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2023
Canadian Consulting Engineering Awards

Category
F. Special Projects

Modern Integrated Waste Management Facility

Transformation of a Regional Landfill into a First Class Facility in just five years

TETRA TECH

CITY OF Lethbridge

Modern Integrated Waste Management Facility

Transformation of a Regional Landfill into a First Class Facility in just five years

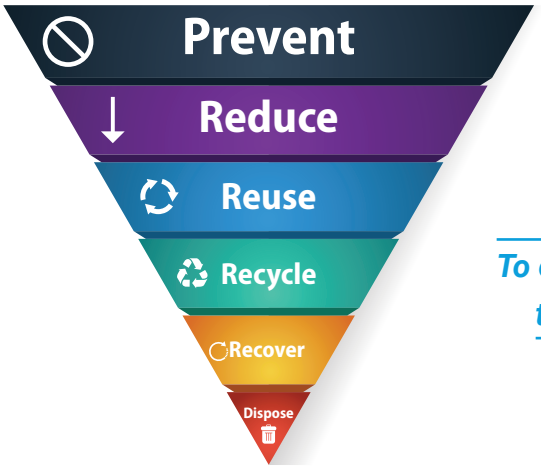
Vision

The City of Lethbridge (City) had an ambitious vision of sustainably modernizing their waste management facility to receive and process multi-stream wastes. The vision revolved around:

- Reducing disposal of recyclables and organics through establishing new sustainable infrastructure;
- Providing new services with supporting infrastructure for waste materials produced by industry (industrial solid wastes and hydrovac returned materials) and thus improving the environment in the surrounding region;
- Proactively evaluating the reuse of problematic materials such as glass, gypsum, shingles, and wood waste; and
- Reducing the traditional environmental effects (land, air, water) and reducing the emissions of Greenhouse Gases (GHGs) from landfill disposal through landfill infrastructure improvements.

Overall, this modernization was to align with the principles of waste reduction through the waste hierarchy and transitioning to a circular economy while providing an improved service offering to their customers.

The City was determined to see this transformation to occur rapidly through their forward-looking administrative leadership and their Capital Improvement Planning Processes.



Approach

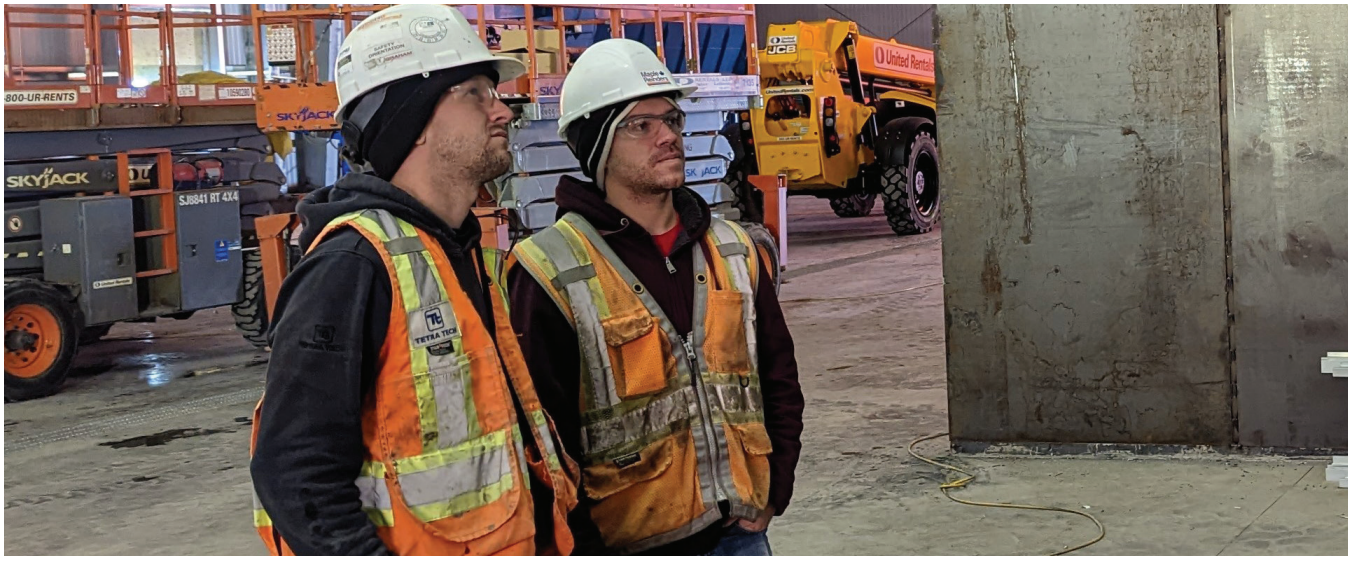
The approach to the site transformation was to look at the site with the end in mind and to evolve the site based on sustainable industry best practice to reduce waste disposal and environmental impacts. To rapidly achieve their goals, the City identified the need for a consulting engineering partnership (term of 5+1+1 years) that could help achieve the site vision with all its integrated infrastructure. (To piecemeal the projects out would take longer, have large coordination/ communication issues and would be make it extremely difficult to be nimble in prioritizing projects). Overall, the consultant was to provide full service specialized solid waste solutions integrating solid waste planning, regulatory support, environmental expertise, geotechnical expertise, solid waste engineering design expertise, traffic engineering, construction and material science expertise, operations and commissioning expertise, and waste characterization expertise. Tetra Tech Canada Inc. (Tetra Tech) was selected to be their partner.

The Lethbridge Waste and Recycling Center (W&RC) has some unique challenges along with the ambitious timeframes that would require the following characteristics to deliver the projects:

- Technical Excellence;
- Innovation;
- Management of Risk; and
- Strong Project Management.

These Sustainable and Environment based projects all contributed to providing increased benefit to society and the environment .

To our knowledge, a Solid Waste Facility transformation this quickly has never been undertaken in Alberta.



The City and Tetra Tech worked together to overcome many challenges.

The Challenges & Complexities

Over the duration of the collective projects the City and Tetra Tech (the Team), had to overcome many challenges:

- Site challenges – The W&RC has been a landfill site for numerous decades. It consists of a deep old coulee system formerly connected to the Old Man River. The topography is varied with some very steep slopes and complex geometric shapes. Climate influences on site include high velocity winds. The site is bisected by high voltage power lines owned by a Third Party and contains legacy landfill cells and aged historical infrastructure.
- Compressed project schedules to complete work within the Capital Budget Cycle.
- Need to re-prioritize projects as urgent needs came up (remediation of failing aged infrastructure).
- Budget pressures with extreme upward inflation on construction and materials costs.
- Technically demanding projects requiring careful design considerations.
- Need to limit impacts on an operating facility while completing capital improvements.

Overcoming these challenges required:

- Significant planning for the future state, including usage, layout, public access, regulatory improvements etc. resulting in staging planning of the site. “Starting with the end in mind.”
- Strong Program Managers within the City and Tetra Tech to track scope, budget, and schedule and to actively triage important urgent projects.
- Frequent communication with external stakeholders, such as Alberta Environment and Protected Areas (AEPA) and Utility Owners, to keep them informed of progress.
- Using different procurement process to offset upward budget pressures such as owner purchased equipment, up-sizing the project to full-scale rather than two phases to take advantage of economies of scale and setting up flexible construction contracts that would allow swift completion of work.
- Bringing in external expertise to review higher risk projects.

5	30	$20M
Years	**Projects**	**Capital Cost**

The Results

Over the last five years, the Team completed over 30 projects, ultimately within capital budgets worth over $20 Million. The ability to complete these projects (many in parallel) required detailed understanding of the final vision of the site, intense knowledge of how each project affected the next, how each project could impact the continuous operation of the W&RC, and that priorities of some projects required by our Team had to be nimble and shift between project demands.

The scale of projects undertaken/accomplished over the last three years is presented in the following table:

Project	Description	Capital Cost
2020		
Cell 5B Sideliner – Stage 1	Design and Construction	$260,000
Landfill Gas Control Plant	Design	N/A
Landfill Gas Wells and Collection System	Design and Construction	$2,400,000
Glass, Concrete, Porcelain Processing	Design and Construction	$260,000
Landfill Cap and Closure Projects	Design and Construction	$1,200,000
Material Recovery Facility Phase 1A Parking Area	Design and Construction	$465,000
Lethbridge Landfill Traffic Study	Design	N/A
Recycled Asphalt Shingle Feasibility Study	Design	N/A
2021		
Landfill Gas Control Plant	Construction	$1,600,000
Cell 5B Sideliner – Stage 2	Design and Construction	$280,000
Manhole #1 Remediation	Design and Construction	$380,000
Hydrovac Facility	Design and Construction	$1,300,000
Cell 5B Leachate Piping and Electrical	Design and Construction	$300,000
Litter Fence Expansion (Fence #2)	Design and Construction	$125,000
2022		
Staging Plan Update	Design	N/A
Organic Processing Facility	Construction	$12,000,000
Cell 5B Sideliner – Stage 3 and Landfill Gas Collection Piping	Design and Construction	$250,000
Industrial Contaminated Soil Cell 7 Sump and Sideliner	Design and Construction	$450,000
Litter Fence Expansion (Fence #1 and #4)	Design and Construction	$570,000

In the following sections, we have highlighted five projects that required innovation and technical excellence while providing benefits to society and the environment. The following projects present a cross section projects representative of the City's Site Vision:

- Sustainable infrastructure for reducing disposal of recyclables – **Compost Facility**
- New infrastructure for waste materials produced by industry – **Hydrovac Facility**
- Evaluation of the reuse of difficult to recycle materials – **Reuse Studies**
- Reducing landfill environmental effects and GHG emissions – **Landfill Gas Facility** and **Remediation of MH1**

Many of these projects are the first or one of "a handful" undertaken in Alberta.

Compost Facility
First Engineered Compost Systems Aerated Static Pile Compost Facility in Alberta.

Hydrovac Facility
First Roller Compacted Concrete-based Hydrovac Facility in Alberta.

Reuse Studies
Lethbridge decided to pilot 15% glass as aggregate in pathways.

Landfill Gas Facility
One of only a few active landfills in Alberta. Renewable Natural Gas capable in the future.

Remediation of Manhole 1
Extremely challenging, unique one-of-a-kind project in Alberta.

Compost Facility

Tetra Tech worked with the City on the design and construction of a compost facility with a rated capacity of 40,000 tonnes per year. Tetra Tech provided technical support for the AEP Approval application and provided engineering services for this **first of its type in Alberta.** The compost facility is an aerated static pile compost system. Engineered Compost Systems (ECS) of Seattle provided the compost aeration equipment and compost controls. Tetra Tech prepared facility design, including eight concrete aeration bunkers for the Primary Stage and concrete pad for the Secondary Stage with ten aeration zones. A feedstock receiving and processing building was designed that includes a tipping floor and processing equipment. The facility is designed for residential food and yard waste and for commercial organic sources such as food retailers and restaurants. Processing equipment for these feedstocks includes a depackager and a horizontal mixer. Green wood and clean construction wood stockpiled at the W&RC is shredded and added to the food waste as a carbon amendment and bulking agent. The facility design includes collection of liquids from the compost process in an underground tank where it can be extracted and used for moisture conditioning of feedstocks. Odour controls for the composting process use natural biofiltration methods. Compost piles in the Primary Stage are aerated either by a downward air draw or an upward air push through the pile. The top of the piles are covered with a layer of stable compost that is kept moist with irrigation sprinklers mounted on bunker walls. This layer acts as a biofilter to reduce odours from the composting process. With negative aeration of the piles, the process air is emitted through an engineered biofilter consisting of a mix of wood chips and compost. The Lethbridge compost facility is a key component of waste diversion programs to reduce reliance on landfill disposal. Furthermore, the composting site contributes to reduction of GHGs associated with decomposing organics in landfills. The resulting compost product is a valued humus like material that is beneficial to soils by adding nutrients and increasing water holding capacity of the soils. Currently expected to be complete April 2023.

Technical Excellence

Tetra Tech had to integrate specialized equipment purchased by the City (depackager and horizontal mixture) with the ECS composting aerations system. Special attention was required to ensure underground services maintained air lock water trap for the leachate storage tank.

Special Challenges

This project was originally intended to be designed and constructed in two equal phases. A tender was issued for Phase 1; however, the tender prices were above budget. In order to take advantage of the economies of scale, Tetra Tech quickly designed and tendered the full facility ultimately receiving tender prices within budget.

Benefits to Environment and Society

- Up to 40,000 tonnes per year diverted from Landfill Disposal (current annual municipal solid waste [MSW] tonnes disposed at the landfill is around 100,000 tonnes)
- Reduction of GHG emissions for landfill of up to 250,000 tonnes of CO2e per 40,000 tonnes of organics (over a twenty-year period)
- Beneficial organic compost growing media of about 20,000 tonnes available to support vegetation growth throughout the region

Hydrovac Facility

The City identified that hydrovac disposal was likely an underserved market in their region as expressed by AEP; the closest disposal facility was over 50 km away and Provincial regulatory changes had created a substantial increase of hydrovac waste. The City engaged Tetra Tech to undertake an analysis of the region's hydrovac disposal market and evaluate if it would be financially viable for the City to construct and operate a hydrovac disposal facility. The analysis also included an assessment of available hydrovac waste processing technologies within the context of what was appropriate for the expected volumes and site constraints, including touring existing facilities. Based on favorable findings from the analysis, Tetra Tech provided the engineering, design, regulatory submissions, and operations plans for a new hydrovac waste disposal facility. The new facility was designed with a dedicated tipping area, an operational storage and drainage area, a low maintenance aggregate and lock block wall filter system, a two-phase evaporation pond, a separate dumping pad to segregate suspect materials, and supporting infrastructure (access roads, bollards and truck stops, surface water drainage ditches, lights, and electrical services). The facility was designed and constructed using a roller compacted concrete (RCC) to provide a cost effective all season durable working surface. The facility was designed with a combination of a compacted clay liner and the concrete pad to meet AEP Hydrovac Facilities authorization requirements. **This type of hydrovac facility is the first of its kind to our knowledge as other sites use a more expensive cast in place concrete or less durable gravel or asphalt surface.** The RCC was a challenge as this was not an industry standard product; therefore, careful development of the concrete mix design was completed and followed by a test strip to prove out the quality of both the mix design and the placement techniques. As well, different finishing techniques were tested to ensure a durable and trafficable surface was achieved. Site is commissioned and in active use.

Technical Excellence

Tetra Tech completed a detailed market analysis through direct contact with 14 waste generators and haulers to understand the size and inner workings of industry best practices in order to design a facility that would cater to the waste generators and haulers in the Region. Knowledge of the market and operations dictated the size and design of the hydrovac facility that would best suit the City's purpose.

Innovation

Tetra Tech helped develop a concrete mix design suitable for the purpose of this project and supplemented this with a required test strip as part of the project. Only once the test strip was shown to meet the project specifications were the mix design and placement techniques approved.

Special Challenges

During the placement of the RCC, daily temperatures rose to above 30°C resulting in Tetra Tech recommending alternative protection and curing procedures, including the use of a curing compound. Working areas were reduced to ensure proper placement and curing could be completed.

Benefits to Environment and Society

- Reduction of Improper Disposal/Land spreading of Hydrovac wastes (A problem identified across the Province) – Up to 48,000 m^3 per year.
- Ability to segregate contaminated hydrovac cuttings allows for reuse of clean materials and proper disposal of contaminated material in a properly designed Industrial Contaminated Soils Landfill Cell at the site.

Reuse Studies

Difficult to Recycle Materials – Reuse Assessment

The City set out to identify beneficial uses for otherwise difficult-to-recycle materials. Lack of established markets and processors for these materials had resulted in the City stockpiling them for several years. Materials examined included: glass containers, plate glass, heat-treated glass, etc., concrete and rubble, asphalt pavement, clean drywall, brick and block, porcelain and ceramics, asphalt shingles.

Ultimately, the City elected to use these materials in municipal infrastructure both in and outside of the W&RC. The City crushed stockpiled materials for use in infrastructure, including glass to be used in the bases of park pathways, concrete rubble, asphalt pavement, and brick and block for use in roadway construction.

A pilot program was completed in partnership with the City Transportation Department to replace 15% of the virgin aggregate material in pathway subbase with recycled glass. This pilot both created a beneficial use for the glass recycled by City residents and decreased the need for virgin materials, preserving these natural resources for future use.

The City continues to explore potential uses for recyclable materials separated by its residents. Walking on, Walking on Broken Glass (lethbridge.ca).

Technical Excellence

Used Tetra Tech's solid waste industry connections to reach out to industry leaders on uses of these materials. Benchmarked against other Municipalities across Canada.

Innovation

Reached into Tetra Tech's industry recognized subject matter experts (Bozena Czarnecki and Art Johnson) to establish applicability of glass pozzolans in concrete, crushed glass as an aggregate replacement in asphalt, and recycling shingles, concrete and pavement as aggregate replacement for asphalt mixes.

Benefits to Environment and Society

- Reduction of landfill disposal of glass, concrete, asphalt, drywall, brick, shingles etc. – Around 2,500 tonnes per year.
- Inexpensive source of aggregate for the City.

Landfill Gas Facility

GHG Emission Reducing Infrastructure – LFG System

Tetra Tech provided engineering services on the landfill gas (LFG) collection system for the W&RC. The engineering services encompassed assistance in securing federal grant application (Federation of Canadian Municipalities [FCM]), feasibility assessments, approvals and permitting, detailed design, tender support and evaluation, construction oversight, LFG training and operations support. LFG constitutes approximately 50% methane by volume (also 50% CO2 and other non-methane organic compounds) and is generated through the decomposition of the organic fractions of MSW.

LFG collection can provide environmental, safety, and financial benefits. The collection and destruction of LFG decreases net fugitive emissions from the waste mass, thereby minimizing the potential environmental liability-associated odour and subsurface LFG lateral migration. This reduction in LFG fugitive emissions also reduces the risk of LFG accumulation in low-lying areas and enclosed spaces, thereby limiting the health and safety concerns associated with potential combustion and asphyxiation.

The secondary, but complementary, objective is to utilize the LFG as a source of renewable energy (typically either used as low BTU boiler fuel, feedstock for electricity generation, or upgraded to natural gas grade fuel (RNG). These two objectives are both complementary and mutually beneficial; an optimized LFG collection system will both reduce GHG emissions and environmental risks, while providing feedstock for beneficial utilization.

Tetra Tech assisted the City to successfully apply for a FCM grant to undertake a LFG utilization feasibility study. This study assisted the City to make an informed decision with respect to LFG utilization options, roles the City can play in project development, access to markets, and life cycle cost analysis for options deemed technically viable for the site. This study was undertaken in three phases to address the following:

1. How much LFG is being generated at the site?
2. How much, and when, can we capture LFG?
3. What are potential options to beneficially use LFG?

The final phase of this project identified potential applications to beneficially use LFG as an alternative renewable fuel source (i.e., low grade, medium grade, and high-grade feedstock). This phase incorporated a review of the current regulatory environment, market conditions, and project risks. Potential site-specific LFG utilization options were identified for further consideration.

Initially a decision was made to develop a system capable of developing utilization in the form of RNG. This was to involve a candlestick flare, as a short-term method of treating the gas until the implementation of an LFG utilization facility, as planned for 2024 and beyond. However, the City chose to shift their focus from utilization to optimizing GHG reductions and carbon credit offset development at this time and to evaluate LFG utilization at a future date. (The carbon offsets have a great potential value and the Global Warming of Potential associated with methane continues to increase potentially making more carbon offsets available). Currently the estimated annual emissions associated with the Landfill are 91,000 tonnes CO2e. The LFG system is poised to collect carbon credits on the order of 15,000 CO2e per year.

The detailed design proceeded in the following steps:

Site Investigation:

- Geotechnical Assessment, accounting for differential settlement impacts in the well field and foundational requirements for the LFG control plant and related infrastructure.

Detailed Design:

- Well Field included the design of vertical wells and horizontal laterals (headers, subheaders etc.) in the waste mass (design factors included landfill staging, geometry, waste composition (organics), differential settlement, proximity to high voltage power lines, and existing landfill cover system). Sixteen vertical wells, with an active extraction area of approximately 4.5 ha are connected to a ring header 1.3 km long around historical and current waste cells.
- Condensate Management - Condensate at the well field was managed via maintaining minimum

pipe grades to permit condensate to flow to low points in the pipe network where condensate traps are installed. The condensate traps are equipped with a pneumatic pump and level transducer which operates at a high-level alarm to pump the condensate to a condensate sump and into the infiltration gallery. The infiltration gallery serves to recirculate the condensate into the waste mass, promoting waste degradation with additional moisture from condensate.

- LFG Control Plant- the LFG Control Plant is composed of two components: an extraction system and treatment system that collect and destroy LFG. The LFG Control Plant was designed to be both a manually operated and automated facility which collects LFG through a mechanical system which induces vacuum pressure within the well field (extraction system). The plant was designed for a peak 850 m^3/hr (500 SCFM) production. LFG was selected to be combusted into an enclosed flare (treatment system). A specialized vendor, John Zink, was selected to provide the blower and flaring system components along with a remote system for monitoring and controlling the plant. The flare package includes a flare PLC that controls the operation of the flare and a chart recorder that is able to both store programmed data in a SD card and through Insite, a John Zink remote monitoring system that is available through a cloud-based subscription service. Insite also allows the City to access the chart recorder remotely and receive alerts when critical alarm(s) (faults, warnings, or alarms at the Control Plant that require system shutdown) or non-critical alarms (s) (i.e., faults, warnings, or alarms at the Control Plant that do not require system shutdown) are triggered. The flare control panel is equipped with a Fireeye burner management system which serves as an isolated controller for the pilot ignition sequence. Overall, engineering disciplines in the LFG Plant design included civil, architectural, structural, mechanical, and electrical.

Tetra Tech provided highly specialized commissioning and training to the City for the startup and ongoing operation of the LFG system. The facility is in active use.

This LFG system is one of only around a half dozen at active landfills in Alberta and will be the only one in Alberta with LFG RNG if implemented in the future.

Technical Excellence

Able to successfully coordinate multiple disciplines (architectural, structural, mechanical, civil, environmental, geotechnical, regulatory expertise) to design, permit and construct the system. Tetra Tech also provided training and ongoing operational support to allow the City to operate and maintain the system moving forward.

Innovation

System built to be nimble for ongoing expansion as cells are developed, allowing for both vertical well connections as well as horizontal LFG collection to allow for earlier LFG capture (the first horizontal collector in a new cell expansion area was recently installed). System also designed to be upgradable in future to allow for LFG utilization as source of renewable energy.

Special Challenges

System constructed across an active facility with extensive existing infrastructure, including a complex crossing of a third-party high voltage power utility corridor.

Benefits to Environment and Society

- Reduction of GHG emissions for landfill of up to 15,000 tonnes of CO2e per year vs. current emissions of 91,000 tonnes of CO2e currently.
- Ability to generate and sell carbon offset credits that benefits the City taxpayers (potential annual value per year = $975,000 assuming a carbon offset price of $65 per tonnes in 2023).
- Designed for the future option to produce sustainable RNG.
- Improved site safety with a reduced risk of gas migration on and offsite.

Remediation of MH1

Retrofit / Remediation of Leachate Collection Manhole MH1

An aged (dating back to the early stages of the landfill) leachate precast concrete manhole critical to the collection of leachate from the entire landfill had severely deteriorated to such a point that it was unusable and could collapse. The manhole was 43 m deep, encapsulated in MSW and founded on the base of an old coulee system.

Leachate contains high concentrations of dissolved and suspended organic matter, inorganic chemicals, heavy metals and has high chemical (COD) and biological oxygen demand (BOD). Leachate build up within the bottom of the landfill could pose an environmental risk if it were to leak into the underlying groundwater or the adjacent Oldman River. Removal of leachate from the system is critical to limit the pressure (head) exerted on the cell liner to reduce the risk of leachate seepage to the environment. The MH 1 remediation project was a critical project to maintain the long-term operation and regulatory compliance of the facility. Further complicating the manhole inspection and remediation was the presence of potentially explosive and asphyxiant/poisonous concentrations of LFGs.

Video inspections showed that sections of the manhole barrels had experienced cracking and spalling and that the vertical alignment of the manhole had deviated at around the 28 m depth. Furthermore, debris, had formed a blockage at the deviation elevation, due mainly to collapse of the access platforms. Remediation required removal of the blockage and the additional debris that had collected at the base of the structure. Hydrovac trucks were used to lower the leachate level and a customized “grabbit” tool was used to “fish” out the debris before the remediation project could commence.

Tetra Tech’s design commenced with the placement of a layer of aggregate at the structures base to provide a foundation for a new stainless steel riser pipe. The 41.75 m long riser pipe included a 1.2 m section of stainless well screen to facilitate leachate collection. Cranes were required to methodically work in tandem to insert the pipe within MH 1, controlling both the rate of installation and the orientation of the pipe. The top

of the riser was cradled in place to limit loading on the bottom screen section until riser pipe supporting materials were placed. Various layers of different sized aggregate were lowered into the manhole/riser pipe annulus to provide a porous void around the well screen to facilitate leachate flow into the riser. A fiber-reinforced concrete plug placed on top of the aggregate provided vertical and lateral support to the riser pipe. Once cured, additional layers of concrete were placed and cured to fully support the pipe. A submersible pump and a pitless adapter were installed to facilitate discharge of leachate from the remediated structure.

This project was extremely challenging and Tetra Tech’s research established that the project is unique, as no other projects like were identified. As such, Tetra Tech reached out globally to retain a specialized consultant experienced in similar failed deep leachate risers to identify and assess risks and critically review the design. The project required significant attention to detail, failure of the manhole during construction or inflow of concrete into the aggregate voids could have resulted in failure and require a complete replacement of the manhole by coring into the waste material which would introduce the risks of an LFG associated fire. The riser pipe needed to be thick walled and heavy to withstand the forces from the crane lift and the shear forces that it would be subjected to once installed. The weight posed a risk of crushing the lower well screen section. Therefore, the riser pipe was cradled at the top to reduce the load on the bottom section until the concrete was placed and cured, providing full vertical and lateral support. Filling the annulus between the manhole barrel and riser pipe required careful consideration and planning. There was a risk that the force applied during the placement of the

"fluid" concrete could rupture the manhole and push the concrete into the surrounding waste. A layered installation approach reduced the forces from the installation to an acceptable level to allow successful, low risk installation.

The City has been operating the new system and have been very satisfied with the results as it is easy to maintain and will fulfil their leachate monitoring and management needs for several generations.

Technical Excellence

Highly specialized solution of slipping a stainless steel pipe capable of sustaining installation and placement forces while ensuring limited deflection within a failing concrete manhole 43 m in length in an active landfill.

Special Challenges

The project required careful attention to safety as cranes were working in proximity to high voltage power lines. Construction sequencing and timing had to be carefully discussed with the contractor as annulus filling needed to occur in such a way that the pipe did not encounter crushing forces. A specialized "grabbit" tool had to be developed to remove fallen debris prior to the insertion of the stainless steel leachate riser.

Risk Management

This project was extremely challenging and unique. As such, Tetra Tech retained a specialized consultant to identify and assess risks and critically review the design.

Benefits to Environment and Society

- Significantly reduced the potential for offsite migration of Leachate thereby providing protection to the underlying aquifer and the adjacent Oldman River.

Future Opportunities at The Site

Possible future innovative or technology advancing work includes:

- Development of long-term plan to assess infrastructure to manage / treat leachate, including leachate evaporation, leachate treatment plant, and leachate force main.
- Assessment of biocovers or biowindows to biologically oxidize methane emitted from landfill cover systems to further reduce GHG emissions (Tetra Tech completed a demonstration project at the Leduc Landfill that proved the viability of this technology) https://www.eralberta.ca/projects/details/biocovers-greenhouse-gas-mitigation-landfills/.
- Evaluation of the feasibility of solar energy generation on the landfill site as Tetra Tech's solid waste group is currently undertaking this for another client.
- Use of Virtual Reality to integrate below and above ground site visualization and decision making.

Meeting Client's Needs

Lethbridge now has a modernized Integrated Waste Management Facility with infrastructure that includes a Compost Facility, a Hydrovac Facility, a landfill gas system that will reduce GHG emissions and a retrofitted leachate riser installed that will improve landfill performance.

Despite the complexity of the projects, the improvements were completed on schedule and within budget. Its innovative design and engineering approach set it apart from similar projects and the City has now seen significantly improved service offering to their customers.

> **At the Lethbridge Waste & Recycling Center, we consider it an integrated system, that has been successfully managed with an engineering services contact. The continuity has helped save cost and drive innovation on the site. Tetra Tech has been a trusted advisor and partner for the City of Lethbridge.**
>
> *~ Mandi Parker, City of Lethbridge*

Transformation of a Regional Landfill into a First Class Facility in just five years

Acknowledgments

Contractors

- Whissell Contracting Ltd.
- McNally Contractors (2011) Ltd.
- GoldRidge Sand and Gravel
- Secure Energy Services
- DMT Mechanical Ltd.
- Southwest Design and Construction
- Engineered Compost System
- John Zink
- Maple Reinders Constructors Ltd.

Subconsultants

- Kumlin Sullivan Architectural Studio Ltd.
- ReLumen Engineering Inc.
- Sunwise Engineering Ltd.
- BCB Engineering Ltd.
- Feeg Engineering Ltd.

Lethbridge

- Joel Sanchez
- Steve Rozee
- Bill MacMillan
- Mandi Parker

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