Bar U National Historic Site

Parks Canada

Riparian Restoration Plan

1.0 Introduction

[redacted] in February 2022 on behalf of Parks Canada to evaluate the riparian health within the Bar U Ranch National Historic Site (herein after referred to as "the Site") and complete a Riparian Restoration Plan for the two middens, and for areas marked as high and medium priority. The middens are reclaimed areas where there were historic landfill activities, however they have not been completely reclaimed successfully.

1.1 Background

The Site is an operational ranch with historical roots and significance in Western Canada. [redacted] completed the Riparian Restoration Assessment for the project area for [redacted] on behalf of Parks Canada in 2021. The results showed the two midden locations required further surface soils and vegetative restoration work, and the riparian corridor at the Site has experienced streambed deterioration and a reduction in riparian health due to livestock use and beaver activity [redacted]. These affected areas are vulnerable to flooding events, where the channel could cut further into the bank and expose the buried waste middens.

1.2 Objectives

The primary goal of this project is to provide a plan and estimate for bioengineering and revegetation along the streambanks and on the middens within the Site. [redacted] completed the following:

1. Evaluate the options available
2. Recommend the best option
3. Provide a plan, [redacted], and regulatory requirements for the selected options, as well as available modifications to accommodation timeline or budgetary restraints

1.3 Project Location and Description

The project location is on the Bar U Ranch National Historic Site property. The Site is located south of Longview, AB.

There are two middens and two work areas classified by priority level along the riparian corridor where work is to be conducted. The middens and areas are listed below and are shown in Figure 1, Figure 2, and Figure 3 within Appendix A.

- West middens
- East middens
- High priority work areas
- Medium priority work areas

2.0 Target Plant Communities

The plant communities on site are part of the fescue parkland natural subregion and have a moderate to heavy grazing history being located so close to the headquarters of the Bar U Ranch.

PFB6 – *Bromus inermis – Poa pratensis* Community

This plant community is part of the C1 Ecosite Phase that has thick black chernozemic soils with the reference plant community being the FPA1 Community (DeMaere et al. 2012). This community is indicative of a history of heavy grazing pressure. Smooth brome and Kentucky bluegrass have invaded this community type and taken it over completely. On site this community is that of one that has not been broken cultivated, but rather converted by heavy use to non-native species and there remains a remanent of native species including *Festuca campestris* on site.

PFD5: *Populus balsamifera – Elaeagnus commutate – Poa pratensis* Community

This community is the disturbed community with an undescribed reference community due to lack of survey points. The reference plant community would have replaced the non-native grasses that dominate this community with Calamagrostis canadensis. However, due to a heavy grazing history this riparian community type has had the dominant native species replaced by Kentucky bluegrass and the shrub layers reduced to grasses under heavy grazing [redacted]

3.0 Integrated Pest Management Plan

An integrated pest management (IPM) approach should be used to control invasive and undesirable species on the Site. If revegetation is only required within the areas of remediation and reclamation the whole IPM may not be required, however in areas where revegetation is required an IPM should be implemented.

It may be determined that an integrated pest management plan (IPMP) should be developed for long term prevention, monitoring, and treatment. Integrated pest management uses several control methods in a coordinated approach on target species. Control methods that may be appropriate for the Site include:

- cultural preventative methods
    - crop rotation, plant nutrition, sanitization
- physical and mechanical methods
    - barriers, screens, tarps, mulches, tillage, pulling, mowing
- biological control agents and beneficial insects
    - predatory and parasitic insects, beneficial nematodes, microbial controls
- pesticides
    - synthetic and naturally derived pesticides

The recommended approach to IPM will occur during the maintenance period on site in both the middens and the riparian areas:

- Prevention:
    - Annual weed monitoring to detect early establishment of undesirable species. This should be completed monthly during the maintenance period.
- Identification:
    - Determine if the species detected is one that existed pre-treatment, or if the species is a new occurrence. New species should be a focus for eradication from site.
    - Determine the best control method for species detected to eradicate it and prevent spread. Utilizing multiple control measures is recommended and choice of the appropriate control measure should be completed by a professional trained in weed control.
- Treatment Plan:

- Develop target thresholds (i.e., what species will we tolerate on the site, and to what % cover).
- Develop prevention measures specific to reclamation goals (e.g., managing for wildlife habitat may require selecting mechanical control over chemical control).
- Develop best management practices for control to be the most selective (e.g., spraying basal rosettes in the fall).

- Monitoring Plan:
  - Set guidelines on when to monitor, what to monitor for, and what tolerances are for the site.

4.0 Midden Conditions and Mitigations

On November 8, 2021 a field assessment was completed at the Bar U National Historic Site for the Riparian Restoration Assessment. The assessment included an ecological health assessment of the reclaimed middens. The middens were categorized based on their respective locations onsite, east midden and west midden.

4.1 West Middens

The west middens include polygons 5, 7, 8, and 10.

This midden was successfully re-vegetated over the majority of the project footprint. However, the ecological health is reduced due to the amount of cover from invasive species. There were a number of bare areas, those with topsoil have shallow topsoil that may be too shallow for vegetation establishment and growth. There were also a number of areas with erosion issues, including channeling down the center of the reclaimed area.

To help mitigate erosion and improve vegetation establishment, three locations will require topsoil placement at polygons 5, 7, and 10 within the west midden (Figure 1, Appendix A).

4.1.1 Polygon 5:

Topsoil will need to fill the 30 centimetres (cm) deep, 40 m long by 50 cm wide erosion channel in polygon 5. Straw wattles or silt fence may be required to filter water before it leaves the site. wattles are the preferred erosion control for this polygon. The wattles will be placed (dug into the soil) so that no water can flow under them. They will then be staked in place. After the topsoil is placed the soil will be seeded with the below seed mix and covered with erosion control matting (COIR Matting) which is 100% biodegradable natural fibre (No plastics are allowed) as per the specifications.

4.1.2 Polygon 7:

The second area, polygon 7, requires 10 cm of topsoil depth to cover the liner. The third topsoil addition, in polygon 10, will be applied as a berm built at an angle across the Site to direct water off the midden and restrict livestock access onto the midden. Wattles or silt fence may be required to filter water before it leaves the site. Wattles are the preferred erosion control for this polygon. The wattles will be placed (dug into the soil) so that no water can flow under them. They will then be staked in place. After the topsoil is placed the soil will be seeded with the below seed mix and covered with erosion control matting (COIR Matting) which is 100% biodegradable natural fibre (No plastics are allowed) as per the specifications.

4.1.3 Polygon 10:

This polygon is an area that requires soil to help direct the cows away from walking down the disturbed footprint long term and help direct water off the site. The berm will be approximately 3 m wide and 60 – 70 cm tall. It should be set at angle to direct water off the footprint of the disturbance and must be field fitted to ensure drainage occurs properly with no pooling on site. After the topsoil is placed the soil will be seeded with the below seed mix and covered with erosion control matting (COIR Matting) which is 100% biodegradable natural fibre (No plastics are allowed) as per the specifications.

4.1.4 Polygon 8:

For polygon 8 the soil will be roughed up with a heavy harrow or raked until the surface soil is loosened up. Then the seed will be broadcasted onto the soil and racked into the surface soil. No erosion control matting is required for this polygon.

4.1.5 Seeding Requirements

Seeding will be completed on polygons 8, 10, 7 and 5. Seeding will occur prior to the erosion control matting being placed on polygons 10, 7, and 5. Seed will be broadcasted onto the soil and raked into the soil at the rate specified below.

4.1.6 Seed Mix

The seed mix to be used should be seeded at a rate of 40.77 kilograms (kg) / hectare (ha), or 1966.5 seeds / metre^2 (m^2). The target cover is the long-term cover target for the community, while the % of seed mix (PLS) is the % composition of the seed mix by pure live seed. Kg required is the kg required for 1 ha of area to be seeded. In this case only a few kg of the seed mix will be required.

Recommended Seed Mix

Species Code	Scientific Name	Common Name	Target Cover	% of Seed Mix (PLS)	Kg Required (PLS)
Agrodas	Agropyron dasystachyum	Northern Wheatgrass	30%	37%	15.27
Agrosmi	Agropyron smithii	Western Wheatgrass	30%	52%	21.38
Koelmac	Koeleria macrantha	Junegrass	35%	4%	1.66
Agrotra	Agropyron trachycaulum var	Slender Wheatgrass	5%	6%	2.45
		Total	100%	100%	40.77

4.1.7 Fencing

Electric fencing is recommended to enclose the midden. Preventing livestock access is critical to encourage vegetation establishment and growth. After two years, if the vegetation establishment is deemed successful and canopy cover is sufficient by a Professional Agrologist or Biologist, the fence may be removed and the midden can be reincorporated into the pasture.

The fence will be high tensile wire (3 wire) on wooden posts with a solar powered electric fencer to power the fence. Posts must be placed 16 feet apart. Fence posts will be a minimum of 1850mm tall with at least 1500mm above ground.

4.2 East Middens

The east midden includes polygons 2, 3, and 4.

Similar to the west midden, it was successfully re-vegetated over the majority of the project footprint. However, the ecological health is reduced due to the amount of cover from invasive species. There were a number of bare areas as well as two areas that require topsoil placement to cover up the liners.

4.2.1 Polygon 2 and 3

Topsoil placement is required along the north and south boundary at the east end of the midden in polygon 2, and 3. Both areas require 10 cm of topsoil depth to cover the bare area and re-establish a rooting zone above the liner. A wattle will be placed at the toe of the slope as well as mid way up the soil placement on the slope to direct water off the freshly placed soil. The wattle will be dug into the ground and staked down so that water cannot run under it. After the topsoil is placed the soil will be seeded with the below seed mix and covered with erosion control matting (COIR Matting) which is 100% biodegradable natural fibre (No plastics are allowed) as per the specifications.

4.2.2 Polygon 4

For polygon 4 the soil will be roughed up with a heavy harrow or raked until the surface soil is loosened up. Then the seed will be broadcasted onto the soil and racked into the surface soil. No erosion control matting is required for this polygon.

4.2.3 Fencing

Electric fencing is recommended to enclose the midden. Preventing livestock access is critical to encourage vegetation establishment and growth. After two years, if the vegetation establishment is deemed successful and canopy cover is sufficient by a Professional Agrologist or Biologist, the fence may be removed and the midden can be reincorporated into the pasture.

The fence will be high tensile wire (3 wire) on wooden posts with a solar powered electric fencer to power the fence. Posts must be placed 16 feet apart. Fence posts will be a minimum of 1850mm tall with at least 1500mm above ground.

5.0 Bank Conditions and Mitigations

On November 8, 2021 a field assessment was completed at the Bar U National Historic Site for the Riparian Restoration Assessment. The assessment included a riparian health assessment completed along each bank throughout the alignment, and was broken into five areas that were similar in health and management to be assessed. For any areas with bare soil the seed mix above used in the middens will be applied to bare soil at the rate described above.

5.1 Benefits of Vegetation in Stabilizing Banks

The benefit of this treatment is that the roots of the plants will stabilize the bank and secure it in place, making movement of the sediments during high flows more difficult. In addition, there will be improved habitat for wildlife along the bank. This includes fish habitat along the shoreline (with vegetation such as falling leaves reaching the water), bird habitat, and another animal habitat.

In addition to the environmental benefits, the plants will improve the aesthetics of the site and restore a more natural feel. It can provide a more historical view of what the Site looked like pre-colonization and during the early colonial ranching period, as opposed to now when the Site has very few links to the original look of the banks of the stream. If the planting plan is implemented properly, it can replicate what was known to be on the banks, but will not guarantee the protection of the banks during extreme events without river engineering as well.

5.2 Planting Plan Options

The planting plan has been broken into three priority categories for the riparian zone. These categories can be separated easily for staged approaches to restoration as well as partial planting plans to adapt to budget constraints. High priority areas are the ones the require restoration work urgently to prevent soil erosion and protect the banks for erosion. These priority areas should be the top of the planting priority list.

Medium priority areas are not as urgent, but represent areas that vegetation plantings will benefit bank stability and riparian health. These areas are lower on the priority list but will supplement the protection on the high priority areas.

Low priority areas are areas away from the water, but represent unhealthy conditions in the riparian forest. These areas are more easily eroded as they lack the woody regrowth of a healthy riparian forest. Although they do not pose an immediate risk to erosion planting within these areas will provide long term protection to soil erosion by slowing erosion if it does occur during high water events in the future.

5.3 High Priority Areas

The high priority areas include banks that are getting undercut along the reach (Appendix A Figure 2 and 3). Polygons 1, 6, 10, 11, and 12 have banks that are being actively eroded and require re-vegetation activities to stabilize them. Polygons 6 and 10 have vertical cuts that require rooted stake installations to help establish woody growth and stop bank de-stabilization (Table 5-1). Additionally, live plantings of shrubs along the upper bank are required to help revegetate and stabilize the bank. Plant materials to be used in these areas include rooted stakes, 1-gallon pots and 180cc plugs as per the Planting Tables found in Appendix B for each Polygon. Within Polygons 1 and 11 there are dense planting rows (Row 1 and Row 2) that will be planted as well. The planting density of high priority sites varies from 1 plant/m^2 and 0.15 plants/m^2. The highest planting densities are in polygon 1 which is highly unstable and polygons 11 and 12 which are gravel bars that once planted will slow water flow towards the eroding bank.

Table 5-1: High Priority Site Planting summary where polygons refer to polygons and rows refer to those found in Figure 3 (Appendix A). Plants/m^2 refers to the planting density of polygons and plants per linear meter in rows.

Polygon Name	Description	Area (m)	Plants/m^2	Plants Required

1	Polygon1	2,245.00	1.00	2,244.00
6	Polygon 6	1,306.00	0.38	489.00
10	Polygon 10	1,053.00	0.15	157.00
11	Polygon 11	955.00	0.65	623.00
12	Polygon 12	169.00	0.65	110.00
16	Row1	202.00	1.00	202.00
17	Row2	43.00	2.00	86.00
18	Row3	359.00	3.00	1,077.00
	Total	**6,332.00**		**4,988.00**

Planting will be completed in a randomized fashion so that no visible lines of plants exist with the exception of the rows (1 and 2). Plants will be planted so that the top of the pot is slightly beneath the soil surface of the surrounding soil. Rooted stakes will be planted 300-500mm deep. Bare soil will then be seeded and the seed raked into the soil.

5.3.1 Fencing

The high priority areas have some areas that should be fenced due to the risk of beaver attack. The primary area is Area 1 with Row 1 (Figure 3). This area is highly susceptible to beaver. A beaver protection fence is recommended. Beaver protection fence will be 1 inch diameter page wire or a similar product secured with T posts or Rebar into the ground along the toe of the slope (below the planting area) and going up the slope to the top of the bank at each end of the bank. The fence must be at least 3 feet tall and be staked into place securely every 2.5m at a minimum. Higher density if required to ensure beaver cannot get into the site.

Trees that are along the shore will be wired to prevent beaver attacks. This will be completed with at least 800mm page wire with holes no more than 25mm in diameter. Heavy gauge wire is necessary and chicken wire is not strong enough for beaver. Wire will be secured to itself and not the trees and then staked into the ground. Wire should be loose fitting on the trees so that the trees can grow within it.

5.4 Medium Priority Areas

Polygons 2, 3, and 14 and row 3 require plantings of 1-gallon potted shrubs, rooted stakes and 180cc plugs for revegetation (Table 5-2) of gravel bars and upper bank stabilization (Appendix B). These areas include gravel bars that require revegetation to re-direct the water flows to areas where they are more desired and stabilize areas that are currently unstable (Appendix A: Figures 2 and 3).

Table 5-2: Medium Priority Site Planting summary where polygons refer to polygons refer to those found in Figure 3 (Appendix A). Plants/m^2 refers to the planting density of polygons.

Polygon Name	Description	Area (m)	Plants/m^2	Plants Required
2	Polygon 2	3,467.00	0.23	781.00
3	Polygon 3	8,701.00	0.23	1,960.00
14	Polygon 14	1,144.00	0.30	344.00
	Total	**13,312.00**	**0.23**	**3,085.00**

Planting will be completed in a randomized fashion so that no visible lines of plants exist with the exception of the rows (1 and 2). Plants will be planted so that the top of the pot is slightly beneath the soil surface of the surrounding soil. Rooted stakes will be planted 300-500mm deep.

5.4.1 Fencing

Trees that are along the shore will be wired to prevent beaver attacks. This will be completed with at least 800mm page wire with holes no more than 25mm in diameter. Heavy gauge wire is necessary and chicken wire is not strong enough for beaver. Wire will be secured to itself and not the trees and then staked into the ground. Wire should be loose fitting on the trees so that the trees can grow within it.

5.5 Low Priority Areas

These areas are those that are not in immediate danger of erosion, but where the riparian habitat has degraded over time as noted in Appendix A (Figure 3). There are mature cotton wood trees but no lower and mid story shrubs and regeneration of the forest is lacking. These forests can become susceptible to erosion and there is not the protection from woody vegetation to slow erosion. Replanting in these areas is necessary but will require a secondary approach. These plantings are not as critical, but they will be challenged by the presence of smooth brome which is aggressive and will compete with the establishing shrubs. To address spraying of patches of grass (1m diameter) will occur at least 1 week before planting while the plants are actively growing. A flag will be placed at the center of the planting area and then the plant will be installed in the location of the flag. This will provide suppression of the grass temporarily allowing for shrub establishment.

The planting areas are found in Appendix A (Figures 2 and 3) and include polygons 4, 5, 7, 8, 9, 13 and 15 (Table 5-3). The planting lists for these polygons are found in Appendix B. Plants will be installed so that the top of the root ball is placed just below the soil surface and the soil is not mounded up at the plant but sunk in creating a slight well for water to gather around the plants base.

Table 5-3: Low Priority Site Planting summary where polygons refer to polygons refer to those found in Figure 3 (Appendix A). Plants/m^2 refers to the planting density of polygons.

Polygon Name	Description	Area (m)	Plants/m^2	Plants Required
4	Polygon 4	2,751.00	0.06	168.00
5	Polygon 5	3,325.00	0.10	332.00
7	Polygon 7	5,739.00	0.11	615.00
8	Polygon 8	3,386.00	0.12	409.00
9	Polygon 9	13,659.00	0.05	708.00
13	Polygon 13	6,986.00	0.05	364.00
15	Polygon 15	6,288.00	0.05	323.00
	Total	**42,134.00**	**0.07**	**2,919.00**

5.6 Species Selection

Species selected for revegetation and bank stabilization were chosen for several reasons including being native to the area, quick establishment, strong and extensive rooting systems, high germination rates, and drought and flood tolerance [redacted]. Species chosen include *Populus balsamifera* (balsam poplar), *Amelanchier alnifolia* (saskatoon), *Prunus virginiana* (chokecherry), *Cornus stolonifera* (red-osier dogwood), *Symphoricarpos*

occidentalis (buckbrush), *Potentilla fruticosa* (shrubby cinquefoil), *Salix exigua* (sandbar willow), *Salix bebbiana* (bebb's willow), *Salix lutea* (yellow willow), *Salix petiolaris* (basket willow), *Elaeagnus commutata* (wolf willow), *Rosa woodsii* (wild rose), and *Elymus piperii* (giant wild rye). While avoiding edible plants was attempted the majority of the best species for slope stabilization around rivers are palatable to beavers. Beaver control will be necessary and wire placement around the base of trees is recommended.

6.0 Regulatory Requirements

6.1 Current Plan

Under the current plan no regulatory applications should be required, but consultation with DFO and the Water Act Approvals group is recommended to ensure they have no concerns. This means no fisheries assessment is likely necessary but is included in the budget in the event that a regulator would like to see it.

6.2 Work Below 1 in 2 Flood Level

This would require the following applications

1. Water act – required for anything below the 1 in 2 level, but may be a simplified process due to the current rock placement on site
2. DFO – required for anything below the 1 in 2 level but likely will be easily approved as it is going to improve fisheries habitat
3. Possibly Transport Canada, but it is unlikely they would have any issues with this design
4. Fisheries assessment may be required to prove we are improving fish habitat and not hurting it

Revegetation to the natural vegetation line (within the 1 in 2 flood level) is possible however, and the regulatory application process is proposed as an optional budget item. In addition to the regulatory requirements to be completed, the cost of revegetation within the zone would need to include time and materials associated with onsite work after the regulatory process is completed (not currently with the scope of the cost estimate). These types of additional costs would include: fisheries assessment, turbidity monitoring, DFO reporting, etc.). If revegetation within the 1 in 2 flood area is desired, associated costs can be provided.

7.0 Potential Modifications

While reinforcement of the bank via vegetation establishment throughout the length of the project area is ideal, various modifications or partial undertakings of the activities described could be implemented depending on the goals of the project and available funding. Modifications available to meet the available resources are provided below:

- Sections could be completed progressively over a few years to lower the annual cost of the project, while still achieving the end goal, though on a longer timeline.
- If desired, the density and size of live plantings could be reduced, or plantings could be focused into limited areas in vegetation islands to reduce the material and labour associated with revegetation.
- If approved by the appropriate authority, a reduced planting density could reduce material and labour costs significantly while still providing the necessary revegetation cover. Most of the species selected were chosen based on their abilities to expand and spread quickly, which means a lower density of planting can still provide effective stabilization.

8.0 Monitoring

Following the bioengineering activities, a monitoring period of three years is recommended to evaluate and assist revegetation success. Monitoring includes evaluation of vegetation cover, weedy species, potential erosion, animal use, beaver impacts, etc. Following monitoring a report should be provided summarizing the field data and providing recommendations and mitigative actions for deficiencies such as weeds requiring control, interseeding, beaver fence repair, shrub mortality/replacement.