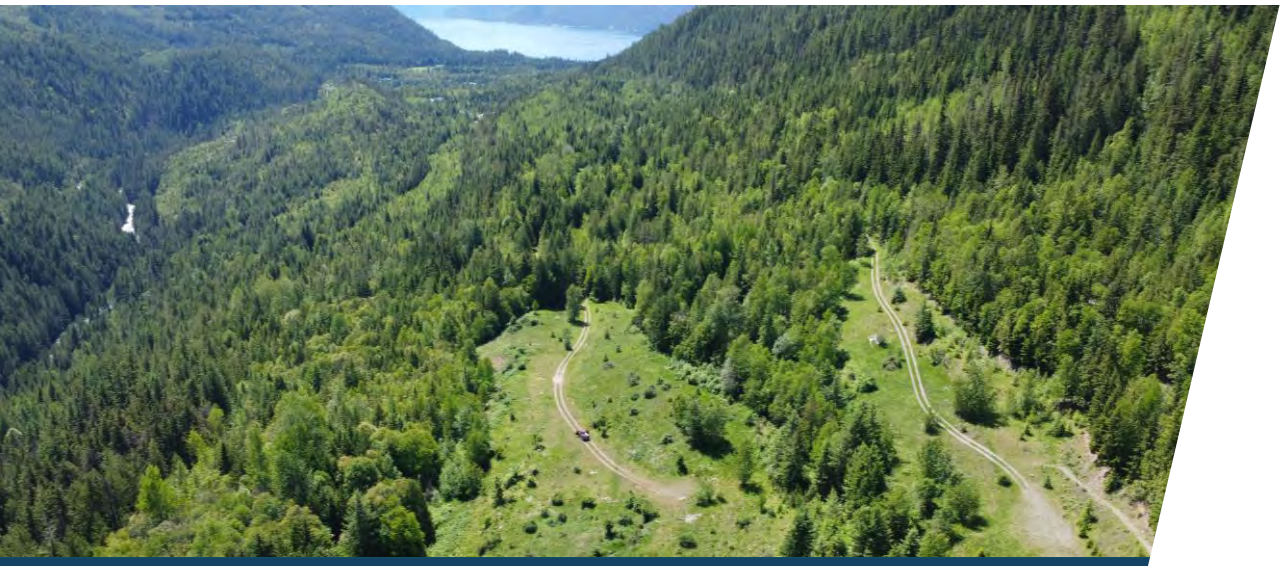
Rosebery Legacy Landfill Closure Plan



Prepared for:

Regional District of Central Kootenay

ISSUED FOR USE

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1. Background

The Regional District of Central Kootenay (RDCK) has ownership and control of several Legacy Landfills which have historically received municipal solid waste with various levels of closure. As these sites are no longer receiving waste the RDCK is looking to abandon the permits for these sites and as such has been instructed to complete Closure Plans for each site. This report seeks to satisfy the requirements set out by the Ministry of Environment and Park's (ENV) for final closure of the Rosebery Landfill site and abandonment of the permit.

To develop the Closure Plan, Sperling Hansen Associates (SHA) has relied on background information provided by the RDCK, gained from a Freedom of Information request made to the ENV. These documents include:

- Paper Correspondence from ENV (1982-2004, 170 pages)
- 1983 Permit PR-06720
- 1993 Amended Permit PR-06720
- 2003 Draft Operational Certificate to Replace Permit PR-6710
- 2004 Decommissioned Landfills Preliminary Risk Assessment Study (Technology Resource Inc.)
- 2004 Rosebery Landfill Closure Plan
- 2019 ENV Inspection Report

SHA conducted a site visit on May 27, 2025 to gather further information and ensure that the landfill can be closed according to the satisfaction of the Ministry of Environment prior to permit abandonment.

2. Introduction and Site History

The Rosebery Landfill is located on an old logging clearcut approximately 2.5 km north of the community of Rosebery, BC (Figure 1). Permit PR-6720 describes the property as an unsurveyed portion of District Lot 13113 as shown on the site plan (Figure 2). The site is otherwise surrounded by natural forest and more logging clearcuts. The site is currently held by the RDKC under a Licence of Occupation (file no. 4496085) from the provincial government.

Figure 1: Location of Rosebery Landfill

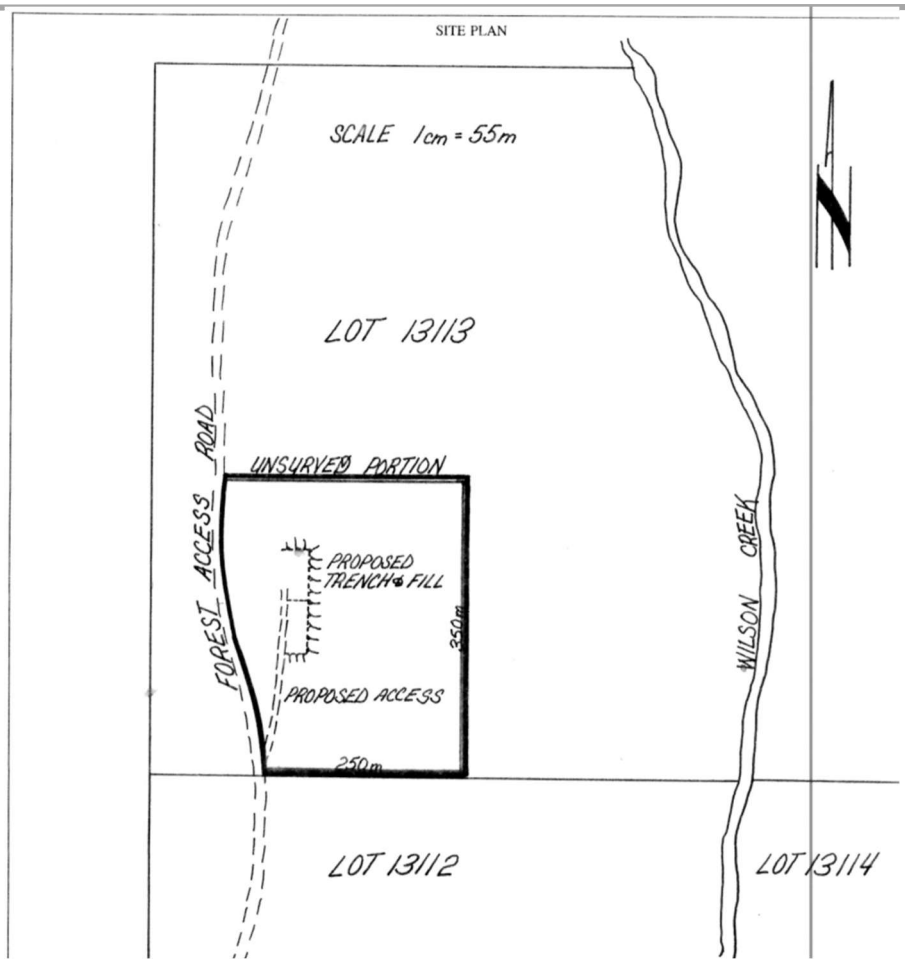

Figure 2: Site Plan from the Original Permit PR-6720

The landfill site was originally authorized in 1983 and does not appear to have been used prior to that year. The site was operated as a trench and fill, with significant bear problems through the late 90s. The landfill was unofficially closed in 2003 with a transfer station being constructed adjacent to Highway 6 (not on the landfill site). Today, the landfill site is unused except for some small portions of the Western area which are utilized for backcountry activities such as hiking and biking. A pit toilet has been installed in the Northwest corner of the site along with a picnic table for users.

There have been two previous assessments as to the volume of waste deposited at the landfill:

1. An RDCK technical review of rural landfills estimated approximately 4,000 tonnes of waste in place at a disposal rate of 200 tonnes per year.
2. A BC MSW Landfill Review estimated the volume of waste deposited at 70,000 m^3 with an expected intake of 3,000 m^3 in 1995. This gives around 94,000 m^3 at closure or around 56,400 tonnes.

These two estimates make it very difficult to estimate the amount of waste that has been deposited at the landfill, and SHA has used two methods to estimate the in-place tonnage:

1. Based on the permitted maximum discharge per day (18.5 m^3/day) and a waste density of 0.6 tonnes/m^3 there could be around 70,000 tonnes of waste in place.

2. Using the population serviced (1,000 persons) and a waste generation rate of 555 Kg/person/year as reported by RDCK in 2017, there could be around 11,100 tonnes in place.

Knowing that these sites are relatively small and likely did not receive large amounts of waste, SHA conservatively estimates that there is approximately 15,000 to 20,000 tonnes of waste in place at the Rosebery Landfill.

3. Final Cover

The Landfill Criteria lists several objectives of the final cover design for any landfill in Section 5.8: Final Cover Design. These are listed below, and the following sections explain how the current cover system either meets these objectives or how more work will be required:

- Prevent exposure of humans and/or wildlife to MSW
- Control infiltration of precipitation
- Minimize the uncontrolled release of methane to the atmosphere
- Limit erosion and release of sediment to surrounding surface waters
- Control release of odours
- Minimize oxygen infiltration and fire risk

Throughout the Rosebery Landfill there is sufficient cover (over 300mm of cover) over the crest/cleared area of the site as found by hand auger investigations conducted by SHA. This was likely achieved in 2003 when the landfill was closed, as some areas of the site still contain log sort waste although vegetation is not growing in these areas (shown on dwg. PRJ25043-ROSEBERY-1). While this does not meet the 500mm thickness requirement of the landfill criteria, SHA believes that an additional 200mm of cover will not provide any further benefits for landfill closure, and that the current cover is working to prevent exposure of the MSW, control infiltration, and is limiting erosion of the landfill surface.

Although the cover is sufficient over the crest, the edges of the landfill consist of a steep drop-off 2 to 3 metres in height much of which consists of concrete and metal (Photos 1 and 2). As the landfill is often used by bikers and hikers, SHA believes that efforts should be made to remove much of the metal waste from the area using an excavator to pull these metal pieces and some auto hulks out of the slope and adjacent area. This metal can then be placed in roll-off bins and transported to active landfills under RDCK control.

Photo 1 and 2: Debris near edge of landfill site and on steep slopes.

While the metal is being removed, some effort should be made to knock down the steep slopes to a grade of 2.5H:1V and ensure a more gradual transition from landfill surface to native ground. This will provide greater slope stability and allow for easier covering of exposed waste. Although the grade is steeper than the 3H:1V recommended in the criteria, the recommended slope grades will ensure stability while minimizing the zone of disturbance.

Following removal of the metal, the remaining exposed waste should be covered with a minimum of 500mm of material as required in the Landfill Criteria. This material is not required to be low-permeability material as there is little concern around surface water management and leachate production, given that there are no concerns around surface water (Section 4) and the age of the waste means any leachate produced will be relatively weak.

As discussed in Section 7, there is minimal gas being produced at the site and no odours were observed by SHA during the site visit. Risk of fire decreases with time as the waste becomes more inert, and there are no concerns around fire starting within the waste mass at this time.

4. Surface Water Management

Upon review of the available documentation and during the site visit, SHA believes that there are no surface water features on or adjacent to the site, with the nearest surface water being Wilson Creek which is located approximately 400m to the East of the landfill site. During SHA's site visit, no evidence of erosion or surface water channels were observed other than some run-on ditching in place to the North and West of the site. As these were dry at the time of the visit, it is believed that the crest is sufficient to shed or infiltrate surface water and no additional surface water management works are required to be constructed.

5. Site Maintenance

During SHA's site visit, several areas of litter were observed on the landfill surface (Photo 3). SHA believes that these are areas where waste was deposited post landfill closure in 2003, and that these are not areas where cover is insufficient. These areas are delineated on dwg. PRJ25043-

ROSEBERY-1, and while any litter on the landfill surface or in surrounding areas should be cleaned up the areas noted on the drawing should be given specific attention.

Photo 3: Litter spread adjacent to landfill surface, likely placed post-closure.

6. Leachate Management

The amount of leachate produced at a landfill is generally related to the amount of precipitation received at the site. Table 1 provides the climate data for the site, indicating a total annual precipitation of 872.6 mm.

Table 1: 1981-2010 Climate Normals for New Denver

Month	Rainfall (mm)	Snowfall (cm)	Precipitation (mm)	Daily Average Temperature (°C)
Jan	43.1	57.6	100.8	-1.7
Feb	36.8	20.3	57.1	-0.3
Mar	54.8	7.9	62.7	3.6
Apr	60.8	0.7	61.6	8
May	66	0.1	66.1	12.5
Jun	84.2	0	84.2	16.1
Jul	60.8	0	60.8	19.1
Aug	54.9	0	54.9	18.9
Sep	55	0	55	13.9
Oct	69.8	0.3	70.1	7.5
Nov	86.1	19.1	105.2	2
Dec	39	55.2	94.2	-1.9
Total	**711.5**	**161.1**	**872.6**	**8.1**

SHA's experience has produced an estimated linear relationship between the amount of precipitation received at a site and the potential leachate generated. This relationship is shown in Figure 3, which also indicates that the Rosebery landfill has a moderate leachate generation potential. However, the moderate potential coupled with no leachate staining observed during

SHA's site visit leads SHA to believe that there is minimal if any impact from leachate being produced at the site. Furthermore, the age of the waste (minimum 22 years) means that any leachate being produced is likely very weak.

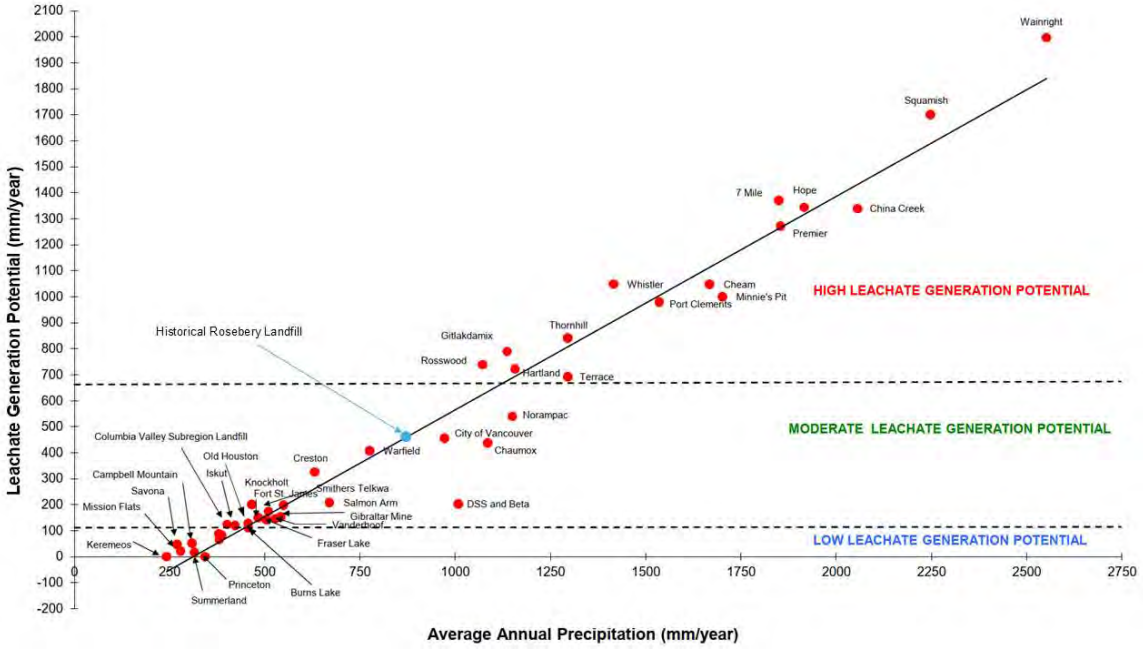

Figure 3: Leachate Generation Potential for Landfills in BC

7. Landfill Gas Management

Landfill Gas (LFG) is a by-product of natural decomposition of organic material in landfills. The two main components of landfill gas are methane (CH4) and carbon dioxide (CO2), which vary in concentration through several parameters, including waste composition, age of the waste, and the level of atmospheric air intrusion into the landfill. [1]

After waste is placed, it takes 1 to 3 years for the landfill to produce amounts of gas large enough to be noticed. Following this, peak production of landfill gas occurs 5 to 7 years after placement, after which the amount of gas produced is significantly reduced. After 20 years, almost all gas will have been produced from waste, but small amounts of gas may be produced for up to 50 years after waste is placed in the landfill. [1] Given that the waste in the Rosebery Landfill was last placed around 22 years ago, it is unlikely that the landfill is currently producing any significant amount of landfill gas and no management infrastructure is required.

8. Contaminating Lifespan and Environmental Monitoring

The amount of waste in place at the historical Rosebery Landfill is estimated to be small, up to around 20,000 tonnes, for which the BC MSW Landfill Criteria recommends a standard contaminating lifespan of 50 years. However, considering the minimal risk of leachate as explained in Sections 3 and 6 and the minimal amounts of LFG being produced at the site, SHA believes that the contaminating lifespan is much shorter. Understanding that the absolute minimum contaminating lifespan is 30 years, SHA believes that this should be used for the Rosebery landfill given that there is a very small amount of waste in place, and that any efforts to cover the waste will remove the current primary concern at this site.

There are no wells within proximity of the site, with the closest well registered in Rosebery, approximately 2.5km away. The contours of the site (Figure 4) show that groundwater likely flows East towards Wilson Creek, which is located approximately 400m East of the landfill. These distances to any receptors of the likely minimal leachate that is being produced at the site lead SHA to believe that no environmental monitoring is required at the site.

Figure 4: Rosebery Landfill and surrounding contours.

9. ENV Closure Plan Requirements

When the RDCK submitted an Application for Permit Abandonment to the ENV, the ENV indicated that this closure plan should address several specific sections of the Landfill Criteria. This section details how these sections are followed within this closure plan or provides justification for exemption from these criteria.

9.1 Section 5.8 – Final Cover Design

Final cover design for the historical Rosebery Landfill site is discussed in Section 3: Final Cover. As discussed there, no additional cover is required on the landfill crest, but the steep slopes on the North and East edges of the landfill site should be cleaned up, regraded to 2.5H:1V and covered with woodchips or soil suited for vegetation growth.

9.2 Section 5.9 – Final Contours

The list below outlines the final contour guidelines as outlined in the BC Landfill Criteria:

- Final contours shall be constructed at grades not steeper than 3H:1V.
- Recommended plateau area is slope not less than 10H:1V. Can be reduced up to 25H:1V for geomembrane systems.
- Surface water control benches shall be provided on the landfill final contours every 15 vertical metres or less.

During SHA's site visit it was found that the historical Rosebery Landfill site is characterized by relatively gentle slopes in the cleared parts of the site, with slopes increasing to be much steeper at the treelines. The steep slopes on the edges should be knocked down to be more gradual 2.5H:1V during the removal of exposed metal from the slopes.

9.3 Section 7.0 – Closure and Post-Closure Criteria

This document presents the Closure Plan for the Rosebery Landfill site and seeks to update the Closure according to the 2016 BC Landfill Criteria for MSW. Post-closure operation has been undertaken since the site was closed around 2003. The contaminating lifespan and post-closure monitoring requirements are discussed in Section 8: Contaminating Lifespan and Environmental Monitoring.

9.4 Section 10.3 – Design, Operations, and Closure Plan

According to the Landfill Criteria, each landfill is required to have current and up to date a Design, Operations, and Closure Plan (DOCP) prepared by a qualified professional. This plan is to demonstrate that the landfill will be 'planned, designed, constructed, operated, monitored, and closed in accordance with the "Criteria"'. SHA believes that as this landfill is no longer receiving waste, the preparation of a DOCP is an exercise that will have no benefit to the site, the Ministry, or the RDCK in closure of the site. Rather, SHA believes that as the only aspects of the DOCP left to be addressed are the monitoring and final closure, this closure plan will be sufficient to satisfy the requirements of the DOCP according to the Criteria.

This Closure Plan, which is required in the DOCP, documents how the facilities environmental controls will be maintained following closure to meet all performance criteria.

9.5 Section 10.3.2 – Surface (Storm) Water Management Plan

The surface water management has been addressed in Section 4: Surface Water Management.

9.6 Section 10.3.4 – Closure Plan

Each landfill is required to have a closure plan, and Sections 1 through 8 of this report seek to satisfy the requirements set forth in the Criteria for Closure Plans. This includes:

- Final cover design to meet requirements and objectives
- Surface water management
- General site maintenance
- Leachate management
- Landfill Gas Management
- Environmental monitoring during the contaminating lifespan
- Practical and implementable contingency measures

Due to the older nature of the site, there are no contingency measures identified at this time.

10. Recommendations

Based on SHA's review of the available documents, the site visit, and our experience with landfill closure, we have the following recommendations for the site prior to the permit being abandoned.

1. Clean up litter present on landfill surface, with specific attention to the areas identified on dwg. PRJ25043-ROSEBERY-1.

2. Exposed metal from the slopes identified in dwg. PRJ25043-ROSEBERY-1 should be removed.
3. While removing metal from the slopes as recommended, the slopes should be knocked down to be more gradual as much as reasonably practical, with a target slope grade of 2.5H:1V.
4. The exposed inert waste on the slopes should be covered with a minimum of 500mm of material suitable for vegetation growth.

The table below provides a recommended timeline for the implementation of these closure measures. It should be noted that these timelines are subject to change, pending acceptance of this Closure Plan by the ENV.

Table 2: Implementation Timelines

Task	Initiation	Duration	Completion
Litter clean up	2025	1 week	2025
Remove exposed metal from slopes	2026	1 month	2026
Regrade steep slopes	2026	1 month	2026
Cover slopes and exposed inert waste	2026	1 month	2026

11. Statement of Limitations

Sperling Hansen Associates (SHA) have prepared this report on behalf of the Regional District of Central Kootenay (RDCK) in accordance with generally accepted engineering practices, to a level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions in British Columbia.

The report is based on site visits, project experience, and analysis of data compiled during the preparation of this report from several sources, done by SHA staff. Except where specifically stated to the contrary, the information on which this study is based has been obtained from external sources. This external information has not been independently verified or otherwise examined by SHA to determine its accuracy and completeness. SHA has relied in good faith on this information and does not accept responsibility of any deficiency, misstatements or inaccuracies contained in the reports as a result of omissions, misinterpretation and/or fraudulent acts of the persons interviewed or contacted, or errors or omissions in the reviewed documentation.

The report is intended solely for the use of the RDCK. Any use which other parties makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such other parties. SHA does not accept any responsibility for other uses of the material contained herein nor for damages, if any, suffered by any third party because of decisions made or actions based on this report. Copying of this intellectual property for other purposes is not permitted.

The findings and conclusions of this report are valid only as of the date of this report. The interpretations presented in this report and the conclusions and recommendations that are drawn are based on information that was made available to SHA during the course of this project. Should additional new data become available in the future, SHA should be requested to re-evaluate the findings of this report and modify the conclusions and recommendations drawn, as required.

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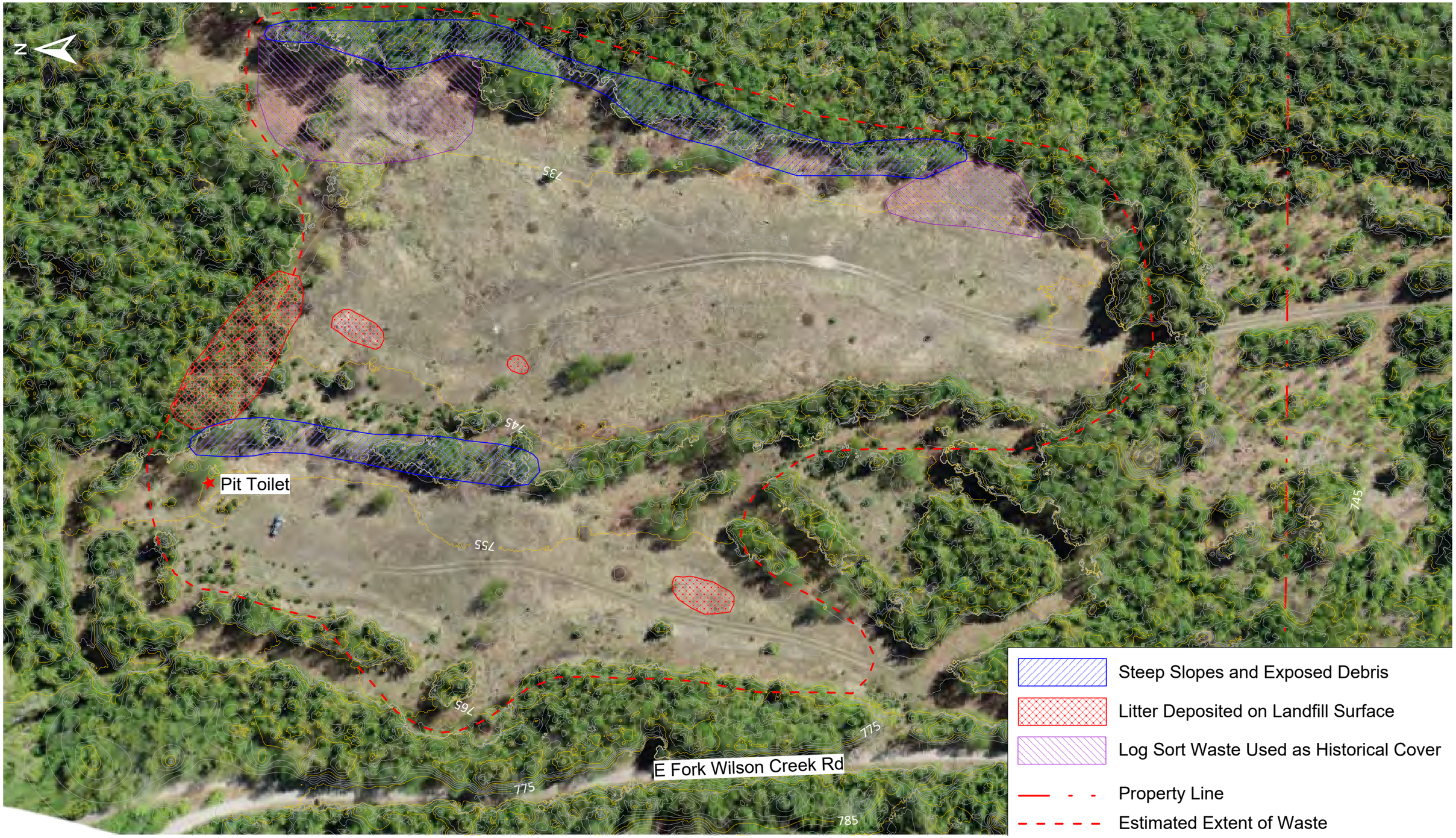
September 19th, 2025

12. References

[1] Agency for Toxic Substances and Disease Registry, "Landfill Gas Primer - An Overview for Environmental Health Professionals," ATSDR, November 2001. [Online]. Available: https://www.atsdr.cdc.gov/hac/landfill/html/ch2.html. [Accessed 10 June 2025].



SPERLING HANSEN ASSOCIATES

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No.	DATE yr/m/day	REVISIONS	DRAWN	CHK'D	APP'D

REGIONAL DISTRICT CENTRAL KOOTENAY

DESIGN BY: -
DRAWN BY: M. DOORNBOS
DATE CREATED: 2025/08/13
SHA PROJECT #: PRJ25043

RDCK LEGACY LANDFILL CLOSURE PLANS

ROSEBERY LANDFILL

DRAWING NO.	REV	SHEET
PRJ25043-ROSEBERY-1	1	1

APPENDIX A
Site Photolog

Photo 1: Overview of site, looking south towards Rosebery.

Photo 2: Overview of site, from East side looking West.

Photo 3: Overview of site from North end, looking South.

Photo 4: Eastern portion of site, debris placed in foreground

Photo 5: Debris and steep slopes visible on treeline on East side of site.

Photo 6: Debris and steep slopes visible on treeline on East side of site.

Photo 7: Debris deposited in East treeline.

Photo 8: Western portion of site, debris in center of photo and pit toilet at top of photo.

Photo 9: Pit Toilet with exposed waste and steep slopes noted at bottom right of photo.

Photo 10: Picnic area with trail entrance and pit toilet in Northwest corner of site.

Photo 11: Metal and debris exposed within steep slope just East of pit toilet area.

Photo 12: Drainage visible adjacent to site. Was dry at time of visit and did not appear to ever have substantial amounts of water.

Photo 13: Drainage visible adjacent to site. Was dry at time of visit and did not appear to ever have substantial amounts of water.

Photo 14: Litter deposited on North side of landfill.

Photo 15: Litter deposited on North side of landfill within treeline. Appeared to be MSW spread by wildlife.

Photo 16: Metal and debris located on East edge of site.

Photo 17: Debris visible on East edge of site, within steep slopes.