Comox Strathcona Waste Management

Staff Report

DATE: October 13, 2021

FILE: 5360-30

TO: Chair and Directors
Comox Strathcona Waste Management Board

FROM: Russell Dyson
Chief Administrative Officer

Supported by Russell Dyson
Chief Administrative Officer

R. Dyson

RE: **Comox Strathcona Waste Management Service Asset Management Plan (2019 to 2038)**

Purpose
To present the Solid Waste Asset Management Plan (AMP) for the Comox Strathcona Waste Management (CSWM) service, prepared by AECOM Canada Ltd (AECOM).

Recommendation from the Chief Administrative Officer:
This report is presented for information only

Executive Summary
Asset management planning is a strategic guide to capital planning and infrastructure investments to build and maintain a reliable solid waste system. The CSWM service hired AECOM to prepare an AMP which provides a long term technical and financial road map for sustainable management of CSWM service assets, as well as a process for the maintenance, repair and replacement of assets as they age past their end of service life and or exceed the risk tolerances of the CSWM service. Given the notable costs associated with the construction of the new engineered landfill, landfill closures and post closures liabilities, regulatory monitoring and maintenance, it is imperative that the CSWM service has the appropriate financing in place to fund the operation and capital projects. The guiding principles of this AMP are to focus on minimizing rate impacts to residents and the need to make significant adjustments from year to year by:

- striking the right balance between disposal fees and charges versus taxation to reflect costs and motivate positive behavioural change; and
- providing a stable rate of reserve fund contributions and accruals of annual surpluses, when available, to help offset future costs to ensure equity between current and future users of the CSWM service (i.e. current beneficiaries of the service will proportionally pay for their share of CSWM assets and progressive landfill closures).

The key objectives of the Solid Waste AMP are to equip the CSWM service with the knowledge and insights to:

1. Make informed decisions identifying all revenues and costs (including operational, maintenance, replacement, and decommissioning costs) associated with asset decisions.
2. Manage the CSWM service assets in an efficient, effective and responsible way by minimizing total life cycle costs, risks to users and risks associated with failure.
3. Take a whole life cost approach when selecting the most appropriate asset interventions, where all costs associated with the asset are taken into consideration and not just the initial capital cost.

4. Integrate corporate, financial, operational, technical and budgetary planning for all assets.
5. Determine and refine the levels of service in consultation with the service area.

The financial analysis for the Solid Waste AMP was based on assumed population growth and 70 per cent diversion rate per the 2012 CSWM Solid Waste Management Plan, a likely outcome pending the implementation of key diversion programs (i.e. regional organics, construction and demolition waste diversion). The funding strategy for the Solid Waste AMP was based on waste disposal tip fees and charges, and taxation revenue. The success of waste diversion program will directly correlate to the volume of waste received at the landfill, which will impact tip fee revenues. Therefore, the financial implications of waste diversion will need to be carefully monitored to ensure revenues are on par with expenditures as zero waste programs mature over time.

The AMP was informed by the asset inventory which details the condition, replacement value, risk and age of all CSWM service assets. Most assets are deemed to be in "very good", "good" and "fair" condition and will meet the immediate and future needs of the service. The current total replacement value of all CSWM system assets is valued at an estimated $27M. As shown in Figure 1 below, the average annual reinvestment funding need for the CSWM is $1.03 M, for a total of approximately $20.67 M over the 20-year analysis period, to be funded through a combination of debt and reserves balanced over the life of the AMP to ensure adequate funding available to offset the annual expenditures.

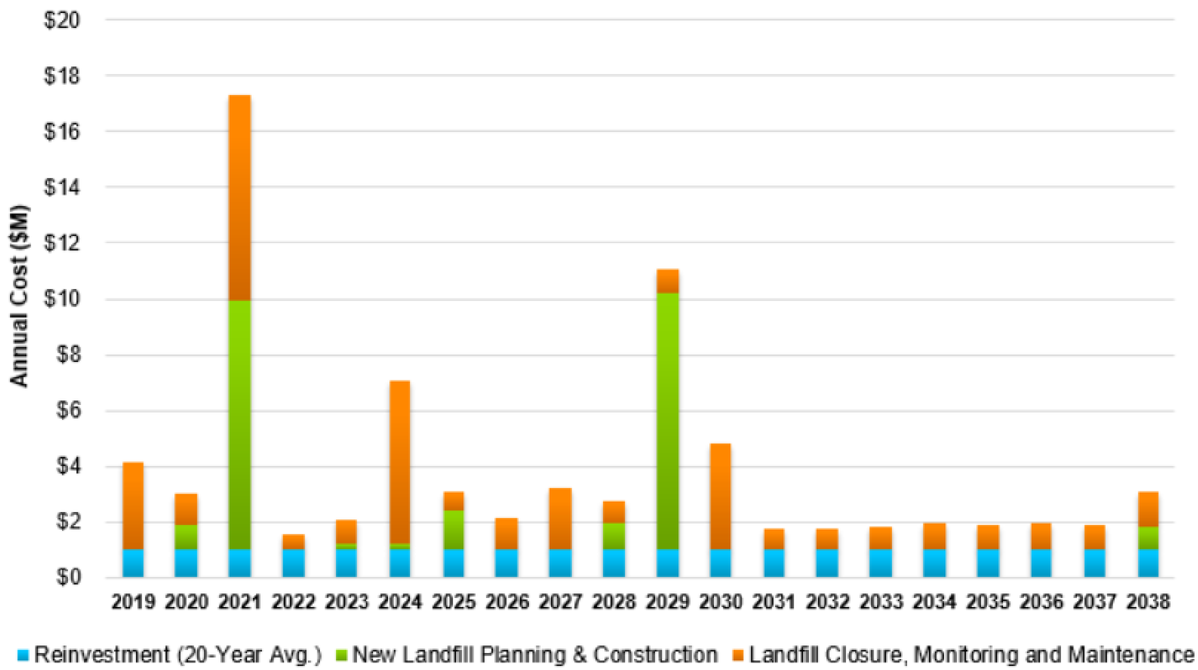

Figure 1 CSWM Annual Reinvestment, New Landfill Planning & Construction and Landfill Closure, Monitoring and Maintenance

The CSWM service will begin to utilize the asset management strategies as detailed in the AMP for the ongoing management of assets over their lifecycle in order to maximize available funding and ensure operational efficiencies, as well as to inform the development of the long-term capital plan. The AMP will provide the Board the assurance and confidence that the CSWM service infrastructure is maintained and replaced in a fiscally sound manner.

Prepared by:	Concurrence:	Concurrence:
V. Schau		***M. Rutten***
Vivian Schau Senior Manager of CSWM Services	Kevin Douville Acting Chief Financial Officer	Marc Rutten, P.Eng General Manager of Engineering Services

Attachments: Appendix A – Asset Management Plan

Asset Management Plan

Comox Strathcona Waste Management (CSWM) Service

Project number: 60565872

September 2021

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AECOM: 2015-04-13

Quality information

Prepared by

Chris Lombard, P. Eng., MBA
Asset Management Leader, Americas Water

Prepared by

Rebecca Dziedzic, PhD
Senior Asset Management Consultant

Prepared by

Kimberly Bueckert, MEL
Asset Management Consultant

Deliverable Approver

Devin Sauer, PhD
Senior Asset Management Consultant

Lead Verifier

David Main, B. Mgmt.
Vice President

Revision History

Revision	Revision date	Details	Authorized	Name	Position
0	November 6th, 2019	Draft Report		Chris Lombard	Project Manager
1	April 23rd, 2020	Final Report		Chris Lombard	Project Manager
2	September 27th, 2021	Final Report V1		Chris Lombard	Project Manager

Distribution List

# Hard Copies	PDF Required	Association / Company Name
	1	Marc Rutten, P. Eng. General Manager of Engineering Services Branch, Comox Valley Regional District

Prepared for:

Comox Valley Regional District (CVRD)
600 Comox Road
Courtenay, BC V9N 3P6

Prepared by:

Chris Lombard
Project Manager
T: 1-604-444-6427
M: 1-604-314-6167
E: Christiaan.lombard@aecom.com

AECOM Canada Ltd.
3292 Production Way
Suite 330
Burnaby, BC V5A 4R4
Canada

T: 604.444.6400
F: 604.294.8597
aecom.com

The preparation of this project was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

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List of Abbreviations

AM	Asset Management
AVICC	Association of Vancouver Island and Coastal Communities
BC MoE	British Columbia Ministry of Environment
CIWMC	Cortes Island Waste Management Centre
CMMS	Computerized Maintenance Management System
CoF	Consequence of Failure
CRWMC	Campbell River Waste Management Centre
CVRD	Comox Valley Regional District
CVWMC	Comox Valley Waste Management Centre
CVWMC-H	Comox Valley Waste Management Centre (Historical Landfill)
CVWMC-1 to 6	Comox Valley Waste Management Centre (Landfill Cells # 1-6)
CSWM	Comox Strathcona Waste Management
DIWMC	Denman Island Waste Management Centre
DSS	Decision Support System
EFW	Energy from Waste
ESL	Expected Service Life
GLOBAL	Asset class associated with assets of no fixed location
GRWMC	Gold River Waste Management Centre
HIWMC	Hornby Island Waste Management Centre
IIMM	International Infrastructure Management Manual
ISO	International Organization for Standardization
LFG/CVWMC	Landfill Gas/Comox Valley Waste Management Centre
LNG	Liquefied Natural Gas
LoS	Levels of Service
LTF/CVWMC	Leachate Treatment Facility/Comox Valley Waste Management Centre
MMBC	Multi-Material BC
NSWBI	National Solid Waste Benchmarking Initiative
O&M	Operation and Maintenance
ORRD	Oyster River Recycling Depot
PLC	Programmable Logic Controller
PoF	Probability of Failure
PVDF	Polyvinylidene fluoride
QIRD	Quadra Island Recycling Depot
SIMPLE	Sustainable Infrastructure Management Program Learning Environment
SWMC	Sayward Waste Management Centre
SWMP	Solid Waste Master Plan
TWMC	Tahsis Waste Management Centre
WERF	Water Environment Research Foundation
WMC	Waste Management Centre
ZWMC	Zeballos Waste Management Centre

Executive Summary

AECOM Canada Ltd. ("AECOM") developed for the Comox Strathcona Waste Management ("CSWM") service an Asset Management (AM) Plan that provides a financial and technical road map for the sustainable management of CSWM assets well into the future. This AM Plan was based on numerous best practice guidelines such as ISO 55000:2014 and the International Infrastructure Management Manual (IIMM). The step-by-step methodology from the Water Environment Research Foundation (WERF) SIMPLE (Sustainable Infrastructure Management Program Learning Environment) process provides the major headings for this report, as follows:

CURRENT STATE OF ASSETS

Asset Hierarchy: Each parent asset in the CSWM inventory has been categorized into a pre-defined asset hierarchy. This pre-defined structure allows an electronic inventory to be managed by asset type or by equipment type. The first two levels of the asset hierarchy for the CSWM service are presented in **Figure 4**, as one branch of the broader inventory of the Comox Valley Regional District (CVRD) .

Asset Inventory: An asset inventory was generated to provide a comprehensive list of the assets within the CSWM service. CSWM had well-organized documentation for many of its assets and AECOM was able to augment this data through on-site records and historical knowledge of the division staff. Please refer to **Appendix A** for a location plan of CSWM assets, and **Appendix B** for a full tabular listing of the asset inventory in terms of the asset hierarchy and the key asset data attributes referenced in this report.

Asset Value: AECOM developed the replacement value of CSWM assets, estimated at a total of approximately $26.5 M (includes 25% contingency). This value represents the cost in 2019 dollars to completely replace all the assets to a new condition with a current / similar model of equipment / asset, as applicable.

Expected Service Lives: The expected service life (ESL) is defined as the period of time over which an asset is actually available for use and able to provide the required level of service at an acceptable risk. A high-level listing of some of the ESLs used for this assignment are provided in **Table 4**, based on actual ESLs experienced in the field. For a full listing of all the ESL values applied in this study, please refer to the detailed asset inventory provided in **Appendix B**.

Asset Condition: All assets are expected to deteriorate over their lifetime, and their assigned condition reflects the physical state of the asset. The project team applied a five-point condition rating scale to all CSWM assets, with 1 being "Very Good" and 5 being "Very Poor" (see **Table 5**). While the condition of the majority of CSWM assets fall between Very Good and Fair, **Table 6** identified a handful of assets considered to be in a Poor or Very Poor condition.

Asset Criticality: Criticality refers to the consequences of asset failure (CoF). For the purpose of this study, criticality was defined in terms of the five-point rating scale presented in **Table 7**. The solid waste assets that are of major importance to the CSWM are summarized in **Table 8**. In general, these are assets that have a criticality score towards the top end of the criticality scale (i.e., a score equal or greater than 4).

Probability of Failure: AECOM assigned a Probability of Failure (PoF) score to all CSWM assets by means of the two-parameter Weibull distribution. **Figure 8** shows the resulting probability of failure for different values of asset age over ESL, along with bands representing what is considered as low, medium, and high PoF values.

Asset Risk: A risk score was calculated for each asset. The risk score reflects the probability of failure and the criticality ratings and was assigned using the following equation: **Risk Score = Probability of Failure x Criticality Rating**. Note, prior to calculating the risk score, PoF values were converted from a 0 to 100% scale to the same scale used for CoF (1 to 5). The majority of CSWM assets fall towards the lower end of the risk scale (less than eight), other than:

- CVWMC's scale software installation: Installed in 2011, this software has a risk score of eight and is critical to the operation of the weigh scale and for calculating tipping fees (CoF = 4). The software costs approximately $130,000 to replace.

- TWMC's CAT Cable Skidder: This vehicle is now 27 years old. It is of medium criticality to TWMC's operations (CoF = 3) but combined with its advanced age makes this asset the highest-risk asset within the CSWM inventory, with a risk score of nine. However, according to CSWM staff, in the event this asset needs to be replaced it would be with a used excavator at a cost of approximately $125,000. Also, according to CSWM staff the TWMC landfill is scheduled for closure in 2025 and this equipment will no longer be required for operations

Please refer to **Appendix B** for a tabular summary of the entire CSWM asset inventory and associated risk values.

LEVELS OF SERVICE

Levels of Service (LoS) are a key foundational element of the AM planning process. Defined LoS may be any combination of parameters deemed important by the CSWM service and represent service-cost trade-offs, established in a flexible, rational, and transparent manner. The National Solid Waste Benchmarking Initiative (NSWBI) has identified approximately 35 Technical LoS (performance measures). Each NSWBI performance measure is coded to a particular Customer LoS.

DEMAND / FUTURE GROWTH

Demand / future growth plays an important role in an organisation's strategic investment planning to support its LoS. AM planning should address potential changes in demand / future growth that include attention to the factors / topics for the CSWM service mentioned in **Table 10**.

ASSET LIFE CYCLE STRATEGIES

The purpose of this section is to fully understand and predict the long-range financial requirements for the CSWM service, in order to facilitate planning and resource management in the most cost-effective manner possible.

Asset Acquisition Activities: In terms of significant CSWM asset acquisition activities that are currently known to the organization and within the 20-year planning horizon of this AMP, there exists the planning and construction costs of landfill cells #2, 3 and 4 (CVWMC-2 to CVWMC-4) at the CVWMC, as well as the remote transfer stations at TWMC and ZWMC .

Asset Operation and Maintenance (O&M) Activities: The maintenance activities performed on CSWM assets are typically divided in three general categories including corrective, preventive and predictive maintenance. This breakdown of maintenance activities should be considered for incorporation in the CSWM O&M practices and the future computerized maintenance management (CMMS) system implementation.

Asset Renewal and Replacement Activities: The third portion of full life cycle costing relates to the renewal and replacement of assets that have deteriorated to the point where they no longer provide the required service. **Section 0** provides a discussion on the future funding needs for CSWM asset renewal and replacement.

Asset Decommissioning and Disposal Activities: Asset decommissioning and disposal activities are performed to decommission and dispose of assets due to ageing or changes in performance and capacity requirements. The landfills present the CSWM service with a significant future liability for closure and post-closure care. The estimated CSWM landfill closure costs are presented in **Table 11**. The estimated annual expenditures on landfill monitoring and maintenance for the respective CSWM landfills are shown in **Table 12**. The estimated combined CSWM landfill closure plus annual monitoring and maintenance costs, by location, are presented in **Figure 16**.

RECOMMENDATIONS

1. AECOM recommends that the allowance for CSWM asset reinvestment be approximately $1.03 M per year for a total of $20.67 M for the period 2019 – 2038. Having sustainable funding in place is especially important when considering, in addition to the CSWM reinvestment costs, the notable costs associated with new landfill construction and landfill closure, monitoring and maintenance, as presented in **Figure E-1**. Construction cost estimates were obtained directly from CSWM Staff and are shown in future dollars.

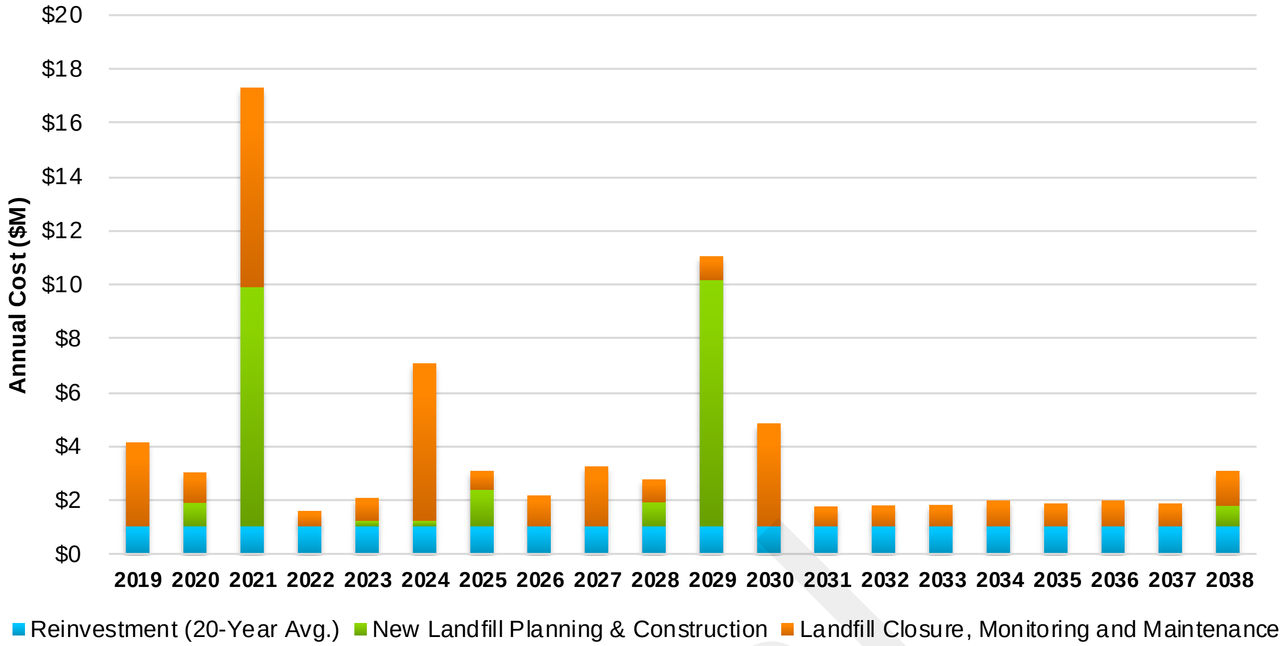


Figure E-1 – CSWM Annual Reinvestment, New Landfill Planning & Construction and Landfill Closure, Monitoring and Maintenance

2. **Appendix C** presents a summary listing of assets that are at, or soon approaching their expected service life (ESL), and / or assets with a high-risk value that theoretically, at the very least, require replacement or major renewal within the immediate future. AECOM recommends that the CSWM service firstly review the list of assets presented in **Appendix C** to confirm the validity of the age and ESLs, condition and criticality scores and replacement values. Should the data presented be correct, then the CSWM service should act to replace the assets identified in the list as a matter of urgency to avoid the catastrophic failure of these assets.

3. AECOM recommends that the CSWM service investigates the National Solid Waste Benchmarking Initiative (NSWBI) and the benchmarking work completed by the Association of Vancouver Island and Coastal Communities (AVICC), and to build out its capabilities to measure its performance in terms of a similar range of metrics relevant to the CVSS. This will enable the CSWM service to report its performance to its Board and stakeholders in a "language" that is consistent with most of its Canadian peer agencies and learn from and share in the best AM practices applied at these agencies.

4. As part of the overall CVRD AM assignment, AECOM has developed two technical memoranda outlining the functional requirements for a computerized maintenance management system (CMMS) and a Decision Support System (DSS), respectively. CVRD has recently purchased the Cityworks CMMS and is currently focusing implementation in the Water Department. AECOM recommends that the CSWM service also implements Cityworks and proceeds with procuring and implementing a DSS for its assets.

5. Informed asset management decision-making relies on information that is accurate, complete and reliable. Having gained some understanding of the current state of infrastructure data of the CSWM, AECOM makes a range of recommendations for improving the data, as summarised in **Section 6.5**.

1 Introduction

1.1 Background

According to ISO 55000:2014, an asset is defined as an item, thing or entity that has potential or actual value to an organization. As such, the Comox Valley Regional District (hereafter referred to as "CVRD") owns, operates and maintains a wide array of assets that include, but are not limited to, information technology systems, equipment, facilities, vehicles and even natural systems. These assets are expected to function efficiently and effectively for many years and support the mission-critical functions of the organization. Actions such as planning, delivery of assets, operations, maintenance, and performance management, which are performed by various divisions within the CVRD, all contribute to effective asset management with support from finance and information systems. These assets have a defined service life and, as they age and deteriorate, it is imperative for the CVRD to understand how to manage them in such a way to ensure that their full service life is reached, and to have in place a mechanism to enable their renewal or replacement whilst risks are managed.

The objective of this Asset Management (AM) Plan is to deliver a financial and technical road map for the management of Comox Strathcona Waste Management (hereafter referred to as "CSWM") assets and to provide the basis for decision making and budgeting for the sustainable management of these assets well into the future.

1.2 Scope – Comox Strathcona Waste Management

The Comox Strathcona Waste Management service manages over 100,000 tonnes of waste and recycled material annually and oversees several diversion and education programs for the CVRD and the Strathcona Regional District (SRD).

The CSWM is responsible for several waste management centres and transfer stations that handle waste and recycling materials within the CSWM service area (**Figure 1**).

The CSWM oversees a multi-recycling program that has active re-use and re-purposing programs (diversion) and provides a wide range of educational programs that encourage region-wide waste reduction efforts through "The Power of R" and organics composting. Various hazardous waste items are also accepted and handled by qualified technicians.

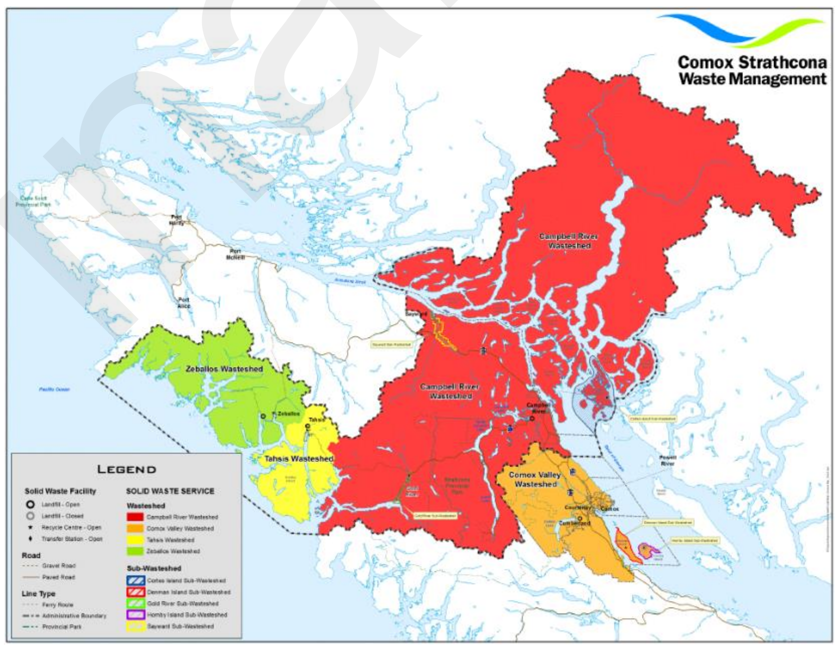


Figure 1 – CSWM Service Area

1.3 Connectivity to Other AM Documents

Because AM affects a large portion of the CVRD's activities, the development of this AM Plan and the practice of AM is a team effort. The AM Plan will define and document the activities that will be implemented, and the resources applied to meet the key objectives for the organization. The formulation of the Plan should include the review of processes, systems, and available data; and based on these findings, determine the required resources and develop a schedule to address the gaps. As such, it is important to set the foundation during the AM Policy development for the subsequent AM planning by achieving alignment between the hierarchy of AM documents (**Figure 2**), including:

- **AM Policy & Governance Framework:** The AM Policy & Governance Framework sets the vision and guiding principles for the management of CVRD assets and articulates commitment to continuous improvement in AM.
- **AM Strategy:** An action plan that determines how the CVRD will implement the Policy and achieve its organizational objectives. Actions outlined address specific capability improvements required to advance AM in the CVRD.
- **AM Plans (this document for the CSWM):** Detailed plans for the lifecycle management of assets that consider criteria such as condition (acquired or derived), levels of service, demand forecasts, projected performance, remaining service life, and risk management. The plans also include long term financial forecasts and consider alternative scenarios and risks. This AMP for the CSWM is prepared in parallel to the AMPs for the four water systems that CVRD manages, as well as the Comox Valley Recreation and Sewerage Systems.

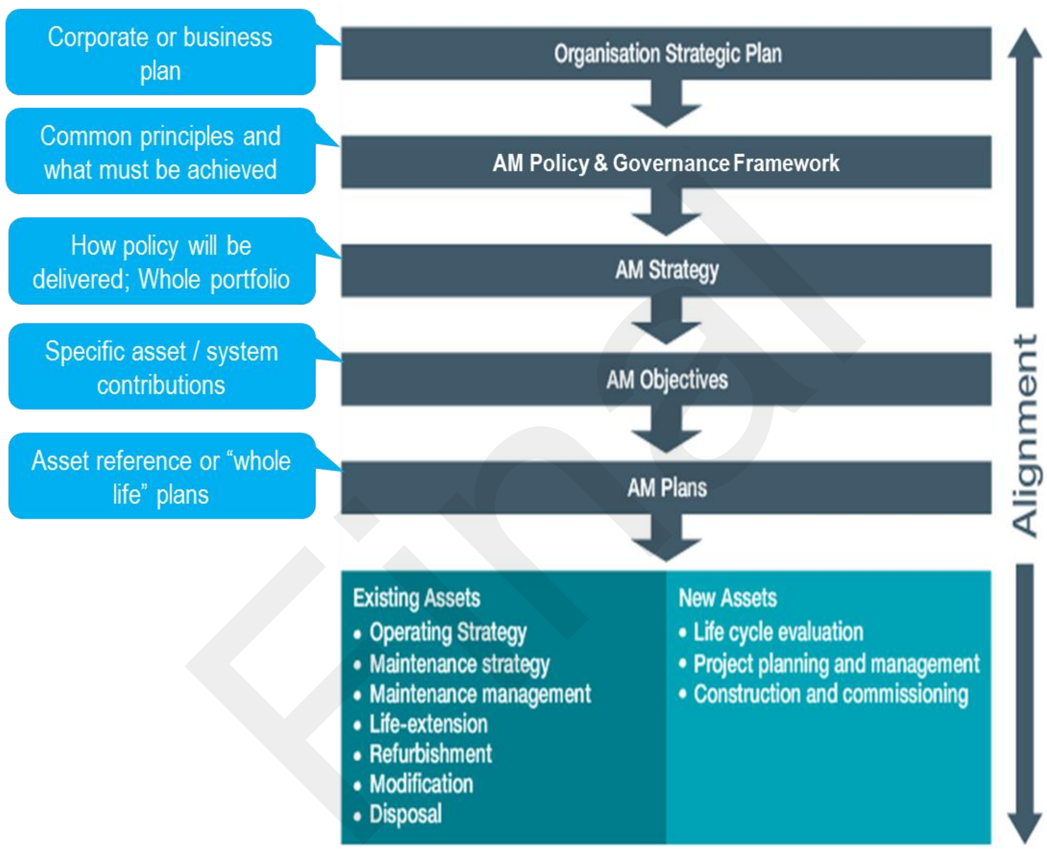


Figure 2 – Successful AM Depends on Alignment from the AM Policy Down to Individual AM Plans

1.4 Guiding Principles

A formal AM system provides an asset-based organization with a consistent framework for understanding, implementing and improving delivery of services. As per the guiding principles outlined in the CVRD's AM Policy, the objectives of this AMP are to equip the CSWM service with the knowledge and insights to:

- Make informed decisions identifying all revenues and costs (including operational, maintenance, replacement, and decommissioning costs) associated with asset decisions, including additions and deletions.
- Manage the CSWM service engineered assets in accordance with formal, consistent and repeatable methods that reinforce the confidence of member stakeholders (CSWM Board, municipalities, electoral areas, and staff) that the CSWM service is managing its assets in an efficient, effective and responsible way.
- Integrate corporate, financial, operational, technical and budgetary planning for all assets.
- Determine and refine the levels of service in consultation with the service area.

- Take a whole life cost approach when selecting the most appropriate asset interventions, where all costs associated with the asset are taken into consideration and not just the initial capital cost.
- Minimize total life cycle costs of assets.
- Create a corporate culture where all employees play a part in the overall care for public assets by providing the necessary awareness, training and professional development.
- Manage assets to be sustainable.
- Identify and manage natural assets in a similar manner to engineered assets as systems and processes for doing so become available.
- Minimize risks to users and risks associated with failure.
- Pursue best practices where available.
- Report the performance of its AM program.
- Continually improve its AM approach by actively monitoring the effectiveness of its AM program, and driving innovation in the development of tools, practices and solutions.

1.5 AM Best Practice and ISO 55000:2014 and IIMM

With the recent growth in AM around the world, the International Organization for Standardization (ISO) brought together specialists from around the world in various industries to develop a standard that can be used by a wide range of asset owning organizations, to ensure consistency and share best practice. The focus of the ISO 55000:2014 Asset Management Standard suite (ISO 55000, 55001, 55002), is the creation of a management system. The management system aims to ensure that optimal value is delivered from an organization's assets through balancing performance, risk and expenditures to meet customer demands. The standard describes asset management as a management system similar to a corporate safety or environmental management system.

This AMP is a major step forward in aligning CVRD with the new ISO 55000:2014 best practice standard. Since certification against the standard is a lengthy and expensive process, the CVRD will focus on aligning with the standard without seeking certification. This includes consolidating the existing asset management practices into a management system. Doing so will help structure and standardize the practice of asset management within the CVRD.

In addition to alignment with ISO 55000:2014, the AM Plan is also aligned with the guidance provided by the International Infrastructure Management Manual (IIMM), which is widely accepted as one of the leading international documents on infrastructure asset management. The ISO 55001:2014 spells out the requirements for the establishment, implementation, maintenance and improvement of a management system for AM, and specifies "what" an organization needs to do to fulfil the Standards' requirements. The IIMM complements the ISO Standard by providing details regarding "how to" implement those requirements and, as such, will inform the more detailed and technical and financial oriented AMPs for Water, Wastewater, Recreation, and Solid Waste that feed into the CVRD's AM Strategy.

1.6 Key Steps Supporting this Asset Management Plan

In addition to the AM best practices outlined in the previous section, the actual steps used to develop this AMP are presented in **Figure 3**, and have been selected to ensure that reliable and robust useful information is provided from which CVRD can have confidence to make fact-based and defensible business decisions. The basic building blocks of the step-by-step methodology outlined in **Figure 3** are founded upon the Water Environment Research Foundation (WERF) SIMPLE (Sustainable Infrastructure Management Program Learning Environment) process. The objective of SIMPLE is "*to drive a broad range of benefits to the industry by providing a systematic rationalization for determining where the most cost effective investment (acquisition, maintenance, renewal) in the asset portfolio is, over the life cycle of the asset portfolio (that is, directing limited dollars toward the optimal application in any given budget cycle)*".

At the heart of the SIMPLE process (and what was the primary focus of this AMP) was to explore the following topics for the CSWM service:

- Current State of Assets.
- Levels of Service.
- Asset Life Cycle Strategies.
- Funding Strategies.
- Implementation Plan.

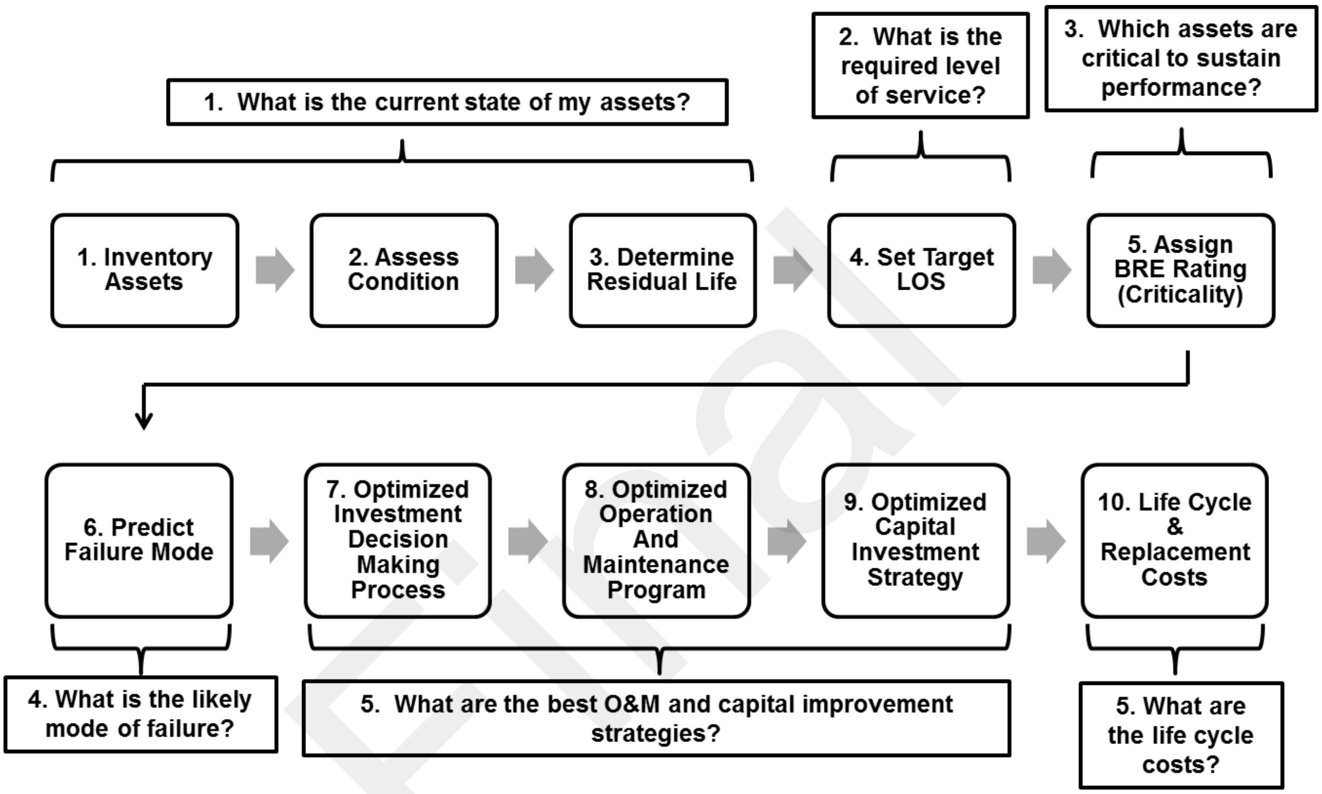


Figure 3 – Key Building Blocks in Developing this AMP

The following sections summarize the exploration and findings of the AM Planning process for the CSWM service.

2 Current State of Assets

This section summarizes the data on asset inventory, value, condition, and risk based on the information currently available from a variety of sources and systems across the organization.

2.1 Asset Hierarchy

An asset inventory was generated to provide a comprehensive list of the assets within the CSWM service. CSWM staff had well-organized documentation for many of its assets and was able to augment this data through on-site records and historical knowledge of the division staff. The project team took this information as a starting point and further developed the asset inventory by adding information collected during site visits and through the review of historical information.

For the purpose of this study the asset inventory must be granular enough to identify which individual assets are due for renewal (refurbishment or replacement). However, it is important to note the fine balance between adequate granularity to provide the necessary information, and too much granularity that the effort to collect and manage the information outweighs the usefulness of the data itself.

The first two levels of the asset hierarchy for the CSWM service are presented in **Figure 4**, as one branch of the CVRD's broader inventory. For this study, the solid waste inventory includes assets down to the level of detail required for asset renewal and replacement planning. Generally, assets below this level would include consumable items that are typically replaced through a preventive maintenance program and are often funded out of the operations and maintenance budget and are, therefore, excluded from the analysis. The complete asset hierarchy, including all four levels, can be found in the supporting documents for this AMP included in the Appendices.

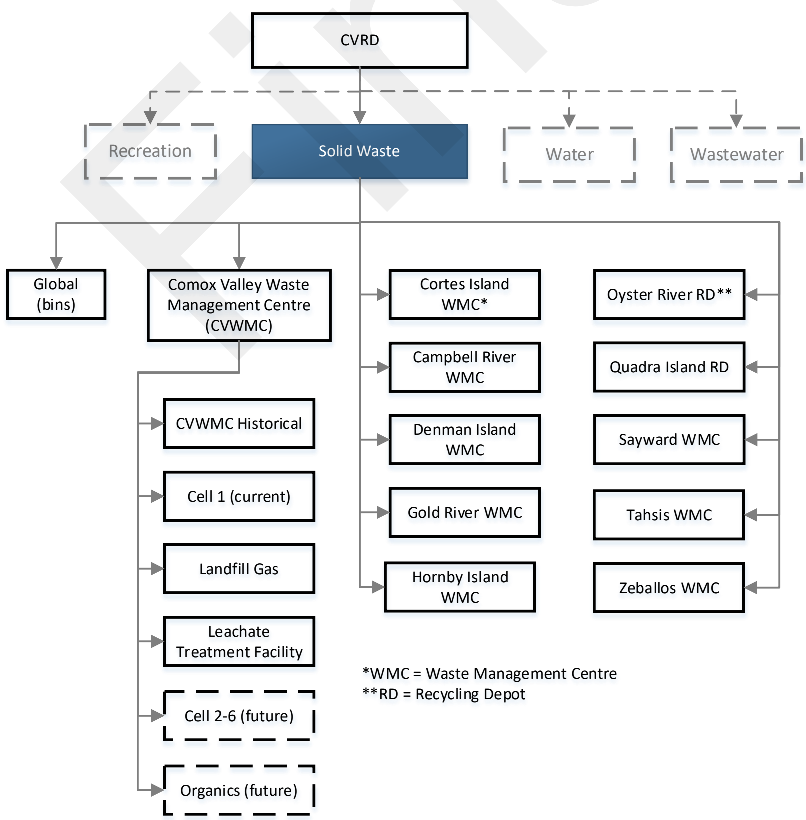


Figure 4 – First Level Asset Hierarchy for the CSWM Service

Each parent asset in the CSWM inventory has been categorized into a pre-defined asset hierarchy. This pre-defined structure allows an electronic inventory to be managed by asset type or by equipment type. A structured hierarchy will allow the CVRD to sort data for assets of common type, and manage the asset inventory as conditions change, including the asset estimated service lives or replacement costs.

2.2 Asset Inventory

The assets within the asset inventory for the CSWM service are presented in summarised format in **Table 1**. The asset inventory information was obtained from the following sources:

- Various MS Excel spreadsheets.
- Discussion and consultation with CVRD staff
- CVRD staff on-site verification of assets.

Table 1 – High-Level Asset Inventory

Asset System	Assets / Components	Quantity & Comments	
Global	• Bins • Containers	• Bins: 36 • Containers: 7	• Roll-off containers for transporting solid waste. • One 20 ft. steel container and 6 MMBC containers.
Comox Valley Waste Management Centre (CVWMC)	• CVWMC Site • Landfill Cell 1 • Landfill gas system • Leachate treatment facility	• Site assets include asphalt roads, traffic light system, bin walls, office trailer, shop building, fencing, compost cover, vehicles, groundwater monitoring wells. • Cell 1 components include cover plates, a 49,000 m^2 liner and 513,000 m^3 of lined landfill with leachate collection system.	• Landfill gas system components include blowers, compressed air treatment, compressor, dryer, electrical service and distribution, fire suppression, flare, HVAC, pipe, pumps and wells. • The leachate treatment facility contains blowers, boiler, building, centrifuge, compressor, dryer, electrical service and distribution, filters, generator, heat recovery, HVAC, membrane, mixers, plumbing, pumps, tanks and wells.
Waste Management Centres (WMCs)	• Cortes Island WMC • Campbell River WMC • Denman Island WMC • Gold River WMC • Hornby Island WMC • Oyster River WMC • Quadra Island WMC • Sayward WMC • Tahsis WMC • Zeballos WMC	• The assets present at each WMC varies depending on the size and location of the facility. Typical assets include roads, vehicles, fencing, buildings, tanks, wells, containers, and in the case of the Campbell River WMC, generators, instrumentation and software.	

Please refer to **Appendix A** for a location plan of CSWM assets discussed within this section, and **Appendix B** for a full tabular listing of the asset inventory in terms of the asset hierarchy and the key asset data attributes referenced in this section.

2.2.1 CSWM Service Master Plans

Pertinent to the discussion of the current CSWM service asset inventory is the strategic direction provided by the 2012 CSWM Master Plan as well as the 2017 CVWMC Master Plan, as it pertains to the following expansion and decommissioning of assets:

- **CVWMC:** Landfill expansion in engineered Cells 1 to 3 has been approved in the CVWMC's Operational Certificate issued by the BC MoE and is estimated to provide regional landfill disposal capacity up to the year 2039 (longer with improved diversion). The 2017 Master Plan details further expansion through the construction of additional Cells 4, 5, and 6, and development of the CVWMC site. Based on a conservative waste disposal scenario, this will provide the CSWM with regional disposal capacity up to the year 2058 based on a conservative waste disposal scenario.
- **Tahsis and Zeballos WMCs:** The Tahsis and Zeballos WMCs are slated for closure by 2025, to meet BC MoE regulations. Upon full closure, each of these sites will be replaced with a transfer station.

2.3 Asset Value

The replacement valuation for all CSWM assets is based on the following assumptions:

- **Replacement Value:** Represents the cost in 2019 dollars to completely replace all the assets to a new condition with a current / similar model of equipment / asset, as applicable. Note that some landfill assets are very unique and are not replaced in the way that a "traditional" asset might be. For example: when a motor burns out it is replaced with a new motor. When a landfill cell (bottom liner) reaches the end of its life, the cell is not replaced. More likely, the cell is closed, and a new cell(s) is constructed and is put into operation. The cost of the new cell is considered as part of capital expenditures related to the creation on new assets (see **Figure 15**) and is not considered part of asset management and reinvestment expenditures (see **Figure 17**).
- **Cost Estimates:** CSWM asset replacement values were determined as follows:
  - CVRD provided historical costs, where available.
  - Where no costs were available, AECOM worked with CVRD staff to determine current costs for a new / similar model of equipment / asset, as applicable.
- **Mark-Ups**: In order to account for potential unexpected costs that could arise throughout a construction project, the mark-up shown in **Table 2** was applied across all cost estimates. Generally, assets within facilities are replaced on an ad hoc basis and do not require a new design and associated project management, unless a whole section of a facility is being renovated. Therefore, engineering and project management costs were not included.

Table 2 – Cost Mark-Ups

Type of Mark-Up	Percentage
Engineering	0%
Project Management	0%
Contingency	25%
TOTAL	**25%**

The total replacement value of each asset system is presented in **Table 3** and in graphical format in **Figure 5**. These values assume that assets will be replaced "like-for-like". Therefore, they do not account for upgrades and improvements in level of service.

Table 3 – High-Level Asset Replacement Value

Asset System	Total Replacement Value
Global	$666,000
Cortes Island WMC (CIWMC)	$1,080,000
Campbell River WMC (CRWMC)	$5,877,000
Comox Valley WMC (CVWMC)	$7,469,000
Landfill Cell 1 (CVWMC) included with CVWMC in Figure 5	$4,032,000
Landfill Gas/Comox Valley WMC (LFG/CVWMC)	$1,347,000
Leachate Treatment Facility/Comox Valley WMC (LTF/CVWMC)	$3,435,000
Denman Island WMC (DIWMC)	$19,000
Gold River WMC (GRWMC)	$352,000
Hornby Island WMC (HIWMC)	$1,145,000
Oyster River Recycling Depot (ORRD)	$35,000
Quadra Island Recycling Depot (QIRD)	$78,000
Sayward WMC (SWMC)	$88,000
Tahsis WMC (TWMC)*	$663,000
Zeballos WMC (ZWMC)*	$212,000
TOTAL	**$26,498,000**

* Upon full closure, each of these sites are to be replaced with a transfer station (refer to Section 2.2.1)

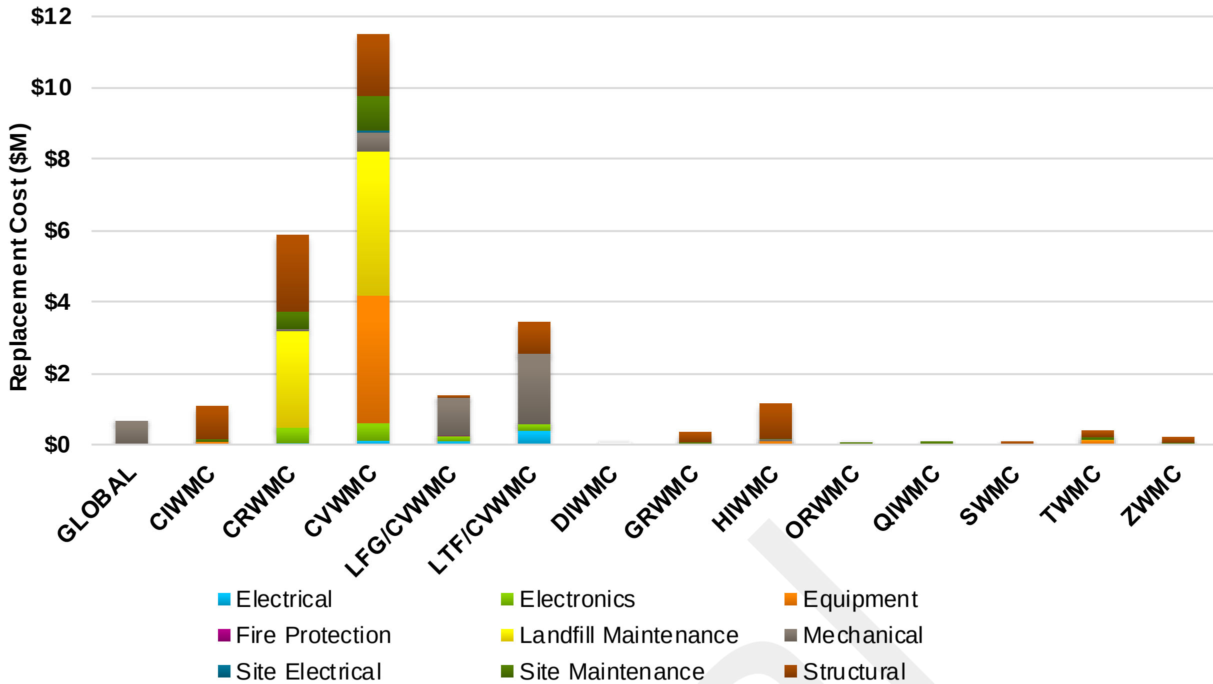


Figure 5 – High-Level Asset Replacement Value

2.4 Expected Service Life (ESL) and Remaining Life

The expected service life (ESL) is defined as the period of time over which an asset is actually available for use and able to provide the required level of service at an acceptable risk; e.g., without unforeseen costs of disruption for maintenance and repair. There are different theoretical modelling tools used in the industry for predicting when an asset will fail or no longer provide useful service. For this assignment, AECOM applied a constant ESL for each asset type based on industry standards. In reality, different assets will deteriorate at different rates, however, it is important to keep in mind the level of effort required to predict failure compared with the asset value. More sophisticated deterioration modelling may be warranted for very high value assets, whilst the cost of deterioration modeling for low-value assets may very well exceed the replacement cost of the asset. The actual service life can vary significantly from the ESL. For CSWM assets, a preventive maintenance program is in place to maintain assets and maximize the useful life of the system. In some instances, a variation in expected vs. actual service life was evident due to the following factors:

- **Operating conditions and demands:** Some equipment is operated intermittently or even infrequently, or is being operated at a lower demand than its design capacity, thus the actual operating "age" of the asset is reduced.
- **Environment:** Some equipment is exposed to very aggressive environmental conditions (e.g., corrosive chemicals), while other assets are in relatively benign conditions, thus the deterioration of assets is affected differently.
- **Maintenance:** Equipment is maintained through refurbishment or replacement of components, which prolongs the service life of the asset.
- **Technological Obsolescence:** Some assets can theoretically be maintained indefinitely, although considerations such as maintenance cost, energy inefficiency and new technologies are likely to render this approach uneconomical.

A high-level listing of some of the ESLs used for this assignment are provided in **Table 4**, based on actual ESLs experienced in the field. For a full listing of all the ESL values applied in this study, please refer to the detailed asset inventory provided in **Appendix B**.

Table 4 – Sample Expected Service Lives (ESLs)

Assets / Components	ESL (years)
Landfill Cover Plates	10
Compost Covers	5
Bins	20 (40 if drywall)
Instruments	15
Controls	15
Software	3
Vehicles	7-10 (depending on type)
Pumps	10-40 (depending on type)
Tanks	40
Valves	35
Wells	40
Buildings	45
Fences	15
Roadways	8

To address the variation in ESL versus actual service life based on the observed condition, the remaining life of each asset was adjusted to reflect the current condition of the assets according to the following methodology:

- The expected condition of the asset was calculated based on age and typical expected service life.
- If the expected condition matched the recorded condition the original replacement date was left unchanged.
- Where the expected condition and recorded condition differed:
  - The condition rating was set equal to the recorded condition.
  - The age of the asset was then adjusted to an "apparent age" using the following formula (note: for this study the Maximum Condition Rating is 5 – refer to Table 5).

$$Apparent\ Age = \left(\frac{ESL}{Maximum\ Condition\ Rating}\right) \times Recorded\ Condition\ Rating$$

  - The remaining life of the asset was calculated based on the expected service life (ESL) less the apparent age.
- For example, if an asset is 15 years into its 25-year ESL, but its condition was observed to be Poor (i.e., a condition rating of 4), then the age of the asset would be adjusted to an apparent age of [(25 ÷ 5) × 4] = 20. In addition, the remaining life of the asset would be set to (25-20) = 5 years.

2.5 Asset Condition

All assets are expected to deteriorate over their lifetime, and their assigned condition reflects the physical state of the asset. The assessment of physical condition for vertical (non-linear) assets was based on on-site condition assessments, consultations with operators with experience in managing the assets, combined with information from past studies. Condition assessments were based on the five-point Condition Rating Scale presented in Table 5.

Table 5 – Condition Rating Scale

Condition Grades	Description	Maintenance Required
1 – Very Good	New or Excellent Condition: Sound modern structure / equipment, operable and well-maintained.	Preventive Maintenance
2 - Good	Minor Defects Only: As 1 but showing some minor signs of deterioration. Minor refurbishment and maintenance required.	Preventive Maintenance, Minor Corrective Maintenance
3 - Fair	Moderate Deterioration: Asset is functionally sound, but appearance is significantly affected by deterioration. Mechanical, electrical and instrumentation components function adequately but with some inefficiency and minor failures. Structure is marginal in its capacity to prevent leakage.	Preventive Maintenance, Major Corrective Maintenance
4 - Poor	Significant Deterioration: Mechanical, electrical and instrumentation components function but require significant maintenance to remain operational. Equipment functional but obsolete. Deterioration has a significant impact on performance of asset due to leakage or other structural problems.	Renewal (if possible)
5 – Very Poor	Virtually Unserviceable: Serious condition problems having a detrimental effect on the performance of the asset. Will require major overhaul / replacement within the immediate future.	Replace (immediately)

The CSWM asset component condition ratings are presented in the asset inventory spreadsheet included in Appendix B. Figure 6 presents the condition distribution for CSWM assets, by asset replacement value.

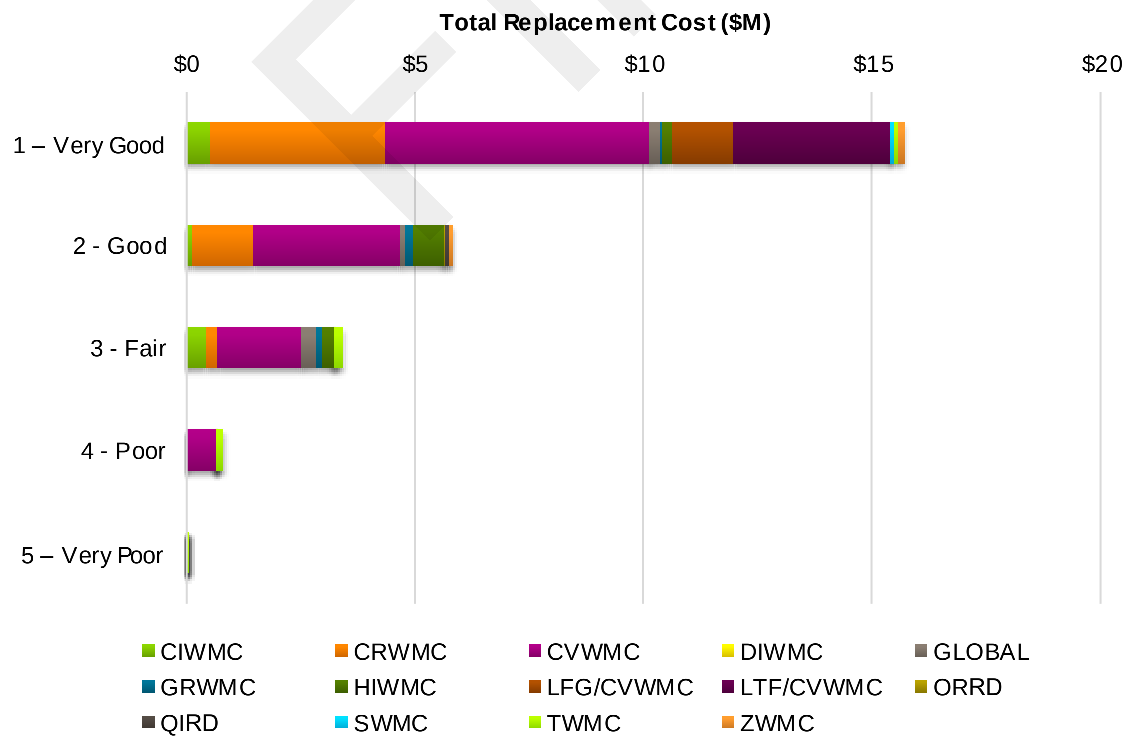


Figure 6 – Breakdown of CSWM Asset Condition by Replacement Value ($ M)

In terms of asset condition, CSWM assets that are of concern are summarized in **Table 6**. These are assets that currently have a condition score of 4 / "Poor" or 5 / "Very Poor".

Table 6 – CSWM Assets with a Condition Score of Four ("Poor") and Five ("Very Poor")

Location	Assets / Components	Comment
CVWMC	• Landfill Fabricated Cover Plate* • Freightliner Roll-Off Truck**	Condition 5, replacement value $9,000 Condition 4, replacement value $218,000
Tahsis	• Landfill Fabricated Cover Plate* • CAT 518 Cable Skidder Vehicle***	Condition 5, replacement value $11,000 Condition 4, replacement value $125,000

* Cover plates require repair, but this is covered by the CSWM service maintenance budget.

** The Freightliner will be sold off as surplus and not replaced.

*** The 518 Cable Skidder Vehicle does not need to be replaced since the Tahsis landfill will be closed within less than five years. According to CSWM staff, in the event this asset needs to be replaced it would be with a used excavator. Purchase price reflects cost of used equipment.

Also, in a poor condition but not shown in **Table 6** are the two Gore Pilot Project compost covers at the CVWMC. However, CSWM is constructing a new Regional Composting facility. Once operational in 2022 the Gore Pilot Project compost covers will no longer be needed; therefore, the existing covers will not be replaced.

2.6 Asset Criticality

Every asset in the CSWM inventory should be reviewed / inspected on a regular basis to ensure that it is performing to its specified requirements. The inspection frequency can vary based on the condition and criticality of the respective asset and its function in supporting the organizational objectives. Criticality refers to the consequences of asset failure (CoF). For the purpose of this study, criticality was defined in terms of the five-point rating scale presented in **Table 7**. This criticality rating scale recognises that poor asset performance or asset failure could have impacts in terms of environmental, public safety, worker safety, equipment and process aspects, with severity of the criticality ranging from "Not Critical" to "Extremely High Criticality", as shown in **Table 7**.

Table 7 – Asset Criticality Rating Table

Criticality Rating	Criticality Level	Category	Impact of Asset Failure
1	Not Critical	Environmental	No Impact
		Public Safety	No Impact
		Worker Safety	No Impact
		Equipment	No Impact
		Process	Process running below design capacity and 100% redundancy available
2	Low Criticality	Environmental	Minor site only
		Public Safety	Low Impact
		Worker Safety	Low Impact
		Equipment	Minor repairs, no new parts necessary
		Process	100% redundancy available
3		Environmental	Minor, local area

Criticality Rating	Criticality Level	Category	Impact of Asset Failure
	Moderate Criticality	Public Safety	Moderate Impact
		Worker Safety	Moderate
		Equipment	Repairs and new parts necessary
		Process	Backup available, between 99% and 25% redundancy available
4	High Criticality	Environmental	Major, large area affected
		Public Safety	Possible risk
		Worker Safety	Minor injury
		Equipment	Necessary to replace equipment
		Process	Reduced capacity of <25% redundancy available
5	Extremely High Criticality	Environmental	Environmental disaster
		Public Safety	High risk of injury
		Worker Safety	Major injury or death
		Equipment	Entire process to be replaced
		Process	Equipment currently running over design capacity with no redundancy

In terms of asset criticality, CSWM assets that are of major concern to the CVRD are summarized in **Table 8**. In general, these are assets that have a criticality score towards the top-end of the criticality scale (i.e., a score equal or greater than 4).

Table 8 – Critical CSWM Assets (Criticality score in brackets)

Location	Assets / Components
CVWMC	• Fuel Storage Tank (4) • Landfill Liner (5) • Landfill Collection System (5) • Weight Scale (4) • Scale Software (4)
Landfill Gas System	• Flame Arrester (4) • Toxic Gas Sensor (4) • PLC (4)
Leachate Treatment Facility	• Electrical Service and Distribution (4) • PVDF hollow fibre membrane x 2 (4) • PLC (4) • Fire tube boiler (4)

Critical assets were identified by using formalized criteria established above and typically included equipment or constructed assets that are critical to solid waste management and that do not have redundancy. When deciding on the timing of asset renewal or replacement it is important to consider the criticality of an asset. Ideally, assets that have a high criticality rating should be replaced before failure to prevent adverse impacts such as environmental disasters or severe injuries. Assets that have a low criticality rating may be allowed to run beyond the expected service life if a failure will not have an immediate negative impact. Please refer to **Appendix B** for a full listing of asset criticality for each asset within the CSWM inventory.

2.7 Probability of Failure

There will naturally be some level of variation in the service life of infrastructure assets of the same type due to inherent defects that may originate during manufacturing or installation, or due to specific local operating conditions. For that reason, some assets may fail prematurely, whereas other may live well beyond their theoretical life expectancy. Probabilistic methods of analysis are typically used to account for the variable nature of asset failure and the impact it has on risk. In this analysis, the probability associated with asset failure was determined using the two-parameter Weibull distribution.

The Weibull distribution has been used extensively in reliability studies and lifetime prediction models in industries ranging from the automotive to the oil and gas industries and provides a suitable distribution for this type of analysis. The probability of failure is represented by the cumulative distribution function, which is given by,

$$F(x) = 1 - e^{-\left(\frac{AGE}{ESL}\right)^k}$$

In addition to the age of the asset and its expected service life (ESL), the Weibull probability distribution is controlled by a shape parameter, k. The shape parameter is equal to the slope of the regressed line in a probability plot and, therefore, controls the rate at which the probability of failure (PoF) increases as assets age. The following figure shows the cumulative density function / probability of failure for several values of shape parameter.

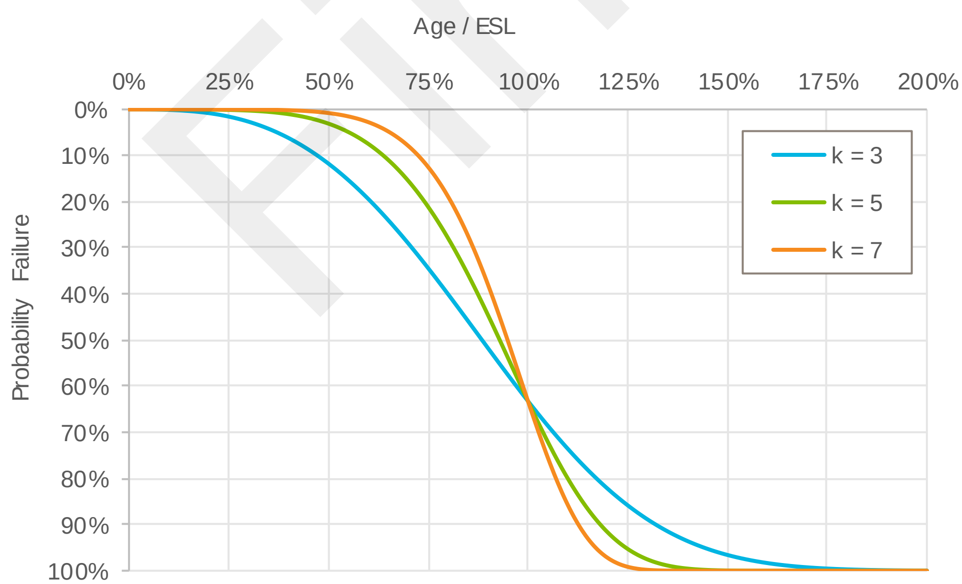


Figure 7 – The Impact of the Shape Parameter

A unique characteristic of the two-parameter Weibull distribution is that, regardless of the shape parameter chosen, an age over ESL of 100% always corresponds to a probability of failure of 63%. Said another way, the distribution assumes that 63% of assets will fail when they reach their expected service life. For this analysis, a shape factor of 3 was selected because it provides a suitable balance in estimating the probability of failure prior to, and after, an asset has reached its expected service life. **Figure 8** shows the resulting probability of failure for different values of asset age over ESL, along with bands representing what is considered as low, medium, and high PoF values.

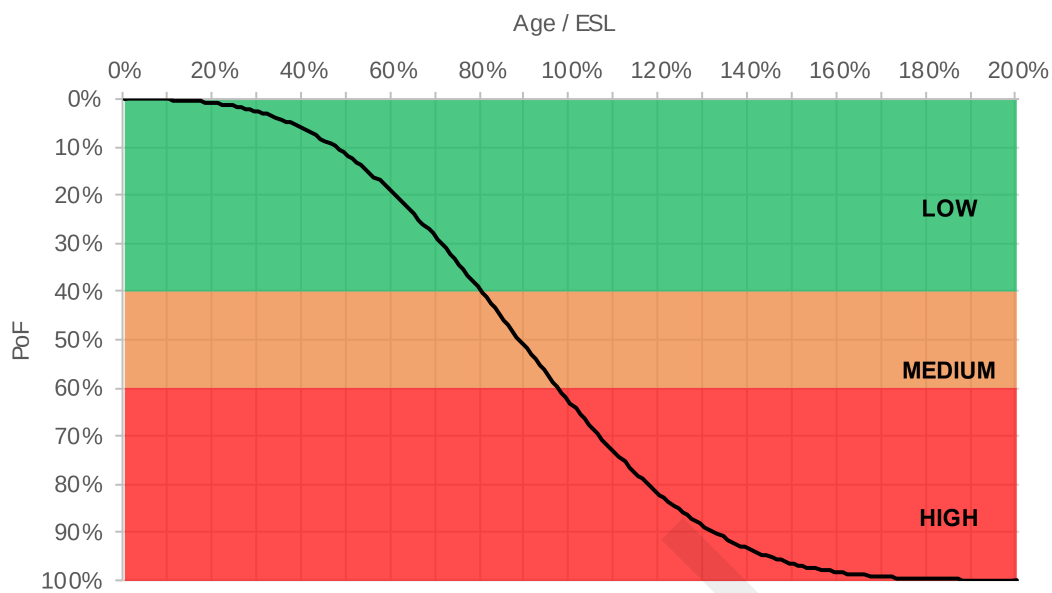


Figure 8 – Probability of Failure versus Asset Life Span Consumed

2.8 Asset Risk

A risk score was calculated for each asset. The risk score reflects the probability of failure and the criticality ratings and was assigned using the following equation: **Risk Score = Probability of Failure x Criticality Rating**. Note, prior to calculating the risk score, PoF values were converted from a 0 to 100% scale to the same scale used for CoF (1 to 5).

The purpose of the risk score is to identify assets that require immediate attention. Understanding the risk exposure for a given set of assets allows the CSWM service to identify where the organization is most exposed, and to target investments to most effectively reduce that exposure. The range of the risk score is from 1 to 25. **Figure 9** presents a sample risk-based intervention plan that provides direction for asset interventions, ranging from monitoring asset condition or "run-to-failure" for low-risk assets to immediate replacement of the very high-risk assets.

Criticality	1	2	3	4	5
5	Monitor	Monitor / Schedule Renewal	Fix Now!	Fix Now!	Fix Now!
4	Monitor	Monitor / Schedule Renewal	Fix Now!	Fix Now!	Fix Now!
3	Monitor	Monitor	Monitor / Schedule Renewal	Fix Now!	Fix Now!
2	Fix on Failure	Fix on Failure	Monitor	Monitor / Schedule Renewal	Schedule Renewal
1	Fix on Failure	Fix on Failure	Fix on Failure	Monitor	Monitor

Probability of Failure

Figure 9 – Sample Risk-Based Intervention Plan

The risk values defined for assets enables the CSWM service to identify management strategies for the different risk categories, especially for the high-risk assets with a risk score approaching 10 or higher, as presented in **Figure 9**. The failure of these assets presents the greatest risk to the organization and should be avoided through close monitoring, scheduling interventions, and performing the necessary renewals / replacements before failure occurs. To provide context for the risk values associated with CSWM assets, **Figure 10** presents an overview of the replacement costs associated with CSWM assets falling in the risk "buckets" of 1 to 25 (the highest risk score in the CSWM inventory was 9).

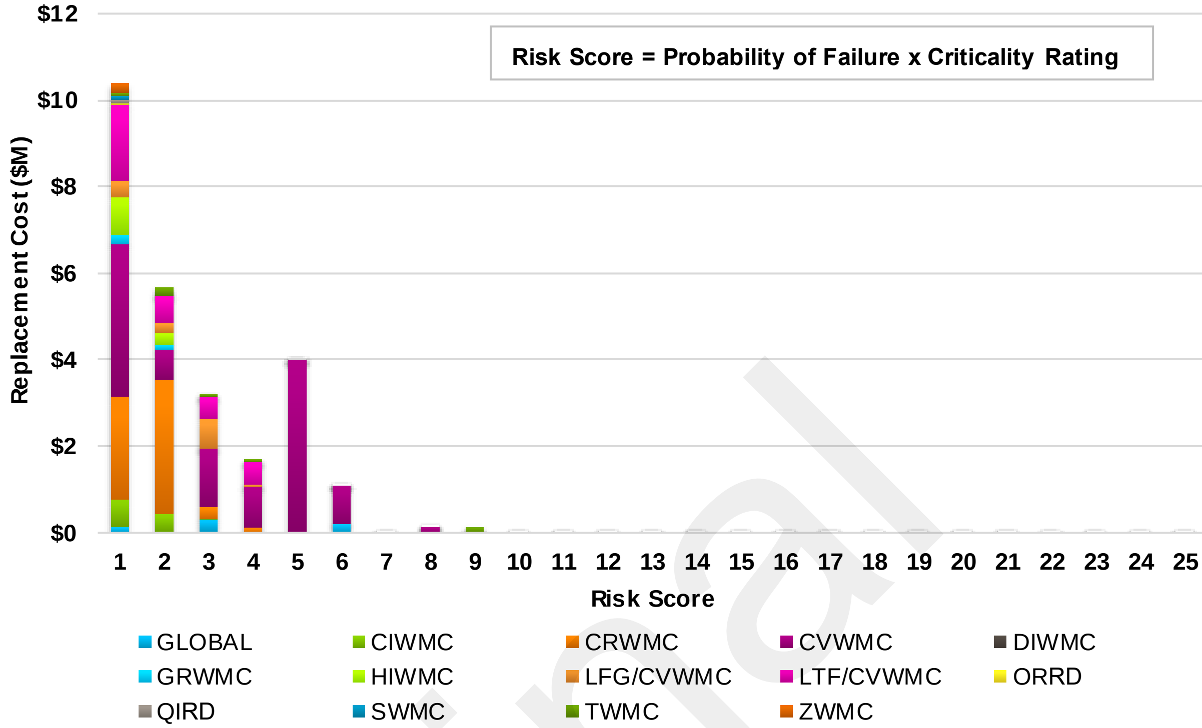


Figure 10 – Replacement Costs versus Risk

The majority of CSWM assets fall towards the lower end of the risk scale (less than eight), other than:

- CVWMC's scale software installation: Installed in 2011, this software has a risk score of eight and is critical to the operation of the weigh scale and for calculating tipping fees (CoF = 4). The software costs approximately $130,000 to replace. Replacement is planned for 2021.
- TWMC's CAT Cable Skidder: This vehicle is now 27 years old. It is of medium criticality to TWMC's operations (CoF = 3) but combined with its advanced age makes this asset the highest-risk asset within the CSWM inventory with a risk score of nine. However, the Tahsis landfill will be closed within less than five years. According to CSWM staff, in the event this asset needs to be replaced before closure, it would be with a used excavator at a cost of approximately $125,000.

Please refer to **Appendix B** for a tabular summary of the entire CSWM asset inventory and associated risk values.

3 Levels of Service (LoS)

3.1 Background to LoS

Levels of Service (LoS) are a key foundational element of the AM planning process. They form the basis for identifying and analyzing the performance (any deficiencies and / or risks) of CSWM assets and also inform decision-making related to the evaluation of issues, identification of potential options and development of the O&M and capital renewal plans. LoS are composite indicators that reflect the social and economic goals of the CSWM service and may include any of the following parameters: safety, customer satisfaction, quality, quantity, capacity, reliability, responsiveness, environmental acceptability, cost, and availability.

Defined LoS may be any combination of parameters deemed important by the CSWM service and represent service-cost trade-offs, established in a flexible, rational, and transparent manner, as follows:

- LoS assist and support decision-making and investment planning related to the planning, development, operation, maintenance, rehabilitation, and replacement of municipal infrastructure.
- LoS promote good practice, sustainable development, and environmental stewardship.
- LoS facilitate community involvement and a public sense of ownership and incorporate community values.

The establishment of LoS is a dynamic process that requires ongoing linkage between a series of activities that overlap with one another (**Figure 11**).

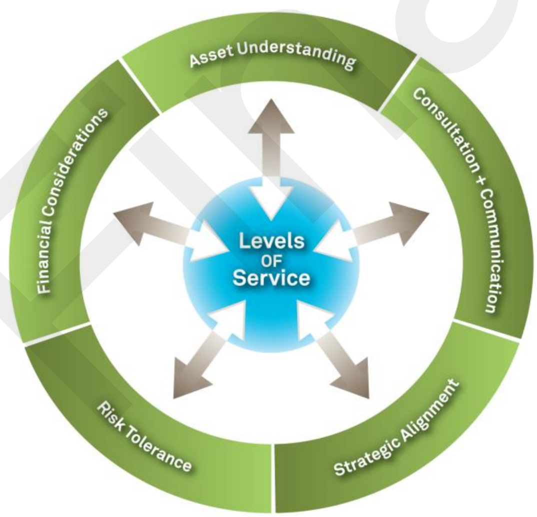


Figure 11 – Level of Service Linkages

3.2 Corporate, Customer and Technical Levels of Service

LoS are an important part of the asset management (AM) business cycle as they determine the expected requirements of assets. LoS are generally separated into the following three levels, as presented in **Figure 12**.

- **Corporate LoS** describe the organizational mission, vision and corporate goals and objectives, as reflected in the direction provided by the board of directors and the municipal administration. The Corporate LoS generally sets the tone for the LoS that stakeholders want and are willing / able to support financially. These goals and objectives should reflect the values of the stakeholders, but may be directed by certain legislative / regulatory requirements.

- **Customer LoS** describe in plain language that is understandable by most stakeholders the service that individual stakeholders and users can expect.
- **Technical LoS** describe parameters that must be achieved to deliver Customer LoS. Technical LoS may be described in more technical language.

LoS do not stand alone. In fact, they must ensure the strategic alignment of corporate goals and objectives with the activities performed at the different levels within an organization. As such, LoS should to be connected through the entire organization and, ultimately, to each individual asset and activity that contributes to providing the service. LoS are evident throughout a complex pyramid of data, performance indicators and information, as presented in **Figure 12**.

LoS must be supported by a suite of indicators that enable an organization to conduct analyses and investigations regarding the optimal selection of strategies to provide the required customer-based outcomes in the most economically efficient manner. Therefore, LoS should be tools to help an organization guide customer expectations about service and price, while at the same time, provide an organization with facts and numbers to help guide mission and business outcomes.

Since the organizational mission and vision forms the top of the pyramid, it is the logical place to begin. Once these statements are generally agreed upon, a cascading suite of goals and objectives, and customer and performance LoS and indicators supporting key performance indicators (KPIs) can be developed. Over time, this will ensure that the overall performance measurement system supports each different layer of the organization, so that it can be used to maintain or improve service delivery and the quality of AM.

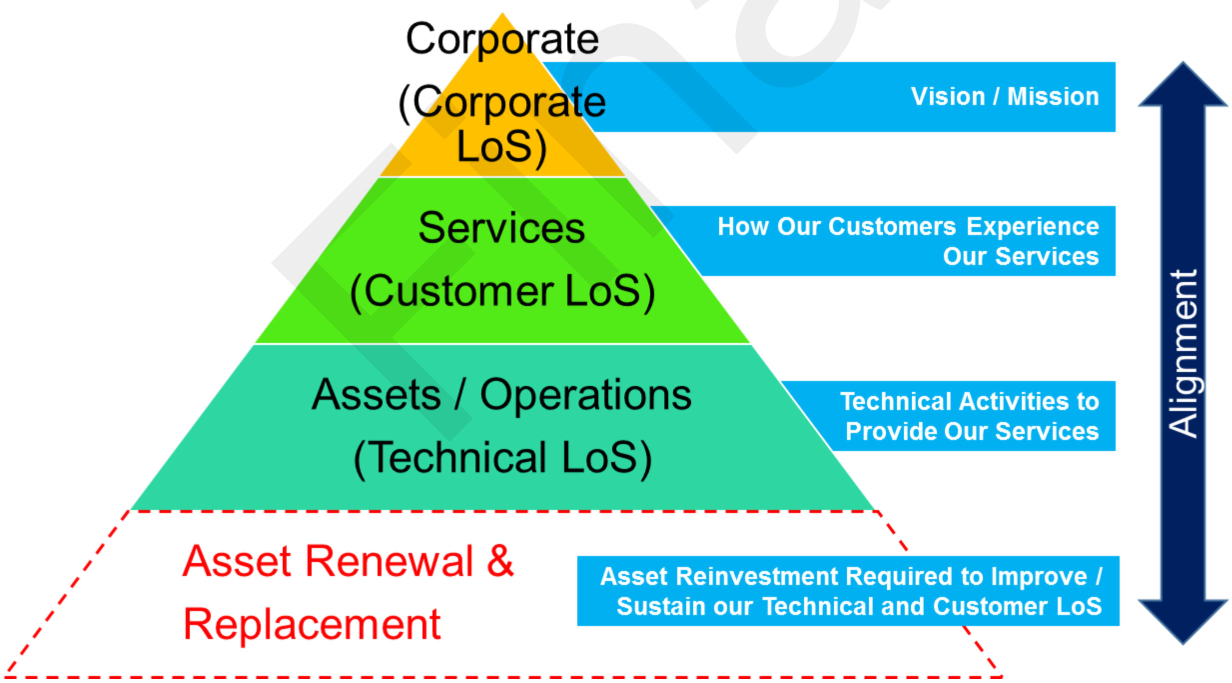


Figure 12 – Level of Service Should Ensure Strategic Alignment of Activities throughout an Organization

3.3 LoS for CSWM Assets

Table 9 presents a summary view of LoS at the different organizational levels within the CVRD.

Table 9 – Level of Service for CSWM Assets

Organizational Level	LoS	Comment
CSWM Service Vision Mission Statement / Goals & Objectives	The CSWM service manages over 100,000 tonnes of waste and recycled material annually and oversees several diversion and education programs for the CVRD and the Strathcona Regional District (SRD). The CSWM is responsible for several waste management centres and transfer stations that handle waste and recycling materials within the CSWM service area. The CSWM oversees a multi-recycling program that has active re-use and re-purposing programs (diversion) and provides a wide range of educational programs that encourage region-wide waste reduction efforts through "The Power of R" and organics composting. Various hazardous waste items are also accepted and handled by qualified technicians.	From https://www.cswm.ca/about/about-us accessed on September 4th, 2019.
Customer LoS	AECOM recommends that CSWM further investigates the Customer LoS from the National Solid Waste Benchmarking Initiative (NSWBI) or the Association of Vancouver Island and Coastal Communities (AVICC).	See https://nswbi.nationalbenchmarking.ca/ for NSWBI or https://avicc.ca/resources/resolutions/solid-waste-management-committee/ for AVICC.
Technical LoS	AECOM recommends that CSWM further investigates the Technical LoS from the National Solid Waste Benchmarking Initiative (NSWBI) or the Association of Vancouver Island and Coastal Communities (AVICC).	

3.4 Demand / Future Growth

Demand / future growth plays an important role in an organisation's strategic investment planning to support its LoS – planning for an existing portfolio of assets or determining future requirements to expand their portfolio to meet changing demand. Demand analysis typically includes the analysis of future demand for the product or services being offered and the requirements this demand places on the asset portfolio. AM planning should address potential changes in demand / future growth that include attention to the following factors / topics for the CSWM service:

Table 10 – Consideration of Demand / Future Growth Factors for CSWM

Demand / Future Growth Factors	Comment
Drivers of demand & future demand and changes in demand over time.	• Current CSWM plans are based on assumed population growth rates and landfill disposal rates. The 2012 CSWM Solid Waste Master Plan (SWMP) detailed several waste diversion and minimization programs required to achieve a target 70% diversion rate. This would extend the service life of the landfill and spread out future closure costs. It is estimated that an additional 16 years of airspace would be gained at the CVWMC if the 70% diversion target were met.

Demand / Future Growth Factors	Comment
	• Funding sources currently include waste disposal fees and charges as well as taxation revenue. Changes to communities' habits can, thus, not only affect operating costs but also revenue. As habits change, the CSWM should ensure fees reflect costs and motivate positive change in customer behaviour. This can be achieved by carefully monitoring revenue from tipping fees versus taxation.
Changes in required levels of service & current and future utilization and capability of assets.	• Changes in building codes and construction materials used. • Changes in retail practices, packaging used, and decentralized recycling depots. • Potential solid waste regulatory changes (see discussion below).
Impact on the future performance, condition and capability.	• If ageing CSWM infrastructure is not replaced in time it will have an adverse effect on service levels and expose the CSWM service to varying levels of risk, depending on the nature of the asset failure.
New assets, asset systems or technology (including obsolescence).	• New technologies such as a computerized maintenance management system (CMMS) and / or decision support system (DSS) hold many benefits for the CSWM service such as the tracking of maintenance (corrective, predictive and preventive), improved budgeting for O&M, better capital planning & prioritization, etc. However, implementing these systems will take some time and considerable staff resources for the systems to become fully functional. • New solid waste treatment and recycling technologies have the potential to improve the efficiency of operations and the sustainability of solid waste management.
Factors external to the organization (including new legal and regulatory requirements).	• As the population and governing agencies become more concerned with the sustainability of solid waste management practices, regulations will likely become more stringent. • Multiple Extended Producer Responsibility Programs already exist in BC and report to the Ministry of the Environment. There are no provincially operated product stewardship programs, but a few communities are already banning organic materials disposal. • BC does not have a regulated energy from waste requirement either, but guidance to regional districts articulates the expectation that districts achieve a diversion rate of 70% prior to considering energy from waste (EFW). Therefore, once the targets set out in the 2012 CSWM SWMP are met, a Waste to Energy facility will be an option.
Supply chain constraints	• The CSWM service must have line of sight to potential supply chain constraints, especially for the highly critical assets / components identified in this study.
Demands on resources	• Skilled resources for the operation, maintenance and renewal of CSWM assets should be a primary concern. An ageing workforce, skills and knowledge retention and new technologies (see CMMS and DSS above) will place greater pressure on existing staff. • The competition for skills in the infrastructure sector in BC is expected to be fierce, especially with large capital projects in the Lower Mainland currently under way (e.g., Metro Vancouver's secondary treatment upgrade program; TransLink's SkyTrain expansions) and projects further afield (Victoria's McLoughlin Point Wastewater Treatment Plant; Woodfibre LNG in Squamish; LNG Canada in Kitimat and BC Hydro's Site C Dam in north-eastern BC).

4 Asset Life Cycle Strategies

4.1 Background

Any responsible owner of assets such as the CSWM service has a desire to preserve the condition of their existing assets for as long as possible, by maintaining or even extending their design lives through routine activities such as maintenance and active intervention. The CSWM service is continually acquiring assets that require increased funding for operating and maintenance. The CSWM service is also responsible for the replacement of deteriorated assets for as long as their service is required. While individual assets may have a useful life that can be predicted in years or decades, the service that the asset provides could be required for a substantially longer duration. The purpose of this section is to fully understand and predict the long-range financial requirements for the CSWM service, in order to facilitate planning and resource management in the most cost-effective manner possible. Decisions that are made at the design stage can significantly influence the maintenance activities required and vice versa (**Figure 13**). Monitoring and measurements during the acquisition phase, and the quality of assembly / construction can significantly affect the durable nature of an asset and the expected serviceable life or operating costs.

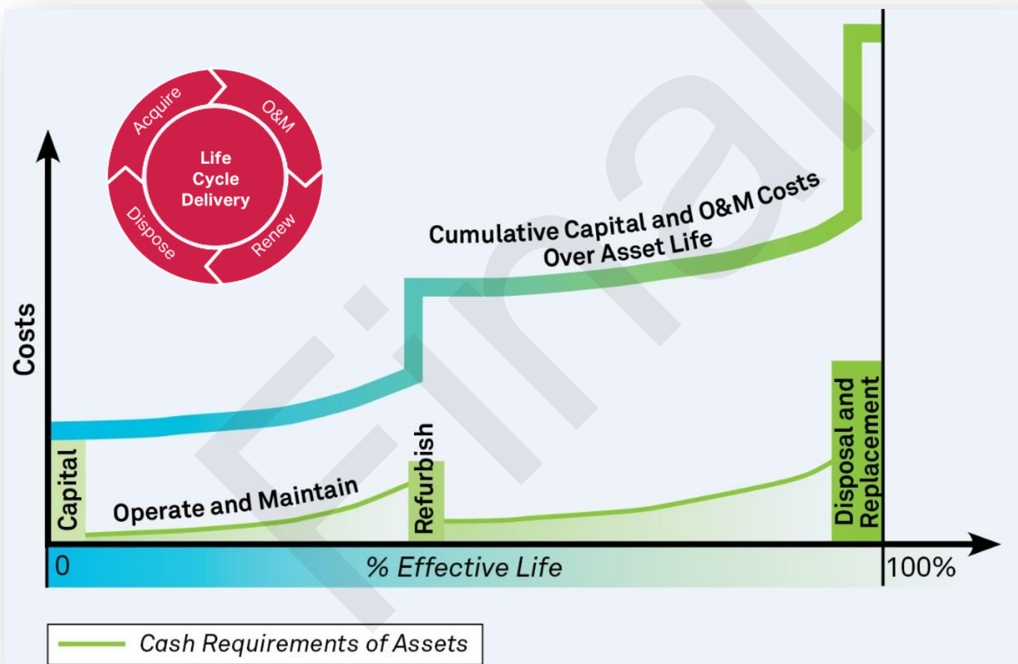
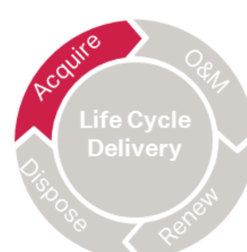


Figure 13 – Asset Life Cycle Delivery

4.2 Asset Acquisition Activities



As shown in **Section 2.3**, the CSWM service has made significant investments in the design and acquisition of its solid waste assets. The CSWM's asset inventory has, to a large extent, been created over the past four decades through funding provided by service participants. Looking towards the future, when acquiring new assets, the CSWM service should evaluate credible alternative design solutions that consider how the asset is to be managed at each of its life cycle stages. Asset management and full life cycle considerations for the acquisition of new assets include, but are not limited to the following:

- The asset's operability and maintainability.
- Availability and management of spares.
- Staff skill and availability to manage the asset.

- The manner of the asset's eventual disposal.

CVRD's procurement staff need clear requirement specifications and must work with engineering and O&M staff to ensure specifications are complete, adequate and match required design criteria. Therefore, it is important that there is good mutual understanding and co-operation between procurement and other parts of the organization.

Organizations from a wide range of industries are quoting 20, 40, or even 50% gains in business performance while simultaneously controlling costs, risks and long-term capability, when whole life cycle and asset management principles are incorporated at the design stage[1]. The starting point for this is a design and construction process that produces the information and data required to manage assets throughout their life. A durability planning approach in specifying asset management and maintenance regimes on CVRD projects will form a continuous link through the full duration of each project, from design through to construction and operation. **Figure 14** presents a sample durability planning approach applied by AECOM, together with several lessons learnt:

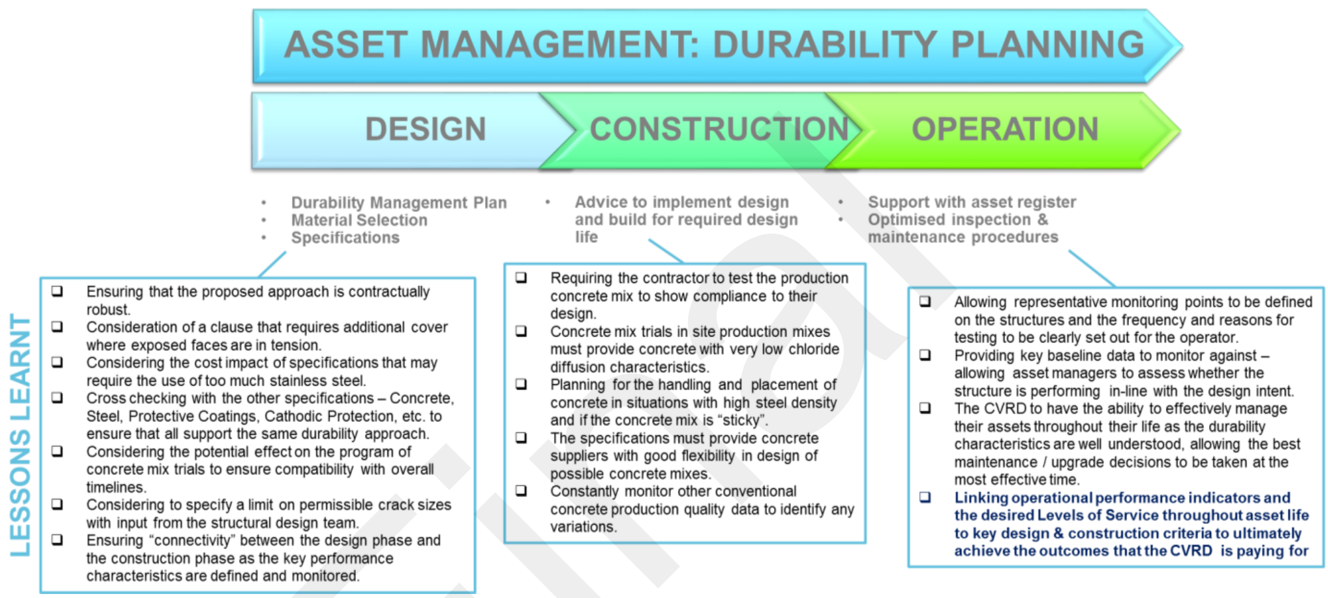


Figure 14 – Quality of Construction Can Significantly Affect Asset Durability

In terms of significant CSWM asset acquisition activities that are currently known to the organization and within the 20-year planning horizon of this AMP, there exists the planning and construction costs of landfill cells #2, 3 and 4 (CVWMC-2 to CVWMC-4) at the CVWMC, as well as the remote transfer stations at TWMC and ZWMC . The respective landfill and remote transfer station planning and construction cost estimates are shown in **Figure 15**. Construction cost estimates were obtained directly from CSWM Staff and are shown in future dollars.

[1] IAM (2011): An anatomy of Asset Management. Issue 1.0, December 2011.

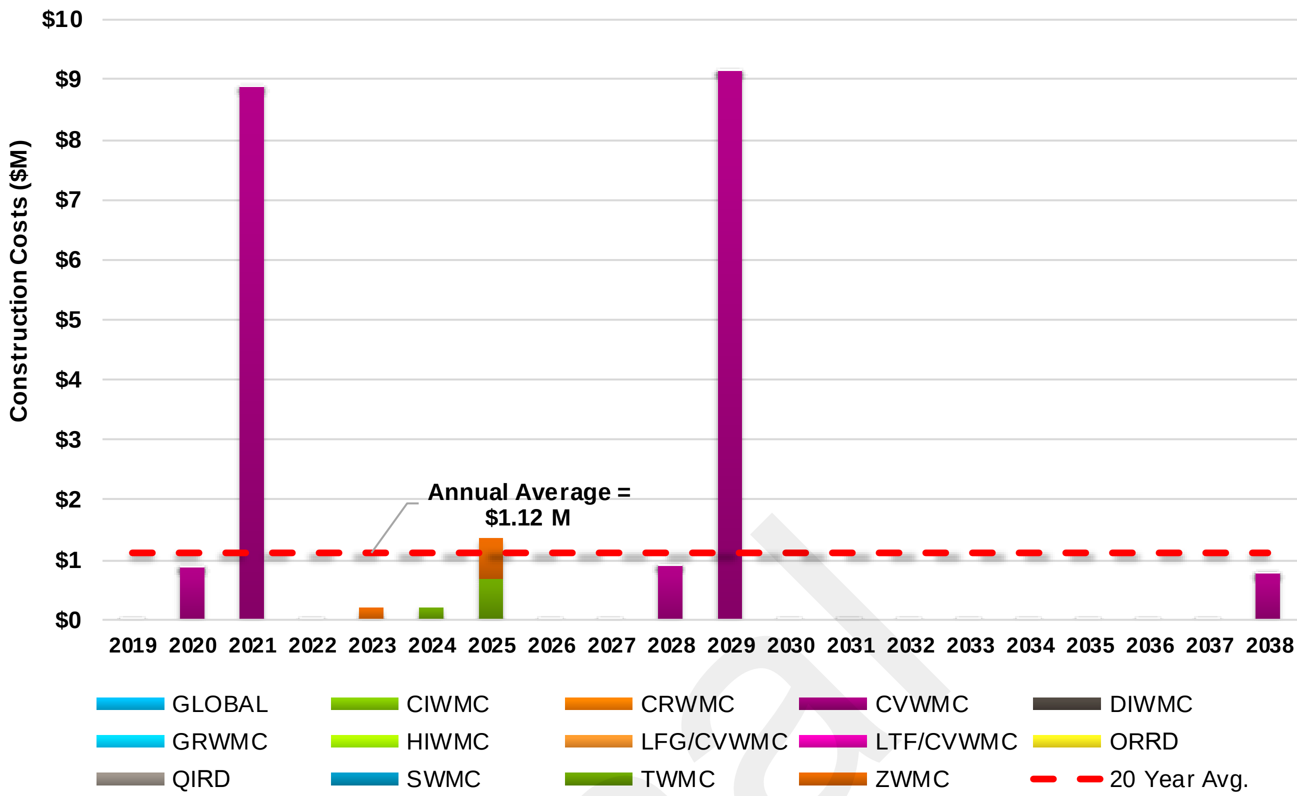
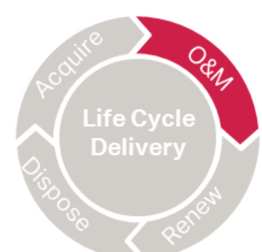


Figure 15 – Estimated CSWM New Landfill and Remote Transfer Station Planning and Construction Costs

4.3 Asset Operations and Maintenance (O&M) Activities



As new assets are commissioned, CVRD accepts the responsibility of operating and maintaining the assets according to O&M standards to ensure that the assets are safe and reliable. Operations staff provide the day to day support required to operate the assets. In few cases, operations costs are minor, but normally there are noticeable increases from year-to-year. For example, bin walls require limited operational support, while the landfill gas system and leachate treatment facility require frequent visits by CSWM service staff to inspect the facilities and ensure they are operating safely and efficiently.

Maintenance expenses include periodic preventive maintenance to ensure that the assets can provide reliable service throughout the life of the asset, and corrective maintenance that is required to repair defective assets, as and when needed. Inadequate funding for O&M will have an adverse impact on the life span of assets. The amount of O&M resources required in any period is a function of the current inventory of assets and the total O&M needs required for each asset. It is of utmost importance to know that, as the inventory of CSWM assets grows, total O&M requirements and associated budgets need to grow in a commensurate fashion.

The bulleted list below presents a listing of maintenance activities performed on infrastructure assets such as those of the CSWM, which are typically divided in three general categories, as follows:

- **Corrective Maintenance:** Repairs that are made after the equipment has failed and cannot perform its normal function anymore.
- **Preventive Maintenance:** Maintenance tasks that are performed at regular intervals, based on industry expected equipment life spans and failure patterns.

- **Predictive Maintenance:** Maintenance that is conducted only when it is confirmed necessary using non-destructive tests that detect potential failure conditions before their occurrence.

This breakdown of maintenance activities should be considered for incorporation in the CSWM O&M practices and the future Cityworks computerized maintenance management system (CMMS) implementation. The implementation of Cityworks will enable CSWM to maintain a direct relationship between an asset and all cost transactions associated with that asset to facilitate summary and detailed activity-based costs. A properly implemented CMMS will also provide tools to create, maintain, and compare monthly and annual budgets in comparison to actual costs on an ongoing basis. This is especially important from a maintenance tracking point-of-view to ensure that CSWM performs adequate maintenance to support the life cycle and asset durability goals set at the design stage.

CSWM O&M and engineering staff understand the issues with assets found in service and are invaluable in providing practical input to improve asset strategies and maintenance instructions. The CSWM service should encourage O&M staff to make recommendations that will improve asset management. These, along with other sources of information regarding asset performance and maintenance, should be analysed and used to improve asset management.

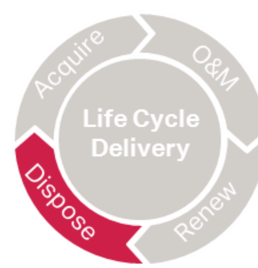
4.4 Asset Renewal and Replacement Activities

The third portion of full life cycle costing relates to the renewal and replacement of assets that have deteriorated to the point where they no longer provide the required service. Renewal cost is sometimes incurred during the life of an asset where an investment is made to improve the condition and / or functionality of the asset (e.g., refurbishment of a piece of equipment). Replacement occurs at the end of an asset's life when it is disposed of and replaced by a fully new asset.

The following assumptions were made in the analysis of future funding needs for asset renewal and replacement presented in **Section 0**:

- All assets are replaced when their apparent age reaches their ESL and / or when their risk score currently exceeds 10. This, in general, meant that any asset with a risk value greater than 10 in year 2019 (i.e., criticality > 2 and condition = 5, or criticality = 5 and condition > 2) was triggered for replacement. However, no assets within the CSWM inventory had a current risk value greater than 10.
- When an asset is replaced, it was assumed that the criticality score remains the same but that the age resets to zero (i.e., age zero = very good condition) and that the new assets last as long as their ESL.
- Please refer to **Section 2.3** for assumptions on the asset replacement values applied in the assessment.

4.5 Decommissioning and Disposal Activities



Asset decommissioning and disposal activities are performed to decommission and dispose of assets due to ageing or changes in performance and capacity requirements. This decision process includes the consideration of costs and benefits of rationalization using a whole life approach, the impact of asset rationalisation on other infrastructure and the processes for disposal of assets. More specifically, the following factors need to be evaluated when considering the decommission and disposal of assets:

- Assets not required for the delivery of services, either currently, or over the longer planning period.
- Assets that have become uneconomical to maintain or operate.
- Assets that are not suitable for service delivery.
- Assets that have a negative impact on service delivery, the environment, or community.
- Assets that no longer support CSWM's service objectives due to a change in type of service being delivered or the delivery method.
- Assets where their use has become uneconomical due to the limited availability of spares or the cost of their replacement parts.

- Assets where their technology has been outdated.
- Assets which can no longer be used for the purpose originally intended.

Considerations for CSWM asset decommissioning and disposal activities include, but are not limited to:

- Updates to the CVRD's Statement of Tangible Capital Assets. Considerations related to the determination of residual value and the disposal of assets include:
  - Residual value and the useful life of an asset should be reviewed, at the very least, at each financial year-end and, if expectations differ from previous estimates, any change should be accounted for prospectively as a change in estimate.
  - The depreciation method used should reflect the pattern in which the asset's economic benefits are consumed.
  - The depreciation method should be reviewed, at the very least, annually and, if the pattern of consumption of benefits has changed, the depreciation method should be changed prospectively as a change in estimate.
- Updates to asset databases such as the GIS and CMMS.
- Environmental impact of disposal and implications for land rehabilitation, where applicable.
- Residual value of assets.
- Continued service delivery while a new asset is being constructed / commissioned: overlap of the start-up of new assets / facilities and the decommissioning of existing assets / facilities being replaced.
- Cost of decommissioning and disposal.
- Other, as needed.

From the point-of-view of decommissioning and disposal activities, CSWM assets such as the landfills, present the CSWM service with a significantly greater future liability when compared to the CVRD's water, wastewater and recreation assets. In layman's terms, this means that the CSWM service must provide financial security for the operation of the site(s) as well as for closure and post-closure care.

Some activities and associated considerations for landfill closure include the following:

- Final design of the landfill and the placement of the final cover.
- Compaction, grading of the landfill surface area and establishment of vegetation.
- Erosion control plan and restoration of surface water drainage.
- Changes (if any) to groundwater and landfill gas monitoring / control systems.
- Changes (if any) to leachate collection and control systems.
- Decommissioning and removal of buildings, storage areas, processing areas, or any other operations or facilities that will no longer be required.
- Installation of fences, gates and construction of any other monitoring and control works that may be required for the post-closure period.[2]

The estimated CSWM landfill closure costs are presented in **Table 11** and **Figure 16**. The estimated CSWM landfill closure costs are presented in future dollars in **Table 12**. Closure cost estimates were obtained from a 2017 GHD Memorandum[3]; however, when available, cost information was updated using more accurate estimates obtained directly from CSWM Staff.

[2] BC Ministry of Environment (2016): Landfill Criteria for Municipal Solid Waste, 2nd Edition.
[3] GHD (2017): 2017 Closure and Post-Closure Fund Estimates, Comox-Strathcona Waste Management, Campbell River, Comox Valley, Gold River, Tahsis and Zeballos, British Columbia.

Table 11 – Estimated CSWM Landfill Closure Costs

Year	CRWMC	CVWMC-H	CVWMC-1	CVWMC-2	CVWMC-3	GRWMC	TWMC	ZWMC
2019	$221,000	$2,760,000	$14,000	$0	$0	$0	$0	$0
2020	$591,000	$0	$328,000	$0	$0	$0	$0	$0
2021	$7,064,000	$0	$150,000	$0	$0	$0	$0	$0
2022	$146,000	$0	$180,000	$25,000	$0	$0	$0	$0
2023	$149,000	$0	$330,000	$151,000	$0	$0	$0	$0
2024	$4,434,000	$0	$870,000	$0	$0	$0	$110,000	$106,000
2025	$0	$0	$0	$150,000	$0	$0	$0	$0
2026	$0	$0	$0	$0	$0	$526,000	$0	$0
2027	$0	$0	$0	$19,000	$0	$1,566,000	$0	$0
2028	$0	$0	$0	$150,000	$0	$0	$0	$0
2029	$0	$0	$0	$149,000	$0	$0	$0	$0
2030	$0	$0	$0	$3,045,000	$0	$0	$0	$0
2031	$0	$0	$0	$0	$0	$0	$0	$0
2032	$0	$0	$0	$0	$0	$0	$0	$0
2033	$0	$0	$0	$0	$25,000	$0	$0	$0
2034	$0	$0	$0	$0	$150,000	$0	$0	$0
2035	$0	$0	$0	$0	$0	$0	$0	$0
2036	$0	$0	$0	$0	$150,000	$0	$0	$0
2037	$0	$0	$0	$0	$0	$0	$0	$0
2038	$0	$0	$0	$0	$450,000	$0	$0	$0

Once the landfill is closed, some activities and associated considerations for the post-closure period include the following:

- Management and maintenance of the landfill final cover including fertilizing, irrigating and re-seeding of the vegetative cover, as needed.
- Operation and maintenance of any on-site or off-site leachate management facilities.
- Operation and maintenance of landfill gas management facilities.
- Operation and maintenance of site infrastructure including surface water control works, roads, fences, etc.
- Construction or replacement of any monitoring or control works as required.
- Annual environmental monitoring and reporting[4].

Annual post-closure monitoring and maintenance cost estimates were obtained from a 2017 GHD Memorandum[5] and are shown in **Table 12**. Note that there is an additional $100,000 of partial monitoring and maintenance costs associated with the CVWMC-H landfill in 2019 that, for simplicity, has been excluded from the table. The combined CSWM landfill closure plus annual monitoring and maintenance costs, by location, are presented in **Figure 16**. All costs in **Figure 16** are shown in future amounts, inflated at a rate of 2% to their year of expenditure.

4 Ibid.
5 GHD (2017): 2017 Closure and Post-Closure Fund Estimates, Comox-Strathcona Waste Management, Campbell River, Comox Valley, Gold River, Tahsis and Zeballos, British Columbia.

Table 12 – Annual CWWM Landfill Monitoring and Maintenance Costs

Landfill Location	CRWMC	CVWMC-H	CVWMC-1	GRWMC	TWMC	ZWMC
Estimated Closure Year	2024	2019	2023	2027	2025	2025
Post-Closure Period (Years)	30	30	30	30	30	30
Annual Post-Closure O&M Costs	$190,000	$165,000	$75,000	$26,500	$24,000	$28,000
Fifth Year Post-Closure O&M Cost	$190,000	$185,000	$85,000	$46,500	$44,000	$48,000

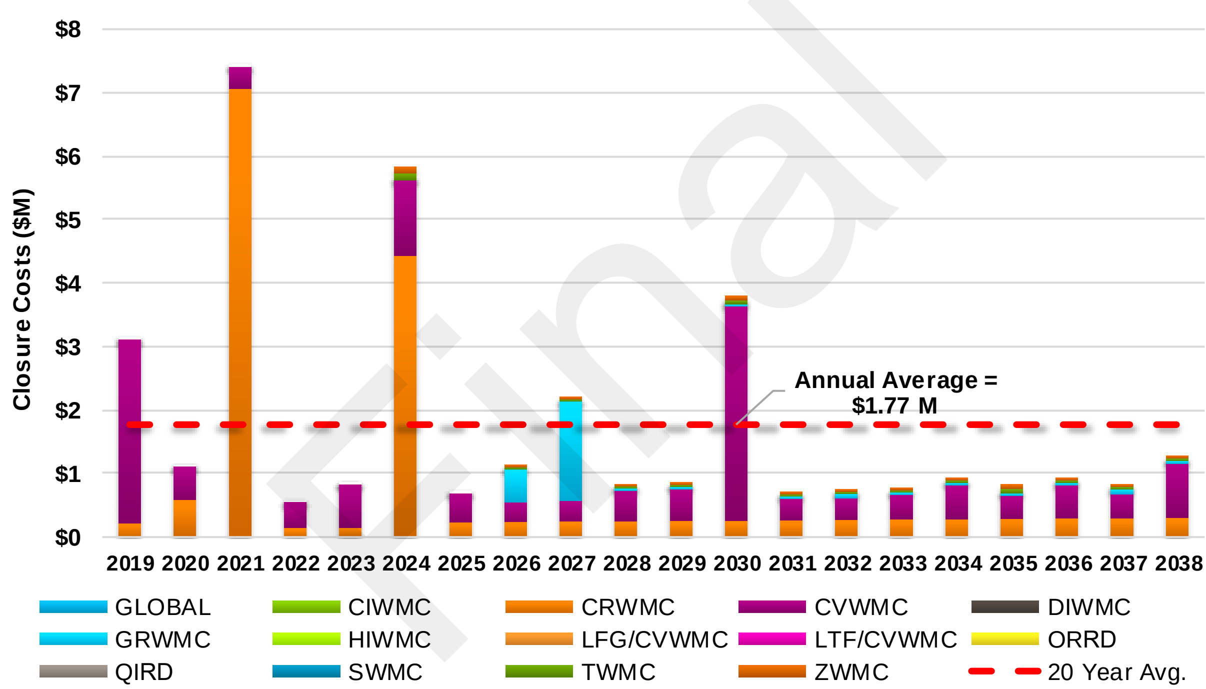


Figure 16 – Estimated Combined CSWM Landfill Closure, Monitoring and Maintenance Costs

Please referrer to **Table 11** for estimated CSWM landfill closure costs, and **Table 12** for Annual CWWM landfill monitoring and maintenance costs.

5 Funding Strategies

5.1 Funding Needs for CSWM Assets

The asset renewal forecasts prepared for this assessment are long-term estimates of what it will cost over the next 20 years to replace assets as they age and move past their ESLs and / or exceed the risk tolerances of the CVRD (see **Section 4.4**). The CSWM service funding needs analysis was based upon a spreadsheet-based analysis that triggers an asset replacement when an asset reaches its expected service life and / or exceeds the risk threshold of 10 in 2019.

As a final comment on the topic it is worth recalling the famous quotation that "*Prediction is very difficult, especially if it's about the future*". It is worth remembering that an analysis of this nature is based on literally thousands of data inputs and many assumptions, and is therefore, at best, a high-level estimate of future funding needs based on the best available information now.

5.2 Reinvestment Funding Needs Analysis

The reinvestment funding needs analysis made use of the asset inventory, condition, age and ESL, replacement values and risk scores to create a theoretical asset replacement cycle for each asset. It is a starting point for planning long-term capital requirements for addressing future asset replacement needs. This forecast is based on the following assumptions:

- Assets will be replaced when their theoretical end of useful life is reached. The age of assets was adjusted to an "apparent age" based on the on-site condition assessment as per the methodology outlined in **Section 2.4**.
- The backlog is the total dollar value of all assets that are currently beyond their ESL. The backlog is included in the calculation of the average annual 20-year funding needs.
- Total replacement costs are based on 2019 Canadian dollars inflated by 2% to the year of replacement.
- No funding restrictions are applied.
- Full asset replacement was the only intervention strategy considered in the analysis.

The average annual reinvestment funding need for the CSWM is $1.03 M, for a total of approximately $20.67 M over the next 20 years, as presented in **Figure 17**.

Of note in **Figure 17** are several expenditure spikes over the analysis period. The notable "big-ticket" items reaching the end of their ESLs over the next decade are as follows:

- 2019: CRWMC recycling depot asphalt.
- 2020: CVWMC scale software program and roll-off truck
- 2021: CIWMC asphalt and GRWMC asphalt.
- 2022: CVWMC gravel truck
- 2023: CRWMC, CVWMC, ORRD and QIRD asphalt paving
- 2024: CIWMC skid steer, CVWMC – bear fence, wheel loaders, dozer, asphalt at maintenance yard / waste area plus at fabric building, and the HIWMC backhoe.
- 2025: CVWMC wheel loader and excavator.
- 2026: GLOBAL roll off containers, LTF/CVWMC hollow fiber membrane, CVWMC software program
- 2027: CRWMC weigh scale, and recycling depot asphalt.

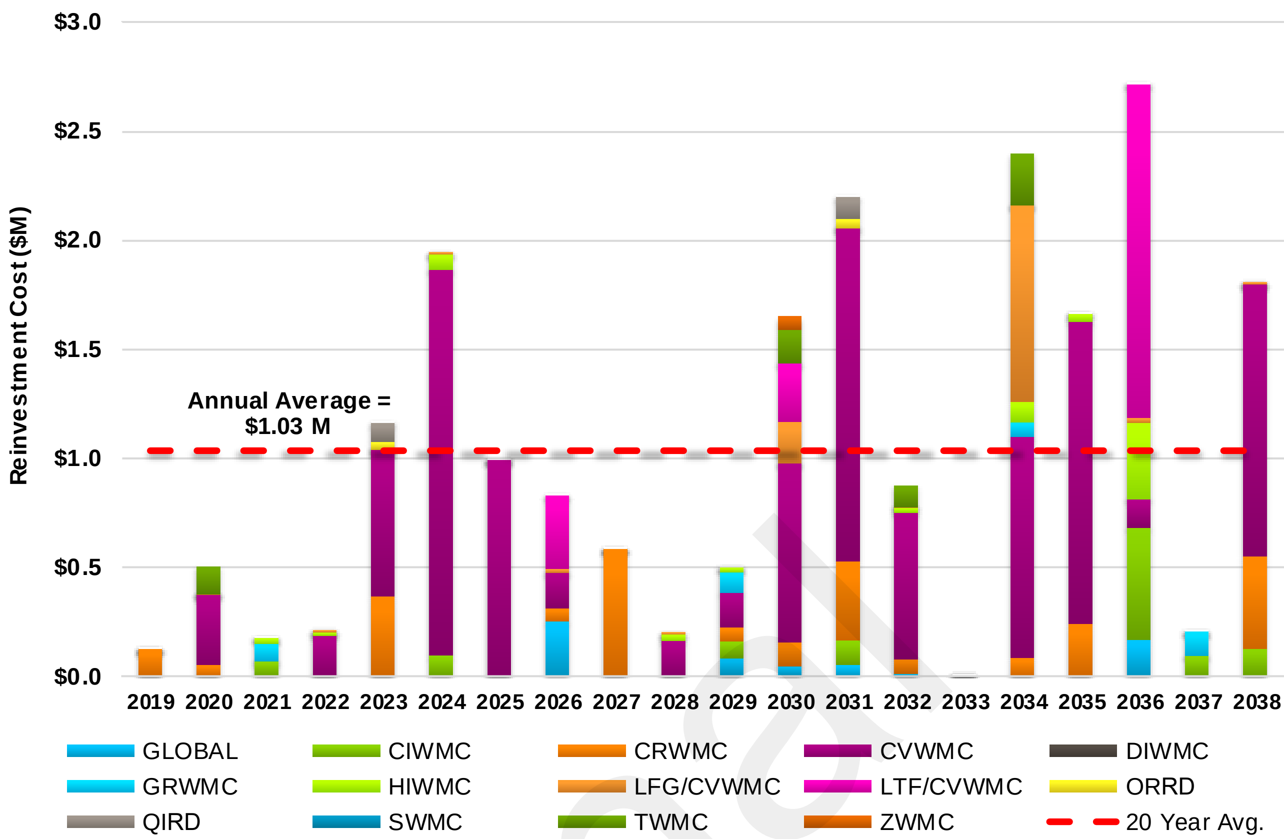


Figure 17 – 20-Year CSWM Reinvestment Funding Need Analysis

6 Recommendations

6.1 Reinvestment Funding Levels 2019 - 2038

AECOM recommends that the funding levels for CSWM asset reinvestment be increased to the values shown in Table 13. Note that these are total expected expenditures and do not differentiate between the source of funding, be it through debt, grants, or reserves. The values were calculated for each asset class by averaging the total recommended reinvestment from **Figure 17** over the 20-year analysis period, as presented in **Figure 18**. Increasing funding to the levels shown will help ensure that the CSWM service has the resources required to meet current and future needs.

Table 13 – Recommended CSWM Funding Levels for Reinvestment (2019 – 2038)

	GLOBAL	CIWMC	CRWMC	CVWMC	DIWMC	GRWMC	HIWMC	LFG/CVWMC	LTF/CVWMC	ORRD	QIRD	SWMC	TWMC	ZWMC	Total
Reinvestment per Year, $ M	$0.03	$0.05	$0.13	$0.56	$0.00	$0.02	$0.03	$0.06	$0.11	$0.00	$0.01	$0.00	$0.03	$0.00	**$1.03**
20-Year Reinvestment Total, $ M (2019-2038)	$0.61	$1.09	$2.53	$11.21	$0.00	$0.35	$0.66	$1.15	$2.13	$0.08	$0.18	$0.00	$0.62	$0.06	**$20.67**

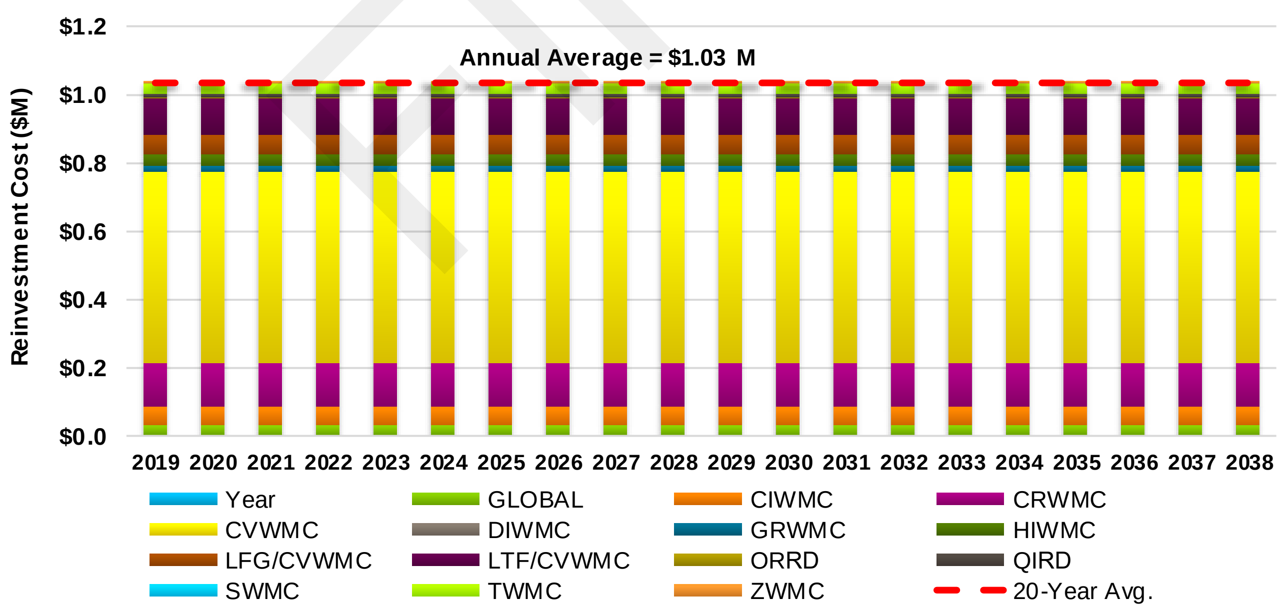


Figure 18 – Recommended CSWM Funding Levels for Reinvestment (2019 – 2038)

Having sustainable funding in place is especially important when considering in addition to the CSWM reinvestment costs, the significant costs associated with new landfill construction and landfill closure, monitoring and maintenance, as presented in **Figure 19**.

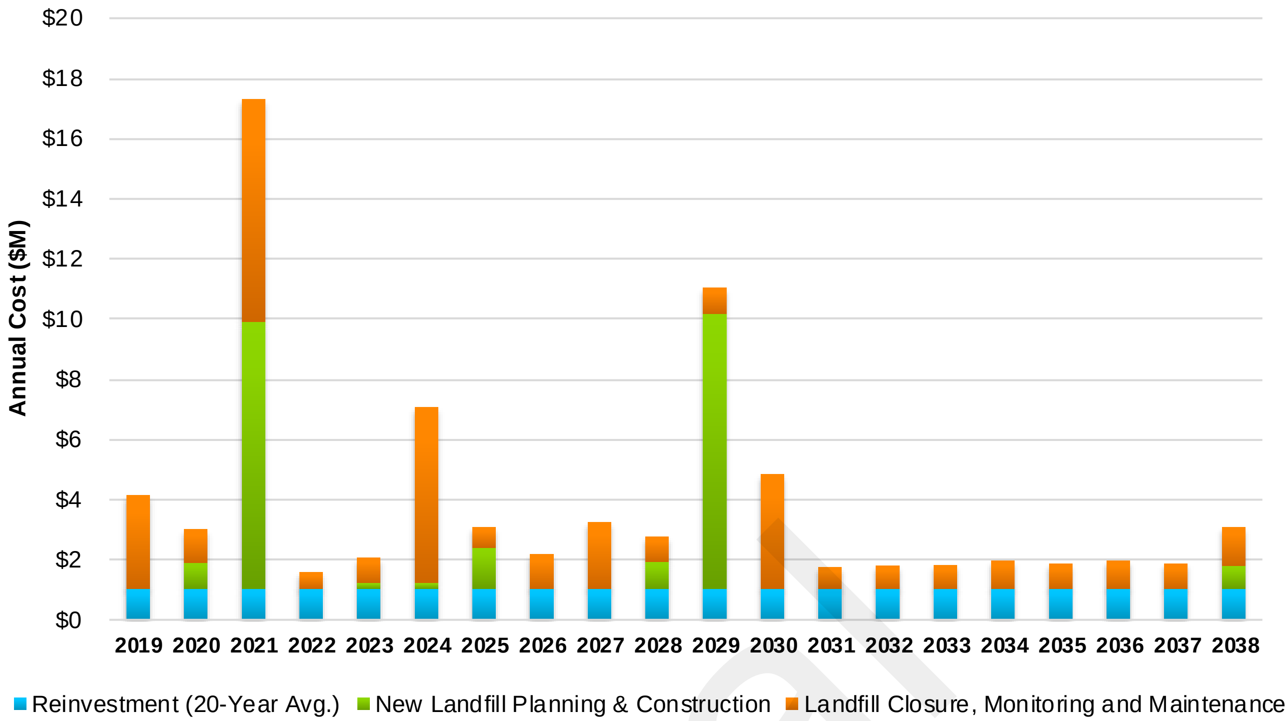


Figure 19 – CSWM Annual Reinvestment, New Landfill Planning & Construction and Landfill Closure, Monitoring and Maintenance

6.2 Replacement of Urgent / High Risk Assets

Figure 17 **presents the funding needs for the period 2019 – 2038 and highlights the investment needs over the short term (i.e., 2019).** Please refer to **Appendix C** for a summary listing of assets that are at, or soon approaching their ESL, and / or assets with a high-risk value that theoretically, at the very least, require replacement or major renewal within the immediate future. AECOM recommends that the CSWM service firstly review the list of assets presented in **Appendix C** to confirm the validity of the age and ESLs, condition and criticality scores and replacement values. Should the data presented be correct, then **the CSWM service should act to replace the assets identified in the list as a matter of urgency to avoid the catastrophic failure of these assets.**

6.3 Implement CMMS and DSS to Support AM

As part of the overall AM assignment, AECOM has developed two technical memoranda outlining the functional requirements for a computerized maintenance management system (CMMS)[6] and a Decision Support System (DSS)[7], respectively. CVRD has recently purchased the Cityworks CMMS and is currently focusing implementation in the Water Department. **AECOM recommends that the CSWM service also implements Cityworks and proceeds with procuring and implementing a DSS for its assets**. **Figure 20** presents a diagrammatical summary of the beneficial use of a CMMS and DSS to support short-term / operational planning, medium-term / tactical planning and, ultimately, long-term / strategic planning.

[6] AECOM (2018): Computerized Maintenance Management System (CMMS) Functional Requirements.
[7] AECOM (2018): Decision Support System (DSS) Functional Requirements.

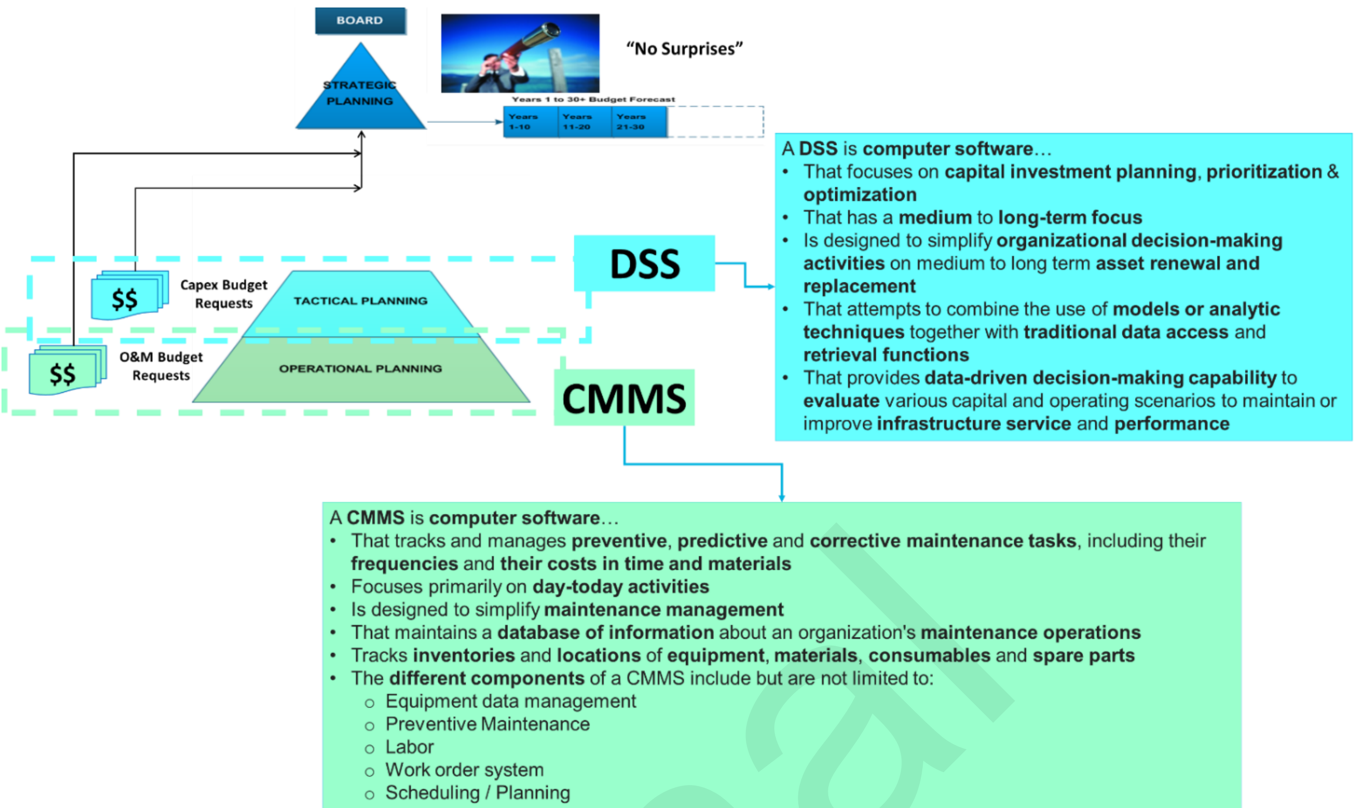


Figure 20 – The Beneficial Use of a CMMS and DSS to Support Asset Management and Strategic Planning

To ensure a successful CMMS and / or DSS implementation, the CSWM service should allow for the allocation of adequate organizational resources (cost and labour) to successfully implement a new system(s), and to adequately plan for the internal change management required to successfully implement the new system(s).

6.4 LoS

Section 3 presented an overview of the Customer and Technical LoS identified for the CSWM, which is informed by the various LoS that solid waste systems on Vancouver Island and in the rest of Canada are measuring and reporting on. **AECOM recommends that the CSWM service investigates the NSWBI and the benchmarking work completed by AVICC, and to build out its capabilities to measure its performance in terms of a similar range of metrics relevant to the CVSS**. This will enable the CSWM service to report its performance to its Board and stakeholders in a "language" that is consistent with most of its Canadian peer agencies and learn from and share in the best AM practices applied at these agencies.

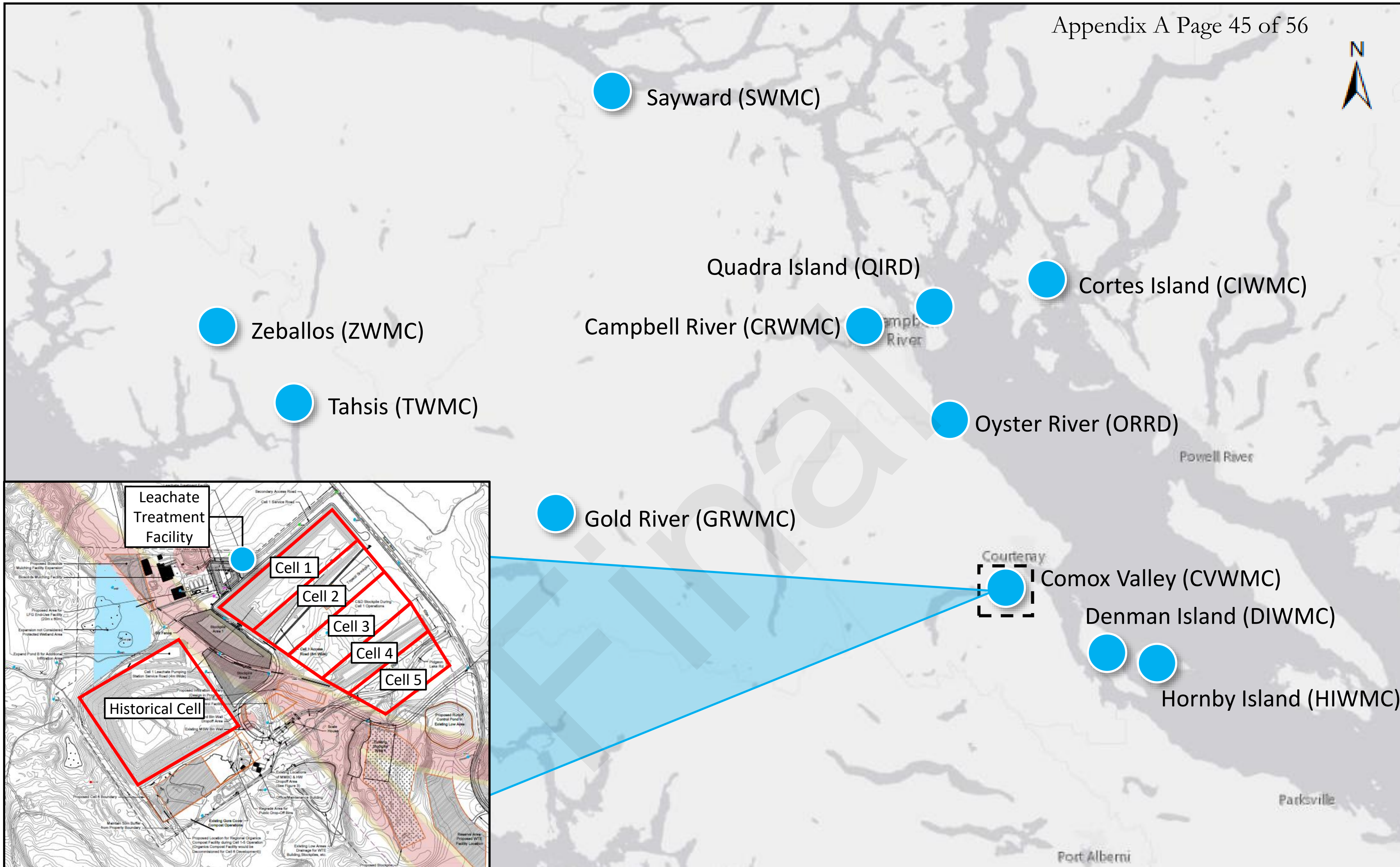
6.5 Recommendations for Data Improvements

Informed asset management decision-making relies on information that is accurate, complete and reliable. Having gained some understanding of the current state of infrastructure data of the CSWM, **AECOM makes the following recommendations for improving the data:**

- Develop a list of standard facility / asset naming conventions to be used by all staff.
- Improve the spatial accuracy of data for linear and non-linear infrastructure and develop a means by which the data can be matched, through an ID field, to the GIS database.
- Update the GIS database to reflect current inventory developed for this assignment. This task may be promoted through the next recommendation.

- There is a need for GIS to be deployed in the field so that staff are less dependent on paper maps and can perform updates in the field.
- A work process is needed whereby all data collected in field books gets updated in GIS (e.g., always opening a work ticket when changes in GIS are needed).
- The CSWM service needs to ensure on an ongoing basis that as-built information is correctly uploaded to GIS and the future CMMS.
- A document management system is needed to store O&M manuals. There is also the need to store pictures from the field in a central location.
- A formal procedure is needed whereby the CVRD's statement of tangible capital assets is kept up to date. New entries should be documented with enough detail to ascertain what exactly is included in the cost entry.
- Develop standards, procedures, and controls to clearly identify and define what infrastructure asset data exists, who is accountable for managing it, methods of data collection, and ensuring data quality. Benefits of such "data governance standards" will include:
  - Improved confidence in decision making and reporting on the CVRD's infrastructure assets.
  - Improved enforcement of asset data integrity for engineering and financial analysis.
- Develop a strategy for the management and documentation of "Inactive" assets to minimize risks (i.e., safety and environmental) and costs associated with their decommissioning / disposal.

APPENDIX A –
LOCATION PLAN FOR CSWM ASSETS



Comox Valley REGIONAL DISTRICT

Project No	Date
60565872	Nov 2019

Comox Valley Regional District

Asset Management Plan: Comox Strathcona Waste Management

Legend

Solid Waste Management Centres

0 15 30 60 90 120 Kilometers

AECOM

Figure 1

APPENDIX B –
CSWM ASSET INVENTORY

Location	System	Subsystem	Asset Class	Asset Type	Item	Manufacturer	Quantity1	Unit	Install Year	Replacement Cost ($)	ESL	Age	Apparent Age	Condition Rating	CoF Score (1 to 5)	PoF Score (1 to 5)	Risk Score (1 to 25)	1st Repl. YR
CIWMC			Site Maintenance	Roadway	Asphalt			M2	1996	$65,090	8	23	6	3	1	2	2	2021
CIWMC			Structural	Exterior Wall	Bin Wall			M	1996	$65,090	40	23	17	2	1	1	1	2042
CIWMC			Structural	Exterior Wall	Bin Wall			M	2014	$27,602	40	5	6	2	1	1	1	2053
CIWMC			Mechanical	Tank	Oil Holding Tank	Tidy Tank	1	M3	2012	$5,743	40	7	9	1	3	1	3	2050
CIWMC			Structural	Exterior Wall	Railing			M	2016	$29,183	40	3	17	2	1	1	1	2042
CIWMC			Structural	Building	Recycling Building			M2	2011	$366,144	45	8	28	3	1	2	2	2036
CIWMC			Structural	Building	Recycling Building			M2	2011	$434,147	45	8	10	1	1	1	1	2054
CIWMC			Equipment	Vehicle	Skid Steer	CAT	1	EA	2016	$86,878	7	3	2	1	1	1	1	2024
CRWMC			Site Maintenance	Roadway	Asphalt			M2	2012	$285,893	8	7	4	2	1	1	1	2023
CRWMC			Site Maintenance	Roadway	Asphalt		1	EA	2011	$122,438	8	8	8		1	4	4	2019
CRWMC			Site Maintenance	Fence	Bear Fence			M	2014	$88,326	15	5	4	1	2	1	2	2030
CRWMC			Electrical	Generator	Diesel Generator		1	EA	2015	$47,762	35	4	5	1	3	1	3	2049
CRWMC			Structural	Building	Drywall		1,984	M2	2012	$57,434	25	7	6	1	1	1	1	2038
CRWMC			Structural	Well	Groundwater Monitoring Well			M2	1999	$118,326	40	20	21	3	1	2	2	2038
CRWMC			Structural	Well	Groundwater Monitoring Well		1	EA	1993	$12,500	40	26	25	3	1	2	2	2034
CRWMC			Structural	Well	Groundwater Monitoring Well		4	EA	1994	$50,000	40	25	25	3	1	2	2	2034
CRWMC			Structural	Well	Groundwater Monitoring Well		5	EA	1999	$62,500	40	20	21	3	1	2	2	2038
CRWMC			Structural	Well	Groundwater Monitoring Well		1	EA	2000	$12,500	40	19	17	2	1	1	1	2042
CRWMC			Structural	Well	Groundwater Monitoring Well		4	EA	2004	$50,000	40	15	17	2	1	1	1	2042
CRWMC			Structural	Well	Groundwater Monitoring Well		4	EA	2011	$50,000	40	8	9	2	1	1	1	2050
CRWMC			Structural	Well	Groundwater Monitoring Well		1	EA	2016	$12,500	40	3	4	1	1	1	1	2055
CRWMC			Structural	Well	Groundwater Monitoring Well		2	EA	2018	$25,000	40	1	2	1	1	1	1	2057
CRWMC			Structural	Building	HHW building				2019	$64,181	45	0	0	1	1	1	1	2064
CRWMC			Structural	Building	Office Trailer			M2	2013	$73,048	45	6	7	2	1	1	1	2057
CRWMC			Mechanical	Tank	Oil Holding Tank		1	M3	2012	$4,595	40	7	9	1	3	1	3	2050
CRWMC			Structural	Building	Scale building			M2	1995	$230,982	45	24	19	2	3	1	3	2045
CRWMC			Mechanical	Container	Shipping Container		1	EA	2015	$16,642	30	4	7	1	1	1	1	2042
CRWMC			Mechanical	Container	Shipping Container		1	EA	2014	$16,561	30	5	7	1	1	1	1	2042
CRWMC			Mechanical	Container	Shipping Container		1	EA	2015	$8,118	30	4	7	1	1	1	1	2042
CRWMC			Structural	Exterior Wall	Tipping Wall		1	EA	2011	$352,456	40	8	8		1	1	1	2051
CRWMC			Structural	Building	Transfer Station			M2	2011	$714,041	45	8	10	1	1	1	1	2054
CRWMC			Structural	Well	Water Well			M2	2005	$258,354	40	14	15	2	1	1	1	2044
CRWMC			Electronics	Instrument	Weight Scale		1	EA	1996	$375,000	15	23	7	2	1	1	1	2027
CRWMC			Landfill Maintenance	MSE Wall				M2	2014	$2,716,098	100	5	6	1	2	1	2	n/a
CRWMC			Electronics	Software			1	EA	2012	$52,199	3	7	2	1	1	2	2	2020
CVWMC			Mechanical	Welding Machine	Arc Welding Machine	Hobart	1	EA	2005	$13,195	10	14	5	2	1	1	1	2024
CVWMC			Site Maintenance	Roadway	Asphalt		5,000	M2	2017	$135,607	8	2	3	1	1	1	1	2024
CVWMC			Site Maintenance	Roadway	Asphalt		2,500	M2	2013	$153,347	8	6	4	2	1	1	1	2023
CVWMC			Site Maintenance	Roadway	Asphalt		1,750	M2	2013	$87,500	8	6	4	2	1	1	1	2023
CVWMC			Site Maintenance	Roadway	Asphalt		1,575	M2	2018	$78,750	8	1	3	1	1	1	1	2024
CVWMC			Site Maintenance	Roadway	Asphalt		5,000	M2	2013	$250,000	8	6	4	2	1	1	1	2023
CVWMC			Site Maintenance	Fence	Bear Fence		2,000	M	2004	$126,170	15	15	10	3	2	2	4	2024
CVWMC			Structural	Exterior Wall	Bin Wall	Design: Wedler Eng	30	M	2013	$77,635	40	6	25	3	1	2	2	2034
CVWMC			Site Maintenance	Fence	Chain link fence		3,000	M	2014	$135,250	15	5	6	2	3	1	3	2028
CVWMC			Mechanical	Filter	Chemical Free Filter		1	EA	2019	$3,275	20	0	0	1	1	1	1	2039
CVWMC			Equipment	Vehicle	Compactor	Bomag	1	EA	2013	$879,372	7	6	5	3	3	2	6	n/a
CVWMC			Mechanical	Cover	Compost Cover System	Gore Cover System	2	EA	2015	$257,078	5	4	5	4	1	4	4	n/a
CVWMC			Electrical	Generator	Diesel Generator	Kubota	1	EA	2014	$52,261	35	5	6	2	3	1	3	2048
CVWMC			Equipment	Vehicle	Dozer	John Deere	1	EA	2017	$681,524	7	2	2	1	3	1	3	2024
CVWMC			Structural	Building	Drywall	Absolutely Covered	1,664	M2	2018	$51,000	25	1	2	1	1	1	1	2042
CVWMC			Equipment	Vehicle	Excavator	CAT	1	EA	2016	$481,767	10	3	4	2	1	1	1	2025
CVWMC			Mechanical	Tank	Fuel Storage	Tidy Tank	4	M3	2017	$15,216	40	2	3	1	4	1	4	2056
CVWMC			Equipment	Vehicle	Gravel Truck	Sterling	1	EA	2007	$174,635	10	12	7	3	2	2	4	2022
CVWMC			Structural	Well	Groundwater Monitoring Well		3	EA	1993	$37,500	40	26	25	3	1	2	2	2034
CVWMC			Structural	Well	Groundwater Monitoring Well		7	EA	1995	$87,500	40	24	25	3	1	2	2	2034
CVWMC			Structural	Well	Groundwater Monitoring Well		1	EA	1999	$12,500	40	20	21	3	1	2	2	2038
CVWMC			Structural	Well	Groundwater Monitoring Well		11	EA	2001	$137,500	40	18	17	2	1	1	1	2042
CVWMC			Structural	Well	Groundwater Monitoring Well		3	EA	2012	$37,500	40	7	8	2	1	1	1	2051
CVWMC			Structural	Well	Groundwater Monitoring Well		1	EA	2013	$12,500	40	6	7	2	1	1	1	2052
CVWMC			Structural	Well	Groundwater Monitoring Well		3	EA	2016	$37,500	40	3	4	1	1	1	1	2055
CVWMC			Structural	Building	Office Trailer	ATCO	1	EA	2015	$189,363	45	4	19	2	1	1	1	2045
CVWMC			Mechanical	Tank	Oil Holding Tank	Tidy Tank	1	M3	2015	$4,330	40	4	5	1	3	1	3	2054
CVWMC			Electrical	Lighting	Outdoor Lighting			EA	2011	$45,276	15	8	4	1	1	1	1	2030
CVWMC			Equipment	Vehicle	Pick-Up Truck	GMC	1	EA	2014	$41,302	10	5	5	2	1	1	1	2024

Location	System	Subsystem	Asset Class	Asset Type	Item	Manufacturer	Quantity1	Unit	Install Year	Replacement Cost ($)	ESL	Age	Apparent Age	Condition Rating	CoF Score (1 to 5)	PoF Score (1 to 5)	Risk Score (1 to 25)	1st Repl. YR
CVWMC			Equipment	Vehicle	Pick-Up Truck	Chevrolet	1	EA	2015	$43,226	10	4	5	2	1	1	1	2024
CVWMC			Mechanical	Pump	Portable water pump	Honda	1	EA	2008	$1,554	20	11	9	2	1	1	1	2030
CVWMC			Mechanical	Pump	Portable water pump	Gorman Rupp	1	EA	2017	$69,573	20	2	3	1	3	1	3	2036
CVWMC			Mechanical	Tank	Pressure Tank		1	EA	2019	$508	40	0	0	1	1	1	1	2059
CVWMC			Mechanical	Tank	Pressure Tank		1	EA	2019	$1,474	40	0	0	1	1	1	1	2059
CVWMC			Mechanical	Pipe	PVC			M	2019	$18,013	25	0	0	1	1	1	1	2044
CVWMC			Mechanical	Screen	Rock Screener			M2	2017	$16,256	20	2	9	2	1	1	1	2030
CVWMC			Equipment	Vehicle	Roll-Off Truck	Sterling	1	EA	2008	$183,046	10	11	9	4	1	3	3	2020
CVWMC			Equipment	Vehicle	Roll-Off Truck*	Freightliner	1	EA	1989	$217,929	10	30	9	4	1	3	3	n/a
CVWMC			Structural	Building	Scale building			M2	2007	$118,898	45	12	13	2	1	1	1	2051
CVWMC			Mechanical	Container	Shipping Container	Sea Can	1	EA	2010	$8,963	30	9	7	1	1	1	1	2042
CVWMC			Mechanical	Container	Shipping Container	Sea Can	1	EA	2007	$12,977	30	12	13	2	1	1	1	2036
CVWMC			Mechanical	Container	Shipping Container	Sea Can	2	EA	2012	$77,242	30	7	8	2	1	1	1	2041
CVWMC			Structural	Building	Shop building		1	EA	2000	$448,097	45	19	20	3	1	1	1	2044
CVWMC			Electrical	Protection	Surge Arrester			EA	2000	$11,278	10	19	3	1	1	1	1	2026
CVWMC			Site Electrical	Site Lighting	Traffic Light System		1	EA	2015	$55,475	15	4	4	1	1	1	1	2030
CVWMC			Equipment	Vehicle	Utility Vehicle	Kubota	1	EA	2018	$31,409	7	1	2	1	1	1	1	2024
CVWMC			Mechanical	Filter	UV Filter		1	EA	2019	$2,055	20	0	0	1	1	1	1	2039
CVWMC			Electronics	Control	VFD		1	EA	2019	$2,047	15	0	0	1	1	1	1	2034
CVWMC			Mechanical	Tank	Water Storage		10	M3	2000	$13,379	40	19	17	2	1	1	1	2042
CVWMC			Mechanical	Tank	Water Storage		2	EA	2019	$14,738	40	0	0	1	1	1	1	2059
CVWMC			Structural	Well	Water Well	Red Williams Well D	1	EA	2018	$15,555	40	1	2	1	1	1	1	2057
CVWMC			Electronics	Instrument	Weight Scale	Unknown	1	EA	2011	$358,204	15	8	4	1	4	1	4	2030
CVWMC			Equipment	Vehicle	Wheel Loader	CAT	1	EA	2018	$98,175	10	1	5	2	1	1	1	2024
CVWMC			Equipment	Vehicle	Wheel Loader	Volvo	1	EA	2012	$352,203	10	7	5	2	1	1	1	2024
CVWMC			Equipment	Vehicle	Wheel Loader	CAT	1	EA	2016	$397,422	10	3	4	2	1	1	1	2025
CVWMC			Mechanical	Pump			1	EA	2019	$753	40	0	0	1	1	1	1	2059
CVWMC			Mechanical	Pump			1	EA	2018	$1,658	40	1	2	1	1	1	1	2057
CVWMC			Mechanical	Pump			1	EA	2019	$3,003	40	0	0	1	1	1	1	2059
CVWMC			Electronics	Software		PIS and MS		EA	2011	$130,291	3	8	2	1	4	2	8	2020
CVWMC			Structural	Building				M2	2011	$467,340	45	8	9	2	2	1	2	2055
CVWMC-1			Landfill Maintenance	Cover	Cover Plate		1	EA	2013	$8,780	10	6	11	5	1	4	4	n/a
CVWMC-1			Landfill Maintenance	Cover	Cover Plate	Imperial Welding	3	EA	2017	$22,775	10	2	3	2	1	1	1	n/a
CVWMC-1			Landfill Maintenance	Liner		Tetra Tech Design, \	49,000	M2	2017	$1,118,688	100	2	3	1	5	1	5	n/a
CVWMC-1			Landfill Maintenance	Collection System		Tetra Tech Design, \	513,000	M3	2017	$2,882,033	100	2	3	1	5	1	5	n/a
GLOBAL			Mechanical	Bin	Drywall		2	EA	2012	$41,414	40	7	8	2	3	1	3	2051
GLOBAL			Mechanical	Container	MMBC Container		6	EA	2014	$121,963	30	5	7	1	1	1	1	2042
GLOBAL			Mechanical	Bin	Roll off Bin		1	EA	2013	$8,140	20	6	7	2	3	1	3	2032
GLOBAL			Mechanical	Bin	Roll off Bin		1	EA	2017	$27,253	20	2	3	1	3	1	3	2036
GLOBAL			Mechanical	Bin	Roll off Bin		3	EA	2012	$42,229	20	7	8	2	3	1	3	2031
GLOBAL			Mechanical	Bin	Roll off Bin		3	EA	2011	$36,346	20	8	9	3	3	1	3	2030
GLOBAL			Mechanical	Bin	Roll off Bin		3	EA	2006	$135,386	20	13	13	3	3	2	6	2026
GLOBAL			Mechanical	Bin	Roll off Bin		1	EA	1999	$12,049	20	20	13	3	1	2	2	2026
GLOBAL			Mechanical	Bin	Roll off Bin		6	EA	2007	$71,010	20	12	13	3	3	2	6	2026
GLOBAL			Mechanical	Bin	Roll off Bin		6	EA	2017	$81,398	20	2	3	1	3	1	3	2036
GLOBAL			Mechanical	Bin	Roll off Bin		6	EA	2010	$66,552	20	9	10	3	3	1	3	2029
GLOBAL			Mechanical	Bin	Self Tipper		4	EA	2017	$10,701	20	2	3	1	1	1	1	2036
GLOBAL			Mechanical	Container	Steel Container		1	EA	2012	$11,615	30	7	8	2	3	1	3	2041
GRWMC			Site Maintenance	Roadway	Asphalt			M2	2007	$77,602	8	12	6	3	1	2	2	2021
GRWMC			Structural	Exterior Wall	Bin Wall			M	2016	$127,233	40	3	17	2	1	1	1	2042
GRWMC			Structural	Well	Groundwater Monitoring Well		4	EA	1993	$50,000	40	26	25	3	1	2	2	2034
GRWMC			Structural	Well	Groundwater Monitoring Well		2	EA	2002	$25,000	40	17	17	2	1	1	1	2042
GRWMC			Structural	Well	Groundwater Monitoring Well		3	EA	2016	$37,500	40	3	4	1	1	1	1	2055
GRWMC			Structural	Exterior Wall	Railing			M	2016	$34,489	40	3	19	2	1	1	1	2040
HIWMC			Equipment	Vehicle	Backhoe	CAT420 D	1	EA	2001	$63,579	10	18	5	2	1	1	1	2024
HIWMC			Equipment	Vehicle	Baler		1	EA	2008	$15,542	7	11	4	2	1	2	2	2022
HIWMC			Equipment	Vehicle	Baler		1	EA	2007	$12,500	7	12	5	3	1	2	2	2021
HIWMC			Equipment	Vehicle	Baler		1	EA	2007	$12,500	7	12	5	3	1	2	2	2021
HIWMC			Structural	Exterior Wall	Bin Wall			M	1995	$50,264	40	24	17	2	1	1	1	2042
HIWMC			Structural	Exterior Wall	Bin Wall			M	1995	$50,264	40	24	17	2	1	1	1	2042
HIWMC			Site Maintenance	Fence	Chain link fence		3	M	2018	$8,420	15	1	2	1	1	1	1	2032
HIWMC			Site Maintenance	Fence	Chain link fence		5	M	2018	$8,327	15	1	2	1	1	1	1	2032
HIWMC			Structural	Building	Free Store			M2	2014	$234,617	45	5	28	3	1	2	2	2036
HIWMC			Mechanical	Tank	Oil Holding Tank	Tidy Tank	1	M3	2012	$5,743	40	7	9	1	3	1	3	2050
HIWMC			Structural	Exterior Wall	Railing				2016	$34,489	40	3	17	2	1	1	1	2042

Location	System	Subsystem	Asset Class	Asset Type	Item	Manufacturer	Quantity1	Unit	Install Year	Replacement Cost ($)	ESL	Age	Apparent Age	Condition Rating	CoF Score (1 to 5)	PoF Score (1 to 5)	Risk Score (1 to 25)	1st Repl. YR
HIWMC			Mechanical	Tank	Rain water storage	Barr Plastics		M3	2016	$4,643	40	3	4	1	1	1	1	2055
HIWMC			Mechanical	Tank	Rain water storage	Barr Plastics		M3	2015	$4,059	40	4	5	1	1	1	1	2054
HIWMC			Mechanical	Tank	Rain water storage	Barr Plastics		M3	2010	$2,988	40	9	9	1	1	1	1	2050
HIWMC			Mechanical	Tank	Rain water storage	Barr Plastics		M3	2010	$2,988	40	9	9	1	1	1	1	2050
HIWMC			Structural	Building	Recycling Building			M2	2011	$401,554	45	8	9	2	1	1	1	2055
HIWMC			Structural	Building	Sheet Metal			M2	2019	$71,250	45	0	0	1	1	1	1	2064
HIWMC			Structural	Building	Sheet Metal			M2	2015	$76,512	45	4	5	1	1	1	1	2059
HIWMC			Structural	Building	Sheet Metal			M2	2000	$45,525	45	19	19	2	1	1	1	2045
HIWMC			Mechanical	Container	Shipping Container	Sea Can	1	EA	2015	$6,765	30	4	5	2	1	1	1	2044
HIWMC			Mechanical	Container	Shipping Container	Sea Can	1	EA	2017	$5,202	30	2	3	1	1	1	1	2046
HIWMC			Mechanical	Container	Shipping Container	Sea Can	1	EA	2017	$5,202	30	2	3	1	1	1	1	2046
HIWMC			Mechanical	Container	Shipping Container	Sea Can	1	EA	2015	$4,059	30	4	7	1	1	1	1	2042
HIWMC			Mechanical	Tank	Water Storage			M3	2015	$5,412	40	4	25	3	1	2	2	2034
HIWMC			Structural	Building		N/A		EA	2007	$12,500	45	12	10	1	1	1	1	2054
LFG/CVWM	Extraction System	LFG Feed Isolatio	Mechanical	Valve	Actuated Valve	ABZ (valve), EMERS	1	EA	2016	$7,959	35	3	4	1	2	1	2	2050
LFG/CVWM	Gas Destruction System	Flare System	Mechanical	Valve	Actuated Valve	ABZ	1	EA	2016	$7,959	35	3	4	1	3	1	3	2050
LFG/CVWM	Electrical Building	System Support-C	Mechanical	Compressor	Air Compressor	Chicago Pneumatic	1	EA	2016	$26,530	20	3	5	1	2	1	2	2034
LFG/CVWM	Electrical Building	System Support-C	Mechanical	Compressor	Air Compressor	Chicago Pneumatic	1	EA	2016	$26,530	20	3	5	1	2	1	2	2034
LFG/CVWM	Electrical Building	System Support-H	Mechanical	HVAC	Air Conditioner	Bard	1	EA	2016	$22,425	30	3	4	1	1	1	1	2045
LFG/CVWM	Gas Destruction System	Flare System	Mechanical	Valve	Air Control Valve	-	1	EA	2016	$10,612	35	3	4	1	3	1	3	2050
LFG/CVWM	Electrical Building	System Support-C	Mechanical	Dryer	Air Dryer		1	EA	2016	$3,980	20	3	5	1	1	1	1	2034
LFG/CVWM	Electrical Building	System Support-C	Mechanical	Dryer	Air Dryer		1	EA	2016	$3,980	20	3	5	1	1	1	1	2034
LFG/CVWM	Electrical Building	System Support-C	Mechanical	Tank	Air Receiver		1	EA	2016	$2,653	40	3	4	1	1	1	1	2055
LFG/CVWM	Electrical Building	System Support-C	Mechanical	Tank	Air Receiver		1	EA	2016	$2,653	40	3	4	1	1	1	1	2055
LFG/CVWM	Extraction System	Blower System	Mechanical	Valve	Butterfly Valve	ABZ	1	EA	2016	$3,316	35	3	4	1	2	1	2	2050
LFG/CVWM	Extraction System	Blower System	Mechanical	Valve	Butterfly Valve	ABZ	1	EA	2016	$3,316	35	3	4	1	2	1	2	2050
LFG/CVWM	Extraction System	Blower System	Mechanical	Valve	Butterfly Valve	ABZ	1	EA	2016	$3,316	35	3	4	1	2	1	2	2050
LFG/CVWM	Extraction System	Blower System	Mechanical	Valve	Butterfly Valve	ABZ	1	EA	2016	$3,316	35	3	4	1	2	1	2	2050
LFG/CVWM	Gas Destruction System	Flare System	Mechanical	Valve	Butterfly Valve	ABZ	1	EA	2016	$3,316	35	3	4	1	2	1	2	2050
LFG/CVWM	Collection Network		Mechanical	Valve	Butterfly Valve	Chemline Plastics	1	EA	2016	$1,990	35	3	4	1	1	1	1	2050
LFG/CVWM	Collection Network		Mechanical	Valve	Butterfly Valve	Chemline Plastics	1	EA	2016	$1,990	35	3	4	1	1	1	1	2050
LFG/CVWM	Collection Network		Mechanical	Valve	Butterfly Valve	Chemline Plastics	1	EA	2016	$1,990	35	3	4	1	1	1	1	2050
LFG/CVWM	Collection Network		Mechanical	Valve	Butterfly Valve	Chemline Plastics	1	EA	2016	$1,990	35	3	4	1	1	1	1	2050
LFG/CVWM	Gas Destruction System	Flare System	Mechanical	Flare	Candlestick flare	PEI	1	EA	2016	$509,623	20	3	5	1	3	1	3	2034
LFG/CVWM	Extraction System	Blower System	Mechanical	Blower	Centrifugal	National Turbine Co	1	EA	2016	$39,795	20	3	5	1	2	1	2	2034
LFG/CVWM	Extraction System	Blower System	Mechanical	Blower	Centrifugal	National Turbine Co	1	EA	2016	$39,795	20	3	5	1	2	1	2	2034
LFG/CVWM	Extraction System	Blower System	Mechanical	Valve	Check Valve	Flexi-Hinge	1	EA	2016	$3,316	35	3	4	1	2	1	2	2050
LFG/CVWM	Extraction System	Blower System	Mechanical	Valve	Check Valve	Flexi-Hinge	1	EA	2016	$3,316	35	3	4	1	2	1	2	2050
LFG/CVWM	Condensate Management		Structural	Chamber	Concrete Chamber	-	1	EA	2016	$6,633	40	3	4	1	1	1	1	2055
LFG/CVWM	Condensate Management		Structural	Chamber	Concrete Chamber	-	1	EA	2016	$6,633	40	3	4	1	1	1	1	2055
LFG/CVWM	Condensate Management		Structural	Chamber	Concrete Chamber	-	1	EA	2016	$6,633	40	3	4	1	1	1	1	2055
LFG/CVWM	Condensate Management		Mechanical	Pump	Condensate Pump	Pump: AutoPump	1	EA	2016	$7,959	40	3	4	1	3	1	3	2055
LFG/CVWM	Condensate Management		Mechanical	Valve	Condensate Sump Colle	Challenger Valve	1	EA	2016	$3,980	35	3	4	1	1	1	1	2050
LFG/CVWM	Condensate Management		Mechanical	Valve	Condensate Sump Colle	Challenger Valve	1	EA	2016	$3,980	35	3	4	1	1	1	1	2050
LFG/CVWM	Condensate Management		Mechanical	Valve	Condensate Sump Colle	Challenger Valve	1	EA	2016	$3,980	35	3	4	1	1	1	1	2050
LFG/CVWM	Condensate Handling	Condensate Tank	Mechanical	Tank	Condensate Tank	ZCL	1	EA	2016	$5,306	40	3	4	1	1	1	1	2055
LFG/CVWM	Electrical Building	System Support-H	Mechanical	HVAC	Electric Heater	Hoffman	1	EA	2016	$6,043	30	3	4	1	1	1	1	2045
LFG/CVWM	Electrical Building	System Support-H	Mechanical	HVAC	Electric Heater	Hoffman	1	EA	2016	$6,043	30	3	4	1	1	1	1	2045
LFG/CVWM	Gas Destruction System	Flare System	Fire Protection	Fire Suppression	Flame Arrester	Groth	1	EA	2016	$6,633	20	3	5	1	4	1	4	2034
LFG/CVWM	Gas Destruction System	Flow Monitoring	Electronics	Instrument	Flow Meter	LandTec	1	EA	2016	$13,265	15	3	4	1	3	1	3	2030
LFG/CVWM	Electrical Building	Gas Monitors	Electronics	Instrument	Gas Sensor	AMC	1	EA	2016	$195	15	3	4	1	3	1	3	2030
LFG/CVWM	Extraction System	Gas Analyzer Sys	Electronics	Instrument	Gas Sensor	LandTec	1	EA	2016	$31,120	15	3	4	1	3	1	3	2030
LFG/CVWM	Collection Network		Mechanical	Pipe	HDPE		1	EA	2016	$195,375	25	3	4	1	1	1	1	2040
LFG/CVWM	Gas Destruction System	Gas Pilot System	Mechanical	Flare	Ignitor	Auburn Ignition Prod	1	EA	2016	$1,327	20	3	5	1	1	1	1	2034
LFG/CVWM	Extraction System	Moisture Removal	Mechanical	Compressed Air T	Knock-Out/ Demister Vessel		1	EA	2016	$6,633	20	3	5	1	2	1	2	2034
LFG/CVWM	Extraction System	Moisture Removal	Electronics	Instrument	Level Switch	Flowline	1	EA	2016	$6,633	15	3	4	1	1	1	1	2030
LFG/CVWM	Electrical Building	System Control ar	Electrical	Electrical Service	Lighting Panel	To be Provided	1	EA	2016	$6,633	15	3	4	1	3	1	3	2030
LFG/CVWM	Gas Destruction System	Gas Pilot System	Mechanical	Hose	Metal Flexible Hose	McMaster-Carr	1	EA	2016	$1,327	10	3	3	1	1	1	1	2026
LFG/CVWM	Gas Destruction System	Gas Pilot System	Mechanical	Hose	Metal Flexible Hose	McMaster-Carr	1	EA	2016	$1,327	10	3	3	1	1	1	1	2026
LFG/CVWM	Extraction System	Moisture Removal	Mechanical	Hose	Metal Flexible Hose	CenFlex	1	EA	2016	$1,327	10	3	3	1	1	1	1	2026
LFG/CVWM	Extraction System	Blower System	Mechanical	Hose	Metal Flexible Hose	CenFlex	1	EA	2016	$1,327	10	3	3	1	1	1	1	2026
LFG/CVWM	Extraction System	Blower System	Mechanical	Hose	Metal Flexible Hose	CenFlex	1	EA	2016	$1,327	10	3	3	1	1	1	1	2026
LFG/CVWM	Extraction System	Blower System	Mechanical	Hose	Metal Flexible Hose	CenFlex	1	EA	2016	$1,327	10	3	3	1	1	1	1	2026
LFG/CVWM	Extraction System	Blower System	Mechanical	Hose	Metal Flexible Hose	CenFlex	1	EA	2016	$1,327	10	3	3	1	1	1	1	2026

Location	System	Subsystem	Asset Class	Asset Type	Item	Manufacturer	Quantity1	Unit	Install Year	Replacement Cost ($)	ESL	Age	Apparent Age	Condition Rating	CoF Score (1 to 5)	PoF Score (1 to 5)	Risk Score (1 to 25)	1st Repl. YR
LFG/CVWM	Gas Destruction System	Flare System	Mechanical	Hose	Metal Flexible Hose	CenFlex	1	EA	2016	$1,327	10	3	3	1	1	1	1	2026
LFG/CVWM	Gas Destruction System	Gas Pilot System	Mechanical	Flare	Pilot	-	1	EA	2016	$3,316	20	3	5	1	3	1	3	2034
LFG/CVWM	Collection Network		Structural	Chamber	Plastic Chamber	Chemline Plastics	1	EA	2016	$1,327	40	3	4	1	1	1	1	2055
LFG/CVWM	Collection Network		Structural	Chamber	Plastic Chamber	Chemline Plastics	1	EA	2016	$1,327	40	3	4	1	1	1	1	2055
LFG/CVWM	Collection Network		Structural	Chamber	Plastic Chamber	Chemline Plastics	1	EA	2016	$1,327	40	3	4	1	1	1	1	2055
LFG/CVWM	Collection Network		Structural	Chamber	Plastic Chamber	Chemline Plastics	1	EA	2016	$1,327	40	3	4	1	1	1	1	2055
LFG/CVWM	Electrical Building	System Control ar	Electronics	Control	PLC	DirectLogic	1	EA	2016	$42,448	15	3	4	1	4	1	4	2030
LFG/CVWM	Electrical Building	System Control ar	Electrical	Electrical Service	Power Panel	To be Provided	1	EA	2016	$82,244	25	3	4	1	3	1	3	2040
LFG/CVWM	Electrical Building	System Control ar	Electrical	Electrical Service	Power Supply	idec	1	EA	2016	$663	25	3	4	1	3	1	3	2040
LFG/CVWM	Electrical Building	System Control ar	Electrical	Electrical Service	Power Supply	idec	1	EA	2016	$663	25	3	4	1	3	1	3	2040
LFG/CVWM	Extraction System	LFG Feed - Temp	Electronics	Instrument	Pressure Gauge	Dwyer	1	EA	2016	$663	15	3	4	1	2	1	2	2030
LFG/CVWM	Extraction System	Moisture Removal	Electronics	Instrument	Pressure Gauge	Dwyer	1	EA	2016	$663	15	3	4	1	2	1	2	2030
LFG/CVWM	Extraction System	Blower System	Electronics	Instrument	Pressure Gauge	Dwyer	1	EA	2016	$663	15	3	4	1	2	1	2	2030
LFG/CVWM	Gas Destruction System	Flare System	Electronics	Instrument	Pressure Gauge	Dwyer	1	EA	2016	$663	15	3	4	1	2	1	2	2030
LFG/CVWM	Gas Destruction System	Gas Pilot System	Mechanical	Tank	Propane Gas Storage	Standard	2	EA	2016	$1,327	40	3	4	1	1	1	1	2055
LFG/CVWM	Gas Destruction System	Gas Pilot System	Mechanical	Valve	Solenoid Valve	ASCO	1	EA	2016	$663	35	3	4	1	3	1	3	2050
LFG/CVWM	Electrical Building	System Control ar	Electrical	Protection	Surge Arrester	Schneider Electric	1	EA	2016	$1,327	10	3	3	1	1	1	1	2026
LFG/CVWM	Electrical Building	System Control ar	Electrical	Protection	Surge Arrester	MCG	1	EA	2016	$1,327	10	3	3	1	1	1	1	2026
LFG/CVWM	Electrical Building	System Control ar	Electrical	Protection	Surge Arrester	MCG	1	EA	2016	$1,327	10	3	3	1	1	1	1	2026
LFG/CVWM	Gas Destruction System	Flare System	Electrical	Wire	T-Couple Wire	Omega	1	EA	2016	$663	2	3	1	1	1	1	1	2020
LFG/CVWM	Gas Destruction System	Flare System	Electrical	Wire	T-Couple Wire	Omega	1	EA	2016	$663	2	3	1	1	1	1	1	2020
LFG/CVWM	Gas Destruction System	Gas Pilot System	Electrical	Wire	T-Couple Wire	-	1	EA	2016	$663	2	3	1	1	1	1	1	2020
LFG/CVWM	Extraction System	LFG Feed - Temp	Electronics	Instrument	Temperature Indicator	Winters	1	EA	2016	$663	15	3	4	1	1	1	1	2030
LFG/CVWM	Extraction System	Blower System	Electronics	Instrument	Temperature Indicator	Winters	1	EA	2016	$663	15	3	4	1	1	1	1	2030
LFG/CVWM	Gas Destruction System	Flare System	Electronics	Instrument	Temperature Switch	Ashcroft	1	EA	2016	$663	15	3	4	1	1	1	1	2030
LFG/CVWM	Gas Destruction System	Flare System	Electronics	Instrument	Thermal Shutoff Valve	Groth	1	EA	2016	$10,612	15	3	4	1	1	1	1	2030
LFG/CVWM	Extraction System	Blower System	Electronics	Instrument	Thermocouple	Omega	1	EA	2016	$663	15	3	4	1	1	1	1	2030
LFG/CVWM	Extraction System	Blower System	Electronics	Instrument	Thermocouple	Omega	1	EA	2016	$663	15	3	4	1	1	1	1	2030
LFG/CVWM	Gas Destruction System	Flare System	Electronics	Instrument	Thermocouple	Pyromation	1	EA	2016	$663	15	3	4	1	1	1	1	2030
LFG/CVWM	Gas Destruction System	Flare System	Electronics	Instrument	Thermocouple	Pyromation	1	EA	2016	$663	15	3	4	1	1	1	1	2030
LFG/CVWM	Electrical Building	Gas Monitors	Electronics	Instrument	Toxic Gas Sensor	AMC	1	EA	2016	$6,633	15	3	4	1	4	1	4	2030
LFG/CVWM	Extraction System	LFG Feed - Temp	Electronics	Instrument	Transmitter-Pressure	Rosemount	1	EA	2016	$1,990	15	3	4	1	3	1	3	2030
LFG/CVWM	Condensate Handling	Condensate Tank	Electronics	Instrument	Ultrasonic Level Sensor	Siemens	1	EA	2016	$3,316	15	3	4	1	1	1	1	2030
LFG/CVWM	Gas Destruction System	Gas Pilot System	Electronics	Instrument	UV Scanner	Honeywell	1	EA	2016	$663	15	3	4	1	3	1	3	2030
LFG/CVWM	Vertical Gas Extraction Network		Mechanical	Well	Vertical LFG Extraction \	LANDTEC (wellheac	1	EA	2016	$36,744	40	3	4	1	2	1	2	2055
LFG/CVWM	Electrical Building	System Control ar	Electronics	Control	VFD	ABB	1	EA	2016	$10,612	15	3	4	1	2	1	2	2030
LFG/CVWM	Electrical Building	System Control ar	Electronics	Control	VFD	ABB	1	EA	2016	$10,612	15	3	4	1	2	1	2	2030
LFG/CVWM	Vertical Gas Extraction Network		Mechanical	Pipe			1	EA	2016	$44,544	25	3	4	1	1	1	1	2040
LTF/CVWM	Instrument air compressor		Mechanical	Compressor	Air Compressor	OMEGA AIR COMPI	1	EA	2017	$13,187	20	2	3	1	2	1	2	2036
LTF/CVWM	Instrument air compressor		Mechanical	Dryer	Air Dryer	GREAT LAKES	1	EA	2017	$1,524	20	2	3	1	2	1	2	2036
LTF/CVWM	Bioreactor		Electronics	Instrument	Ammonium and Nitrate S	HACH	1	EA	2017	$20,760	15	2	4	1	2	1	2	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	Ammonium and Nitrate S	HACH	1	EA	2017	$20,358	15	2	4	1	2	1	2	2030
LTF/CVWM	Sodium hypochlorite dosage		Mechanical	Valve	Back Pressure Valve	CHEMLINE	1	EA	2017	$2,317	35	2	3	1	1	1	1	2051
LTF/CVWM	Hydrochloric acid dosage		Mechanical	Valve	Back Pressure Valve	CHEMLINE	1	EA	2017	$2,317	35	2	3	1	1	1	1	2051
LTF/CVWM	Permeate system		Mechanical	Valve	Back Pressure Valve	CHEMLINE	1	EA	2017	$2,472	35	2	3	1	1	1	1	2051
LTF/CVWM	Permeate system		Mechanical	Valve	Back Pressure Valve	CHEMLINE	1	EA	2017	$2,472	35	2	3	1	1	1	1	2051
LTF/CVWM	C		Electrical	Generator	Diesel Generator	CULLEN	1	EA	2017	$358,379	35	2	3	1	2	1	2	2051
LTF/CVWM	Antifoam agent dosage		Mechanical	Tank	Dilution Tank	ACO CONTAINER	1	EA	2017	$984	40	2	3	1	2	1	2	2056
LTF/CVWM	Polymer dosage		Mechanical	Pump	Dosing Pump	NORCHEM	1	EA	2017	$11,251	10	2	3	1	3	1	3	2026
LTF/CVWM	Antifoam agent dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,782	10	2	3	1	1	1	1	2026
LTF/CVWM	Antifoam agent dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,782	10	2	3	1	1	1	1	2026
LTF/CVWM	Carbon dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,782	10	2	3	1	1	1	1	2026
LTF/CVWM	Carbon dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,782	10	2	3	1	1	1	1	2026
LTF/CVWM	Carbon dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,782	10	2	3	1	1	1	1	2026
LTF/CVWM	Carbon dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,782	10	2	3	1	1	1	1	2026
LTF/CVWM	Citric acid dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$2,012	10	2	3	1	1	1	1	2026
LTF/CVWM	Citric acid dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$2,012	10	2	3	1	1	1	1	2026
LTF/CVWM	Hydrochloric acid dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$2,012	10	2	3	1	1	1	1	2026
LTF/CVWM	Hydrochloric acid dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$2,012	10	2	3	1	1	1	1	2026
LTF/CVWM	Phosphoric acid dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,772	10	2	3	1	1	1	1	2026
LTF/CVWM	Phosphoric acid dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,772	10	2	3	1	1	1	1	2026
LTF/CVWM	Polymer dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,772	10	2	3	1	3	1	3	2026
LTF/CVWM	Sodium hydroxide dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,905	10	2	3	1	1	1	1	2026
LTF/CVWM	Sodium hydroxide dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,905	10	2	3	1	1	1	1	2026

Location	System	Subsystem	Asset Class	Asset Type	Item	Manufacturer	Quantity1	Unit	Install Year	Replacement Cost ($)	ESL	Age	Apparent Age	Condition Rating	CoF Score (1 to 5)	PoF Score (1 to 5)	Risk Score (1 to 25)	1st Repl. YR
LTF/CVWM	Sodium hypochlorite dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$3,314	10	2	3	1	1	1	1	2026
LTF/CVWM	Sodium hypochlorite dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$3,314	10	2	3	1	1	1	1	2026
LTF/CVWM	Sodium sulfide dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,647	10	2	3	1	1	1	1	2026
LTF/CVWM	Sodium sulfide dosage		Mechanical	Pump	Dosing Pump	GRUNDFOS	1	EA	2017	$1,647	10	2	3	1	1	1	1	2026
LTF/CVWMC			Electrical	Electrical Service	Electrical Service and Distribution		1	EA	2017	$36,349	15	2	4	1	4	1	4	2030
LTF/CVWM	Leachate heating system		Mechanical	Boiler	Fire tube boiler	SERL	1	EA	2017	$221,893	20	2	3	1	4	1	4	2036
LTF/CVWM	Equalization Basin		Electronics	Instrument	Flow Meter	EXISTING EQPT	1	EA	2017	$2,447	15	2	4	1	1	1	1	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	Flow Meter	ENDRESS HAUSEF	1	EA	2017	$2,756	15	2	4	1	1	1	1	2030
LTF/CVWM	Equalization Basin		Electronics	Instrument	Flow Meter	ENDRESS HAUSEF	1	EA	2017	$2,447	15	2	4	1	1	1	1	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	Flow Meter	ENDRESS HAUSEF	1	EA	2017	$2,447	15	2	4	1	1	1	1	2030
LTF/CVWM	Permeate system		Electronics	Instrument	Flow Meter	ENDRESS HAUSEF	1	EA	2017	$2,447	15	2	4	1	2	1	2	2030
LTF/CVWM	Permeate system		Electronics	Instrument	Flow Meter	ENDRESS HAUSEF	1	EA	2017	$2,447	15	2	4	1	2	1	2	2030
LTF/CVWM	Zinc precipitation		Electronics	Instrument	Flow Meter	ENDRESS HAUSEF	1	EA	2017	$2,447	15	2	4	1	2	1	2	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	Flow Meter	FCI	1	EA	2017	$4,415	15	2	4	1	2	1	2	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	Flow Meter	FCI	1	EA	2017	$4,243	15	2	4	1	2	1	2	2030
LTF/CVWM	Sludge storage		Electronics	Instrument	Flow Meter	FCI	1	EA	2017	$4,243	15	2	4	1	1	1	1	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	Flow Meter	ENDRESS HAUSEF	1	EA	2017	$3,288	15	2	4	1	1	1	1	2030
LTF/CVWM	Dewatering system		Electronics	Instrument	Flow Meter	ENDRESS HAUSEF	1	EA	2017	$2,387	15	2	4	1	1	1	1	2030
LTF/CVWM	Leachate heating system		Electronics	Instrument	Flow Switch	ABB	1	EA	2017	$3,014	15	2	4	1	1	1	1	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	Foam Sensor	BABBITT	1	EA	2017	$2,594	15	2	4	1	1	1	1	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	Gas Sensor	HACH	1	EA	2017	$5,924	15	2	4	1	1	1	1	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	Gas Sensor	HACH	1	EA	2017	$5,924	15	2	4	1	1	1	1	2030
LTF/CVWM	Leachate heating system		Mechanical	Heat Recovery	Heat Exchanger	CARON ET FILS	1	EA	2017	$34,975	20	2	3	1	1	1	1	2036
LTF/CVWM	Leachate heating system		Mechanical	Heat Recovery	Heat Exchanger	CARON ET FILS	1	EA	2017	$34,975	20	2	3	1	1	1	1	2036
LTF/CVWM	Leachate heating system		Mechanical	Heat Recovery	Heat Exchanger	ARMSTRONG	1	EA	2017	$12,341	20	2	3	1	1	1	1	2036
LTF/CVWM	Leachate heating system		Mechanical	Pump	Heat Transfer Fluid Circ	ARMSTRONG	1	EA	2017	$6,838	40	2	3	1	1	1	1	2056
LTF/CVWM	Leachate heating system		Mechanical	Pump	Heat Transfer Fluid Circ	ARMSTRONG	1	EA	2017	$6,838	40	2	3	1	1	1	1	2056
LTF/CVWM	Equalization Basin		Electronics	Instrument	Level Transmitter	ENDRESS HAUSEF	1	EA	2017	$1,433	15	2	4	1	1	1	1	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	Level Transmitter	ENDRESS HAUSEF	1	EA	2017	$1,433	15	2	4	1	1	1	1	2030
LTF/CVWM	Membrane filtration		Electronics	Instrument	Level Transmitter	ENDRESS HAUSEF	1	EA	2017	$1,433	15	2	4	1	1	1	1	2030
LTF/CVWM	Membrane filtration		Electronics	Instrument	Level Transmitter	ENDRESS HAUSEF	1	EA	2017	$1,433	15	2	4	1	1	1	1	2030
LTF/CVWM	Permeate system		Electronics	Instrument	Level Transmitter	ENDRESS HAUSEF	1	EA	2017	$957	15	2	4	1	1	1	1	2030
LTF/CVWM	Zinc precipitation		Electronics	Instrument	Level Transmitter	ENDRESS HAUSEF	1	EA	2017	$957	15	2	4	1	1	1	1	2030
LTF/CVWM	Sludge storage		Electronics	Instrument	Level Transmitter	ENDRESS HAUSEF	1	EA	2017	$1,433	15	2	4	1	1	1	1	2030
LTF/CVWM	Carbon dosage		Electronics	Instrument	Level Transmitter	ENDRESS HAUSEF	1	EA	2017	$1,169	15	2	4	1	1	1	1	2030
LTF/CVWMC			Mechanical	Tank	Micro C Tank	NORWESCOSUPPI	1	EA	2017	$984	40	2	3	1	2	1	2	2056
LTF/CVWM	Leachate heating system		Electronics	Instrument	O2 Level Switch	AMI	1	EA	2017	$16,227	15	2	4	1	2	1	2	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	ORP Sensor	HACH	1	EA	2017	$1,317	15	2	4	1	2	1	2	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	ORP Sensor	HACH	1	EA	2017	$1,317	15	2	4	1	2	1	2	2030
LTF/CVWM	Permeate system		Mechanical	Tank	Permeate Tank	ACO CONTAINER	1	EA	2017	$4,217	40	2	3	1	2	1	2	2056
LTF/CVWM	Bioreactor		Electronics	Instrument	pH Sensor	HACH	1	EA	2017	$3,895	15	2	4	1	2	1	2	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	pH Sensor	HACH	1	EA	2017	$1,232	15	2	4	1	2	1	2	2030
LTF/CVWM	Bioreactor		Electronics	Instrument	pH Sensor	HACH	1	EA	2017	$3,895	15	2	4	1	2	1	2	2030
LTF/CVWM	Permeate system		Electronics	Instrument	pH Sensor	HACH	1	EA	2017	$4,409	15	2	4	1	2	1	2	2030
LTF/CVWMC			Electronics	Control	PLC		1	EA	2017	$25,000	15	2	4	1	4	1	4	2030
LTF/CVWM	Bioreactor		Mechanical	Valve	Plug Valve	DM Valves (PRATT)	1	EA	2017	$5,025	35	2	3	1	1	1	1	2051
LTF/CVWM	Membrane filtration		Mechanical	Valve	Plug Valve	PRATT	1	EA	2017	$3,826	35	2	3	1	2	1	2	2051
LTF/CVWM	Membrane filtration		Mechanical	Valve	Plug Valve	PRATT	1	EA	2017	$3,826	35	2	3	1	2	1	2	2051
LTF/CVWM	Leachate heating system		Mechanical	Valve	Plug Valve	BRAY	1	EA	2017	$6,990	35	2	3	1	1	1	1	2051
LTF/CVWM	Bioreactor		Mechanical	Valve	Plug Valve	DM Valves (PRATT)	1	EA	2017	$2,825	35	2	3	1	1	1	1	2051
LTF/CVWM	Antifoam agent dosage		Mechanical	Mixer	Portable Mixer	DYNAMIX	1	EA	2017	$3,606	20	2	3	1	1	1	1	2036
LTF/CVWM	Zinc precipitation		Mechanical	Mixer	Portable Mixer	DYNAMIX	1	EA	2017	$6,362	20	2	3	1	1	1	1	2036
LTF/CVWM	Dewatering system		Electronics	Instrument	Pressure Switch	ONYYX VALVE	1	EA	2017	$1,573	15	2	4	1	1	1	1	2030
LTF/CVWM	Leachate heating system		Electronics	Instrument	Pressure Transmitter	ENDRESS HAUSEF	1	EA	2017	$1,234	15	2	4	1	1	1	1	2030
LTF/CVWM	Permeate system		Electronics	Instrument	Pressure Transmitter	ENDRESS HAUSEF	1	EA	2017	$957	15	2	4	1	2	1	2	2030
LTF/CVWM	Permeate system		Electronics	Instrument	Pressure Transmitter	ENDRESS HAUSEF	1	EA	2017	$957	15	2	4	1	2	1	2	2030
LTF/CVWM	Zinc precipitation		Electronics	Instrument	Pressure Transmitter	ENDRESS HAUSEF	1	EA	2017	$957	15	2	4	1	1	1	1	2030
LTF/CVWM	Process air blowers		Electronics	Instrument	Pressure Transmitter	ENDRESS HAUSEF	1	EA	2017	$957	15	2	4	1	1	1	1	2030
LTF/CVWM	Dewatering system		Mechanical	Pump	Progressive cavity pump	NETZSCH	1	EA	2017	$6,233	20	2	3	1	3	1	3	2036
LTF/CVWM	Permeate system		Mechanical	Pump	Progressive cavity pump	NETZSCH	1	EA	2017	$11,742	20	2	3	1	3	1	3	2036
LTF/CVWM	Permeate system		Mechanical	Pump	Progressive cavity pump	NETZSCH	1	EA	2017	$11,742	20	2	3	1	3	1	3	2036
LTF/CVWM	Zinc precipitation		Mechanical	Pump	Progressive cavity pump	NETZSCH	1	EA	2017	$7,172	20	2	3	1	1	1	1	2036
LTF/CVWM	Zinc precipitation		Mechanical	Pump	Progressive cavity pump	NETZSCH	1	EA	2017	$7,172	20	2	3	1	1	1	1	2036
LTF/CVWM	Membrane filtration		Mechanical	Membrane	PVDF hollow fiber meml	KOCH	1	EA	2017	$121,110	10	2	3	1	4	1	4	2026

Location	System	Subsystem	Asset Class	Asset Type	Item	Manufacturer	Quantity1	Unit	Install Year	Replacement Cost ($)	ESL	Age	Apparent Age	Condition Rating	CoF Score (1 to 5)	PoF Score (1 to 5)	Risk Score (1 to 25)	1st Repl. YR
LTF/CVWM	Membrane filtration		Mechanical	Membrane	PVDF hollow fiber meml	KOCH	1	EA	2017	$121,110	10	2	3	1	4	1	4	2026
LTF/CVWM	Process air blowers		Mechanical	Blower	Rotary lobe blower	KAESER	1	EA	2017	$37,459	20	2	3	1	1	1	1	2036
LTF/CVWM	Process air blowers		Mechanical	Blower	Rotary lobe blower	KAESER	1	EA	2017	$34,363	20	2	3	1	1	1	1	2036
LTF/CVWM	Process air blowers		Mechanical	Blower	Rotary lobe blower	KAESER	1	EA	2017	$34,363	20	2	3	1	1	1	1	2036
LTF/CVWM	Process air blowers		Mechanical	Blower	Rotary lobe blower	KAESER	1	EA	2017	$34,363	20	2	3	1	1	1	1	2036
LTF/CVWM	Process air blowers		Mechanical	Blower	Rotary lobe blower	KAESER	1	EA	2017	$15,511	20	2	3	1	1	1	1	2036
LTF/CVWM	Membrane air scour blowers		Mechanical	Blower	Side channel blower	AIRCOM	1	EA	2017	$21,985	20	2	3	1	3	1	3	2036
LTF/CVWM	Membrane air scour blowers		Mechanical	Blower	Side channel blower	AIRCOM	1	EA	2017	$21,985	20	2	3	1	3	1	3	2036
LTF/CVWM	Membrane air scour blowers		Mechanical	Blower	Side channel blower	AIRCOM	1	EA	2017	$21,985	20	2	3	1	3	1	3	2036
LTF/CVWM	Dewatering system		Mechanical	Centrifuge	Sludge dewatering centr	ANDRITZ	1	EA	2017	$333,719	30	2	3	1	3	1	3	2046
LTF/CVWM	Bioreactor		Mechanical	Mixer	Submersible Mixer	KSB	1	EA	2017	$13,858	20	2	3	1	1	1	1	2036
LTF/CVWM	Bioreactor		Mechanical	Mixer	Submersible Mixer	KSB	1	EA	2017	$13,858	20	2	3	1	1	1	1	2036
LTF/CVWM	Bioreactor		Mechanical	Mixer	Submersible Mixer	KSB	1	EA	2017	$13,858	20	2	3	1	1	1	1	2036
LTF/CVWM	Bioreactor		Mechanical	Mixer	Submersible Mixer	KSB	1	EA	2017	$13,858	20	2	3	1	1	1	1	2036
LTF/CVWM	Bioreactor		Mechanical	Pump	Submersible pump	KSB	1	EA	2017	$26,810	20	2	3	1	2	1	2	2036
LTF/CVWM	Bioreactor		Mechanical	Pump	Submersible pump	KSB	1	EA	2017	$26,810	20	2	3	1	2	1	2	2036
LTF/CVWM	Bioreactor		Mechanical	Pump	Submersible pump	KSB	1	EA	2017	$27,616	20	2	3	1	2	1	2	2036
LTF/CVWM	Bioreactor		Mechanical	Pump	Submersible pump	KSB	1	EA	2017	$27,616	20	2	3	1	2	1	2	2036
LTF/CVWMC			Mechanical	Pump	Submersible pump		1	EA	2017	$2,211	20	2	3	1	2	1	2	2036
LTF/CVWM	Zinc precipitation		Mechanical	Tank	Sulfide Oxidation Tank	ACO CONTAINER	1	EA	2017	$4,576	40	2	3	1	2	1	2	2056
LTF/CVWM	Leachate heating system		Electronics	Instrument	Temperature Transmitte	ENDRESS HAUSEF	1	EA	2017	$1,211	15	2	4	1	1	1	1	2030
LTF/CVWM	Leachate heating system		Electronics	Instrument	Temperature Transmitte	ENDRESS HAUSEF	1	EA	2017	$1,211	15	2	4	1	1	1	1	2030
LTF/CVWM	Leachate heating system		Electronics	Instrument	Temperature Transmitte	ENDRESS HAUSEF	1	EA	2017	$1,211	15	2	4	1	1	1	1	2030
LTF/CVWM	Leachate heating system		Electronics	Instrument	Temperature Transmitte	ENDRESS HAUSEF	1	EA	2017	$1,211	15	2	4	1	1	1	1	2030
LTF/CVWM	Permeate system		Electronics	Instrument	Turbidity Sensor	HACH	1	EA	2017	$2,392	15	2	4	1	2	1	2	2030
LTF/CVWM	Permeate system		Electronics	Instrument	Turbidity Sensor	HACH	1	EA	2017	$2,392	15	2	4	1	2	1	2	2030
LTF/CVWMC			Mechanical	Tank	Water Storage	NORWESCOSUPPI	1	EA	2017	$4,576	40	2	3	1	2	1	2	2056
LTF/CVWMC			Structural	Well	Water Well	RED WILLIAMS WE	1	EA	2017	$17,297	40	2	3	1	2	1	2	2056
LTF/CVWM	Zinc precipitation		Mechanical	Filter	Zinc Filter	Fil-Trek	1	EA	2017	$19,424	20	2	3	1	1	1	1	2036
LTF/CVWM	Zinc precipitation		Mechanical	Filter	Zinc Filter	Fil-Trek	1	EA	2017	$19,424	20	2	3	1	1	1	1	2036
LTF/CVWM	Zinc precipitation		Mechanical	Tank	Zinc Precipitation React	ACO CONTAINER	1	EA	2017	$4,419	40	2	3	1	2	1	2	2056
LTF/CVWMC			Structural	Building			1	EA	2017	$864,833	45	2	3	1	1	1	1	2061
LTF/CVWMC			Mechanical	Plumbing			1	EA	2017	$163,863	30	2	3	1	1	1	1	2046
LTF/CVWMC			Mechanical	HVAC			1	EA	2017	$163,863	30	2	3	1	1	1	1	2046
LTF/CVWM	Equalization Basin		Mechanical	Pump			1	EA	2017	$81,431	40	2	3	1	1	1	1	2056
LTF/CVWM	Equalization Basin		Mechanical	Pump		Wacor	1	EA	2017	$39,721	40	2	3	1	3	1	3	2056
LTF/CVWM	Equalization Basin		Mechanical	Pump		Wacor	1	EA	2017	$39,721	40	2	3	1	3	1	3	2056
ORRD			Site Maintenance	Roadway	Asphalt			M2	2014	$34,503	8	5	4	2	1	1	1	2023
QIRD			Site Maintenance	Roadway	Asphalt			M2	2005	$78,319	8	14	4	2	1	1	1	2023
SWMC			Structural	Building	Sheet Metal		440	M2	2017	$75,000	45	2	3	1	1	1	1	2061
SWMC			Mechanical	Container	Shipping Container	Sea Can	1	EA	2017	$12,500	30	2	3	1	1	1	1	2046
TWMC			Site Maintenance	Fence	Bear Fence				2018	$76,500	15	1	2	1	1	1	1	2032
TWMC			Equipment	Vehicle	Cable Skidder	CAT	1	EA	1992	$125,000	10	27	9	4	3	3	9	2020
TWMC			Landfill Maintenance	Cover	Cover Plate		1	EA	2014	$10,596	10	5	11	5	1	4	4	n/a
TWMC			Structural	Well	Groundwater Monitoring Well		12	EA	1990	$150,000	40	29	25	3	1	2	2	2034
TWMC			Structural	Well	Groundwater Monitoring Well		2	EA	1993	$25,000	40	26	25	3	1	2	2	2034
TWMC			Mechanical	Tank	Oil Holding Tank		1	M3	2012	$5,743	40	7	9	1	3	1	3	2050
ZWMC			Structural	Well	Groundwater Monitoring Well		6	EA	2013	$75,000	40	6	7	2	1	1	1	2052
ZWMC			Mechanical	Container	Shipping Container		1	EA	2017	$12,500	30	2	3	1	1	1	1	2046
ZWMC			Structural	Building			440	M2	2017	$75,000	45	2	3	1	1	1	1	2061
ZWMC			Site Maintenance	Fence			600	M	2012	$49,213	15	7	4	1	1	1	1	2030

APPENDIX C – ASSET REPLACEMENT OVER THE SHORT-TERM

Location	System	Subsystem	Asset Class	Asset Type	Item	Manufacturer	Quantity1	Unit	Install Year	Replacement Cost ($)	ESL	Age	Apparent Age	Condition Rating	CoF Score (1 to 5)	PoF Score (1 to 5)	Risk Score (1 to 25)	1st Repl. YR
CRWMC			Site Maintenance	Roadway	Asphalt		1	EA	2011	$122,438	8	8	8		1	4	4	2019
CRWMC			Electronics	Software			1	EA	2012	$52,199	3	7	2	1	1	2	2	2020
CVWMC			Equipment	Vehicle	Roll-Off Truck	Sterling	1	EA	2008	$183,046	10	11	9	4	1	3	3	2020
CVWMC			Electronics	Software		PIS and MS		EA	2011	$130,291	3	8	2	1	4	2	8	2020
LFG/CVWM	Gas Destruction System	Flare System	Electrical	Wire	T-Couple Wire	Omega	1	EA	2016	$663	2	3	1	1	1	1	1	2020
LFG/CVWM	Gas Destruction System	Flare System	Electrical	Wire	T-Couple Wire	Omega	1	EA	2016	$663	2	3	1	1	1	1	1	2020
LFG/CVWM	Gas Destruction System	Gas Pilot System	Electrical	Wire	T-Couple Wire	-	1	EA	2016	$663	2	3	1	1	1	1	1	2020
TWMC			Equipment	Vehicle	Cable Skidder	CAT	1	EA	1992	$125,000	10	27	9	4	3	3	9	2020
CIWMC			Site Maintenance	Roadway	Asphalt			M2	1996	$65,090	8	23	6	3	1	2	2	2021
GRWMC			Site Maintenance	Roadway	Asphalt			M2	2007	$77,602	8	12	6	3	1	2	2	2021
HIWMC			Equipment	Vehicle	Baler		1	EA	2007	$12,500	7	12	5	3	1	2	2	2021
HIWMC			Equipment	Vehicle	Baler		1	EA	2007	$12,500	7	12	5	3	1	2	2	2021
CVWMC			Equipment	Vehicle	Gravel Truck	Sterling	1	EA	2007	$174,635	10	12	7	3	2	2	4	2022
HIWMC			Equipment	Vehicle	Baler		1	EA	2008	$15,542	7	11	4	2	1	2	2	2022
CRWMC			Site Maintenance	Roadway	Asphalt			M2	2012	$285,893	8	7	4	2	1	1	1	2023
CVWMC			Site Maintenance	Roadway	Asphalt		2,500	M2	2013	$153,347	8	6	4	2	1	1	1	2023
CVWMC			Site Maintenance	Roadway	Asphalt		1,750	M2	2013	$87,500	8	6	4	2	1	1	1	2023
CVWMC			Site Maintenance	Roadway	Asphalt		5,000	M2	2013	$250,000	8	6	4	2	1	1	1	2023
ORRD			Site Maintenance	Roadway	Asphalt			M2	2014	$34,503	8	5	4	2	1	1	1	2023
QIRD			Site Maintenance	Roadway	Asphalt			M2	2005	$78,319	8	14	4	2	1	1	1	2023
CIWMC			Equipment	Vehicle	Skid Steer	CAT	1	EA	2016	$86,878	7	3	2	1	1	1	1	2024
CVWMC			Mechanical	Welding Machine	Arc Welding Machine	Hobart	1	EA	2005	$13,195	10	14	5	2	1	1	1	2024
CVWMC			Site Maintenance	Roadway	Asphalt		5,000	M2	2017	$135,607	8	2	3	1	1	1	1	2024
CVWMC			Site Maintenance	Roadway	Asphalt		1,575	M2	2018	$78,750	8	1	3	1	1	1	1	2024
CVWMC			Site Maintenance	Fence	Bear Fence		2,000	M	2004	$126,170	15	15	10	3	2	2	4	2024
CVWMC			Equipment	Vehicle	Dozer	John Deere	1	EA	2017	$681,524	7	2	2	1	3	1	3	2024
CVWMC			Equipment	Vehicle	Pick-Up Truck	GMC	1	EA	2014	$41,302	10	5	5	2	1	1	1	2024
CVWMC			Equipment	Vehicle	Pick-Up Truck	Chevrolet	1	EA	2015	$43,226	10	4	5	2	1	1	1	2024
CVWMC			Equipment	Vehicle	Utility Vehicle	Kubota	1	EA	2018	$31,409	7	1	2	1	1	1	1	2024
CVWMC			Equipment	Vehicle	Wheel Loader	CAT	1	EA	2018	$98,175	10	1	5	2	1	1	1	2024
CVWMC			Equipment	Vehicle	Wheel Loader	Volvo	1	EA	2012	$352,203	10	7	5	2	1	1	1	2024
HIWMC			Equipment	Vehicle	Backhoe	CAT420 D	1	EA	2001	$63,579	10	18	5	2	1	1	1	2024

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