THURBER ENGINEERING LTD.

MEMORANDUM

To:	Ministry of Transportation and Infrastructure	Date:	January 5, 2024
Attn:	Julie Sandusky	File:	42491
From:	Gundeep Randhawa		
Reviewer:	Lora Paul		

ISLAND RAILWAY CORRIDOR, VANCOUVER ISLAND, BC
TYPICAL RAILWAY CORRIDOR ASSESSMENTS AND REMEDIATION OPTIONS

Dear Ms. Sandusky,

Thurber Engineering Ltd. (Thurber) prepared this memorandum for Ministry of Transportation and Infrastructure (MOTI) detailing typical assessment and remediation options for a railway corridor on Vancouver Island. It is our understanding that the Island Railway Corridor (IRC) foundation is considering investigating and remediating sections of the railway corridor (the "Site").

It is a condition of this memorandum that the performance of Thurber's professional services is subject to the attached Statement of Limitations and Conditions.

1. TYPICAL APECS/PCOCS AT RAILWAY CORRIDORS

The areas of potential environmental concern (APECs) and associated potential contaminants of concern (PCOCs) along railway corridors are dependent on the activity that occurred in different areas of the corridors.

The APECs for the linear portion of the rail lines may only be related to the use of creosote treated timber, ballast material, and areas of herbicide application. Fill material of unknown source or quality is not expected given that the rail line was constructed in the late 1800s through forested areas where fill likely would not have been required. However, if fill material is encountered during the investigation, the PCOCs would be the same as for rail beds. The APECs and associated PCOCs for rail beds are in the table below.

APEC	Federal PCOCs	Provincial PCOCs
Rail beds (soil under creosote treated wood and ballast material)	PHC F2 – F4, PAH, chlorophenols, metals	LEPH/HEPH, PAH, chlorophenols, metals
Herbicide application[1]	Herbicides	Herbicides

PHC F2 – F4 = petroleum hydrocarbon fractions 2 – 4 PAH = polycyclic aromatic hydrocarbons
LEPH/HEPH – light/heavy extractable hydrocarbons

[1] = herbicide contamination is likely low risk based on their short half-lives. This APEC should be confirmed through a site visit.

If the Site includes activities beyond a rail line, additional APECs may be present. A list of possible APECs which may be encountered at former rail properties, along with PCOCs, is presented in the table below.

APEC	Federal PCOCs	Provincial PCOCs
Treated wood rail ties or trestles (below-ground or piled)	PHC F2 – F4, PAH, chlorophenols, metals	LEPH/HEPH, PAH, VPH, chlorophenols, metals
Areas used for unloading / loading	PHC F2 – F4, F1/BTEX, PAH, metals	LEPH/HEPH, PAH, VPH/BTEX, metals
Dumping and/or burning areas	PHC F2 – F4, F1/BTEX, VOC, PAH, chlorophenols, metals	LEPH/HEPH, PAH, VOC/VPH, chlorophenols, metals
Use of coal / coal piles, cinders	F1/BTEX, PAH, metals	LEPH/HEPH, PAH, BTEX/VPH, metals
Placement of suspected poor-quality fill	PHC F2 – F4, PAH, metals	LEPH/HEPH, PAH, metals
Locations of fueling and fuel spills / combustion and use of fuel along rail corridor/yards	PHC F2 – F4, F1/BTEX, PAH, metals	LEPH/HEPH, PAH, VPH/BTEX, fuel VOC, metals
Maintenance yards (including herbicide storage)	PHC F2 – F4, F1/BTEX, VOC, PAH, metals, herbicides	LEPH/HEPH, PAH, VOC/VPH, metals, herbicides
Locations of transformers / use of PCBs / PCB spills	PHC F2 – F4, PAH, PCB	LEPH/HEPH, PAH, PCB
Former Rail Stations, potentially containing creosote timbers, coal piles, cinder dumps	PHC F2 – F4, F1/BTEX, PAH, chlorophenols, metals	LEPH/HEPH, PAH, BTEX/VPH, chlorophenols, metals
Location of historical spills or derailments	PHC F2 – F4, F1/BTEX, PAH, metals	LEPH/HEPH, PAH, VPH/BTEX, fuel VOC, metals

PHC F1 – F4 = petroleum hydrocarbon fractions 1 – 4
LEPH/HEPH – light/heavy extractable hydrocarbons
BTEX = benzene, toluene, ethylbenzene, xylenes, styrene
PCB = polychlorinated biphenyls
PAH = polycyclic aromatic hydrocarbons
VPH = volatile petroleum hydrocarbons
VOC = volatile organic compounds

2. REGULATORY FRAMEWORK FOR INVESTIGATION TO SITE CLOSURE

The regulatory framework is based on jurisdiction of the site. The sections of the railway corridor being considered for investigation and remediation are owned by Island Railway Foundation and are either adjacent to Reserve Land or intersecting Reserve Land. Although currently under provincial jurisdiction, if the corridors became Addition to Reserve Lands, the lands would then be under federal jurisdiction. Additionally, if a BC Ministry of Environment and Climate Change Strategy (ENV) legal certificate is required, then the provincial framework will apply.

The below sections outline the federal and provincial frameworks for investigation to Site closure for a typical railway corridor. Further detail regarding remediation of a typical railway corridor is provided in Section 3 below. Associated approximate costs and timelines are discussed in further detail in Sections 4 and 5 below.

2.1 Federal Framework

The Federal Contaminated Sites Action Plan (FCSAP) provides a step-by-step process from identifying suspect contaminated sites, investigation, remediation, and eventual closure of the Site through the Site Closure Tool (SCT).

Once a suspect contaminated site is identified, a Phase I Environmental Site Assessment (ESA) is conducted. A Phase I ESA is a desktop historical review of the Site consisting of available records review, interviews, and a site visit. If through the Phase I ESA, there are suspected environmental or human health issues of concern, then a Phase II ESA is required. The Phase II ESA is an intrusive investigation of soil, sediment, surface water, and groundwater.

The Canadian Council of the Ministers of the Environment (CCME) provides the soil, surface water, and sediment guidelines. The groundwater guidelines are listed under the Federal Interim Groundwater Quality Guidelines (FIWQG) for federal contaminated sites. Groundwater results may also be compared to the Guidelines for Canadian Drinking Water provided by Health Canada.

The appropriate guidelines to be used are based on the location of the Site and should consider the following:

- Current and future land use
  - If future land use is not known at the time of the investigation, community plans for adjacent lands should be consulted and, if not available, consideration should be given to current adjacent land use. Efforts should be made to establish future land use prior to initiating the investigation.
- Current and future groundwater and surface water use
- Proximity of the Site to receptors such as drinking water wells, surface water bodies, agricultural land, and residential land use

Typically, contamination at railway corridors is in shallow soil within the top 1 metre below grade and does not extend into the groundwater. If, however, the groundwater table is shallow, then contamination may be present in the groundwater. Typically, during the Phase II ESA,

groundwater will be characterized to determine its depth and quality, but at less frequency than the soil characterization.

If concentrations of volatile petroleum hydrocarbons are high, soil vapour characterization may be required. As there are currently no soil vapour guidelines available from the federal framework, it is suggested that soil vapour standards from the BC Contaminated Sites Regulation (CSR) be used.

If the investigation identifies contamination, then a Phase III ESA is required to delineate the contamination, i.e., determine the lateral and vertical extents. Typically, for a railway corridor, additional step out locations are incorporated into a Phase II ESA in an attempt to complete the Phase II ESA and Phase III ESA in one drilling program. However, separate mobilizations are generally needed if additional delineation is required. Following delineation, a remedial action plan can be developed for the Site. Remediation options are further discussed in Section 3.

Once remediation is completed, then the SCT can be completed to close the Site (upon approval by FCSAP). The National Classification System for Contaminated Sites (NCSCS) form will also require completion prior to Site closure. Completing the NCSCS and SCT will be required if the Site will become Reserve Land.

2.2 Provincial Framework

In British Columbia, environmental matters pertaining to contaminated sites generally fall under the jurisdiction of the ENV, pursuant to the *Environmental Management Act (Act)*. The key regulations under the *Act* relating to contaminated sites and contaminated soil relocation are the Contaminated Sites Regulation (CSR, B.C. Reg. 375/96, last amended May 31, 2022) and the Hazardous Waste Regulation (HWR, B.C. Reg. 63/88, last amended March 11, 2021).

Similar to the federal framework, a historical desktop review and site visit through a Stage 1 Preliminary Site Investigation (PSI) is required to identify APECs. The APECs are then investigated through a Stage 2 PSI (an intrusive soil, sediment, soil vapour, surface water and/or groundwater investigation).

As with the federal framework, the appropriate CSR standards to apply are based on current and future land use, surface water, and groundwater use at the Site, and proximity of the Site to receptors such as drinking water wells, surface water bodies, agricultural land, and residential land use.

Any identified contamination would then be delineated through a Detailed Site Investigation (DSI). As mentioned previously, it is typical for a railway corridor to include additional step out locations during the Stage 2 PSI to complete the Stage 2 PSI and DSI in one drilling program, if possible. However, separate mobilizations are generally needed if additional delineation is required. Once delineation is achieved, a remedial action plan can be developed for the Site, followed by remediation (discussed further in Section 3). Once remediation is completed, if required, an ENV legal certificate (i.e., a Certificate of Compliance (CoC)) could be obtained.

Per the *Act*, once a CoC is received, then the responsible person essentially becomes a non-responsible person. A 'responsible person' is defined as the person/entity who caused the contamination or is the current owner of the contaminated property. Once a CoC is in place, then if a future owner wants to change the land use or causes contamination, then they would become responsible. If a CoC is not sought, then the original owner would remain the responsible person.

Periodically, the CSR standards and ENV policies and protocols are reviewed and updated. The most recent overall update to the standards was the Omnibus change effective in November 2017. Changes to some ENV policies and protocols last occurred in February 2021 and again in March 2023. Generally, if a CoC is desired, it is best to complete the investigation, remediation, and CoC application process back-to-back without long delays in between the milestones. If for example, remediation has been completed and a CoC is not sought immediately, there is a risk that the CSR standards for some parameters become more stringent, which would require remobilization(s) to the Site to collect additional data, and potentially conduct additional remediation.

2.2.1 Soil Relocation

If contaminated soil is being relocated to a provincially permitted facility, the provincial CSR standards should be used, regardless of whether the federal framework is being followed for investigation and remediation.

Per the BC HWR, prior to disposal, toxicity characteristic leaching procedure (TCLP) testing may be required for some parameters. If concentrations trigger TCLP testing, the disposal facilities will require this data prior to accepting the material.

2.2.2 Protocol 6 Preapproval

Protocol 6 (P6) preapproval is required for any deviation from protocols and guidance as per the *Act*. For a typical railway corridor project, there is a potential for P6 preapprovals to be required

in support of investigation and remediation works, if a CoC is desired for each section of the corridor. If a CoC is not desired, then the P6 preapproval process would not be required.

Technical Guidance #1 – Site Characterization and Confirmation Testing (TG1) lays out the framework for spacing between sample locations. Per TG1, spacing during the Stage 2 PSI should be every 25 m to 50 m between sample locations. To deviate from the TG1 guidance, for example, to increase the distance between sample locations to 100 m, a P6 preapproval would be required. This deviation to 100 m spacing is typical for railway corridors where contamination source is generally consistent throughout the corridor and contamination depth and extent is not expected to vary greatly.

A P6 preapproval can also be obtained for no groundwater investigation. Depending on site conditions (i.e., if contamination identified in soil is shallow and well above the groundwater table), it may be worthwhile to obtain a P6 preapproval to not investigate groundwater during the Stage 2 PSI. Based on our experience, the ENV requires a strong case and lines of reasoning as to why groundwater won't be investigated.

If contamination is migrating from offsite sources, a P6 preapproval is required to consider the contamination flow-through. With P6 preapproval, the investigation and remediation of contamination migrating from offsite sources would only be required within Site boundaries and delineation offsite would not be required. The risk of offsite contamination migrating to the Site is low.

The preapproval requests require a letter be submitted to ENV for review and approval.

3. RAILWAY CORRIDOR REMEDIATION

3.1 Decommissioning

The first step in conducting a railway corridor remediation is to decommission the railway infrastructure. This would consist of:

- Removing rail tracks, cross ties (creosote treated wood), fasteners, etc.; and
- Excavating the ballast material.

The table below outlines disposal options for the railway infrastructure.

MATERIAL	FACILITY	COST per METRIC TONNE
Metal/Steel (rail tracks, fasteners, etc.)	Radius Recycling (Victoria, Cassidy, Campbell River)	See Note 1 below[1]
Creosote-Treated Wood (rail ties)	CRD Hartland Landfill (Victoria)	$110 + $10 bin fee $254 if material is larger than 8 ft
	GFL Environmental Inc. (Victoria, Duncan, Chemainus)	$271
Ballast[2]	Global Remediation Technology (Nanaimo, BC)	$59[3]

[1] = Radius Recycling will purchase rail iron for $200/metric tonne (this is the current rate and is subject to change).

[2] = The bulk of the ballast that will be removed is not considered soil and therefore cannot be sampled as soil for comparison to the federal soil guidelines and/or the provincial soil standards. Note – acid rock drainage potential testing may be required prior to reuse or disposal.

[3] = GRT can wash and sort the ballast material. Any fine material that may be mixed in with the ballast would get screened out and the ballast will get washed. If the volume is large enough, they can return the washed material back for free, which can then be used as clean backfill material for the remedial excavations. The ballast volume requiring washing can be decreased based on visual observations during remediation. For example, only dispose the ballast that has visible staining and/or sheen.

3.2 Remediation Options

Remediation generally falls under two categories:

1. Physical excavation to numerical standards.
2. Risk assessment (contamination is left in place).

The remediation option should be selected based on the planned future use of a site, Site access, time, and cost to complete each option, and the overall remediation goals.

If, for example, a section of the railway corridor is planned to be converted into a trail or a road, then risk assessment may be more appropriate. If a section of the railway corridor will be converted into residential use, then physical excavation may be more appropriate as it will be less restrictive in terms of activities that can take place on the land, for example, growing fruits and vegetables.

3.2.1 Physical Excavation

This remediation option assumes remediating only the linear portion of the railway corridor and does not include other railway activities such as storage yards, fueling area, etc.

The physical remediation scope of work includes:

- Excavating contaminated soil;
- Collecting confirmatory samples from the excavation(s); and
- Backfilling excavation(s).

3.2.2 Disposal

The contaminated soil can be disposed on-island depending on the soil quality. The table below summarizes disposal options.

SOIL QUALITY	GRT (NANAIMO)	QM (DUNCAN)
	per METRIC TONNE	
IL+ (metals and hydrocarbons)	$79	-
IL+ (hydrocarbons only)	$59	$66
CL- (metals and hydrocarbons)	$49	$66

Note – these costs could change based on sample data.

3.2.3 Groundwater

If during the Phase II ESA or the Stage 2 PSI groundwater contamination is identified, remediation of groundwater will typically be achieved by source removal. If Site closure is desired through the federal or provincial regime, then a post remediation groundwater investigation will be required to confirm remediation to numerical or risk-based standards. The risk of groundwater contamination under the rail line is low.

3.3 Risk Assessment

Remediation through risk assessment allows for contamination to be left in place. A summary of the risk assessment scope of work is as follows:

- Problem formulation – analysis of contaminants of concern, fate and transport of contamination, receptors of concern (human or ecological), and exposure pathways. This task requires a site visit by a qualified biologist to review site habitat and potential ecological receptors.
- Exposure assessment – determines exposure point concentrations and quantifies chemical intakes for the complete exposure pathways identified for identified receptors.
- Effects assessment – assesses the relationship between exposure to a chemical (daily intake or dose) and an adverse effect (receptor response based on chemical intake).

- Risk characterization – estimates risks to potential human and ecological receptors posed by the presence of contaminants of concern in the environmental media at the Site.

If the risk characterization determines an unacceptable risk to human or ecological health, then risk management controls can be put into place, such as institutional or physical controls. Examples of institutional controls are restricting the use of groundwater for drinking water or prescribing land uses (i.e., land can be used for industrial purposes but not residential). Physical controls can be in the form of capping the contamination by a depth of clean soil, paving the site, barriers around contaminated zones (i.e., fencing), signage, etc.

4. COSTS FOR INVESTIGATION TO SITE CLOSURE

The costs from investigation to Site closure are summarized below. The costs were estimated based on Thurber's experience at similar sites, information obtained from other sources, and Phase I ESAs conducted for each section under consideration.

4.1 Investigation Costs

Workplans for the completion of a Phase I ESA/Stage 1 PSI and a Phase II ESA/ Stage 2 PSI for the eight sections that IRC is considering completing investigation and remediation were provided to MOTI for review. The total costs for approximately 7200 m of railway corridor were approximately $350,000, which is approximately $5000 per 100 m of railway corridor.

Allowing for an additional mobilization event per section to complete delineation (i.e., Phase III ESA or DSI) of the vertical and lateral extent of contamination, the total costs for investigation of approximately 7200 m of railway corridor is estimated to be approximately $350,000 to $700,000, which is approximately $5000 to $10,000 per 100 m of railway corridor. There is not a significant difference in costs for investigation for the provincial versus the federal framework assuming P6 preapproval is granted for 100 m spacing between test locations (if a CoC is desired).

4.2 Remediation Costs

The estimated remediation costs for a 100 m section are provided in the below table. The following was assumed:

- 50 – 100 MT of creosote treated wood will require disposal.
- 300 – 500 MT of ballast material will require disposal.
    - This volume may decrease based on visual observation during decommissioning.

- 200 – 300 MT of metals and petroleum hydrocarbon contaminated soil and 100 – 200 MT of petroleum hydrocarbon contaminated soil will require disposal. Typically, contamination is mainly limited to the top 0.3 m with contamination extending to a depth of 1 m in portions of the railway corridor. In estimating soil volumes, we have assumed that in a 100 m section, the top 0.3 m will be contaminated, and then approximately 50 m of this 100 m section will have contamination down to 1.0 m. The estimated width is based on typical rail track width (1.4 m) and approximately 2.3 m on either side of the rail tracks.
    - Note – the soil volume estimates are approximate and are on the conservative side.
- The disposal volumes above are estimates only and will become more accurate once data is collected.
- Remediation through risk assessment assumes the contaminated area will be paved.
- Radius Recycling will buy the rail iron (rail tracks and fasteners) at the market rate during decommissioning (see Section 3.1.1 for current rate).
- Costs do not include consideration for offsite migration.
- Costs assume no groundwater contamination identified during Phase II ESA/ Stage 2 PSI

REMEDIATION COSTS FOR 100 M SECTION – INDUSTRIAL LAND USE				
	Physical Remediation		Risk Assessment	
	Low	High	Low	High
Consulting Fees (decommissioning & remediation)	$20,000	$30,000	$10,000	$20,000
Contractor (decommissioning)	$35,000	$45,000	$35,000	$45,000
Contractor (remediation)	$20,000	$30,000	$15,000	$20,000
Disposal (creosote ties)	$15,000	$30,000	$15,000	$30,000
Disposal (ballast material)	$30,000	$50,000	$30,000	$50,000
Disposal (contaminated soil)	$35,000	$55,000	-	-
Backfill	$15,000	$20,000	-	-
Total	**$170,000**	**$260,000**	**$105,000**	**$165,000**

If remediation is conducted to residential or parkland use, then more stringent guidelines and standards apply. This typically adds 15 – 25% to the above costs. The total remediation costs to meet the federal guidelines can be greater since PAH federal guidelines are more stringent and may require more soil disposal, however, the above range of estimated costs is considered suitable for both the federal and provincial framework.

4.3 Site Closure Costs

The costs for site closure vary the most depending on whether the federal or provincial framework is being completed. For site closure following the FCSAP, the completion of the site closure tool is estimated to be $5000 per site. If a CoC is required under the provincial framework, depending on the remediation option chosen, the estimated costs for one legal instrument range from $40,000 to $50,000 for Contaminated Sites Approved Professional (CSAP) review, completion of ENV forms and ENV and CSAP fees.

4.4 Total Costs Summary

The total costs from investigation to Site closure discussed in the above sections for a 100 m section are summarized below.

INVESTIGATION TO SITE CLOSURE COSTS FOR 100 M SECTION				
	Physical Remediation		Risk Assessment	
	Low	High	Low	High
	FEDERAL			
Industrial Land Use	$176,000	$276,000	$111,000	$181,000
Residential/Parkland Use	$203,000	$345,000	$128,000	$227,000
	PROVINCIAL			
Industrial Land Use	$180,000	$280,000	$115,000	$185,000
Residential/Parkland Use	$207,000	$350,000	$133,000	$232,000

5. TIMELINE FOR INVESTIGATION TO SITE CLOSURE

The approximate timelines from investigation to Site closure discussed in the above sections are summarized in the table below.

TASK	PROVINCIAL	FEDERAL
Phase II ESA / Stage 2 PSI	3 months	
Phase III ESA / DSI (assume two mobilizations)	6 months	
Remediation (physical or risk assessment)	6 – 9 months	
Site Closure (NCSCS and SCT) (explained in Section 2.1)[1]	-	1 month
P6 Preapprovals, as required (explained in Section 2.2.2)[2]	4 months – 1 year	-
CoC, as required (explained in Section 2.2)[3]	2 months – 1 year	-
Approximate Overall Timeline	**1.5 – 3.5 years**	**1 to 2 years**

[1] = Timeline is for the completion of the National Classification System for Contaminated Sites and Site Closure Tool only – once this step is completed and submitted, the Site status is updated by FCSAP.
[2] = ENV's timeline for P6 reviews are averaging four months but can take up to a year.
[3] = ENV's timeline for granting CoCs is typically 2 to 4 months. However, if the CoC application is selected for an audit, then this process can take up to one year or longer. One in eight applications are randomly selected for an audit.

6. CLOSURE

We trust the above meets your needs. Should you require additional information or a discussion, please do not hesitate to contact us.