

Parks Canada Agency

763 - Waterton Boundary Fence Detailed Design Report

Prepared by:

AECOM

300 – 48 Quarry Park Blvd SE

Calgary, AB, Canada T2C 5P2

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of the Client ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

AECOM shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. AECOM accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

AECOM agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but AECOM makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

Without in any way limiting the generality of the foregoing, any estimates or opinions regarding probable construction costs or construction schedule provided by AECOM represent AECOM's professional judgement in light of its experience and the knowledge and information available to it at the time of preparation. Since AECOM has no control over market or economic conditions, prices for construction labour, equipment or materials or bidding procedures, AECOM, its directors, officers and employees are not able to, nor do they, make any representations, warranties or guarantees whatsoever, whether express or implied, with respect to such estimates or opinions, or their variance from actual construction costs or schedules, and accept no responsibility for any loss or damage arising therefrom or in any way related thereto. Persons relying on such estimates or opinions do so at their own risk.

Except (1) as agreed to in writing by AECOM and Client; (2) as required by-law; or (3) to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by Client.

AECOM accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of AECOM to use and rely upon the Report and the Information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

June 17, 2016

Christopher Mariotti, EIT
Project Manager | Chef de Projet
Project Delivery Services West | Exécution de projets de l'Ouest
Asset Management and Project Delivery | Gestion des actifs et execution des projets
Parks Canada Agency | L'Agence Parcs Canada

Dear Mr. Mariotti:

Project No: 60485867
Regarding: 763 - Waterton Boundary Fence
Detailed Design Report

We are pleased to present the following Detailed Design Report for the Waterton Lakes National Park eastern boundary fence rehabilitation to the Parks Canada Agency.

Should you have any questions or comments regarding the contents of this report, please do not hesitate to contact the undersigned.

Sincerely,
AECOM Canada Ltd.



Kurt Gibb, P.Eng.
Civil Engineer, Transportation, Western Canada
kurt.gibb@aecom.com

\svm
Encl.

Table of Contents

	page
1. Project Summary	1
2. Scope & Project Delivery.....	2
2.1 Preliminary Design.....	2
2.2 Detailed Design	3
2.3 Tender Support Services	3
2.4 Construction Support Services.....	3
3. Design Progress Summary	4
3.1 Access Routes.....	4
3.2 Clearing & Brushing.....	4
3.3 Fence Rehabilitation	8
3.4 Environmental Alignment Sheets (EAS).....	9
3.5 Environmental Best Management Practices (BMP).....	10
3.6 Construction Schedule & Cost Estimate.....	10

List of Figures

Figure 1: Boundary Fence Alignment	1
--	---

List of Tables

Table 1: Project Schedule	2
---------------------------------	---

Appendices

- Appendix A. Construction Drawings (100% design)
- Appendix B. Environmental Best Management Practices

1. Project Summary

In August 2015, the Government of Canada announced funding initiatives totalling over \$100 million for infrastructure projects within Waterton Lakes National Park. Among these initiatives was the rehabilitation of the boundary fence, stretching approximately 46 kilometers from the United States & Canada border north to Yarrow Canyon. The perimeter boundary fence has not been extensively brushed for a number of years and now has a number of overgrown and damaged sections, reducing the effectiveness of the fence and making maintenance difficult. This has led to resource management issues with cattle from neighboring lands entering the park and an unclear delineation of the park boundary.

Parks Canada is proposing to perform brushing activities and restore the fence to a serviceable condition, with brushing and construction activities to commence in the late summer of 2016. In January 2016, AECOM was retained to provide the engineering consulting services necessary from the preliminary design phase through to the construction execution phase.

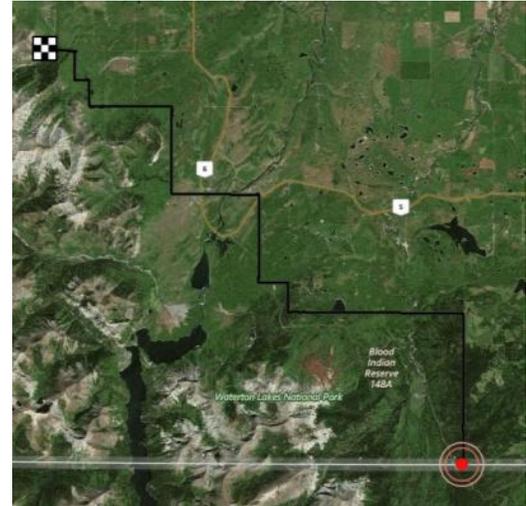


Figure 1: Boundary Fence Alignment

2. Scope & Project Delivery

AECOM's scope of work was broken into four key phases to take the project from design through to construction, as identified in **Table 1**.

This Detailed Design Report is the pre-final deliverable, providing an opportunity to integrate any last comments into the design deliverables before they are finalized for construction and sent out to obtain contractor bids.

Table 1: Project Schedule

Project Phase	Timeframe
Preliminary Design	January – April 2016
Detailed Design	April – May 2016
Tender Support Services	June – July 2016
Construction Support Services	August 2016 – December 2017

2.1 Preliminary Design

At the commencement of the project, Parks Canada supplied background GIS and environmental information, as well as outlining parameters for the design work to follow. Activities undertaken during the preliminary 30% design phase included:

- Reviewing background information supplied by Parks Canada.
- Gathering environmental data from provincial and federal databases.
- Participating in a helicopter reconnaissance flight on March 2, 2016.
- Developing draft Environmental Alignment Sheets (EAS), featuring:
 - Areas of temporary construction access and permanent access routes (gates);
 - Sensitive environmental features (e.g. Wetlands, identified habitat);
 - Drainages and aquatic features;
 - Vegetation inventory data;
 - Cultural and archaeological resources;
 - Terrain (i.e. contours);
 - Land use and parcel boundaries;
 - Fence line elevation profile;
 - Relative level of brushing/clearing required; and,
 - Reference to proposed fence type and typical details.
- Preparing fence detail drawings, based on Parks Canada guidelines.
- Generating draft Environmental Best Management Practices (BMP) to supplement the EAS.
- Preparing a high-level Class C construction cost estimate.

2.2 Detailed Design

Tasks that occurred during the detailed design phase that took the design from 30% to 90% include:

- Continued review of background information and refining the Environmental Alignment Sheets, formalizing them into the primary construction design document.
- Hiked the length of the fence together with Parks Canada, more accurately pinpointing special features and clearing requirements with hand-held GPS. AECOM's reconnaissance occurred as follows:
 - April 19: Hiked KM 17 to 26.
 - April 20: Hiked KM 38 to 46.
 - April 21: Hiked KM 0 to 8. Parks Canada also hiked KM 28 to 38 this day and supplied the data.
 - April 27: Hiked KM 8 to 11, 14 to 17, 26 to 28, and 31 to 32.
- Integrated comments received from Parks Canada during site visits and discussions, based on earlier design submissions.
- Added access routes within the park to AECOM's scope of work and included them on the alignment sheets.
- Continued developing the Environmental Best Management Practices document.
- Developed technical specifications.
- Prepared the contract Schedule of Quantities.
- Generated an updated cost estimate.

The Detailed Design from 90% to 100% involves:

- Integrating minor comments received from Parks Canada into the design deliverables noted above.
- Additional specification revision for contractor submittals.
- Minor revisions to design deliverables from comments captured in verbal review meetings dated 30/05/16 and 12/06/16.

2.3 Tender Support Services

AECOM will support the public tendering of the construction services contract by Parks Canada. Activities are expected to include responding to inquiries via the Parks Canada Project Manager throughout the tender period, issuing Addendums upon request and evaluation support of received bids.

2.4 Construction Support Services

Upon selection of a contractor, finalized construction drawings will be issued for their use if any changes are required from those issued at the time of tendering. AECOM will attend a preconstruction meeting, assumed to occur in Waterton. As construction progresses, AECOM will make periodic site visits to view progress, address areas or items of concern, and assess if there are opportunities for improvement. Office-based assistance will also be provided in addressing technical questions that may arise during construction.

3. Design Progress Summary

3.1 Access Routes

Due to terrain and a lack of maintenance of past access routes, large sections of the existing fence line are only accessible on foot. This has made it difficult to monitor the condition of the fence, and maintenance activities that do occur typically rely on hiking in with the materials and equipment. These routes were originally outside of AECOM's scope of work as it was going to be a separate project handled by Parks Canada, but were added to the scope during the detailed design phase. The work required on these routes generally only involves minimal clearing and brushing. In many areas the best access routes are through private land bordering the National Park, which requires making suitable arrangements with local landowners and other governing bodies. This remains outside of AECOM's scope. Presented in **Appendix A** is a drawing detailing the known and potential access routes both inside and outside the park.

Clearing activities along the fence will help improve access for all-terrain vehicles where conditions allow, however no formal roads or paths are proposed, thus some sections of the fence will remain only accessible by foot.

3.2 Clearing & Brushing

Parks Canada has requested that 3 metres inside the fence and 1 metre outside the fence be cleared of all trees and brush. Coniferous forest dominates from the US/Canada border (km 0) to Belly River (km 11), while the remainder of the fence typically passes through deciduous forest and prairie grasslands. An initial assessment of the level of clearing required was conducted by flying the length of the fence on March 2, 2016, during which a geotagged video was recorded. The following images summarize the observed conditions at that time. Ground reconnaissance during the detailed design phase allowed for a more accurate assessment, with deciduous trees starting to leaf and less snow masking lower brush, which is detailed below the flight images.



KM 0-8.3: Generally well defined cut line through coniferous forest. Trees of varying height to be cleared. Lower brush was generally masked by the lingering snow.



KM 8.3-11.1: Moderately defined cut line through mixed coniferous & deciduous forest. Considered one of the most difficult areas to maintain.



KM 11.1-14.9: Very well defined through mixed forest. KM 11.1-14.3 is out of scope, maintained by the Blood Timber Reserve.



KM 14.9-16.2: Seasonally underwater, the existing steel post fence has generally collapsed and cannot be maintained.



KM 16.2-19.0: Moderately defined cutline through predominantly coniferous forest, with numerous smaller trees and brush evident.



KM 19.0-25.7: Typically a poorly defined cutline through deciduous forest.



KM 25.7-31.4: Grasslands with thick deciduous patches. Portions have adjacent roads and power lines.



KM 31.4-39.4: Moderately defined through deciduous forest. Remnants of a former road run generally parallel, used now unofficially as a hiking trail.



KM 39.4-41.4: Opens up into more open terrain with patches of deciduous forest. The fence breaks as it passes through Kesler Lake.



KM 41.4-42.7: Becomes poorly defined and overgrown through deciduous forest. A partially overgrown cutline runs parallel to adjacent private land.



KM 42.7-43.4: Minimal clearing required through grassy hills.



KM 43.4-44.9: Very poorly defined through overgrown deciduous forest. Access and terrain is difficult.



KM 44.9-46.1: Well delineated as it passes through mixed forest, ending at Yarrow Canyon. Some long steep slopes.

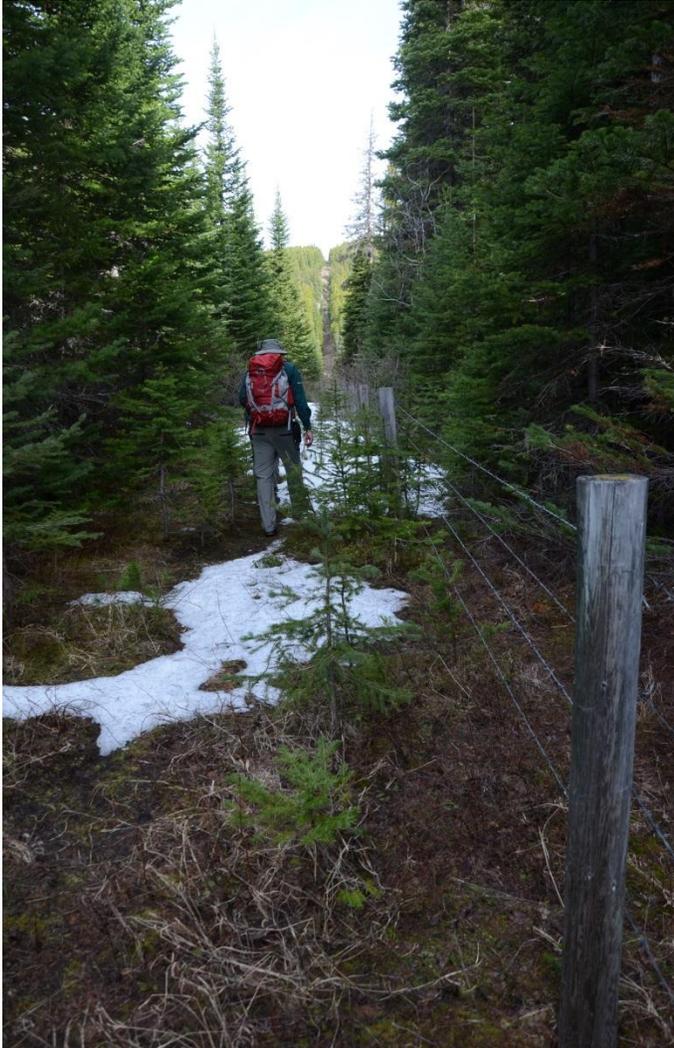
To better establish the on-ground conditions, the full length of the fence was walked during April 2016 over the span of a few days. Due to a low snow pack and warmer than average temperatures, conditions were unusually dry and trees/foliage were 3 to 4 weeks ahead of their normal spring cycle. While walking, the relative amount of brushing required was assessed, and this breakdown is presented on the Environmental Alignment Sheets. Brushing was qualitatively categorized as negligible, light, moderate, or heavy. Images representing these typical conditions are presented as follows.



Negligible Brushing – Generally open grasslands, with sporadic trees or brush.



Light Brushing – Well spaced trees and brush, generally easy to walk through.



Moderate Brushing – Numerous trees and brush, fence can be indistinct, walking is noticeably slowed.



Heavy Brushing – Fence is completely overgrown, sight is limited to a few meters, difficult to walk through.

Clearing procedures and guidelines were developed as a part of the Environmental BMP in an effort to minimize environmental damage. Cleared materials will be scattered in the adjacent forest, subject to the recommendations of the BMP and Parks Canada. Existing fence materials and other unnatural construction debris will be removed and disposed of off-site at an appropriate waste handling facility.

3.3 Fence Rehabilitation

The existing fence is predominately a 4-wire wood-post barbwire fence, with sections of metal posts where ground conditions are unfavourable (excessively wet regions, and rocky soils). Preliminary input from Parks Canada indicated 38 gate locations. No cattle guards were observed within the sections being rehabilitated, as the gates are provided for maintenance access primarily and are not subject to frequent access. There are five permanent breaks in the boundary fence:

- KM 11.1: Belly River (Note: Belly River to KM 14.3 is maintained by the Blood Timber reserve)
- KM 26-26.1 Highway #5
- KM 28-28.1 Waterton River
- KM 29.4 Highway #6

- KM 41.2-41.3 Kesler Lake

At the highways, the fence joins to road right of way fences. At rivers and larger creeks, the fence has braces set back from the banks, with seasonal drift fences extending in to or across the water. For Kesler Lake, the fence extends past the low water line with metal posts. For all other waterbody crossings, the fence remains continuous, but in some cases is suspended due to creek bed erosion.

The intent of the rehabilitation project is to replace or repair the existing fence in kind. As such, there are no changes proposed to the alignment; the fence structure will follow similar design guidelines; gates will be placed in the same locations; and the fence will remain continuous except for the locations already noted. The only exception to this is at Birds Eye Lake between km 15 and 16, where it is proposed only boundary markers are installed to replace the fallen fence. Installing and maintaining the fence through this seasonally underwater wetland section is generally impractical, hence its current condition of complete failure. Seasonal drift fences that extend from braces at the high water line are a more practical option for preventing livestock trespass, while boundary markers will still delimit the legal boundary with less maintenance.

Design work has progressed on the assumption that the existing fence accurately follows the legal park boundary, however ahead of construction activities a legal survey will be required to verify the fence alignment. In some areas, ground slumping appears to have shifted the fence.

The design drawings will be provided to the construction contractor as a guideline for the work, with the understanding that adaptations will need to be made based on localized conditions that are encountered. As a fence replacement on previously disturbed ground, the level of engineering detail is commensurate with that, so sound field judgement during construction will be necessary. Parks Canada will monitor the construction, and refer design questions or clarifications to AECOM as needed.

3.4 Environmental Alignment Sheets (EAS)

Attached as part of **Appendix A**, the EAS are the central source of information and will ultimately act as the construction drawings. Data that has been included:

- Areas of temporary construction access and permanent access routes (gates);
- Sensitive environmental features (e.g. Wetlands, identified habitat);
- Drainages and aquatic features;
- Vegetation inventory data;
- Cultural and archaeological resources;
- Terrain (i.e. contours);
- Land use and parcel boundaries;
- Relative level of brushing/clearing required;
- Reference to proposed fence type and typical details;
- Potential access routes;
- Environmental timing restrictions;
- Recommendation of method of clearing; and,
- Other special considerations as deemed relevant.

3.5 Environmental Best Management Practices (BMP)

Attached as **Appendix B**, the BMP will act in conjunction with the EAS to outline environmental considerations, along with mitigation measures necessary to ensure minimal environmental impact during the boundary fence replacement.

3.6 Construction Schedule & Cost Estimate

Construction is anticipated to begin in late August or early September 2016, commencing with legal surveying of the boundary to verify the fence alignment and other special features. By September, the majority of environmental restrictions will be lifted and clearing and fence construction activities can freely proceed through most areas until restrictions come back into force in the spring of 2017. Work is not anticipated to continue through the winter months, but may be an option if mild conditions prevail as they did during the 2015-2016 winter. Overall fence completion is targeted by December 2017.

The previous fence rehabilitation was completed during one season, but with the length of over 42 kilometers, there are numerous ways in which construction could proceed and be influenced, dependent on factors such as:

- Crew size
- Number of crews
- Available equipment
- Material availability
- Contractor experience
- Weather
- Environmental windows
- Ease of access
- Seasonal springs/flows
- Adjacent landowner cooperation
- Air versus ground supply

While reasonable steps have been taken to reduce the uncertainty, it is anticipated contractors will submit a very wide range of bid rates and schedules based on their planned methodology. A baseline cost estimate was provided in the previous Preliminary Design Report, which remains an accurate portrayal of likely costs, but the potential is there for variances in bids of as much as $\pm 50\%$.

To help reduce the financial and schedule risks of these uncertainties, the 42 kilometers has been broken into three sections for tendering purposes, where each section shares similar traits in terms of access and conditions. This enables contractors to provide more strategic pricing and methodology for each section, rather than inflating all costs for the whole length to cover their perceived uncertainties. It also offers Parks Canada the opportunity to easily engage up to 3 different contractors to complete the project, which may be appropriate if one contractor doesn't have the resources to complete the entire project, yet proposes better methodology and pricing for a certain section.

About AECOM

AECOM (NYSE: ACM) is built to deliver a better world. We design, build, finance and operate infrastructure assets for governments, businesses and organizations in more than 150 countries.

As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges.

From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. A Fortune 500 firm, AECOM companies had revenue of approximately US\$19 billion during the 12 months ended June 30, 2015.

See how we deliver what others can only imagine at aecom.com and [@AECOM](https://twitter.com/AECOM).

Contact
Kenn Leonhardt, P.Eng.
Civil Engineer, Transportation, Western Canada
T +1 403 254 3384
E kenn.leonhardt@aecom.com