APPENDIX A contains the following site location information:

- Mt.Ozzard Google Earth image showing location – 1 page
- Mt.Ozzzard Bypass Road – Overhead Transmission Line Background Information - 1 page dated 03 June 2019 – for information purposes only.
- Mt. Ozzard Summit – 1 page

**Mt.Ozzard - Site Location Air Photo**

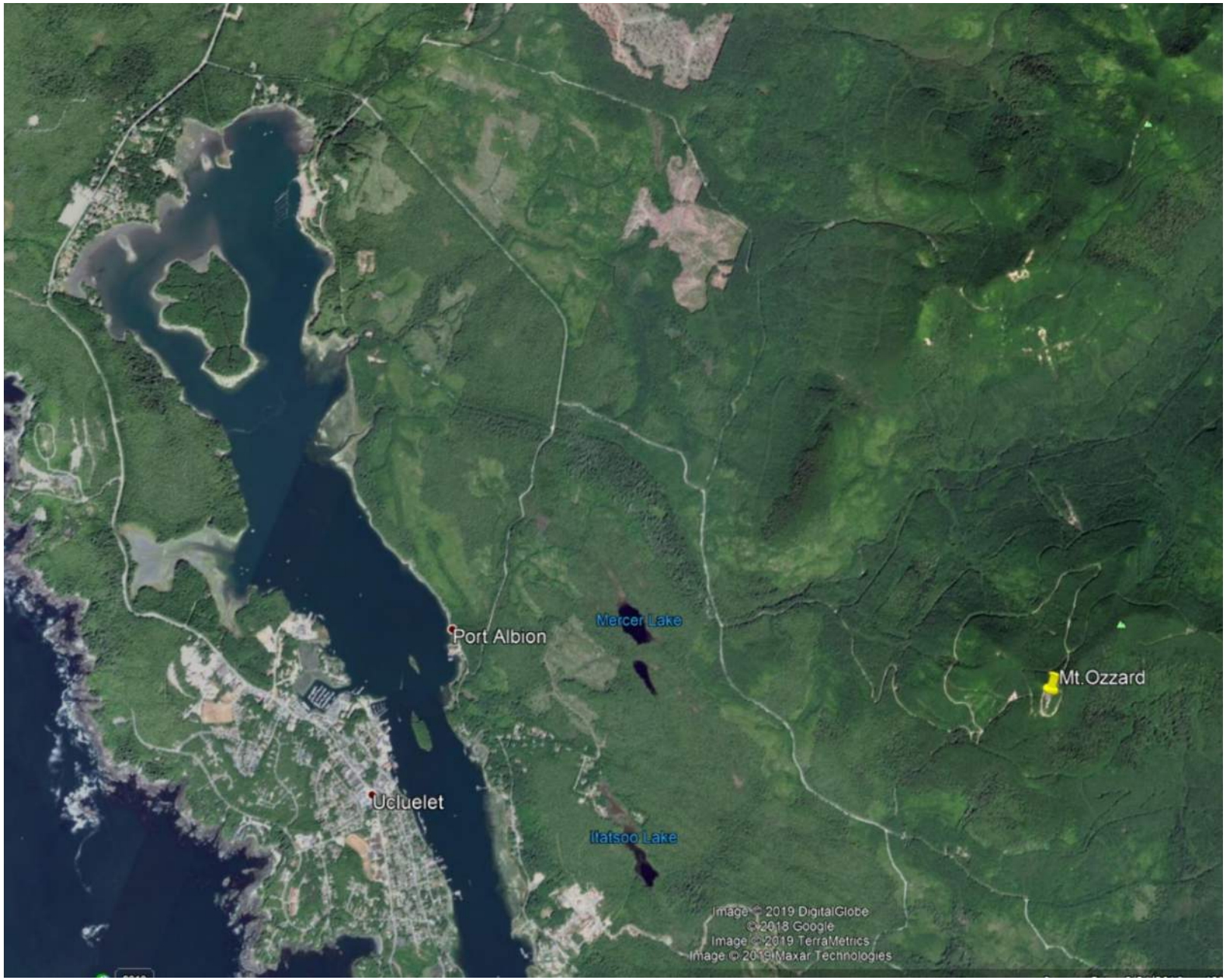



***Figure 1 - Site Location***

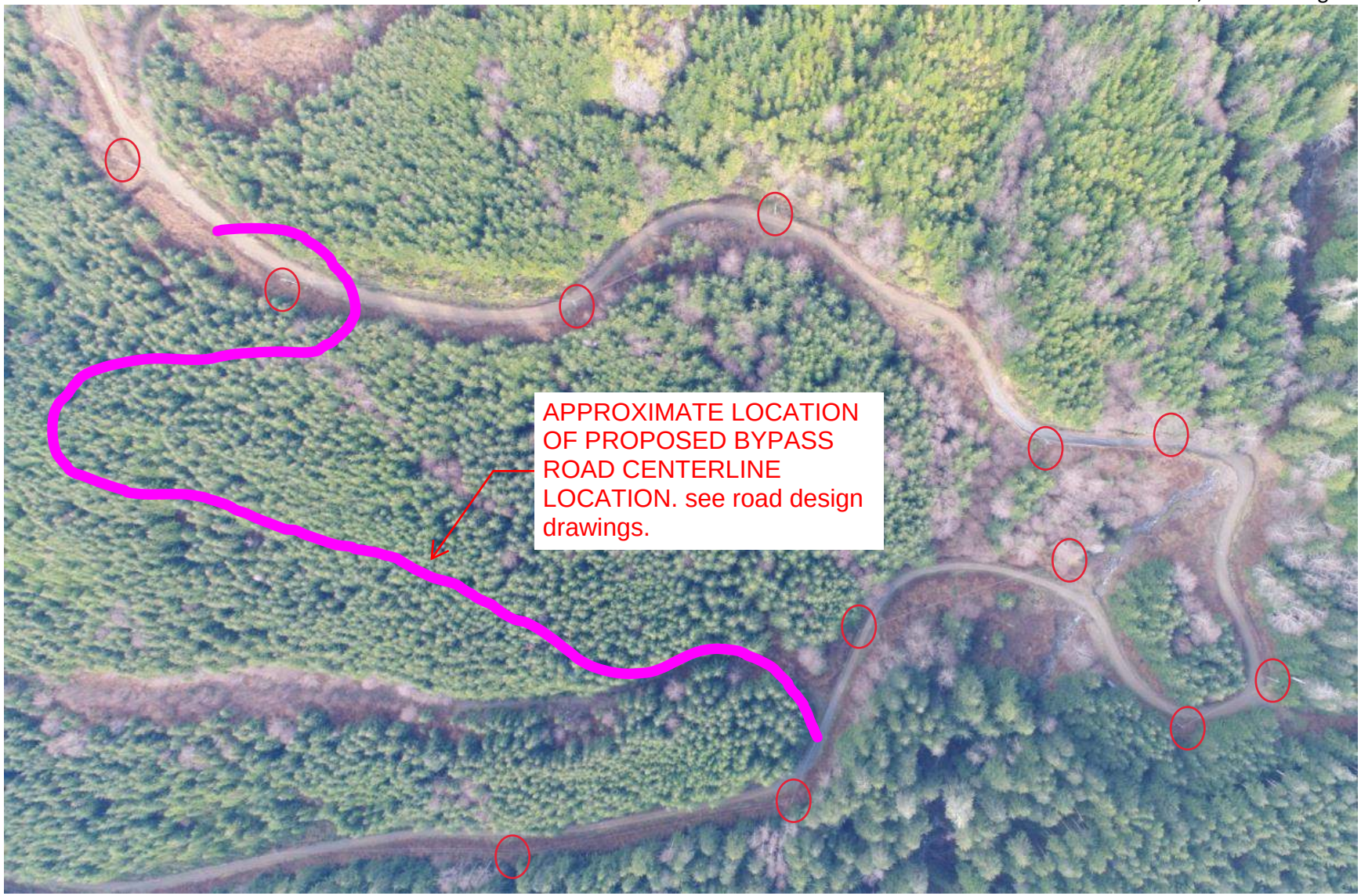
**Mt.Ozzzard Bypass Road – Overhead Transmission Line Background Information**

**Project: N6246**

Existing Road and overhead transmission lines show

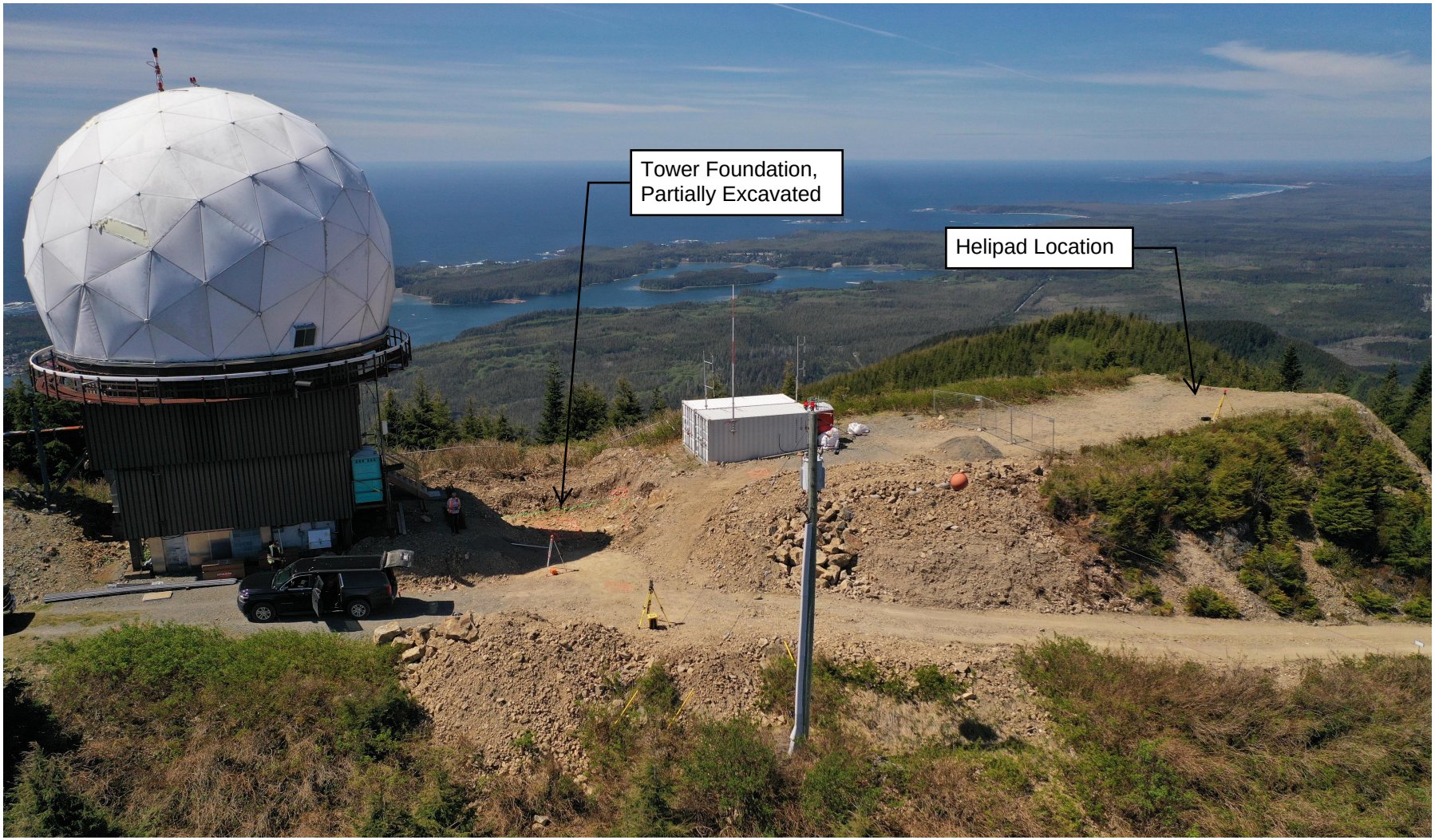
03 June 2019

S.Childs, Canadian Coast Guard,
Maritime and Civil Infrastructure, Western Region




RED CIRCLE INDICATES APPROXIMATE LOCATION OF EXISING HYDRO POLE

**Mt. Ozzard - Summit**



| SECTION (s) | ITEM | SUBMISSION DESCRIPTION | REQUIRED DATE |
|---|---|---|---|
| 00 11 00 | 1.3.1.1 | Design Drawings | within 28 calendar days of contract award |
| | 1.3.1.2 | Schedule | within 28 calendar days of contract award |
| | 1.3.1.3 | Construction Plan | within 28 calendar days of contract award* |
| | 1.3.1.5 | As-Built Information | within 21 calendar days of acceptance of Works |
| *Except as stated otherwise in the relevant Sections. | | | |
| | | | |
| 01 35 29.06 | 1.5.2.1 | Company Safety Manual | within 21 calendar days of contract award |
| | 1.5.2.2 | Site-specific Health and Safety Plan | within 21 calendar days of contract award |
| | 1.5.2.3 | Copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors. | within 21 calendar days of contract award |
| | 1.5.2.4 | Copies of incident and accident reports | within 21 calendar days of contract award |
| | 1.5.2.5 | Hazardous Products Documentation | within 21 calendar days of contract award |
| | 1.5.2.6 | Emergency Procedures | within 21 calendar days of contract award |
| | 1.13.2 | Notice of Project | |
| | | | |
| 01 35 43 | 1.3.2 | Environmental Protection Plan | minimum 21 calendar days prior to commencing construction activities |
| | | | |
| 03 30 00 | 1.4.2 | Concrete Plan | minimum 2 weeks prior to commencing concrete construction activities |
| | 1.4.3 | Concrete Test Results | |
| | | | |
| 26 05 27 | 1.3.2 | Grounding Plan | (21) calendar days before commencing grounding construction activities. |

| SECTION (s) | ITEM | SUBMISSION DESCRIPTION | REQUIRED DATE |
|---|---|---|---|
| | | | |
| 31 05 16 | 1.2.2 | Product Data | |
| | | | |
| 32 23 33.01 | 1.4.2 | Excavation Plan | minimum 2 weeks prior to commencing excavation activities |
| | 1.4.3 | Disposal Records | (21) days following removal |
| | 1.4.4 | Material Delivery Records | (7) days following delivery |
| | | | |
| 32 23 31.01 | 1.5.2.1 | Soil disposal facility documentation | within 21 calendar days of contract award |
| | 1.5.2.2 | Underground pre-locates records | 2 calendar days of work being completed |
| | 1.5.2.3 | Construction equipment list | 14 calendar days prior to start of construction |
| | 1.5.2.4.1 | Fill source location documentation | within 21 calendar days of contract award |
| | 1.5.2.4.2 | Certificates confirming aggregate material compliance | within 21 calendar days of contract award |
| | 1.5.3.1 | Design and supporting data for excavations | within 14 calendar days prior to beginning Work |
| | 1.5.3.2 | Truck manifest and disposal records documentation | within 14 calendar days of removal of material from site |
| | 1.5.3.3 | Truck manifest and import fill source documentation | within 7 calendar days of delivery to site |
| | 1.5.3.4 | Compaction testing result submission | within 1 calendar day of testing |

# Westcoast Geotechnical

2 – 1140 Dallas Rd.
Victoria, B.C.
Canada V8V 1C1

Phone: (250) 381-1975
dhazenboom@shaw.ca


July 15, 2012

Canadian Coast Guard
25 Huron Street
Victoria, B.C.
V8V 4V9

File: 12-10

Attention: Mr. Dieter Losel
Marine Civil Infrastructure Supervisor

**MT. OZZARD DEBRIS FLOW SITE INVESTIGATION AND BYPASS ROAD EVALUATION**

Dear Sir:

This report summarizes the results of a terrain assessment of two crossings on the Mt. Ozzard access road that have been recently impacted by debris flows. The purpose of the assessment was to evaluate the suitability of ford type[1] crossings as replacements for the present corrugated metal pipes and granular fills. This assessment also included the evaluation of an approximately 400 m long alternate alignment that would bypass the two crossings impacted by the debris flows.

*This report is subject to the attached Statement of General Conditions, which must be followed for proper use and interpretation of this report.*

## 1. BACKGROUND & PROJECT DESCRIPTION

An old forest road is presently used by the Canadian Coast Guard (CCG) to access a radar tower on Mt. Ozzard on the north side of Ucluelet Inlet on the west coast of Vancouver Island. The road and several spurs were constructed starting in approximately 1972 to facilitate harvest of the timber along the slopes of Mt. Ozzard, which rises to approximately 675 m elevation above sea level. Most of the spur roads have since been deactivated, but approximately 5 km of the main road is presently used to access the tower. Various service vehicles (utility trucks, fuel trucks etc.) and four wheel drive passenger vehicles require periodic access to the site. See Figure 1 (attached).

Landslides[2] have impacted much of the terrain along the flanks of Mt. Ozzard and several sections of the access road have over-steepened cutslopes or fillslopes that have historically

1 Ford type crossings are generally armored dips in the road at stream crossings designed to flood during peak flows and allow debris to pass over the crossing in order to minimize erosion and maintenance costs.
2 A landslide is defined as the movement of a mass of rock, debris or earth down a slope (Cruden, 1991). Landslide and size classification tables are attached.

failed. In addition, debris flows and debris slides have initiated on the terrain upslope and runout onto or beyond the main access road. These events contribute significantly to the overall road maintenance costs.

It is understood that a major road upgrade was carried out approximately 6 years ago. This upgrade included deactivation of several of the old logging roads, improvements to several stream crossings, installation of cross-ditches and water bars and re-locating the power lines along the road alignment. The purpose of the upgrades was to reduce long term maintenance costs by improving the existing road system and reducing the number of landslides from old roads impacting the road surface.

In November 2009, a large debris flow ranout in a gullied stream channel on the southwest slopes of Mt. Ozzard destroying the two road crossings at Station 17+80 and 20+00[3]. The crossings were re-constructed utilizing 1800 mm diameter corrugated metal pipes (CMPs) surrounded with granular fill and a metal grate (grizzly) was installed at the upstream edge of the upper crossing to minimize plugging by transported debris. Following the re-construction, Stantec Consulting Ltd. was retained to provide a qualitative assessment of the debris flow and make recommendations for additional remedial measures if necessary. Stantec's memo report dated March 4, 2010 recommended including a budget for emergency road repairs due to additional debris flows and considering an alternate alignment to minimize the overall costs associated with regular and emergency road repairs.

In January 2012, another debris flow initiated within the channel completely destroying the upper crossing and burying the lower crossing in sand, gravel, boulders and logs. The lower crossing (Sta. 17+80) was repaired and a temporary crossing was constructed at the upper crossing (Sta. 20+00) utilizing a 1000 mm CMP.

Following the most recent event, an alternate alignment that bypasses the affected crossings was located in the field by Mr. David Edwards, a private contractor who carries out most of the routine maintenance of the access road. See Figure 2 (attached).

## 2. ASSESSMENT

A site visit was carried out on June 19, 2012 in the company of Mr. David Wilson, CCG to assess the impacted road crossings for suitability of armored ford construction and to evaluate the terrain stability along the proposed alternate route. A cursory inspection of the built road upslope of the debris flow initiation zone was conducted to rule out road-related drainage as a contributing factor in the recently observed instability.

3 Road chainages are given in meters and are relative to the junction with Mercantile Creek Road.

Continued....

## 2.1 Debris Flow

A foot traverse of the start zone confirmed a debris flow has previously initiated within the fillslope of an old spur road used for timber harvest. The road was fully deactivated approximately 6 years ago, by partially pulling-back sidecast fill and placing it against the cutslope, creating a re-contoured road surface intended to mimic natural slope angles and drainage. However, not all fill could be retrieved and much of the remaining fill is over-steepened. In addition, woody debris and stumps incorporated into the original fills have lost much of their strength due to decay and likely contributed to the observed instability. However, comparisons of photographs in the Stantec report dated March 4, 2010 and those taken during my site assessment indicate that only a nominal amount of surface erosion has occurred along the scarp since the debris flow in November 2009. In addition, apart from areas of scour caused by subsurface seepage converging on the slide path, vegetation development appears to be more than a few months old and is likely consistent with the November 2009 debris flow event. As such, the most recent debris flow is believed to have initiated farther downstream from a gully bank failure or within a connected gully system.

A foot traverse of the slide path/ gully upstream of the upper road crossing (Sta. 20+00) revealed a vertical till bank more than 10 m high approximately 250 m upstream. This over-steepened area is believed to be related to the most recent debris flow and may be the result of a gully bank failure or erosion at the confluence with a connected gully. Several similar gully systems join the main gully downstream of the upper deactivated road. These gullies have been historically active and are likely to have recurring debris flow activity that impacts the switchback and adjacent terrain up the access road. The approximate extent of unstable terrain impacting this segment of the access road is shown in Figure 2. Note: *This figure does not show unstable terrain on adjacent slopes.*

The upper crossing is located immediately downslope of the main gully system which is incised 10 to 15 m deep upstream. The gully banks are comprised of shallow bedrock and lose confinement immediately upstream of the crossing. This loss of confinement causes partial deposition of the landslide debris and a thick accumulation of gravelly sandy colluvium has deposited on either side of the channel. Past events have also runout down the road alignment and impacted the power line along the switchback. However, not all debris is deposited at the switchback location and although the lower crossing survived the most recent debris flow, the crossing was partially buried and additional debris entrainment and deposition appears to have occurred downstream.

A brief foot traverse was also carried out at the bridge crossing of Barkley Road where a large fan (Figure 1) has developed as a result of both recent and historic debris flow events. It was not clear if the 2012 event reached this crossing, but thick deposits of gravel and cobbles were observed and are believed to be related to the 2009 event based on the age of vegetation growing on the deposit. Although, most sediment and woody debris from past debris flow events appears to deposit onto or just downstream of Barkley Road, additional debris transport as suspended sediment or bedload likely extends much farther downstream. Based on these observations, past debris flows have travelled more than 1.5 km from the initiation zones.

Continued....

## 2.2 Ford Construction

Ford construction involves creating a lowered grade through a stream crossing and armoring the grade to provide erosion resistance to storm flows and smaller debris flows. Large rock is generally placed within the channel maintaining a high void ratio to pass low flows. Higher flows are designed to overtop the road surface and may make the crossing impassable during peak flows depending on the final design. Modified ford crossings are constructed utilizing a combination of large rock and low flow CMPs to provide more frequent dry access on channels with higher seasonal flows.

Ford or modified ford crossings could be constructed on the two crossings along the switchback of the access road. Such crossings could be designed to pass peak channel flows and would be less prone to plugging or washing out than conventional crossings utilizing CMPs and granular fill. However, the gully banks dissipate immediately upstream of the upper crossing and as such, larger debris flows such as the two recent events in 2009 and 2012 would be expected to overtop the ford crossings and would likely cause debris to deposit onto the adjacent road surfaces similar to past events. As such, the power line would still be at risk and future debris flow runout distances would not be significantly impacted.

The primary advantage to a ford type crossing compared to a conventional crossing with a CMP is that larger debris flow events could pass over much of the in-stream works leaving a repairable crossing in place. However, due to the poor quality bedrock in the area (Bonanza Group volcanics), much of the rock for the original construction and subsequent repairs will likely need to be imported from off site. The associated costs of construction and re-construction should be considered before finalizing plans for a ford type crossing.

## 2.3 Alternate Alignment

The alternate alignment avoids the unstable gully system with the recent debris flows as well as several other stream crossings farther along the alignment that have been historically unstable (Figure 2). The proposed alignment switches back along an old spur road approximately 150 m before the lower crossing and follows the gently sloping grade for approximately 50 m before climbing across moderately steep terrain for approximately 250 m. After approximately 250 m of a relatively consistent climb at approximately 18%, the alignment reaches a gently sloping bench and switches back towards the original access road. The total length of the bypass route is approximately 400 m.

Side slopes along the alternate alignment are generally 40 to 50% with no slopes steeper than 55%. As such, conventional cut and fill road construction techniques can be utilized. The road cut is expected to encounter a thick till blanket. The till was observed in the cutslope of the access road just upstream of the upper crossing and generally consists of a dense mixture of gravelly sand with some cobbles and boulders. No bedrock exposures were noted along the alignment and as such, much of the construction should be within the till blanket. However, some blasting should be anticipated if/ where bedrock is encountered.

Continued....

No signs of past instability or slope movement were identified during our traverse of the alternate alignment. In addition, no permanent water courses are crossed. As such, this segment of road is expected to be relatively stable, with only routine cutslope maintenance and ditch cleaning required.

## 3. RECOMMENDATIONS

Further instability of the gully system impacting the access road at Sta. 17+80 and 20+00 is certain due to the over-steepened road fills and gully banks, as well as the numerous woody debris jams within the channel upstream of the crossings. In addition, soils stripped from the gully banks have destabilized root systems of some trees bordering the channel. Windthrow of these trees and potentially adjacent trees will likely create an on-going source of large woody debris entering the channel. Although ford-type crossings could minimize the long term maintenance costs by allowing some of this debris and smaller debris flows to pass over the crossings with minimal damage, relatively significant earth works would be required to provide adequate channel confinement at the crossing locations. In addition, the larger events that appear typical of this area are likely to at least partially destroy the crossings and will continue to runout down the road alignment due to the abrupt change in channel confinement at the upper road crossing. As such, the power line would still be vulnerable during larger debris flows and considerable re-construction costs of the ford type crossings are anticipated after larger events.

The alternate alignment avoids the recently unstable gully, as well as several adjacent gully systems that have been historically active farther up the alignment. As such, the risk of landslides impacting the road or road users is greatly reduced. In addition, this bypass route will likely prove to be the most cost-effective solution to maintaining road access on Mt. Ozzard and should be considered further. If this option is chosen, a road layout specialist should be retained to finalize a road location in the field and prepare a road design that can accommodate the required service vehicles. This design could also be utilized to help estimate construction costs.

Once the layout of the road is finalized and rough road designs are available, it is recommended that a more detailed terrain stability assessment of the alignment be undertaken. The assessment should evaluate the road stability with respect to cut slopes and fill slopes and should make recommendations for any sections requiring specialized construction techniques or construction inspections. Stable cutslope and fillslope angles should be provided for the anticipated soil conditions. In addition, the terrain stability downslope of the alignment should be evaluated with respect to road drainage.

Continued....

## 4. CLOSURE

The preceding assessment is intended to provide sufficient information to allow evaluation of the various design alternatives. Adequate site information was collected to allow preparation of design sketches for ford type crossings at Sta. 17+80 and 20+00; however, the true long term costs will be strongly related to the magnitude and frequency of future debris flows and will be difficult to estimate. I would be pleased to provide detailed design sketches of the ford type crossings or geotechnical recommendations for the alternate road alignment.

Please contact me if you have any questions or need further assistance.

Yours truly,
Westcoast Geotechnical

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D. M. HAZENBOOM
#28050
Aug 13, 2014

D.M. Hazenboom, P.Eng.
Principal

Enclosures: Figure 1 and Figure 2
Statement of General Conditions, Landslide Classification, Landslide Size

**Figure 1** 2010 Google Earth image showing key site features and the path of past debris flows initiating within the gully system that has been recently active (red line).

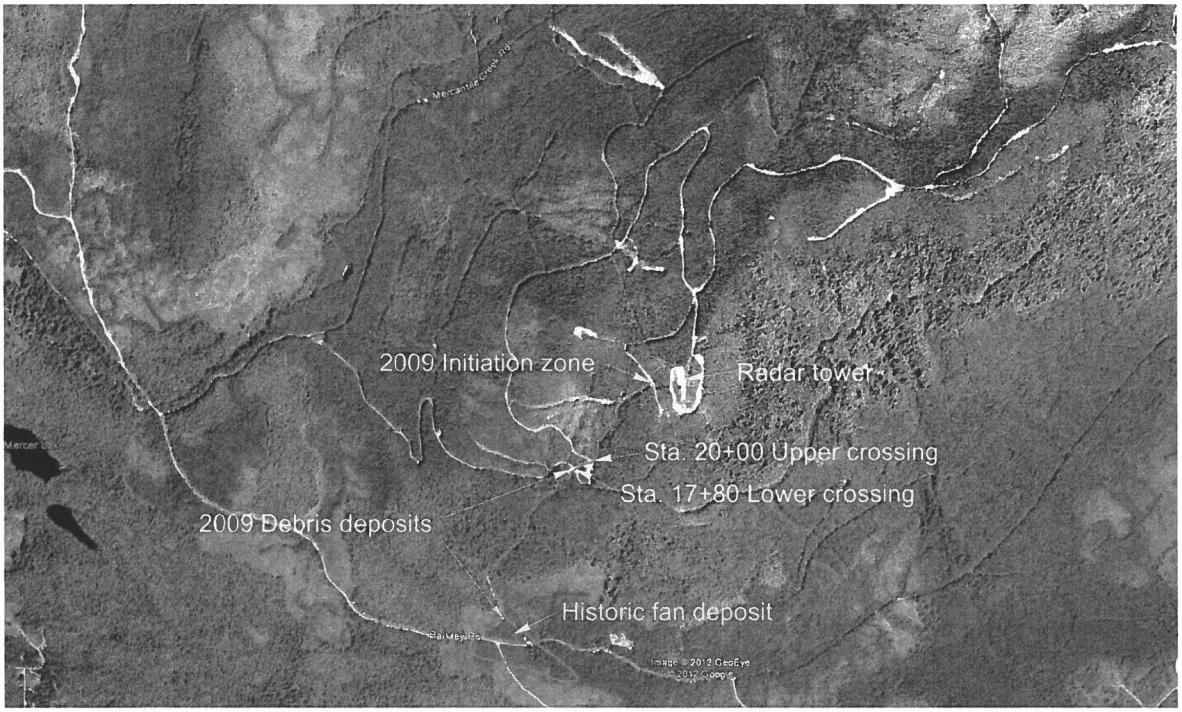
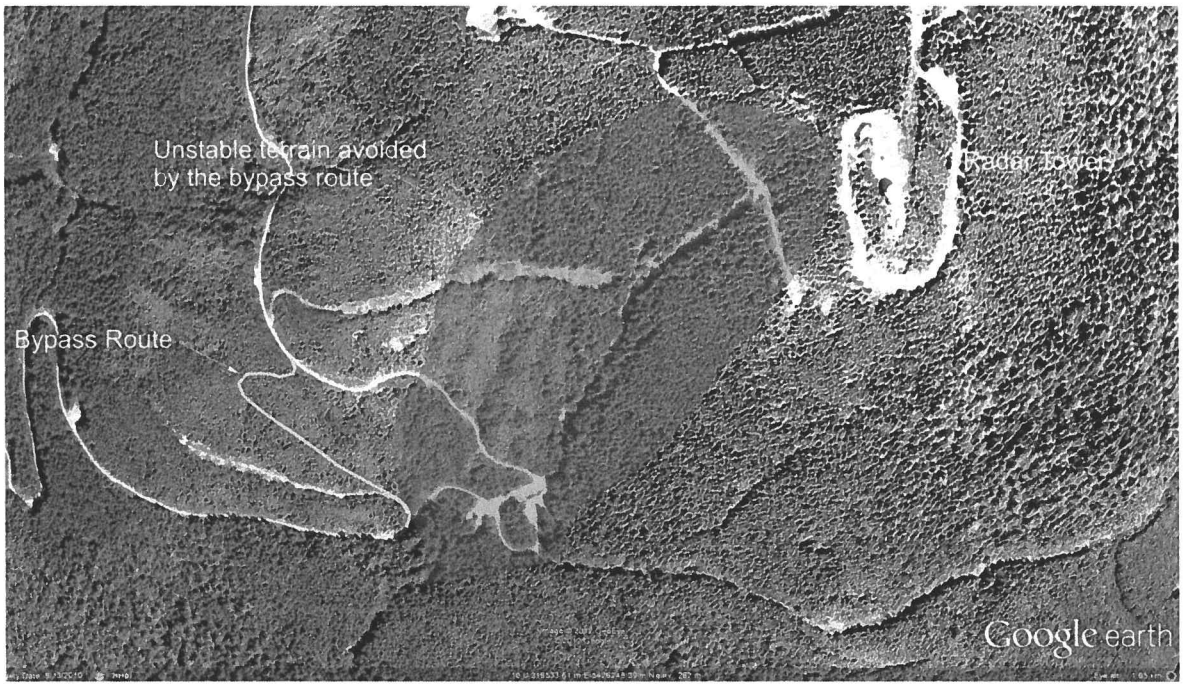



**Figure 2** 2010 Google Earth image showing the proposed location of the bypass route and the approximate extent of unstable terrain (red shading) that is avoided compared to the current access road.



# STATEMENT OF GENERAL CONDITIONS

## 1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering consulting practices in this area. No other warranty, expressed or implied, is made.

## 2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

## 3. BASIS OF REPORT

The Report has been prepared for the specific site and proposed development that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

## 4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS "APPROVED USERS". The contents of the Report remain our copyright property and we authorize only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of the Report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make the Report, or any portion thereof, available to any party without our written permission. Any use which a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorized use of the Report.

## 5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil Description: Classification and identification of soils, rocks and geological units have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgemental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of persons providing information.

## 6. CONTROL OF WORK AND JOBSITE SAFETY

We are responsible only for the activities of our employees on the jobsite. The presence of our personnel on the site shall not be construed in any way to relieve the Client or any contractors on site from their responsibilities for site safety. The Client acknowledges that he, his representatives, contractors or others retain control of the site and that we never occupy a position of control of the site. The Client undertakes to inform us of all hazardous conditions, or other relevant conditions of which the Client is aware. The Client also recognizes that our activities may uncover previously unknown hazardous conditions or materials and that such a discovery may result in the necessity to undertake emergency procedures to protect our employees as well as the public at large and the environment in general. These procedures may well involve additional costs outside of any budgets previously agreed to. The Client agrees to pay us for any expenses incurred as the result of such discoveries and to compensate us through payment of additional fees and expenses for time spent by us to deal with the consequences of such discoveries. The Client also acknowledges that in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed and the Client agrees that notification to such bodies by us will not be a cause of action or dispute.

## 7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on our interpretation of conditions revealed through limited investigation conducted within a defined scope of services. We cannot accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes decisions made to either purchase or sell land.

# LANDSLIDE CLASSIFICATION

| Type of Mass Movement | Materials Involved | Moisture Content | Nature of Mass Movement | Rate of Movement | Typical Velocity |
|---|---|---|---|---|---|
| Rock Fall | Bedrock, rock debris | Low | Free falling, rolling and bouncing of rock debris from a steep, vertical or overhanging rock face. | Very rapid | 3 m/min to 5 m/sec |
| Rock Topple | Bedrock | Low | Typically occur in very fractured/jointed bedrock that is steeply sloping, near vertical or overhanging. | Very rapid | 3 m/min to 5 m/sec |
| Rock Slide | Coherent bedrock blocks, rock debris | Low to moderate | Failure of bedrock slopes along pre-existing planes of weakness. Usually occur slowly in weak rock types and rapidly in strong rock types. | Slow to very rapid | 1.6 m/yr to 5 m/sec |
| Debris Flow | Rock debris, surficial deposits, soil | Very high to high | Failure of predominantly coarse grained soil and sometimes larger organic debris on steep terrain. Usually occurs within pre-existing drainage channels. Scours additional material as it moves downslope. | Rapid | 1.8 m/hr to 3 m/min |
| Debris Avalanche | Rock debris, surficial deposits, soil | Very high to high | Similar to a debris flow but occurs in an open slope area. Erodes additional material as it moves downslope. | Rapid | 1.8 m/hr to 3 m/min |
| Debris Slide | Rock debris, surficial deposits, soil | Very high to high | Typically shallow failures that occur along planes of weakness between looser overlying soil (colluvium, weathered till) and denser underlying material (un-weathered till, bedrock). Can develop into debris flows. | Slow to rapid | 1.6 m/yr to 3 m/min |
| Earth Flow | Fined grained soil and/or weathered volcanic bedrock | Moderate to high | Typically large, slow moving failures involving large tracts of land. Often occur in glaciomarine or glaciolacustrine sediments. | < rapid | < 3 m/min |
| Earth Slump | Fined grained soils | Low to high | Variable size rotational failures that typically occur along river banks, steep valley sides or road cuts. Often retrogressive. | Very slow to rapid | 16 mm/yr to 3 m/min |
| Soil Creep | Soil | Low | Shallow, slow moving failure of thin layers of near-surface soil. | Very slow to slow | 16 mm/yr to 150 m/yr |

Modified after Huntley (2008), Cruden and Varnes (1996), Hungr et al. (2001) and the Resources Information Standards Committee (1997).

## LANDSLIDE SIZE

| Size | Description |
|---|---|
| 0 – 0.05 ha | Extremely small |
| 0.05 – 0.1 ha | Very small |
| 0.1 – 0.25 ha | Small |
| 0.25 – 0.5 ha | Medium |
| 0.5 – 1 ha | Large |
| >1 ha | Very large |

APPENDIX D contains the following geotechnical reports related to the communications tower foundation:

- Geopacific Memo dated April 10, 2019 – 2 pages
- Geopacific Report datead July 18, 2019 – 7 pages

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY

# TECHNICAL MEMORANDUM

| | | | |
|---|---|---|---|
| CLIENT: | Public Works and Government Services Canada | FILE NO: | 13974-B |
| PROJECT: | Mt.Ozzard Self Support Tower | DATE: | April 10, 2019 |
| ADDRESS: | **Mt Ozzard, BC** | | |

PURPOSE: SITE CONDITIONS: WEATHER: OBSERVATIONS: CONCLUSIONS: RECOMMENDATIONS: ACTIONS:

**Purpose:** GeoPacific onsite to review ground conditions for proposed self support tower.

**Observations:**

- At the time of our review the contractor had exposed the bedrock contact at various points, which ranged in depth between 6' to 8' below existing site grades. No definitive tower layout was present at the time of our review. Contractor using a backhoe to excavate.
- Subsequently contractor brought in a 200 sized excavator to expose the rock contact and rip weathered zone.

- Rock appears fractured and is rippable with excavator, contractor reported that rock is rippable up to 8', with minor improvement.

Prepared by: ZAKHAR OKUNEV
REVIEWED BY: KEVIN BODNAR



SIGNED: _____

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY

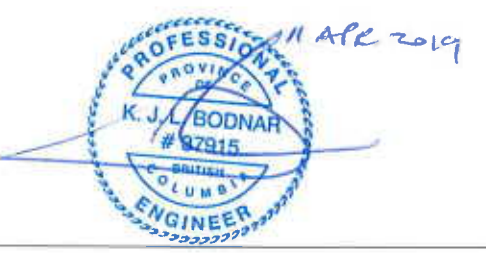
# TECHNICAL MEMORANDUM

| | | | |
|---|---|---|---|
| CLIENT: | Public Works and Government Services Canada | FILE NO: | 13974-B |
| PROJECT: | Mt.Ozzard Self Support Tower | DATE: | April 10, 2019 |
| ADDRESS: | **Mt Ozzard, BC** | | |

PURPOSE: SITE CONDITIONS: WEATHER: OBSERVATIONS: CONCLUSIONS: RECOMMENDATIONS: ACTIONS:

**Conclusions/Recommendations :**

- We recommend contractor exposes the rock contact and removes the top 5' of rock
  - Based on the observed rock during our site visit and contractor photo's following removal of rock the subgrade is suitable for a bearing pressures of 2 Mpa
  - GeoPacific to be onsite for anchor installation and drilling. Contractor to provide 72 hour notice
- All slopes to be inclined at 1 Horizontal:1 Vertical from the base of the excavation. Contractor to monitor slopes during worker entry and report any changes to ground conditions to GeoPacific immediatley. No Stockpiling of material or equipment travel within 5' of top of slope during worker entry.
- Outrigger loads and positions to be provided to GeoPacifics review prior to placement, however, outriggers should generally be positioned 5' or further from the edge of cut slope, and should not impose a load greater than 2000 psf
- Cable bridge foundations may be founded on a subgrade of fractured rock and silty sand fill compacted to 95% Modified Proctor within 2% of it's optimum moisture content. If a Hoe-pack is used, placement of material should not exceed lifts of 4'. If 1000 lb plate tamper is used, lifts not to exceed 2'. Provided these recommendations are met, the cable bridge foundations may be designed based on an SLS bearing pressure of 2500 psf and an unfactored ULS bearing pressure of 3750 psf.




11 APR 2019

Prepared by: ZAKHAR OKUNEV
REVIEWED BY: KEVIN BODNAR



SIGNED: _____

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY

P 604.439.0922
F 604.429.9189
geopacific.ca
1779 W 75th Ave.
Vancouver, B.C. Canada V6P 6P2

Canadian Coast Guard - Marine & Civil Infrastructure
25 Huron Street
Victoria, BC
V8V 4V9

July 18, 2017
File: 13974-B

Attention: Andrew Wight

**Re: Geotechnical Report - Self-Supported Communication Tower, Mt. Ozzard, Ucluelet, B.C.**

## 1.0 INTRODUCTION

We understand that the Canadian Coast Guard (CGC) proposes to construct a 24 to 31 m self supported communications tower at Mt. Ozzard near Ucluelet, British Columbia. It is our understanding that the tower is a relatively light structure and will be constructed on concrete columns and pads bearing on competent bedrock.

This report has been prepared exclusively for the Canadian Coast Guard (CGC), for their use and the use of others on their design team for this project. The report presents the results of a geotechnical site investigation and makes recommendations for the design and construction of the new tower.

## 2.0 SITE DESCRIPTION

The site of the proposed tower is located on top of Mt. Ozzard located approximately 4 kilometres northwest, inland from the east coast of Ucluelet, British Columbia. The proposed location of the tower was approximately located by CGC Engineer Andrew Wight, who was present at the time of the site investigation. The site of the proposed tower is located on the gravel road, to the north of the existing radar tower and immediately south of existing secants. West of the site is a steeply dipping slope of exposed bedrock and vegetation. A CGC Bell 429 Helicopter provided access to the site and a backhoe excavator was present to dig the test pit at the proposed site. The observed ground surrounding the existing radar tower is improved with a top layer gravel fill to provide near horizontal grades. South of the existing radar tower, bedrock is exposed which appears to show moderately fractured bedrock, interpreted to be damaged during blasting to grade the foundation for the radar tower. Further down the access road to the north and northwest of the proposed tower, in-tact to lightly fractured bedrock is exposed. The fill underlying the gravel fill appears to be of similar lithology as the bedrock and could be assumed to have been crushed or blasted on site during construction.

The approximate location of the test pit with respect to surrounding infrastructure on the site can be found in Drawing No. 13794-B-01, following the text of this report.

## 3.0 FIELD INVESTIGATION

The area was investigated on July 5, 2017. The investigation consisted of 1 test pit terminated at a depth of approximately 1.4 m below existing grade as well as a review of the rock exposed along the access road and to the south of the existing radar tower.

The approximate location of the test pit can be found in Drawing 13974-B-01, following the text of this report.

## 4.0 SUBSURFACE CONDITIONS

### 4.1 Soil/Bedrock Conditions

The subgrade observed at the site of TP17-01 consisted of approximately 150 mm of gravel fill underlain by fragmented bedrock, all over massive to moderately fractured bedrock.

Due to blasting to level the grade before construction of existing infrastructure at the site, bedrock immediately underlying the gravel fill was found to be highly fragmented in the form of angular cobbles. These cobbles increased in size with depth until moderately fractured bedrock was observed at a depth of approximately 1.4 m which resembled the lithology exposed near the south end of the existing radar tower.

The bedrock outcrops exposed at the face of the road cuts directly north and west of the proposed tower along the access road revealed a more intact and massive bedrock.

Bedrock at the site was interpreted to consist of very fine grained, dense, and crystalline andesite of the Bonanza Group. The high degree of fracturing in the bedrock near surface was interpreted to be damage due to blasting while grading the site for the existing radar tower.

Detailed logs can be found in Figure 1 of Appendix A of this report.

### 4.2 Groundwater Conditions

Due to the site being located on a mountain top, the static groundwater table was not encountered during our investigation and is well below the development grades of the site. Some perched groundwater seepage may occur during wetter periods.

## 5.0 RECOMMENDATIONS

### 5.1 Discussion

The site is located on bedrock with limited fill cover and thus we would expect that the compression loads from the tower would be supported on a conventional pad foundation bearing on competent bedrock.

### 5.2 Site Preparation

Prior to construction of any foundations, all organic material and weathered and loose rock must be removed to expose a subgrade of competent, unweathered bedrock. Variable overbreak can be expected due to reduced rock strength along weathered zones if encountered in the upper few feet.

### 5.3 Spread Foundations

The tower loads can be supported directly on the competent bedrock. Foundations on the competent bedrock may be designed for serviceability limit state (SLS) bearing pressures of up to 2 MPa. Factored ultimate bearing pressures can be taken as 1.5 x the SLS bearing pressures for short term transient loadings such as those induced by winds and earthquakes.

Footings should not be less than 18 inches (450 mm) in width for strip footings and not less than 24 inches (600 mm) for square or rectangular footings. Foundations on competent bedrock do not require frost protection.

We expect that post construction settlements should be less that 13 mm total and 5 mm per 5 metre differential at the recommended bearing pressures.

### 5.4 Rock Anchors

We expect that the foundation design will be dictated by the requirement for uplift capacity rather than compressive capacity, due to the expected wind loading imposed on the tower. We expect that rock anchors may be employed to provide restraint against uplift, therefore, the grout-to-rock bond capacity of the anchors should be considered during design. The capacity of rock anchors is dependent on the cleanliness and roughness of the drilled socket. We recommend utilizing an ultimate grout-to-rock bond stress capacity of 2.0 MPa for the local bedrock geology.

We understand that rock anchors for towers of this type are often designed to resist conical failures of the rock surrounding each rock anchor. For design purposes, we recommend that the unfactored unit weight and cone apex angle be taken as 25 $kN/m^3$ and 90 degrees, respectively. We expect that the grout-to-rock bond stress will govern the design of rock anchors.

A minimum anchor length of 6 metres in solid rock is recommended for all new rock anchors. The anchors should be fully grouted with microsil non-shrink grout or equivalent. Each new anchor should be proof tested to at least 150 percent of the design load capacity.

*Rock anchors must be reviewed by the geotechnical engineer.*

### 5.5 Seismic Design

The site is considered to be generally underlain by bedrock which can be considered as Site Class B, in accordance with Table 4.1.8.4.A. of the 2012 BCBC provided that footings are supported directly on the bedrock. Peak ground accelerations on firm ground for the approximate site location is 0.513 g (National Resource Canada, Site Coordinates: 48.959 degrees North, 125.493 degrees West).

The subsurface soils beyond the depth of foundations are not considered prone to ground liquefaction or other forms of ground softening caused by earthquake induced ground motions.

## 6.0 FIELD REVIEWS

The preceding sections make recommendations for the design and construction of the proposed 24 to 31 m tall self-supported communication tower on Mount Ozzard in Ucluelet, B.C. We have recommended the review of certain aspects of the design and construction. It is important that these reviews are carried out to ensure that our intentions have been adequately communicated. It is also important that any contractors working on the site review this document prior to commencing their work.

It is the contractors' responsibility to advise GeoPacific Consultants Ltd. (a minimum of 48 hours in advance) that a field review is required. Geotechnical field reviews are normally required at the time of the following:

1. Review of foundation subgrade prior to footing construction for the tower
2. Review of rock anchor installations and testing

## 7.0 CLOSURE

This report has been prepared exclusively for the Canadian Coast Gaurd (CGC) for the purpose of providing geotechnical recommendations for the design and construction of the proposed 24 to 31 m self-supported communication tower, temporary excavations and related earthworks. The report remains the property of GeoPacific Consultants Ltd. and unauthorized use of, or duplication of, this report is prohibited.

We are pleased to be of assistance to you on this project and we trust that our comments and recommendations are both helpful and sufficient for your current purposes. If you would like further details or would like clarification of any of the above, please do not hesitate to call.

For:
GeoPacific Consultants Ltd.

Reviewed by:


JUL 19 2017

Matt Krystofiak, B.A.Sc.
EIT

Kevin Bodnar, M.Eng., P.Eng.
Principal


## LEGEND:

TP17-# – TEST PIT (TP) LOCATION

## SITE PLAN

*TEST HOLE LOCATIONS ARE APPROXIMATE

REFERENCE:

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY
1779 W. 75th Avenue
Vancouver, B.C. V6P 6P2
P 604.439.0922
F 604.439.9189

| DATE: | JULY 18, 2017 | |
|---|---|---|
| DRAWN BY: R.J. | APPROVED BY: M.J.K. | REVIEWED BY: M.K. |
| SCALE: | NOT TO SCALE | |

# COMMUNICATION TOWER
MT. OZZARD, UCLUELET, BC
TEST HOLE SITE PLAN

FILE NO.: 13974-B
DWG. NO.: 13974B-01

REVISIONS:
A.
B.
C.

ORIGINAL PAPER SIZE 8.5"x11"

# APPENDIX A – Test Hole Logs

# Test Pit Log: TP17-01

**File:** 13974-B
**Project:** Proposed Self-Supported Communications Tower
**Client:** Canadian Coast Guard - Marine and Civil Infrastructure
**Site Location:** Mt. Ozzard, Ucluelet, B.C.

GEOPACIFIC CONSULTANTS
215 - 1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Tel: 604-439-0922 Fax:604-439-9189

| INFERRED PROFILE | | | | | | |
|---|---|---|---|---|---|---|
| Depth (ft / m) | Symbol | SOIL DESCRIPTION | Depth (m)/Elev (m) | Moisture Content (%) | Groundwater / Well | Remarks |
| 0 ft / 0 m | | Ground Surface | 0.0 | | | |
| | | ***Gravel (Fill)*** | 0.0 | | | |
| | | ***Cobbles and Gravel (Fill)*** Orangish-grey gravel with some cobbles and silty sand. Consists of angular cobbles and gravel at the top of unit and increases in size. Same lithology as bedrock, likely used as fill following blasting | -1.4 | | | |
| | | End of Borehole | 1.4 | | | Moderately fractured bedrock encountered @4.5 ft depth. Excavator refusal |

Logged: MK
Method: Backhoe Excavator
Date: 7/5/2017

Datum: Ground Level
Figure Number: 1
Page: 1 of 1

# Bulletin 1: General Operations

## Background

Without the implementation of appropriate mitigation measures, construction activities have the potential to affect the biophysical environment (e.g., fish habitat, vegetation, wildlife) directly and indirectly, and may result in adverse environmental effects. Through the use of mitigation measures, potential effects associated with construction activities can be reduced or avoided. The mitigation measures included in this document are intended to provide easy reference to staff and contractors onsite during construction activities and are designed to limit adverse environmental effects. Project personnel have a responsibility to protect environmental, heritage and socio-economic values while undertaking construction work.

## Biophysical Environment

Physical work, associated with operations activities, has the potential to upset the balance of healthy aquatic, and terrestrial ecosystems. Natural water quality or quantity can be affected whenever there is a disruption of water flow, loss of vegetation, increase of sediment in the water, or pollution from harmful substances (such as petroleum products and hazardous washwater) that could contaminate groundwater and soils, and could enter storm drains which discharge to water bodies (EPA 2012). Impacts may include alteration or destruction of habitat, changes in water chemistry leading to potential die-offs of aquatic or other organisms, reproductive failure, disruption of local food chains, the creation of migration barriers, and contamination of local drinking water (DFO 2010, BC MWLAP 2004). Operating heavy equipment can affect local air quality and introduces noise pollution that could disrupt normal wildlife behaviour. Work with machines could also compromise soil structure and vegetation, which may lead to soil erosion or project failures.

Therefore, it is important to have measures in place that minimize the environmental effects of the project. Many mitigation measures apply to all phases of construction activities; such measures are included in this document and

should be implemented on Fisheries and Oceans Canada (DFO) and Canadian Coast Guard (CCG) projects, where applicable.

## Federal and Provincial Legislation

The following table summarizes some of the key federal and provincial environmental legislation that may apply to construction activities carried out by DFO or CCG.

| Federal Legislation | Provincial Legislation |
|---|---|
| *Canadian Environmental Assessment Act* | *British Columbia Environmental Assessment Act* |
| *Canadian Environmental Protection Act* | *Environmental Management Act* |
| *Fisheries Act* | *Heritage Conservation Act* |
| *Species at Risk Act* | *Land Act* |
| *Migratory Birds Convention Act* | *Parks Act* |
| *Navigation Protection Act* | *Water Sustainability Act* |
| *Canada Shipping Act* | *Fish Protection Act* |
| *Transportation of Dangerous Goods Act* | *Wildlife Act* |
| | *Waste Management Act* |
| | *Forest and Ranges Practices Act* |
| | *Dike Maintenance Act* |
| | *Drainage, Ditch and Dike Act* |
| | *Riparian Area Protection Act* |

## Best Management Practices

### Permits

- Consult with appropriate Qualified Professionals, as needed, to confirm permitting requirements.
- Copies of all issued permits or approvals issued by regulatory agencies (e.g., DFO, Transport Canada and BC Ministry of Forests, Lands and Natural Resource Operations) must be kept on site (e.g., site trailer, construction barge, accommodation vessel) and readily available. This includes permits and approvals issued directly to DFO or CCG, as well as any issued to contractors or subcontractors.
- Construction-related restrictions, conditions or mitigation measures that are included in regulatory permits should be communicated to the field crew(s).

### Timing

- Choose appropriate timing of works (weather conditions, regional timing windows for species at risk). Have contingency plans designed and in place to address unforeseen weather events.

- Permits and approvals may include construction timing restrictions. Refer to regulatory permits to see if construction timing is restricted.
- In-water work should aim to occur within the DFO (DFO 2015) or Provincially (BC MOE 2017a) identified least-risk work window for the area, where practicable. Where in-water work cannot be conducted within the least-risk window, additional mitigation measures may be needed and should be developed in consultation with the appropriate regulatory authority.
- Construction timing should be planned to occur outside of the nesting periods for raptors, migratory birds and seabirds, whenever possible. General nesting periods of migratory birds in Canada are provided by Environment and Climate Change Canada (ECCC 2016a). Breeding seasons are provided by ECCC (ECCC 2016b) and Atlas of Breeding Birds of British Columbia (ABBBC n.d.). If unavoidable, mitigation measures must reflect the necessary protocols for avoiding or mitigating harm to birds, nests, and fledglings (ECCC 2016c).

**Training**

- Project personnel will be adequately trained and will use appropriate personal protective equipment. Training should be documented and kept up to date.

**Tailgate Meetings**

- Applicable Environmental Management Plans (EMP) and regulatory permit conditions will be reviewed by the RPSS Project Manager, Site Manager and Environmental Monitor (EM; where applicable)
- The author of the EMP (or the delegate) will provide a briefing to the crews.

**Stop Work**

- Where an Environmental Monitor (EM) is onsite, they will have authority to issue a Stop Work Order where activities are harming, or may imminently harm the biophysical environment. The EM will make recommendations in the field as needed, to limit or avoid damage to the environment.
- Work will stop and the EM will be contacted for assistance prior to starting or continuing with activities that may pose any environmental or archaeological risk not addressed in project health, safety or environment documents (e.g., EMP, environmental regulatory permit requirements).

**Public Notice**

- If applicable, proper notice should be given to transportation and navigation authorities to warn of potential disruptions during works.
- Construction areas will be clearly marked and, to the extent necessary, isolated from the public to prevent public access to the active construction site.

**Site Cleanliness**

- Aesthetic effects created by construction activities will be short-term and localized. The site should be kept tidy during activities and left in a good condition at the end of the project.

- Garbage in the form of coffee cups, lunch wrappers, cigarette butts, and other such items will be placed in covered trash containers at all times.
- Waste or miscellaneous unused materials will be recovered for either disposal in a designated facility or placed in storage. Under no circumstances will materials be deliberately thrown into the aquatic or terrestrial environments.
- Where practicable, recyclable materials, such as drink containers, plastics and paper will be separated onsite and recycled at an appropriate offsite facility.
- Onsite personnel will make best efforts to prevent debris from entering the aquatic and terrestrial environment outside of the worksite.

**Wastewater**

- Sewage from portable toilets will be disposed of in an approved sewage disposal facility on an as-needed basis.

**Contractors/Subcontractors**

- Contractors and subcontractors must comply with the mitigation measures outlined in this bulletin and measures identified within applicable regulatory permits or approvals.

**Noise and Air Quality**

- Machinery must be operated efficiently, to limit noise and air quality effects.
- Noise abatement fittings (e.g., mufflers) on equipment and machinery will be kept in good working order.
- Painting activities should be completed in such a way as to limit fumes entering the environment.
- Smoking will only be permitted in designated areas.
- Fire suppressing equipment must be present at designated smoking areas.
- Fires and burning of rubbish and vegetation is not permitted on work sites.
- Dust will be controlled via the application of water or similar dust control measures.
- Chemical dust suppressants are prohibited.
- To prevent unnecessary local air pollution, anti-idling measures should be put in place when vehicles and machines are not in use.

**Paint**

- The amount of paint used should be limited and unused containers must be covered.
- Wash water from equipment should be contained and disposed of appropriately.

**Safety Data Sheets**

- Chemical products must have their applicable Safety Data Sheets onsite and readily available to all construction crew members.

**Stock Piles/Laydown Areas**

- Stockpiling of material will be conducted in accordance with Best Management Practices (BMPs) and limited to material staging areas and barges, where practicable.
- Stockpiles should remain covered during inclement weather.
- Temporary stockpiling areas located adjacent to the aquatic environment will be approved by the EM and materials will be removed prior to inundation by the tide or high water levels. These sites should be identified in advance of construction.

**Soils**

- Care should be taken to prevent soils from being exposed and eroded into waterbodies.

**Deleterious Substances**

- Harmful substances (e.g., fine sediments, hydrocarbons, contaminants) will not be deposited into aquatic environments.
- Storage of fuels and petroleum products will comply with safe operating procedures, including secondary containment devices (e.g., drip trays), double walled tanks or vacuum tanks in case of a leak or spill.
- Routinely inspect heavy equipment for lubricant and fuel leaks
- Onsite crews will have emergency spill equipment available and readily accessible, and will know how to use it properly.
- Refuel diesel-powered equipment at least 30m from the water.
- Work will be conducted such that no contaminated water or other effluent potentially harmful to aquatic life enters the marine environment. Examples of contaminated water or effluent may include silt laden water, wash water containing concrete, site run off, oil or fuel spills, and sewage.

**Sediment**

- Where necessary, sediment control measures (e.g., silt curtains) will be used to limit the dispersal of sediments and sediment-laden waters beyond the immediate work area.
- Intertidal work should be conducted at low tide and in the dry where practicable.
- Prop wash should be limited in shallow aquatic environments in such a way to reduce disturbance of sediment.

**Power Washing**

- Power washing should be limited to the immediate construction area.

**Spudding/Anchoring**

- Where practicable, crews will position barges and vessels in a way that minimizes damage to sensitive aquatic habitat (e.g., surfgrass, eelgrass, kelp beds, spawning gravels, large woody debris) and alternative methods will be employed (e.g., use of anchors instead of spuds, flat deck barge rather than spud barge) as needed. In the event that sensitive habitats cannot be avoided, the EM (or appropriate delegate) must approve the location of the spudding or anchoring to construction crews in order to limit disturbance.
- Prop-wash and scouring will be avoided within 30 m of kelp, eelgrass or surfgrass beds, where practicable.

**Grounding**

- Barge grounding will be avoided to the extent practicable.
- Rock drilling must be conducted conservatively so that physical changes to rock remain small and localized.
- Rock drilling is to be done in the dry (i.e., not in-water).
- Dust and fines entering the water must be avoided (e.g., vacuum or otherwise collect fines and dust).

**Blasting**

- Blasting will follow the *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters* (Wright and Hopky 1998).
- In the marine environment, use a protection shield, such as a bubble curtain, around the blast area to limit shockwaves.
- In the terrestrial environment, place rubber mats over the blasting area to limit flying debris.
- Using a sounder, monitor fish movement; if schools of fish are present, blasting may be halted until the fish move out of the area.

**Water Quality**

- Before allowing water to leave the work site, crews will verify that the following water turbidity criteria are achieved (MOE 2017b):
    - Change from background of 8 NTU at any one time for a duration of 24 h in all waters during clear flows or in clear waters
    - Change from background of 2 NTU at any one time for a duration of 30 d in all waters during clear flows or in clear waters
    - Change from background of 5 NTU at any time when background is 8–50 NTU during high flows or in turbid waters
- Change from background of 10% when background is >50 NTU at any time during high flows or in turbid watersBefore allowing water to leave the work site, crews will verify that water is within the pH range of 7.0–8.7 pH units unless it can be demonstrated that such a pH is a result of natural processes (MOE 2017b).
- Before allowing water to leave the work site, crews will verify that water does not have detectable oil and grease (detectable by sight or smell).

**Flora and Fauna (General)**

- Activities should be completed in such a way as to limit stress and disturbance to resident flora and fauna (aquatic or terrestrial).
- Construction footprints should be limited to the area necessary to safely complete the works, to reduce effects to nearby soils, vegetation, and resident species.
- Feeding of wildlife is not permitted.
- If dead, sick or injured animals are observed, report to the EM (or delegate) immediately. Also, contact DFO's Observe, Record, Report phone line (1800-465-4336).
- Site-access routes should consider resident flora and fauna, especially during times of the year when they are most sensitive.
- Foot traffic on riparian and foreshore areas will be limited to prevent trampling flora and fauna.
- All activities should be completed in a way that reduces stress and disturbance to resident flora and fauna.
- The project footprint should be clearly defined by construction crews. Equipment presence within the aquatic environment (e.g., intertidal, riparian areas, stream banks) will be restricted to the immediate work area. The establishment of approved work areas will reduce disturbance and the potential to alter, damage, or destroy fish habitat.
- Locations where project activities may occur (e.g., Fixed Aid footprint, barge landing, laydown areas, watercourse crossings, or in-water components) should be inspected for sensitive habitats and species at risk before and during work.
- Work in and around the marine foreshore environment (e.g., tide pools, intertidal areas) that may be affected by project activities will be reviewed in consultation with a Qualified Professional.
- If intakes are used to withdraw water from the aquatic environment, they will be appropriately screened to prevent the entrainment and impingement of fish. Intake screens will be monitored every half hour while in use for fish entrainment and impingement.
- Any instances of fish kill must be reported to the EM promptly. It is the EMs responsibility to inform the relevant regulatory agency (DFO or Ministry of Forests, Lands and Natural Resource Operations)
- Site- or project-specific mitigation measures may be needed to limit or avoid damage to sensitive habitats or species (e.g., abalone presence, herring spawn in the marine environment; spawning gravels in the freshwater environment). A Qualified Professional should be consulted to identify sensitive habitats in advance of construction, where appropriate.

**Birds**

- When travelling near seabird colonies, travel parallel to shore rather than approaching a colony directly.
- Avoid travelling through areas where concentrations of seabirds are observed on water.
- Avoid sharp loud noises, blowing whistles or horns, and maintain constant engine noise levels when within 300 m of seabird colonies.

- If breeding birds, seabird colonies or nests are encountered at the construction site, contact the EM (or delegate) for guidance. If work is expected to occur during the nesting window for raptors, migratory birds or seabirds, construction should not go ahead until given approval by the EM and, if required, under applicable regulatory permits. If allowable, work must be conducted as efficiently as possible and not disturb birds, nests, and their fledglings. Walk with care as nests and juveniles can be camouflaged on the ground.
- Site- or project-specific mitigation measures (e.g., no-disturbance buffers)) may be required where breeding birds, seabird colonies or nests are encountered at the construction site; attempts should be made to identify these resources ahead of construction.

**Brushing/ Falling**

- No falling will occur without the EM's (or delegate) prior knowledge and approval and must follow applicable regulations.
- Prior to brushing and falling, the area will be inspected for bird nests, wildlife dens and culturally modified trees. Trees containing these features will not be removed without approval from the EM (or delegate) and under appropriate permits, if applicable.
- Prior to brushing and falling, the EM (or delegate) will monitor trees and understory vegetation within 30 m of the construction site for nesting activity. The EM should monitor the active trees and branches identified for brushing and falling, including the path for falling, for a minimum of 15 minutes (or longer, if necessary) to assess nesting activity.
- If an active raptor, migratory bird, or seabird nest or cavity is identified directly at a construction site (i.e., at or within 10 m of the site), brushing and falling activities should be stopped and the EM should consult with a wildlife biologist.
- If an active raptor, migratory bird, or seabird nest or cavity is identified near a construction site, the EM (or delegate) should initiate monitoring activities (described below) for the duration of construction at those sites.
- If an inactive active raptor, migratory bird, or seabird nest or cavity is identified at a construction site, brushing and falling activities can be completed as scheduled.
- If an inactive bald eagle, peregrine falcon, osprey, or great blue heron nest is present in a tree that is proposed to be fallen or within the pathway for falling the EM will determine how to proceed as unoccupied nests of these birds are protected year round.
- Physical injury to tree roots, bark, trunk and crown (e.g., from machinery) will be avoided.
- Use discretion when deciding whether to remove cut debris or leave it on site. In remote sites, cut or brushed debris may be left above highest high water or top of bank to decompose. Remove debris from sites that are not remote.
- Do not dispose of or leave cut vegetation debris in the aquatic environment.

**Archaeological and Heritage Resources**

- Archaeological and heritage sites in remote locations are not likely to have been previously identified. Care should be taken to avoid archaeological deposits while work is being completed. If an archaeological or heritage resource is encountered during construction, the work should be stopped in the vicinity of the find and the work crew the EM (or delegate) notified.
- Inspect the proposed construction site footprint (including laydown areas, temporary work areas, and barge landings) for archaeological evidence (e.g., rock art pictographs and petroglyphs) before construction activities (e.g., power washing, rock drilling, concrete pour). If project activities will impact an archaeological site, stop work and contact the EM (or delegate). Trees should be inspected for cultural modification prior to brushing or falling.
- The location of Aboriginal communities and information pertaining to their potential or established Aboriginal or Treaty rights can be found on ATRIS (INAC 2017).

## References

BC MOE (Ministry of Environment). 2017a. Regional Terms & conditions & Timing Windows. Available at: http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights/working-around-water/regional-terms-conditions-timing-windows. Accessed April 2017.

BC MOE. 2017b. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture. Summary Report. Available at: http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf. Accessed April 2017.

BC MOE. 2017c. General BMPs and Standard Project Considerations. British Columbia Ministry of Environment. Available at: http://www.env.gov.bc.ca/wld/instreamworks/generalBMPs.htm Accessed: April 2017.

BC MOE. 2005. *A User's Guide to Working In and Around Water. Understanding the Regulation Under British Columbia's Water Act.* British Columbia Ministry of the Environment, Water Stewardship Division

BC MWLAP (Ministry of Water, Land and Air Protection). 2004. Standards and Best Practices for Instream Works. British Columbia Ministry of Water, Land and Air Protection, Ecosystems Standards and Planning, Biodiversity Branch: Victoria, BC.

DFO. 2010. Projects Near Water: Pathways of Effects – Structure Removal. Fisheries and Oceans Canada. Available at: http://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/removal-enlevement-eng.html Accessed: April 2018.

DFO (Fisheries and Oceans Canada). 2015. Timing Windows to conduct Projects in or around Water, Available at: http://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/index-eng.html. Accessed April 2017.

DFO. 2016. Photograph inventory. Pacific Regional Office of Environmental Coordination, Real Property, Safety & Security Branch, Sidney, BC. Accessed December 2017.

ECCC (Environment and Climate Change Canada). 2016a. General Nesting Periods of Migratory Birds in Canada. Available at: http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4f39a78f-1#_03 Accessed: April 2017.

ECCC. 2016b. Birds at Sea. Table 1: Dates Selected for the breeding and non-breeding seasons used in the data analysis for each species. Available at: https://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=FD3D610E-1 Accessed: April 2017.

ECCC. 2016c. Guidelines to Avoid Disturbance to Seabird and Waterbird Colonies in Canada. Available at: https://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=E3167D46-1 Accessed April 2017

Wright, D.G. and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Can. Tech. Rep. Fish. Aquat. Sci. 2107: iv + 34p

## Additional Information

Atlas of the Breeding Birds of British Columbia. n.d. Breeding Bird Atlas. Species breeding dates. Available at https://www.birdatlas.bc.ca/download/brdates.pdf. Accessed May 3, 2018.

CCG. 2000. Best Management Practices for Concrete Pouring Programs at DFO – Canadian Coast Guard Sites. Prepared by Canadian Coast Guard Pacific Region Technical Services. Prepared for DFO – Canadian Coast Guard – Marine Programs.

CCG (Canadian Coast Guard). 1999. Best Management Practices for Undertaking Maintenance Cleaning/Painting of Canadian Coast Guard Lightstations. Prepared by Canadian Coast Guard Pacific Region Technical Services. Prepared for DFO – Canadian Coast Guard – Marine Programs.

CCG. 2009. Best Management Practices for Brushing Activities at DFO - Canadian Coast Guard Sites. Prepared by Canadian Coast Guard Pacific Region.

CCG. 2005. CCG Protocol for On-site Visits to Navigation Aids in Sensitive Bird Nesting Sites. Prepared by Canadian Coast Guard Aids to Navigation Program.

DFO (Fisheries and Oceans Canada). 1992, updated 1993. Land Development Guidelines for the Protection of Aquatic Habitat

EC (Environment Canada). 2013. Guidelines to Avoid Disturbance to Seabird and Waterbird Colonies in Canada. Accessed November 2015, from: https://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=E3167D46-1

EPA (Environmental Protection Agency). 2012. Best Management Practice Concrete Washout. United States Environmental Protection Agency.

INAC (Indigenous and Northern Affairs Canada). 2017. Aboriginal and Treaty Rights Information System (ATRIS). Available at https://www.aadnc-aandc.gc.ca/eng/1100100014686/1100100014687. Accessed May 5, 3018.

Manning, Cooper and Associates. 2013. Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (2013). A Companion Document to Develop with Care 2012. MOE. 2015. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture. Summary Report.

Province of BC (Province of British Columbia). 2014. Develop with Care 2014. Environmental Guidelines for Urban and Rural Land Development in British Columbia.

## Bulletin 2: Site Access

### Background

Accessing remote sites by land, air or water may impact natural vegetation, wildlife, soil characteristics and other environmental aspects (Berch, Bulmer, Chapman and Thompson, 2014). Best management practices (BMPs) serve as planning tools that, if implemented successfully, will avoid or mitigate harmful environmental impacts resulting from creating site access and should be considered prior to the commencement of work.

### Best Management Practices

In addition to the BMPs below, refer also to the 'GENERAL OPERATIONS', 'VEGETATION BRUSHING', and 'SITE RESTORATION' bulletins.

**General**

- During planning stages, determine the most appropriate location for site access and estimate the proportion of land to be occupied by a road, structure or clearing (Berch et al., 2014).
- A detailed site map should be created to show access points, work zones, archeological sites, environmentally sensitive areas, and emergency response (e.g., spill kit) locations. Sensitive areas should be flagged off upon arrival on-site and avoided at all times.
- Site access practices must be undertaken with regard to personnel safety and protection of flora and fauna (CCG, 2009).
- Operations should only be conducted where it is necessary to reduce the effects on nearby vegetation, soil substrate and resident species (DFO, 2018).
- Reduce foot traffic on vegetation where possible to limit project impact, respect should be given to the natural environment (DFO, 2018).
- A species at risk search will identify if there are any sensitive habitats in the vicinity of the site. If there is sensitive flora or habitat in the access points or work zones, a protection plan may be required (i.e., rig-matting prior to using heavy equipment on site). Contact a qualified professional.

**Road Access**

- Minimize vegetation clearing and soil disturbance to areas necessary for access (Berch et al., 2014).
- Keep to platforms and well-used paths (some wildlife burrow under bare or mossy ground in open areas or under forest canopies).
- If roads and access structures are temporary, rehabilitate the disturbed areas (Berch et al., 2014).Ensure proper drainage channels to avoid surface runoff flooding or pooling (Berch et al., 2014).

**Water Access**

- When vessel or barge nears kelp beds, eel grass or surfgrass:
    - Prop-wash and scouring will be avoided within 30 m, where practical.
    - Water-borne equipment shall be positioned in a manner that limits damage to identified sensitive habitat. Where possible, alternative methods will be used (e.g., anchors instead of spuds).

      (Stantec, 2017)

- Seabirds
    - Avoid travelling through areas with a high concentration of seabirds.
    - When travelling near seabird colonies, travel parallel to shore rather than towards the colony directly.
    - Avoid loud noises such as whistles or horns and maintain a consistent engine noise level when less than 300 m from seabird colonies.
      (Stantec, 2017)
- Marine Mammals
    - Marine mammals are classified as "fish" under the Fisheries Act and additional regulations specific to these taxa are detailed in the Marine Mammal Regulations. Under Section 7 of the Marine Mammal Regulations, "disturbance" of marine mammals is prohibited except when fishing for them under the authority of the Regulations. The Regulations also prohibit moving a marine mammal from the immediate vicinity in which it is found (DFO, 2018).
    - Acoustic monitoring is recommended if noise levels (decibels; dB) have the potential to exceed 160 dB re: 1 µPa (potentially altering behaviour of marine mammals; NOAA, n.d.). A hydrophone should be deployed by the EM to monitor noise levels.
- Tide pools may be impacted by work activity (site mob, barge ramp) and should be inspected for sensitive habitat or species (DFO, 2018).
- If work is to be conducted in areas where fish spawning is present the project must first be authorized via the Fisheries Protection Program to ensure compliance with the Fisheries Act. Once authorized, appropriate monitoring by a qualified professional will be undertaken to monitor spawn activity. Stop work if the project is disrupting the spawn activity (DFO, 2018).
- Any occurrence of fish kill must be reported to the EM without delay (DFO, 2018).

**Air Access**

- Determine affected wildlife species of concern which may be disturbed by noise of low-altitude flights and landings. Choose appropriate seasons and times of day to fly (Churchill and Holland, 2003).
- Avoid wetlands, shallow lakes, alpine and sub-alpine habitats (Churchill and Holland, 2003).
- Avoid special features (e.g., wildlife trees, bird colonies) (Churchill and Holland, 2003).
- Maintain sight and noise barriers between areas of aircraft operations and sensitive habitats (Churchill and Holland, 2003).
- Monitor wildlife sightings and aircraft activities, where appropriate (Churchill and Holland, 2003).
- Minimize excessive disturbances by:
    - Using a single flight path, preferably lower elevation corridors.
    - Restrict standby helicopters in or around high elevations.
    - Plan flights for predictable timing and within defined areas to decrease flight responses. If possible, use a quieter aircraft to reduce wildlife disturbances (e.g., light duty vs. heavy duty helicopter, choice of propellers for fixed wing).
    - Specify suitable landing sites and avoidance distances (400 m vertical x 2000m horizontal rule).
      (Churchill and Holland, 2003)

## References


Berch, S., Bulmer, C., Chapman, B., and Thompson, S. 2014. Temporary Access Structures: Considerations for Site Plans and Post-Harvest Assessments. British Columbia Ministry of Forests, Lands and Natural Resource Operations. Accessed from https://www.for.gov.bc.ca/ftp/hfp/external/!publish/frep/extension/FREP_Extension_Note_28.pdf

Canadian Coast Guard (CCG). 2009. Best Management Practices for Brushing Activities at DFO-Canadian Coast Guard Sites. Canadian Coast Guard, Pacific Region.

Churchill, B. and Holland, B,. 2003. Wildlife and Aircraft Operation: Assessment of Impacts, Mitigation and Recommendations for Best Management Practices in the Peace Region. Created by Chillborne Environmental for the Ministry of Water, Land and Air Protection, Peace Region. Accessed from https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/regional-wildlife/northeast-region/best-mgmt-practices/aircraft_operations_wildlife_mitigation_report.pdf

DFO. 2018. Inskip Islands Navigation Aids Range Rebuild Environmental Management Plan. Prepared by the Regional Office of Environmental Coordination, Real Property Safety and Security-Pacific Region, Fisheries and Oceans Canada.

NOAA (National Oceanic and Atmospheric Administration). n.d. Interim Sound Threshold Guidance. Available at: http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html Accessed: April 2017.WWPI (Western Wood Preservers Institute). 2011. Best Management Practices for the Use of Treated Wood in Aquatic and Wetland Environments. Available at: http://www.wwpinstitute.org/documents/BMP_Revise_4.3.12.pdf Accessed: April 2017.

Stantec. 2017. Barkely Sound and Alberni Inlet Navigation Aids Upgrade Project. Prepared by Stantec Consulting.

# Bulletin 4: Machinery Operation

## Background

Project activities often require machinery such as excavators, drilling equipment, and large trucks. Such equipment introduces the potential for harm to the environment from such things as soil erosion and sedimentation, and the release of harmful chemicals (e.g., hydraulic fluids). Best management practices (BMPs) serve as planning tools that, when implemented successfully, will avoid or reduce these adverse environmental effects and should be considered prior to the start of work.


## Best Management Practices

In addition to the BMPs outlined below, refer also to the "GENERAL OPERATIONS" bulletin.

- Be familiar with, and follow, relevant Acts and Regulations.
- Limit the construction footprint to the area needed to safely complete the work, thus reducing effects on nearby soils, vegetation, and resident species.
- Machinery should be clean when it arrives on site and will be maintained free of fluid leaks, invasive species, and noxious weeds (DFO 2016).
- Machinery must be operated efficiently to limit noise and air quality issues.
- Carry out work during appropriate timing of works (weather conditions, species at risk regional timing windows) (BC MOE 2017a; DFO 2015).
- Have contingency plans designed and in place to address unforeseen weather events.
- Wash, refuel and service machinery and store fuel and other materials for the machinery in a way that prevents them from entering the water.
- Store fuels and petroleum products in accordance to safe operating procedures and have a spill response plan and emergency spill kits on-hand.

- In addition to the spill kits on site, each piece of mobile equipment (e.g., cranes, concrete trucks) should have a vehicle spill kit. The suggested contents of the spill kit include:
  a) 25 x Oil Only/Marine Pads (White)
  b) 2 x Oil Only/Marine Absorbent Socks (White)
  c) 2 x Nitrile Gloves
  d) 2 x Disposable Non-Latex Gloves
  e) 2 x Splash Goggles
  f) 2 x Waste Labels/Zip Ties
  g) 2 x Hazmat Disposal Bags
  h) 1 x Sharpie- Permanent Black Marker
  i) 1 x Jug Universal or Oil Only/Marine Floor Dry (3lbs)
  j) 1 x Hand Broom, Dustpan and Hand Shovel
  k) 1 x 10 oz Plug'n'Dike
  l) 1 Laminated Contents Listing Sheet


- Vehicles should not be operated below the line of Highest High Water in marine environments (BC MPDCA 2003) or the High Water Mark in freshwater environments (DFO 2016). Vehicles should be operated from the land, on ice, or on a floating vessel above the Highest High Water or the High Water Mark in a way that limits disturbance to the banks, shorelines, or bed of a water body.
- Avoid crossing a watercourse or water body with machinery to a one-time event (i.e., over and back), and only if no alternative crossing method is available. If repeated crossings of the watercourse are needed, build a temporary crossing structure (DFO 2016).
- Use temporary crossing structures or other practices to cross streams or waterbodies with steep and highly erodible (e.g., dominated by organic materials and silts) banks and beds. For fording equipment without a temporary crossing structure, use stream bank and bed protection methods (e.g., swamp mats, pads) if minor rutting is likely to occur during fording.
- Do not ford, place crossing materials, or operate machinery on the bed of a waterbody where *Species at Risk Act* (SARA)-listed shellfish occur, or critical habitat or residences of freshwater SARA-listed aquatic species occur.
- At the discretion of the Environmental Monitor (EM), or delegate, drip trays that can contain 150% of the fuel will be placed beneath machinery, equipment and fuel storage facilities that are within 30 m of the Highest High Water mark (or on vessels) or within 30 m of the High Water Mark in freshwater environments.
- Hydraulic hoses and couplings should be inspected and be kept free of leaks and excess hydrocarbons before use near aquatic environments.
- Containers will be sealed with a properly fitting cap or lid when not in use.
- Select environmentally sensitive hydraulic oils when feasible.
- Refer also to "FUEL TANK SECONDARY CONTAINMENT" bulletin.

**References and Additional Information**

BC MOE (Ministry of Environment). 2017a. Regional Terms & conditions & Timing Windows. Available at: http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights/working-around-water/regional-terms-conditions-timing-windows. Accessed April 2017.

BC MOE. 2017b. General BMPs and Standard Project Considerations. British Columbia Ministry of Environment. Available at: http://www.env.gov.bc.ca/wld/instreamworks/generalBMPs.htm Accessed: April 2017.

BC MOE. 2005. *A User's Guide to Working In and Around Water. Understanding the Regulation Under British* Columbia's Water Act. British Columbia Ministry of the Environment, Water Stewardship Division

BC MPDCA (British Columbia Marine and Pile Driving Contractors Association). 2003. Best Management Practices for Pile Driving and Related Operations. Available at: https://buyandsell.gc.ca/cds/public/2016/08/17/f0fcf96f5bd08535ff8e81aac62bbd74/fp802-160141_bc_pile_driving_practices.pdf. Accessed April 2017.

BC MWLAP. 2004. Standards and Best Practices for Instream Works. British Columbia Ministry of Water, Land and Air Protection, Ecosystems Standards and Planning, Biodiversity Branch: Victoria, BC.

DFO (Fisheries and Oceans Canada). 2014. Pathways of Effects. Available at: http://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/index-eng.html Accessed: April 2017.

DFO. 2015. Timing Windows to conduct Projects in or around Water. Available at: http://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/index-eng.html. Accessed April 2017.

DFO. 2016. Measures to avoid causing harm to fish and fish habitat including aquatic species at risk. Available at: http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html Accessed: April 2017.

DFO. 2016. Photograph inventory. Pacific Regional Office of Environmental Coordination, Real Property, Safety & Security Branch, Sidney, BC. Accessed December 2017.

# Bulletin 12: Vegetation Brushing

## Background

The clearing of vegetation is sometimes necessary to create enough workable space for construction activities or for safety (e.g., clearing vegetation around helicopter-landing areas). Vegetation is an important component of local ecosystems as it, among other things, provides habitat for other living organisms, moderates local temperatures and ground moisture, limits soil erosion, and provides nutrients to surrounding soils and water bodies. Best management practices (BMPs) serve as planning tools that, if implemented successfully, will avoid or mitigate harmful environmental impacts resulting from vegetation brushing and should be considered prior to the commencement of work.

## Best Management Practices

In addition to the BMPs below, refer also to the 'GENERAL OPERATIONS' and 'IN-WATER WORKS' bulletins.

### Preparation

- Species at risk must be considered before brushing activities occur; contact your Environmental Officer.
- Brushing activities that are not part of maintenance or repair of existing physical work require an Environmental Assessment under the Canadian Environmental Assessment Act.

### Brushing Activities

- Brushing should be defined or limited to the removal of small trees (6" in diameter), shrubs and bushes and herbaceous vegetation (grass/weeds).
- Complete all activities in such a way that minimizes stress and disturbance to surrounding ecosystems (e.g., soil, noise etc.) (CCG, 2009).
- Avoid the removal of wildlife trees and other vegetation that would affect birds and other wildlife that are breeding or roosting (BC MWLAP, 2004).
- Removal, relocation or destruction of bird nests is prohibited without prior approval. When topping or removing trees within riparian areas, have them assessed by a qualified professional

biologist. Fall away from the channel if safe to do so and clean up all woody debris (BC MWLAP, 2004).

- When removing hazardous trees, consult with a professional arborist (BC MWLAP, 2004).

**Riparian Areas**

- Minimize riparian vegetation removals. If unavoidable, use proper clearing techniques and protect retained vegetation (Coker, Ming & Mandrak, 2010).
- Methods such as selective or phased vegetation removal or species management should be used to maintain or reduce shade on stream and provide specialized riparian communities or habitats (Coker et al., 2010).
- Prohibit or limit access to banks or areas adjacent to waterbodies, to the extent required to protect the structural integrity of banks or shorelines (Coker et al., 2010).
- Use sediment and erosion control methods to minimize the erosion of exposed soils to adjacent waterbody (e.g., erosion control fencing, fabrics, straw) (Coker et al., 2010).
- Use in-water silt curtains to contain suspended sediments, if required (Coker et al., 2010).
- Properly store and dispose of all generated debris (e.g., organics, soils, woody debris, temporary stockpiles, construction debris) during all phases of operation in a manner that mitigates their entry to waterbody (Coker et al., 2010).

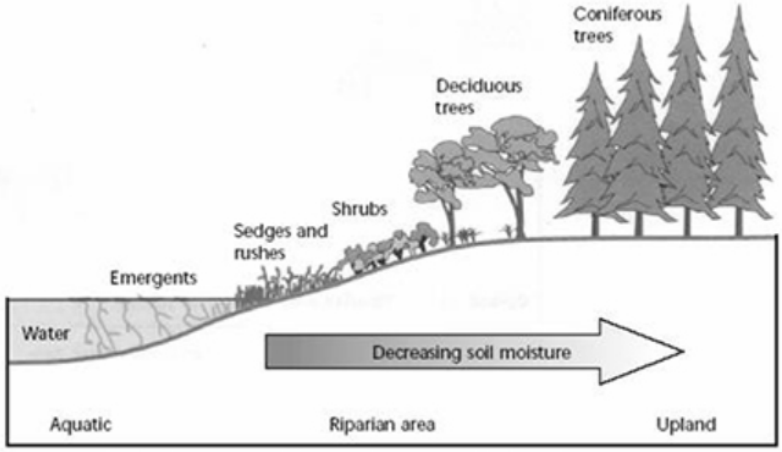



FIGURE 1 *Illustration of the moisture gradient in a typical riparian ecosystem (from Stevens et al. 1995:2).*

**Site Clean Up**

- Use discretion when deciding whether to remove cut debris or leave it on site. In remote sites, cut debris may be left above highest high water to decompose. Remove debris in sites that are not remote or when there is a copious amount of debris (CCG, 2009).

## References and Additional Information

BC MWLAP (British Columbia Ministry of Water, Land and Air Protection). 2004. Standards and Best Practices for Instream Works. Ecosystems Standards and Planning, Biodiversity Branch: Victoria, BC.

Canadian Coast Guard. 2009. Best Management Practices for Brushing Activities at DFO-Canadian Coast Guard Sites. Canadian Coast Guard-Pacific Region

Coker, G.A., Ming, D.L., and Mandrak, N.E. 2010. Mitigation guide for the protection of fishes and fish habitat to accompany the species at risk recovery potential assessments conducted by Fisheries and Oceans Canada (DFO) in Central and Arctic Region. Version 1.0. Can. Manuscr. Rep. Fish. Aquat. Sci. 2904: vi + 40 p.

## Bulletin 15: Site Restoration Activities

### Background

Oftentimes, construction or operation activities negatively impact the local, natural environment (e.g., vegetation clearing, stream diversion, soil compaction etc.). Upon the completion of these activities, it is important to rehabilitate the site back to its natural condition so that it is ecologically sustainable as well as aesthetically pleasing. Best management practices (BMPs) serve as planning tools that, if implemented successfully, will enhance the successful restoration of a construction site. BMPs should be considered prior to restoration activities.

### Best Management Practices

In addition to the BMPs below, refer also to the 'GENERAL OPERATIONS' and 'IN-WATER WORKS' bulletins.

#### General

- Prohibit or limit access to banks or areas adjacent to waterbodies, to the extent required to protect the structural integrity of banks or shorelines (Coker, Ming & Mandrak, 2010).
- Use sediment and erosion controls to mitigate erosion of exposed soils to adjacent waterbodies (e.g., erosion control fencing, fabrics, straw) (Coker et al., 2010).
- Avoid or minimize diversion of surface and groundwater drainage to or from a waterbody (do not divert across watershed boundaries) (Coker et al., 2010).

**Slopes and Banks**

- Grade disturbed areas to a stable angle of repose once work is completed (BC MWLAP, 2004).
- Stabilize exposed soils (planting vegetation, seed mats, perforated soil cloth, etc.) (Coker et al., 2010).
- Stabilize/reinforce stream banks using tree and shrub plantings, root wads, boulders, vortex weirs, etc. (Coker et al., 2010).
- Consult with an environmental professional.

**Planting**

- Plant a mix of diverse native plants appropriate to site conditions (BC MWLAP, 2004).
- For riparian vegetation plantings, design and implement a vegetation rehabilitation plan to return the area to pre-construction or better condition (e.g., trees for shade to cool water and provide overhead cover). If possible:
    - Re-instate native soils or replacement with topsoil/suitable planting medium.
    - Use soil/seedbank salvage, vegetation transplant or bio-engineering (e.g., live stakes, cuttings) techniques.
- Use only specified amounts and types of fertilizer in areas draining to waterbodies. Do not use of chemical dust suppressants, pesticides and herbicides in areas draining to waterbodies. Be aware of seasonal timing to minimize impacts (Coker et al., 2010).

**Channel Restoration**

- Restore in-channel or active floodplain habitats that have been disturbed, in accordance with guidelines and/or permit and approval conditions (BC MWLAP, 2004).
- Ensure appropriate instream structure and cover for habitat, in such a way as to not destabilize the channel. Match structure/substrate type with previous or adjacent types where possible. This may entail the salvage and reinstatement of existing instream structure such as large wood debris, boulders, or instream aquatic vegetation (Coker et al., 2010).
- Consult with an environmental professional.

**Clean Up**

- Properly store and dispose of all generated debris (e.g., organics, soils, woody debris, temporary stockpiles, and construction debris) during all phases of operation in a manner that mitigates their entry to waterbodies (Coker et al., 2010).
- Use discretion when deciding whether to remove natural debris or leave it on site. In remote sites, natural debris may be left above highest high water to decompose. Remove debris in sites that are not remote or when there is a copious amount of debris (CCG, 2009).

**Monitoring**

- Monitor replanted areas annually (or as required by permits or approvals), to verify vegetation survival (BC MWLAP, 2004).

## References and Additional Information

BC MWLAP (British Columbia Ministry of Water, Land and Air Protection). 2004. Standards and Best Practices for Instream Works. Ecosystems Standards and Planning, Biodiversity Branch: Victoria, BC.

Canadian Coast Guard. 2009. Best Management Practices for Brushing Activities at DFO-Canadian Coast Guard Sites. Canadian Coast Guard-Pacific Region

Coker, G.A., Ming, D.L., and Mandrak, N.E. 2010. Mitigation guide for the protection of fishes and fish habitat to accompany the species at risk recovery potential assessments conducted by Fisheries and Oceans Canada (DFO) in Central and Arctic Region. Version 1.0. Can. Manuscr. Rep. Fish. Aquat. Sci. 2904: vi + 40 p.

# Bulletin: Fuel Tank Secondary Containment

## Background

Fuels used for the operation of heavy machinery (e.g., excavators, generator, drilling machines, and large trucks) are typically contained in either portable tanks (e.g., jerry cans) or fixed tanks. Secondary containment is required to prevent or limit the migration of deleterious hydrocarbons to soils and aquatic environments following a leak in the primary storage tank. Best management practices (BMPs) for fuel tank secondary containment, where appropriately implemented, will limit the migration of deleterious fuels to land-based and aquatic environments. These BMPs should be considered prior to the commencement of works that require portable or fixed fuel storage.

## Biophysical Environment

Unmitigated releases from fuel tanks have the potential to adversely affect water and sediment quality and, therefore, may cause a reduction in functional habitat quality for fish and wildlife. The release of fuel may result in lethal and sublethal effects to wildlife, vegetation and aquatic organisms through various mechanisms, such as smothering, ingestion, physical exposure, and disruption of feeding behaviour, photosynthesis or respiration. It is important to implement secondary containment to limit the potential for leaks from fuel tanks to migrate to surrounding environments and adversely affect environmental resources.

## Best Management Practices

- Storage of fuels and petroleum products shall comply with safe operating procedures, including containment facilities in case of a spill.
- Portable fuel tanks (e.g., jerry cans) shall be stored within leak-proof secondary containment with a capacity of 110% of the fuel tanks volume.
- Fuel storage, including secondary containment, shall be kept free and clear of collected rainwater and snowfall. Accumulated water, in the containment, should be removed regularly as not to diminish the capacity of the containment.
- At the discretion of the Environmental Monitor (EM; or delegate), drip trays capable of containing 110% of the fuel will be placed beneath machinery, equipment and fuel storage facilities that are within 30 m of the Higher High Water Large Tide (HHWLT) line, high water level of watercourses, or edge of a lake. Similar drip trays will be considered appropriate for use under machinery, equipment, and fuel storage facilities on vessels.

- Small machinery (e.g., generators) should be placed in secondary containment, such as within drip trays with sorbent pads.
- Impervious materials, such as tarps, drip pans or spill trays should be placed underneath equipment and machinery during servicing when there is a potential for accidental drips or spills.
- Refuelling activities with the potential to cause contamination of soils, surface, or ground water, shall be completed offsite, completed at least 30m away from a water body, or shall have adequate containment to prevent flammable and combustible materials from spilling into the surrounding environment.

**Spill Response**

- Spill kits shall be kept in readily accessible locations.
- Spill kits will be inspected on a regular basis and will be refilled immediately after use.
- A Spill Response Plan / Environmental Emergency Response Plan (EERP) shall be developed and implemented to mitigate accidental leaks or spills during all phases of the project.
- Work crews shall be fully trained and competent in these measures.
- The Contractor will have adequate spill response supplies to maintain spill kits.
- Site personnel is required to notify the EM (or delegate) of any spill. The EM will prepare an Environmental Incident/Non-Compliance Report in the event of a spill beyond the confines of secondary containment (Environmental and Climate Change Canada [ECCC] 2016).


**Fuel Storage Tank**

- Fixed-tank systems containing petroleum products should be compliant with the CEPA Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations. Such regulations only apply to fixed-tank systems and not TDG (transportable) tanks.
- Consult with ROEC in advance of the project if a fixed storage tank system is being commissioned or decomissioned.

## References and Additional Information

BC MOE (British Columbia Ministry of Environment). 2017. General BMPs and Standard Project Considerations. British Columbia Ministry of Environment. Available at: http://www.env.gov.bc.ca/wld/instreamworks/generalBMPs.htm Accessed: April 2017.

BC MOE. 2005. *A User's Guide to Working In and Around Water. Understanding the Regulation Under British Columbia's Water Act.* Water Stewardship Division

BC MWLAP (British Columbia Ministry of Water, Land and Air Protection). 2002. A Field Guide to Fuel Handling, Transportation & Storage.

BC MWLAP (British Columbia Ministry of Water, Land and Air Protection). 2004. Standards and Best Practices for Instream Works. Ecosystems Standards and Planning, Biodiversity Branch: Victoria, BC.

ECCC (Environment and Climate Change Canada). 2016. Canadian Environmental Protection Act, 1999: Fact Sheets: Tank Tips: Tank Tip 12 – Reporting a Spill. Available at: http://www.ec.gc.ca/rs-st/default.asp?lang=En&n=400DB49F-1&offset=12 Accessed: April 2017.

# Bulletin 17: Tree Clearing and Grubbing

## Background

Various project activities may require tree clearing as a one-time event, particularly at previously undeveloped sites. The removal of trees is likely to involve heavy equipment and machinery and has the potential to result in adverse effects to flora and fauna, including birds, and can result in the introduction of deleterious substances to undisturbed areas. Best management practices (BMPs) serve as planning tools that, if implemented successfully, will mitigate these adverse environmental effects and should be considered prior to the commencement of work. This Bulletin provides mitigation measures and BMPs specific to tree clearing, including grubbing of root systems; soil stripping and grading is not addressed in this Bulletin. This Bulletin should be read in conjunction with Bulletin 14: Vegetation Brushing and Bulletin 4 Machinery Operation.

## Biophysical Environment

Tree clearing and associated ground disturbance (e.g., grubbing of root systems) results in the direct loss of vegetation and, depending on the location, has the potential to result in disturbance to, or loss of, species of conservation concern or sensitive plant communities. Tree clearing and associated ground disturbance in upland areas and riparian areas can adversely affect the aquatic environment by reducing slope stability and introducing fine sediments to the water column. Trees provide valuable habitat for wildlife such as songbirds, raptors, marbled murrelets, and furbearers; removing trees can result in loss of habitat and can increase mortality risk, particularly for nesting birds and animals using tree cavities. Trees can also be archaeological sites (e.g., culturally modified trees [CMTs]). It is important that tree clearing activities are carried out such that adverse environmental effects are mitigated and managed appropriately.

## Legislation

Key legislation applicable to tree clearing in British Columbia is identified in Table 1.

Table 1 Key Legislation

| **Federal Legislation** | **Provincial Legislation** |
|---|---|
| *Fisheries Act* | *Wildlife Act* |
| *Species at Risk Act* | *Forest and Range Practices Act* |
| *Migratory Birds Convention Act* | *Heritage Conservation Act* |
| | *Park Act* |
| | *Land Act* |

## Best Management Practices

### *General*

- Retain a Qualified Environmental Professional (QEP) and/or Environmental Monitor (EM) as appropriate, depending on construction site sensitivities.
- Do not fall trees without the Project Manager's (PM) or EM's (where applicable) prior knowledge and approval.
- Limit the area that will be disturbed, and the number of trees to be felled.
- Clearly delineate clearing boundaries using flagging or fencing.
- Know and follow applicable regulations.
- Use pre-existing trails, roads or cut lines as access routes where possible to limit the number of trees to be felled.

- Avoid unnecessary removal of trees when using existing access or opening up overgrown or decommissioned access; consider instead trimming existing vegetation and maintenance of an undisturbed root mat, particularly near watercourses.
- Limit disturbance and removal of vegetation and ground cover immediately adjacent to the trees to be felled, where possible.
- Limit tree clearing within and adjacent to wetlands.
- Fall trees toward construction area(s) where possible, to reduce disturbance to vegetation outside of the work area.
- Do not skid logs across watercourses.
- To prevent spread of noxious or invasive plants clean (i.e., remove dirt, plant parts, seeds) heavy machinery and equipment prior to working on site.
- In the case of hazard trees, if topping or removal of a dead limb can remove the danger or impediment to site use, do this rather than remove the entire tree.

***Grubbing***

- Limit grubbing to the extent possible; consider the following when planning and executing project activities:
    - Limit the width of grubbing through wet areas to reduce disturbance and facilitate the restoration of shrub communities.
    - Limit root grubbing to the extent possible in wet areas and near watercourses to avoid creation of bog holes.
    - Limit root grubbing on steep erosion-prone slopes in order to reduce erosion.
    - Limit grubbing in sensitive ecosystems (potential rare plant habitats [e.g., rock outcrops, seepages], blue- or red-listed ecosystems, wetlands, old forest) to the extent possible
- Shrubs, stumps and root systems will be left in place to the extent possible. The root network will be retained within salvaged soil when practical to encourage recruitment of native species at reclamation.

***Old Forests and Listed Ecosystems***

- A QEP experienced in ecosystem classification and delineation will flag or stake the boundary of old forest and red- and blue-listed ecosystems prior to tree clearing, where applicable.
- Avoid removal of old growth trees (i.e., trees older than 250 years) to the extent possible, as these trees provide valuable habitat to birds and small mammals.
- Avoid felling trees within red- and blue-listed ecosystems.
- Clear only to blade width, or 20 m if necessary, when practical, when working within old forest ecosystems.
- Avoid felling trees into old forest ecosystems to the extent possible.
- Fall trees away from wetlands, riparian areas, red- or blue-listed ecosystems, and old forest areas to reduce damage to stream banks, stream beds, and plant communities.
-

***Birds and Nests***

- Prior to construction, trees to be cleared within sensitive areas will be inspected by a QEP or by a licensed arborist in low sensitivity for wildlife features, as well as understory vegetation within 30 m of the trees, if likely to be affected (e.g., trampled or damaged) by equipment. The most likely wildlife features to be encountered are related to birds (e.g., bald eagle nests, nest cavities, stick nests,

marbled murrelet nests). Trees containing these features will not be removed without approval from the PM or EM and under appropriate permits, if applicable.

- To reduce potential effects to migratory birds (i.e., incidental take), plan project activities (i.e., vegetation clearing and construction) to occur outside of the nesting period for breeding birds.
    - Identify the nesting period(s) for the area applicable to the project: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html
    - Migratory bird nests are protected under the federal *Migratory Birds Convention Act* while they are being used for breeding, nesting, roosting or rearing young. If tree removal or vegetation clearing must occur during the migratory bird nesting period for a specific geographic location, a "nest sweep" will be completed. Trees planned for removal, and a 30-m zone around other planned disturbance areas (e.g., construction site), will be inspected by a QEP for active bird nests. Ideally the inspection should be 24 to 48 hours before the disturbance is to begin, but can be up to seven days before disturbance is to begin, otherwise another nest sweep must be undertaken. Where active bird nests are identified, an appropriate setback will be established by the QEP in consultation with the EM.
- Nests of eagles, peregrine falcons, gyrfalcons, ospreys, and herons are protected year-round under the BC *Wildlife Act*, even when unoccupied. If such a nest is identified during the wildlife feature inspection (bullet 1), the QEP will consult with the PM or EM on appropriate mitigation measures (e.g., avoidance).
- Collect photo documentation and field notes

***Wildlife Discovery Contingency Measures***

- If an active bird nest or cavity is identified at a construction site (i.e., at or within 10 m of the flagged boundaries for clearing), tree clearing activities should be suspended and the PM or EM should consult with a QEP.
- If an active bird nest or cavity is identified in the vicinity of the construction site, the QEP may recommend site-specific monitoring activities for the duration of construction activities.
- If an inactive bird nest or cavity is identified at a construction site, assuming the nest does not belong to a bald eagle, peregrine falcon, osprey, or great blue heron, brushing/falling activities can be completed as scheduled.
- If an inactive bald eagle, peregrine falcon, osprey, or great blue heron nest is present in a tree that is proposed to be fallen or within the pathway for falling the PM or EM should consult with a QEP who will determine how to proceed, as unoccupied nests of these birds are protected year-round.

**Archaeology**

Archaeological sites in remote locations are not likely to have been previously identified. Care should be taken to avoid archaeological deposits while work is being completed. If a potential archaeological or heritage resource (e.g., CMT) is encountered during construction, work should be stopped in the vicinity of the find and the PM or EM notified.

Trees should be inspected by a qualified archaeologist for cultural modification prior to falling if the area is designated as a high potential for archaeological significance.

If a potential archaeological or heritage resource is encountered, the following steps are recommended:

- Cease all ground disturbance in the vicinity of the find and leave all possible archaeological or heritage materials in place.

- Briefly note the type of potential archaeological materials, their location, including, if applicable, the depth below surface that the material was found.
- Identify a no-work area of no less than 30-m with flagging tape or other suitable material.
- Photograph the material, preferably with a scale, and record the location with GPS, if available.
- Notify the PM or EM who will then contact an archaeological consultant for advice, the applicable First Nations, and the Archaeology Branch at 250-953-3334. In the unlikely event that possible human remains are encountered, the PM will also contact the RCMP.

**Disposal of Woody/Vegetative Debris**

General:

- Do not place fallen trees or other cleared material within 30 m of a watercourse or wetland, or place on sensitive vegetation communities such as rock outcrops.
- Use discretion when deciding whether to remove cut debris or leave it on site. In remote sites, cut or brushed debris may be left above highest high water mark to decompose. Remove debris in sites that are not remote; review debris options with PM or EM.
- Do not leave cut vegetation debris in the marine environment.
- When a significant amount of materials is cleared or there is no appropriate area to place cleared materials, trees and vegetation should be remove from site and either salvage or dispose of at an approved facility.

Coarse Woody Debris:

Spreading of medium/coarse woody debris (CWD) on site is allowable at the following specifications:

- CWD should not be distributed in areas where it would not naturally be present (e.g., shrub and grassland meadows and wetlands where there are no trees being removed do not need to be included). This does not mean that all areas mapped as wetlands would be excluded, as many of these areas are forested. Ground truthing and/or knowledge of on-the-ground conditions is necessary.
- CWD should not be re-distributed where this would result in damage to sensitive soils/vegetation and/or where extensive mitigation work, (e.g. construction of snow roads), would be required for

Chipping/Mulching/Spreading debris on-site:

Due to the dry climate at many locations site locations, chipped/mulched fuel does not decompose rapidly, instead remaining on the ground for extended period of time. Over time, this dry, fine fuel layer represents a significant fire hazard and inhibits natural forest succession processes. As such, chipping/mulching must be spread in an area at a very low application rate.
Mulching will be limited to as small an area as possible – wherever possible, existing small trees and shrub cover should be left in place.

- Mulch will be spread to a depth of no more than 3 cm.
- Rough mulching (i.e. removing branches but leaving logs intact) is preferable to fine mulch in areas with larger stems (i.e. where small trees are being mulched).
- The distribution of mulch chips will be non-uniform so that native vegetation is not completely covered by mulched material.
- Mulching of Aspen stands has the potential for acid leachate to negatively affect aquatic ecosystems. Mulching of aspen should not occur within 30 m of riparian areas, bogs, lakes, streams or wetlands. This includes ephemeral water features.
- If mulch inadvertently occurs in depths greater than 3 cm or in areas where concerns exist with leaving mulch in place (such as areas with large infestations of non-native vegetation, or where native plants will not regrow within 1 growing season) further restoration efforts will be required

during the reclamation.

**Additional Information and References**


Bulletin 1: General Operations

Bulletin 4: Machinery Operation

Bulletin 14: Vegetation Brushing

British Columbia Ministry of Environment. General BMPs and Standard Project Considerations. Available at: http://www.env.gov.bc.ca/wld/instreamworks/generalBMPs.htm.

Canadian Coast Guard. 2005. CCG Protocol for On-site Visits to Navigation Aids in Sensitive Bird Nesting Sites. Prepared by Canadian Coast Guard Aids to Navigation Program.

Canadian Coast Guard. 2009. Best Management Practices for Brushing Activities at DFO – Canadian Coast Guard Sites. Prepared by Canadian Coast Guard Pacific Region.

Environment and Climate Change Canada. Guidelines to reduce risk to migratory birds. Last modified October 30, 2018. Available at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reduce-risk-migratory-birds.html.

Environment and Climate Change Canada. Beneficial management practices to reduce risk to migratory birds. Last modified October 30, 2018. Available at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/beneficial-management-practices.html.

Environment and Climate Change Canada. General nesting periods of migratory birds. Last modified October 30, 2018. Available at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods.html.

Environment and Climate Change Canada. Guidelines to avoid disturbance to seabird and waterbird colonies in Canada. Last modified October 30, 2018. Available at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/avoid-disturbance-seabird-waterbird-colonies-canada.html.

Government of British Columbia. Natural Resource Best Management Practices. Available at: https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices.

Manning, Cooper and Associates. 2013. Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (2013). A Companion Document to Develop with Care 2012. Available at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/raptor_conservation_guidelines_2013.pdf.

Parks Canada Alberta Region. 2017. BFU/LLYK Woody/Vegetative Debris Management Guidelines (2017). Prepared by Parks Canada.

# Steps to Prevent the Unintentional Introduction of Invasive Species from Equipment

Inspection and cleaning of all machinery and equipment should be performed in accordance with the procedures, checklists and diagrams provided in this protocol.

When visiting more than one site, always schedule work in the sites that are the least disturbed and free of known invasive species first, and visit sites with known invasive species infestations last. This will greatly reduce the risk of transferring plants to new locations.

## When to Inspect

**Inspection should be done before:**

- Moving vehicles out of a local area of operation
- Moving machinery between properties or sites within the same property where invasive species may be present in one area, and not in another
- Using machinery along roadsides, in ditches, and along watercourses
- Vehicles using unformed dirt roads, trails or off road conditions
- Using machinery to transport soil and quarry materials
- Visiting remote areas where access by vehicles is limited

**Inspection should be done after:**

- Operating in areas known to have terrestrial invasive plants or are in high risk areas (i.e. recently disturbed areas near known invaded areas)
- Transporting material (i.e. soil) that is known to contain, or has the potential to contain, invasive species
- Operating in an area or transporting material that you are uncertain contain invasive species
- In the event of rain. If mud contains seeds, they can travel indefinitely until it rains or the road surface is wet, allowing for long distance transport. This may result in transporting seeds to areas where those species did not previously exist

## How to Inspect

- Inspect the vehicle thoroughly inside and out for where dirt, plant material and seeds may be lodged or adhering to interior and exterior surfaces.
- Remove any guards, covers or plates that are easy to remove.
- Attention should be paid to the underside of the vehicle, radiators, spare tires, foot wells and bumper bars.

If clods of dirt, seed or other plant material are found, removal should take place immediately, using the techniques outlined below.

## When to Clean

Vehicles and heavy equipment that stay on formed and sealed roads have a low risk of spreading invasive species. Cleaning is only required when inspection identifies visible dirt clods and plant material or when moving from one area to another.

Depending on the invasive species present, vehicles may need to be cleaned even when deep snow is present. Invasive *Phragmites*, for example, can still be spread, even in packed snow because the seed heads are usually above the surface of the snow. Other plants, such as dog-strangling vine, will be contained beneath deep snow.

**Regular inspection of vehicles and machinery will identify if any soil or plant material has been collected on or in vehicles and machinery.*

## Where to Clean

Clean the vehicle/equipment in an area where contamination and seed spread is not possible (or limited). The site should be:

- Ideally, mud free, gravel covered or a hard surface. If this option is not available, choose a well maintained (i.e. regularly mowed) grassy area.
- Gently sloping to assist in draining water and material away from the vehicle or equipment. Care should be taken to ensure that localized erosion will not be created, and that water runs back into the area where contamination occurred.
- At least 30m away from any watercourse, water body and natural vegetation.
- Large enough to allow for adequate movement of larger vehicles and equipment.

**Safely locate the vehicle and equipment away from any hazards. If mechanized, ensure engine is off and the vehicle or equipment is immobilized.*

## How to Clean Inside

Clean the interior of the vehicle by sweeping, vacuuming or using a compressed air device. Particular attention should be paid to the floor, foot wells, pedals, seats, and under the seats.

## How to Clean Outside

Knock off all large clods of dirt. Use a pry bar or other device if necessary.

Identify areas that may require cleaning with compressed air rather than water such as radiators and grills. Clean these areas first prior to using water.

Clean the vehicle with a high pressure hose in combination with a stiff brush and/or pry bar to further assist the removal of dirt clods.

Start cleaning from the top of the vehicle and work down to the bottom.

Emphasis should be placed on the undersides, wheels, wheel arches, guards, chassis, engine bays, radiator, grills, and other attachments.

When the cleaning is finished avoid driving through the waste water when removing the vehicle or equipment from the cleaning site.

For equipment such as water trucks that may be exposed to aquatic invasive species, trucks should be disinfected with bleach solution before conducting work in a new area. For further information please refer to the Invading Species Awareness Program's Technical Guidelines listed under Contacts and Resources.

**Hosing down a vehicle in Queensland, Australia**
Photo by: TH9 Outdoor Services

# Final Inspection Checklist

**Conduct a final inspection to ensure the following general clean standard has been achieved:**

- No clods of dirt should be visible after wash down.
- Radiators, grills, and the interiors of vehicles should be free of accumulations of seed, soil, mud and plant material parts including seeds, roots, flowers, fruit, and or stems.

Diagrams have been provided to assist in quickly identifying key areas to inspect and clean on a variety of vehicles associated with the targeted industries. These can be used in combination with vehicle checklists to ensure all areas of the vehicles have been inspected and cleaned.

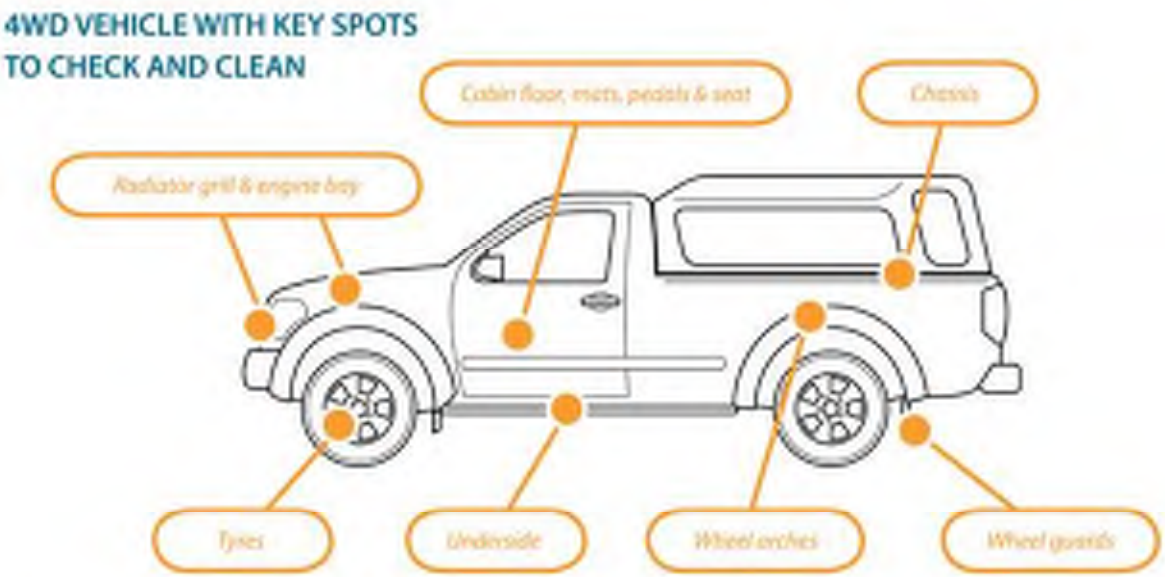
## Equipment Required

- A pump and high pressure hose OR high pressure water unit
- Minimum water pressure for vehicle cleaning should be at least 90 pounds per square inch. Water can be supplied as high volume/low pressure or low volume/high pressure (NOAA Fisheries Service).
- Air compressor and blower OR vacuum
- Shovel
- Pry bar
- Stiff brush or broom

**Cleaning station at construction site.**
Photo by: Mark Heaton, OMNR

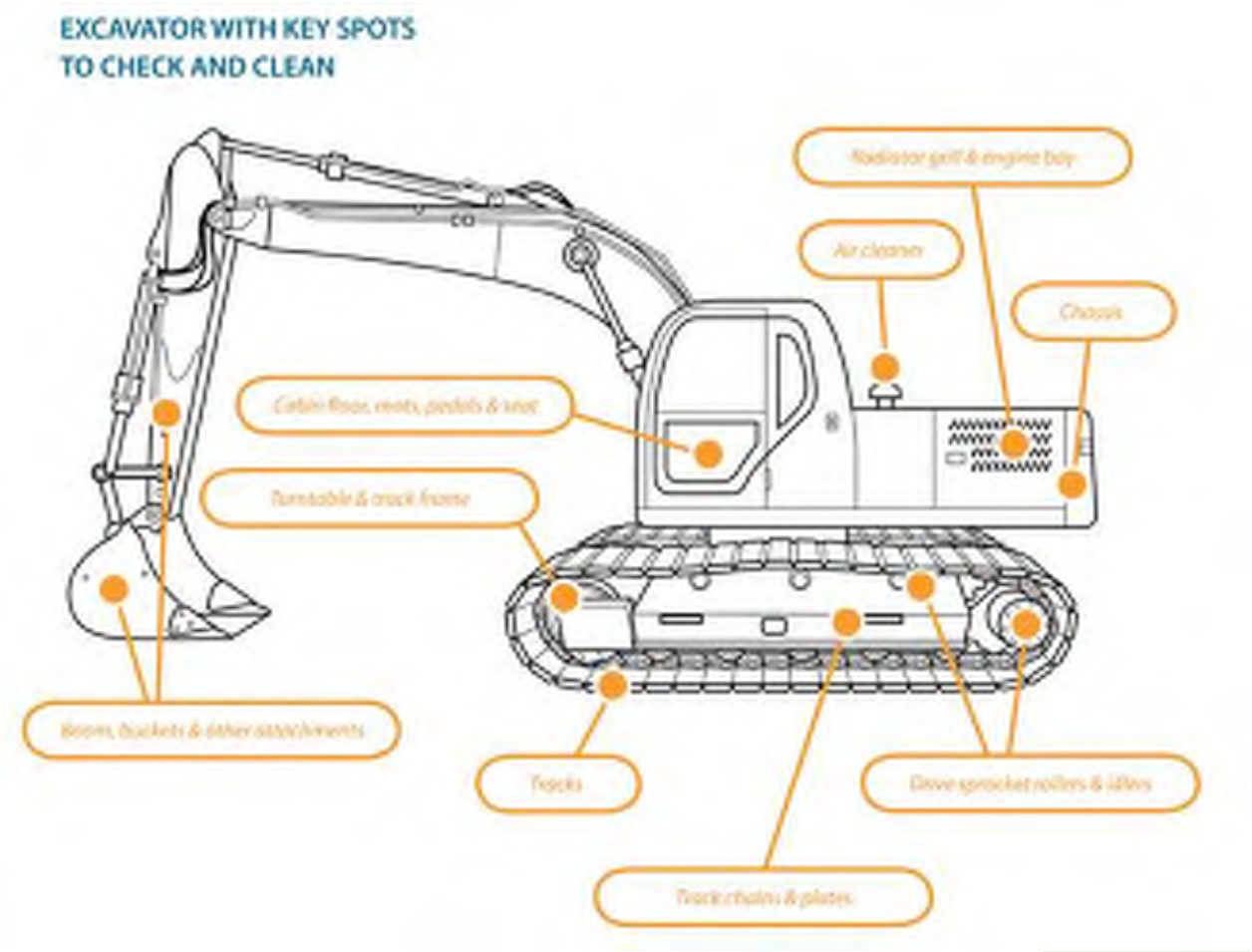
# Inspection and Cleaning Diagrams and Checklists

## 2WD and 4WD Vehicles



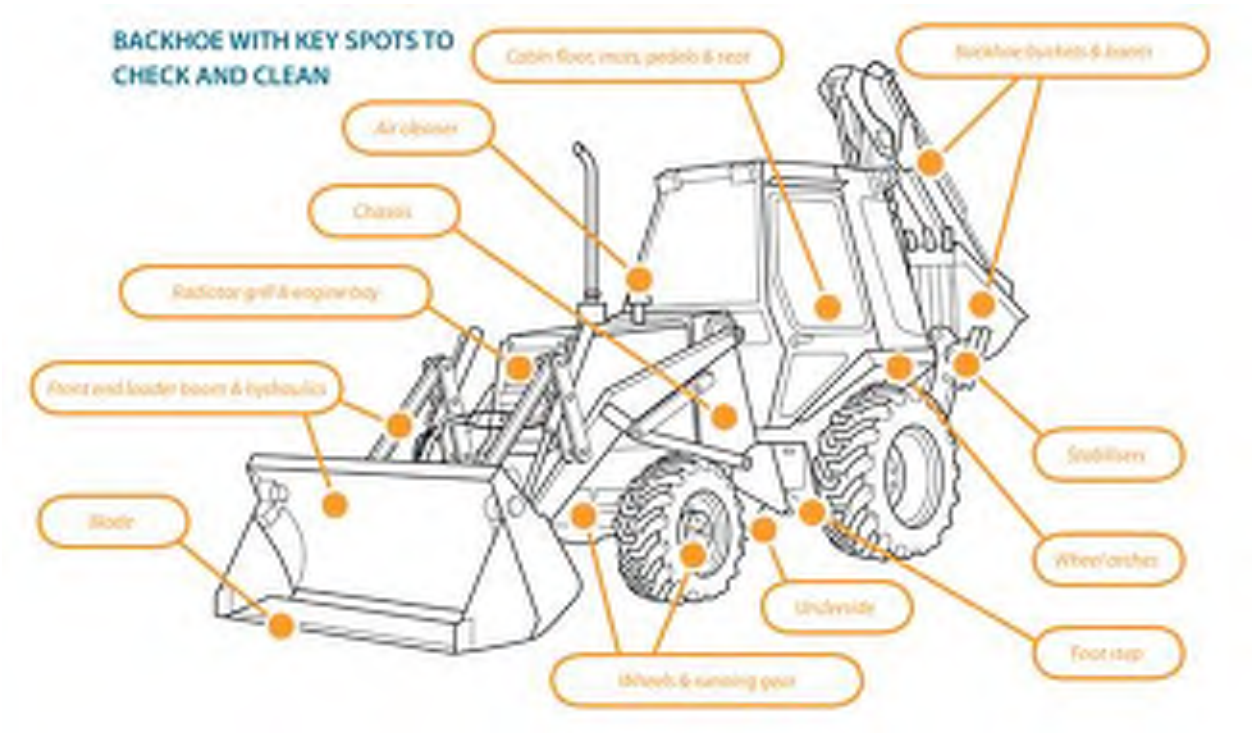

| | | ✓ |
|---|---|---|
| **Cabin** | Floor, mats, pedals, seats | |
| **Engine** | Radiators, engine bay, grill | |
| **Body** | Underside, chassis, crevices, ledges, bumper bars | |
| **Wheels** | All wheels (including spare), wheel arches, guards | |
| **Tray** | Floor, canopy (if included) | |

# Excavator



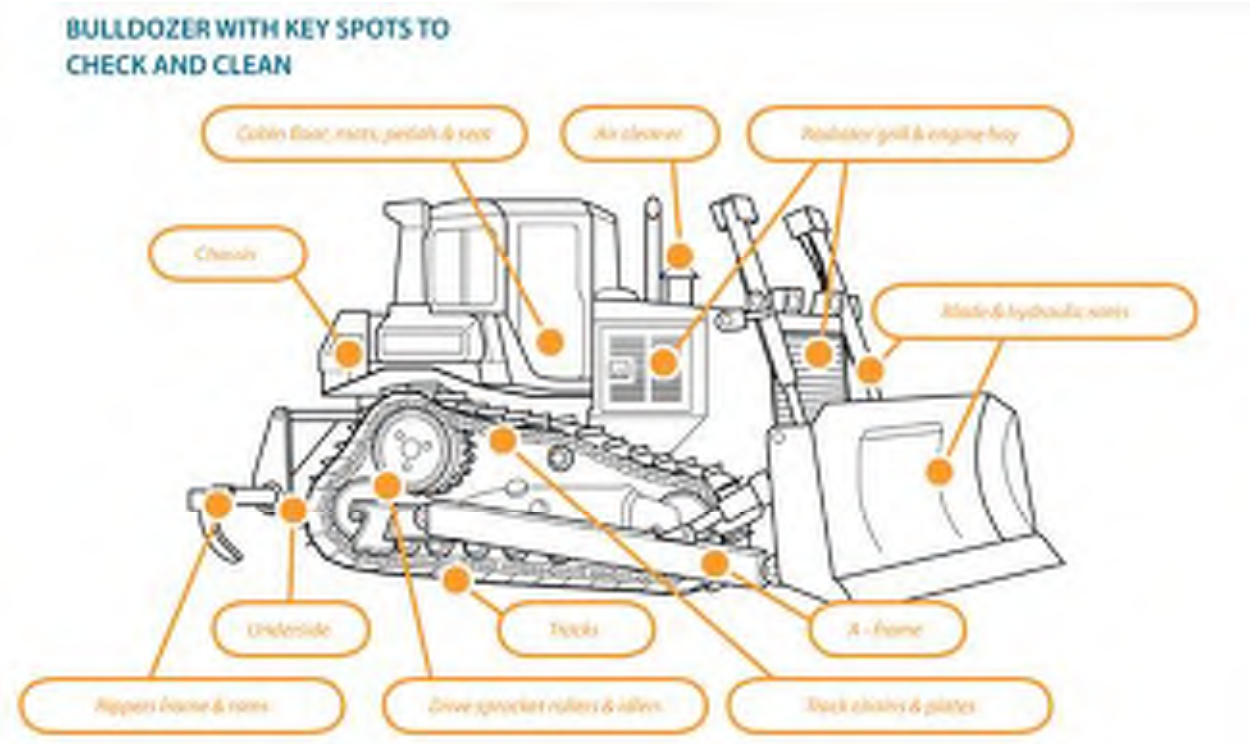

| | | ✓ |
|---|---|---|
| **Cabin** | Floor, mats, pedals, seats | |
| **Engine** | Radiators, engine bay, grill, air cleaner | |
| **Tracks** | Tracks, track frame, drive sprocket rollers, idlers | |
| **Body Plates** | Plates of cabin | |
| **Body** | Ledges, channels | |
| **Bucket** | | |
| **Booms** | | |
| **Turret Pivot** | | |

# Backhoe




| | | ✓ |
|---|---|---|
| **Cabin** | Floor, mats, pedals, seats, foot step | |
| **Engine** | Radiators, engine bay, grill, air cleaner | |
| **Wheels** | All wheels (including spare), wheel arches, guards | |
| **Front end loader** | Blade, hydraulics, booms | |
| **Backhoe** | Buckets, boom, hydraulics, stabilisers | |

# Bulldozer




| | | ✓ |
|---|---|---|
| **Cabin** | Floor, mats, pedals, seats | |
| **Engine** | Radiators, engine bay, grill, air cleaner | |
| **Tracks** | Tracks, track frame, drive sprocket rollers, idlers | |
| **Body Plates** | Belly plates, rear plates | |
| **Body** | Ledges, channels | |
| **Blade** | Pivot points, hydraulic rams, a-frame | |
| **Ripper** | Ripper frame, ripper points | |