# Residential Yard and Garden Remediation

OVERVIEW – describe the goal, how it works,

Overview of program only. Details on the prioritization of yards and gardens for remediation (based on lead concentrations in soil), the actual activities involved in remediation, as well as restoration of the yards and gardens are provided in SNC-Lavalin (2011). This document also includes Standard Operating Procedures, notification letters, and detailed methods for analyzing and managing data.

APPROACH

METHODS –

OTHER AVAILABLE SERVICES AND INFORMATION –

## Overview

The primary objective of the residential soil remediation program is to reduce the potential for lead exposure by children in the Trail Area[[1]](#footnote-1), primarily by reducing potential exposure pathways from yard and vegetable garden surface soil. The remediation activities complement the Family Health and Air Quality Programs described in Sections XX.

Residential properties are prioritized and selected for remediation based on the measured concentrations of lead[[2]](#footnote-2) for ***yard*** and ***vegetable gardens*** determined through soil assessment as outlined in Section XX. Lead concentrations are compared to the Remediation Trigger values to determine remediation.

## Risk Based Remediation

THEP conducts soil remediation using a risk-based approach. Remediation trigger values were determined based on the results of the Human Health Risk Assessment (HHRA) and community consultation related to the HHRA (need to check with Steve for the precise history). The remediation triggers are consistent with Protocol 12 of the BC Ministry of Environment Contaminated Sites Regulation (CSR) for High Risk Sites. However, given the risk-based approach, remediation work does not necessarily meet all of the requirements of the CSR with respect to individual site remediation to numerical standards.

The remediation trigger values are as follows:

for entire ***yards,*** the property is prioritized for remediation when the 95% Upper Confidence Limit of the Mean (UCLM)

is greater than 1,000 mg/kg lead and children 3 years of age or younger live on the property, or,

is greater than 5,000 mg/kg lead.

for ***vegetable gardens***, mean lead concentrations.

are greater than 1,000 mg/kg lead.

In the case of the Healthy Homes Program, THEP may conduct partial remediation in cases where the soil lead levels are lower than the remediation triggers where there is poor ground cover and young children or expectant families living on the property. In these cases, the remediation typically consists of removing soil and existing ground cover and replacing it with better ground cover. The objective is to prevent young children’s potential exposure to metals in the soil.

## Roles and Responsibilities

The remediation of residential properties involves Teck, the Home & Garden Team, the Remediation Contractor, Property Owners and, in some cases, Tenants. Their roles are outlined below.

### Property Owners and Tenants

Property owners are responsible for authorizing access to their properties. Property owners and tenants must comply with Health & Safety measures to protect themselves and the home when the work is in process. This includes staying out of the excavation area and closing windows to prevent dust from entering the home. The Health & Safety measures are described to property owners (and tenants when they are involved) during the Remediation Planning stage.

### Teck

Teck Metals Ltd. (Teck) is responsible for final decision-making regarding the management and implementation of remediation activities. Teck has named the Home & Garden Team[[3]](#footnote-3) as its representative for the remediation work. As needed on a case-by-case basis, Teck may be consulted prior to, during, or after remediation to clarify issues or resolve disputes.

### Home & Garden Team

The ***Home & Garden Team*** manages the remediation work including:

Acting as Teck’s representative on-site;

Project planning and scheduling (including scheduling of meetings with Property Owners);

Submitting regulatory documentation including Notification of Independent Remediation (NOIR), Site Risk Classification Reports, Exposure Pathway Questionnaire, etc.

For High Risk Sites (under Protocol 12); providing site reclassification documentation signed by an approved professional to change the high-risk designation on the Site Registry to either non-high risk or risk-managed high risk.

Attending meetings with Property Owners to negotiate Remediation Plans;

On-site project supervision including coordination and management of all remediation planning or implementation activities;

Liaison between Teck, the Remediation ***Contractor*** and the Property Owner,

Collection of confirmatory soil samples[[4]](#footnote-4) and post-remediation soil samples and input into GIS database;

Construction auditing and quality control (compliance with Remediation Plan and health & safety measures, including dust control and industrial hygiene, environmental and construction requirements);

Soil sample management including implementation of analytical program and data analysis/interpretation;

Drafting (AutoCAD®) and Geographical Information System (GIS) support;

Input and tracking of property information and remediation milestones in the THEDB Database;

Residential Health & Safety Plan compliance monitoring (isn’t this the same as what was said above under “construction auditing and quality control?);

Administrative and progress reporting to Teck on a weekly basis outlining remediation activities including the list of scheduled properties as well as any health, safety or environmental issues that may have arisen;

Post-remediation reporting to property owners and Teck.

At Teck’s discretion, the ***Home & Garden Team*** may be responsible for resolving issues that may arise in the course of remediation activities, and may approve modifications to the Remediation Plan as necessary.

### Remediation Contractor

The ***Remediation Contractor*** is responsible for managing and implementing the physical work of remediation, including the following:

Attending meetings with the **Home and Garden Team** andProperty Owners to negotiate Remediation Plans;

On-site project supervision and management of the Remediation **Contractor**; (What?)

Compliance with, and implementation of its corporate Health & Safety Plan and management of human and environmental risks in accordance with all applicable legislation and Teck’s Health & Safety policies[[5]](#footnote-5);

Property site preparation (including utility locates, removal of any features/items identified and recorded on the Remediation Plan, landscape preparation, etc.);

Provision of and transportation of equipment to, from and between properties selected for remediation;

Transportation and management of soils to and from properties;

Documented control of excavation and restoration depths; and

Provision of daily updates to ***Consultant (who is this? this is a new character)*** summarizing daily activities, health, safety and environmental issues, and daily load count summaries.

## Approach/Process

The process of residential soil remediation is as follows:

* Obtain signed remediation consent form and Remediation Plan from Property Owner;
* Remediate soil by improving ground cover and/or excavating soils to a depth of 0.30 m below ground surface (bgs) in ***yards*** and 0.60 m bgs in ***vegetable*** ***garden***s.
* Where excavation base samples exceed High Risk Site Conditions, excavate soil to a maximum depth of 1 m or the depth at which soil lead concentrations are less than the remediation trigger (the previous version said “Upper Cap Concentration” but we haven’t mentioned this term), whichever is less.
* Install a ***demarcation layer*** within all full-depth excavation work;
* Transport excavated soil to the Teck-owned landfill for disposal; and
* Replace excavated soils with suitable **replacement soil** and restore properties to pre-remediation conditions to the satisfaction of the Property Owner (as per the terms of the Remediation Plan).

THEP’s Home & Garden Program is engaged in a long-term study to monitor lead concentrations in replaced soil (see Section xx).

### Prioritization of Properties for Remediation

Remediation of sites with ***exposure point concentrations*** exceeding ***risk-based remediation triggers*** are prioritized as follows:

* Properties with children aged 3 years or younger and expectant families;
* Vegetable gardens;
* Yards
* within each of the above categories, properties are prioritized starting with those having the highest soil metal concentrations

Prioritization of properties is carried out by the Home & Garden Team in consultation with Teck and the Remediation Contractor. The precise remediation schedule also depends on logistical details such as homeowner scheduling, the technical details of the remediation work, and proximity to other remediation properties. Remediation takes place in spring, summer and fall, when the Trail area climate enables feasible soil removal and supports the success of healthy ground cover.

### Pre-remediation procedures

#### Property Owner Notification and Agreements

Once properties are selected for remediation, property owners will be contacted by the ***Home and Garden Team*** to set up an onsite meeting to discuss remediation and develop a Remediation Plan. This meeting will provide the Property Owner with an overview of the planned regarding remediation activities and provide an opportunity for the property owner to ask questions. If the property owner is interested in remediation, the Consultant will have the **Remediation** Consent Form signed.

At that meeting, or at a later date with the Remediation Contractor, the Property Owner and the Home and Garden Team, a Remediation Plan will be developed to outline the specific remediation work. This will include items such as; tree and plant removals, cover materials, areas that will not be remediated, and items that are the property owners responsibility, etc which will be incorporated into a remediation drawing. These site specific items will be written into the **Remediation Plan** form and provided to the Property Owner and the Prime Contractor prior to the start of remediation.

For more difficult properties or unique situations, Teck may wish to attend the site meetings to facilitate the development of a remediation plan.

#### Notification of Independent Remediation

Properties will be registered prior to remediation using a Notification of Independent Remediation (NOIR) form submitted to the Ministry of Environment. As part of the NOIR, a Site Risk Classification Report and Exposure Pathway Questionnaire will be completed and submitted. A site plan showing soil lead concentrations will assist in identifying **High Risk Sites (**properties with soil lead greater than 5,000 ppm and soil area greater than 50 m2).

##### High Risk Site Classification,

In addition to the NOIR, Site Risk Classification Report, and Exposure Pathway Questionnaire, properties with metal concentrations that exceed Upper Cap Concentrations outlined in CSR Protocol 11, must be submitted as a High Risk Site in accordance with Protocol 12. Following remediation, the property will be re-classified as Non-High Risk as long as samples do not exceed Upper Cap Concentrations at the base of the excavation or are anticipated to cover an area less than 50 m2. If samples above Upper Cap Concentrations exist within the top 1 m at our excavation base and cover an area greater than 50 m2, the property will be classified as a risk-managed high risk site.

#### Hazardous Waste Regulation[[6]](#footnote-6) (HWR)

Previous work in Trail has shown that Toxicity Characteristic Leachate Procedure (TCLP) results for soil contaminated by smelter emissions in Trail are typically less than HWR standards, particularly when appropriately evaluated on a statistical basis. However, soil that exceeds the HWR has been encountered for select metals. Thus, soil with total metal concentrations greater than 5,000 ppm lead and 60 ppm cadmium is evaluated prior to disposal. Where TCLP exceedances are identified (sometimes as a result of other contaminant sources) they will be evaluated on a case-by-case basis.

#### Construction and Environmental Management Planning (Health and Safety)

The ***Contractor*** is to ensure the efficient movement of materials (from and to the property) in a manner that manages human and environmental risks to an acceptable standard of care/best practice and in accordance with all applicable legislation (including Teck’s Health and Safety policies). The construction and excavation management planning is to consider the physical layout of each property and neighbourhood, operations sequencing, scheduling and timing for carrying out the required work on a case by case basis.

The construction and excavation management planning should include (but are not limited to) the following:

Site access and traffic control;

Sequence of excavation;

Prevention of damage to site features; geotechnical considerations near structures (i.e. buffer or slopes);

Placement of stockpiles and materials;

Stormwater management;

Spill Contingency;

Vehicle and Equipment Decontamination;

Physical layout including construction equipment and staff facilities; and

Air quality and dust control during excavation activities.

The ***Prime Contractor*** is to develop a site-specific Health and Safety Plan, using their corporate Health and Safety Documents (e.g. working with heavy equipment, utilities etc.), with the following additional Key Risks addressed:

Metals Contamination and Industrial Hygiene (including dust control and air quality monitoring[[7]](#footnote-7), hand washing, no smoking or eating on site, decontamination, etc.);

Public Interaction (potential for interaction with public members who have concerns with the project, control of public and homeowner access; refer to Resident Health and Safety Plan presented within Appendix III);

Management of animals (e.g. aggressive dogs, pets in the yard); and

Unstable structures (geotechnical stability), voids (e.g. unknown septic tanks), heating oil tanks etc.

### 

#### Site Documentation

The remediation will be documented by the **Consultant** using photographic/video documentation. It is recommended that a survey only be completed in cases where visual property lines are unable to be determined. In most instances it is recommended to remediate up to visual property lines if available. The following will be completed:

Site Inspection including: record of site and pre-remediation conditions (condition of ***yards*** and ***vegetable gardens***, structural conditions of buildings/fences/sheds, presence of lead based exterior paint etc., debris removal/movable object, and storage);

Video/photographic record (record of property conditions before, during and after remediation);

Utility locates[[8]](#footnote-8) of all underground and overhead services (including natural gas, electric, telephone, cable, irrigation system, municipal water lines and septic field) (completed by ***Prime Contractor***);

Site survey (if required to identification of legal property boundaries), and/or a site drawing of the property layout [location and size of feature] and grades/access; and

Depending on the complexity of the property and the wishes of the property owner, a layout of each garden (vegetable/flower) may be required. In which case the ***a Horticulturalist/Arborist*** will complete including size, species name and locations of all plants within each garden

If required, the ***Prime Contractor’s Surveyor*** will define the legal boundaries and site features (pre-remediation conditions) of the properties and prepare a property plan. The property plan will include the following:

Legal property boundary;

Property features including the house and any secondary buildings, fences, paved/concrete driveways/pathways/patios, gardens (flower and vegetable), drainage areas, sprinkler controls and lines (if possible), ornaments, landscape features (i.e., lighting);

Underground/Aboveground utilities (including natural gas, electric, telephone, cable, irrigation system, municipal water lines and septic field); and

Grades (elevation) and access.

The property drawing will be used to record site-specific conditions as part of the Remediation Plan. Site-specific conditions including but not limited to the following will be recorded:

Existing site conditions;

Trees, shrubs, plants, and landscaping to be removed, replaced, or altered;

Large objects located on the proposed excavation areas to be removed by the landowner including but not limited to:

1. Boats, trailers, motor homes;
2. Wood debris (i.e., wood piles, scrap lumber, etc.);
3. Structures or items in a very poor state of repair that may be easily jeopardized by excavation works[[9]](#footnote-9)
4. Landscape equipment (i.e., wheelbarrows, lawnmowers, etc.); and
5. Landscape ornaments.

Site documentation will be used to record the condition of the property throughout the remediation process. Additional conditions encountered during the course of remediation (which were not identified on the Remediation Agreement) will be discussed with the Property Owner andowner prior to a course of action being determined and the change will be noted on the remediation agreement. Should discrepancies related to site conditions be identified following remediation, site documentation will be used for resolution of grievances/damages. Teck will be included in cases where a resolution or course of action cannot be achieved.

#### Site Preparation

Site preparation comprises the removal, by the ***Prime Contractor,*** of those objects/items identified and recorded on the Remediation Plan as requiring removal from the property in order to facilitate remediation activities[[10]](#footnote-10). An offsite temporary storage facility and/or portable storage unit will be made available by the ***Prime Contractor***, if deemed necessary, for the duration of the remediation activities to store large items from the property. The landowners will be requested to assist in the removal of the features/items from the property during the site meetings, and agreements will be documented in the Remediation Agreement.

#### Landscape Preparation

If required due to the complexity of the vegetation on the property, the ***Prime Contractor’s Horticulturalist/Arborist*** will provide consultation services and will be responsible for the following:

Identify and list all plant species located within each garden. Provide hand drawn layout of each garden with location and size of each plant. The garden layouts will become addenda to the property plan.

Select and mark plants/shrubs/trees (on a site plan) that should/can remain and/or be removed during remediation activities due to size, age, location, and/or condition. Landscaping Specifications are presented in Appendix IV.

The ***Consultant’s Horticulturalist/Arborist*** will attend the second meeting with the landowner, the ***Consultant*** and the ***Prime Contractor*** in order to support decision making in regard to the property landscape.

The ***Prime Contractor*** will provide landscaping services during the remediation program and will be responsible to remove and maintain plants during soil excavation and replacement activities. Plants will be removed in a manner consistent with BC Landscape Standards[[11]](#footnote-11), as per specifications outlined in Appendix IV, and/or as specified in the Remediation Agreement. For plants that are to be salvaged, the ***Prime Contractor*** will be responsible for providing a temporary storage location for the plants and maintaining them until such time as they can be replanted.

Plants to be removed by the landowner (as determined through the landowner Remediation Agreement process) will be stored and cared for by the landowner unless an agreement is made that the ***Prime Contractor*** care for and maintain the plants until such time as they are replanted. It is recommended that only plants that cannot be replaced or have a special meaning to the homeowner be salvaged during remediation. Otherwise, plant replacement is a more efficient option.

## Remediation Activities

On site remediation work are only to occur between 7:00 am and 6:00 pm, Monday to Friday. Remediation works on any specific property are to be completed within a two week period. There may be additional terms or exceptions specified in the Remediation Agreement on a property-by-property basis.

### Excavation Activities

***Prime Contractor*** will be responsible to carry out excavation activities. The selection of equipment will be determined by the ***Prime Contractor*** but will likely consist of a combination of powered equipment (skid-steers, front-end loaders and small backhoes) and hand tools. Hand tools including shovels and rakes are recommended for properties with difficult access and within 1 m proximity to buildings (drip lines), permanent structures (i.e., fences) utilities, and larger trees/plants.

Prior to excavation activities, all underground/aboveground utilities (including natural gas, electric, telephone, fibre-optic, cable, irrigation system, municipal water lines and septic field) are to be identified and marked on the property by the ***Prime Contractor’s Utility Locator***. The ***Prime Contractor*** is responsible to ensure all reasonable efforts are made to locate and prevent damage to known underground utilities in a documented format; only where utilities are encountered that could not be known or reasonably avoided (i.e. underground sprinklers) will Teck will be responsible for repair or replacement costs.

#### Excavation of Residential **Yards**

All residential ***yards*** will be excavated by ***Prime Contractor*** to a depth of 0.3 mbelow ground surface, with a tolerance of +/- 0.1 m. ***Prime Contractor*** will be required to demonstrate surveyed control of excavation depths. Once the soils are removed, confirmatory soil samples will be collected by the **Consultant** from the excavation floor (refer to Section 3.4.2, below). In cases where XRF screening indicates that excavation base samples are greater than Upper Cap Concentrations additional soil will be excavated to a depth of up to 1 m if it can be removed safely and without damaging existing structures.

A ***demarcation layer*** will be installed prior to Restoration activities in all ***yards*** and ***vegetable gardens.***

Inaccessible areas (i.e., under porches, decks, etc.) will be reviewed on a site-by-site basis during the site meetings. Soils will remain in place and either 1) a permanent soil marker/barrier will be installed (i.e., gravel) or 2) exclusion measures will be implemented (i.e., screwed in latticework, etc.).

#### Excavation of Vegetable Gardens

***Prime Contractor*** will excavate ***vegetable gardens*** to a depth depending on whether gardens are levelled or raised as described below:

Level bed will be excavated to a depth of 0.6 m below ground surface with a tolerance of +/- 0.2 m.

Raised bed[[12]](#footnote-12) will be excavated to either the full depth of the bed up to 0.60 m or to a depth of 0.3 m below adjacent ground surface (whichever comes first) , with a tolerance of +/- 0.1 m.

***Prime Contractor*** will be required to demonstrate surveyed control of excavation depths. Once the soils are removed, the Consultant will collect confirmatory soil samples from the excavation floor (refer to Section 3.4.2, below), as required. As with yards, where XRF screening indicates that excavation base samples are greater than Upper Cap Concentrations additional soil will be excavated to a depth of up to 1 m if it can be removed safely and without damaging existing structures. A ***demarcation layer*** will be installed prior to restoration activities in all ***yards*** and ***vegetable gardens*** (refer to Section 3.4.2.3, below).

### Confirmatory Soil Sampling

Confirmatory samples will be collected from all properties (***yards*** and/or ***vegetable*** ***gardens***) from the excavation floor to determine concentrations of the remaining soils following the remediation program. Where XRF screening indicates that excavation base samples are greater than Upper Cap Concentrations in yards and vegetable gardens additional soil will be excavated to a depth of up to 1 m if it can be removed safely and without damaging existing structures. Quality control and quality assurance measures for sample collection and field screening are presented in Appendix VI. Niton™ xLi x-ray fluorescence (XRF) Operating Procedures are presented in Appendix VI.

#### Yards

The collection of confirmatory soil samples from the excavation floor will be based on the same approximate sample location program as was completed for Soil Assessment of the property (i.e., samples will collected from the same general area as samples collected from the surface). Discrete soil samples will be collected manually with a stainless steel shovel/hand soil auger (diameter 2”) from the top 0.1 m of the excavation floor at each sample location. To minimize cross contamination, sampling equipment will be rinsed with de-ionized water between sample locations.

Soil conditions will be logged in the field with respect to relative grain size distribution, moisture content, colour, and apparent indicators of contamination, including Niton™ xLi x-ray fluorescence (XRF) analyzer field screening (described below) measurements of primary contaminants.

All recovered soil samples will be placed as discrete samples for the targeted depth interval into a dedicated polyethylene bag for homogenization, which provides more consistent analytical results, especially for blind duplicate samples.

To assist with assessing potential metal concentrations in the soil, soil samples will be screened in the field with an XRF analyzer provided by Teck. XRF readings will be obtained through the side of a polyethylene bag. The concentrations of the primary metals (arsenic, lead and zinc) from the XRF will be recorded in the field and used for comparison purposes to determine metal concentrations of in-situ soil, and/or to select soil samples for laboratory analysis. A complete digital set of XRF results will be downloaded from the unit following the field work.

As noted above, in the instance where XRF soil metal concentrations are above Upper Cap Concentrations, it may be recommended that the ***Prime Contractor*** remove additional soil from the excavation to remove High Risk conditions within the top 1 m of soil on the property.

Where initial soil assessment indicated yard soil lead concentrations greater than 5,000 ppm[[13]](#footnote-13) the two highest samples from the excavation base will be submitted for laboratory analysis and the confirmation of metal concentrations.

#### Vegetable Gardens

A composite sample consisting of 10 aliquots will be collected from the floor of the ***vegetable gardens*** excavation by the Consultant following the same methodologies as for the ***yard*** confirmatory samples.

#### Interpretation of Confirmatory Soil Samples

***Yards***

Confirmatory soil samples from the excavation floor of the residential ***yards*** will be interpreted as follows:

In order to allow the properties to progress quickly and limit the amount of time the property is under remediation it is recommended to place a ***demarcation layer*** at the base of all remediation excavations. This will identify the depth to which remediation has occurred for a reference for property owners and future soil sampling on the property and accounts for future changes in soil ingestion standards.

***Vegetable Gardens***

The calculated ***garden uncertainty factor[[14]](#footnote-14)*** will be added to the mean lead concentration from the 10-aliquot composite confirmatory sample (after applying the laboratory correlation equation to the XRF readings) to obtain a ‘***representative garden concentration***’ and then compare to CSR matrix standard for soil ingestion of 500 mg/kg for lead. A ***demarcation layer*** will be laid and covered with 0.6 m of ***replacement soil*** to pre-remediation grades. Confirmatory soil samples with metal concentrations above the Upper Cap Concentrations will be recommended to have additional soil removal and a sample will be submitted for laboratory analysis. Soil less than the CSR will not be submitted for laboratory analysis and XRF results will be provided to land owners in the remediation report.  
Landowners will be provided with maintenance instructions for the ***demarcation layer*** as presented in the Homeowner Brochure (Appendix X).

#### Analytical Program

A subset of soil samples from each residential property will be forwarded to ALS Laboratories (ALS) in Burnaby, BC for analysis of total metals by the BC Strong Acid Leachable Metals (SALM) method, in order to confirm the interpretation of XRF field screening results as outlined in Appendix V. Samples from the excavation base of properties with soil over UCC with the two highest metal concentrations based on XRF readings will be selected for analysis from each property. As such two samples will be analyzed from each residential property. The remainder of the samples will be stored at a storage locker until it is decided how long soil should be stored. At that time they will be returned to Teck for appropriate disposal.

The samples from each individual property will be submitted to the laboratory on separate chains of custody so that separate laboratory reports are generated for each property. As such, laboratory reports can be provided to each landowner without providing data from other properties.

## Excavated Soil Disposal

***Prime Contractor*** will transport all excavated soil to the Teck owned landfill in Warfield. Long term disposal options are currently not being assessed as it is understood that the volume of soil required at the landfill can accommodate the residential remediation program for many years. Use of “Licensed to Transport” trucks or manifesting is not required, however standard procedures to be adhered to (e.g. weight limits, dust control, tarping of all loads).

Prior to hauling the soil to the landfill it must meet HWR.

## Restoration Activities

Once the excavation of soil to 0.30 m bgs in ***yards*** and to 0.60 m bgs in ***vegetable gardens*** has been completed and a ***demarcation layer*** has been placed on the excavation floor, ***yards*** and ***vegetable gardens*** will be restored by the ***Prime Contractor*** to pre-remediation conditions as recorded on the Remediation Agreement. ,.

Restoration will consist of the following:

Soil Replacement - Back-filling ***yards*** and ***vegetable gardens*** with “***replacement soil***”; ***Prime Contractor*** will be required to demonstrate surveyed control of backfill depths;

Re-installation of any existing sprinkler systems;

Landscape Replacements - placing sod on lawn areas; Replacing/transplanting landscape plants; replacement of landscape features; and

Property Features Restoration – replacing fences, ornaments, movable objects, etc.

The ***Prime Contractor*** will be responsible for the sourcing of topsoil, fill, and gravel, sod and replacement plants to restore ***yards*** and ***vegetable gardens***. Future soil sourcing requirements will be detailed in a *Material Procurement and Disposal Review Report,* Appendix VI (in progress). The source of topsoil, fill, gravel and plants will be dependent on availability and costs, although they will be required to meet the specifications as outlined in Appendix IV.

### Yard Restoration

#### Soil

**Yards** will be replaced with topsoil from 0 to 0.30 m . The depth of topsoil may be adjusted as required based on pre-remediation conditions identified during soil assessment activities or as outlined in the Remediation Agreement. The topsoil is required to assist in supporting sod replacement so alternatives may be used in areas without sod (i.e. below a gravel parking area). Once the source of topsoil is determined, soil samples will be collected by the ***Consultant*** and analyzed for total metals (SALM method) and landscape package analysis (including nutrient content and percent organic mater). The quality of topsoil is to be consistent with BC Landscape Standards, as outlined in Appendix IV.

Properties are to be backfilled to pre-remediation grade based on elevation and site drainage conditions determined prior to remediation (through survey if required). Topsoil will be trucked to the property, temporarily stockpiled and spread with a combination of power equipment and handwork. Soils are to be moderately compacted to reduce settling following restoration.

Once the soils are placed, if required, irrigation or underground lighting systems removed prior to remediation will be re-installed by the ***Prime Contractor***, including replacement of any components damaged during remediation activities.

#### Sod

Sod is the preferred choice for re-establishing the ***yard*** as grasses are already established, there is less watering required and there is a lower potential for additional applications/maintenance. As such, areas that were previously grassed will be replaced with sod unless otherwise indicated on the Remediation Agreement. Although the source for the sod may change from year to year, the type of sod for replacement will likely consist of a Kentucky bluegrass/Perennial Rye Grass/Red Fescue (industry standard), as per the specifications in Appendix IV.

Areas below shrubs/trees may not support new sod due to reduced light and competition for moisture, alternative covers including but not limited to bark, gravel, sand or other material, may be substituted (as identified on Remediation Agreement).

Sod will be watered by the ***Prime Contractor*** for two weeks following installation, after which time the landowner will be responsible for the upkeep of the yard as outlined in the Remediation Agreement and presented in the Homeowner Brochure (Appendix X).

#### Perennial Plants, Shrubs and Trees

As described in Section 3.3.3 above, the ***Prime Contractor*** will be responsible for the inventory of perennial plants, shrubs and trees prior to remediation. Theywill be responsible to remove, salvage, maintain and replant or replace shrubs and trees, as defined within the Remediation Agreement for each property. Shrubs/trees may remain in place if soil can be removed without damaging the plant. Shrubs/Trees will be planted in the locations presented on the construction drawing (unless otherwise indicated on the Remediation Agreement) and replanted in accordance with the specifications presented in Appendix IV.

For vegetation that was salvaged during pre-remediation activities but did not survive the storage period, replacements shrubs/trees will be sourced and a cost per plant will be determined by ***Prime Contractor*** . Landowners will be contacted by **Consultant** to confirm proposed replacement plants prior to replanting (the additional plants will be listed as an addendum to the original Remediation Agreement which will be signed by the Landowner). Shrubs/Trees will not be substituted without the written permission of the Landowner/resident. Non-salvageable and replacement plants shall be sourced from nurseries with climatic conditions similar to those in the locality of the project and be of a similar size (or may be larger).

#### Landscape and Property Feature Restoration

Landscape features, including rock walls, edging, and lava rock, that must be removed to facilitate the remediation etc. will be replaced by the ***Prime Contractor*** at the same locations and condition as presented in the Remediation Agreement. Those property features (identified and recorded on the Remediation Agreement) removed from the property during site preparation activities by the ***Prime Contractor*** to facilitate remediation activities (i.e. fences, ornaments, movable objects, etc) are also to be replaced. Any features that were removed by the landowners prior to the commencement of remediation activities will be the landowner’s responsibility to replace. ***Prime Contractor*** to remove any accumulated dust on features and structures (including house, garage, sheds, etc) by hand rinsing with water (power washers will not be used due to potential damage from high pressure water).

### Vegetable Garden Restoration

#### Soil

The quality of soil to be replaced in the ***vegetable gardens*** will be a mixture of topsoil and organic matter of a quality consistent with BC Landscape Standards, as outlined in Appendix IV. Soil samples will be collected by the **Consultant** from the sourced topsoil and analyzed for total metals, and landscape package analysis (including nutrient content and percent organic mater).

Soils will be uncompacted and the original subsurface drainage conditions will be maintained to pre-remediation conditions. Weed growth restriction cover (i.e., landscaping fabric, plastic) will be replaced at locations where it previously existed or as indicated in the Remediation Agreement.

#### Plants and Landscape/Property features

Where there are perennial plants and/or landscaping/property features in a ***vegetable garden***, they are to be managed as described in Section 3.6.1.3 and Section 3.6.1.4, respectively.

# 

## Remediation Completion

### Post Remediation Sampling

Following restoration activities, soil samples will be collected by the ***Consultant*** from the ***yards*** and ***vegetable gardens*** to confirm concentrations of the ***replacement soils*** after replacement activities are completed, and to provide a baseline for future soil quality monitoring. Quality control and quality assurance measures for sample collection and field screening are presented in Appendix VI. Procedures for operation of Niton XRF are presented in Appendix VI.

The soil sample methodologies are presented in the following sections.

### Residential Yards and Vegetable Gardens

The collection of soil samples from ***yards*** and ***vegetable gardens*** will be based on the same approximate sample location as was completed for Soil Assessment of the property (i.e., samples will collected from the same general area as previous samples collected from the surface). Discrete soil samples will be collected manually with a stainless steel shovel/hand soil auger (diameter 2”) from the top 0.1 m at each sample location. To minimize cross contamination, sampling equipment will be rinsed with deionized water between sample locations.

Soil conditions will be logged in the field with respect to relative grain size distribution, moisture content, colour, and apparent indicators of contamination, including Niton™ xLi x-ray fluorescence (XRF) analyzer field screening (described below) measurements of primary contaminants.

To assist with assessing potential metal concentrations in the soil, soil samples will be screened in the field with an XRF analyzer provided by Teck. XRF readings will be obtained through the side of a polyethylene bag. The concentrations of the primary metals (arsenic, lead and zinc) from the XRF will be recorded in the field and used for comparison purposes to determine metal concentrations of in-situ soil and/or to select soil samples for laboratory analysis. A complete digital set of XRF results will be downloaded from the unit following the field work

All recovered soil samples will be placed as discrete samples for the targeted depth interval into a dedicated polyethylene bag for homogenization, which provides more consistent analytical results, especially for blind duplicate samples. A composite sample (consisting of an aliquot from each discrete soil sample) will be forwarded to ALS Laboratories (ALS) in Burnaby, BC for analysis of total metals by the BC Strong Acid Leachable Metals (SALM) method.

### Individual Property Remediation Report

Individual reports will be prepared by the ***Consultant*** that will contain factual information relevant to each property. The individual reports will include the following:

Summary of general methodology associated with remediation and restoration activities;

Soil sample logs including XRF readings for confirmatory soil samples collected from the excavation floor as well as soil samples collected from the surface following restoration activities;

Copies of detailed laboratory reports; and

Record drawings: a GIS based map will be prepared to illustrate the remediation activities and soil sample locations on the property including areas were soils were not replaced and/or the location of ***demarcation layer***.

Individual property reports will be provided to each landowner in a format that is approved by Teck.

### Individual Property Remediation Closure

Following the remediation and restoration of the property, an inspection of the property will be held with the landowner and the ***Consultant*** to review the remediation and restoration activities. Deficiencies associated with remediation as well as damage to any structures as a result of activities will be noted.

If necessary, pre-remediation documentation (including video and photographic documentation) will be reviewed to identify property damage due to remediation activities and corrective actions will be implemented to address the issue. Structures and landscape features that were clearly damaged as a result of the excavation and replacement activities will be repaired or replaced. Where damage was a result of inappropriate practice or non-diligence on the part of the Prime Contractor, the Prime Contractor will be responsible for repair or replacement. Where damage was reasonably unavoidable due to site conditions out of the control of the Prime Contractor, Teck will be responsible for repairs or replacement.

Following consensus on any outstanding issues, landowners will be requested to “sign-off” on the Remediation Completion Form for the property. A copy of Remediation Completion Form is presented within Appendix III. Documentation (video/photographic) will be taken of the property following completion (within 30 days) and will become part of the project record.

## Regulatory Reporting

Upon completion of the remediation, a NOIR indicating the property has been remediated will be forward to the MoE (

If the property was determined to be High Risk during the soil assessment phase, a letter report signed by an approved professional and summarizing the remediation activities and excavation/post remediation sample results is provided to the MoE within 90 days from the start of remediation. A Site Risk Classification Report is included in this letter report to indicate the change to the property risk status under the following scenarios:

* If High Risk conditions have been removed, it is recommended that the property is re-classified as non-high risk
* If High Risk conditions exist within the top 1 m it is recommended that the property be re-classified as risk-managed high risk.

For properties where excavation base samples exceed UCC after remediation, a soil map showing the soil concentrations contours and areas will be attached to the letter report to support the re-classification recommendations.

## Overall Data Management and Annual Reporting

In addition to weekly progress updates (generally via email), the ***Consultant*** will provide Teck with annual reports following the completion of the remediation program for the year. This will include:

Summary Report

A combined summary of the work completed on the individual properties including:

1. Soil sample logs including XRF readings for confirmatory soil samples collected from the excavation floor, if completed, as well as soil samples collected from the surface following restoration activities;
2. Summary statistics of costs, remediated volumes and areas and number of properties completed;
3. Analytical results for total metals will be tabulated and compared to the applicable CSR human health matrix and MoE "High Risk Site" standards;
4. Copies of detailed laboratory reports; and
5. Record Drawings; a GIS based map will be prepared to illustrate the soil sample locations on the properties including areas were soils were not replaced and/or location of ***demarcation layer***.
6. Combined summary of cost tracking on a property by property basis.

Project Database

As outlined in the Spatial Database Management Plan (Appendix VIII, in progress), on an annual basis, Teck will be provided with the final version of the database management system (DBMS) and GIS files following remediation and restoration activities. The database will be used to store all project records such as copies of Remediation Agreements, individual property reports (prepared for each landowner), signed Remediation Completion Agreement Form, invoices and budget tracking separated for each property.

### Continual Improvement Recommendations

A project debriefing meeting will be arranged following the remediation program. The goal of the meeting will be to evaluate the:

Completeness and practicality of Guidelines presented herein;

Roles and responsibilities; and

Methodologies of landowner notification and agreements, pre-remediation activities, remediation activities (including excavation works, soil sampling, analytical program, etc.), restoration activities, and remediation closure.

Recommendations for subsequent remediation programs will also be presented to Teck.

## FORMS

Remediation Consent

Remediation Plan

Remediation Drawing

Remediation Completion

REFERNCE MATERIAL

1. The Assessment and Remediation Program Area includes the communities of Trail and Rivervale. (THEP accepts assessment requests from other communities in Greater Trail on a case-by-case basis but advises residents that the soil levels are likely to be lower than those in Trail and Rivervale. [↑](#footnote-ref-1)
2. It has been established that lead is the primary contaminant and can be used as an indicator for other contaminants such as cadmium. [↑](#footnote-ref-2)
3. SNC Lavalin Environment [↑](#footnote-ref-3)
4. Confirmatory samples will be collected from the base of the remedial excavation of both yards and vegetable gardens to determine soil metal concentrations below the demarcation layer. On High Risk Sites, a portion of these samples will be submitted for laboratory analysis. Otherwise samples will be analyzed with the XRF and provided to homeowners in the remediation report. [↑](#footnote-ref-4)
5. The Prime Contractor’s corporate Health and Safety Plan will be reviewed by Teck’s Projects/Contractor Management Group to confirm compliance with Teck’s Health and Safety Regulations. [↑](#footnote-ref-5)
6. Hazardous Waste Regulation (HWR)*,* B.C. Reg. 63/88, including amendments up to B.C. Reg. 261/2006. [↑](#footnote-ref-6)
7. Air quality monitoring was completed by Teck for the 2008 Remediation Pilot Project and air quality issues were not identified. Future air quality monitoring programs may be recommended prior to the commencement of remediation activities (i.e. particularly dry and dusty weather). [↑](#footnote-ref-7)
8. Utility locates will be the independent responsibility of the Prime Contractor prior to the commencement of excavation activities. [↑](#footnote-ref-8)
9. In such cases, it will be discussed with the land owner whether the land owner should repair or replace the items, or otherwise waive warranty that the item will not be damaged by the works. [↑](#footnote-ref-9)
10. Where possible, the landowners will be encouraged during the site meeting to remove as many items themselves as possible, especially those that have sentimental or other value to the landowner. [↑](#footnote-ref-10)
11. BC Society of Landscape Architects and BC Landscape and Nursery Association, *BC Landscape Standards*, 6th Edition, 2001. [↑](#footnote-ref-11)
12. With a minimum raise of 0.3 m. [↑](#footnote-ref-12)
13. Protocol 12 High Risk Site Designation [↑](#footnote-ref-13)
14. Currently there is no garden uncertainty factor as this continues to be evaluated and preliminary results suggest homogeneous soil conditions in gardens. [↑](#footnote-ref-14)