, Subgrade, Stabilization, RG 1 and the <i>Road Reactivation Cost Estimate Template</i>).		Physical evidence of the work or documentation as per the IAM requirements.	

¹ – Information is to be retained by licensees and made available to the Ministry upon request during the office or field review stage (as per the IAM).

Item A: Road Construction - Long Term Primary Access Roads

IAM ECE Item

New construction of long term, primary access road sections with a finished running surface greater than 6 m wide and agreed to by district engineering staff.

Application

This section applies to new construction only, where the proponent has clearly demonstrated to the district engineering staff that the access road meets the requirement for long-term access.

Supporting Information

1. District engineering staff may request the following data to support an ECE:
2. Where necessary, geometric road design including plans, profiles and cross sections. The design must include relevant design notes and identify the natural ground profile, final grade lines, road width, drainage structures, cut/fill slopes and soil types;
3. Volume calculations by soil type;
4. Mass haul volume reports and diagrams to a measurable scale, complete with balance lines, direction of haul and identified waste & borrow areas;
5. Summary report for all drainage structures;
6. Location of borrow pits, gravel pits, rock quarries and/or waste areas complete with estimated volumes;
7. Reference to designs and/or specifications for other structures, such as railway and pipeline crossings when these structures are within the section, but costs may be applied under another item;
8. Copies of any documentation of requirements from other agencies that are relevant to the new construction; and
9. Intersection design or specifications, if applicable.

Eligible Costs

The ECE may contain all phases of construction including road survey, layout and design, grubbing and stripping, subgrade construction, drainage construction and surfacing. It is not constrained by the road group construction equations, but it must use the IAM subgrade variable definitions, tabular culvert costs (for those sizes referenced in the ECE) and the IAM equipment and labour rates. Right of way logging activities do not form part of an ECE.

Item B: Road Construction - Uphill Side Slopes exceeding 50 Percent

IAM ECE Item - Road construction where the uphill side slope exceeds 50 percent.

Application

The following is applicable to this ECE item:

1. The natural ground uphill side slope will be taken from measurements at cross-section stations along the section length in accordance with the IAM.
2. The natural ground uphill side slopes must be greater than 50 percent to qualify for inclusion in the ECE section length.
3. Slope percent for a road section can be calculated from an acceptable road design software package.
4. The natural ground uphill side slope greater than 50 percent must intersect the road prism cut to be considered.

Eligible Costs

The ECE may contain all phases of construction, including road survey, layout and design, grubbing and stripping, subgrade construction, drainage construction and surfacing. It is not constrained by the road group construction equations, but it must use the IAM subgrade variable definitions, tabular culvert costs for those sizes used in the ECE, and the IAM equipment and labour rates. Right of way logging activities do not form part of the ECE.

BCTS Submission Content

The proponent will provide the following information to support the ECE:

1. Geometric road design including plans, profiles and cross sections. The design must include relevant design notes and identify the natural ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types for the entire road length proposed as an ECE;
2. Volume calculations by soil type;
3. Mass haul volume reports and diagrams to a measurable scale, complete with balance lines, direction of haul and identified waste & borrow areas;
4. Summary report for all drainage structures; and
5. Location of borrow pits, gravel pits, rock quarries and/or waste sites.

Cross-sections must identify the various grade breaks for a road design and must show the complete road prism. The natural ground uphill side slope will be determined from the geometric road design.

Item C: Road Construction - Rock exceeding 50 Percent

IAM ECE Item

Road construction where the rock exceeds 50 percent.

Application

Percent rock is measured as per the IAM and applies to both tabular and ECE road sections.

Where estimates of rock volume from acceptable commercial road design programs are available for sections, that information may be used to estimate the percent rock.

The following methods may be used to estimate the height or depth of rock contained within the proposed road right-of-way:

1. Assessment along proposed alignment by QRP (preferred method);
2. Estimating the overburden depth (requires visible surface rock);
3. Using adjacent roads constructed in similar materials; or
4. Digging soil pits and/or examining blowdown to determine the depth of overburden materials.

Eligible Costs

The ECE may contain all phases of construction including road survey, layout and design, grubbing and stripping, subgrade construction, drainage construction and surfacing. It is not constrained by the road group construction equations but it must use the IAM subgrade variable definitions, tabular culvert costs for those sizes used in the ECE, and the IAM equipment and labour rates. Right of way logging activities do not form part of the ECE.

BCTS Submission Content

The proponent will provide the following information to support an ECE:

1. Geometric road design including plans, profiles and cross sections. The design must identify the ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types;
2. Volume calculations by soil type; and
3. Mass haul volume reports and diagrams to a measurable scale, complete with balance lines, direction of haul and identified waste & borrow areas.

Item D: IAM ECE Item Road Construction - Terrain Class IV or V

Application

An interpretation of Terrain Class IV and V is provided below from the *Land Management Handbook Number 18* (Chatwin et. al., 1994):

Class IV terrain is:

1. Expected to contain areas with a moderate to high likelihood of slope failures following conventional road construction. Wet season construction will significantly increase the potential for slope failure.
2. Where there is a moderate likelihood of slope failure in logged areas.

Class V terrain is where there is a high likelihood that slope failure will follow logging or conventional road building.

The identification of Terrain Class IV and/or V will be determined through a Terrain Stability Field Assessment. The Assessment should include recommended site-specific actions to reduce and/or manage the landslide hazards and risks resulting from the road construction or development. From the Assessment, a prescription should be completed that outlines specific design requirements which must be included in the geometric road design.

Eligible Costs

The ECE may contain all phases of construction including road survey, layout and design, grubbing and stripping, subgrade construction, drainage construction and surfacing. It is not constrained by the road group construction equations, but it must use the IAM subgrade variable definitions, tabular culvert costs for those sizes used in the ECE and the IAM equipment and labour rates. Right of way logging activities do not form part of the ECE.

BCTS Submission Content

The proponent will provide the following information to support an ECE for Terrain Class IV and V:

1. Geometric road design including plans, profiles and cross sections. The design must include relevant design notes and identify the ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types;
2. Volume calculations by soil type;
3. Mass haul volume reports and diagrams to a measurable scale, complete with balance lines, direction of haul and identified waste & borrow areas;
4. For Terrain Class IV and V, professional terrain stability assessment which clearly outline the limits of the Class IV and V terrain with respect to road location; and
5. For Terrain Class ECEs, the prescription outlining the measures to maintain slope stability for the ECE section.

Item E: Road Construction - End Haul

IAM ECE Item

End haul construction (of roads and landings) requiring removal by truck of excavated material to a separate area to avoid side casting on steep and/or sensitive sites.

Application

The following applies to this item:

1. Requirement for the road to be constructed by trucking out the material from the road/landing cut;
2. Requirement to haul the excavated material to a separate area from the end haul road section;
3. Requirement to avoid side casting on steep and/or sensitive sites within the section length;
4. Steep terrain or steep sites are defined as having a natural downslope equal to or greater than 60% measured from the outside edge of the road prism or where the angle of repose of the soil precludes its use as fill material in the road section;
5. Sensitive sites are defined as sites where the sidecasting of the excavated soil material would cause a material adverse effect on forest resources or increase the risk of slope failure; and
6. Where it is not feasible to move the material by a conventional push, gravel trucks will be considered in the ECE. Where a significant volume of material is required to be moved, consideration should be given to using multiple trucks to increase the loading efficiency.

Eligible Costs

The ECE may include the costs to move and waste the endhailed material to the nearest feasible waste or spoil area. This may also include utilizing the endhaul material, if applicable, as general fill at another location in the road.

The ECE may contain all phases of construction including road survey, layout and design, grubbing and stripping, subgrade construction, drainage construction and surfacing. It is not constrained by the road group construction equations but it must use the IAM subgrade variable definitions, tabular culvert costs for those sizes used in the ECE, and the IAM equipment and labour rates. Right of way logging activities do not form part of the ECE.

BCTS Submission Content

The proponent will provide the following information to support an ECE for end haul construction:

1. Geometric road design, including plans, profiles and cross sections. The design must include relevant design notes and identify the ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types;
2. Volume calculations by soil type;
3. Mass haul volume reports and diagrams to a measurable scale, complete with balance lines, direction of haul and identified waste & borrow areas; and
4. Average road grade and distance to a separate area from the road section or the designated spoil site(s).

Item F: Road Construction - Overland

IAM ECE Item

Overland construction to provide a roadbed by trucking in material for extensive filling (see page 81 of the *Forest Road Engineering Guidebook* for a more detailed description).

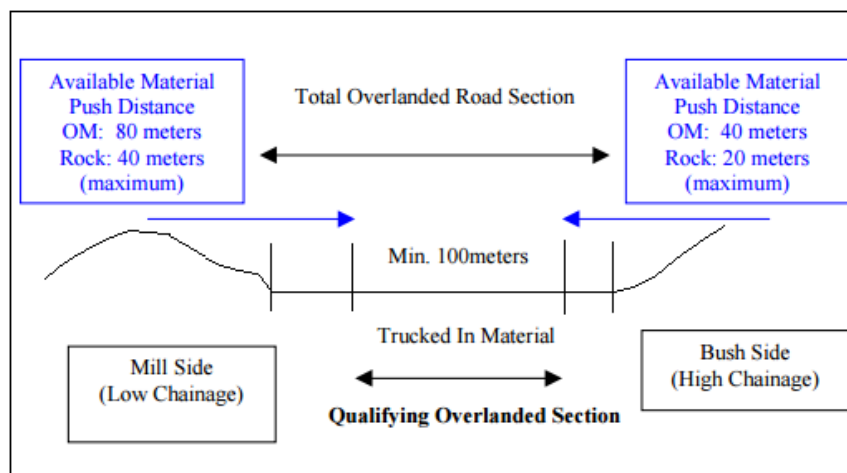
Application

The following applies to this item:

1. A requirement for the roadbed fill material to be trucked into the site; and
2. A requirement for extensive filling over undisturbed natural, thick organics and/or weak soils, or over shallow depressions on stable terrain with slopes less than 20%.

For road sections where the design includes a cut adjacent to an area of fill and these fill sections are within the average push range of crawler equipment; an ECE for overland construction is not permitted in the 'pushed' section. The qualifying ECE section is to be reduced by the volume of cut material available to the maximum push distance as described below. Average crawler equipment push distances are defined as:

	<u>Low Chainage</u>	<u>High Chainage</u>
Rock:	40 meters	20 meters
OM:	80 meters	40 meters



Overland construction does not apply to snow roads, including when snow is imported to the site.

Eligible Costs

An ECE for overland construction may include costs for the following:

1. Supply, transportation (truck), placement, spreading and compaction of fill material;
2. Supply, transportation and installation of geo-synthetics;
3. Installation of corduroy, puncheon and/or brush mats;
4. Supply and installation of any culverts; and
5. Surfacing, if allowable. Where fill materials are considered suitable as surfacing material, no additional allowance for road surfacing is to be included with the ECE. If the fill material is not suitable as road surface material, the costs for road surfacing may be considered.

The ECE may contain all phases of construction including road survey, layout and design, grubbing and stripping, subgrade construction, drainage construction and surfacing. It is not constrained by the road group construction equations, but it must use the IAM subgrade variable definitions, tabular culvert costs for those sizes used in the ECE and the IAM equipment and labour rates. Right of way logging activities do not form part of the ECE.

BCTS Submission Content

The proponent should provide the following information to support an ECE for overlanding:

1. Typical cross-sections and plan for overland section (including both the ECE and approaches);
2. Volume calculations showing total volume required and any deductions for material pushed from adjacent road sections;
3. A description of the underlying soil type or condition to justify the use of overlanding;
4. The location of the designated borrow site(s); and
5. Where the proponent proposes to utilize quarried rock for the fill material, the proponent must provide sufficient information to determine that the use of quarried material represents the least cost compared to importing organic material fill.

Item G: Bridge Installations

IAM ECE Item

Bridges (including ice bridges) not included in the subgrade construction cost estimate. Eligible costs are described in section 4.3.6(9) of the IAM.

For guidance and additional information regarding the completion of site surveys and bridge designs, both the Joint Practices Board's *Guidelines for Professional Services in the Forest Sector – Crossings* and Appendix E of the *Forest Service Bridge Design and Construction Manual* can be referenced.

Application

The following applies to this item:

1. The supply and installation of new structures and the re-installation of a superstructure at a new site are both covered under this ECE item. The bridge structure type and span for a new structure should be based on the planned life span and designed standard of the road.
2. Removal costs for the purposes of re-installation of superstructure or substructure, including mob/demob to the new site, may be included. These costs are applied when the structure is being proposed for re-installation at a new site and not with the previous or initial installation. This is not considered deactivation but removal and transportation to a new site for installation.
3. General deactivation costs such as cleanup and rehabilitation of the site or the removal and disposal of other materials (not reused) are not allowed.
4. The construction of some log culverts is also included in this ECE section. This does not include single log abutment culverts with span lengths less than 3.5 metres, which are included in the tabular costs for subgrade construction.

Tabular Bridge Cost Estimates

The engineered cost estimate must be determined from Table 4-4 of the IAM for bridge types and sizes represented. Otherwise a QRP, Detailed calculation or tendered contract must be used for the estimate.

Supply of the Superstructure

1. Superstructure includes all girders, decking materials, ballast walls, curbs and rails, bearing pad assemblies and miscellaneous steelwork and hardware;
2. Includes all fabrication and/or purchase costs, costs for in-plant design and inspection, all applicable taxes and freight charges. Assumes installation site is within 200 kms by road of the FOB site as defined by the IAM;
3. Assumes steel girders fabricated with 350AT steel; and
4. Assumes CCA treatment or equivalent for treated timber.

Installation of a Single Abutment

1. The ECE should include a cost for each of the two abutments based on the design. A bridge design may include two different types or sizes of foundations. These costs include end fills and approach fills to a completed subgrade stage; and
2. Includes all costs related to the supply and installation of one abutment including:
 - i. supply, placement and compaction of endfill;
 - ii. supply and installation of approach fills to 15 metres of each end of the bridge, including culverts;
 - iii. shaping and grading to form a completed subgrade;
 - iv. supply and placement of rip rap;
 - v. supply and placement of geotextile;
 - vi. supply and installation of any signs, delineators or other road markers;
 - vii. erection of foundations; and
 - viii. freight and mobilization and demobilization.

Supply and Installation of a Bearing Cap or Bearing Sill

1. The ECE may include a cost for each Cap and/or Sill based on the design type;
2. Assumes CCA treatment for treated timbers; and
3. Cast-in-place concrete pad is cast-in-place on bedrock with 2 pads per abutment. Costs include dowlings and anchors.

Installation of the Superstructure

1. Includes the girders, deck, curbs and rails; and
2. Includes all costs associated with the erection and assembly of the bridge superstructures including:
 - i. site preparation (labour and equipment);
 - ii. mobilization and demobilization of labour and specialized equipment, and
 - iii. erection of bridge superstructure on a suitable foundation.

Supply, Installation and Removal of a Work Bridge

1. The ECE may include a cost for a work bridge only when the construction occurs, or should occur, at a different time than with road construction; otherwise the temporary crossing is considered part of the subgrade construction cost estimate; and
2. The span for a work bridge is based on the submitted site plan for the main crossing.

Removal and Transport of a Bridge Superstructure and Interlocking Pre-Cast Concrete Blocks

1. The ECE may include a cost for the re-installation of these materials at a new site, and represent the costs for dismantling and transportation to the new installation site; and
2. These costs are not considered deactivation, as they do not cover any rehabilitation costs at the old site and are only applied when the material is reused at another location.

Mobilization and Demobilization of Equipment and Supplies to Site that is Greater than 200 kms

1. The ECE may include a detailed cost for mob/demob when the installation site is greater than 200 kms from the FOB site, or the site is not serviced by all-season roads. This is in addition to the tabular bridge costs and is only for the transportation costs beyond 200 kms; and
2. The proponent may be required to provide documentation of barge or rail cost.

Survey, Site Plan and Design**Site Specific Drawings**

1. New bridge cost estimate includes a cost allowance for structural design;
2. Where a site specific detailed site plan is required or prepared;
3. Includes all site specific professional and non-professional costs for survey, production of a site plan and general arrangement, and detailed design drawings for the bridge components (including detailed steel design); and
4. Assumes the proponent is not using superstructure drawings previously developed for another site or for repeated use (i.e. standard drawings).

Standard Drawings

1. Includes all site specific professional and non-professional costs for survey, production of a site plan and general arrangement; and
2. Assumes the proponent is already in possession of engineered drawings for a steel superstructure. Includes when a new superstructure is being fabricated from standard drawings or when an existing superstructure is being reinstalled at its original design loading or less.

Crossing Certification/Assurance Statement

1. Certification of Construction prepared by a Professional Engineer.

Example of a Bridge ECE using Tabular Cost Estimates

The proponent requires a 12.2-metre-long L100 steel and treated timber bridge to be installed within 200 km of the FOB site. The bush end is founded on a 2-tier interlocking concrete block foundation with an un-treated timber sill. The town end is a 1-tier interlocking concrete block foundation with an un-treated timber sill. A work bridge is also required.

Engineering Services (based on 2019 IAM estimates):

Superstructure:

Superstructure supply	\$ 12,500	
Deck supply	\$ 14,400	
Superstructure installation	\$ 10,000	
Subtotal Superstructure		\$ 36,900

Work Bridge:

\$ 4,500

Substructure:

Bush - 2-tier concrete block	\$ 9,000	
Town - 1-tier concrete block	\$ 5,000	
Non-treated timber sills	\$ 500	
Subtotal Substructure		\$ 14,500

Survey and Design

\$ 4,000

Construction Certification

\$ 1,250

Subtotal Survey and Design \$ 5,250

Total Allowable ECE \$ 61,150

Log Bridge Cost Estimates

The engineered cost estimate for log bridges may be determined using the tabular log bridge methodology in the Coast Appraisal Manual effective at the time of the appraisal data submission.

Supporting Information

All portable structures are required to be assigned a tracking number that is affixed to the structure at the time of initial installation. Any existing portable structures in use must also be assigned a tracking number and a list with the number and location submitted to the district.

Non-Tabular Eligible Costs

Costs for the following items may be included in the ECE:

1. Production of site specific site plan and general arrangement;
2. Production of structural design drawings for new structures only;
3. Purchase cost of bridge superstructure (only for new superstructures or used superstructures if purchased from a third party and never previously used in an appraisal);
4. Purchase cost of bridge substructure and associated components;

5. Transportation (freight) for materials;
6. For log culverts, costs for the production of logs into culvert material not including felling and skidding costs;
7. Site preparation which may include the removal and disposal of existing bridge components (bridge replacement) and stripping and grubbing within the footprint of the endfill (new bridge);
8. Superstructure installation;
9. Substructure installation;
10. For log culverts and log bridges, crib construction or sill log construction, where applicable;
11. For bridges, supply, placement and compaction of structural endfills (volumes and materials as per design);
12. For log culverts and log bridges, the supply, placement and compaction of structural endfill or backfill up to 15 metres from the crib;
13. Development, supply and placement of rip rap or scour protection (volumes as per design);
14. Identify location(s) of sources for select endfill and rock;
15. For replacement of a culvert with a bridge, cost to re-establish the stream channel and stream bed;
16. For bridges only, supply and installation of fenders, delineators, hazard markers and required signage;
17. Supervision by a Professional Engineer (complex structures only);
18. Certification by a Professional Engineer (as per Appendix 2);
19. Installation and removal of a work bridge, where bridge construction equipment must cross the stream and the proponent shows that no in-stream crossing is feasible or permitted. This cost is not allowed if installation of the structure occurs, or should occur, commensurate with tabular road construction; and
20. For the reinstallation of bridge components, costs may be included for the dismantling, transportation and re-installation at the new site for the reused components.

Ineligible Costs

Costs for the following items will not be accepted in the ECE:

1. General approach fills unless the bridge or log culvert length has been removed from the tabular road section.

Bridge Rentals

The cost estimate for the rental of bridge superstructures will be based on the current purchase price of the structure over the average lifespan of the superstructure. For portable bridges, the

average lifespan will be taken as 15 years for the steel superstructure, 8 years for an untreated wooden deck or deck module and 15 years for a treated deck or deck module. This would apply to all proponents that can purchase and re-use a portable superstructure, however choose to rent a structure for other reasons.

Regional Timber Pricing Staff may accept a higher or market based rental price if he/she determines it would not be cost effective and/or feasible to purchase or re-use a portable structure and other construction options do not exist. A rationale must be provided by the licensee for the use of a rental bridge. It must include any mitigating reasons that may have implications on applying the least cost principle. The licensee must also provide supporting documentation (i.e. copies of quotes).

Supervision of Complex Structures by a Professional Engineer

The IAM allows a cost estimate for a Professional Engineer for the supervision of complex structures. Complex and simple structures are defined in these Procedures and are outlined in Appendix 2 (Supervision and Certification Costs).

Certification of Bridges by a Professional Engineer

Costs for certification of a bridge will only be considered when completed by a Professional Engineer, regardless of the professional completing the design.

BCTS Submission Content

The proponent will provide the following information to support the ECE:

For the installation of a bridge, a site specific site plan and a general arrangement (conceptual design) which includes:

1. Sufficient information to review the suitability of the structure and the estimated cost, may include, but not be limited to:
 - a. High Water Mark (HWM) and Present Water Level (PWL);
 - b. Designed discharge;
 - c. Stream gradient, cross-section and velocity;
 - d. Stream bed materials;
 - e. Stream classification (note if default or classified);
 - f. Road centreline;
 - g. Natural ground profile, existing road profile (if applicable) and final road profile;
 - h. Bridge superstructure and substructure components;
 - i. Extents and volumes and specifications for structural endfill and general bridge approach fills; and
 - j. Extents, volume and class of rip rap.

Item H: Bridge Maintenance or Upgrade

IAM ECE Item

Structural maintenance of bridges, substructure and cribwork.

Application

The following apply to this item:

1. Structural maintenance is the repair and/or replacement of a structural component or load bearing member of a bridge or the structural components of a major culvert.
2. Structural maintenance is limited to repair of, or replacement with, similar or comparable materials that meet the original design standard. Where structural changes are proposed that increase the design load rating or enhance the physical properties of a structure, those changes are considered an upgrade which is also administered under this item.
3. Structural maintenance includes:
 - a. Replacement of rip rap when volume exceed 50m^3 , and is specified by a QRP;
 - b. Repair or replacement of structural back-fill or endfill;
 - c. Repair or replacement of structural plates, for multi-plate structures;
 - d. Repair or replacement of structural components for non-structural plate structures, this includes replacement of failed (collapsed) pipe sections;
 - e. Repair or replacement of cross-ties;
 - f. Repair or replacement of log or timber cribs;
 - g. Repair or replacement of panels on ACROW® bridges;
 - h. Repair or replacement of foundation and/or bearing components;
 - i. Repair or replacement of concrete deck panels or structural steel deck panels, where repair is required on more than 10% of the deck area;
 - j. Any structural steel repairs as designed and recommended by a Professional Engineer, to maintain the current design loading;
 - k. Removal and re-installation of fill when done in conjunction with structural works; and
 - l. Replacement of timber decking, only where done in conjunction with cross-tie replacement.
4. Upgrade of structures includes:
 - a. Installation of new rip rap when volume exceed 50 m^3 , and is specified by a QRP;
 - b. To increase the design loading replacement of cross-ties with a larger dimension;
 - c. Replacement of timber decks with concrete deck panels or structural steel deck panels, which result in an increase in either design life or design loading;
 - d. Any structural steel works as designed by a Professional Engineer, to increase the design loading;
 - e. Lengthening of existing major culverts, where justified;
 - f. Removal and re-installation of fill when done in conjunction with structural works; and

- g. Replacement of timber decking, only where done in conjunction with cross-tie replacement.
- 5. Structural maintenance and upgrade of structures does not include these items:
 - a. Replacement or repair of timber decking, unless associated with repair or replacement of structural components;
 - b. Repair, removal or replacement of gravel on gravel decked structures;
 - c. Repair or replacement of asphalt or concrete topping on bridge decks or approaches;
 - d. Replacement or repair of curb rails, risers or connectors;
 - e. Replacement or repair of approach guard rail systems (for example, fender logs or concrete no-posts);
 - f. Placement of less than 50m³ of rip rap; and
 - g. The repair or replacement of signs.
- 6. For maintenance and upgrade projects not explicitly stated in either of the above lists, the work should be referred to the Regional Timber Pricing Coordinator and Bridge Engineer for a decision as to whether the project qualifies for an ECE under this item.
- 7. Projects under this item will not be accepted where the required regular maintenance has not been undertaken or where a failure is caused by improper installation or use.
- 8. The requirement to replace or repair a structural component must be documented in an inspection by a qualified bridge inspector.
- 9. Where replacement of or upgrade to concrete deck panels or structural steel panels are proposed, the project details must be referred to the FLNRORD for pre-approval.
- 10. District engineering staff, 30 days prior to the commencement of works, must be notified of all upgrades on Forest Service Road bridges and major culverts. Where required by the district engineer, the work may require design and/or supervision by a Professional Engineer. The costs associated with the survey, design and supervision in this situation will be allowed as part of the structural maintenance ECE.
- 11. Structural maintenance and structural upgrades should be carried out under the supervision of and follow a design prepared by a Professional Engineer (refer to Appendix 2). Where the services of a Professional Engineer are required for the design, supervision and/or certification of structural repairs, the fees for services will be accepted as part of the ECE.

Supporting Information

District engineering staff may request the following data to support the ECE:

- 1. Copy of the most recent documented inspection by a qualified bridge inspector indicating the condition of the structure;
- 2. For structural repairs, specific details regarding the individual structural component requiring repair or replacement;
- 3. Copy of drawings for repair, replacement or upgrade for those components requiring a design by a Professional Engineer; and

4. When requested, copies of previous inspection reports with information regarding maintenance history of bridge component being repaired, replaced or upgraded.

Eligible Costs

The ECE may contain all costs associated with the professional design, repair, replacement and upgrade of structural components and certification of the structural works. Supervision costs will only be included for works that are considered complex (refer to Appendix 2).

The allowable costs for an ECE for structural maintenance or upgrade of a bridge may include some or all of the cost components that are allowable for a new bridge construction. For the structural maintenance or upgrade of a major culvert, the cost components may include some or all of those listed for new construction of a major culvert.

Item I: Road Reactivation

IAM ECE Item

Road reactivation activities necessary to re-open a road where there were no prior road management obligations.

Application

No prior road management obligations mean where road management obligations under the *Forest Act* never existed, or where the licensee has been relieved of their obligations (e.g. cancelled tenure or was never tenured by the applicant).

The *FLNRORD Road Reactivation Cost Estimate Template* must be used in a cost estimate when the submitter expects the work will be completed, and/or is completed within the categories and features described. Where the work is substantially different than the categories and features described, a Detailed Calculation or Tendered Contract may be used for a cost estimate. An example may be extensive cross-ditching to backfill.

The template is for road reactivation cost estimates only. It is not meant for use if road reconstruction or road upgrade activities are also needed for the same segment(s) of road. When a section of road must be reactivated in conjunction with road reconstruction and/or road upgrades, a Detailed Calculation or Tendered Contract must be used.

A link to the template is provided below:

<https://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/interior-timber-pricing/interior-ece>

Further information is provided in the ‘Instructions’ tab of the template.

Eligible Costs

All costs required to reactivate the road to the current standard are eligible for inclusion in the ECE. Estimates must use the IAM subgrade variable definitions, tabular culvert costs for those sizes used in the ECE, and the IAM equipment and labour rates. Right of way logging activities do not form part of the ECE.

BCTS Submission Content

The proponent should submit sufficient information to substantiate the ECE. This may include a geometric road design, including plans, profiles and cross sections, for road sections requiring major reactivation.

Item J: Road Reconstruction

IAM ECE Item

Reconstruction of roads and pertinent structures required to return the subgrade or structure to the standard that existed at the time of original construction.

Application

The following apply to this item:

1. Reconstruction is defined as the re-establishment of the road prism to repair damage to the road resulting from natural forces or restoring the road carrying capacity to meet the design vehicle loads.
2. Reconstruction may be undertaken where an existing road is not capable of sustaining the design vehicle loads or where the operational function of the road has been lost. The operational function of a road may be impaired through either a major event (storm) or through the deterioration of the road or structure over time when maintenance obligations did not apply. Regardless of road maintenance agreements, the permit holder is responsible for the maintenance obligations for their permitted roads.
3. Reconstruction will not apply if there is a change in the physical road standard, such as an increase in the effective running surface width. A change in the road standard, such as increasing road width or realignment, is considered an upgrade and is administered under Item K of the Procedures.
4. The ECE for reconstruction resulting from natural forces, will reflect only those phase costs directly associated with the reconstruction. Unless justified, no costs will be reviewed for any work that is listed in section 4.4 of the IAM for Road Management.

Eligible Costs

An ECE for subgrade reconstruction of a permitted road under this section may include all phases of construction and when justified, may include costs for work covered under Section 4.4 of the IAM for Road Management.

Where a licensee did not have road management (maintenance) obligations prior to the reconstruction works, the ECE should be submitted under Road Reactivation.

BCTS Submission Content

The proponent should submit sufficient information to substantiate the submitted ECE. This may include a geometric road design, including plans, profiles and cross sections, for road sections requiring major reconstruction.

Item K: Road Upgrade

IAM ECE Item

- i. Upgrade of roads and pertinent structures resulting in changes to the standard of the existing road and/or structure, including changes to the width of the running surface, horizontal and vertical realignment, additional culverts, lengthening of existing pullouts or adding additional pullouts where not required by the road standard or use of the road at the time of original construction. Blasting, or major switch back realignment is not restricted by the minimum 0.100 km section length requirement.
- ii. With the intention to upgrade the road standard, a reassessment of the specified design vehicle load configuration for an existing bridge structure administered by a non-ministry authority. The submitter must receive approval of the reassessment from the non-ministry authority prior to submitting the cost estimate in an appraisal.

Application

The following applies to this item:

1. Upgrade of stand-alone structures such as bridges, major culverts and special structures are to be submitted under the applicable item in section 4.3.6 of the IAM.
2. The upgrade of a road may occur for several reasons, including:
 - a. Development planning requires that the road access additional timber volumes, with the additional volume or longer haul distance necessitating a change to the physical standard of the road;
 - b. Safety improvements, resulting in a change to the width, horizontal or vertical alignment, to address changes to the volume of traffic using the road, to address a known documented safety issue, or changes due to utilization of modern truck haul configurations; and
 - c. A reassessment of the specified design vehicle load configuration for an existing bridge structure administered by the non-ministry authority. Timber from the cutting authority must travel over the bridge structure.
3. Eligible costs may include additional culverts, larger culverts (when supported by a rationale e.g. hydrologist report, increased flows, etc.), lengthening or adding pullouts where not required by the road standard or use at the time of original construction, blasting, or major switchback realignment.
4. Blasting and switchback realignment are not constrained by the minimum 0.100km section length.

Eligible Costs

The ECE may contain all phases of construction, including road survey, layout and design, grubbing and stripping, subgrade construction, drainage construction and surfacing. It is not constrained by the road group construction equations, but it must use the IAM subgrade variable

definitions, tabular culvert costs for those sizes used in the ECE and the IAM equipment and labour rates. Right of way logging activities do not form part of the ECE.

BCTS Submission Content

The proponent will submit sufficient information to substantiate the submitted ECE for the upgrade of roads. This information may include, but is not limited to:

1. Rationale for the road upgrade, including all benefits that will be derived from the work;
2. A geometric road design including plans, profiles and cross-sections (where required). The design must include relevant design notes, and identify the ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types for the entire road length proposed as an ECE;
3. Volume calculations and mass haul diagrams; and
4. Location of borrow pits, gravel pits, rock quarries and/or waste sites.

Item L: Road Surfacing - Placement of Stabilizing Material

IAM ECE Item

Placement of stabilizing material to an existing road with uninterrupted road section lengths of 0.3 km or more; regardless if the road was previously stabilized.

Application

The following applies to this item:

1. Each 300 m section must be continuous or uninterrupted; otherwise it qualifies as road management under section 4.4 of the IAM.
2. This section applies to access roads that were initially surfaced and where the surface material has been lost due to extensive wear and tear or where stabilizing material was not previously used.
3. This ECE item does not include the replacement or recovery of gravel that should have been retained on the road surface through normal surface maintenance. Recovery of gravel from ditches is not considered replacement of gravel regardless of length. This situation is considered maintenance, as ditch cleaning and spot gravelling is not eligible where the licensee is responsible for road management.
4. The re-application of surface binding agents (e.g. CaCl, MgCl) to protect the integrity of existing surface material. To be eligible the road must have been part of a major stabilization project in the past.

Eligible Costs

Section 4.3.4 of the IAM may also be used to calculate the cost estimate.

BCTS Submission Content

The proponent should provide the following information to support an ECE for replacement of stabilizing material to the running surface:

1. Location of and haul distance to material sources.

Item M: Culvert Installations

IAM ECE Item

Culverts greater than 1800mm in diameter, or culverts greater than 20 meters in length regardless of diameter. The cost estimate includes all costs of transporting the culvert to the jobsite and all costs of installation of the culvert to the final subgrade stage.

For guidance and additional information regarding the completion of site surveys and bridge designs, both the Joint Practices Board's *Guidelines for Professional Services in the Forest Sector – Crossings* and Appendix E of the *Forest Service Bridge Design and Construction Manual* can be referenced.

Application

The following applies to this item:

1. This section applies to culverts greater than 1800 mm in diameter or equivalent to a corrugated steel pipe greater than 1800 mm in diameter. This provides for the use of elliptical pipe culverts with an end area greater than an 1800 mm (2.54 m²) round culvert.

Eligible Costs

The ECE may include all costs associated with the design, purchase, transportation and installation of a culvert to the final sub-grade stage. Costs for the following items may be included in an ECE:

1. Production of a site specific site plan and general arrangement;
2. Purchase cost of culvert components;
3. Transportation (freight) for materials;
4. Mobilization and demobilization of specialized equipment;
5. Site preparation;
6. Temporary creek diversion, if required;
7. Supply, placement and compaction of foundation (volume as per design);
8. Supply, placement and compaction of structural fill envelope (volume as per design);
9. Supply and placement of general fill for road subgrade (volume as per design);
10. Development, supply and placement of rip rap or scour protection (volumes as per design);
11. Identify location(s) of sources for select endfill and rock;
12. For embedded culverts, the cost to re-establish the stream channel and stream bed through the pipe;
13. Supply and installation of any roadside barriers, hazard markers or required signage; and
14. Supervision by a Professional Engineer (complex structures only).

BCTS Submission Content

The proponent must provide the following information, but not limited to, to support the ECE:

1. A site-specific site plan and general arrangement (for culverts greater than 1800 mm) with sufficient information to review the suitability of the culvert and the estimated cost of the structure such as:
 - a. Plan and profile view of the watercourse;
 - b. High Water Mark (HWM) and Present Water Level (PWL);
 - c. Design discharge;
 - d. Stream gradient, cross-section and velocity;
 - e. Stream bed materials;
 - f. Stream classification (note if default or classified);
 - g. Road centreline;
 - h. Natural ground profile, existing road profile (if applicable) and final road profile;
 - i. Culvert dimensions and type;
 - j. Extents and volumes for foundation material and structural fill envelope;
 - k. Road subgrade volumes to the top of subgrade based on fill lines and extent of structural fill envelope; and
 - l. Extents, volume and class of rip rap.

Item N: Road Surfacing - Placement of Specialized Materials

IAM ECE Item

Placement of stabilizing material to a new or existing road where geo fabric, corduroy, crushed and/or screened rock/gravel is used.

Application

The following applies to this item:

1. Additional stabilization is the placement of screened gravel or broken rock, corduroy or geo-synthetics in the road subgrade to provide stable support for a running surface for logging equipment using the road during the harvesting of tributary timber.
2. When the subgrade materials developed during construction are insufficient then additional stabilizing material must be trucked in from select borrow pits.

Eligible Costs

The ECE may include all phase costs, except for supervision, including:

1. Supply, transportation and installation of geo-synthetics or corduroy;
2. Loading, hauling, placing and compaction of processed materials; and
3. Pit development for ballasting.

BCTS Submission Content

The proponent should provide the following information to support an ECE for additional stabilization materials:

1. Rationale for the use of special materials for stabilization;
2. Location of material sources;
3. Depth and volume of material to be applied to the sections which are indicated on a map;
4. Representative cross-section to support volume calculations; and
5. Construction equipment employed, with estimated hours and rates.

Where the proponent applies for an ECE under this item, they are obligated to demonstrate that the materials developed, or that will be developed during sub-grade construction, and materials available in select pits (including quarries) are inadequate to stabilize the subgrade to meet the designed vehicle loads, without the use of special materials or processing.

Item O: Road Surfacing - Portable Platforms

IAM ECE Item

Placement of a portable platform to be used as a structural roadway.

Application

Temporary placement of a portable platform on top of the intended road location to provide stable support for a running surface for logging equipment and log hauling equipment using the roadway during the harvesting of tributary timber.

Eligible Costs

The ECE may include costs for the following:

1. Rental cost of the structural components. The rental period must reasonably reflect active log hauling and harvest operations.
2. Purchase cost of the structural components.
3. Transportation (freight) for materials.
4. Mobilization and demobilization of specialized equipment.
5. Labour and equipment costs for installation, removal and cleaning of the structural components.
6. Supply and installation of any roadside barriers, hazard markers or required signage.
7. If new road construction, then the tabular subgrade cost estimate from section 4.3.2.3 of the IAM.
8. Provincial Sales Tax (PST) and platform rentals:
 - a. Pre-construction material estimates may include PST.
 - b. Post-construction estimates may include PST if applicable (i.e. material, delivery or transportation, and other services as applicable).

Note: PST charges can vary depending on the rental (or lease) arrangement and the location of the supplier.

If the platforms are being re-used, and the purchase cost has already been included in an appraisal from another cutting authority, then the purchase cost is not eligible in the ECE.

BCTS Submission Content

The proponent should provide the following information to support an ECE for the placement of a portable platform to be used as a structural roadway:

1. Rationale for the use of the portable platform;
2. Cost estimate for the rental or purchase cost of the structural components;

3. Cost estimate for the mobilization and demobilization of specialized equipment;
4. Construction equipment and labour employed, with estimated hours and rates;
5. Road sections where the portable platform will be used as indicated on a map.

Where the proponent applies for an ECE under this item, they are obligated to demonstrate that the local material and materials available in select pits (including quarries) are inadequate to stabilize the subgrade to meet the designed vehicle loads, without the use of a portable platform.

Item P: Special Structures

IAM ECE Item

Retaining walls, railway crossings and other special structures (such as multiple culverts, baffled culverts, arched culverts, culverts that require a “dry” installation and other structures determined by the Timber Pricing Co-coordinator).

Application

The following applies to this item:

1. In addition to retaining walls and railway crossings, the costs for the design and construction of other special structures may be applicable under this item.
2. The current list of other approved special structures is below. This list may be updated from time to time by the Regional Timber Pricing Coordinators.
 - a. Arched culverts (bottomless culverts);
 - b. Corrugated box culverts;
 - c. Structural plate arch culverts;
 - d. Structural plate pipe arch structures;
 - e. Culverts manufactured with baffles;
 - f. Culverts to be installed with either cast-in-place headwalls, pre-cast headwalls, reinforced geotechnical soil headwalls or corrugated steel plate headwalls;
 - g. Culvert installations that require the temporary diversion of the water course (“dry” installation);
 - h. Reinforced geotechnical soil systems for retaining walls and road embankments;
 - i. Embedded culverts that meet the requirements of the *Fish Stream Crossing Guidebook*;
 - j. New surfacing (asphalt or concrete) of bridge decks and approaches where pre-approved by the Regional Bridge Engineer. Does not include replacement or repair of previous surfacing materials;
 - k. Surfacing projects using high fines, crushed gravel and calcium chloride (initial application concurrent with construction).
3. Special structures do not include those structures specifically identified in tabular cost estimates (for example IAM section 4.3.3), culverts with an equivalent diameter up to 950 mm, cattle guards, fencing and pipeline crossings.
4. Where the proponent proposes a change or addition to the list of Other Special Structures, the proponent must provide a rationale to the Regional Timber Pricing Coordinator for consideration under this ECE.

Railway Crossings

For railway crossings, the ECE will include the costs for installation of the crossing however, the cost for the road subgrade will be included in the tabular subgrade cost estimate (IAM section

4.3.2.3) unless it qualifies under another ECE item. The ECE may include costs for the following:

1. Production of a site plan and crossing design where required by the rail authority;
2. Purchase cost of structure crossing components, including signs;
3. Transportation (freight) for materials;
4. Safety personnel as required for the rail authority; and
5. Installation of the crossing components.

Reinforced Soil Systems for Retaining Structures and Road Embankments

The ECE for retaining walls and reinforced soil systems may include costs associated with the design, purchase, transportation and installation of the structure to the final sub-grade stage. The ECE may include costs for the following:

1. Purchase cost of structure components;
2. Transportation (freight) for materials;
3. Mobilization and demobilization of specialized equipment;
4. Supply, placement and compaction of foundation and structural fill (volumes as per design);
5. Labour and equipment costs for installation of structure components;
6. Supply, placement of general fill for road subgrade (volume as per design);
7. Supply and installation of any roadside barriers, hazard markers or required signage; and
8. Supervision by a Professional Engineer (complex structures only).

Other Special Structures

The ECE for the remaining Special Structures in P.2.(2) above may include all costs associated with the design, purchase, transportation and installation of the structure to the final subgrade stage. The ECE may include costs for the following:

1. Purchase cost of structure components;
2. Transportation (freight) for materials;
3. Temporary creek diversion, if required;
4. Supply, placement and compaction of foundation (volume as per design);
5. Supply, placement and compaction of structural fill envelope (volume as per design);
6. Supply and placement of general fill for road subgrade (volume as per design);
7. Supply and placement of rip rap or scour protection (volumes as per design);
8. Supply and installation of any roadside barriers, hazard markers or required signage; and
9. Supervision by a Professional Engineer (complex structures only).

BCTS Submission Content

The proponent should provide the following information to support an ECE for special structures:

1. For retaining walls and reinforced geotechnical soil systems, a geometric road design and a detailed design for the proposed structure;
2. For railway crossings, copies of any crossing plan, any documentation from the rail authority including certification, and invoices for work by rail authority;
3. For stream crossing structures, a site plan and general arrangement (see ECE Item K for content requirements);
4. For all embedded culverts regardless of culvert diameter, a detailed design indicating level of embedment and volumes of materials required to meet Fish Stream Crossing Guidebook;
5. Volume calculations by soil types;
6. Mass haul volume reports and diagrams to a measurable scale, complete with balance lines, direction of haul, and identified waste and borrow areas, if applicable;
7. List of required materials and components; and
8. Any professional prescription completed which substantiates the requirement for a special structure.

Item Q: Road Construction - Road Group 1

IAM ECE Item

New subgrade construction and the placement of stabilizing material in Road Group 1 are determined using the methodology outlined in the *Interior Engineering Cost Estimate Procedures*.

Application

New Road Subgrade Construction

Where the physical dimensions and conditions of the new road subgrade construction fall within the tabular limits set out in section 5.3.3 of the *Coast Appraisal Manual* (CAM), a tabular cost estimate will be made using the applicable BankHeight tables, formulas and procedures in the CAM.

Tabular road subgrade construction cost estimates in the CAM do not include pipe culverts (including those under 0.95 m diameter and all single log abutment culverts up to 3.4 m).

Where the physical dimensions and conditions of the new road subgrade construction do not fall within the tabular limits set out in section 5.3.3 of the CAM, a non-tabular cost estimate may be used for the kinds of new road subgrade construction listed in subsection 5.3.1.1(4) (a). The ECE procedures outlined in this document must be followed (i.e. not the methodology and procedures in the CAM, *Non-Tabular Development Cost Procedures* (effective on or after April 1, 2019) or *Detailed Engineered Cost Estimates for Coast Appraisals*).

Culverts

All pipe culverts must use the IAM methodology and procedures for a cost estimate in an appraisal.

All single log abutment culverts with spans less than 3.5 m must use the CAM section 5.3.3.2.3 (2) for a cost estimate in an appraisal.

Bridges

All non-log bridges must use the IAM methodology and procedures for a cost estimate in an appraisal.

All log bridges must use the CAM section 5.3.3.2.1 for a cost estimate in an appraisal.

Placement of Stabilizing Material beyond 3.2 km

Where trucking of material is required for a section of tabular road and the source of the material is greater than 3.2 km away, the methodology and procedures in the *Coast Non-Tabular Development Cost Procedures* (Type 12) may be used for a cost estimate in an appraisal.

Capping

Where capping is required as defined in the *Coast Non-Tabular Development Cost Procedures* (Type 12), an engineered cost estimate may be submitted in an appraisal.

Submission Content

The licensee is to submit a completed Tabular Roads (Bankheight Method) Field Data Entry Sheet (Bankheight data field entry sheet Apr 19 2006 v 2.xls) which can be accessed at the following link:

<https://www.for.gov.bc.ca/ftp/rni/external/!publish/web/revenue/Bankheight%20data%20field%20entry%20sheet%20Apr%2019%202006%20v%202%20.xls>.

Alternatively this spreadsheet can be found on the Northern Interior Forest Region (NIFR) website under Revenue and Timber Pricing, Forms and Procedures: (www.for.gov.bc.ca/rni/NIFR_Revenue/index.htm).

In addition to the Tabular Roads (Bankheight Method) Field Data Entry Sheet, a Tabular Roads (Bankheight Method) recording/costing spreadsheet is to be submitted (Bankheight cost calculation sheet, revised April 19, 2006.xls) which can be accessed at the following link.:

<https://www.for.gov.bc.ca/ftp/rni/external/!publish/web/revenue/Bankheight%20cost%20calculation%20sheet%20revised%20April%2019,%202006.xls>

Alternatively this spreadsheet can be found on the NIFR website under Revenue and Timber Pricing, Forms and Procedures (www.for.gov.bc.ca/rni/NIFR_Revenue/index.htm):

Note: The Bankheight cost calculation spreadsheet was built for internal use only. The Ministry is not responsible for any errors in the cost submission.

Item R: Forwarding Roads

IAM ECE Item

The costs of designing and construction of a forwarding road. A forwarding road is not a trail but a road built to a designed standard which includes stripping, grubbing, stumping and primary excavation to establish subgrade that is used for transporting crews and equipment and forwarding timber but not for hauling logs.

Application

A forwarding road is used to forward timber in lieu of constructing a higher cost truck haul road to a cutblock(s) or employing a higher cost harvest method.

Forwarding roads are used by specialised skidders or forwarding equipment, and for the transportation of crews, equipment, or supplies.

These roads are typically too steep for truck hauling. They replace the need for higher cost switchbacks, end haul, blasting or other subgrade construction activities required for logging trucks.

Where terrain or site conditions do not require a detailed design, tabular subgrade equation estimates are acceptable.

Submission Content

The proponent will provide the following information to support an ECE, where required:

1. Geometric road design, including plans, profiles and cross sections. The design must include relevant design notes and identify the ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types;
2. Volume calculations by soil type;
3. Mass haul volume reports and diagrams to a measurable scale, complete with balance lines, direction of haul and identified waste and borrow areas;
4. Geotechnical reports and designs if required; and
5. Least cost rationale.

Item S: Blasting Rock within Tabular Road Sections

IAM ECE Item

Rock blasting within new sections of tabular road subgrade or borrow pit construction. Blasting is not restricted by the minimum 0.100 km section length requirement.

Application

The following applies to this item:

1. Blasting rock during the subgrade construction of a new tabular road section.
2. Blasting rock for the purposes of developing a borrow pit to generate stabilizing material.

Eligible Costs

The ECE may include costs for the following:

1. mob and demob of blasting equipment;
2. rock drilling;
3. explosives;
4. transportation, on-site storage and inspection of explosives;
5. loading of explosives; and
6. blasting.

Ineligible Costs

The ECE must not include costs for activities or materials already considered in the tabular road subgrade or stabilization equations in the IAM.

BCTS Submission Content

The proponent will provide the following information to support an ECE:

1. Geometric road design, including plans, profiles and cross sections. The design must identify the ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types;
2. Volume calculations by soil type; and
3. Mass haul volume reports and diagrams to a measurable scale, complete with balance lines, direction of haul and identified waste and borrow areas.

Appendix 1: Definitions

Arm's length: Of or relating to dealings between two parties who are not related or not on close terms and who are presumed to have roughly equal bargaining power; not involving a confidential relationship. An arm's length transaction does not create fiduciary duties between the parties.

Abutment Height: Measurement taken as the difference in elevation from the underside of the footing to the underside of the girder or stingers.

All-Steel Portable Bridges: Constructed entirely of steel utilizing both steel box girders and a steel deck. Decks usually come with a coating to allow for traffic-ability. The ministry doesn't accept the use of all-steel portable bridges on its FSRs used for industrial purposes.

Chainage: Low chainage is on the POC direction, start of the road. High chainage is on the POT direction, end of the road.

Composite Bridge: Constructed of steel or concrete girders with steel or concrete decks. Visually, they look much like a non-composite bridge, except that the girders will likely have less cross-sectional area for a given span. In a composite bridge, the deck is continuous with individual panels welded or grouted to each other. In addition, the deck is intimately connected to the girders. Only Professional Engineers are permitted to design composite bridges.

Concrete Slab Girder Bridge: Constructed using reinforced concrete slabs or girders. They are usually solid and rectangular in cross section. Due to problems with cracking and weight, they are usually limited to short spans of 12 metres or less.

ECE Cost Base: For planned projects, use the Cost Base of the IAM in effect at the time of submission; if the project is completed prior to submission, use the Cost Base of the IAM in effect at the time the majority of the work was completed on the project; for reappraisals, if the reappraisal effective date is the day after the original effective date, use the same Cost Base of the IAM that was in effect at the time of the original submission.

Geo-synthetics: Includes woven and non-woven geofabric, geogrid and geoweb.

Log Culverts: Constructed using log stringers on either a single log sill or log crib. Log culverts are constructed with a minimum 300 mm depth of gravel over the stringers that form the running surface. Designs usually utilize pre-existing tables developed by a Professional Engineer.

Log Bridges: Constructed using log stringers on log cribs or a single sill log. Log bridges differ from log culverts in that no gravel or fill is placed over the stringers to form a running surface. Log bridges may utilize either in-place timber deck on cross-ties or modular deck panels. Designs usually utilize pre-existing tables developed by a Professional Engineer.

Non-composite Bridge: A bridge constructed with steel girders with either timber or concrete decks. In the case of a concrete deck, the deck can be bolted, clipped or grouted to the girders. The deck on a non-composite bridge does not act as a load-sharing member; the vehicle loading is completely supported by the girders.

Other Materials (OM): includes all soil types which do not require drilling, blasting or ripping, or the use of special equipment for excavation. Instead, material is excavated using equipment such as crawler tractors, hydraulic excavators, scrapers and rubber-tired loaders.

Permanent Bridge: Bridge structure that has a planned installation period of at least 15 years.

Pre-stressed Concrete Box Girders: Rectangular in cross-section with a hollow rectangular shape in the center. These girders are pre-stressed in a shop and are lighter than concrete slabs of equal span because of the reduced cross-section. These girders can be up to 18 m in length.

Pre-stressed Concrete I-girders: Pre-stressed concrete girders in a similar shape as steel I-beams. A bridge constructed with pre-stressed I-girders is always considered composite. They are used for larger spans and long-term structures.

Portable Bridges: Bridge superstructure designed and fabricated to be re-installed more than once. May be used in temporary or permanent installations based on planned service life. May include a professionally designed portable bridge to be installed over top of an existing, stable log crib.

Post-tensioned Bridge Components: Post-tensioning is the same principle as pre-stressing. The post-tensioning is usually done in the field, where a series of concrete components are required to be joined together longitudinally. The components are set in place and cables are then inserted through pockets longitudinally and tensioned. Once tensioned, grout is inserted into the pockets and allowed to cure. Once cured, the cables are released of tension and the system has been post-tensioned.

Pre-stressed Bridge Components: For pre-stressed components, the reinforcing steel is put under tension before the concrete is poured. After the concrete is cured, the tension on the steel is released and the tension portion of the concrete is under compression.

QRP: Qualified Registered Professional - A person who possesses the specified knowledge, skills, training, experience and other requirements to perform a specified type of work as: set out in legislation, set out in government policy or required by an organization satisfactory to government that has the responsibility for specifying the requirements. The requirements include holding an accreditation bestowed by: government, a professional association constituted under an Act, or other organization satisfactory to government.

Seasonal Bridge: Bridge structure installed for less than one year and generally not designed to pass a Q100 flood event. Includes bridges built with snow fills, single log sills or log bundles.

Single Heading Construction: When pilot trail construction is not practical due to conditions such as shallow soil to bedrock and/or lack of timber to support pilot trail. Justification of single heading construction must be provided.

Temporary Bridge: Bridge structure that has a planned installation period of less than 15 years.

Work Bridge: Temporary crossing installed to allow for the movement of bridge construction equipment necessary to complete the installation of a temporary or permanent bridge.

Appendix 2: Supervision and Certification Costs

Supervision of Construction:

The IAM provides for inclusion of costs related to supervision by a Professional Engineer of complex structures construction. Structures that qualify for consideration as complex are listed below (Structures Considered Complex for the Purposes of Inclusion of Costs of Supervision by Professional Engineers in ECEs and appraisals).

The list below is not exhaustive. For an interpretation of whether a structure is considered complex, please contact the Regional Timber Pricing Coordinator.

Structures Considered Complex for the Purposes of Inclusion of Costs of Supervision by Professional Engineers in ECEs and appraisals:

1. Composite concrete bridges;
2. Multiple span bridges;
3. Major culverts (>1800 mm in diameter or with flows >6 m³/sec).
Density testing of the compacted structural backfill must be completed using standardized testing methods. The results of these tests, including testing methodology, must be retained and available for certification. The extent of structural backfill and the specifications (including minimum density requirements) must be shown on the design drawings;
4. Non-composite bridges with spans greater than 24 m (bearing to bearing) and/or an abutment height (above ground) greater than 5.4 m;
5. Bridges comprised of pre-stressed and post-tensioned concrete beams and girders;
6. Any structure that incorporates a bolted or welded field splice in the girders;
7. Any structure placed on piles, or not identified in the Simple Structures listed below;
8. Any structure not identified as a Simple Structure (in the Procedures);
9. Complex road structures are limited to road sections that require a QRP for a design. This would be limited to retaining walls, reinforced earth/soil systems, or special construction methods for areas where a Terrain Stability Assessment is required. Gravel or rock berm walls do not fall under the definition of a retaining wall or elaborate construction as these are usually a slope stabilizing solution.

The general supervision of simple structures is not an allowable cost estimate in an ECE; regardless of whether the supervision is by a professional or non-professional. The list below includes structures, which are considered to be simple, therefore not eligible for supervision cost estimate in ECEs and appraisals.

This is not to imply that supervision of simple structures is not required. The distinctions between simple and complex structures are made solely to determine eligibility for inclusion of costs for supervision within ECEs and appraisals.

The list below is not exhaustive. For an interpretation of whether a structure is considered simple, please contact the Regional Timber Pricing Coordinator.

Structures, which are considered simple, and therefore ineligible for inclusion of supervision costs in ECEs and appraisals:

1. Tabular structures, including culverts ≤ 1800 mm in diameter or < 6 m³/sec design flow;
2. Single span non-composite structures up to and including 24 m in length (bearing to bearing) for both wood and concrete decks;
3. Non pre-stressed concrete slab bridges;
4. Abutment systems constructed of any of the following:
 - a. Lock block walls up to two courses high under the pile cap or girders;
 - b. Log cribs up to 5.4 m high;
 - c. Bin wall structures up to 1.6 m in height;
 - d. Pre-cast concrete footings with steel pipe columns;
5. Log, mud sills or concrete sleepers;
6. Placement of additional stabilizing on a road subgrade.

Definitions of Supervision and Certification Cost Estimates:

Supervision:

The IAM allows a cost estimate for a Professional Engineer for the supervision of complex structures and the certification/assurance of bridges only.

Supervision of a structure includes the general supervision of the construction for those structures or components that are identified as complex in the list above (List of Structures Considered Complex for the Purposes of Inclusion of Costs of Supervision by Professional Engineers in ECEs and appraisals). Visits by a Professional Engineer for certification are to verify those critical aspects of the construction are in general conformance to the design. This would include inspection of subsurface components such as footings, structural fill, bridge components, bridge elevation and alignment, and construction of the bridge.

The supervision of complex structures is not constrained to a maximum number of days, but will be based on the project size, project components and complexity. The number of days allowed for supervision will be for only those portions of the project that requires supervision by a Professional Engineer as opposed to general project supervision. If requested by district or regional staff, the proponent must provide documentation to justify the number of days estimated for supervision or certification.

Bridge Certification:

Certification of bridges at the time of fabrication is an eligible ECE item. For bridges which are designed for re-use, this cost estimate would be included on the first installation, as part of the bridge purchase cost and not included on re-use.

The length and number of trips should coincide with the project phases that must be viewed by a Professional Engineer to certify the bridge to the design. The certification cost estimate may include additional office time for the completion of the report or record drawings as dictated by the project.

Appendix 3: Calculation of Slope Percent for an ECE Road Section

Slope percent for an ECE road section is calculated by the formula:

$$\text{Percent (\%)} = \frac{[X_1 (10 + 0.5d_1) + X_2 (0.5d_1 + 0.5d_2) + \dots + X_{(n-1)} (0.5d_{(n-1)} + 0.5d_n) + X_n (0.5d_n + 10)]}{D}$$

D

Where:

D is the ECE road section length

d is the distance between cross-sections

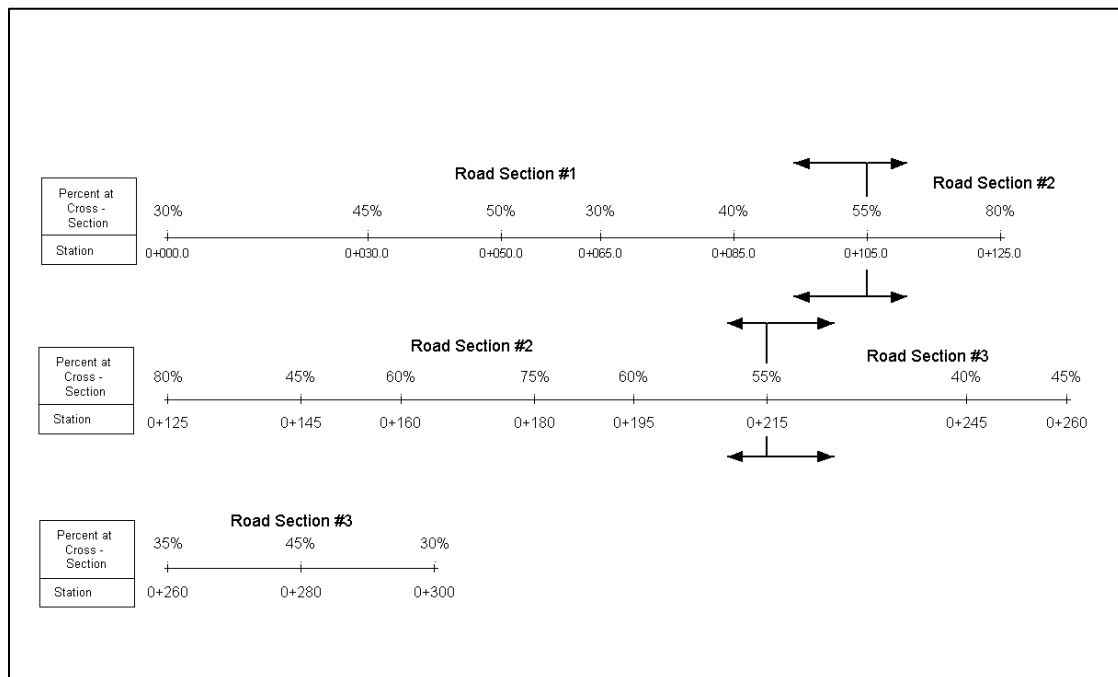
d1 is the distance from the first cross-section to the next

X is the slope % at each cross-section along the road

X1 is the slope % at the first qualifying cross-section.

As shown in Figure A-3-1, the section length will be comprised of only those cross-sections that meet the slope criteria. The start and end of the ECE section is half the distance to the preceding or following cross-section to a maximum of 10 m. This is based on an industry standard of a maximum spacing of 20 m between cross-sections in rock or steep terrain.

Figure A-3-1. Example for Determination of Qualifying Cross-Sections for Uphill Side Slope.



In Figure A-3-1, the ECE section starts at 0+095 and ends at 0+225. The tabular road sections include from 0+000 to 0+095, and from 0+225 to 0+300. The following sample calculation calculates the average side slope percent for the qualifying road section (Road Section #2).

Example Calculation of Side Slope Percent (%) for Road Section #2

$$\begin{aligned} &= [55\% (10 + 0.5*20) + 80\% (0.5*20+0.5*20) + 45\% (0.5*20+0.5*15) + \\ &60\% (0.5*15+0.5*20) + 75\% (0.5*20+0.5*15) + 60\% (0.5*15+0.5*20) + \\ &55\% (0.5*20 +10)] \div 130 \\ &= [55\% (20m) + 80\% (20m) + 45\% (17.5m) + 60\% (17.5m) + 75\% (17.5m) + \\ &60\% (17.5m) + 55\% (20m)] \div 130m \\ &= 80m \div 130m \\ &= 62\% \end{aligned}$$

Appendix 4: Calculation of Rock Percent for a Road Section

Rock percent for a road section is calculated by the formula:

$$\text{Percent (\%)} = \frac{[X_1 (10 + 0.5d_1) + X_2 (0.5d_1 + 0.5d_2) + \dots + X_{(n-1)} (0.5d_{(n-1)} + 0.5d_n) + X_n (0.5d_n + 10)]}{D}$$

D

Where:

D is the ECE road section length

d is the distance between cross-sections

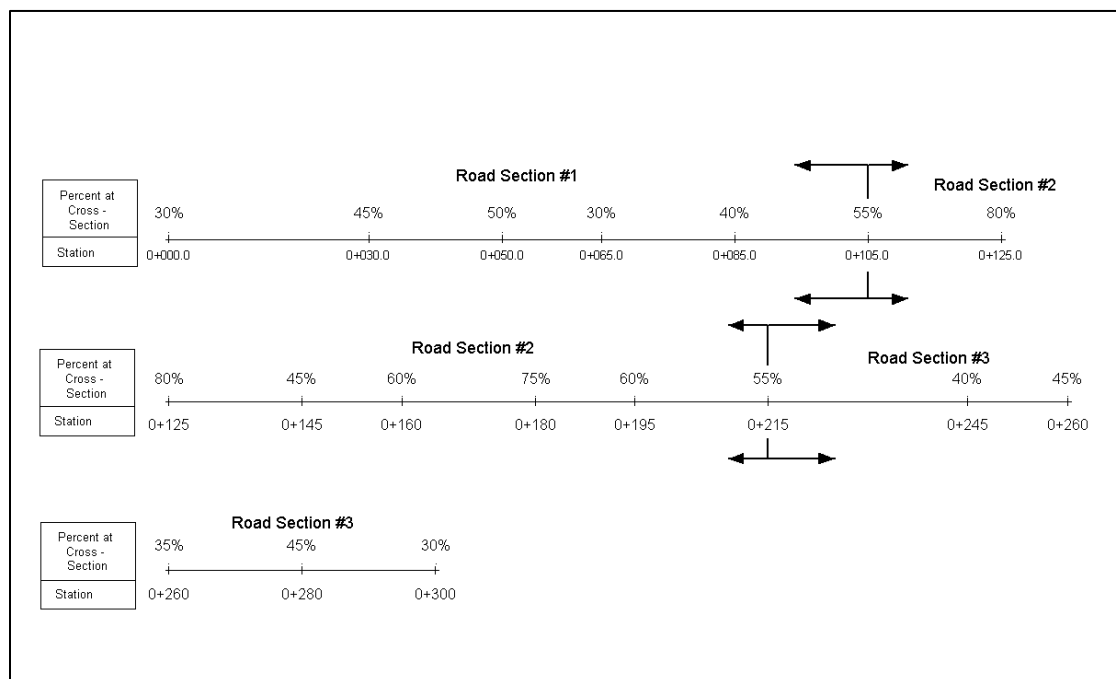
d₁ is the distance from the first cross-section to the next

X is the rock % at each cross-section along the road

X₁ is the rock % at the first qualifying cross-section.

As shown in Figure A-4-1, the section length will be comprised of only those cross-sections that meet the slope criteria. The start and end of the ECE section is half the distance to the preceding or following cross-section to a maximum of 10 m. This is based on an industry standard of a maximum spacing of 20 m between cross-sections in rock or steep terrain.

Figure A-4-1. Example for Determination of Qualifying Cross-Sections for Rock Percent



In Figure A-4-1, the ECE section starts at 0+095 and ends at 0+225. The tabular road sections include from 0+000 to 0+095, and from 0+225 to 0+300. The following sample calculation calculates the average rock percent for the qualifying road section (Road Section #2). As the ditch depth may impact whether a section qualifies for an ECE, the ditch depth used to calculate rock height should not exceed 0.5 m as measured from the top of sub-grade.

Example Calculation of Percent Rock (%) for Road Section #2

$$\begin{aligned} &= [55\% (10 + 0.5*20) + 80\% (0.5*20+0.5*20) + 45\% (0.5*20+0.5*15) + \\ &60\% (0.5*15+0.5*20) + 75\% (0.5*20+0.5*15) + 60\% (0.5*15+0.5*20) + \\ &55\% (0.5*20 +10)] \div 130 \\ &= [55\% (20m) + 80\% (20m) + 45\% (17.5m) + 60\% (17.5m) + 75\% (17.5m) + \\ &60\% (17.5m) + 55\% (20m)] \div 130m \\ &= 80m \div 130m \\ &= 62\% \end{aligned}$$

Appendix 5: References

Chapter 3, 1993 Engineering Manual

https://spc-flnr.gov.bc.ca/sir_rtp/RSI%20DirectionGuidelinesInterpretationProcedures/Forms/AllItems.aspx?RootFolder=%2Fsir%5Fftp%2FRSI%20DirectionGuidelinesInterpretationProcedures%2FIAM%20Sec%204%2E3%2DDDevelopment%20Cost%2FECE

North Area Productivity Guide

<http://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/interior-timber-pricing>

North Area Detailed Engineering Procedures (in effect for used bridge installs only)

<https://www.for.gov.bc.ca/ftp/rni/external/!publish/web/revenue/July12006ECE1.pdf>

Forest Road Engineering Guidebook

<https://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/road/fre.pdf>

Guidelines for Professional Services in the Forest Sector – Forest Roads

<https://www.apeg.bc.ca/getmedia/b76d39fb-f39c-4939-8bc7-2c48013c4895/APEGBC-Guidelines-Professional-Services-Forest-Roads.pdf.aspx>

Guidelines for Professional Services in the Forest Sector – Crossings V.2

<https://www.apeg.bc.ca/getmedia/97dcbad3-5482-416a-9bc0-55b3c662e71a/APEGBC-Guidelines-for-Forest-Sector-Crossings.pdf.aspx>

Land Management Handbook Number 18

<https://www.for.gov.bc.ca/hfd/pubs/docs/lmh/Lmh18.pdf>

Road Reconstruction Cost Estimate Template

<http://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/interior-timber-pricing>