

# Transportation Association of Canada

Submission for:

## *Environmental Achievement Award 2015*



# Flood Recovery Stampede Pathway along Elbow River



## Project Overview

Calgary, Alberta encompasses approximately 230 kilometres of stream bank along the Bow River, Elbow River, Nose Creek and West Nose Creek. A substantial portion of Calgary's 800-kilometre pedestrian pathway network is located adjacent to these stream banks. During the catastrophic Southern Alberta flood in June 2013, many stream banks suffered severe erosion causing extensive damage to numerous critical sections of the regional pathway network.

Located immediately across from the Calgary Stampede grounds, the **Flood Recovery – Stampede Pathway along Elbow River** project comprises the south and east banks of the river. This area was eroded and undercut due to high water volumes and velocities, and the resulting damages made the area unsafe for public use, leading to its closure. This scenic and highly-used riverwalk is part of Calgary's network of **pedestrian and cycling pathways** that link the city together and provide an important route for commuters and recreational users. Of equal importance in this location is ENMAX Park, which is being transformed into a beautiful new western-themed public space and riverfront gathering place through the work of the **Calgary Exhibition & Stampede (CES)**. This park will link the east and west banks of the Elbow River and provide a scenic oasis for years to come.

To restore pathway operation and support the planned growth and development in this area, extensive rehabilitation work was required to protect the stream bank (as well as adjacent public and private infrastructure), abate human safety risks, address potential hydraulic obstruction and morphologic risks, and control impacts on the riparian environment.

**Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler)** was retained by **The City of Calgary (The City)** to return this site to pre-flood conditions while implementing various resiliency measures to mitigate the impact of future flood events. An additional requirement was to complement area aesthetics. At the site there were five distinct areas where restoration works were required – the Elbow River confluence with the Bow River is located approximately two kilometres downstream of these areas. The repair areas extended from the right angled meander bend where the river turns from an easterly to a northerly direction to the southern extent of the Stampede's current River Park (approximately 700 lm).

In addition to **Amec Foster Wheeler** serving as the technical lead and Prime Consultant, two specialist consultants were also critical contributors to the project. Carson McCulloch Associates Limited (CMAL) and Tannas Conservation Services Limited (Tannas) were engaged to provide landscape/pathway design and restoration ecology services, respectively. CMAL has a long history of providing landscape architecture expertise and context-sensitive design for The City's infrastructure projects while Tannas' qualified agrologists and ecologists were key in selecting plants that would be available to meet the compressed project schedule.

### *Success Measures*

The City set the following expectations for project success:

- A high quality final product

- A sustainable design
- All project activities are concluded within the "optimistic" schedule
- All phases of the project are under budget
- Permits are obtained within the project schedule

As it turned out, all of these objectives were duly met thanks to a strong Consultant team, a capable and willing Contractor (Wilco Contractors Southwest Inc.), an engaged and knowledgeable Owner (The City), and cooperation from impacted Stakeholders including the CES.

## Innovation

River bank restoration and protection was realized using both traditional and novel design methodologies. A team of water resources engineers, geotechnical engineers, riparian area ecologists, landscape architects and bioengineering specialists implemented a comprehensive suite of restoration and resiliency measures that satisfied technical requirements while being aesthetically conscious and environmentally responsible. **Amec Foster Wheeler** coordinated with The City to integrate life-cycle maintenance work into the project.

This was truly a multidisciplinary effort that included the following services:

- Hydrotechnical Assessment
- Geotechnical Evaluation
- Engineering and Aesthetic Design of Restoration and Resiliency Measures
- Cost Estimating
- Permitting Support
- Supporting Client Applications for the Disaster Relief Program (DRP) and Flood Recovery Erosion Control Program (FRECP)
- Geomatics and Unmanned Aerial Vehicle (UAV) Surveys
- Environmental Assessment and Monitoring
- Development of an Erosion and Sediment Control (ESC) Plan
- Tendering and Construction Contract Administration
- Construction Quality Assurance

A key feature of this project was that **bioengineering** heavily informed the design process. The use of vegetated bank stabilization structures, specifically, gabion wall and a log crib wall was an innovative approach to protecting the stream bank from severe hydrologic events, improving slope stability and enhancing fish habitat. These works prevent scour and undercutting on outside bends and encourage siltation and re-vegetation behind the structure. When grown out, these structures provide a softer, more natural appearance to stream bank armour.

The 80 m crib wall comprises several hundred hand-peeled cedar logs and thousands of live willow stakes. Multiple courses of these logs are integrated with drainage materials, geotextiles, backfill and live vegetation. Gabion baskets are inter-planted with willow stakes to better blend with the

surrounding environment. This approach, which is proven in other locales, is a sustainable solution that balances engineering function, aesthetics, and environmental stewardship.

As well, traditional techniques such as longitudinal peaked stone toe protection (LPSTP) were employed. LPSTP is constructed with well-graded angular riprap rock as a river training and bank protection structure.

## Technical Excellence

The design criteria for the project required conformance to The City’s “Design Guidelines for Streambank Stability for Erosion and Flood Control” and “Parks Development Guidelines and Specifications, Landscape Construction”. The constructed works were to be resilient against future flood impacts, have minimal environmental impact (including during construction), and be based on principles of context-sensitive design. As well, options analysis that considered durability and life-cycle costs was a stated requirement. The bioengineering methodology maximized the speed of restoration and minimized the chances of a hydrologic event causing a failure during restoration activities.

A key design function that **Amec Foster Wheeler** provided was a constructability analysis. This determined that the designed works were both “biddable” and “buildable”. The site posed many physical constraints regarding access and working space but the constructability analysis confirmed that, with specialized equipment and easily transportable material, the desired product was achievable. Conveying the importance of this at the pre-tender meeting aided bidders in planning and pricing the work appropriately. The team aptly demonstrated its cost estimating capability as shown by the less than 10% spread between the Engineer’s Estimate and the lowest compliant bid.

### *Plant Material Selection*

A combination of native seed, plugs, potted plants, and willow/poplar stakes were employed in restoring the banks. Plants were selected for their rooting capacity and ability to hold the bank together during flood events. As well, neighbouring intact stream banks were assessed to replicate the habitat that was previously at the site.

To ensure the availability of appropriate plant materials to accommodate the compressed schedule, a survey of suppliers was conducted to obtain availability of each species prior to any being specified.

## Management of Risk

**Amec Foster Wheeler** provided a certified Project Manager (i.e., PMP) to lead the team and, by starting the project with a focus on integrating the Project Management tasks, the project benefitted from planned phasing and clear and concise communication from initiation through to completion. This approach was key to effective risk management and included high-value activities such as:

- Describing the project in measurable goals
- Developing a Project Charter
- Conducting a Chartering Session

- Sub-consultant management
- Active Scheduling, including milestones and deliverables
- Stakeholder analysis (RASCI)
- Development of a stakeholder register and communication strategy
- Implementing a Quality Management Plan
- Conducting regular progress review meetings
- Lessons learned meetings

During construction, risk was managed and minimized by having resident engineering staff providing Construction Quality Assurance as well as monitoring the Contractor's site Health, Safety and Environmental management activities.

## Environmental Value

The project is located in a highly sensitive environment where the majority of construction activities were completed in a delicate riparian ecosystem. Extensive isolation measures, including tree protection, were implemented to minimize and mitigate the impact of construction operations on in-stream, interface and bank environments. Steep working slopes further complicated construction activities as highly erodible top soils necessitated advanced siltation and erosion control techniques.

Although the work resulted in a decline in shrub density along the stream bank a wildlife habitat assessment and breeding bird survey determined that it would not have a negative effect.

The use of the vegetated stream bank protection structures have been shown to improve fish habitat by providing shade and releasing organic materials into the stream. Anticipating a high survivability rate of the embedded willow stakes and other plantings, it is quite possible that the stream bank will take on a more natural aesthetic than its previous form.

## Added Value

The City benefitted from a number of "value-adds" as a result of **Amec Foster Wheeler's** involvement in the project. As a full-service consulting engineering firm, most of the required services were provided directly by **Amec Foster Wheeler's** local office including water resources engineering, survey, geotechnical engineering, materials testing, environmental assessment and monitoring, civil design, constructability review, cost estimating, and construction quality assurance. This multidisciplinary team was structured to adapt and respond quickly to changing circumstances – germane to an aggressive schedule with fixed constraints (e.g., Restricted Activity Periods).

Another example of added value was the employment of an unmanned aerial vehicle (UAV) for site reconnaissance. This relatively new technology offered a perspective of the site that cannot be realized on the ground or from traditional aerial photos.



## Benefit to Society

The immediate benefit that society realizes from this project is reinstatement and protection of an important link on the regional pathway network for downtown pedestrian/cyclist commuters and recreational users. This also serves as a direct route to the LRT system for those communities east of the Calgary Stampede grounds.

Furthermore, the works protect the toe of the river valley slope, which would otherwise be destabilized by further erosion. Critical infrastructure that is located at the crest of the valley slope includes private residences, major roadways and Calgary Stampede maintenance buildings.

The proximity of the constructed works to the “Greatest Outdoor Show on Earth” also must be considered. Application of context-sensitive design principles ensured that the final product fit aesthetically with the local surroundings and serves to complement the growth and development plans of the Calgary Exhibition and Stampede. The use of bioengineering practices and landscape architecture created an aesthetic that does not compromise natural beauty for engineering functionality. The result is a highly enjoyable public space that improves pedestrian and cyclist connectivity.

## Advancement of Technology

As municipalities and other public jurisdictions are continually challenged to do more with less and balance the Triple Bottom Line, sustainable approaches such as those employed on the Stampede Pathway will become more prevalent. Engineering works such as vegetated structures, that mimic and work in concert with nature, and utilize readily-available natural materials; are proving to be effective long-term solutions.

This project was one of the first in Southern Alberta to apply vegetated stream bank stabilization structures on a large scale. The knowledge gained and lessons learned by the consulting team and the local construction industry can be applied on numerous similar sites to mitigate the costly impact of future flood events.

## Degree of Difficulty

Inner city projects in a major center such as Calgary present a multitude of project management and engineering challenges that require the expertise and resources that **Amec Foster Wheeler** offers. Much of Calgary’s infrastructure was never designed to survive an event with the magnitude of the June 2013 flood and consequently the restoration process was extremely complex, both technically and logistically. The consulting team was required to manage a number of challenges including:

- High degree of stakeholder engagement
- Compressed timeline for project design and tendering
- Complex permitting requirements to complete in-stream repairs
- Ongoing construction required during Restricted Activity Periods
- Limited access for equipment and materials

- Continuous coordination to accommodate CES events
- Atypical approach to bank stabilization (i.e., learning curve)

### ***Stakeholders***

The many uses and high profile nature of the site gave rise to a large number of affected stakeholders including:

- Alberta Environment and Sustainable Resource Development (ESRD): As the Elbow River is an important spawning ground for multiple fish species including Bull Trout, ESRD is mandated to ensure that all in-stream work does not have a deleterious effect on habitat.
- Calgary Exhibition & Stampede (CES): With a vested interest in an aesthetically-pleasing environment providing easy access throughout the year and securable access during the Calgary Stampede, CES had a desire to see work done quickly with minimal disturbance to events.
- Landowners along the embankment of the Elbow River with varying land use agreements. Some properties extend to the water's edge due to land titles with grandfathered rights.
- Federal Department of Fisheries and Oceans Canada (DFO): As the regulating body for river use in Canada, DFO have strict controls over the timing of any work done in the Elbow River.
- The City of Calgary (The City): The City's Parks, Transportation Infrastructure, Roads and Water Services departments managed the overall project. Much emphasis was placed on providing long-term solutions to prevent future costly damage.

**Amec Foster Wheeler** was tasked with developing a solution that would take into account all of the main stakeholder concerns.

### ***Compressed Timeline***

Public safety concerns as well as the looming threat of future flood events and additional damage resulted in a highly compressed timeline for delivery. The time available for permitting, engineering, detailed design, tendering and construction was constrained to approximately nine months. Managing this schedule proved to be a challenge for multiple reasons including:

- The extent of flood damage throughout Southern Alberta created extreme resource scarcity in both material and personnel availability.
- Multiple and highly-engaged stakeholders presented unique challenges impacting design and execution. A number of necessary scope additions developed during construction activities.
- The sensitive environment within which construction operations were to be carried out created significant logistic and constructability challenges.

### ***Limited Site Access***

Access to the site was limited by the topography of the area. Steep slopes ranging in height from 30-50 m are present along approximately 600 lm of the project length, with less than two metres of clearance for any working area from the base to the bank of the river in some extreme cases. Multiple bridges crossing the damaged areas prevented access for most standard size equipment and trucks.

High voltage transmission lines limited the use of cranes to reach from opposite bank launch points. As well, the CES controls 3 of 4 entry points for recreational users and the commuting public.

With the access challenges, equipment employed to complete the project was limited in size. All riparian and other materials had to be sized to protect the critical areas but also to allow safe transport and handling with smaller equipment.

### ***Restricted Activity Periods***

In order to complete construction of the in-stream works, regulatory permits had to be attained from Alberta ESRD and the DFO. These permits are issued based on compliance with the provincial *Water Act* and *Public Lands Act*, as well as federal *Fisheries Act*.

Alberta ESRD restricts all in-stream activities during certain extended periods to allow for proper management and protection of spawning grounds in the Elbow River, which falls into the Oldman / Bow River Watershed. As it was necessary to work during these Restricted Activity Periods (RAP), **Amec Foster Wheeler** was tasked with developing a plan to protect the waterway and isolate the work area.

**Amec Foster Wheeler** was able to leverage its positive history of working with Alberta ESRD to fast-track the permitting process and allow work to begin quickly after the project design phase. Riparian sections and in-stream work that had the potential for fish disturbance would be completed outside the RAP, and these same works would be the basis for isolation coffer dams. The coffer dams allowed for excavation and work to continue during the RAP, with minimal potential for environmental release into the Elbow River.

## **Closing**

**Amec Foster Wheeler** successfully completed multiple complex and extensive flood restoration deliverables under a highly compressed timeline while integrating novel bioengineering practices in a sensitive riparian environment. Project budget and schedule were managed within the constraints of an aggressive timeline and multiple funding sources. Stakeholders were engaged on a high level and we worked with The City to understand their expectations. The work was constructed safely and with no negative impact to the natural environment. The end result is a fully restored active modes link with substantially improved flood resiliency, as well as a pleasing aesthetic that integrates seamlessly with the surrounding environment.

## **Acknowledgement**

**Amec Foster Wheeler** would like to acknowledge the following contributors to this exciting and successful project:

- The City of Calgary
- Carson McCulloch Associates Ltd.
- Tannas Conservation Services Ltd.
- Wilco Contractors Southwest Inc.



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Submission for:

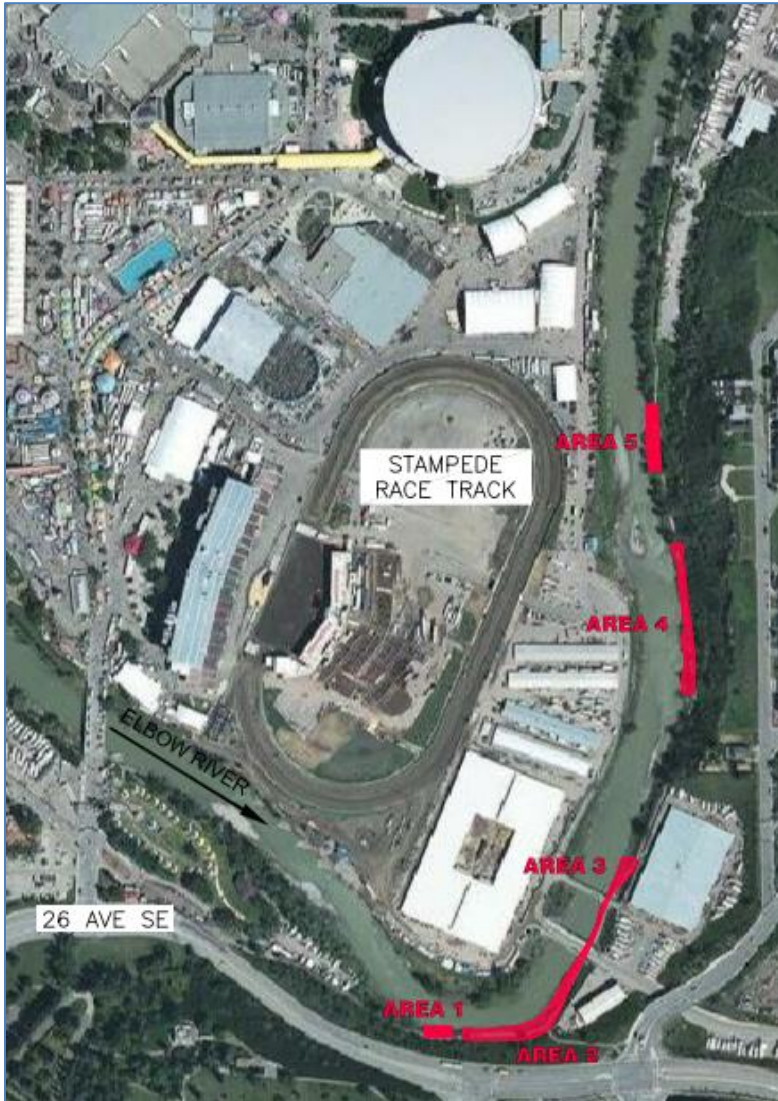
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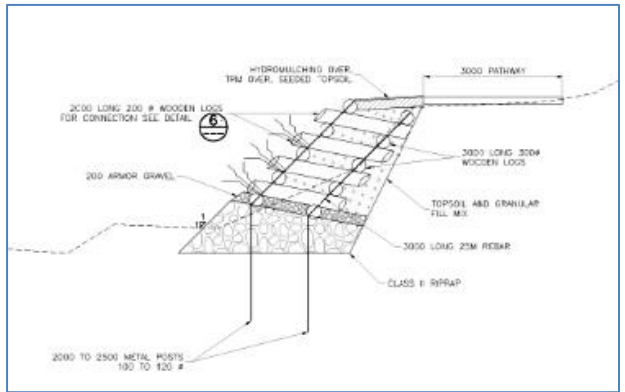
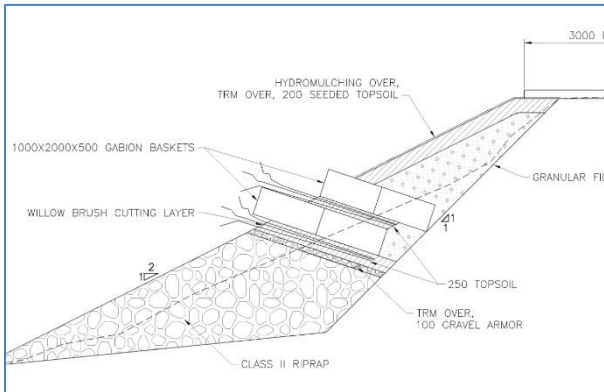


# APPENDIX



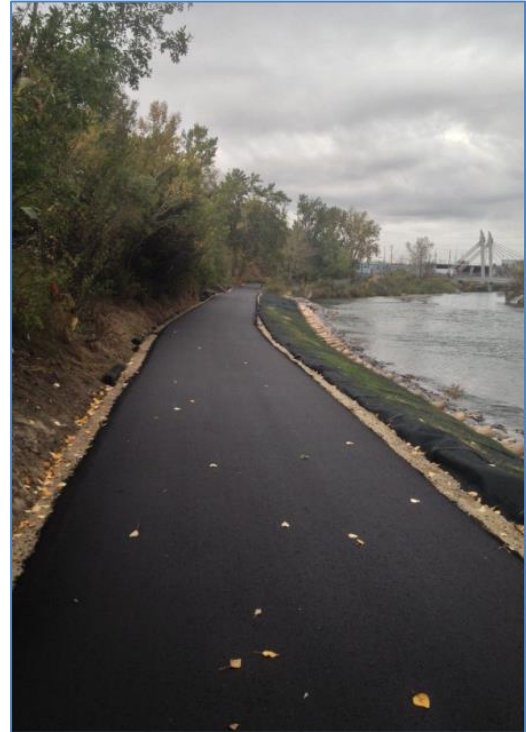
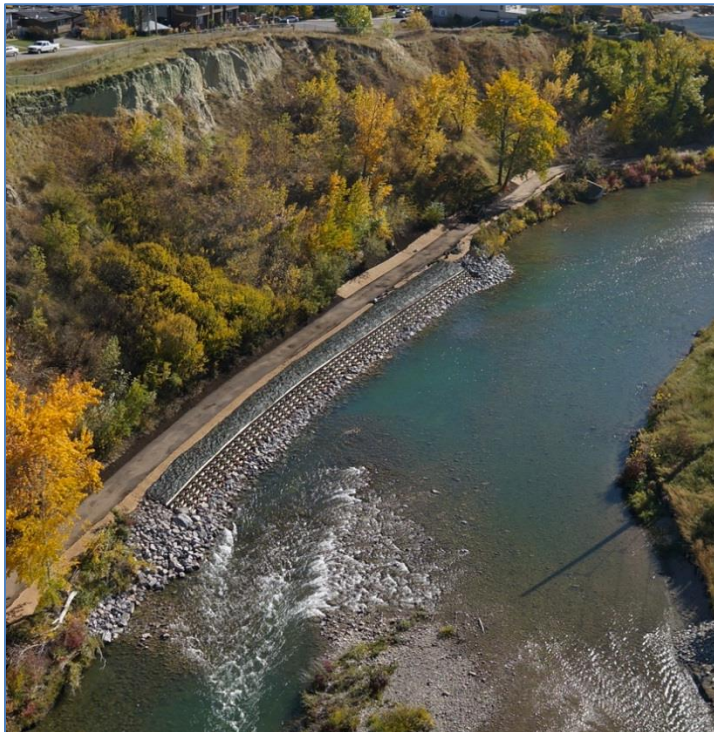
## PROJECT SITE & FLOOD DAMAGE





**VEGETATED CRIB & GABION WALLS**





## FINISHED WORKS