Basic Impact Analysis

For: Riverbank Stabilization
Rocky Mountain House National Historic Site

Prepared for:
Parks Canada Agency
Banff Field Unit

McElhanney Consulting Services Ltd.
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Executive Summary

McElhanney Consulting Services Ltd. was retained by Parks Canada to complete an impact analysis for the proposed bank stabilization works at Rocky Mountain House National Historic Site. An engineered plan has been developed to protect the bank from further erosion and protect the heritage sites from damage or even loss.

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Appendices

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1 PROJECT TITLE

Rocky Mountain House Riverbank Stabilization

2 SCOPE OF WORK

Rocky Mountain House National Historic Site

3 PROJECT SITE

The left bank of the North Saskatchewan River, within the Rocky Mountain House National Historic Site.

4 PROPONENT

Parks Canada Asset Management

5 PROPONENT CONTACT INFORMATION

John Rose, Parks Canada Asset Manager, Tel: 403-762-1475, email john.rose@pc.gc.ca

6 PROJECT DATES

Commencement: October 2014

Completion: November 2014

7 INTERNAL PROJECT FILE

Bnp-000927

8 PROJECT DESCRIPTION

8.1 BACKGROUND

The project includes stabilizing approximately 680m of river bank within the Rocky Mountain House (RMH) National Historic Site (NHS). Works are required to prevent further bank erosion of the North Saskatchewan River, which may expose and/or impact historic cultural artifacts in the adjacent areas. The project stems from one of the Key Actions of the RMH National Historic Site of Canada Management Plan (2007); "Identify ways to reduce the threats of erosion along the riverbank."

Conventional methods of bank stabilization using locally sourced, appropriately sized riprap will be utilized to armor the river bank. In addition, select large rocks will be used to create up to 2m long protrusions spaced at 20m intervals to add habitat complexity. Where possible, the interstices of the rip rap will be planted with woody vegetation, and the bank above the rip rap will be planted as well. This combination of techniques should achieve a balance between the armoring objectives and maintaining the historical, natural appearance of the site to the fullest extent possible.

This type of work will require an excavator with a thumb to place the rock and a staging area to store the rock until placed. As the project requires instream work below the high water mark, it will require Fisheries and Oceans Canada (DFO) review before commencing. All applicable "measures to avoid harm to fish" will be followed. Further, an application will be made to the Alberta Environment and Sustainable Resource Development ministry for Water Act and Public Lands Act approvals.

One alternative method has been suggested, which would remove the need for instream works. This alternate process would include the creation of a set-back berm. Essentially, a new, armored riverbank would be constructed behind the natural bank, in the dry. Over time, as the river naturally eroded back, it would expose the set-back berm which would then prevent any future bank erosion. This method removes the need for any instream works, and therefore avoids any serious harm to fish. However, it has been determined that this method would cause excessive disturbance to the National Historic Site near the river bank with potential to impact artifacts, and is therefore deemed not feasible.

This project conforms to Section 3.6 of the RMH NHS Management Plan, as it will reduce the threat of erosion along the riverbank.

8.2 PROJECT DESCRIPTION

The project includes stabilizing approximately 660m of the North Saskatchewan River bank, in two sections. Area A is the upstream segment, and includes approximately 230 linear meters of rip rap (~1800m^3 of rock). Area B, the downstream segment is approximately 430 linear meters, and requires 4820m^3 of rip rap. Approximately 850 square meters and 2400 square meters respectively will be impacted below the average high water mark, which is estimated to fall at approximately the 962m contour.

A detailed design plan (Issued for Tender drawings) has been engineered, and is included in Appendix A. The rip rap installation will occur using an excavator with a bucket and thumb to place the rock along the river bank; no end dumping will occur. Two access points have been identified, one on each construction section (as shown on the design). Starting at the downstream end of the site, the excavator will place rock instream and on the bank, creating a platform to work from. The excavator will continue working upstream placing rock in front of itself. This method will reduce the impact of the machinery along the top of river bank, where potential archeological artifacts may be vulnerable to disturbance. Rock will be placed to create a scalloped edge, increasing habitat complexity, interrupting laminar flow and providing slower moving water for resting areas.

There are no plans for dewatering during the project. If it is determined that dewatering is required, methodologies will be included at a later date. A hard clay layer is present but not continuous; wherever possible, existing hardened areas will be utilized, to minimize impact to soils, vegetation, and areas of cultural significance.

The project is anticipated to begin in October 2014, when water levels are lower. It is anticipated that works will be completed by the end of November, before weather becomes a limiting factor. The In-Water Work Restricted Activity Period is September 1 to April 30 for this area (Alberta ESRD 2014). It is generally preferable to complete instream works from May through August to minimize potential fisheries impacts from instream works. However, as winter approaches, water levels within the river continue to drop. From a constructability perspective the project is best completed at a time of low flow prior to ice formation on the river as far less instream work is required.

A small amount of vegetation clearing is anticipated to access the river bank. Clearing will be kept to a minimum and grubbing will not be done, if possible. Fill should not be required for this project, but some amount of excavation may be needed to appropriately slope or contour some areas of the riverbank for riprap installation.

There are no anticipated requirements for off-site land use.

No toxic or hazardous materials will be used for any part of this project. Fuel and oil from the machinery present a potential hazard. However, all applicable best practices and “measures to avoid causing harm to fish and fish habitat” as outlined on DFO’s Working Near Water website (http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/index-eng.html) will be followed. Storing of waste materials and any toxic/hazardous materials (including fuels) on site is not anticipated. Handling and disposal of these materials will be conducted by appropriately trained workers, and follow all applicable Best Management Practices (BMP’s).

A full time qualified environmental monitor or other Parks Canada Representative will be onsite at all times. They will have the authority to direct or stop works in the event that mitigation measures are not being properly implemented or if undue environmental impacts are occurring.

9 ENVIRONMENTAL COMPONENTS LIKELY TO BE AFFECTED

Land use history for this site is vast. Trading posts occupied the site between 1799 and 1875, and nine different aboriginal cultures came to trade during that time. In 1922, many years after

the fur traders left the area, the Brierley family began farming the land. RMH was declared a National Historic Site of Canada (NHSC) in 1926, and the NHSC officially opened to the public in 1976.

Currently, the NHS also includes the Seafort Burial Site and a gas plant and other development surrounds the site. Oil wells can be found near the park boundary, gravel pits are to the west and propane storage facility to the north. Numerous buried pipelines cross the property and connect to a gas plant located on the site. When Parks Canada purchased the Brierley property in the 1970's, encumbrances were in place for the gas plant to operate in perpetuity, or until they surrender their interests.

Human use on the North Saskatchewan River has increased in recent years. The Brierley Rapids are popular with kayakers and canoeists. The river is used for jet boating, kayaking, canoeing and swimming.

The North Saskatchewan River borders the site along the eastern edge. Riverbank instability has been a problem for many years. Parks Canada undertook bank stabilization work in 1973, after it acquired the Brierley farm. A flood in 2005 destabilized sections of the bank above the 1835-1861 post and along the access road to the campground. There is a real possibility that the river will breach the bank again at the north end of the site, resulting in a major loss of land (Parks Canada 2007). The Management Plan (2007) also identifies problems with flooding and ice dams caused by fluctuating water levels from the Bighorn Dam (managed by TransAlta Utilities), approximately 120km upstream from the site.

A Water Survey of Canada gauge provides flow data for the North Saskatchewan River. Flow information was reviewed as part of the engineering design process and findings incorporated into this analysis and final design.

A search of the Fish and Wildlife Internet Mapping Tool (FWIMT) within a 2km buffer from the site showed the following fish species present: Brook Stickleback (*Culaea inconstans*), Brook Trout (*Salvelinus fontinalis*), Brown Trout (*Salmo trutta*), Bull Trout (*Salvelinus confluentus*), Burbot (*Lota lota*), Longnose Sucker (*Catostomus catostomus*), Mountain Whitefish (*Prosopium williamsoni*) and Walleye (*Sander vitreus*). According to McPhail (2007) Brook, Brown and Bull Trout are all fall spawners that are known to commence spawning following a drop in water temperatures (less than 9-11 degrees Celsius, depending on species). They also tend to prefer areas of groundwater upwelling, often associated with pool tailouts. As the majority of this project is an outside bend thalweg, with a dominant hard clay bank, the probability of this being a spawning area is low. The one possible exception is the most upstream works, where a small island and side channel are present. This area will be carefully inspected for redds by the Environmental Monitor before works are permitted to proceed.

A search of the FWIMT within a 1km and 2km buffer from the site showed no wildlife species present. A 3km buffer produced the following species: Bobolink (*Dolishonyx oryzivorus*), Common Yellowthroat (*Geothlypis trichas*), Grizzly Bear (*Ursus arctos*), Least Flycatcher (*Empidonax minimus*), Northern Leopard Frog (*Rana pipiens*), and Sora (*Porzana carolina*). It was also noted in the Management Plan (2007) that there is a population of ground squirrels on site.

During the site visit in April 2014, small circular holes were noted along a section of riverbank between stations 0+500 and 6+600. Upon further investigation, it was determined that these holes were most likely nesting burrows of the Belted Kingfisher (*Megaceryle alcyon*).

Climate in this area is characterized by long, cold winters and short, mild summers.

Vegetation on the site includes grass, shrubs and trees. Most of the bank is devoid of shrubs or trees, but there are pockets of aspen (*Populus tremuloides*), cottonwood (*P. trichocarpa*) and spruce (Picea spp.). There were a few shrubs present as well, including red osier dogwood (*Cornus sericea*) and willow (*Salix* spp.) The Management Plan (2007) indicates that the invasive tall buttercup species is also present.

In the event of an emergency situation with the gas plant, the Management Plan (2007) identifies a coordinated emergency response plan with the operators of the gas plants, Parks Canada and others. There are mitigation measures in place to minimize wildfire hazard at the site.

The site contains both cultural resources of national historic significance (formerly known as Level I cultural resources) and cultural resources of other heritage value (formerly known as Level II cultural resources). A remote sensing study is being undertaken by Parks Canada archaeologists in the project area and a recent report is included as Appendix 4.

This project works towards the Key Visitor Experience Objectives in that it will:

- Protect and present key elements of the cultural landscape and the special sense of place that contribute to the image, appeal and quality of the visitor experience.
- Emphasize the site's unique features – the authentic cultural landscape, the North Saskatchewan River, and the large natural space.

10 IMPORTANT EFFECTS IDENTIFIED

Impacts from construction activities are expected to be short term. However, impacts associated with bank armoring are expected to be long term.

10.1 VALUED ECOSYSTEM COMPONENTS

10.1.1 Soils and Landforms

Only lands directly adjacent to the stabilization project and those used as staging areas will be impacted. Wherever possible, existing roads and trails will be utilized for moving equipment and machinery. While the site will be impacted from construction works, this disturbance will be short term only. Short term disturbance to a relatively small footprint is expected to prevent larger, long term impacts associated with continued riverbank erosion.

10.1.2 Aquatics/Hydrological Resources

A review of the project was undertaken to identify both aquatic environmental impacts and mitigation measures associated with the bank stabilization. The construction activities that are likely to have an impact on aquatic environmental values are:

- Access to the stream channel to place rip rap;
- Placement of riprap, including scalloping.

These works were then compared to DFO's Pathways of Effects for determination of impacts to habitats. We determined the risk for all pathways to be medium to low, and mitigable. The one exception is that this will result in a permanently hardened bank which will permanently preclude natural, habitat forming stream processes. However, with the presence of the park site and known heritage values, the need to preclude further river migration at this location is clear. Further, the addition of scallops and roughening of the rip rap will add complexity to this channel where it is currently lacking. If DFO deems these works to be 'serious harm' to fish habitat, an additional offsite offsetting plan will be developed.

The instream work to install riprap may temporarily displace fish in and near the site, but is not anticipated to block access to critical habitat. The riprap used for bank armoring will create a permanent hardened surface. It is anticipated that this impact will be offset by the habitat created by the scalloped edge of the rock. In the vicinity of the project, the North Saskatchewan River is approximately 100m wide. Given the width, instream works will not block fish movement past the site. Resting areas within new eddies and slack waters are an expected benefit.

A Turbidity Monitoring Plan has been developed (Appendix 3) to ensure turbidity levels do not exceed CCME guidelines.

Some riparian habitat may be impacted during this project. Vegetation along the riverbank will likely be impacted by the machinery required to install the riprap, at the access points, and potentially within the rip rap footprint in places. Impacts are expected to be low as vegetation should regenerate (naturally and through supplementary planting) by the following spring.

Table 1 provides a summary of the potential impacts and mitigation measures to reduce these. Additional mitigation measures are listed in Appendix 2, "DFO Measures to Avoid Harm".

Table 1 Potential Environmental Impacts

Impact	Risk Assessment	Mitigation
Fish Mortality	low	Work in the dry at low water conditions. Place rock individually rather than dumping. Inspect area for redds and do not proceed if redds are present.
Change in channel morphology or shoreline/change in hydraulics	medium	Due to the size of the channel, and the long, outside-bend morphology, we do not foresee adverse effects to opposite banks due to hardened bank deflection. Scalloping, oversizing rock and general

		roughening will slow edge flows and help create new micro-habitats.
Change in substrate composition	low	This section of the river is fairly homogenous with gravels and cobbles. The addition of instream complexity is an expected benefit
Change in food supply	low	Micro flora and fauna production will be temporarily interrupted due to placement of new rock.
Change in fish habitat structure and cover	low	We expect a net increase in structure and cover due to scalloping and boulder complexity
Change in sediment concentrations	low	Work will be performed, to the fullest extent possible, in the dry. Where boulders are placed in the wet, they will be clean, and machine placed, not dumped. Extremely localized pulses of sediment of insignificant duration are anticipated. These will be monitored by the EM to ensure turbidity does not exceed 8 NTU over background (per Alberta Environment, 1999).
Change in contaminant concentrations	low	Equipment will be washed before entering worksite, and monitored for leaks by the onsite monitor. Spill pads and containment equipment will be onsite at all times. Excavators working near or over water shall have hydraulic fluid replaces with non-toxic biodegradable fluid.
Potential mortality of fish/eggs/ova from equipment (or placement of rip rap)	low	Work outside of wetted width and inspect gravels for presence of redds beforehand. Do not commence works if redds are located.
Disruption or destruction of Belted Kingfisher	low	Nests will not be occupied while work is undertaken; work will all take place below where nests are located.

10.1.3 Vegetation

Vegetation impacted by the project will likely be caused by machinery only at the access ponts, and will be a short term impact. It is expected that any shrubs pushed over will regenerate again next year. Impacted vegetation will be replaced with similar species at similar densities in spring of 2015. There will be no introduction of non-native species, and negative effects on rare, endangered or special resource species is not anticipated.

10.1.4 Wildlife

Impact to wildlife as a result of this project are expected to be small, and of limited duration. Smaller animals such as birds, ducks, ground squirrels etc. are most likely to be impacted, and may be temporarily displaced or disturbed as a result of the project. It is not anticipated that this project will cause any change in species composition, distribution, habitat change or fragmentation, habituation, or corridor impairment.

The Northern Leopard Frog and Grizzly Bears were both identified within a 3km buffer from the site, and are both threatened species, by the Government of Alberta Species at Risk (2012). Based on the size and location of this project, Grizzly Bears are not anticipated to be impacted. Northern Leopard Frogs, which are also classified as Endangered by the Government of Canada, (SARA 2013), utilizes several types of habitat throughout the year. They generally live near ponds and marshes, but will often venture into well covered grasslands, and overwinter in well oxygenated water bodies that do not freeze to the bottom (larger streams, creeks and rivers etc.). Given the lack of ponds and marshes on or near the site, and the time of year that construction will occur, it is unlikely that this species will be affected by the project. Birds who use the area may be temporarily disturbed or displaced by works.

Belted Kingfisher nests have been identified near the top of bank in the northern extent of the project. Kingfisher occupy both inland and coastal habitats, feeding primarily on small fish. Breeding takes place between April and July and can result in 1-2 broods. Incubation period lasts 22-24 days per brood. In more northern extent of their range, there is typically only one brood per year. The Belted Kingfisher is sensitive to human disturbance and may abandon nests during the breeding season if disturbed. Work is anticipated to start in September, after nesting is complete and nests are vacant. Additionally, all bank stabilization works are well below the nesting areas, therefore no impacts are expected.

As supplementary planting is required, only willow stakes will be planted below the nests such that growing vegetation does not adversely change the habitat type.

10.1.5 Pollution

The only potential source for pollution associated with this project would be oil or fuel that might inadvertently leak from machinery. Spills of this nature are typically minor and occur infrequently. Given the size and volume of water (and therefore dilution potential) in the North Saskatchewan River, compared to the volume of oil and fuel contained in the machinery, any spills that may reach the water should have little effect on the aquatic system. Following applicable BMP's and inspecting machinery regularly should minimize the potential for pollution, and having a spill response plan should capture most pollution in the event of an accidental

spill. Excavators working below top of bank should have non-toxic, biodegradable hydraulic fluids.

10.2 CULTURAL FEATURES

10.2.1 Aesthetics

Long term sensory effects are not expected. Short term effects may include those related to construction works and materials storage. Views of the river may be temporarily obscured by machinery and construction works.

10.2.2 Public Facilities and Services

Changes to visitor services, facilities and opportunities may include temporary closure to portions of riverside trails and restricted access to areas near the river. As the 680m of bank stabilization work will likely be done successively, area and/or trail closures will be limited in length and duration. Areas/trails will be reopened as soon as safely possible, to limit visitor disturbance. It is possible that some disruption to traffic may be required during construction, however efforts will be made to limit this type of work to times when the park is closed to the public.

10.2.3 Public Safety

Overall, public safety near the river will be improved once the project is completed. Any bank instability caused by ongoing erosion will be mitigated, making it safer for visitors. Construction works and machinery required may have a temporary negative effect on safety at the National Historic Site. Efforts will be made to block construction and staging areas from public access, and limit the movement of heavy machinery while the park is open to the public.

10.2.4 Cultural Heritage

The effects of this project on cultural heritage are expected to be positive. This bank stabilization project will protect the site from further erosion, and therefore the loss of land and buried cultural artifacts. Staging areas and machinery access routes will be planned ahead to avoid specific culturally sensitive areas. The archaeology report within Appendix 4 and the mitigation section below provide recommendations to minimize impacts. As well, Parks Canada's Cultural Resource Management (CRM) Policy provides policy requirements for managing the wide range of cultural resources administered by Parks Canada.

Effective cultural resource management operates at two levels: it applies to the entire national historic site as well as to the individual cultural resources associated with a protected heritage place, including landscapes and landscape features, buildings and engineering works, archaeological sites, and archaeological and historical objects.

To ensure the protection of the site's cultural resources, excavation will be limited to what is absolutely necessary for the project.

Where excavation is absolutely necessary, only pre-approved excavation can proceed with direction from the Departmental Representative. Contractor must give 2 working days notice for any pre-approval. The project has been designed in a way that does not require excavation. Rip rap is only intended to be placed on the surface. In areas where ground penetration occurs, stop work immediately and seek direction Departmental Representative.

10.2.5 Key Visitor Experience Objectives

There are no expected adverse effects on key visitor experience objectives. Construction works may temporarily interrupt views of the cultural landscape, however this will be limited in time and area. As the stabilization works will likely occur gradually, only small areas of the NHS landscape will be disrupted at any given time. Once works are completed, there will be no residual effects from the project.

11 MITIGATION MEASURES

Mitigation measures will be used to eliminate, avoid or reduce anticipated short and long term impacts of the projects. Although work is planned within the Restricted Activity Period for the area, which is September 1 to April 30, it is expected that far less instream work will be required by doing so. It may be useful to install an information sign about the project, to let National Historic Site visitors know the "what and why" of the project. Table 1 below summarizes the other proposed mitigation measures.

Table 1. Summary of proposed mitigation measures

Potential Impact	Mitigation Measure
Soils and landforms	Existing roads and trails will be utilized as much as possible.
Aquatics/hydrological resources	Install appropriate sediment and erosion control measures.
	Follow all applicable "measure to avoid causing harm to fish and fish habitat."(DFO 2014). Applicable measures have also been included as Appendix 2.
	Any spoil is to be placed on the bank and covered with geotextile and riprap.
	Works should be timed when water levels are low, so that as much work as possible can be completed in the dry.
	Limit the amount of riprap bank armoring as much as possible.
	Inspect gravels for presence of redds. Do not commence work if redds are located.
	Monitor sediment generated in the water column; comply with Alberta Environment Guidelines (1999)
	Existing roads and trails will be utilized as much as possible.
Vegetation	Efforts will be made to work around existing bank vegetation and leave it in place wherever possible. Where vegetation is removed, replace with similar species at similar densities the following spring. Where soil access is available, woody vegetation will be planted within the rip rap at a

Potential Impact	Mitigation Measure
	density of one plant per three square meters. The bank between the rip rap and crest will also be planted
	Follow BMPs for machinery working near water. (DFO 2014)
Pollution	Inspect machinery regularly for leaks.
	Excavators working below top of bank should have non-toxic, biodegradable hydraulic fluid.
	Spills will be dealt with appropriately and quickly, as per BMPs, and contaminated soil will be removed from the site, if required.
	Limit trail and/or area closures as much as possible.
Aesthetics	Any works required in/near high visitor-traffic areas, will be completed while the park is closed, when possible.
	Limit trail and/or area closures as much as possible.
Public facilities and services	Avoid disrupting traffic, by timing works to when the NHS is closed or has lower visitor numbers.
	Ensure that construction sites and staging areas are made inaccessible to the public.
Public safety	Limit the movement of heavy machinery while the NHS is open to the public.
	Any works required in/near high visitor-traffic areas, while be completed while the park is closed, when possible.
	Avoid all areas of significant cultural heritage.
Cultural heritage	All work will stop if any artifacts are noted during works.
	Parks Canada archaeologists or Parks Canada CRM specialists will oversee machine works, particularly access from top of bank. Works will comply with Parks Canada's Cultural Resource Management (CRM) Policy. Where excavation is absolutely necessary, only pre-approved excavation can proceed with direction from the Departmental Representative. Contractor must give 2 working days' notice for any pre-approval. In areas where ground penetration occurs, stop work immediately and seek direction Departmental Representative.
	Works in high visitor-traffic areas will be timed to avoid high volume days, and completed when the NHS is closed, when possible.
Wildlife	Ensure Kingfisher nests are not physically disturbed. Supplemental planting will be planted such that nests will not be adversely affected in future years due to vegetation growth.
Key visitor experience objectives	Works in high visitor-traffic areas will be timed to avoid high volume days, and completed when the NHS is closed, when possible.

Additional mitigation measures may be required by DFO, particularly once DFO has made a determination as to whether or not the project will cause serious harm to fish. A compensation plan will be created, if required, to offset any permanent harm to fish that may occur as a result of the project.

12 IMPACT SIGNIFICANCE

Overall the project impacts are expected to be low. At this point, short term minor impacts to soil, vegetation, aesthetics, aquatic values, visitor experience and wildlife are outweighed by the positive effect on commemorative integrity that the project will have.

13 SITE INSPECTION

Environmental monitoring will be required during construction works. As well, a follow up site inspection will likely be required following the first freshet after installation. This follow-up inspection will be expected to focus on bank and riprap stability, vegetation condition, as well as identify any additional remediation works required.

14 EXPERTS CONSULTED

At this point, no outside experts beyond the authors have been contacted, with the exception of:

- Alberta Environment and Sustainable Development Fish and Wildlife contacts
- Department of Fisheries and Oceans Fisheries Protection Program

15 PUBLIC PARTICIPATION

No public participation is required, except as may be directed by the Alberta ESRD review process.

16 DECISION

DFO will need to review the design and mitigative measures to determine whether an Authorization or further mitigation measures are required. Alberta ESRD has issued a Water Act approval and may also require a Public Lands Act Temporary Field Authorization for the work. Long term, a Department Licence of Occupation will likely also be required, in order for the works to remain in place longer than one year.

Transport Canada will need to be consulted to determine whether Impacts to Navigation exist.

It is expected that by implementing mitigation measures, including those potentially required by the aforementioned federal agencies, that this project is NOT likely to cause significant adverse environmental effects.

EA Author

Name: Susan O'Bryan PBiol	John Summers PBiol
Title: Biologist	Senior Biologist
Date: August 8, 2014	Date: August 8, 2014
Signature	

Decision Approval

Name:

Title:

Signature Date:

17 REFERENCE LIST

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Species at Risk Public Registry website. Date last modified: 2013-12-05. Accessed Jan 30, 2014. http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=551

18 ATTACHMENTS LIST

Appendix 1: Engineered Drawings

Appendix 2: DFO Measures to Avoid Harm

Appendix 3: Turbidity Monitoring Plan

Appendix 4: Report on the Archaeological Testing of the 2013 Geophysical Survey of the North Saskatchewan River Bank-Parks Canada

19 ADDITIONAL CONSIDERATION/COMMENTS

A Navigable Waters Protection Request for Work Approval may also be required for this project, as this section of the North Saskatchewan is a Scheduled Waterway.

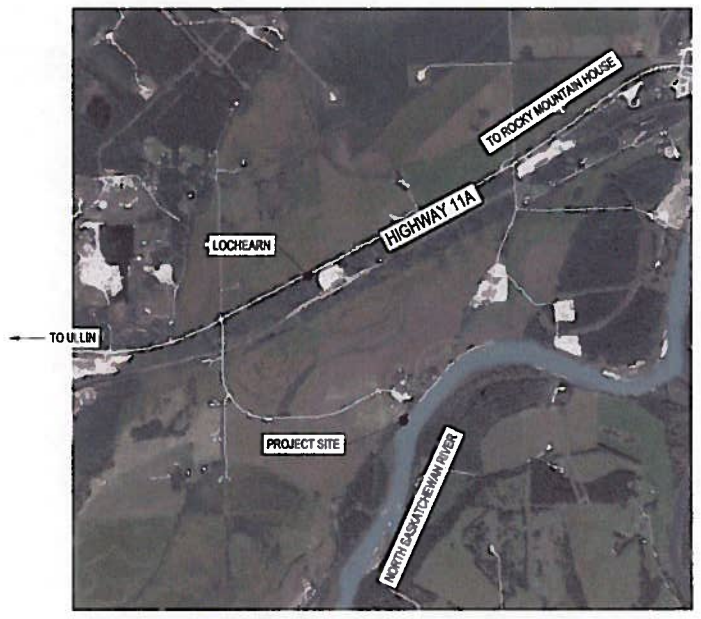
20 APPENDIX I-ENGINEERED DRAWINGS

PARKS CANADA / PARCS CANADA

ROCKY MOUNTAIN HOUSE
EROSION PROTECTION

2511-00460-0

JULY 2014



KEY PLAN

N.T.S.

REGION MAP

N.T.S.

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ISSUED FOR TENDER

DRAWING INDEX		
DWG NO.	REV.	DESCRIPTION
001	0	EXISTING CONDITION STA 0+000 TO 0+350
002	0	EXISTING CONDITION STA 0+350 TO 1+062.494
003	0	DESIGN PLAN STA 0+000 TO 0+350
004	0	DESIGN PLAN STA 0+350 TO 1+062.494
005	0	RIP RAP AREA A STA 0+050 - 0+160
006	0	RIP RAP AREA A STA 0+170 - 0+280
007	0	RIP RAP AREA B STA 0+430 - 0+580
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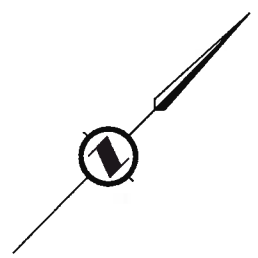
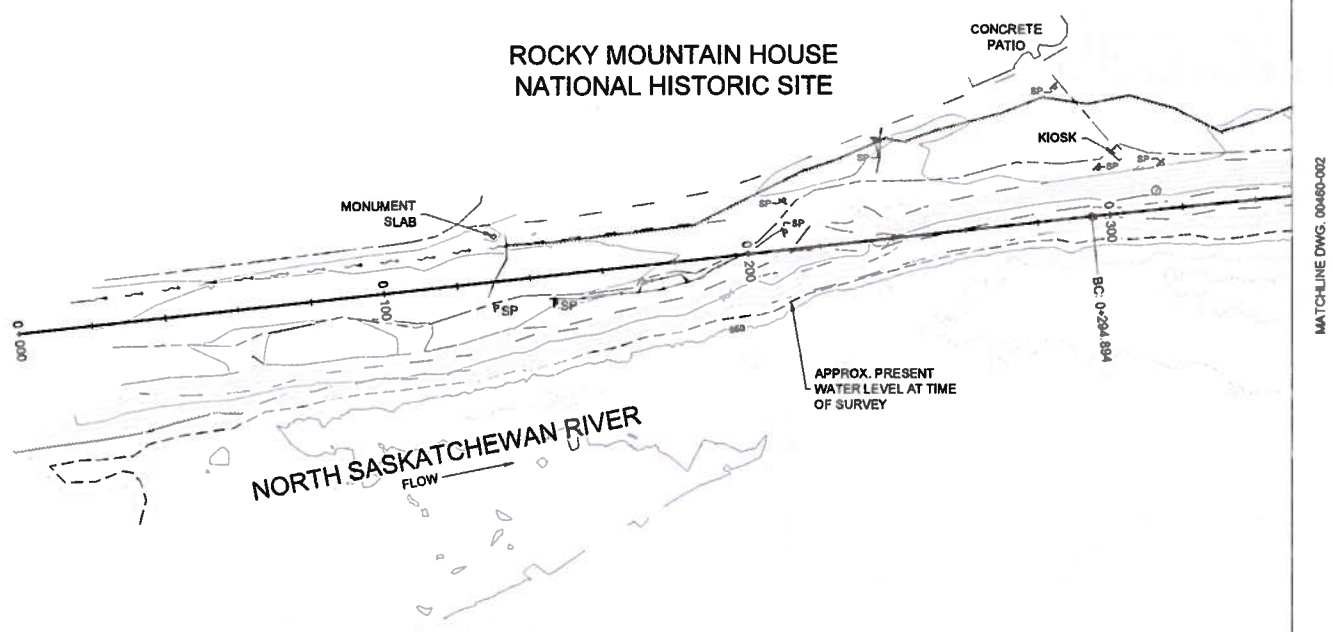




THE FIELD SURVEY DEPICTED HEREIN IS A COMPILATION OF DATA COLLECTED BY McELHANNEY LAND SURVEYS LTD. - CANMORE (ARLEY PAUTLER 2014-06-12)

SURVEY CONTROL WAS ESTABLISHED FROM ASCM 143214.
DATUM - NAD83 (CSRS) ZONE 11 CENTRAL MERIDIAN 117° W
GEOID GSD95

COORDINATES ARE GRID AND CAN BE CONVERTED TO GROUND BY APPLYING A SCALE FACTOR OF 1.000314 AROUND ASCM 143214.
RIVER BED POINT DATA DERIVED FROM ECHO SOUNDER EQUIPMENT CONNECTED TO RTK/GPS.

PRIMARY PROJECT REFERENCE POINTS

POINT	NORTHING	EASTING	ELEVATION
ASCM 143214	5803412.845	638432.271	968.793
ASCM 37754	5804233.134	638807	965.992

ISSUED FOR TENDER

LEGEND

- TREELINE
- APPROX. WATER LEVEL
- DIRT PATH
- GRAVEL PATH
- ASPHALT PATH
- WIRE FENCE
- WOOD FENCE
- DITCH
- SP SIGNPOST
- MANHOLE

No	Date	Revision	Dr	Ckd

McElhanney
McElhanney Consulting Services Ltd.
1633 First Avenue
Prince George BC
Canada V2L 2Y8
Tel 250 561 2229

Designed: WWC | Checked: - | QC: -
Drawn: ES | DATE: 14/07/15
0 1:1000 50
Scale: 22" x 34" Sheet

Approved Sealed

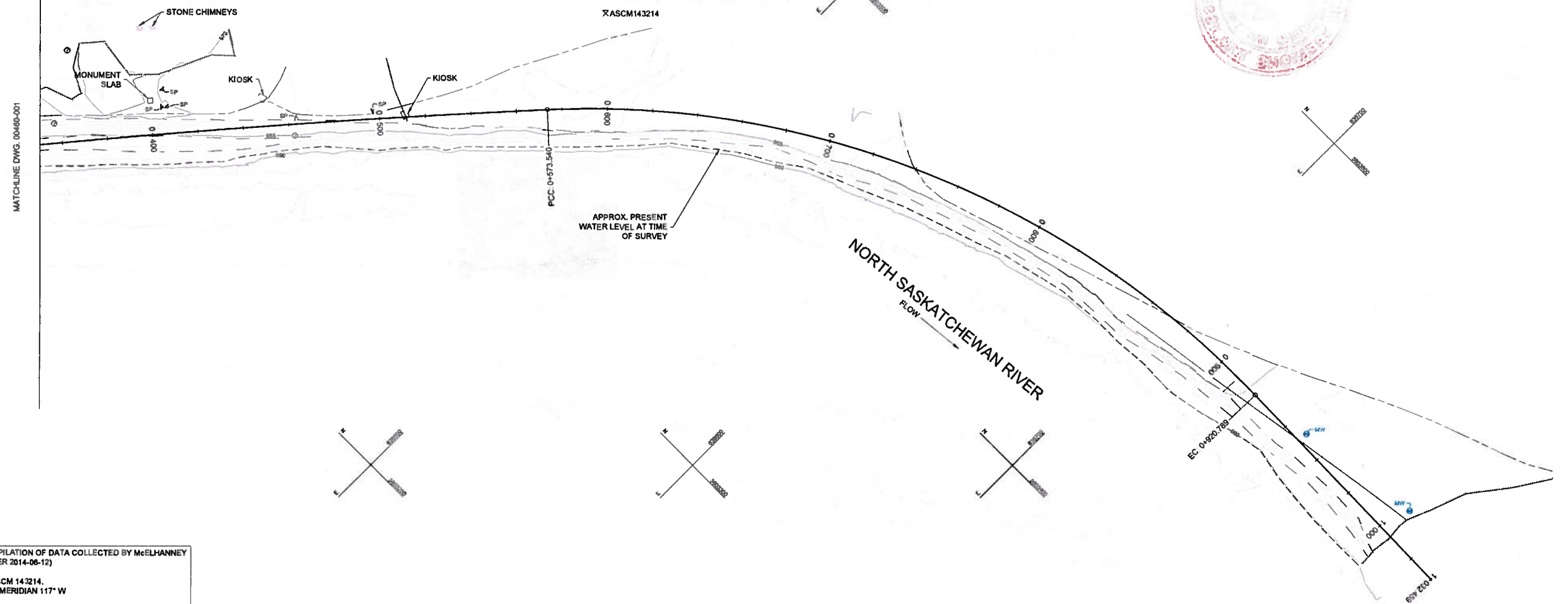
PARKS CANADA / PARCS CANADA

ROCKY MOUNTAIN HOUSE
EROSION PROTECTION
EXISTING CONDITION STA 0+000 TO 0+350

Client Project No: -
Client Drawing No: -
MCSL Project No: 2511-00460-0
Drawing No: 00460-001
Sheet 1 of 9 | Revision 0

Destroy all prints bearing previous number

ROCKY MOUNTAIN HOUSE
NATIONAL HISTORIC SITE



THE FIELD SURVEY DEPICTED HEREIN IS A COMPILATION OF DATA COLLECTED BY McELHANNEY LAND SURVEYS LTD. - CANMORE (ARLEY PAUTLER 2014-06-12)

SURVEY CONTROL WAS ESTABLISHED FROM ASCM 143214.
DATUM - NAD83 (CSRS) ZONE 11 CENTRAL MERIDIAN 117° W
GEOID GSD95

COORDINATES ARE GRID AND CAN BE CONVERTED TO GROUND BY APPLYING A SCALE FACTOR OF 1.000314 AROUND ASCM 143214.
RIVER BED POINT DATA DERIVED FROM ECHO SOUNDER EQUIPMENT CONNECTED TO RTK/GPS.

PRIMARY PROJECT REFERENCE POINTS

POINT	NORTHING	EASTING	ELEVATION
ASCM 143214	5803412.845	638432.271	968.793
ASCM 37754	5804233.134	638807	965.992

LEGEND

- TREELINE
- APPROX. WATER LEVEL
- DIRT PATH
- GRAVEL PATH
- ASPHALT PATH
- WIRE FENCE
- WOOD FENCE
- DITCH
- SP SIGNPOST
- MW MONITORING WELL

ISSUED FOR TENDER

PROFESSIONAL ENGINEER ALBERTA WILLIAM CHENG

Aug 13/2014

No.	Date	Revision	Dr.	Ckd

McElhanney
McElhanney Consulting Services Ltd.
1633 First Avenue
Prince George BC
Canada V2L 2Y8
Tel 250 561 2229

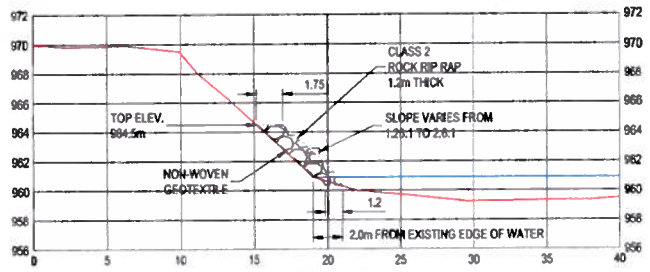
Designed: -
Drawn: ES
Checked: -
QC: -
DATE: 14/07/15
0 1:1000 50
Scale: 22" x 34" Sheet

Approved Sealed

PARKS CANADA / PARCS CANADA
-
ROCKY MOUNTAIN HOUSE
EROSION PROTECTION
EXISTING CONDITION STA 0+350 TO 1+032.459

Client Project No: -
Client Drawing No: -
MCSL Project No: 2511-00460-0
Drawing No: 00460-002
Sheet 2 of 9
Revision 0

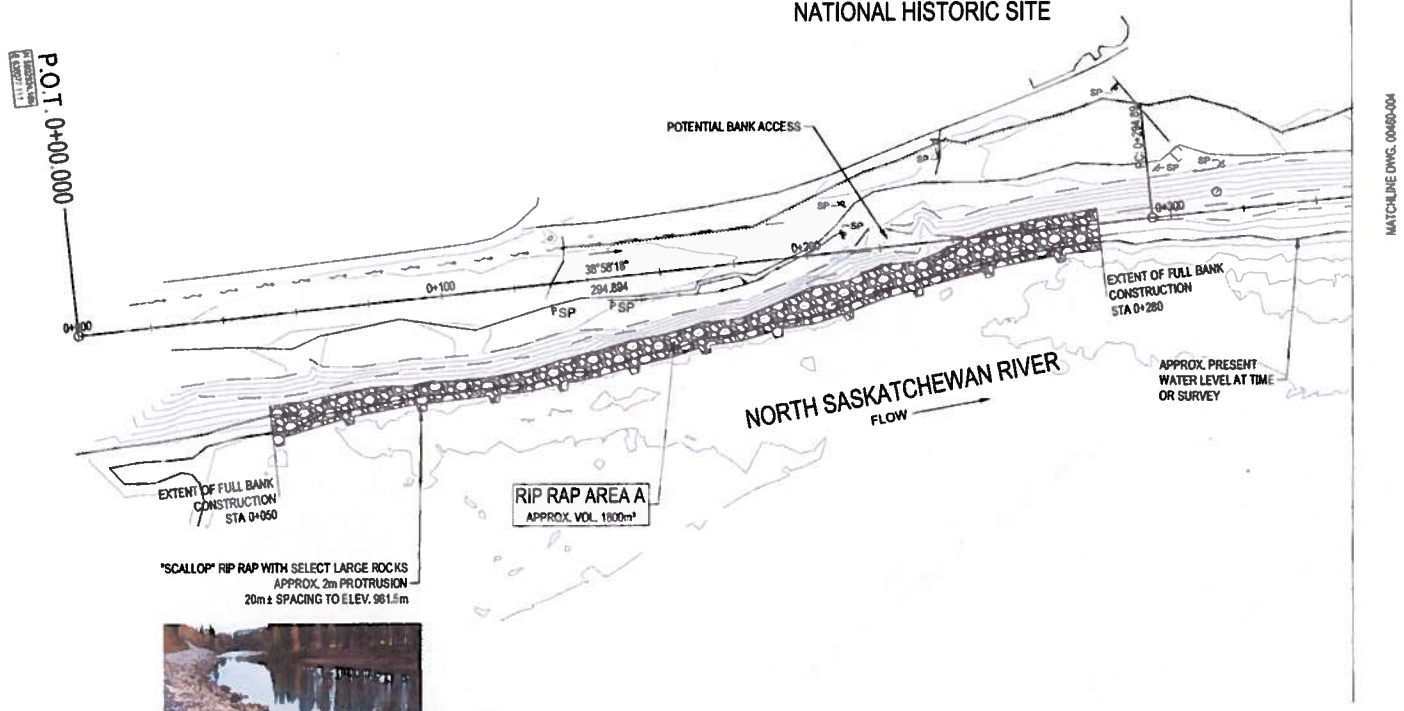
Destroy all prints bearing previous number



RIP RAP AREA A DETAIL (TYP)

SCALE 1:250

ROCKY MOUNTAIN HOUSE
NATIONAL HISTORIC SITE



THE FIELD SURVEY DEPICTED HEREIN IS A COMPILATION OF DATA COLLECTED BY McELHANNEY LAND SURVEYS LTD.- CANMORE (ARLEY PAUTLER 2014-06-12)

SURVEY CONTROL WAS ESTABLISHED FROM ASCM 143214.
DATUM - NAD83 (CSRS) ZONE 11 CENTRAL MERIDIAN 117° W
GEOID GSD95

COORDINATES ARE GRID AND CAN BE CONVERTED TO GROUND BY APPLYING A SCALE FACTOR OF 1.000314 AROUND ASCM 143214.
RIVER BED POINT DATA DERIVED FROM ECHO SOUNDER EQUIPMENT CONNECTED TO RTK/GPS.

PRIMARY PROJECT REFERENCE POINTS			
POINT	NORTHING	EASTING	ELEVATION
ASCM 143214	5803412.845	638432.271	968.793
ASCM 37754	5804233.134	638807	965.992

APPROXIMATE RIP RAP AREA A VOLUME = 1800m³

ISSUED FOR TENDER

LEGEND
- TREELINE
- APPROX. WATER LEVEL
- DIRT PATH
- GRAVEL PATH
- ASPHALT PATH
- WIRE FENCE
- WOOD FENCE
- DITCH
- SP SIGNPOST
- MANHOLE

No.	Date	Revision	Dr.	Ck'd

McElhanney
McElhanney Consulting Services Ltd.
1633 First Avenue
Prince George BC
Canada V2L 2Y6
Tel 250 561 2229

Designed: WWC | Checked: - | QC: -
Drawn: ES | DATE: 14/07/15
0 1:1000 50
Scale: 22" x 34" Sheet

Approved Sealed

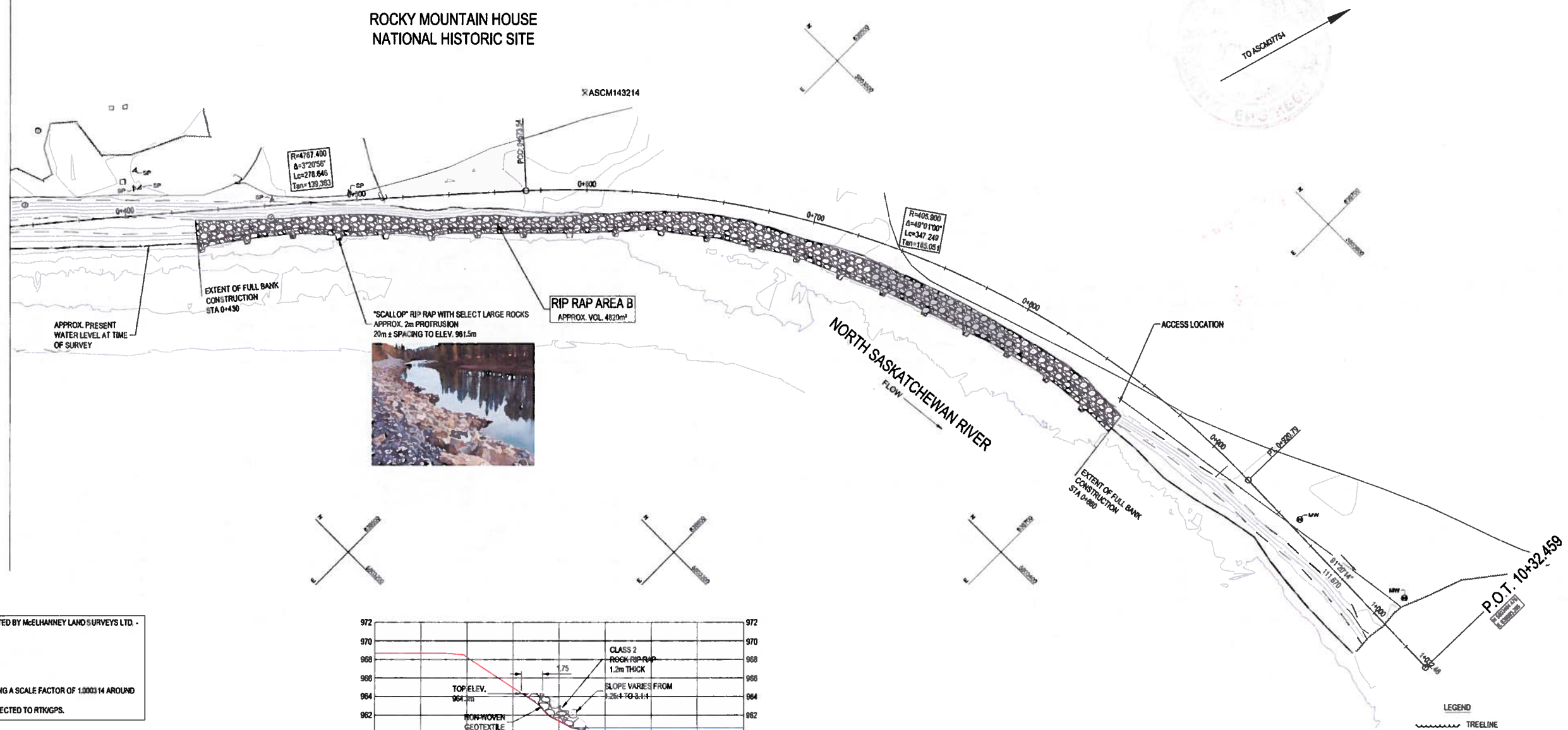
PARKS CANADA / PARCS CANADA

ROCKY MOUNTAIN HOUSE
EROSION PROTECTION
DESIGN PLAN STA 0+000 TO 0+350

Client Project No: -
Client Drawing No: -
MCSL Project No: 2511-00460-0
Drawing No: 00460-003
Sheet 3 of 9 | Revision 0

Destroy all prints bearing previous number

ROCKY MOUNTAIN HOUSE
NATIONAL HISTORIC SITE



RIP RAP AREA B DETAIL (TYP)
SCALE 1:250

THE FIELD SURVEY DEPICTED HEREIN IS A COMPILATION OF DATA COLLECTED BY McELHANNEY LAND SURVEYS LTD. - CANMORE (ARLEY PAUTLER 2014-06-12)

SURVEY CONTROL WAS ESTABLISHED FROM ASCM 143214.
DATUM - NAD83 (CSRS) ZONE 11 CENTRAL MERIDIAN 117° W
GEOID GSD95

COORDINATES ARE GRID AND CAN BE CONVERTED TO GROUND BY APPLYING A SCALE FACTOR OF 1.000314 AROUND ASCM 143214.
RIVER BED POINT DATA DERIVED FROM ECHO SOUNDER EQUIPMENT CONNECTED TO RTK/GPS.

PRIMARY PROJECT REFERENCE POINTS			
POINT	NORTHING	EASTING	ELEVATION
ASCM 143214	5803412.845	638432.271	968.793
ASCM 37754	5804233.134	638807	965.992

LEGEND
- TREELINE
- APPROX. WATER LEVEL
- DIRT PATH
- GRAVEL PATH
- ASPHALT PATH
- WIRE FENCE
- WOOD FENCE
- DITCH
- SP SIGNPOST
- MH MANHOLE

ISSUED FOR TENDER

APPROXIMATE RIP RAP AREA B VOLUME = 4820m³

PROFESSIONAL ENGINEER ALBERTA WILLIAM CHEUNG
Aug 31 2014

No.	Date	Revision	Dr.	Ckd

McElhanney
McElhanney Consulting Services Ltd.
1633 First Avenue
Prince George BC
Canada V2L 2Y9
Tel 250 561 2229

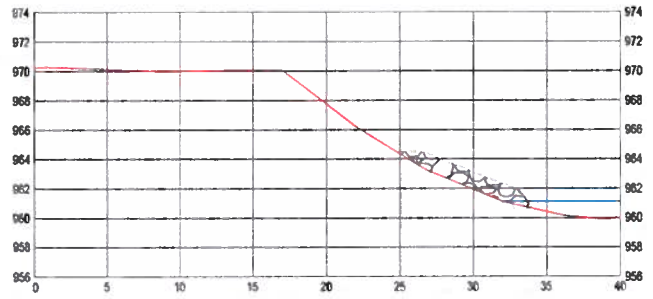
Designed: WWC | Checked: - | QC: -
Drawn: ES | DATE: 14/07/15
Scale: 22" x 34" Sheet
0 1:1000 50

Approved / Sealed

PARKS CANADA / PARCS CANADA
-
ROCKY MOUNTAIN HOUSE
EROSION PROTECTION
DESIGN PLAN STA 0+350 TO 1+062.494

Client Project No: -
Client Drawing No: -
MCSL Project No. 2511-00460-0
Drawing No. 00460-004
Sheet 4 of 9 | Revision 0

Destroy all prints bearing previous number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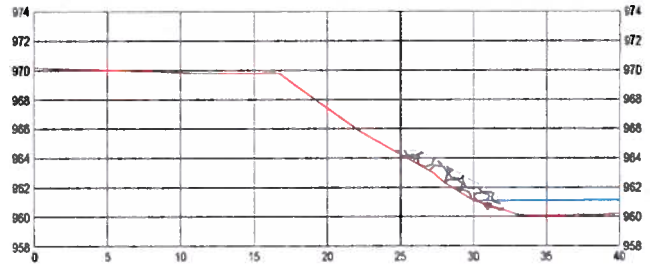
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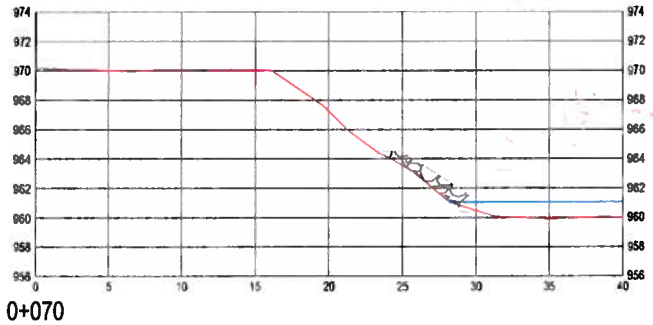
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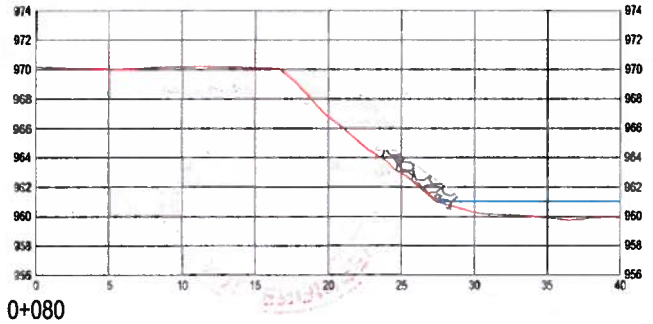
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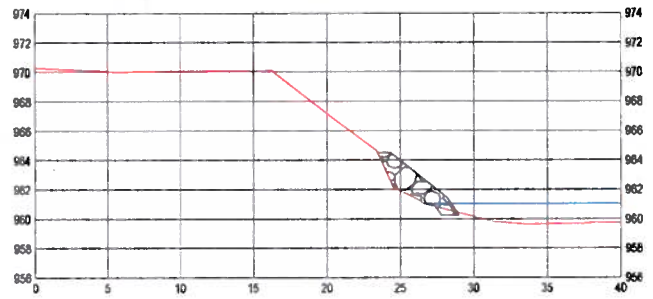
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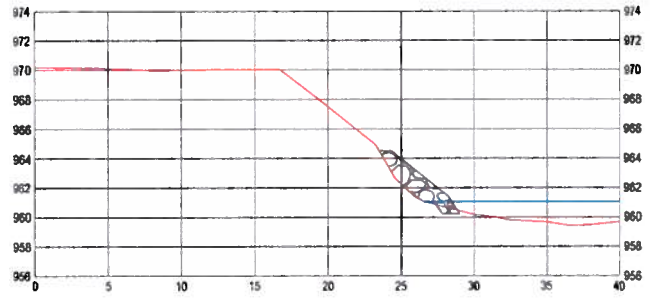
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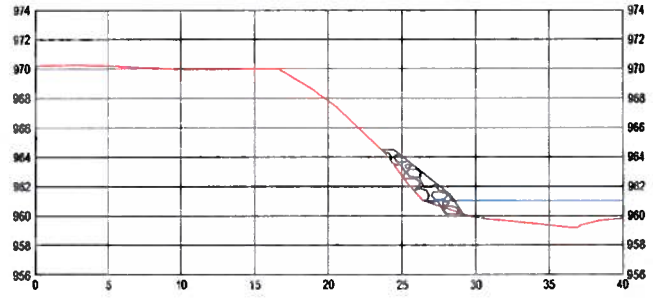
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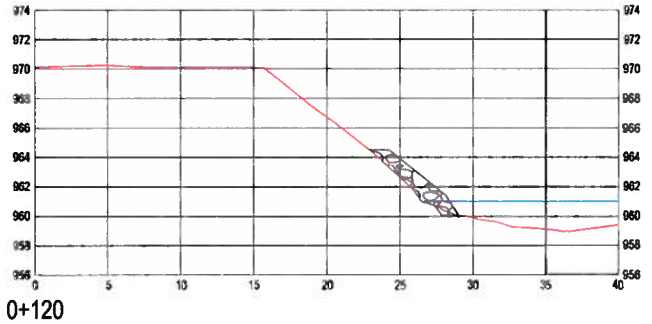
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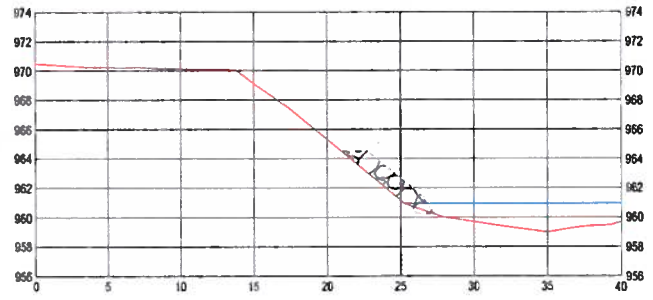
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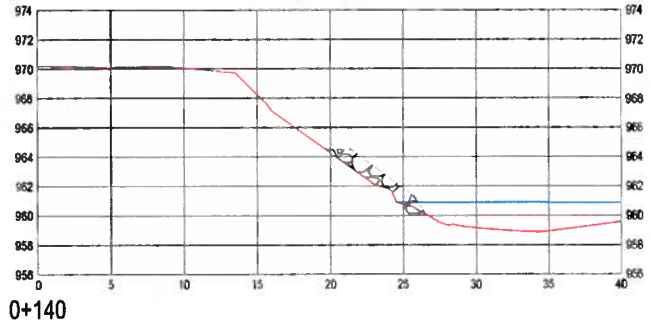
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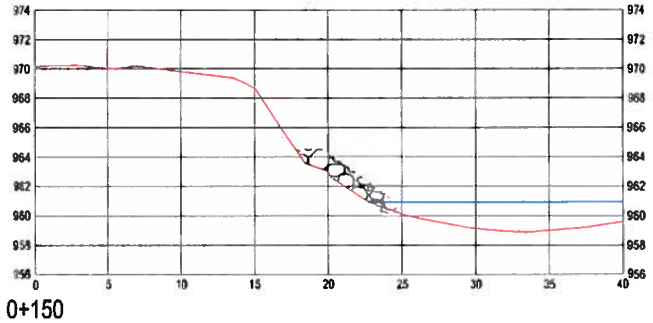
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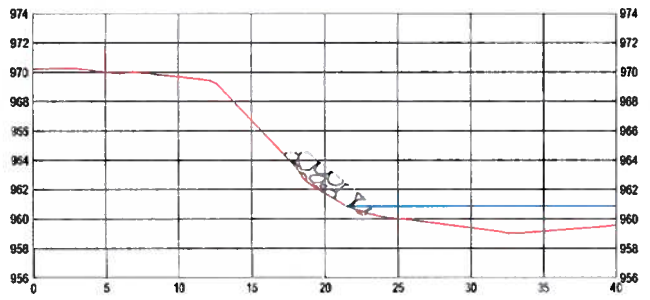

0+160

ISSUED FOR TENDER

LEGEND
APPROX. WATER LEVEL
EXISTING GROUND

No.	Date	Revision	Dr.	Ck'd

McElhanney
McElhanney Consulting Services Ltd.
1633 First Avenue
Prince George BC
Canada V2L 2Y6
Tel 250 561 2229

Designed: WWC	Checked: -	QC: -	
Drawn: ES	DATE: 14/07/15		

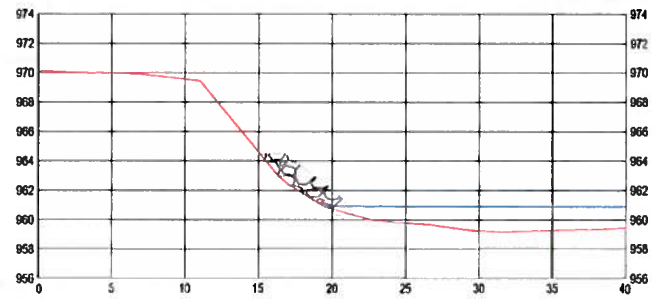
0 1:250 10
Scale: 22" x 34" Sheet

Approved Sealed

PARKS CANADA / PARCS CANADA
-
ROCKY MOUNTAIN HOUSE
EROSION PROTECTION
RIP RAP AREA A 0+050 - 0+160

Client Project No
--
Client Drawing No -
MCSL Project No. 2511-00460-0
Drawing No.
00460-005
Sheet 5 of 9 Revision 0

Destroy all prints bearing previous number



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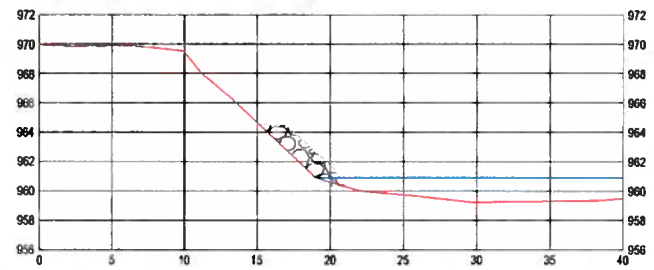

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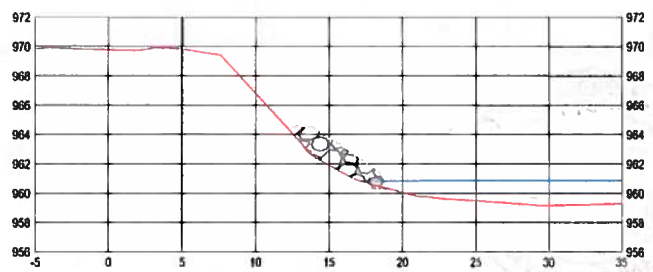

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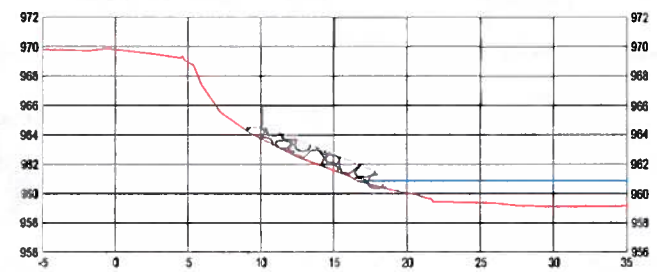

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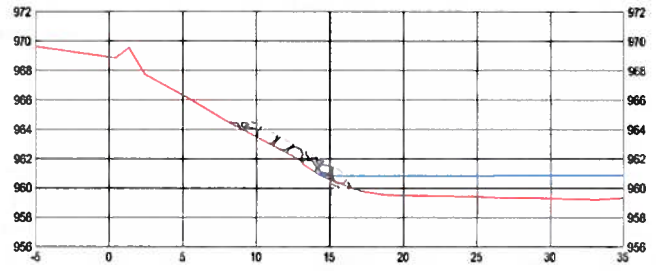

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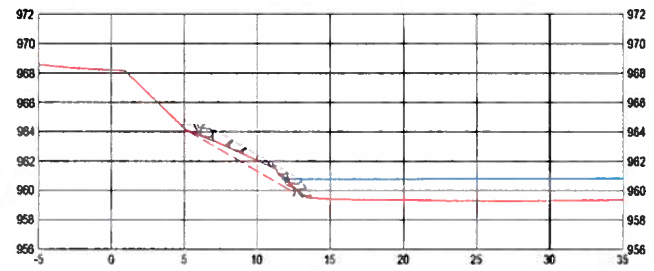

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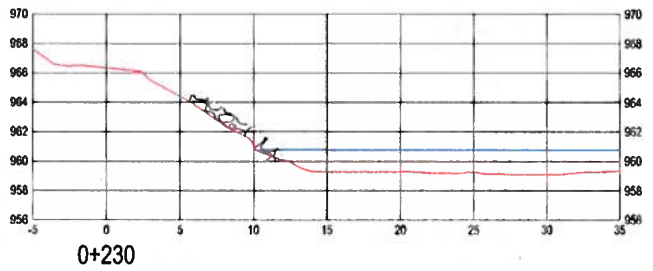

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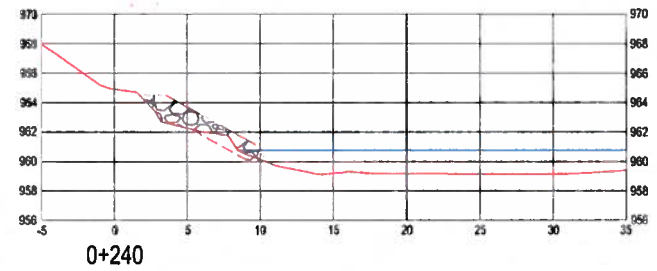

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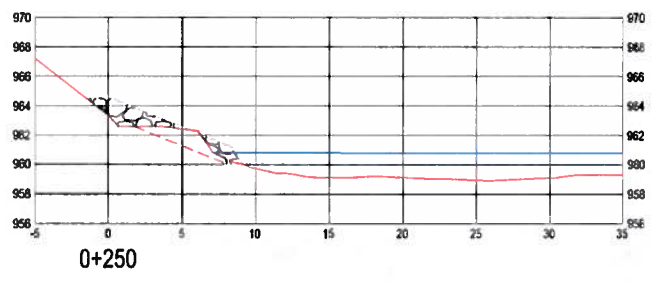

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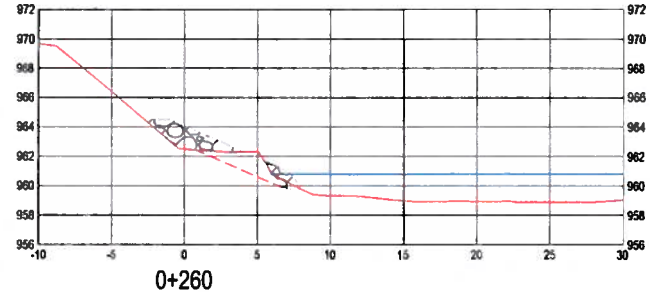

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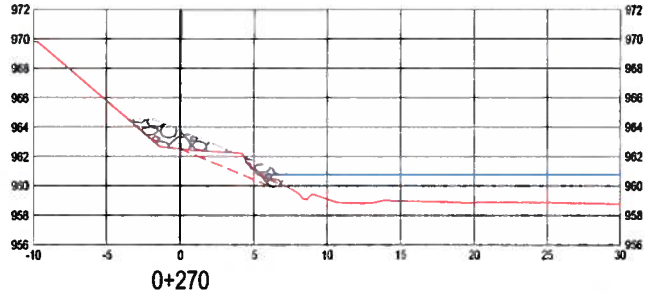

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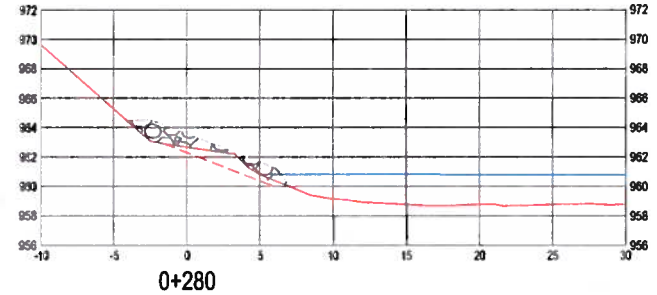


0+280

ISSUED FOR TENDER

NOTE:
TRIM SLOPE AS NEEDED TO RETAIN ROCK RIP RAP THICKNESS OF 1.2m

LEGEND
- APPROX. WATER LEVEL
- EXISTING GROUND
- SLOPE TRIM

No.	Date	Revision	Dr.	Chk

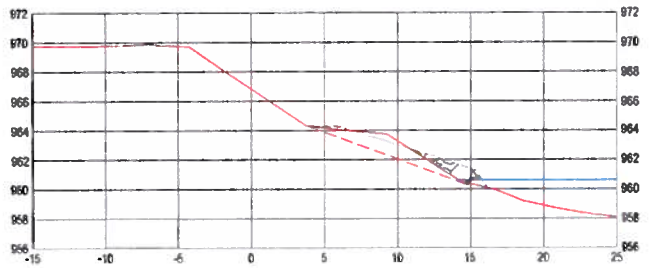
McElhanney
McElhanney Consulting Services Ltd.
1633 First Avenue
Prince George BC
Canada V2L 2Y9
Tel 250 561 2229

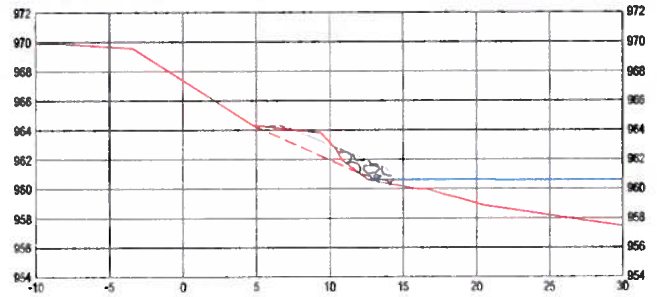
Designed: WWC	Checked: -	QC: -	
Drawn: ES	DATE: 14/07/15		
0 1:250 10			
Scale: 22" x 34" Sheet			Approved Sealed

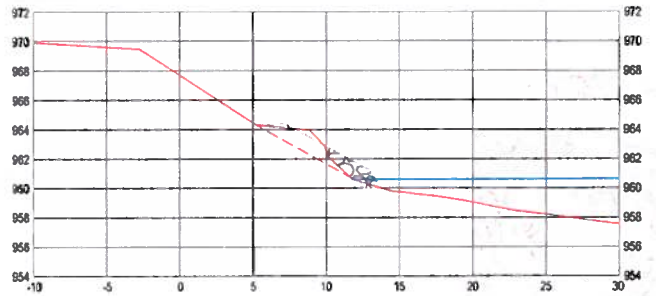
PARKS CANADA / PARCS CANADA
-
ROCKY MOUNTAIN HOUSE
EROSION PROTECTION
RIP RAP AREA A 0+170 - 0+280

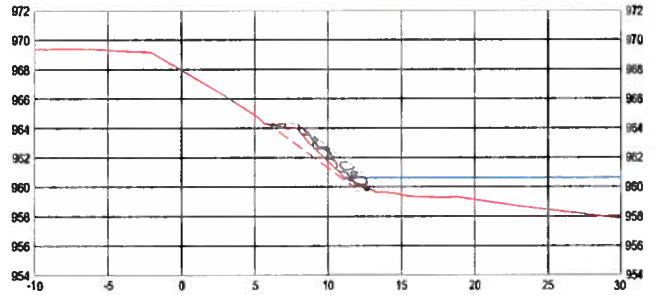
Client Project No: -
Client Drawing No: -
MCSL Project No: 2511-00460-0
Drawing No: 00460-006
Sheet 8 of 9 | Revision 0

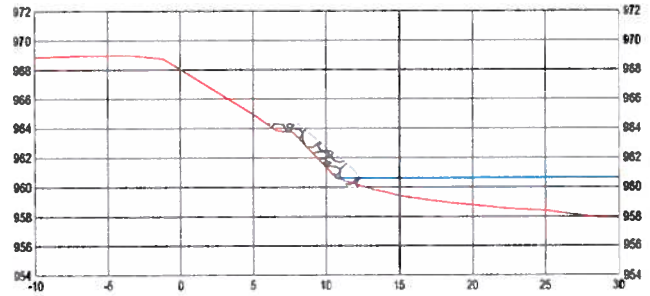
DesDwy still prints bearing previous number

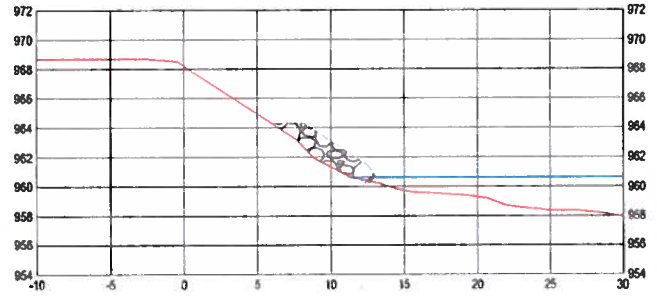


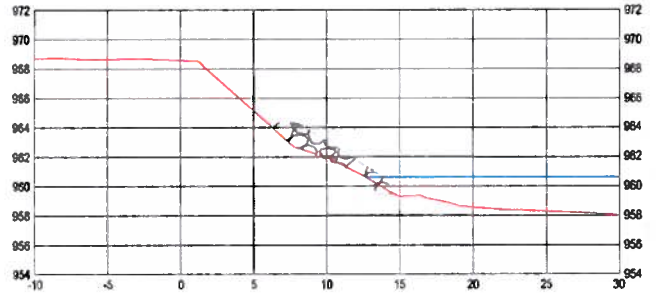


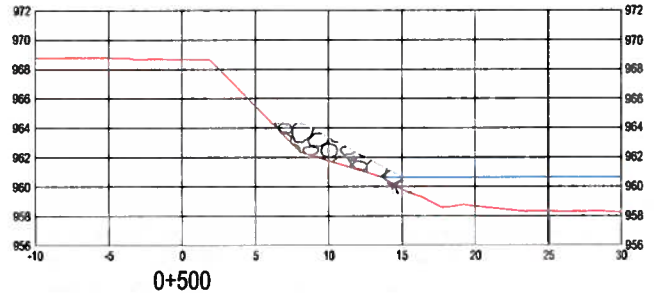


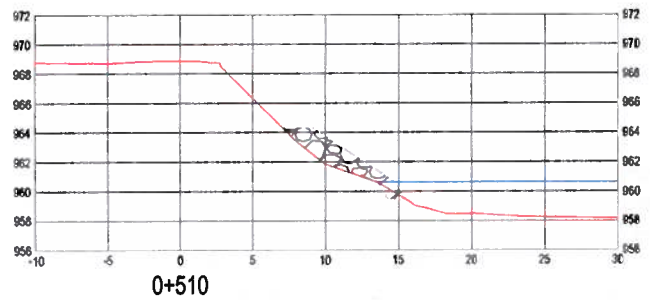


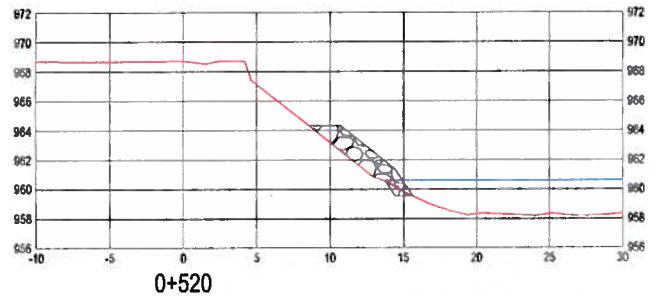


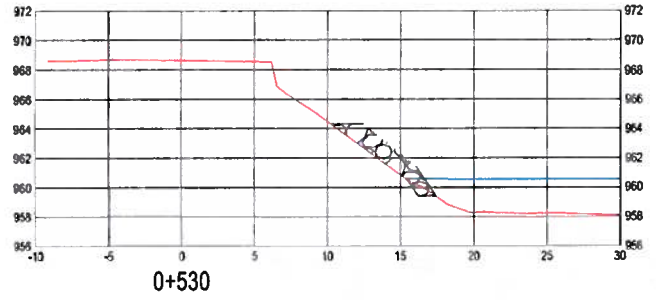


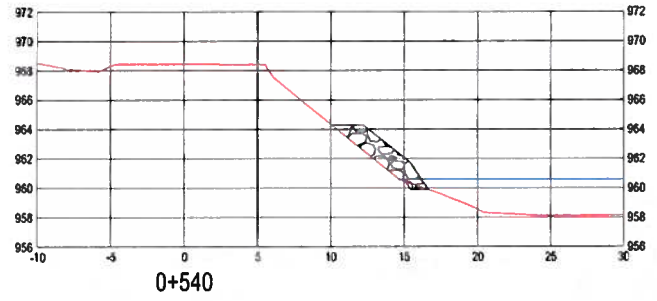


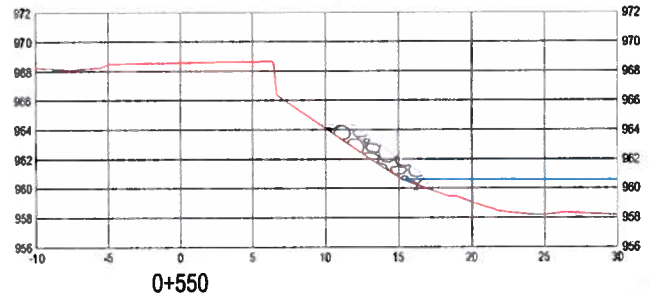


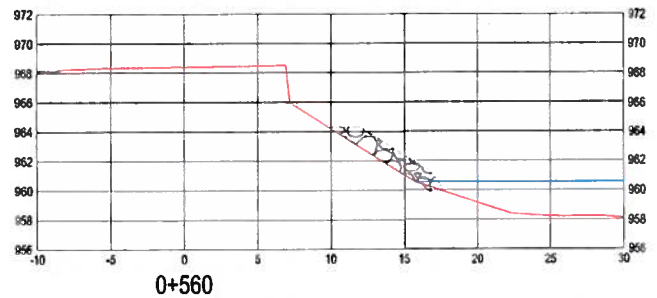


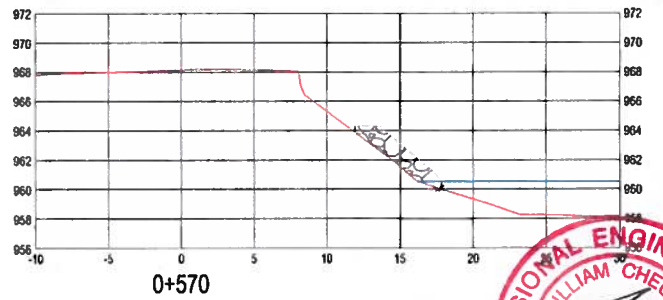


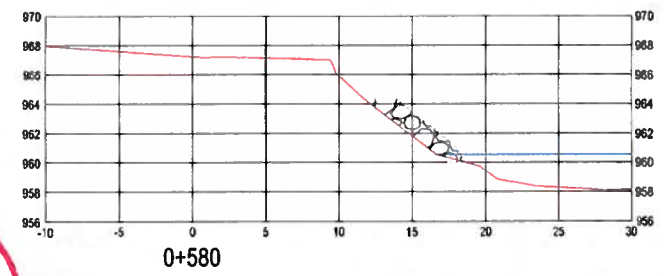












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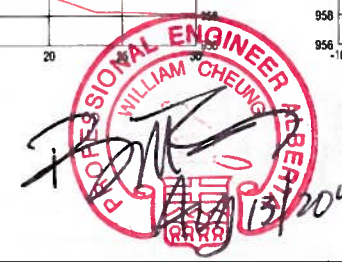

NOTE:
TRIM SLOPE AS NEEDED TO RETAIN ROCK RIP RAP THICKNESS OF 1.2m

LEGEND
- APPROX. WATER LEVEL
- EXISTING GROUND
- SLOPE TRIM

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-
ROCKY MOUNTAIN HOUSE
EROSION PROTECTION
RIP RAP AREA B STA 0+430 - 0+580

Client Project No: -
Client Drawing No: -
MCEL Project No: 2511-00460-0
Drawing No: 00460-007
Sheet 7 of 9
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ROCKY MOUNTAIN HOUSE
EROSION PROTECTION
RIP RAP AREA B STA 0+590 - 0+740

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Drawing No.: 00460-008
Sheet 8 of 9 Revision 0

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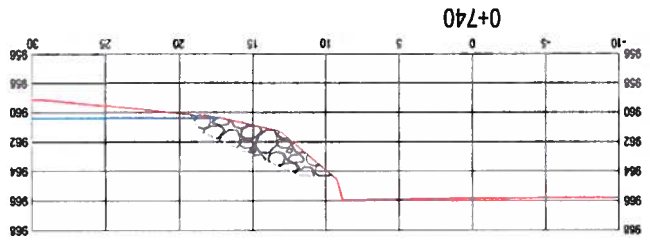
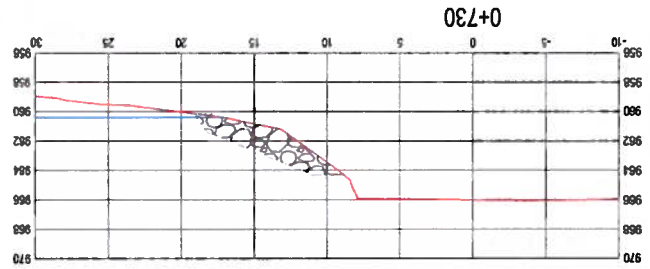
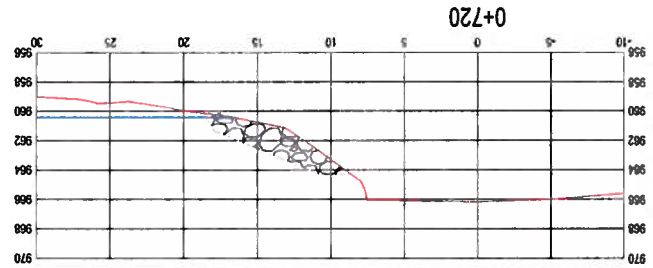
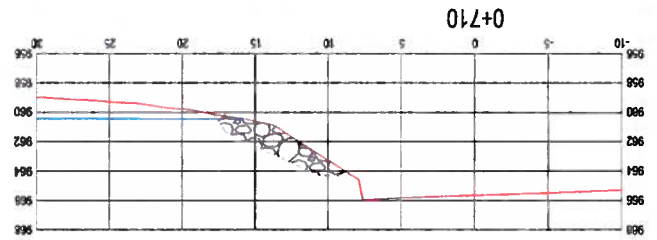
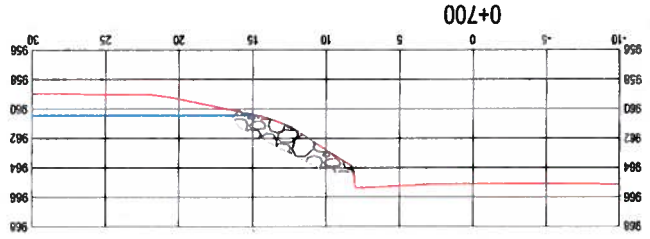
LEGEND
APPROX. WATER LEVEL
EXISTING GROUND

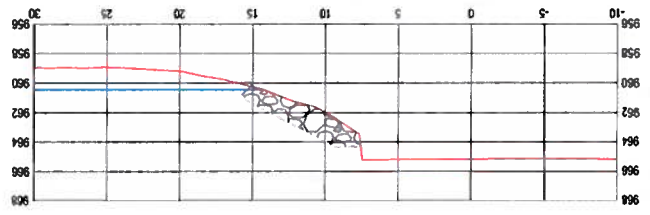


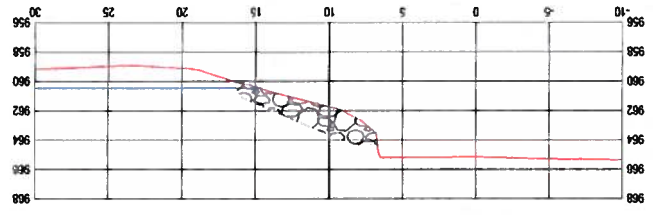


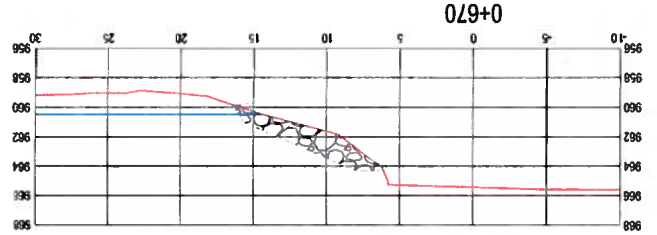


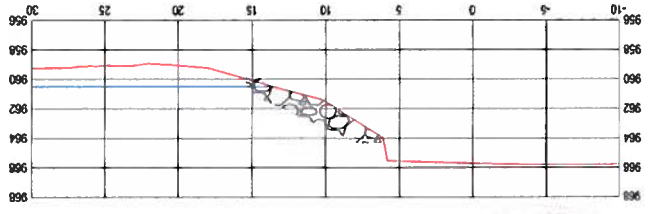


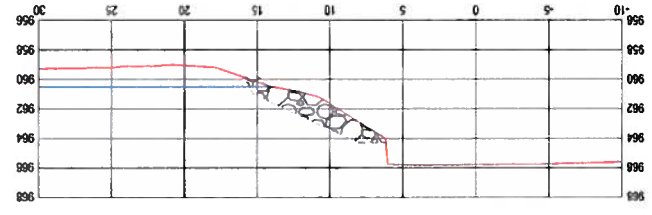


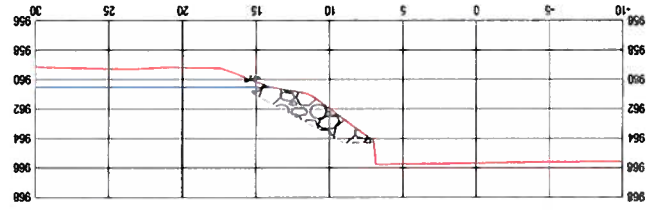


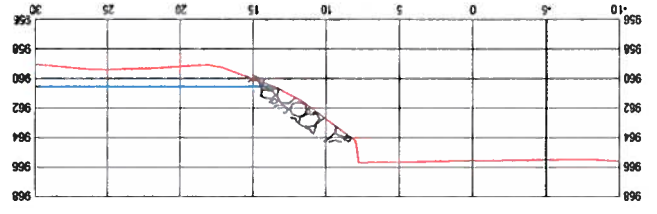


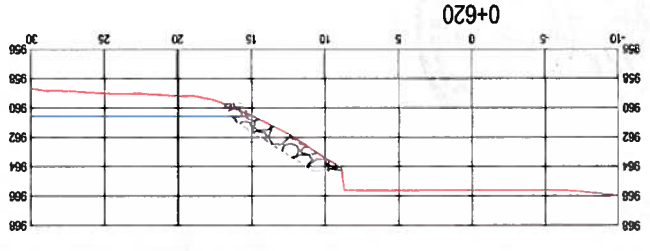


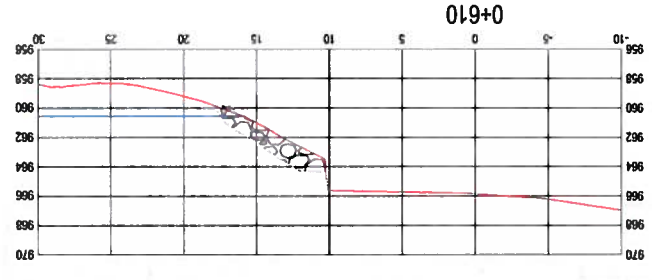


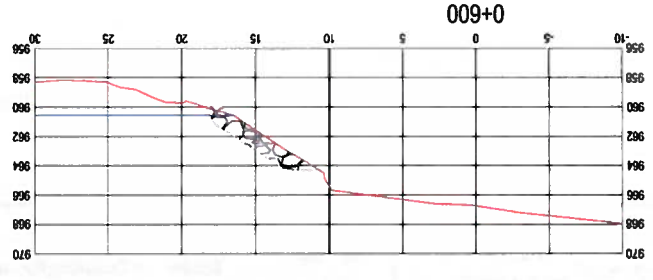


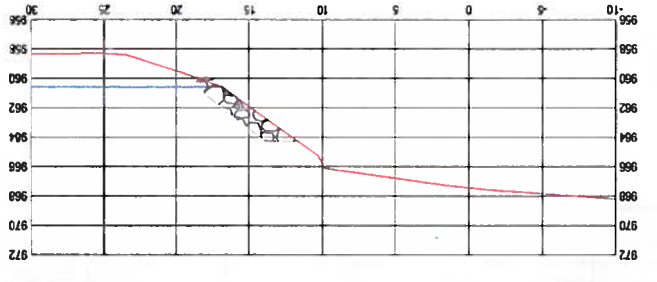


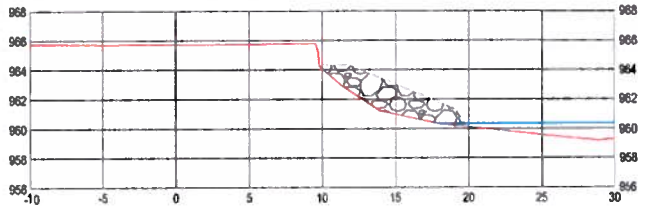








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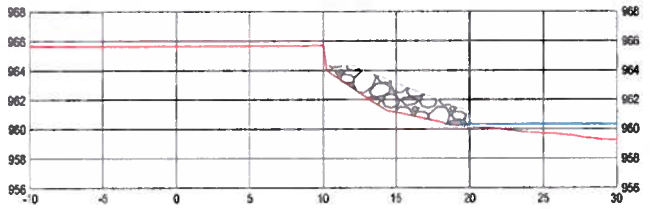
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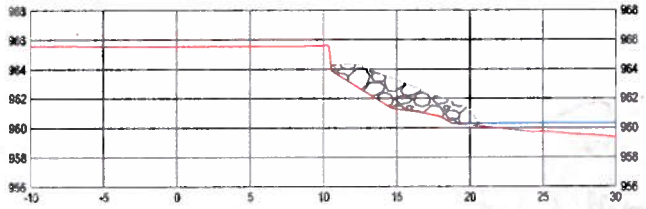
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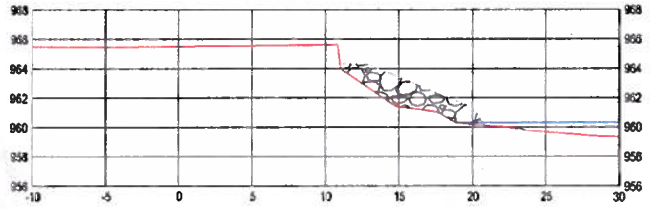
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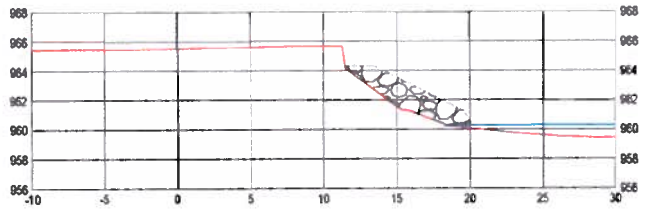
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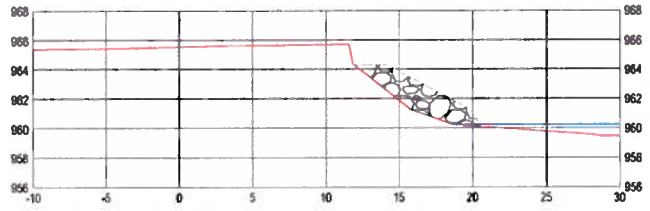
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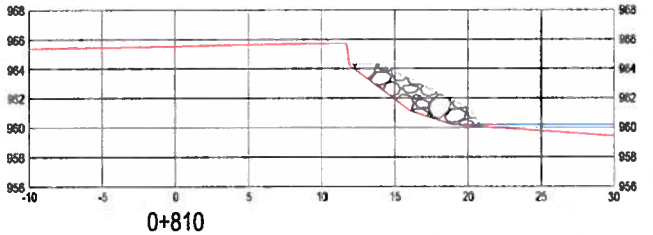
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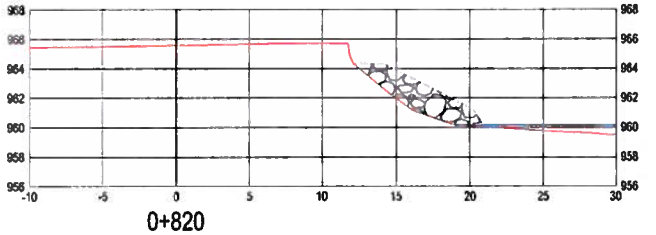
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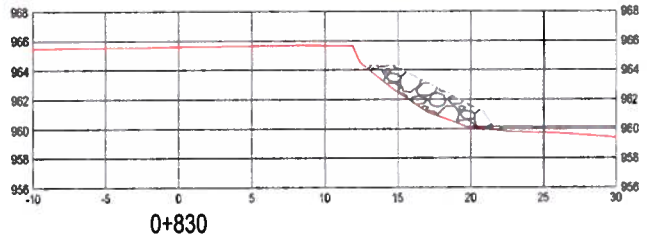
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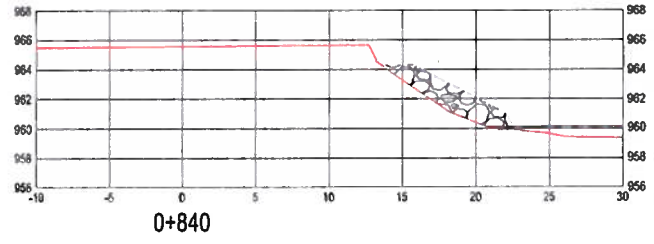
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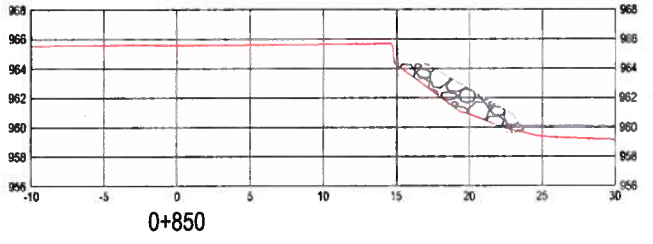
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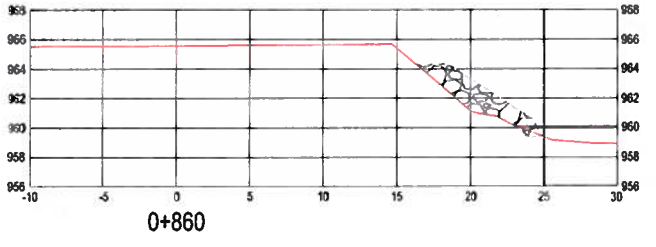
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LEGEND
APPROX. WATER LEVEL
EXISTING GROUND

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PARKS CANADA / PARCS CANADA

ROCKY MOUNTAIN HOUSE
EROSION PROTECTION
RIP RAP AREA B STA 0+750 - 0+860

Client Project No: -
Client Drawing No: -
MCSL Project No: 2511-00460-0
Drawing No: 00460-009
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21 APPENDIX 2: DFO MEASURES TO AVOID HARM

The following DFO Measures to Avoid Harm will be implemented:

Measures

Project Planning
Timing

- Minimize duration of in-water work.
- Conduct instream work during periods of low flow, or at low tide, to further reduce the risk to fish and their habitat or to allow work in water to be isolated from flows.
- Schedule work to avoid wet, windy and rainy periods that may increase erosion and sedimentation.

Site Selection

- Design and plan activities and works in waterbody such that loss or disturbance to aquatic habitat is minimized and sensitive spawning habitats are avoided.
- Design and construct approaches to the waterbody such that they are perpendicular to the watercourse to minimize loss or disturbance to riparian vegetation.

Contaminant and Spill Management

- Plan activities near water such that materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, or other chemicals do not enter the watercourse.
- Develop a response plan that is to be implemented immediately in the event of a sediment release or spill of a deleterious substance and keep an emergency spill kit on site.
- Ensure that building material used in a watercourse has been handled and treated in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish.

Erosion and Sediment Control

- Develop and implement an Erosion and Sediment Control Plan for the site that minimizes risk of sedimentation of the waterbody during all phases of the project. Erosion and sediment control measures should be maintained until all disturbed ground has been permanently stabilized, suspended sediment has resettled to the bed of the waterbody or settling basin and runoff water is clear. The plan should, where applicable, include:
    - Installation of effective erosion and sediment control measures before starting work to prevent sediment from entering the water body.
    - Measures for managing water flowing onto the site, as well as water being pumped/diverted from the site such that sediment is filtered out prior to the water entering a waterbody. For example, pumping/diversion of water to a vegetated area, construction of a settling basin or other filtration system.
    - Measures for containing and stabilizing waste material (e.g., dredging spoils, construction waste and materials, commercial logging waste, uprooted or cut aquatic plants, accumulated debris) above the high water mark of nearby waterbodies to prevent re-entry.
    - Regular inspection and maintenance of erosion and sediment control measures and structures during the course of construction.
    - Repairs to erosion and sediment control measures and structures if damage occurs.
    - Removal of non-biodegradable erosion and sediment control materials once site is stabilized.

Shoreline Re-vegetation and Stabilization

- Clearing of riparian vegetation should be kept to a minimum: use existing trails, roads or cut lines wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction. When practicable, prune or top the vegetation instead of grubbing/uprooting.
- Minimize the removal of natural woody debris, rocks, sand or other materials from the banks, the shoreline or the bed of the waterbody below the ordinary high water mark. If material is removed from the waterbody, set it aside and return it to the original location once construction activities are completed.
- Immediately stabilize shoreline or banks disturbed by any activity associated with the project to prevent erosion and/or sedimentation, preferably through re-vegetation with native species suitable for the site.
- Restore bed and banks of the waterbody to their original contour and gradient; if the original gradient cannot be restored due to instability, a stable gradient that does not obstruct fish passage should be restored.
- If replacement rock reinforcement/armouring is required to stabilize eroding or exposed areas, then ensure that appropriately-sized, clean rock is used; and that rock is installed at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment.
- Remove all construction materials from site upon project completion.

Fish Protection

- Ensure that all in-water activities, or associated in-water structures, do not interfere with fish passage, constrict the channel width, or reduce flows.
- Screen any water intakes or outlet pipes to prevent entrainment or impingement of fish. Entrainment occurs when a fish is drawn into a water intake and cannot escape. Impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself.
    - In freshwater, follow these measures for design and installation of intake end of pipe fish screens to protect fish where water is extracted from fish-bearing waters:
        - Screens should be located in areas and depths of water with low concentrations of fish throughout the year.
        - Screens should be located away from natural or artificial structures that may attract fish that are migrating, spawning, or in rearing habitat.
        - The screen face should be oriented in the same direction as the flow.
        - Ensure openings in the guides and seals are less than the opening criteria to make “fish tight”.
        - Screens should be located a minimum of 300 mm (12 in.) above the bottom of the watercourse to prevent entrainment of sediment and aquatic organisms associated with the bottom area.
        - Structural support should be provided to the screen panels to prevent sagging and collapse of the screen.
        - Large cylindrical and box-type screens should have a manifold installed in them to ensure even water velocity distribution across the screen surface. The ends of the structure should be made out of solid materials and the end of the manifold capped.
        - Heavier cages or trash racks can be fabricated out of bar or grating to protect the finer fish screen, especially where there is debris loading (woody material, leaves, algae mats, etc.). A 150 mm (6 in.) spacing between bars is typical.
        - Provision should be made for the removal, inspection, and cleaning of screens.
        - Ensure regular maintenance and repair of cleaning apparatus, seals, and screens is carried out to prevent debris-fouling and impingement of fish.
        - Pumps should be shut down when fish screens are removed for inspection and cleaning.

Operation of Machinery

- Ensure that machinery arrives on site in a clean condition and is maintained free of fluid leaks, invasive species and noxious weeds.
- Whenever possible, operate machinery on land above the high water mark, on ice, or from a floating barge in a manner that minimizes disturbance to the banks and bed of the waterbody.

- Limit machinery fording of the watercourse to a one-time event (i.e., over and back), and only if no alternative crossing method is available. If repeated crossings of the watercourse are required, construct a temporary crossing structure.
- Use temporary crossing structures or other practices to cross streams or waterbodies with steep and highly erodible (e.g., dominated by organic materials and silts) banks and beds. For fording equipment without a temporary crossing structure, use stream bank and bed protection methods (e.g., swamp mats, pads) if minor rutting is likely to occur during fording.
- Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water.

22 APPENDIX 3: TURBIDITY MONITORING REPORT

McElhanney

Sept 23, 2014
File: 2511-0460-0

Todd Aasen P.Eng.,
Approval Manager
Alberta Envt and Sustainable Resource Development Operations
Red Deer-North Saskatchewan Region
304, 4920 - 51 Street (Provincial Building)
Red Deer, AB T4N 6K8

TURBIDITY MONITORING PROGRAM FOR THE NORTH SASKATCHEWAN RIVER BANK STABLIZATION WORKS AT ROCKY MOUNTAIN HOUSE NATIONAL HISTORIC SITE

Dear Mr. Aasen:

As requested, please find a summary of the turbidity monitoring program that Parks Canada intends to implement while placing rip rap on the North Saskatchewan River bank.

Project overview

The project includes stabilizing approximately 660m of the North Saskatchewan River bank, in two sections. Area A is the upstream segment, and includes approximately 230 linear meters of rip rap (~1800m^3 of rock). Area B, the downstream segment is approximately 430 linear meters, and requires approximately 4820m^3 of rip rap.

The rip rap installation will occur using an excavator with a bucket and thumb to place the rock along the river bank; no end dumping will occur. Starting at the downstream end of the site, the excavator will place rock on the bank and in places, instream. This will create a platform from which to work. The excavator will continue working upstream placing rock in front of itself. This method will have less impact than multiple access points.

Turbidity Monitoring Program

Prior to installation, rip rap will be washed well beyond the top of bank at the stockpile locations (refer to attached map). Any sediment removed during the washing process will filter into surrounding vegetation and will not be permitted to enter the North Saskatchewan River.

During the process of rip rap installation, turbidity will be monitored at three locations (refer to attached map) using a LaMotte 2020 turbidity meter. The upstream monitoring station will be used to establish baseline turbidity measurements, while Monitoring Stations A and B will document any potential silt loading that occurs as a result of the work.

CEQG Turbidity Guidelines established by the CCME will be followed:

- For clear flow - Maximum increase of 8 NTU from background levels for any short-term exposure (e.g., 24-h period). Maximum increase of 2 NTU from background levels for any long-term exposure (e.g., inputs lasting between 24-h and 30-d).

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- For high flow or turbid waters - Maximum increase of 8 NTU from background levels at any one time when background levels are between 8 and 80 NTU. Should not increase more than 10% of background levels when background is >80 NTU.

If, at any point during rip rap installation, turbidity exceeds acceptable levels as outlined by the CEQG Turbidity Guidelines, instream rip rap installation will stop until turbidity levels return to acceptable range.

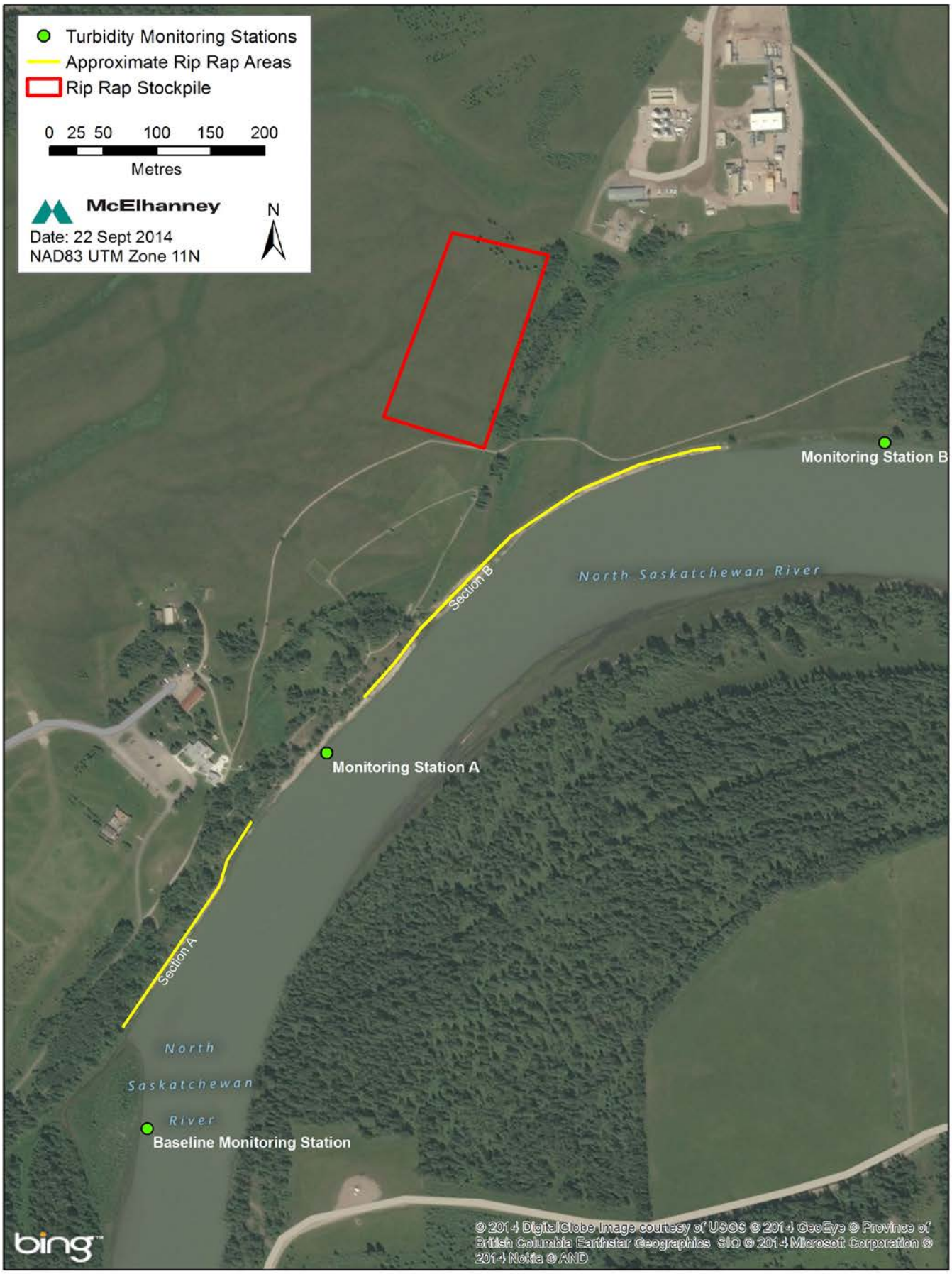
Yours truly

McElhanney Consulting Services Ltd.

John Summers PBiol, RPBio
Senior Biologist

Cc: Fisheries and Oceans Canada, Burlington

McElhanney



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23 APPENDIX 4: ARCHAEOLOGICAL REPORT

Final Report

Report on the Archaeological Testing of the 2013 Geophysical Survey of the North Saskatchewan River Bank

Riverbank Stabilization Project, Rocky Mountain House National Historic Site of Canada

Peter D. Francis and John E.P. Porter

July 1, 2014

Final Report

Report on the Archaeological Testing of the 2013 Geophysical Survey of the North Saskatchewan River Bank

Riverbank Stabilization Project

Rocky Mountain House National Historic Site of Canada

Peter D. Francis and John E.P. Porter

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Summary

Erosion of the terrace edge of the North Saskatchewan River as it flows through Rocky Mountain House National Historic Site is an ongoing process that is periodically punctuated with catastrophic high water events that results in more severe losses of riverbank and the cultural resources buried within. Most recently, such catastrophic episodes occurred in 2005 and 2013. Following the latter event, Parks Canada decided to undertake remedial measures to protect the riverbank at the north end of the national historic site. In advance of any engineered remedial measures that will likely impact the terrace north of archaeological Site 1R (HBC fort 1868-75), Parks Canada archaeology carried out a geophysical survey of approximately 210 metres of unstable terrace edge, using ground penetrating radar and magnetometer techniques. The study area was divided into a series of contiguous 20 metre by 30 metre grids that were located within one metre of the erosional edge of the terrace. Seven grids were surveyed beginning with Grid 2 and ending with Grid 8. Part of this section of the riverbank is believed to be near to, or within, the area once occupied by the heretofore archaeologically unidentified 1864-1868 Hudson's Bay Company fort (i.e., the so-called "temporary fort").

Analysis of the geophysical datasets identified a total of 79 anomalies within the study area. For the purposes of the archaeological subsurface testing programme to verify the presence or absence of archaeological features, only those anomalies that are situated within 10 metres of the erosional edge of the terrace (i.e., the possible limit of potential engineering requirements to impact the landform back from the erosional edge of the riverbank), were considered for archaeological fieldwork. A total of 53 potential geophysical anomalies were considered for archaeological testing.

Due to limitations of time and personnel, the geophysical analyst returned to the study area to relocate and mark the location of those anomalies considered to be the most likely candidates for archaeological verification. A total of 17 highest potential anomalies were measured and marked, including both ground penetrating radar and magnetometer examples, spanning the entire study area from the southern part of Grid 2 to the northernmost part of Grid 8 with targets in all seven grids. The larger sized anomalies were subjected to several subsurface tests while smaller anomalies were usually investigated with a single targeted test as measured and marked on the surface by the geophysical analyst.

The results of the 2014 archaeological subsurface testing of selected high potential geophysical anomalies from the 2013 remote sensing survey is both surprising and puzzling. All 17 targeted anomalies in the study area were tested archaeologically and completed to a depth well into culturally sterile sediments. No archaeological features or other cultural evidence of any significance was found. The report discusses the results of the archaeological investigations and offers recommendations for future management direction.

Introduction

Erosion of the terrace edge of the North Saskatchewan River as it flows through Rocky Mountain House National Historic Site is an ongoing process that is periodically punctuated with catastrophic high water events that result in more severe losses of riverbank and the cultural resources buried within. Most recently, such catastrophic episodes occurred in 2005 and 2013. Following the latter event, Parks Canada decided to undertake remedial measures to protect the riverbank at the north end of the national historic site. In advance of any engineered remedial measures that will likely impact the terrace north of archaeological Site 1R (Hudson's Bay Company fort, 1868-75), Parks Canada archaeology carried out a geophysical survey of approximately 210 metres of unstable terrace edge, using ground penetrating radar and magnetometer techniques. This report discusses the results of the 2014 archaeological subsurface testing programme undertaken to verify the presence of buried cultural resources as guided by the 2013 geophysical survey.

Historical and Archaeological Background

During the summer of 1799 the North West Company initiates construction of a post of the North Saskatchewan River upstream of the Clearwater/North Saskatchewan Rivers confluence. In the fall both companies arrive together at the site with the North West Company completing the construction of Rocky Mountain House (Site 16R). The Hudson's Bay Company begins construction of Acton House (Site 13R). David Thompson is sporadically at Rocky Mountain House between the spring of 1800 and the spring of 1802. Both forts are closed from the summer of 1802 to the summer of 1805. They remain open for two years and are once again closed at the end of the 1807 season and remain closed until the autumn of 1810. The forts remain open for two seasons and then are closed from the summer of 1812 to July 1819. News of the merger of the two companies arrives in August 1821. The name Hudson's Bay Company is retained for the newly amalgamated company and the name Rocky Mountain House is retained for the post.

The post remains open for two years and is once again closed on orders of Governor George Simpson in the summer of 1823. It does not reopen until the fall of 1825. It stays open until the end of the 1834/35 season during which construction of a new establishment (Site 15R) is commenced.

During this site's history a variety of missionaries and explorers visit the site. Reverend R.T. Rundle visits the site four times between 1842 and 1848. Other missionaries include Father Jean-Baptiste Thibeault (1842), Father Pierre De Smet (1845) and Reverend Thomas Woolsey (1857). From late April to early May 1848 artist Paul Kane is at the site and during this time completes a detailed sketch of the fort. John Palliser, James Hector and other members of the Palliser Expedition are at the site at various times between January 1858 and early May 1859. At the end of the 1860/61 season the post was abandoned and in the autumn of that year the Blackfoot burned the abandoned fort.

In the fall of 1864 a small temporary fort was constructed northeast of 15R. In late winter the construction of a permanent fort (Site 1R) was commenced. The new permanent fort was initially occupied during the 1868/69 season. This site was subsequently abandoned at the end of the 1874/75 season. A number of people visited these last two sites during their existence. Reverend John McDougall visited the site in 1866 and again in 1869. Fathers Albert Lacombe and Constantine Scollen were at the site during the 1870/71 season to produce the first Cree dictionary. In November 1871 Charles Horetzky and Walter Moberly of the Canadian Pacific Railway visited the site. While there Charles Horetzky

photographed Jean l'Heureux and a group of Peigans. Jean l'Heureux subsequently visited the site during the 1873/74 season and completed a sketch of the site and surrounding area.

Subsequent to the abandonment of the last fort a variety of surveyors and pioneers enter the area. The recently abandoned site was visited by R.W. Ells and party from the Geological Survey of Canada in August 1875. In 1885 and 1886 J.B. Tyrell of the Geological Survey of Canada visited the site. During the 1886 visit he makes two photographs of the remains of site 1R. In 1904 a George Fletcher arrives and builds near the fort ruins, though which fort ruins are unknown. In 1915 major flooding along the North Saskatchewan River may have removed most or perhaps all of the surviving remains of the 1864-68 temporary fort.

In 1922 the Brierley family arrives and spend the winter in a cabin located at a sawmill below Site 16R. They also begin renting land from the Hudson's Bay Company. The following year the family builds and moves into a farmhouse built on the site of 16R. Sometime during the 1920s the Brierley family purchases the adjacent McKay property and in 1928 it purchases the Hudson's Bay Company land holdings.

In May 1926 the Historic Sites and Monuments Board of Canada recommends Rocky Mountain House for commemoration. The following year the Board approves the commemorative plaque inscription. In 1930 the Brierley family donate 0.14 acre to the Historic Sites and Monuments Board of Canada for construction of the commemorative cairn location. The completed cairn and plaque were unveiled the following year. The Brierley family donates additional land to the Board in 1939 which enlarges the protected area to just over eight acres.

For many years people had been "pothunting" at the old fort sites looking for a buried cannon and keg of rum. In 1937 the first official excavation occurred. It took place at the site of the 1864-68 temporary fort and no evidence for the cannon or rum was found.

In 1958 a Glenbow Foundation team identify a fur trade site now known to be the Hudson Bay Company's Acton House (Site 13R). Excavation of this site occurred in 1962 and 1963. Then in 1966 excavations were undertaken at the Hudson Bay Company's Rocky Mountain House 1868-75 (Site 1R). This work was designed to recover remains being eroded by the North Saskatchewan River; to determine the fort construction techniques and to verify the accuracy of the 1873 Jean l'Heureux sketch. Low oblique aerial photographs taken during this project revealed the location of a nearby fort which was later determined to be the Hudson Bay Company's Rocky Mountain House 1835-61 (Site 15R).

In 1968 the Historic Sites and Monuments Board of Canada recommended the creation of a national historic park that would encompass all the known fort sites. The following year land is sold for the construction of a gas plant. During construction 11 fur trade era burials are found. This site is subsequently called the Seafort Burial Site and designated Site 17R. In 1970 the Government of Canada purchased the remaining land of the Brierley farm.

Commencing in 1975 Parks Canada archaeologists undertook an intensive subsurface testing programme which resulted in the location of two new fur trade sites. These were the Northwest Company's Rocky Mountain House 1799-1821 (Site 16R) and the Hudson Bay Company's Rocky Mountain House 1835-61 (Site 15R). Excavations at both sites continued to 1977.

Rocky Mountain House National Historic Site officially opened in 1979. That same year 12 additional burials were recovered from the Seafort Burial Site. In the 1980s a number of small archaeological resource impact assessments were completed at the site. Early in the 1990s an Archaeological Site

Inventory Programme resulted in the recording of six new sites. During the 1993 season geophysical studies were completed at five locations and the following year archaeological testing confirmed the presence of two post-fur trade era burials (Site 1632R) near Site 16R. During the 1996 season excavations were conducted in the presumed area of the 1864-68 temporary fort. While some fire-broken rock and calcined bone was recovered no evidence relating to the temporary fort was identified. Between 1997 and 1999 excavations were undertaken at a refuse area associated with the nearby site of the Hudson Bay Company's Rocky Mountain House 1835-61 (Site 15R). During the 1999 season construction of the Bicentennial Trail was monitored and resulted in the recording of several refuse areas associated with Site 15R.

In the 2000s additional archaeological resource impact assessments were completed. Especially noteworthy was the examination of severe riverbank erosion after major flooding along the North Saskatchewan River in 2005 and 2013. A pilot public archaeology programme was initiated during the 2011 season. In late 2013 an extensive geophysical study was undertaken adjacent to the eroding bank of the North Saskatchewan River prior to planned riverbank stabilization activities. This work resulted in the identification of a large number of anomalies within 10 metres of the riverbank. This report details the results of the ground truthing programme conducted during June 2014.

The 2013 Geophysical Survey of the Study Area

Following severe high water erosion of the river bank through Rocky Mountain House National Historic Site by the North Saskatchewan River in 2013, Parks Canada archaeologist William Perry undertook a geophysical survey of approximately 210 metres of unstable terrace edge that requires engineered stabilization measures (Perry 2014). Ground penetrating radar (500mHz) and magnetometer techniques were used over a series of contiguous 20 metre by 30 metre grids that were located within one metre of the erosional edge of the terrace between the rise in slope to the upper terrace on the southern margin and the remains of a barbed wire fence along the northern margin (Figures 1 to 4). Seven grids were surveyed beginning with Grid 2 and ending with Grid 8. (Grid 1 was discarded in the field due to poor collection results). This section of the riverbank is believed to be near to, or within, the area once occupied by the heretofore archaeologically unidentified 1864-1868 Hudson's Bay Company fort (i.e., the so-called "temporary fort"; see Francis and Porter 2003:121-127).

Perry's analysis of the geophysical data sets produced a total of 79 anomalies identified throughout the seven contiguous grids. For the purposes of the archaeological subsurface testing programme that is the substance of this report, only those anomalies that are situated within 10 metres of the erosional edge of the terrace (i.e., the possible limit of potential engineering requirements to impact the landform back from the erosional edge of the riverbank), were considered for archaeological fieldwork. A total of 53 potential geophysical anomalies were considered for archaeological testing.

The 2014 Archaeological Testing of the 2013 Geophysical Survey Anomalies

Selection of Anomalies for Archaeological Testing

Due to limitations of time and personnel, Perry returned to the study area to relocate and mark the location of those anomalies that he considered to be the most likely candidates for archaeological verification. With his extensive experience undertaking geophysical investigations, and drawing upon clues from surface features, past land use, and previous archaeological investigations (see the archaeological background section in this report), Perry selected the anomalies having the highest potential to be historic features. A total of 17 anomalies, including both ground penetrating radar and magnetometer examples, span the entire study area from the southern part of Grid 2 to the northernmost part of Grid 8 with targets in all seven grids.

Fieldwork Methods

In addition to Perry's essential participation, Parks Canada archaeologist Brad Himour provided excellent and welcome assistance during the first week of archaeological testing. Standard archaeological subsurface testing techniques were employed using hand tools (spades, trowels, brushes, tape measures), with excavated sediments selectively sieved through a 6mm mesh screen. Detailed field notes were taken by all participants and a photographic record was maintained for the project. Any possible cultural materials found within each archaeological test were recorded but not collected. Most frequently, small fragments of faunal bone were found, but in total that number was small. Nine full days of archaeological testing completed the fieldwork portion of the project.

Results of Archaeological Subsurface Testing

Descriptions and locations of the archaeologically tested geophysical anomalies are taken directly from Perry (2014). Beginning with Grid 2 in the southern part of the study area, the results of the archaeological testing of each geophysical anomaly is presented in chronological sequence proceeding broadly northward through the landform. Results of the archaeological testing are summarized in Table 2.

Grid 2

One geophysical anomaly was tested in Grid 2: **Anomaly #1**.

Anomaly #1 is described as a near surface Ground Penetrating Radar (GPR) anomaly that appears rectangular in shape and visible in both the plan view and vertical slice view of the GPR dataset (see Perry 2014: Figures 3 and 5). Perry thought that this geophysical anomaly might be a structural feature and, if determined archaeologically to be historic, could potentially be related to the commemoration of the national historic site and thus of national significance. As measured and staked out by Perry, three archaeological subsurface tests were placed strategically over this anomaly.

Test #1: Located at 14.5m to 15.5m N and 16.0m to 17.0m W within Grid 2, this 1.0m by 1.0m test was excavated to a depth of 33cm below surface (DBS). As will be proven ubiquitously across the study area, Test #1 exhibits a soil profile that consists of a grass-covered sod layer underlain by a dark brown-

coloured cultivation (plough) zone of approximately 10+ cm thickness that in turn is underlain by a thick stratum of medium brown sandy clay that is variously mottled with lighter or darker brown silts (Figure 5). This typical soil profile has been found within previous archaeological excavations elsewhere across the national historic site where the post-fur trade era agricultural use of the land involved the cultivation of hay fields. Artefacts and faunal remains have almost always been recovered within the cultivation layer and within the top few centimetres of the underlying clay. Historic features have likewise been found within the same relative stratigraphic context of the soil profile.

The excavator of Test #1 uncovered three faunal bone fragments, four pieces of burned faunal bone and one small fragment of fire-broken rock (FBR). All items were found within the cultivation layer and none were collected. There was no evidence for any cultural feature within the profile walls of the test unit.

Test #2: Located at 9.5m to 10.0m N and 4.5m to 5.5m W within Grid 2, this 0.5m by 1.0m test was excavated to a depth of 35cm DBS in the northern half of the unit and to 40cm DBS in the southern half. The excavator found the right distal half of a bison tibia, six small faunal bone fragments and one small piece of clinker (waste resulting from forging activity). The fragments of bone and the clinker were found in the cultivation layer and the bison leg bone element was recovered from the top of the underlying clay layer. None of these items were collected. There was no evidence for any cultural feature within the profile walls of the test unit.

Test #3: Located at 4.5m to 5.0m N and 4.0m to 5.0m W within Grid 2, this 0.5m by 1.0m test was excavated to depth of 50cm DBS. The excavator found a few small fragments of calcined and non-calcined faunal bone, all within the cultivation layer. There was no evidence for any cultural feature within the profile walls of the test unit.

Anomaly#1 Test Results: There was no evidence for any cultural feature within the profile walls of the three test units. Therefore, this GPR-derived anomaly is not an archaeological feature.

Grid 3

Two geophysical anomalies were tested in Grid 3: **Anomaly #4** and **Anomaly #8**.

Anomaly #4 is described as single large rectangular GPR anomaly situated in the south portion of Grid 3 at approximately 30cm depth (see Perry 2014: Figure 8). It appears indistinct near the ground surface and does not show clearly within the Grid 3 vertical slices except as a strong subsurface layer at 20cm depth (see Perry 2014: Figure 10) and a distinct disturbed area in Line 21 (see Perry 2014: Figure 9). The rectangular shape of the anomaly stands out from the surrounding geophysical data noise within the plan view. Thus the shape of the anomaly is suggestive of a structural feature and, if proven by archaeological testing, it may represent an archaeological feature tied to the commemoration of the national historic site. As measured and staked out by Perry, two archaeological subsurface tests were placed strategically over this anomaly.

Test #1: Located at 6.0m to 6.5m N and 14.0m to 15.0m W within Grid 3, this 0.5m by 1.0m test was excavated to a depth of 50cm DBS, well into the clay layer below the cultivation zone. The excavator found neither cultural materials nor any evidence for any cultural feature within the profile walls of the test unit.

Test #2: Located at 9.5m to 10.0m N and 7.0m to 8.0m W within Grid 3, this 0.5m by 1.0m test was excavated to a depth of 35cm DBS, well into the clay layer below the cultivation zone. The excavator

found neither cultural materials nor any evidence for any cultural feature within the profile walls of the test unit.

Anomaly #4 Test Results: There was no evidence for any cultural feature within the profile walls of the two test units. Therefore, this GPR-derived anomaly is not an archaeological feature.

Anomaly #8 is described as a Magnetometer-derived anomaly located 10 metres west along the margin of Grid 3 and measuring three metres east-west extending out of the grid's southern margin (see Perry 2014: Figure 13). Possibly structural, Perry suggests this magnetic anomaly in this area of the magnetic dataset may be located "inside" the larger GPR anomaly (Anomaly#4). As measured and staked out by Perry, one archaeological subsurface test was placed strategically over this magnetic anomaly within the larger GPR Anomaly#4.

Test #1: Located at 0.0m to 1.0m N and 9.5m to 10.0m W within Grid 3, this 0.5m by 1.0m test was excavated to a depth of 50cm DBS, well into the clay layer below the cultivation zone. The excavator found neither cultural materials nor any evidence for any cultural feature within the profile walls of the test unit.

Anomaly #8 Test Results: There was no evidence for any cultural feature within the profile walls of the test unit. Therefore, this magnetic anomaly is not an archaeological feature.

Grid 4

Two geophysical anomalies were tested in Grid 4: **Anomaly #29** and **Anomaly #80**.

Anomaly #29 is described as a large magnetometer dataset anomaly located along the south margin of Grid 4, measuring approximately 10 metres east-west (see Perry 2014: Figure 18). Perry notes this may be the location of a previous archaeological test unit (14R87A) which straddled both Grids 3 and 4. Perry recommended targeted testing to verify the origin of this anomaly. As measured and staked out by Perry, one archaeological subsurface test was placed strategically over this anomaly.

Test #1: Located at 4.5m to 5.0m N and 0.0m to 1.0m W within Grid 4, this 0.5m by 1.0m test was excavated to a depth of 35cm DBS, well into the clay layer below the cultivation zone. The excavator found a few small faunal bone fragments but no evidence for either previous archaeological testing or any cultural feature within the profile walls of the test unit.

Anomaly #29 Test Results: There was no evidence for any cultural feature or previous archaeological testing within the profile walls of the test unit. Therefore, this magnetic anomaly is not an archaeological feature.

Anomaly #80 is described the "apex of cross-over" of a large X-shaped linear GPR anomaly located from the near surface to 10 cm deep horizontal plan view slice (see Perry 2014: Figure 14 and Table 4). The larger anomaly is characterized by steep-sided cuts into the soil. Perry states that the anomaly's size, shape and consistency argues for a cultural origin. As measured and staked out by Perry, one archaeological subsurface test was placed strategically over this anomaly at the putative point of intersection of the two linear arms of the X-shaped geophysical feature.

Test #1: Located at 16.0m to 16.5m N and 15.5m to 16.0m W within Grid 4, this 0.5m by 0.5 m test was excavated to a depth of 40cm DBS, well into the clay layer below the cultivation zone. The excavator found three small faunal bone fragments but no evidence for any cultural feature within the profile walls of the test unit.

Anomaly #80 Test Results: There was no evidence for any cultural feature within the profile walls of the test unit. Therefore, this GPR anomaly is not an archaeological feature.

Grid 5

Two geophysical anomalies were tested in Grid 5: **Anomaly #54** and **Anomaly #81**.

Anomaly #54 is described as a large anomaly derived from the magnetometer dataset that occupies a portion of the southwestern quadrant of Grid 5 (see Perry 2014: Figure 23). The anomaly corresponds to the 20cm rise and vegetation change noted on the surface in the southwest quadrant of the grid. As measured and staked out by Perry, two archaeological subsurface tests were placed strategically over this anomaly. Test #1 was expanded to the north and the east to try to bring into sharper resolution the identity of a compressed concentration of charcoal and ash deep within the soil profile.

Test #1: The original part of Test #1 is located at 4.0m to 5.0m N and 10.5m to 11.0m W within Grid 5, this 0.5m by 1.0m test was excavated to a depth of 40cm DBS, well into the clay layer below the cultivation zone. A compressed concentration of charcoal and ash was identified at 40cm DBS. In order to better identify the nature of that concentration, Test #1 was expanded twice; first 0.5m to the north and then 0.5m to the east from the second expansion, producing an approximately "L"-shaped unit totalling a one square metre test.

The excavator found a single small faunal bone fragment. The charcoal and ash feature was clearly within a sealed stratigraphic context, showing no evidence of being intrusive from higher in the soil profile (Figure 6). It is therefore a natural feature: the remnants of burned wood of unknown date. Three charcoal samples were taken from the main concentration for possible future analysis. There is no evidence for any cultural feature within the profile walls of this expanded test unit.

Test#2: Located at 8.5m to 9.0m N and 16.0m to 17.0m W within Grid 5, this 0.5m by 1.0m test was excavated to a depth of 40cm DBS, well into the clay layer below the cultivation zone. The excavator found two small faunal bone fragments and a small piece of FBR, but no evidence for any cultural feature within the profile walls of the test unit.

Anomaly #54 Test Results: Despite an interesting natural feature low in the stratigraphic profile, there was no evidence for any cultural features within the profile walls of the test units. Therefore, this magnetic anomaly is not an archaeological feature.

Anomaly #81 is situated by a linear arrangement of GPR anomalies (Anomalies #30 - 37), which may be either cultural depressions or part of a naturally undulating landform (see Perry 2014: Figure 21 and Table 6). As measured and staked out by Perry, one archaeological subsurface test was placed strategically at the north end of this line of eight anomalies.

Test#1: Located at 29.5m to 30.0m N and 1.0m to 2.0m W within Grid 5, this 0.5m by 1.0m test was excavated to a depth of 35cm DBS, well into the clay layer below the cultivation zone. The excavator found four small faunal bone fragments, all within the cultivation layer, and no evidence for a cultural

feature within the profile walls of the test unit. A buried palaeosol was visible in the south wall profile, measuring 1cm to 2cm thick and situated 4cm below the base of the cultivation zone (Figure 7).

Anomaly #81 Test Results: There was no evidence for any cultural feature within the profile walls of the test unit. Therefore, this GPR anomaly (as well the linear arrangement of GPR anomalies) is not an archaeological feature (depression) and likely reflects the undulating nature of the landform.

Grid 6

Four geophysical anomalies were tested in Grid 6: **Anomaly #57/#66, Anomaly #59, Anomaly #64** and **Anomaly #67**.

Anomaly #57/#66: Perry linked GPR Anomaly #57 and magnetic Anomaly #66 as one targeted test area. Anomaly #57 is described as an area visible from the near surface planview showing numerous high value signal return concentrations and a linear network of anomalies that occupies a portion of the southeast corner of Grid 6 (see Perry 2014: Figure 24). The pattern is also apparent at 30cm depth (see Perry 2014: Figure 25). Perry suggests that the pattern may be related to known ploughing activities on the landform. Within the same southeast corner a 1.0m by 1.0m magnetic anomaly of unknown origin lies within the GPR anomaly (see Perry 2014: Figure 34). Perry suggests the shape of anomaly is reminiscent of an archaeological test but correctly notes that none of this size is known for this area.

Test #1: Located at 2.5m to 3m N and 1.5m to 2.0m W within Grid 6, this 0.5m by 0.5m test was excavated to a depth of 35cm DBS, well into the clay layer below the cultivation zone. The excavator found no evidence for either artefacts or cultural features within the profile walls of the test unit.

Anomaly #57/#66 Test Results: There was no evidence for any cultural feature within the profile walls of the test unit. Therefore, this GPR and magnetic anomaly target area contains no archaeological features.

Anomaly #59 is a very large GPR anomaly of unknown function measuring 6m wide in the centre of an undulating subsurface (see Perry 2014: Figure 27). It includes Perry's anomalies #60, #62 and #63. The size of the anomaly and how it is picked up in all the north-south profiles may indicate a buried drainage channel. Perry marked out a cross-section of the anomaly for archaeological testing. As measured and staked out by Perry, two subsurface tests were completed.

Test #1: Located at 6.0m to 6.5m N and 8.5m to 9.0m W within Grid 6, this 0.5m by 0.5m test was excavated to a depth of 35cm DBS, well into the clay layer below the cultivation zone. The excavator found three faunal bone fragments within the disturbance (plough) layer but no evidence for a cultural feature within the profile walls of the test unit.

Test #2: Located at 12.5m to 13.0m N and 8.5m to 9.0m W within Grid 6, this 0.5m by 0.5m test was excavated to a depth of 35cm DBS, well into the clay layer below the cultivation zone. The excavator found two faunal bone fragments within the disturbance layer but no evidence for a cultural feature within the profile walls of the test unit.

Anomaly #59 Test Results: There was no evidence for any cultural feature within the profile walls of the two test units. Therefore, this GPR anomaly target area contains no archaeological features and may indeed be a subsurface drainage channel as Perry suggested.

Anomaly #64 is a GPR anomaly that can be traced along the northern edge of Grid 6 with high value GPR returns. The anomaly is of unknown origin. Three target areas were staked out by Perry. Two of these targets were identified by the excavators as previous archaeological tests and not tested. The NW marker of the anomaly at 30m N and 6m W in Grid 6 corresponds to previous Archaeology Test (Suboperation) 14R118A. The NE marker of the anomaly at 28.5m N and 3.0m W in Grid 6 corresponds to previous Archaeology Tests (Suboperations) 14R117A and B. Both previous tests were excavated in 1976. As measured and staked out by Perry, one target was tested archaeologically.

Test #1: Located at 28.0m to 28.5m N and 17.5m to 18.0m W within Grid 6, this 0.5m by 0.5m test was excavated to a depth of 30cm DBS, well into the clay layer below the cultivation zone. No cultural evidence was found.

Anomaly #64 Test Results: There was no evidence for any cultural feature within the profile walls of the test unit. Notwithstanding the two previous archaeological tests identified within the larger area of the anomaly, the tested target area contains no archaeological features.

Anomaly #67 is a one metre square magnetometer anomaly near the northeast corner of Grid 6 (see Perry 2014: Figure 34). It was interpreted as the location of a previous archaeological test, though no test is known for this location. As measured and staked out by Perry, one archaeological subsurface test was completed.

Test #1: Located at 28.0m to 28.5m N and 6.5m to 7.0m W within Grid 6, this 0.5m by 0.5m test was excavated to a depth of 36cm DBS, well into the clay layer below the cultivation zone. The excavator recovered a single faunal bone fragment within the disturbance layer but no evidence for a cultural feature within the profile walls of the test unit.

Anomaly #67 Test Results: There was no evidence for any cultural feature within the profile walls of the test unit. Therefore, this magnetometer anomaly contains no archaeological features or any evidence of previous archaeological subsurface testing.

Grid 7

Two geophysical anomalies were tested in Grid 7: **Anomaly #69** and **Anomaly #72**.

Anomaly #69 is a GPR anomaly measuring 4m long N-S by 1m-2m wide E-W and located in the northern half of Grid 7 toward the east side (see Perry 2014: Figure 38). Perry suggests the anomaly has the dimensions of an archaeological test unit although there is no known previous test at this location. As measured and staked out by Perry, one archaeological subsurface test was completed.

Test #1: Located at 20.0m to 20.5m N and 5.0m to 5.5m W within Grid 7, this 0.5m by 0.5m test was excavated to a depth of 36cm DBS, well into the clay layer below the cultivation zone. No cultural evidence was found.

Anomaly #69 Test Results: There was no evidence for any cultural feature within the profile walls of the test unit. Therefore, this GPR anomaly contains no archaeological features.

Anomaly #72 is a GPR anomaly measuring 2.0m wide N-S by 4.0m long E-W within Grid 7 (see Perry 2014: Figure 41). Perry suggests the possibility that this anomaly represents previous archaeological test

14R92A, excavated in 1976, noting that the orientation and measurements conform well. As measured and staked out by Perry, one archaeological subsurface test was completed.

Test #1: Located at 25.0m to 25.5m N and 16.0m to 16.5m W within Grid 7, this 0.5m by 0.5m test was excavated to a depth of 30cm DBS, well into the clay layer below the cultivation zone. No cultural evidence was found and there was no evidence suggesting that the location was that of a previous archaeological excavation.

Anomaly #72 Test Results: There was no evidence for any cultural feature within the profile walls of the test unit. Therefore, this GPR anomaly contains no archaeological features or any evidence of previous archaeological subsurface testing.

Grid 8

This northernmost grid on the landform was surveyed only with the magnetometer due to technical problems with the GPR at the time of survey. Three geophysical anomalies were archaeologically tested in Grid 8: **Anomaly #76, Anomaly #77** and **Anomaly #79**.

Anomaly #76 is a magnetic anomaly located along the northern margin of Grid 8 towards the northeast corner. It is a one metre square anomaly within the centre of a larger rectangular one which Perry suggests may be structural (see Perry 2014: Figure 43). As measured and staked out by Perry, one archaeological subsurface test was completed.

Test #1: Located at 27.0m to 28.0m N and 6.0m to 6.5m W within Grid 8, this 0.5m by 1.0m test was excavated to a depth of 40cm DBS, well into the clay layer below the cultivation zone. Due to the proximity of this test to the bicentennial trail a thick gravel layer was present in the soil profile (Figure 8). However, no other cultural evidence was found.

Anomaly #76 Test Results: There was no evidence for any cultural feature within the profile walls of the test unit. Therefore, this magnetic anomaly is not an archaeological feature.

Anomaly #77 is a magnetic anomaly located at the southeast corner of Grid 8. It is a circular anomaly of unknown origin and function measuring one metre in diameter (see Perry 2014: Figure 43). As measured and staked out by Perry, one archaeological subsurface test was completed.

Test #1: Located at 0.5m to 1.0m N and 1.0m to 1.5m W within Grid 8, this 0.5m by 0.5m test was excavated to a depth of 34cm DBS, well into the clay layer below the cultivation zone. No cultural evidence was found.

Anomaly #77 Test Results: There was no evidence for any cultural feature within the profile walls of the test unit. Therefore, this magnetic anomaly is not an archaeological feature.

Anomaly #79 is a magnetic anomaly located along the southern edge of Grid 8. It is a circular anomaly of unknown origin and function measuring one metre in diameter (see Perry 2014: Figure 43). As measured and staked out by Perry, one archaeological subsurface test was completed.

Test #1: Located at 0.5m to 1.0m N and 16.5m to 17.0m W within Grid 8, this 0.5m by 0.5m test was excavated to a depth of 33cm DBS, well into the clay layer below the cultivation zone. No cultural evidence was found.

Anomaly #79 Test Results: There was no evidence for any cultural feature within the profile walls of the test unit. Therefore, this magnetic anomaly is not an archaeological feature.

All 17 targeted anomalies in the study area that were measured and staked out by Perry were tested archaeologically and completed. No archaeological features or other cultural evidence of any significance was found.

Discussion

The results of the 2014 archaeological subsurface testing of selected high potential geophysical anomalies from the 2013 remote sensing survey of the North Saskatchewan River terrace within the putative area of the Hudson's Bay Company 1864-68 fort (the so-called "temporary fort") is both surprising and puzzling. The two geophysical techniques employed in the 2013 survey at Rocky Mountain House National Historic Site have been proven to be suitable for locating unmarked subsurface cultural features in a non-invasive manner. This is particularly true for GPR with its capabilities of estimating depth and shape of buried objects (Perry 2014:3).

Both magnetometer and GPR techniques have been used to great effect at many locations throughout western Canada's national parks and national historic sites. Why these techniques have apparently failed to produce any positive results in this study area will need to be investigated further. Is it a question of something in the landscape that is distorting or failing to bring into sharper resolution buried subsurface cultural features? Perhaps the effects of ploughing, creating a thick layer of disturbed soils, may somehow affect the accuracy of the geophysical datasets.

More likely, regardless of the interpretations of the geophysical evidence, there are neither subsurface cultural features nor concentrations of artefacts within the study area. Previous subsurface testing on this particular landform have produced only meagre results (e.g., see Steer 1976; Steer and Rogers 1976; Francis 1997, 1998; Francis and Porter 1996). Since the late-1990s until their retirement from the Agency in 2012, former Parks Canada archaeologists Francis and Porter conducted inspections of the North Saskatchewan River terrace along the historic zone of the national historic site. These riverbank inspections were carried out annually in response to the active erosion of the terrace edge due to seasonal high water flow, which in the years 2005 and 2013 took on catastrophic proportions. That portion of the riverbank corresponding to the current study area never produced any cultural evidence in the form of eroding artefacts or cultural features visible in the profile of the terrace's cut bank. Like the results of the 2014 archaeological investigation, only a few faunal bone fragments were ever found during those annual riverbank inspections.

Recommendations

1. Despite the lack of evidence for buried cultural resources within the study area resulting from the 2014 archaeological subsurface testing project, it is strongly recommended that all ground disturbance undertaken during the course of engineered riverbank stabilization measures be monitored by either Parks Canada archaeologists or qualified contracted archaeologists. The 2014 archaeological subsurface targeted testing must be viewed as a non-random sampling program guided by a geophysical survey. Given the size of the landform, there is always the

possibility of unknown buried cultural resources being exposed during the course of large-scale mitigation work using heavy machinery.

2. The authors of this report strongly urge Parks Canada managers to adopt a "less is more" approach in deciding upon a suitable engineered solution to the riverbank erosion along this part of the national historic site. The study area is part of the historic cultural landscape walked upon by Hudson's Bay fur traders and Aboriginal peoples during the course of three historic fort phases. The heretofore suggested cutting back of up to 10 metres from the current terrace edge is perhaps a drastic, over-engineered remedial measure that will compromise the commemorated historic place as well as the historic views of the cultural landscape northward from archaeological Sites 1R and 15R and the historic view down the North Saskatchewan River toward its confluence with the Clearwater River.

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Tables

Table 1 List of geophysical anomalies within the 10m flood remediation zone

Grid	Anomaly	Recommendation and Interpretation
2	1	Targeted testing is required; structural?
2	3	Targeted testing is required; unknown function and origin.
3	8	Targeted testing is required; structural?
4	9-22	Targeted testing is required; depressions.
4	28	Targeted testing is required; patterned depressions.
4	80	Targeted testing is required; large X-shaped linear GPR anomaly.
5	30-47	Targeted testing is required; depressions.
5	53	Targeted testing is required; unknown function and origin.
5	54	Targeted testing is required; structural?
5	56	Targeted testing is required; unknown function and origin.
5	81	Targeted testing is required; cultural depressions or part of the naturally undulating landform?
6	57	Targeted testing is required; plough lines?
6	58	Targeted testing is required; unknown function and origin.
6	59	No testing is required; natural feature.
6	60	Targeted testing is required; unknown function and origin.
6	61	Targeted testing is required; unknown function and origin.
6	65	Targeted testing is required; structural?
6	66	Targeted testing is required; unknown function and origin.
6	67	Targeted testing is required; unknown function and origin.
7	68	Targeted testing is required; cultural depression?
7	69	Targeted testing is required; unknown function and origin.
7	73	Targeted testing is required; unknown function and origin.
7	74	Targeted testing is required; unknown function and origin.
7	75	Targeted testing is required: plough furrows?
8	76	Targeted testing is required; structural?
8	77	Targeted testing is required; unknown function and origin.
8	78	Targeted testing is required; unknown function and origin.

Table 2 Summary of Archaeological Testing Results

Grid No.	Anomaly No.	Test No.	Northing	Westing	Size	Depth	Findings
2	1	1	14.5m-15.5m	16m-17m	1.0m X 1.0m	33cm DBS	3 bone fragments 4 calcined bone fragments FBR fragment
2	1	2	9.5m-10.0m	4.5m-5.5m	0.5m X 1.0m	35cm to 40 cm DBS	bison tibia fragment clinker (1) 6 bone fragments
2	1	3	4.5m-5.0m	4.0m-5.0m	0.5m X 1.0m	50cm DBS	bone fragments calcined bone fragments
3	4	1	6.0m-6.5m	14.0m-15.0m	0.5m X 1.0m	50cm DBS	
3	4	2	9.5m-10.0m	7.0m-8.0m	0.5m X 1.0m	35cm DBS	
3	8	1	0.0m-1.0m	9.5m-10.0m	0.5m X 1.0m	50cm DBS	
4	29	1	4.5m-5.0m	0.0m-1.0m	0.5m X 1.0m	35cm DBS	bone fragments
4	80	1	16.0m-16.5m	15.5m-16.0m	0.5m X 0.5m	40cm DBS	3 bone fragments
5	54	1	4.0m-5.0m	10.5m-11.0m	0.5m X 1.0m	40cm DBS	charcoal concentration
5	54	2	8.5m-9.0m	16.0m-17.0m	0.5m X 1.0m	40cm DBS	2 bone fragments 1 piece of FBR
5	54	3	5.0m-5.0m	10.5m-11.0m	0.5m X 0.5m	40cm DBS	charcoal concentration
5	54	4	5.0m-5.5m	10.0m-10.5m	0.5m X 0.5m	40cm DBS	charcoal concentration
5	81	1	29.5m-30.0m	1.0m-2.0m	0.5m X 1.0m	35cm DBS	4 bone fragments buried palaeosol
6	57/66	1	2.5m-3.0m	1.5m-2.0m	0.5m X 0.5m	35cm DBS	
6	59	1	6.0m-6.5m	8.5m-9.0m	0.5m X 0.5m	35cm DBS	3 bone fragments
6	59	2	12.5m-13.0m	8.5m-9.0m	0.5m X 0.5m	35cm DBS	2 bone fragments
6	64	1	28.0m-28.5m	17.5m-18.0m	0.5m X 0.5m	30cm BDS	
6	67	1	28.0m-28.5m	6.5m-7.0m	0.5m X 0.5m	36cm DBS	1 bone fragment
7	69	1	20.0m-20.5m	5.0m-5.5m	0.5m X 0.5m	36cm DBS	
7	72	1	25.0m-25.5m	16.0-16.5m	0.5m X 0.5m	30cm DBS	
8	76	1	27.0m-28.0m	6.0m-6.5m	0.5m X 1.0m	40cm BDS	
8	77	1	0.5m-1.0m	1.0m-1.5m	0.5m X 0.5m	34cm DBS	
8	79	1	0.5m-1.0m	16.5m-17.0m	0.5m X 0.5m	33cm DBS	

Figures

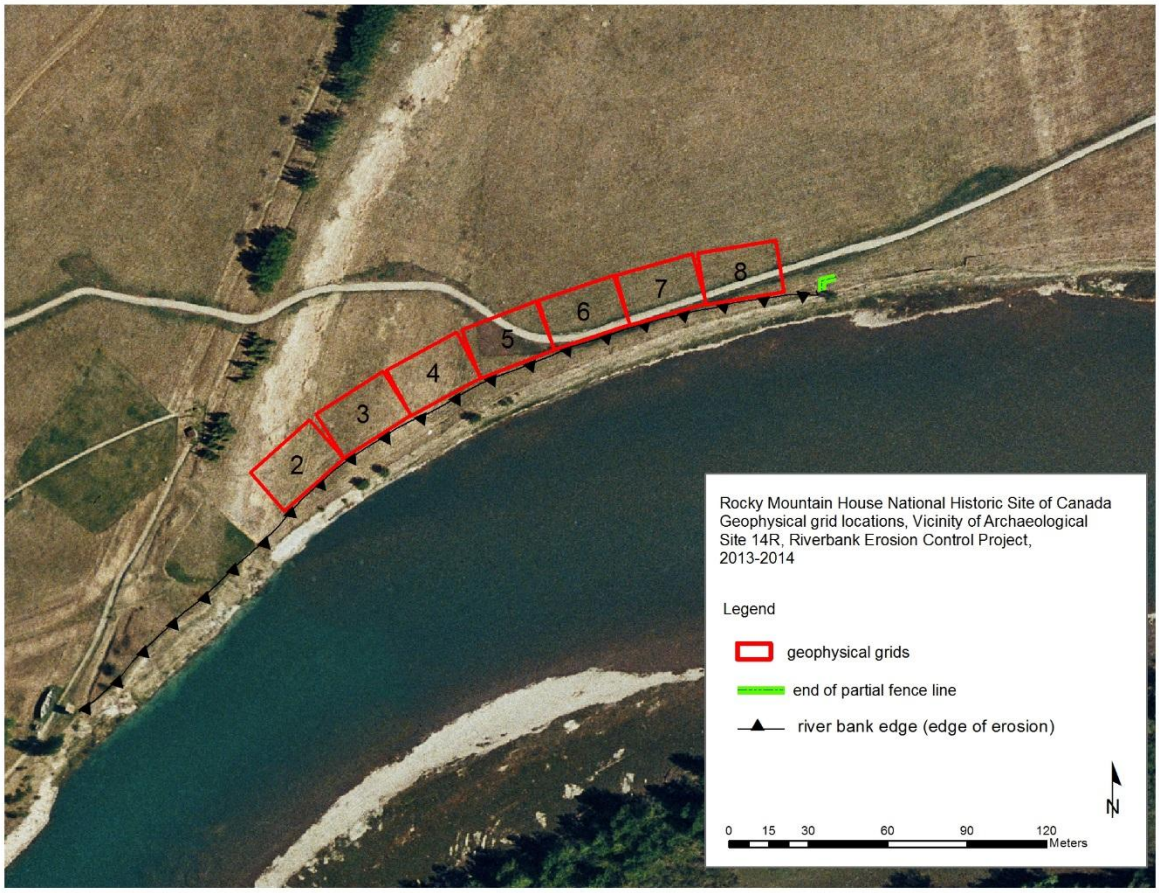

Figure 1 Geophysical grid locations, riverbank erosion project, Rocky Mountain House National Historic Site of Canada. From Perry (2014: 2).

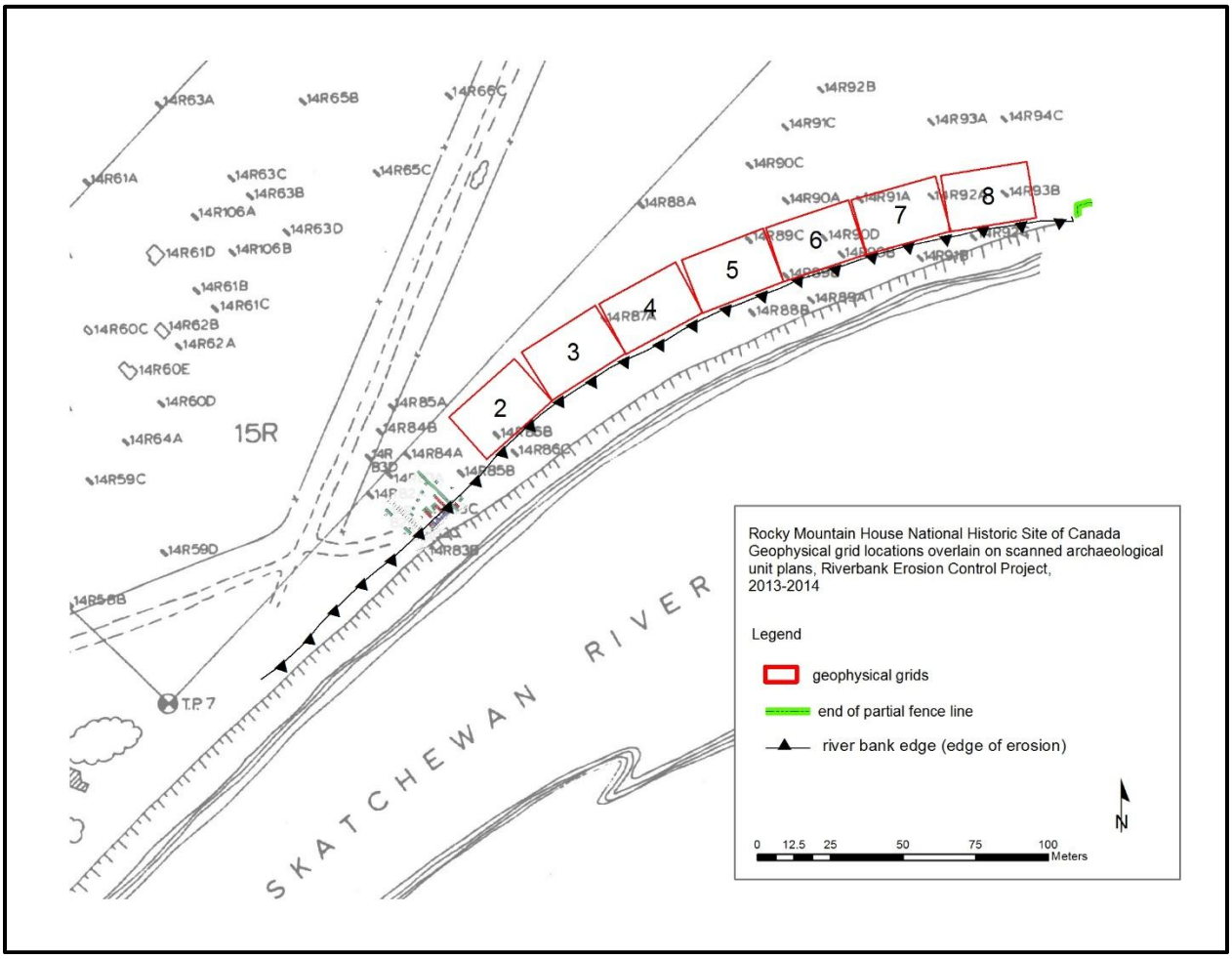

Figure 2 Geophysical grid locations overlain on the 1976 archaeological test locations, Rocky Mountain House National Historic Site of Canada. From Perry (2014:3).

Figure 3 View ENE across the study area. Grid 2 is in the foreground.

Figure 4 View WSW of the study area from the north end of Grid 8.

Figure 5 View SE of the south wall profile of Test #1, Anomaly #1, in Grid 2. This shows the typical soil profile noted in many of the test units.

Figure 6 View NNW of the west wall profile of Tests #1 and #3, Anomaly 54, Grid 5 showing the ash and charcoal lens (natural feature).

Figure 7 View WSW of the south wall profile of Test #1, Anomaly 81, Grid 5 showing the buried palaeosol.

Figure 8 View WNW of the north wall profile of Test #1, Anomaly 76, Grid 8 showing the gravel lens associated with the nearby bicentennial trail.