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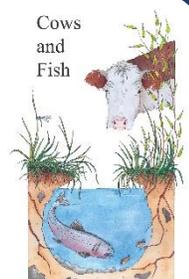
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Foothills Land Trust Spitzee Riparian Area Riparian Habitat Management Plan

2017



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Foothills Land Trust

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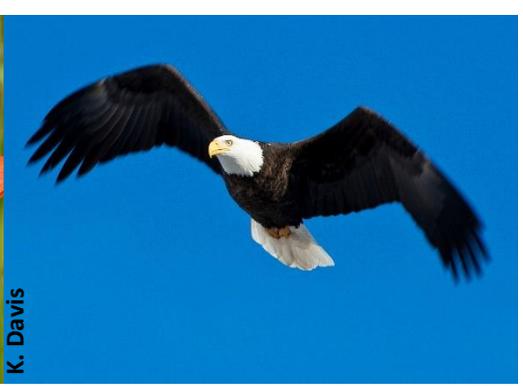


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1 Introduction

The “Spitzee Riparian Area” represents twenty-four acreages upstream from High River that were obtained through the Government of Alberta (GoA) Disaster Recovery Program following the catastrophic 2013 flood. Conservation Easements have been placed on these land parcels after transferal of ownership of land to the Municipal District (MD) of Foothills. The Conservation Easements are being managed by the Foothills Land Trust to protect and restore riparian habitat for flood mitigation, drought resiliency, water

quality protection and fish and wildlife habitat protection. Riparian habitat protection and restoration will help achieve flood and water quality management objectives as set out by the Highwood River Management Plan (Hart 2006, Alberta Environment 2008a and b). Non-structural flood mitigation by way of riparian habitat protection and restoration is also strongly supported by the GoA’s Alberta Disaster Recovery Program, the Watershed Resiliency and Restoration Program (WRRP) and the South Saskatchewan Regional Plan. Riparian restoration and initiatives in support of “re-naturalizing” the floodplain are identified as important flood mitigation options for the Highwood River as part of *the Bow Basin Flood Mitigation and Watershed Management Project* (WaterSmart and Alberta Innovates 2014). The entire project area is mapped as having high priority for flood and drought mitigation and water quality protection on the GoA’s WRRP Priority Areas maps¹.

In 2017, the Alberta Riparian Habitat Management Society (Cows and Fish) conducted ground-based riparian health inventories and assessments of the Spitzee Riparian Area on behalf of the Foothills Land Trust. The purpose of this fieldwork was to evaluate baseline riparian health conditions, record and identify management features of concern (e.g. invasive plant species), and to create a geo-referenced photography catalogue for monitoring purposes. Findings from this baseline study have been integrated into this management plan. The intent of this document is to help guide the Foothills Land Trust with stewardship, restoration and monitoring of the Conservation Easement land parcels in collaboration with the MD of Foothills and other project partners. This management plan focuses on riparian habitat management recommendations and zoning. Of note, water management considerations (e.g. flow ramping, diversion rates, water quality protection etc.) are outside of the scope of this plan.

¹ www.wrrp.alberta.ca

2 Project Area Description

2.1 Project Area Location

The Spitzee Riparian Area encompasses approximately 53 ha of land in parts of Sections 32, 33 and 34 Township 18, Range 29 W4M (Table 1, Figure 1). Figure 1 shows the individual land parcels within the project area for which Conservation Easements have been established. Baseline riparian health polygons (evaluated in 2017 by Cows and Fish) are also shown (Table 1, Figure 1). Land parcels are identified in this report by a GIS-based object identification (ID) reference number (Table 1, Figure 1).

Table 1 Project Area Riparian Health Polygons, Legal Land Locations and Land Parcel ID Nos.

Cows and Fish Riparian Health Polygon No.	Riparian Polygon Type*	Legal Land Descriptor	Land Parcel GIS ID Nos.
HIG25	RHI	NE/NW 32/33 18-29 W4M	Mainland portion of 4, 19, 42, 46, 56, 87
HIG26	RHI	NE 33-18-29 W4M	7, 10, 20, 23, 25, 26, 27, 43, 59, 63, 84
HIG27	RHA	SE 32-18-29 W4M	Island portion of 4, 19, 42, 46, 56, 87
HIG28	RHA	SE 33-18-29 W4M	Encompasses both HIG25 and HIG27
HIG29	RHI	NW 34-18-29 W4M	5, 31, 65
HIG30	RHA	NW 34-18-29 W4M	72
HIG31	RHA	NE 33-18-29 W4M	21
HIG32	RHA	SE 33-18-29 W4M	78
HIG33	RHA	SW 33-18-29 W4M	47

*RHI = Detailed Riparian Health Inventory; RHA = Rapid Riparian Health Assessment ²

2.2 Hydrology and Water Management

The Spitzee Riparian Area is within the broad floodplain of the Highwood River within the MD of Foothills, upstream from the Town of High River. The Highwood River is a tributary to the Bow River, entering the Bow River southeast of Calgary and north of High River. The Highwood River

² As part of Riparian Health Inventories (RHIs), detailed information is collected to document plant species, plant community composition, life form structure and age class structure, in addition to soil and hydrology site characteristics. A Riparian Health Assessment (RHA) is a rapid survey technique aimed at the evaluation of key riparian health indicators only in order to determine a relative health rating, in addition to monitoring photography and broad descriptions of plant community types. For more information on RHIs and RHAs see: <http://cowsandfish.org/riparian/health.html>.

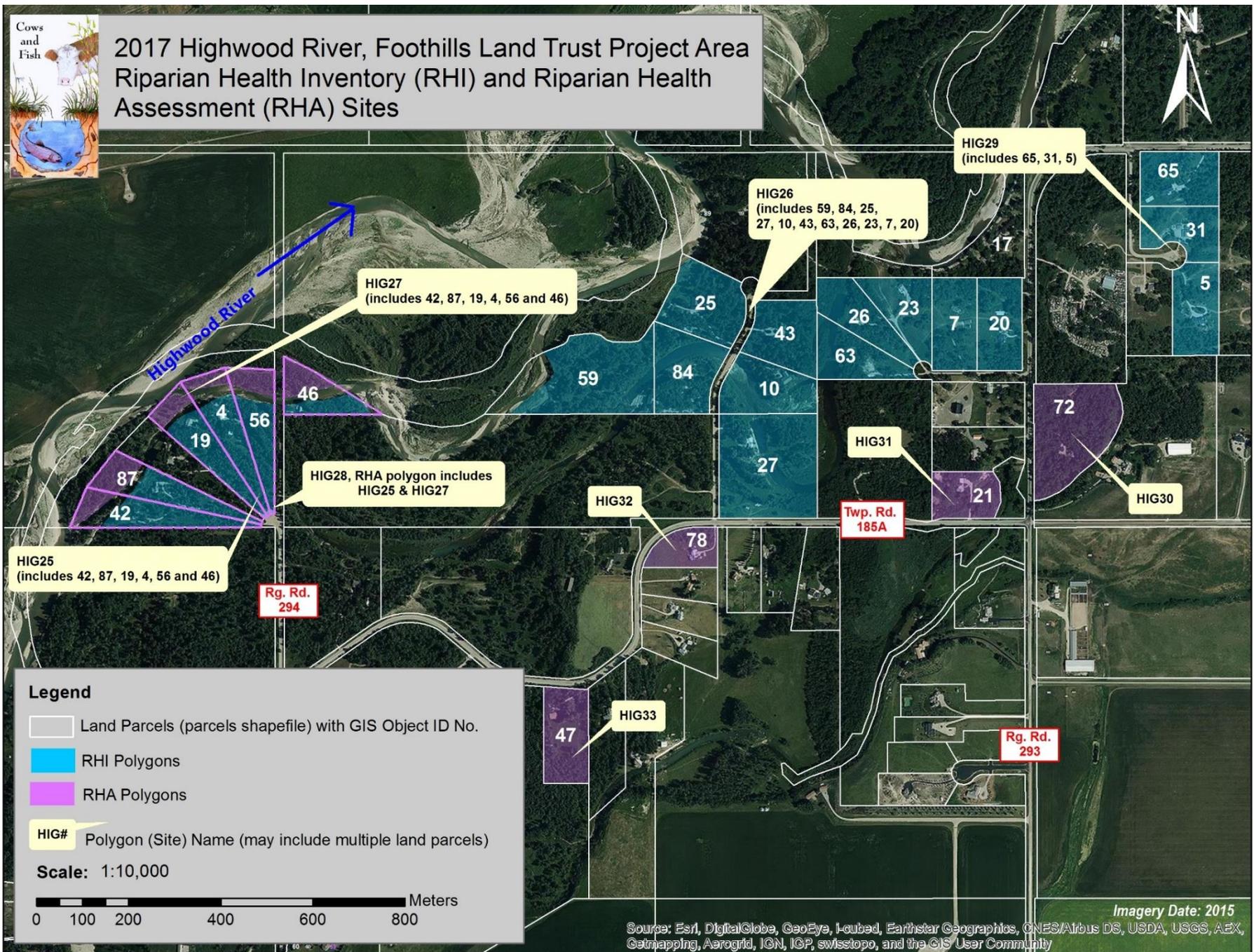


Figure 1 Spitzee Riparian Area RHI/RHA Polygons and GIS Land Parcel ID Nos.

sub-basin extends from the eastern slopes of the Highwood Range of the Rocky Mountains below Peter Lougheed Provincial Park eastward to the Town of High River, and then north to where the Highwood River joins the Bow River, just southeast of Calgary (BRBC 2010). There are no major impoundments along the Highwood River. Water use consists of diversions to the Little Bow River and licensed water withdrawals for irrigation, livestock watering and municipal purposes (BRBC 2010). The project area is located immediately downstream from the Woman's Coulee Diversion that diverts water into the Woman's Coulee Reservoir and Mosquito Creek, a tributary to the Little Bow River. In 2008, the first phase of a comprehensive Water Management Plan for the Highwood River (upstream of the Sheep-Highwood River confluence, and the Little Bow River upstream of the Travers Reservoir) was approved (Alberta Environment 2008a and b). The plan incorporates recommendations from a Public Advisory Committee to achieve the best balance between diversions for water supply and consumptive use and protection of the Highwood River fishery, water quality (water temperature and dissolved oxygen) and maintenance of riparian vegetation (i.e. flow management criteria to promote balsam poplar regeneration, survival and growth) (Hart 2006, Alberta Environment 2008 a and b).

2.3 Land Use

The primary land use in the project area was previously rural residential acreages. Parts of the project area were also historically used for agricultural purposes (hay fields, tame and native pasture) for horse and cattle grazing. Works were initiated in 2015 by Alberta Infrastructure to remove all built structures (e.g. houses, barns etc.) and to reclaim these areas. All existing roads and driveways are also in the process of being decommissioned and reclaimed. All water wells will be decommissioned and septic tanks will also be removed from the area.

2.4 Plant Communities

The project area falls within the Foothills Fescue Natural Subregion of the Grassland Natural Region (Natural Regions Committee 2006). Dominant plant communities in the project area were described as part of the baseline 2017 riparian health evaluation (Figure 2, page 5).

In general, the least disturbed native plant community types (with the exception of land parcel no.72) are located in the western and central portions of the project area. Former and ongoing agricultural land uses have altered natural plant community composition in the south peripheral and eastern land parcel units. This includes long-term browse pressure resulting in reduced native tree and shrub understory species and an influx of disturbance-caused, non-native herbaceous and weedy species. Additionally, conversion of native plant community types to

tame pasture or hayland has also created monocultures of smooth brome grass (*Bromus inermis*³) in some areas.

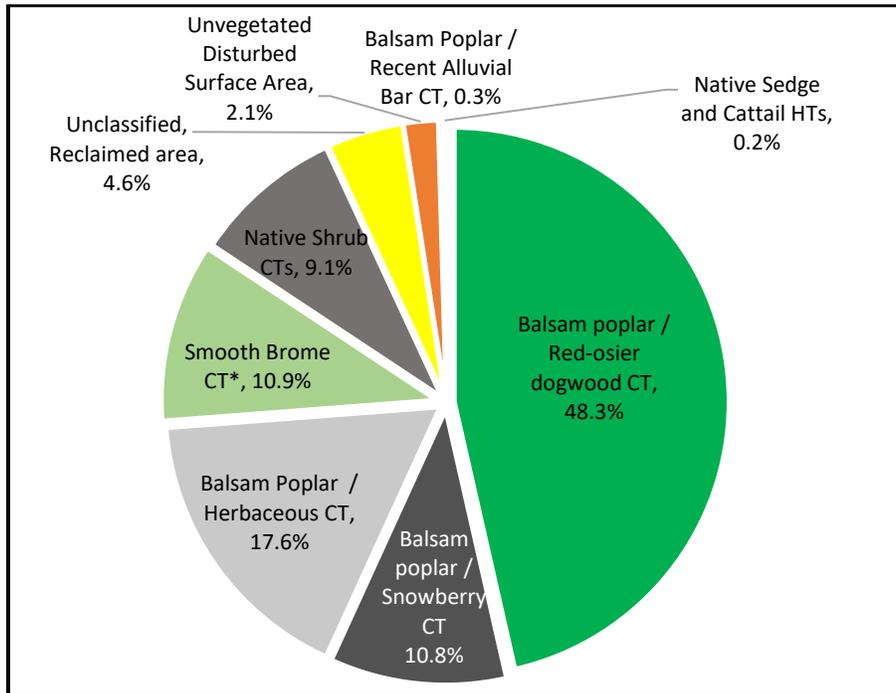


Figure 2 Plant Community Classification of the Project Area

The dominant vegetation type in approximately 50% of the Spitzee Riparian Area is a Balsam Poplar (*Populus balsamifera*) / Red-osier Dogwood (*Cornus stolonifera*) Community Type with a diverse native shrub understory (Thompson and Hansen 2002) (Figure 2). This community type is generally representative of low disturbance and is in a mid-seral state that usually progresses toward a White Spruce (*Picea glauca*) / Red-Osier Dogwood Habitat Type over time (Thompson and Hansen 2002). The integrity of this plant community varies across the project area, with some parcels of land within the HIG25, HIG30 and the central portion of the HIG26 polygons having relatively undisturbed understory conditions (Figure 1). Native shrub community types comprise approximately 9% of the project area (Figure 2). High integrity native forest and shrubland portions of the project area provide habitat to a broad suite of birds and other wildlife species such as deer, porcupine and beavers.

Livestock use impacts have contributed to altered riparian forest conditions in approximately 30% of the project area as represented by Balsam Poplar / Buckbrush (*Symphoricarpos*

³ Plant species nomenclature in this report follows Moss (1994) or the Integrated Taxonomic Information System website (<http://www.itis.gov>) for species not listed in Moss (1994).

occidentalis) and Balsam Poplar / Herbaceous Community Types (Figure 2) (Thompson and Hansen 2002). Moderate browse pressure over the long-term contributes to an increase in non-preferred shrubs such as buckbrush and rose species (*Rosa* spp.) and a corresponding decline in more palatable, preferred species such as red-osier dogwood, saskatoon (*Amelanchier alnifolia*) and chokecherry (*Prunus virginiana*). As browsing pressure consistently continues or increases in intensity without rest periods, eventually all shrubs can be eliminated and the understory converted to disturbance-caused non-native herbaceous species (typically smooth brome and Kentucky bluegrass [*Poa pratensis*]). Mowing or clearing of vegetation associated with rural residential acreages can also contribute to a change to these disturbance-state poplar forest communities.

Smooth brome tame pasture or hayfield areas comprise about 11% of the project area due to historical conversion of native plant communities for agricultural land use purposes. Residential acreage developments, including driveways and access roads, have contributed to severely altered soil and vegetation conditions in approximately 7% of the project area.



A Balsam Poplar / Red-Osier Dogwood Community Type in land parcel no. 43 with a high diversity of native understory shrubs.



A Balsam Poplar / Herbaceous Community Type in land parcel no. 59 that has likely resulted from historical livestock browse pressure, contributing to loss of understory native shrubs.



A native Sandbar Willow Community Type along a side channel to the Highwood River in land parcel no.10. Native willows provide beneficial bank stabilization and fish and wildlife habitat functions.



A modified Smooth Brome Community Type in the southern periphery of the project area (in land parcel no.78).

3 Spitzee Riparian Area Management Objectives

The primary management objectives for the Spitzee Riparian Area are to protect and restore native riparian habitat and its associated ecological, fish and wildlife habitat and watershed functions. The long-term management goal is to create an interconnected corridor of riparian habitat for the purposes of providing non-structural flood mitigation, wildlife habitat, fish habitat protection, water quality protection, drought resiliency and to support nature-based education and wildlife viewing recreational opportunities. The Foothills Land Trust (FLT) will be primarily responsible for coordinating and monitoring habitat restoration and invasive species management activities. The FLT is working toward creating a local volunteer watershed stewardship group to assist with these activities in the long-term, under the direction of a project coordinator (hired by the FLT).

Land uses that are compatible with meeting the overall management objectives for the Spitzee Riparian Area could include (but are not necessarily limited to):

- Non-motorized recreational use (e.g. limited foot trails, wildlife viewing, outdoor education); and
- Land stewardship activities (weed pulls, restoration activities etc.).

The focus of this management plan is to provide recommendations primarily for:

- riparian health improvement;
- invasive plant species management;
- riverbank and riparian habitat restoration; and
- long-term habitat stewardship priorities.

The management plan also provides some considerations regarding recreational access management and educational / stewardship opportunities. **Ultimately, decisions as to appropriate land uses within the project area, will be left to the discretion of the FLT in collaboration with the MD of Foothills and other project partners.** Of note, this management plan does not provide specific wildlife habitat management recommendations, but the importance of healthy riparian habitat for fish and wildlife is well documented (Thomas *et al.* 1979, Ohmart 1996, Palliser Environmental Services Ltd. 2007a and b, Tremblay 2010). In order to build specific wildlife habitat management recommendations into this plan, additional baseline inventories are needed to assess wildlife use (including amphibians, reptiles, fish, benthic invertebrates, mammals and birds) and identify key wildlife habitat features in the project area (e.g. important nest sites, snake hibernacula, fish spawning / rearing habitat etc.).

4 Riparian Health Improvement Management Priorities

A comprehensive review of the riparian health inventories and assessments conducted by Cows and Fish in June and July of 2017 is provided in a separate cover report (Cows and Fish 2017). Three riparian health inventories (RHIs) were completed for three groups of land parcels along the Highwood River floodplain (HIG25, HIG26 and HIG29) (Figure 1). Six supplementary riparian health assessments were completed on additional individual land parcels and land parcels where islands were present (HIG27, HIG28, HIG30, HIG31, HIG32 and HIG33) (Figure 1).

Most land parcels or land parcel groupings rated as “Healthy, but with Problems” in 2017 (Figure 3). Of note, although the HIG26 polygon rated “Healthy” overall, this is a very large grouping of land parcels with variable conditions. More heavily impacted and altered habitat conditions are present within the eastern portion of the HIG26 polygon (i.e. land parcel nos. 63, 26, 23, 7 and 20); however healthier conditions are generally present in the remainder of the polygon. Future riparian health monitoring should assess the eastern portion of this polygon separately as it requires different management. Table 2 on page 11 gives a summary of existing riparian health conditions and management recommendations for each of the RHI and RHA polygons evaluated by Cows and Fish in 2017.

Some of the priority riparian health management concerns in the project area include:

- **Invasive species**

- A total of 15 invasive species were observed in the project area (Table 3, page 32), the majority of which are regulated *noxious*⁴ weeds.
- A single *prohibited noxious*³ weed (spotted knapweed [*Centaurea maculosa* syn. *C. stoebe*]) was found in HIG29 (land parcel no.5) (Appendix B, map iv). There is a legal requirement to immediately ‘destroy’ weeds in the *prohibited noxious* category.
- The most widespread invasive species within the project area are Canada thistle (*Cirsium arvense*), perennial sow-thistle (*Sonchus arvensis*) and common burdock (*Arctium minus*).

- **Disturbance-caused herbaceous species**

- Most polygons have greater than 50% ground cover from disturbance-caused herbaceous plants, primarily introduced grasses with aggressive rhizomatous growth habits (i.e. smooth brome, Kentucky bluegrass and quack grass [*Agropyron repens*]). In the absence of native trees and shrubs, these grasses can form monoculture habitats

⁴ As designated by the Alberta *Weed Control Act* (<http://www.qp.alberta.ca/documents/Acts/W05P1.pdf>) and *Weed Control Regulation* (http://www.qp.alberta.ca/documents/Regs/2010_019.pdf)

with diminished plant species biodiversity and reduced ecological functionality for wildlife habitat, bank protection and flood or drought resiliency.

- **Clearing of woody plants**

- All sites have greater than 5% clearing of woody vegetation due to country residential road and housing developments and in some land parcels due to clearing to accommodate hay fields / tame pasture.

- **Human-caused bare ground**

- Recent reclamation works have decreased the amount of exposed soil surface due to revegetation of roadways, driveways and former house lots.
- Reclamation works had not yet been completed in HIG25 and HIG29 at the time of the 2017 RHI, resulting in higher amounts of bare ground (>5%) in these sites associated with roadways or unvegetated areas of active reclamation.
- Active horse use in HIG31 in June 2017 contributed to localized, elevated levels of bare ground within this site.

- **Riverbank root mass protection (HIG25 only)**

- Most of the riverbank in HIG25 (except for land parcel no. 19 and the downstream half of no. 46) lacks sufficient root mass protection from deeply rooted native trees and shrubs. Constructed berms and clearing around houses has removed woody cover from the bank.

- **Riverbank alterations (HIG25 only)**

- More than 50% of the riverbank in HIG25 has been altered due to removal of an earthen berm in land parcel nos. 42 and 87, disturbed ground conditions adjacent to the house in land parcel no. 4 and bank armouring in land parcel no. 46.

- **Floodplain structural alterations (i.e. changes to soil conditions)**

- Country residential roadway and housing developments have created compacted soil conditions and altered native plant communities in the project area. Historic conversion of native plant communities to hayfields or tame pasture has also contributed to soil compaction and modified plant community composition, especially in the eastern portion of the project area (excepting land parcel no. 72).
- Active horse use within confined pastures is creating localized areas of soil compaction in land parcel no. 21 and the southwest portion of no. 27.

Management recommendations are given in Table 2 (page 11) and in Sections 6, 7 and 8 to address each of the above concerns.

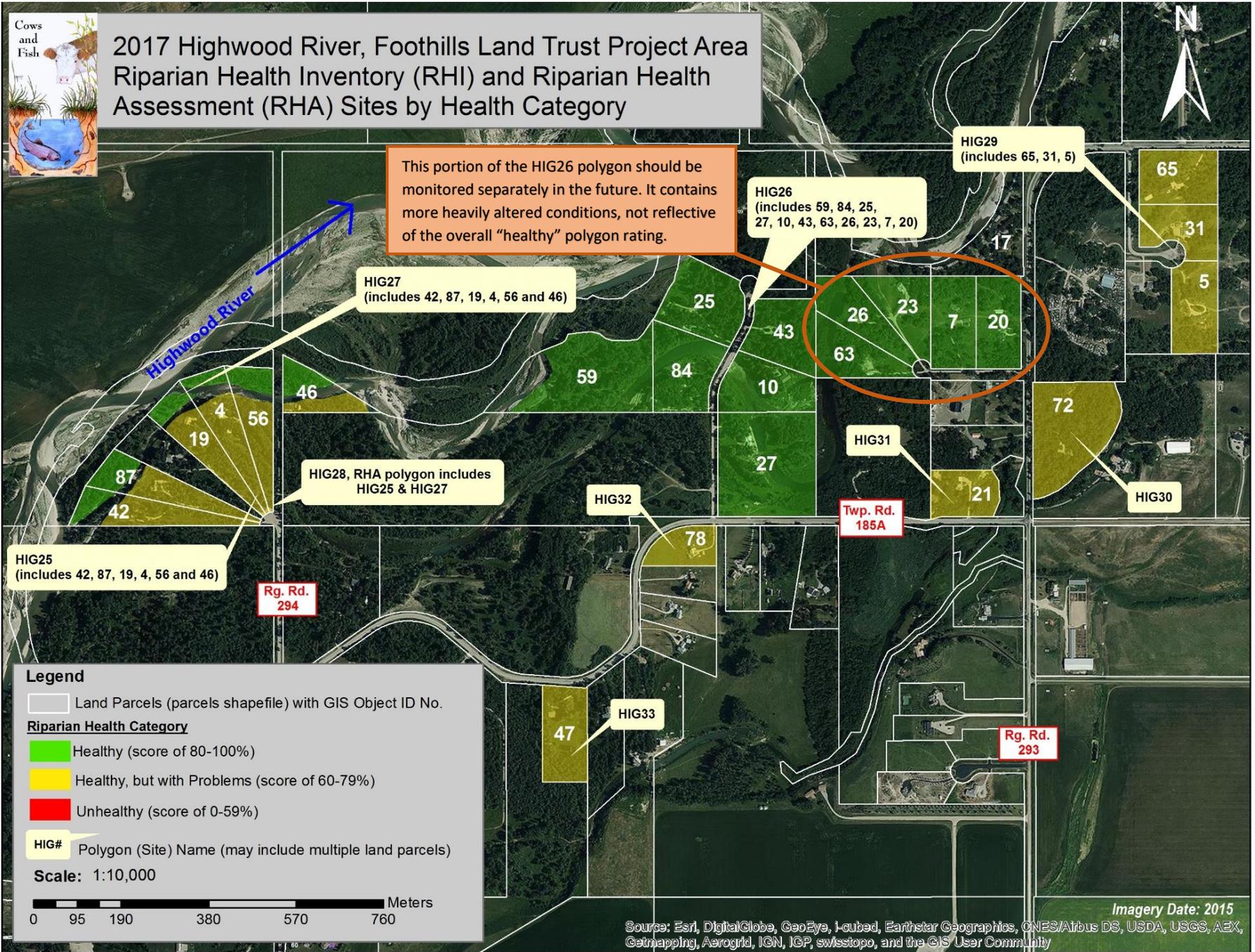


Figure 3 Baseline (2017) Riparian Health Conditions in the Project Area

Table 2 Summary of Baseline Riparian Health Conditions and Management Recommendations

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
HIG25	<ul style="list-style-type: none"> - Aside from disturbed roadway and house footprints (under reclamation), the majority of this polygon is otherwise largely comprised of a fairly high integrity Balsam Poplar / Red-Osier Dogwood Community Type. The poplar understory consists of a dense, and diverse shrub canopy (mainly saskatoon, red-osier dogwood and willow species). The understory shrub canopy has multiple structural layers (i.e. a ground cover layer, a tall forb layer, a medium [<3 m] shrub layer and a tall shrub layer). Understory structural complexity contributes to biodiversity, habitat heterogeneity for wildlife, soil stabilization and improved soil moisture retention, flood and drought resilience. Natural swales in this polygon (vegetated low lying, depression channels) create unique microsites for willow, rush and horsetail riparian vegetation. - As of June 28 2017, house removal and road/driveway reclamation had not yet been completed for land parcel no. 4 and a small wood shed was still present in land parcel no. 46. A beehive (apiary) staging area was present in the house footprint of land parcel no. 46 on July 19, 2017. - Most of the bank length in this polygon is altered and has minimal deeply rooted native tree / shrub cover. Landscape fabric and concrete rubble riprap are present along the riverbank in land parcel nos. 56 and 46, respectively. A berm along the riverbank in parcel nos. 42 and 87 was removed in 2017 (prior to June 28), creating a large area of compacted bare soil. - Primary concerns are for appropriate riverbank stabilization/restoration and remediation of compacted and bare (unvegetated) soil conditions in parcel nos. 42 and 87 (in the berm removal area and along the reclaimed access road and house footprints). 	<ul style="list-style-type: none"> - Retain and protect core areas of intact balsam poplar forest (avoid new disturbance to this area). - There is a high potential for natural recovery of vegetation in this polygon, except for the larger disturbance footprint of the house, loop driveway and access road into land parcel no. 4. - Use a ‘rough and loose’ soil surface treatment (Polster 2009) to remediate compacted soil conditions in the roadway, house footprint and former riverbank berm in land parcel nos. 42 and 87 (see Section 8.1). Conduct native tree and shrub plantings in this area following a ‘rough and loose’ soil surface treatment without application of a grass seed mix. This area has good natural recovery potential. Application of a grass seed mix may contribute to overseeding of grasses, inhibiting tree and shrub regeneration or growth. Monitor and control weeds. If a grass seed mix is used, careful attention should be paid to appropriate application rates and native species composition to reduce potential for competition with woody plants (see Section 8.1). - Conduct native tree and shrub plantings along altered portions of riverbank using locally harvested willow and balsam poplar cuttings.

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
HIG25 continued	<ul style="list-style-type: none"> - Riverbank conditions and willow / poplar regeneration are best within the downstream half of the bank in land parcel no. 46. - Nine invasive species (primarily <i>noxious</i> weeds) have 1-5% canopy cover and are distributed in patches or as scattered individual plants within this polygon (see Table 3, page 32 and Appendix B – Map i). - Horticultural / ornamental perennials, trees and shrubs are present near the houses in land parcel nos. 4 and 56. - Active beaver cuttings (26-100 cut stems) are present at the west edge of land parcel no. 46 along the riverbank adjacent to the public right-of-way. 	<ul style="list-style-type: none"> - Consult with soil bioengineering specialists to design riverbank stabilization designs plans for more heavily impacted portions of the riverbank where active erosion is a fish habitat or water quality concern. - Complete house removal / roadway reclamation in land parcel no. 4 using an alternate native seed mix prescription to better promote natural recovery of trees and shrubs (see Section 8.1 for more details). - Monitor and salvage or remove all invasive and horticultural herbaceous species. Salvage or remove horticultural trees and shrubs such as lilac and cotoneaster that have aggressive growth habits. Replace with suitable native shrub species. - Allow beaver use to continue unhindered.
HIG26	<ul style="list-style-type: none"> - The most intact native riparian habitats within this polygon are contained in land parcel nos. 25, 43, 10, east ½ of no. 27, the northwest corner of no. 84 and west of the side channel in nos. 63 and 26. - The side channel of the Highwood River flowing through this polygon has high cover of native trees and shrubs and evidence of a recent flux of native willow and balsam poplar regeneration, likely in response to the 2013 flood. The same is true for the Highwood River bank flanking the westerly portion of the polygon (adjacent to and within land parcel nos. 59 and 25). - Intact portions of habitat include Balsam Poplar / Red-Osier Dogwood and Yellow Willow (<i>Salix lutea</i>) Community Types with a high native compliment of willows. Saskatoon, red-osier dogwood, yellow willow, choke cherry and water birch (<i>Betula occidentalis</i>) are among the dominant native shrub species. 	<ul style="list-style-type: none"> - Retain and protect core areas of high integrity native habitat. - Protect streambank and new floodplain alluvial bars along the Highwood River side channels to promote continued progression of balsam poplar and willow regeneration. - Future riparian health monitoring of this large polygon should assess land parcel nos. 63, 26, 23, 7 and 20 as a separate polygon unit. The overall <i>Healthy</i> riparian health score for the HIG26 polygon is not representative of these more heavily disturbed land parcels.

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
<p>HIG26 Continued</p>	<ul style="list-style-type: none"> - Riparian habitat conditions are markedly different in the eastern portion of this polygon where there is more evidence of agricultural and country residential land use disturbance. For example, land parcel nos. 63, 26, 23, 7 and 20 have high concentrations of invasive species (e.g. common burdock) and large open areas of smooth brome. - Historic livestock use has contributed to altered plant communities and a reduction in native understory shrub and young tree cover in the core area of land parcels no. 59 and no. 84. Streambank fencing within land parcel no. 59 shows a marked fenceline contrast, indicating the natural potential of this area. - Active (unauthorized) horse use in the southwest portion of land parcel no. 27 is contributing to localized areas of heavy browse use, trampling and bare ground issues. The horse pasture area was estimated in the field to be approximately 0.5 ha with approximately 0.1 ha of exposed bare ground. - Active recreational use (picnic area and canoe launch) is occurring along the side channel abutting the southwest edge of land parcel no. 63, contributing to bare ground and soil compaction concerns locally. - A beehive (apiculture) staging area was present near the former house in land parcel no. 63 on June 29, 2017. - Most houses have been removed and most roadway / driveway and house footprint surfaces have been reclaimed and seeded. Exceptions are no. 43 (reclamation of this parcel was ongoing at the time of the riparian health inventory; the paved driveway, house foundation and garage structure had not yet been removed). Houses and driveways/ access roads in land parcels no. 23 and no. 20 had not yet been removed or reclaimed at the time of the riparian health inventory. 	<ul style="list-style-type: none"> - Continue house removal and roadway reclamation efforts in land parcel nos. 23 and 20 using the standard reclamation treatment, but with more effort put into soil decompaction using a ‘rough and loose’ soil surface treatment (Polster 2009). Soil compaction is a major limiting factor to plant establishment. Using a rough and loose technique is needed to promote topographic heterogeneity, important for moisture retention and natural plant recovery. - Remove and reclaim the grassy flood protection berm along the western edge of land parcel no. 25 and replant with native, locally harvested balsam poplars and willows. - Focus weed control efforts on removing discrete weed patches for which geo-referenced locations were recorded by Cows and Fish in 2017 (see Appendix B, Map ii). Common burdock control is a particular concern within the north half of land parcel no. 20. - Monitor and salvage or remove all invasive and horticultural herbaceous species in former rock gardens and flower beds. Potentially invasive species such as mountain knapweed (on the NE corner of the house footprint in no. 84) should be a priority for short-term complete removal. - Salvage or remove horticultural trees and shrubs such as lilac and cotoneaster that have aggressive growth

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
<p>HIG26 Continued</p>	<p>- A flood protection berm structure with concrete reinforcements has altered the floodplain along the western edge of land parcel no. 25, contributing to topographic and vegetation alterations. The berm is fully vegetated with smooth brome and other non-native grasses (e.g. Kentucky bluegrass).</p> <p>- Most reclaimed driveway and house footprints were vegetated with a grass seed mix, with variable grass establishment and high cover from disturbance introduced herbaceous forbs (mainly stinkweed [<i>Thlapsi arvense</i>] and tall hedge mustard [<i>Sisymbrium loeselii</i>]). It is likely that cover from disturbance annual weeds like stinkweed and tall hedge mustard will naturally decline as grasses establish. This is true of the reclaimed house footprint in no. 63 (reclaimed in 2015) where there is good grass establishment from green needle grass (<i>Stipa viridula</i>) and western wheatgrass (<i>Agropyron smithii</i>) and minimal disturbance-caused forb cover.</p> <p>- Remnant horticultural flower beds and persistent perennial ornamental flowers, trees and/or shrubs are present in the vicinity of most reclaimed houses, in particular in nos. 84, 63 and 26. The invasive potential of some of these persistent perennials is not well understood, but may be a concern for species such as <i>Centaurya montana</i> (mountain knapweed⁵) that is related to highly invasive knapweed species.</p> <p>- Active beaver dams were observed along side channels within land parcel nos. 59, 63 and 26. Beaver utilization overall was estimated at 26-100 cut stems.</p> <p>- Although not within the HIG26 polygon area, the main riverbank of the Highwood River immediately north of the no. 23 land parcel has been heavily disturbed. It lacks adequate deeply rooted tree and shrub cover (i.e. it is mainly vegetated by disturbance-caused grasses). It has also been armoured with large concrete slabs.</p>	<p>habits. Replace with suitable native shrub species (e.g. saskatoon, chokecherry, red-osier dogwood).</p> <p>- Discontinue horse use in ecologically sensitive portions of the polygon (with intact native tree and shrub communities). Controlled and well managed cattle or horse use may be appropriate in permanently modified land parcels (e.g. no. 23, 7 and 20), not directly connected with stream or riverbank habitat. This includes areas with smooth brome fields and balsam poplar / herbaceous communities. Managed grazing may help to control fuel loads and create more structurally diverse habitat for ground nesting songbirds.</p> <p>- Continue to promote beaver use to stimulate willow and poplar regrowth. Beaver dams can also locally flood disturbed or weedy meadows, favouring naturalization and recovery of native riparian species.</p> <p>- Bank plantings and soft soil bioengineering techniques are needed to improve root mass protection and enhance riparian habitat conditions in the Highwood River bank segment directly north of land parcel no. 23. This area is currently not part of the Conservation Easement project area, but should be a priority for future land securement.</p>

⁵ Otherwise referred to by the common names: Perennial Cornflower, Mountain Cornflower, Bachelor's Button, Montana Knapweed, Mountain Bluet.

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
<p>HIG26 Continued</p>		<ul style="list-style-type: none"> - Consider creating designated recreational trails and stream/river bank access points as indicated on map ii, Appendix B. Trails have been delineated within existing disturbed habitats or using existing trails and recreational access points. A picnic, stream access and canoe launch point could continue to be maintained in land parcel no. 63, but with allowance for less impact to the bank. This can be done by creating an enhanced riparian buffer with fencing, signing access points, involving community groups and volunteers with restoration activities, and installing educational signage.
<p>HIG27</p>	<ul style="list-style-type: none"> - This is the island portion of the land parcels contained within HIG25. There are minimal human-caused alterations within the island aside from a few remnant wood sheds and a raised wood platform in land parcel no. 46. - The island is comprised predominantly of a Balsam Poplar / Red-Osier Dogwood Community Type in addition to Sandbar Willow (<i>Salix exigua</i>) and Common Cattail (<i>Typha latifolia</i>) communities along the bank and/or along depressional channels within the island. There is high native species diversity, habitat structural layers and age class diversity within the island in general (particularly along the bank and within the east half of the site). However, smooth brome has encroached and is prevalent in the understory. It is less of a management concern in this site, since the native woody component is in a healthy condition. - A few scattered Canada thistle and perennial sow-thistle weeds are present, but these have less than 1% canopy cover overall. - Of note, there is a maintained berm crossing structure adjacent to the west edge of land parcel no. 19 (within an excluded land parcel that is not part of the project 	<ul style="list-style-type: none"> - Continue to minimize human use of this island so that it can function as a wildlife sanctuary. - In the long-term, land securement of the land parcel gap (between nos. 87 and 19) is a priority. If this is possible, this could allow for removal and restoration of the berm crossing structure abutting no. 19. - Periodically monitor and remove weeds from this island. Island sites are continually prone to new invasive threats from upstream sources.

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
HIG27 Continued	<p>area). The crossing provides foot access onto the island within the excluded land parcel. Tufted vetch is encroaching in proximity to recreational trails here.</p> <ul style="list-style-type: none"> - A beaver lodge is present at the downstream end of this polygon along the inner bank and beaver utilization was estimated at 26-50 cut stems. 	
HIG28	<ul style="list-style-type: none"> - This polygon represents a combination of the HIG25 (mainland) and HIG27 (island) polygons. It was assessed so as to provide a riparian health rating for the entire extent of land parcel nos. 4, 19, 42, 46, 56 and 87. See comments above for HIG25 and HIG27. 	<ul style="list-style-type: none"> - See comments above for HIG25 and HIG27.
HIG29	<ul style="list-style-type: none"> - The house structures and driveways in land parcel nos. 65 and 31 have yet to be removed and reclaimed. There is potential to use the house or house pad in no. 65 as a future Nature Center building since it has a raised footing that was not impacted by the 2013 flood. - The driveway and house footprint in land parcel no. 5 has been reclaimed and seeded with a grass mix (Section 8.1). Soil compaction and exposed bare ground is evident along the driveway tire tracks, but the house footprint is well vegetated by a mix of wheatgrasses (<i>Agropyron</i> spp.) and disturbance-annual forbs such as stinkweed and tall hedge mustard. - There are a mix of community types in this polygon. At least half of the polygon has been disturbed by country residential development (roads, houses driveways) and likely also historic agricultural use. Modified (disturbed) meadow areas have a mix of smooth brome and buckbrush. - A native Balsam Poplar / Red-osier Dogwood Community Type is intact in the northwest corner of no. 65 and along the east edge of nos. 65 and 31. This forest type has a fairly diverse native shrub compliment and a diversity of structural layers, although cotoneaster is invading in places. The balsam poplar forest at the 	<ul style="list-style-type: none"> - Continue to work with the MD of Foothills Agricultural Fieldman to remove spotted knapweed from within land parcel no. 5. Conduct frequent annual monitoring and control efforts for this <i>prohibited noxious</i> weed within the general vicinity of the initial infestation. - Monitor and control large patches of Canada thistle, ox-eye daisy (<i>Chrysanthemum leucanthemum</i> [syn. <i>Leucanthemum vulgare</i>]) and yellow toad flax (<i>Linaria vulgaris</i>) in land parcel no. 31 and the adjoining area of land parcel no. 65. - Monitor and salvage or remove all invasive and horticultural herbaceous species in former rock gardens and planting beds adjacent to the house in land parcel no. 31. - Salvage or remove horticultural trees and shrubs such as sea buckthorn (<i>Hippophae rhamnoides</i>) and cotoneaster that have aggressive growth habits.

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
<p>HIG29 Continued</p>	<p>south end of no. 5 has minimal cover from red-osier dogwood (an indication of historic livestock use).</p> <ul style="list-style-type: none"> - Interior, drier portions of the polygon with well drained soils have dense stands of silverberry (<i>Elaeagnus commutata</i>) with a mix of native and non-native grasses in the understory, typical of a wide variety of mesic riparian sites. - Non-native horticultural / ornamental plants (herbaceous perennials and/or trees and shrubs) are present near all of the houses in this polygon. In particular, there is a large rock garden feature adjacent to the house in land parcel no. 31 with creeping bellflower (<i>Campanula rapunculoides</i>) and other potentially invasive perennial ornamental forbs. A large patch of sea buckthorn is present adjacent to the house in no. 5 (on the west property line). - Of particular concern, is a large patch of spotted knapweed (a <i>prohibited noxious</i> weed) located along a vehicle trail in the northeast corner of land parcel no. 5 (see Appendix B, Map iv). <i>Prohibited noxious</i> weeds must be ‘destroyed’ in accordance with <i>Weed Control Act</i> regulations in Alberta. - Large patches of Canada thistle, yellow toadflax and ox-eye daisy are present around the house in no. 31 and in the disturbed meadow to the north of this house. - An excavated depression west of the house in land parcel no. 31 has formed a unique naturalized cattail wetland surrounded by encroaching young balsam poplars and willows. This creates a unique wildlife habitat feature within this polygon. - Balsam poplars are naturally encroaching south of the house in land parcel no. 65 in an excavated depression. 	<p>Replace with suitable native shrub species (e.g. saskatoon, chokecherry, red-osier dogwood).</p> <ul style="list-style-type: none"> - Investigate the potential for conversion of the house in no. 65 or no. 31 into a permanent Nature Center. Develop a Nature Center design plan that incorporates green building features and low-impact development landscaping (e.g. rain garden). Consider options for integration of an interpretive loop trail adjacent to the Nature Center (see map 3, Appendix C). - Monitor reclamation success in land parcel no. 5. Ameliorate soil decompaction issues where this is inhibiting plant establishment.

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
HIG29 Continued	<p>- Of interest, western false gromwell (<i>Onosmodium molle</i>) (an “S3” rare plant on the Alberta Conservation Information Management System Tracking List⁶) was observed along the east edge of land parcel no. 65 (Appendix B, Map iv).</p>	
HIG30	<p>- This is a predominantly undisturbed treed polygon except for the cleared, reclaimed house and driveway footprint. Some woody clearing was also historically done along an unmaintained truck trail that runs from the house to the northeast corner of this polygon. Native shrubs are naturally encroaching along this truck trail. Baker Creek borders the east edge of this polygon and there is a small tributary channel in the northwest.</p> <p>- The majority of this polygon is comprised of a Balsam Poplar / Red-osier Dogwood Community Type characterized by a mature balsam poplar canopy and high cover from tall understory saskatoon, water birch and chokecherry shrubs. Some young white spruce are establishing in places. Red-osier dogwood is regenerating within the site, but it has less than 5% overall canopy cover. Cotoneaster (an introduced shrub) is encroaching in places (mainly in the northeast corner). Smooth brome is fairly abundant in the herbaceous forest understory layer.</p> <p>- The reclaimed house and driveway footprint has good establishment of the applied grass seed mix, although there is also high cover from quack grass, foxtail barley (<i>Hordeum jubatum</i>), stinkweed and tall hedge mustard. Saskatoon, buckbrush and chokecherry seedlings are naturally encroaching along the west edge of the house footprint, suggesting there is good potential for natural woody species recovery over time.</p>	<ul style="list-style-type: none"> - Conserve native balsam poplar forest habitat. - Continue to minimize and avoid new disturbance along the Baker Creek corridor and along the tributary in the northwest. - Continue to monitor vegetation establishment within the reclaimed house and driveway footprint. Promote continued natural recovery of native trees and shrubs. - Monitor and control Canada thistle, perennial sow-thistle and common burdock infestations. A priority is for removal of discrete weed patches where possible (e.g. the common burdock patch in the northeast corner). - Monitor and salvage / remove introduced cotoneaster shrubs in the northeast corner. - Promote continued natural succession and regeneration of red-osier dogwood and white spruce seedlings.

⁶ “S3” indicates that it is known from 100 or fewer occurrences, or somewhat vulnerable due to other factors, such as restricted range, relatively small population sizes, or other factors (Source: <https://www.albertaparks.ca/albertaparksca/management-land-use/alberta-conservation-information-management-system-acims/tracking-watch-lists/>)

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
<p>HIG30 Continued</p>	<p>- There are few invasive species present, except for patches of Canada thistle and a few perennial sow-thistle patches. A large infestation of common burdock is present in the northeast corner near the truck trail.</p>	<p>- An informal recreational / wildlife viewing trail could be established in this land parcel utilizing existing disturbed corridors (see map 4, Appendix C).</p>
<p>HIG31</p>	<p>- The majority of this polygon (except for the southeast corner) has been heavily impacted by ongoing horse use. Historic and ongoing horse use has contributed to compacted soil conditions and exposed bare soil in addition to removal of understory trees and shrubs. The area impacted by horses is comprised of a Balsam poplar / Herbaceous disturbance Community Type. Horse use is especially severe in a round corral feature in the northwest corner (actively being used). However, horses have largely been excluded from the Baker Creek tributary that runs through this site, except for a designated watering access point in the southwest corner. Temporary exclusion fencing along the Baker Creek tributary was in place at the time of the 2017 inventory.</p> <p>- The driveway and house in this polygon have been fully reclaimed. Most of the reclaimed area has good establishment of the applied grass seed mix, although there is also high cover from quack grass, stinkweed and tall hedge mustard.</p> <p>- A large spoil pile (subsoil) infested with Canada thistle and other weeds is present in the northeast corner.</p> <p>- The tributary channel through this site is largely undisturbed and is characterized by tall, mature willows (mainly beaked willow and yellow willow) along the banks. Dense overhanging willow vegetation provides shade for fish and nesting habitat</p>	<p>- Discontinue horse use to allow for natural recovery of preferred native trees and shrubs.</p> <p>- Remove the spoil piles from the northeast corner.</p> <p>- Monitor and control Canada thistle, yellow toadflax and goutweed infestations.</p> <p>- Monitor revegetation success within reclaimed areas and within heavily trampled areas. Apply a 'rough and loose' soil surface treatment where appropriate to alleviate highly compacted soils (Polster 2009).</p> <p>- Conduct localized balsam poplar and willow plantings at the streambank watering access point in the southwest corner.</p> <p>- Promote beaver use in the polygon to help with rejuvenation of the riparian willow community. Local flooding from beaver ponds is also beneficial for natural recovery of native riparian plants.</p>

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
<p>HIG31 Continued</p>	<p>for songbirds. A noticeable portion of willows have more than 30% dead branches in their canopy, a sign of an ageing stand.</p> <ul style="list-style-type: none"> - Canada thistle patches and a few yellow toadflax patches are the primary weed concerns. A large patch of goutweed (<i>Aegopodium</i> spp.), an ornamental ground cover, is also present near the southeast corner of the house footprint. Goutweed although not a regulated weed, does have an aggressive spreading growth habit. - Disturbance-caused introduced grasses (mostly smooth brome and quack grass) are the primary ground cover in this site. 	<ul style="list-style-type: none"> - Conduct selective cutting of willows along the tributary to help stimulate suckering and stand rejuvenation.
<p>HIG32</p>	<ul style="list-style-type: none"> - This polygon is largely comprised of a smooth brome hayfield except for a dense chokecherry community along the north edge and a dense buckbrush patch in the southwest. The chokecherry community has a diversity of native shrub species including tall (saskatoon, water birch and beaked willow [<i>Salix bebbiana</i>]), mid-height (silverberry) and short (buckbrush and rose) shrubs. - There are few trees in this polygon, except for planted spruce (<i>Picea</i> spp.) near the former house and a cluster of younger aged naturally occurring balsam poplar within the chokecherry stand. - There is a widespread Canada thistle infestation in the brome field along the south edge of the polygon. Burdock patches are also present in the shrubland in the northeast. - The house and driveway areas have been reclaimed and seeded. Most of the reclaimed area has good establishment of the applied grass seed mix, although there is also high cover from quack grass, stinkweed and tall hedge mustard. - A fully vegetated buried gas pipeline runs diagonally through the west portion of this polygon. 	<ul style="list-style-type: none"> - Carefully managed livestock use may be appropriate to manage fuel loads in the smooth brome meadow. Techniques such as molasses application, can be used to help train livestock to help with Canada thistle control. - Promote natural recovery of native trees and shrubs. - Experiment with application of a native seed mix to promote improved biodiversity within the brome meadow (Calgary 2017). - Work with partners such as the Carbon Farmer (https://thecarbonfarmer.ca/) on native tree and shrub planting initiatives within this polygon. Native trees and shrubs should be planted in natural groupings or clusters. Apply layers of cardboard and mulch around new plantings to help reduce grass competition.
<p>HIG33</p>	<ul style="list-style-type: none"> - The house and driveway areas have been reclaimed and seeded. The reclaimed area has patchy establishment of the applied grass seed mix in addition to high 	<ul style="list-style-type: none"> - Allow the cleared meadow area to naturally recover by promoting natural succession of woody plants.

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
<p>HIG33 Continued</p>	<p>cover from quack grass, Kentucky bluegrass, stinkweed and tall hedge mustard. There are some large patches of bare ground along the entry driveway where vegetation establishment is poor.</p> <ul style="list-style-type: none"> - Natural woody vegetation has been cleared in about 20-25% of this polygon, including within the house and driveway footprint and within a large tame pasture / hayfield meadow (approximately 3, 380 m2). The cleared meadow area is comprised of a mix of non-native grasses (mainly redtop [<i>Agrostis stolonifera</i>], Kentucky bluegrass and smooth brome) and clovers (<i>Melilotus</i> spp.). - There are several large Canada thistle, perennial sow-thistle and common burdock patches in this site (mainly in and around the disturbed meadow area). A large patch of goutweed (, an ornamental ground cover, is also present at the south-mid edge of the disturbed meadow. Goutweed although not a regulated weed, does have an aggressive spreading growth habit. - There are numerous planted (introduced, ornamental) trees along the entry driveway and around the house footprint (including blue spruce [<i>Picea pungens</i>], purple-leafed sandcherry (<i>Prunus</i> spp.), crab apple [<i>Malus</i> spp.]). - Native balsam poplar forest habitat is present in the north and west edges of the polygon. This represents a Balsam poplar / Red-osier Dogwood Community Type with high cover from tall saskatoon, chokecherry and water birch in the understory. The forest understory has a regenerating layer of young shrubs (mainly red-osier dogwood, saskatoon and roses) but few seedling or sapling aged poplars. - The southeast portion of the polygon is characterized by a dense, tall chokecherry community (intermixed with saskatoon, water birch and beaked willow), with less than 5% overhead poplar cover. - A natural drainage channel (a tributary to Baker Creek) runs diagonally through the southwest portion of the polygon. This drainage channel has minimal signs of 	<ul style="list-style-type: none"> - Monitor and control invasive species (See Section 6). - Continue to monitor establishment of vegetation in the reclaimed areas. Apply a ‘rough and loose’ soil surface treatment where appropriate to alleviate highly compacted soils (Polster 2009). - Allow for natural recovery of the mowed footpaths along the east edge of the polygon. - Maintain signage to mark property boundaries and to prohibit the use of motorized vehicles within the site. - Salvage or remove non-native horticultural / ornamental trees and shrubs from near the old house footprint.

RHI Poly No.	Summary of Baseline Conditions and Key Riparian Health Concerns	Summary of Management Recommendations
HIG33 Continued	<p>human-caused alterations. Beaked sedge (<i>Carex utriculata</i>) forms the dominant cover along the channel in addition to patches of water hemlock (<i>Cicuta maculata</i>), a poisonous native plant). Dense native willows and shrubs provide overhead bank shading and root mass protection along this tributary.</p> <p>- There are several maintained foot paths through the wooded habitat in the southeast. Actively mowed trails along the east property fence are also being maintained within the polygon by the neighbouring landowners.</p>	

5 Riparian Habitat Management Zoning Recommendations

Detailed management zone maps are provided in Appendix C (maps 1 to 7) based on the five management zone categories described below. The intent of the management zoning approach is to provide guidance for conservation prioritization, short and long-term reclamation and restoration, and recreational access management. Management zoning was done based on the findings of the 2017 riparian health assessment / inventory and plant community mapping by Cows and Fish. Of note, the recreational access / facility zoning is intended as a preliminary concept plan only. Further work (under the direction of the Foothills Land Trust, the MD of Foothills and other project partners) is needed on this as part of a separate long-term planning initiative.

5.1 Conservation Zone

Areas mapped as “Conservation Zone” represent high integrity native riparian plant communities typically in a mid to late-seral successional state with minimal to no disturbance and a high floristic diversity of native plant species and habitat structural layers. These areas are priority areas to conserve for protection and maintenance of riparian health and wildlife habitat functions.

Conservation Zone Management Priorities:

- Conserve native riparian habitat and biodiversity.
- Protect wildlife habitat.
- Promote natural succession.
- Limit or prohibit recreational access.
- Monitor and remove invasive species.



5.2 Built Footprint Reclamation Zone

The “Built Footprint Reclamation Zone” encompasses the footprint of all existing built infrastructure features (e.g. roads, houses, driveways, barns, garages etc.) that have been or that will be removed and reclaimed in the near future. Reclamation is in varying degrees of completion within the project area. Topsoil application and seeding of a standardized grass mix (Seed Mix “D”) has been done as part of the reclamation works to date by Alberta Infrastructure. Refer to Section 8.1 for more details on this seed mix and recommendations pertaining specifically to continued riparian restoration and reclamation works in the project area, as informed by baseline inventory findings. Monitoring will be important to track all reclamation areas over time to assess reclamation success and to inform future reclamation prescriptions / design plans. Monitoring of reclamation areas should be done relative to the desired end goal for the reclaimed area. In the short term, the priority for reclamation areas includes weed removal and additional restoration efforts such as alleviating soil compaction and planting native trees and shrubs.

Built Footprint Reclamation Zone Management Priorities:

- Monitor success of revegetation efforts.
- Remediate compacted soil conditions where this is found to be limiting to plant growth.
- Monitor and remove invasive weeds.
- Actively plant native trees and shrubs.
- Promote natural recovery of native trees and shrubs.



Reclamation works were at various stages of completion in the project area in 2017. Long-term monitoring and weed control of reclaimed sites is important.

“Reclamation” is usually the first step toward stabilizing disturbed lands through removal of built structures and ameliorating soil conditions to allow for plant growth and revegetation. In the long-term, additional management interventions are needed to further restore these areas to a higher level of biodiversity and ecological function. It is recommended that all parts of the project area within the “Built Footprint Reclamation Zone” be evaluated as to their restoration potential. Where possible, additional restoration works should be done to further enhance native species biodiversity, habitat structure and ecological function. In some instances, however, return to a natural reference condition may not be possible where the surrounding landscape is highly modified. In other instances, it may not be desirable to fully restore reclaimed roads/houses, where the intent is to utilize these disturbed corridors / footprints to provide designated recreational access.

5.3 Active Restoration Zone

The “Active Restoration Zone” encompasses disturbed areas where more intensive types of active restoration works can be focused such as tree or shrub plantings, invasive species removal and soil decompaction. Examples include:

- Physically altered stream or riverbanks lacking adequate root mass protection from native plants (e.g. mainland bank portions of land parcel nos. 4 and 46);
- Riverbank berm removal areas in land parcel nos. 42 and 87 (within HIG25) and the proposed berm removal area in land parcel no. 25 (within HIG26);
- Heavily utilized pasture lands with soil compaction, bare ground and invasive species concerns;
- Tame pasture or hayfield areas dominated by monocultures of smooth brome and weedy species and with no tree or shrub cover;
- Balsam poplar / herbaceous disturbed communities lacking native understory trees and shrubs;
- Weed infestation areas;
- Former horticultural rock gardens or ornamental gardens with high cover from non-native and potentially fast-spreading perennial forbs;
- Areas with soil compaction and bare ground impacts from heavy recreational use.

Restoration goals should be defined on a site-specific basis. All restoration projects should include clear goals and objectives which can then be used to inform monitoring indicators of restoration success.

Refer to Section 8 for riparian planting and soil bioengineering restoration considerations.

Active Restoration Zone Management Priorities:

- Work with a qualified restoration ecologist and/or soil bioengineering specialist to develop appropriate restoration and soil bioengineering design plans.
- Conduct native plantings using an appropriate mix of tree, shrub and/or herbaceous species.
- Involve local community volunteers with doing riparian tree/shrub planting projects where possible.
- Implement an invasive species management and control strategy in collaboration with local community volunteers.
- Monitor restoration success.



Example of an altered streambank that is a candidate for a soil bioengineering bank stabilization project to improve cover and root mass protection from native tree and shrub species and to remove concrete rubble.



This area of bare ground has resulted from removal of a riverbank berm structure and initial reclamation of adjacent house footprints. Soil bioengineering bank stabilization, rough and loose soil surface treatment and riparian plantings should be considered as part of the restoration prescription for this site.

5.4 Natural Recovery Zone

The “Natural Recovery Zone” includes those areas with minimal amounts of human-caused disturbance adjacent to intact native plant communities. For example, small cleared areas or narrow trails next to large forested areas are likely to naturally recover over time. This zone also includes areas where historic long-term livestock use has altered the natural plant community, for example by removing understory trees and shrubs. This includes successional plant community types where preferred, ‘decreaser’ species (e.g. red-osier dogwood or willows) are

absent or much reduced due to suppression by long-term browse use or mechanical removal. Examples include the Balsam Poplar / Buckbrush, and Buckbrush Community Types (Thompson and Hansen 2002). For these community types, natural recovery is usually possible with rest from livestock use, following natural succession pathways. However, in some cases, high cover from non-native grasses like smooth brome can slow or inhibit succession of woody plant seedlings. Natural recovery potential is greatest for those sites that still have an evident native shrub component. Once a balsam poplar stand has converted from a shrub-dominated understory to an introduced herbaceous understory, the potential to reverse this state can be very difficult and can require drastic management intervention (Thompson and Hansen 2002). Loss of understory shrubs and young trees, results in a poplar stand drying out and ageing. Drier site conditions are caused by loss of overhead canopy shading and loss of penetrating roots that improve soil infiltration. Drier site conditions and altered soil porosity negatively impacts establishment of native riparian plants, in addition to negatively impacting flood and drought resiliency.

The “Natural Recovery Zone” intent is to prioritize areas where rest from disturbance (e.g. livestock or recreational use) is needed to promote natural tree and shrub regrowth. Natural flooding processes can help speed up the recovery of native plant communities in this zone.

Natural Recovery Zone Management

Priorities:

- Remove disturbance pressures (e.g. vehicle use, recreational use or livestock use) to promote natural recovery of native plants, biodiversity and improved soil infiltration capacity.
- Monitor and remove invasive plant species.
- Monitor natural succession of preferred woody species.
- Promote natural restorative processes (e.g. flooding and beaver activities).



5.5 Public Recreational Access and Facility Zone

The priority for the “Public Recreation Access and Facility Zone” is to allow for wildlife viewing, outdoor education and nature appreciation opportunities in the project area. This zone incorporates possible opportunities to facilitate passive recreational use of the Spitzee Riparian Area, utilizing existing disturbance corridors as much as possible. Since the management intent of the project area is to conserve ecologically sensitive riparian habitats and to protect water quality and fish and wildlife habitat, only limited foot-traffic should be allowed. Non-motorized recreational opportunities in the project area could include:

- informal recreational trails (pedestrian use);
- informal picnic areas;
- river access view points / boat launch/ designated fishing sites; and
- an interpretive trail network with signage connected to a Nature Center facility.

Public Recreation Access and Facility Zone Management Priorities:

- Provide opportunities for passive wildlife viewing, outdoor education, and nature appreciation.
- Utilize existing disturbance corridors for informal foot trails where possible.
- Minimize or avoid recreational use access within core areas of the “Conservation Zone”.
- Explore options for creation of a “Nature Center” (e.g. utilize an existing flood-proofed building footprint in land parcel no. 65 or no. 31). Incorporate low-impact development features as part of the building/ landscape design (e.g. green roof; rain garden; xeriscaping etc.). Develop an interpretive trail network linked to the Nature Center.
- Avoid / minimize any new disturbance to native plant communities to accommodate recreational land use facilities and trails.



Possible location of a future interpretive Nature Center / eco-tourism and stewardship hub (land parcel no. 31)



Reclaimed roadways can be used (where appropriate) for informal foot trails.

6 Invasive Species Management Recommendations

An important strategy for managing invasive species is to follow an “early detection / rapid response” management framework. This strategy relies on ongoing annual monitoring and weed management programs. New weed threats are constantly emerging in Alberta, requiring land managers to be vigilant in being able to recognize them and promptly remove potentially problematic invasive species. Even without public access, invasive species can be spread by wind, water or wildlife dispersal.

Priorities for invasive species control in the project area are as follows:

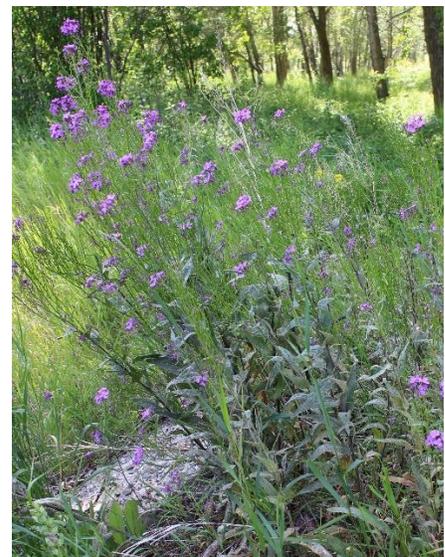
- Continue efforts to remove and monitor spotted knapweed in land parcel no. 5 (Appendix B, Map iv). Consult with the MD of Foothills Agricultural Fieldman for recommended spotted knapweed control treatments.
- Conduct frequent weed monitoring for new invasive species threats (i.e. *noxious* and *prohibited noxious* weeds) to prevent the spread of invasive plant species into areas where they are not already established.
- Focus in the short-term on controlling and preventing the spread of species that are not yet well established or widespread in the project area (Table 3). There is good potential for removal of most of the invasive species listed in Table 3, since many of them are localized in occurrence (e.g. black henbane [*Hyoscyamus niger*] and dame’s rocket [*Hesperis matronalis*]).
- Develop a long-term integrated weed management strategy for widespread invasive species such as Canada thistle, common burdock and perennial sow-thistle (Figure 4).



Spotted knapweed, a *Prohibited Noxious* weed, was observed in one location in land parcel no. 5.



Black henbane was observed in one location, adjacent to the disturbed house footprint in land parcel no. 84.



Dame’s rocket was observed in one location west of the driveway leading into the house in land parcel no. 23.

General invasive weed management considerations:

- Meet legal obligations to control *noxious* and destroy *prohibited noxious weed* species, as required by Alberta's *Weed Control Act* and to prevent harm to adjacent and downstream landowners and surrounding ecosystems. Refer to Table 3 (page 32) for a complete listing of invasive species observations (including canopy cover and density distribution) within the project area. Table 4 (page 34) has a summary of applicable invasive species management / control strategies.
- Carefully apply herbicide treatments only where necessary and with due care to waterbody setback requirements and native plants.
- Use mechanical control treatments where possible to minimize potential for adverse impacts from herbicides to insect pollinators. For example, mowing early in the season (prior to seed set) can help reduce seed dispersal. Hand pulling can be effective for localized weed occurrences for non-rhizomatous species.
- Invasive species control efforts should also include salvage or removal of potentially invasive ornamental woody and herbaceous perennials. Several persistent, potentially invasive ornamental plants were found near existing or reclaimed houses in land parcel no. 56, 84, 26, 23, 31, 5, and 21. Of particular concern are shrubs with an aggressive growth habit such as lilac (*Syringa* spp.), cotoneaster (*Cotoneaster* spp.) and sea buckthorn. Also of concern are aggressive ornamental perennial groundcovers (e.g. goutweed) and ornamental plants with known invasive relatives (e.g. mountain knapweed⁷).
- Local plant nurseries could be contacted to provide free removal (salvage) of ornamental (non-native, horticultural) trees / shrubs / flowering perennials with the incentive that these plants could then be put up for resale. Alternatively, ornamental plants could be put up for auction as part of a unique fundraising initiative for the Spitzee Riparian Stewardship Society.
- Engage community stewardship groups or individual volunteers with conducting regular weed pulls in the spring and early summer (before seed set of most flowering weeds).



Sea buckthorn, an introduced shrub, occurs west of the former house in land parcel no. 5



Goutweed is encroaching into native habitat at the south end of land parcel no. 47 and in land parcel no. 21.



Mountain knapweed (a potentially invasive ornamental plant) was observed near the former house in no. 84.

⁷ Otherwise referred to by the common names: Perennial Cornflower, Mountain Cornflower, Bachelor's Button, Montana Knapweed, Mountain Bluet.

Weed prevention strategies:

- Encourage area users to stay on designated trails.
- Minimize new ground disturbance.
- Carefully clean machinery and mowers prior to their use in native habitats (e.g. for trail maintenance or habitat improvement purposes). Avoid seed transfer from weed infested areas.
- Focus weed monitoring (early detection and rapid response) to newly reclaimed areas with exposed soil.
- Work with local nurseries and flower shops in High River to prevent the sale of invasive ornamental species such as Russian olive (*Elaeagnus angustifolia*).
- Distribute the “*Grow Me Instead*” pamphlet produced by the Alberta Invasive Species Council (AISC) to rural residential homeowners in the vicinity of the project area. This pamphlet can be ordered directly from the AISC website ([https:// https://www.abinvasives.ca/getting-involved/gardening](https://www.abinvasives.ca/getting-involved/gardening)). It provides native and non-invasive ornamental plant alternatives for gardeners.
- Avoid the use of generic pre-packaged wildflower mixes (Alberta Native Plant Council 2006). Use only seed mixes for which a Seed Certificate of Analysis is provided to ensure seed purity and composition.

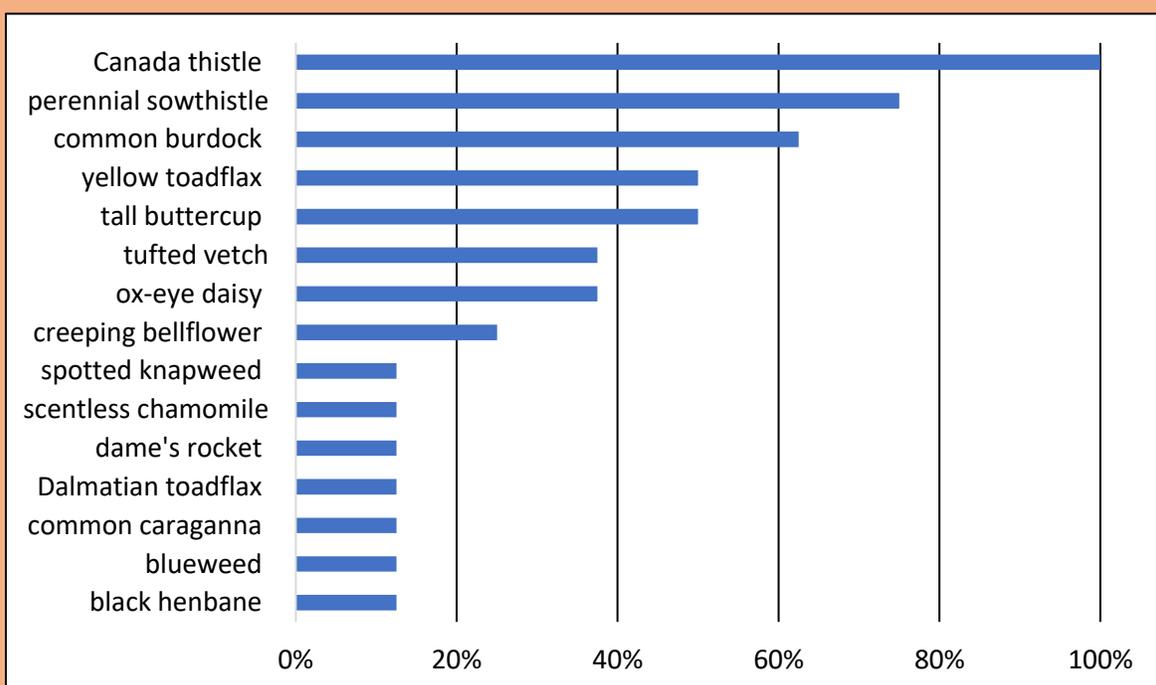


Figure 4 Invasive Species Constancy (Frequency of Occurrence) in RHI/RHA Polygons (n=8)

Table 3 Invasive Species Occurrence, Canopy Cover and Density Distribution in the Project Area

Invasive Species Name	Regulated Weed Status*	HIG25		HIG26		HIG27		HIG29		HIG30		HIG31		HIG32		HIG33	
		CC	DD	CC	DD	CC	DD	CC	DD	CC	DD	CC	DD	CC	DD	CC	DD
		black henbane (<i>Hyoscyamus niger</i>)	Noxious	-	-	<1%	1	-	-	-	-	-	-	-	-	-	-
blueweed (<i>Echium vulgare</i>)	Noxious	<1%	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canada thistle (<i>Cirsium arvense</i>)	Noxious	<1%	8	<1%	8	<1%	6	<1%	8	<1%	8	<1%	8	5-15%	8	1-5%	8
common burdock (<i>Arctium minus</i>)	Noxious	<1%	4	<1%	6	-	-	-	-	<1%	4	-	-	<1%	7	<1%	3
common caraganna (<i>Caragana arborescens</i>)	CF Listed	-	-	<1%	2	-	-	-	-	-	-	-	-	-	-	-	-
creeping bellflower; garden bluebell (<i>Campanula rapunculoides</i>)	Noxious	-	-	<1%	7	-	-	<1%	3	-	-	-	-	-	-	-	-
Dalmatian toadflax (<i>Linaria dalmatica</i>)	Noxious	-	-	<1%	2	-	-	-	-	-	-	-	-	-	-	-	-
dame's rocket (<i>Hesperis matronalis</i>)	Noxious	-	-	<1%	3	-	-	-	-	-	-	-	-	-	-	-	-
ox-eye daisy (<i>Chrysanthemum leucanthemum</i> syn. <i>Leucanthemum vulgare</i>)	Noxious	<1%	7	<1%	7	-	-	<1%	2	-	-	-	-	-	-	-	-

Invasive Species Name	Regulated Weed Status*	HIG25		HIG26		HIG27		HIG29		HIG30		HIG31		HIG32		HIG33	
		CC	DD	CC	DD	CC	DD	CC	DD	CC	DD	CC	DD	CC	DD	CC	DD
		perennial sowthistle (<i>Sonchus arvensis</i>)	Noxious	<1%	7	1-5%	8	<1%	5	<1%	8	<1%	4	-	-	-	-
scentless chamomile (<i>Matricaria perforata</i> syn. <i>Tripleurospermum inodorum</i>)	Noxious	<1%	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
spotted knapweed (<i>Centaurea maculosa</i> syn. <i>C. stoebe</i>)	Prohibited Noxious	-	-	-	-	-	-	<1%	3	-	-	-	-	-	-	-	-
tall buttercup (<i>Ranunculus acris</i>)	Noxious	<1%	1	<1%	6	-	-	<1%	1	-	-	-	-	-	-	-	-
tufted vetch (<i>Vicia cracca</i>)	CF Listed	1-5%	8	1-5%	8	<1%	2	-	-	-	-	-	-	-	-	<1%	1
yellow toadflax (<i>Linaria vulgaris</i>)	Noxious	<1%	2	-	-	-	-	<1%	8	-	-	<1%	3	-	-	-	-

*As per the Alberta *Weed Control Act*, *Weed Control Regulation* designated weed status.

“CF Listed” refers to vascular plants that have not yet been designated as *noxious* or *prohibited noxious* weeds, but that are known to be problematic and invasive within riparian areas specifically according to Cows and Fish riparian health data. When evaluating riparian health ‘invasive species’ parameters, these species were factored into the scoring.

Table 4 Invasive Species Management Recommendations

Invasive Species Name	Regulated Weed Status	RHI/RHA Polygons where found	Management Recommendations*
black henbane <i>(Hyoscyamus niger)</i>	Noxious	HIG26	<ul style="list-style-type: none"> • Poisonous to livestock but will generally be avoided if other forage is available • Shade intolerant (maintaining and improving tree and shrub cover is a good prevention strategy) • Mechanical control options: <ul style="list-style-type: none"> – Hand-pulling is effective, but wear gloves and protective clothing. – Mowing is effective but difficult due to it's thick, tough stem. – Hand pull or mow prior to seed set. – Be careful to avoid spreading seeds of mature plants using mechanical control options. • Chemical control options: <ul style="list-style-type: none"> – No selective herbicides are currently available for this species. • Biological control options: <ul style="list-style-type: none"> – None researched to date.
blueweed <i>(Echium vulgare)</i>	Noxious	HIG25	<ul style="list-style-type: none"> • Potentially poisonous to livestock but is also unpalatable • Mechanical control options: <ul style="list-style-type: none"> – Mowing is effective but must be repeated because cut stems encourage re-growth – Hand-pulling can be effective is the soil is loose because it is difficult to remove the deep taproot when soils are compacted. Wear gloves to prevent skin irritation. • Chemical control options: <ul style="list-style-type: none"> – Mecoprop-p is approved for use on blueweed however, it is always important to check labels. Use of chemicals near water is restricted. Consult local Agricultural Fieldman for more information. • Biological control options: <ul style="list-style-type: none"> – None researched to date.
Canada thistle <i>(Cirsium arvense)</i>	Noxious	HIG25, HIG26, HIG27, HIG29, HIG30, HIG31, HIG32, HIG33	<ul style="list-style-type: none"> • Shade intolerant (maintaining and improving tree and shrub cover is a good prevention strategy) • Effective control must involve killing the roots as most of the biomass is underground. • Mechanical control options: <ul style="list-style-type: none"> – Repeated mowing during the growing season over several years can deplete energy stores in the roots. – Repeated hand-pulling (in loose soils) can stress root systems over several seasons • Chemical control options: <ul style="list-style-type: none"> – Several chemicals (i.e. 2,4-D, Aminopyralid, Chlorsulfuron) are approved for use on Canada thistle in Canada. Use of chemicals near water is restricted. Consult local Agricultural Fieldman for more information. • Biological control options: A few different options are available but some have been discontinued due to non-target effects. Consult local Agricultural Fieldman for more information.

Invasive Species Name	Regulated Weed Status	RHI/RHA Polygons where found	Management Recommendations*
common burdock (<i>Arctium minus</i>)	Noxious	HIG25, HIG26, HIG30, HIG32, HIG33	<ul style="list-style-type: none"> • Preventing current infestations from producing seeds by removing seed heads is the best way to prevent spread. • Common burdock is palatable to livestock but grazing must be managed in the riparian area to prevent damage • Mechanical control options: <ul style="list-style-type: none"> – Mowing and cutting are effective but should be done just prior to flowering to prevent seed production. • Chemical control options: <ul style="list-style-type: none"> – Several chemicals and chemical combinations (i.e. 2,4-D, Dichlorprop) are approved for use on common burdock. Use of chemicals near water is restricted. Consult local Agricultural Fieldman for more information. • Biological options: <ul style="list-style-type: none"> – There are no official biocontrol agents for common burdock however, several species have been investigated. The Burdock moth (<i>Metzneria lappella</i>) reduces the number of viable seeds and is the only species investigated that occurs in North America.
common caragana (<i>Caragana arborescens</i>)	CF Listed	HIG26	<ul style="list-style-type: none"> • Large, mature stands of caragana can be virtually impossible to completely eradicate, but small populations can be adequately controlled. • Hand pulling can be effective for controlling small seedlings. Mowing or cutting in early and late June for several years can help reduce stem heights and reduce seed set⁸. Mechanical control options should attempt to remove as much of the root as possible to prevent re-sprouting.
creeping bellflower; garden bluebell (<i>Campanula rapunculoides</i>)	Noxious	HIG26, HIG29	<ul style="list-style-type: none"> • Many wildflower seed mixes contain creeping bellflower. Ensuring you know all the species in any seed mixes is the best method of prevention. • Mechanical control options: <ul style="list-style-type: none"> – Hand-pulling or cutting can be effective if as much of the root system as possible is removed. Plants will re-sprout from cut roots and so repeated efforts over several years would be required. • Chemical control options: <ul style="list-style-type: none"> – No selective herbicides are currently available for this species. • Biological options: <ul style="list-style-type: none"> – None researched to date.
Dalmatian toadflax (<i>Linaria dalmatica</i>)	Noxious	HIG26	<ul style="list-style-type: none"> • Poisonous to livestock but is also unpalatable • Disturbance and degraded vegetation are needed for new infestations to establish. Restoring native vegetation and minimizing disturbance may be the best way to prevent spread. • Mechanical control options:

⁸ <https://www.nd.gov/ndda/sites/default/files/legacy/resource/CARAGANA.pdf>

Invasive Species Name	Regulated Weed Status	RHI/RHA Polygons where found	Management Recommendations*
			<ul style="list-style-type: none"> - Mowing and hand pulling are effective and preventing seed production but re-sprouting from roots will occur. Removing as much root as possible in loose soils and repeating for several years can effectively control or eradicate small infestations. • Chemical control options: <ul style="list-style-type: none"> - Several chemicals (i.e. Acetic acid, Amitrole, Dichloroprop) are approved for use on Canada thistle in Canada. Use of chemicals near water is restricted. Consult local Agricultural Fieldman for more information. • Biological options: <ul style="list-style-type: none"> - Eight species have been approved in Canada for release, including four weevils, three moths and one beetle. Five of these species have been released in British Columbia.
dame's rocket (<i>Hesperis matronalis</i>)	Noxious	HIG26	<ul style="list-style-type: none"> • Many wildflower seed mixes contain creeping bellflower. Ensuring you know all the species in any seed mixes is the best method of prevention. Dame's rocket requires disturbance to become established but once established it is able to outcompete native species. • Mechanical control options: <ul style="list-style-type: none"> - Hand-pulling is the most effective method since roots are easily removed by hand or by digging with a small knife. Plant density can increase after removal due to disturbance of soils however, can be effective will continued use. - Burning can be an effective method of control. • Chemical control options: <ul style="list-style-type: none"> - No selective herbicides are currently available for this species. • Biological options: <ul style="list-style-type: none"> - None researched to date.
ox-eye daisy (<i>Chrysanthemum leucanthemum</i> syn. <i>Leucanthemum vulgare</i>)	Noxious	HIG26, HIG29	<ul style="list-style-type: none"> • Cattle avoid this species however other livestock will graze it. Seeds may remain viable even after passing through digestive system and therefore care should be taken not to spread species with livestock. • Mechanical control options: <ul style="list-style-type: none"> - Repeated mowing prevents seed production but also stimulates re-sprouting - Hand-pulling or digging is effective but as much of the rhizomatous roots should be removed. Ground disturbance should be minimized and removal needs to be repeated over several years. • Chemical control options: <ul style="list-style-type: none"> - Aminopyralid as well as combinations of Aminopyralid and Metsulfuron-methyl or 2,4-D are approved for use in Canada. Use of chemicals near water is restricted. Consult local Agricultural Fieldman for more information. • Biological options: <ul style="list-style-type: none"> - European insect species are being investigated for their potential use as biological control agents. No species are currently available for use.

Invasive Species Name	Regulated Weed Status	RHI/RHA Polygons where found	Management Recommendations*
perennial sowthistle (<i>Sonchus arvensis</i>)	Noxious	HIG25, HIG26, HIG27, HIG29, HIG30, HIG33,	<ul style="list-style-type: none"> • The best method of prevention is to control new infestations before extensive roots systems are able to develop. • Mechanical control options: <ul style="list-style-type: none"> – Mowing can prevent seed production but must be repeated several times over the flowering period. – Seedlings can be easily hand-pulled. • Chemical control options: <ul style="list-style-type: none"> – Several chemicals and chemical combinations (i.e. 2,4-D, Bromoxynil) are approved for use on common burdock. Use of chemicals near water is restricted. Consult local Agricultural Fieldman for more information. • Biological options: <ul style="list-style-type: none"> – Options have been investigated but none have been effective at managing infestations.
scentless chamomile (<i>Matricaria perforata</i> syn. <i>Tripleurospermum inodorum</i>)	Noxious	HIG25	<ul style="list-style-type: none"> • Does not compete well with vigorous, healthy plant communities. • Generally unpalatable for livestock and seeds remain viable after digestion. • Mechanical control options: <ul style="list-style-type: none"> – Mowing can prevent seed blooms but plants will re-bloom. – Hand-pulling can be effective on small infestations and to prevent spread. – Burning can also be effective at preventing seed spread. • Chemical control options: <ul style="list-style-type: none"> – Several chemicals and chemical combinations (i.e. Aminopyralid, Chlorsulfuron) are approved for use in Canada. Use of chemicals near water is restricted. Consult local Agricultural Fieldman for more information. • Biological options: <ul style="list-style-type: none"> – A weevil (<i>Omphalapion hookeri</i>) and a gall midge (<i>Rhopalomyia tripleurospermi</i>) have been released in Alberta.
spotted knapweed (<i>Centaurea maculosa</i> syn. <i>C. stoebe</i>)	Prohibited Noxious	HIG29	<ul style="list-style-type: none"> • Seeds have a hard seed coat and can remain viable for 5-10 years. • Knapweed is somewhat palatable however, seeds will remain viable after digestion. • Mechanical control options: <ul style="list-style-type: none"> – Cutting or pulling before flowering can prevent seed production. Remove as much of the root system as possible and repeat efforts over several years. Wear gloves to prevent skin irritation. • Chemical control options: <ul style="list-style-type: none"> – Aminopyralid and Picloram are approved for use in Canada. Use of chemicals near water is restricted. Consult local Agricultural Fieldman for more information. • Biological options:

Invasive Species Name	Regulated Weed Status	RHI/RHA Polygons where found	Management Recommendations*
			<ul style="list-style-type: none"> - 12 biocontrol agents have been introduced in North America (3 moths, 4 flies, 4 weevils and a rust). Many of these species have become established in the northwestern US and southern BC resulting in reductions of plant size and seed production.
tall buttercup (<i>Ranunculus acris</i>)	Noxious	HIG25, HIG26, HIG29, HIG33	<ul style="list-style-type: none"> • Some grass and forage seeds may contain perennial sow-thistle. Ensuring you know all the species in any seed mixes is the best method of prevention. • Mechanical control options: <ul style="list-style-type: none"> - Mowing is only effective prior to seed set - Hand-pulling is effective for individual plants or small infestations but always wear gloves to prevent skin blistering and redness. • Chemical control options: <ul style="list-style-type: none"> - Several chemicals (i.e. Aminopyralid, MCPB, MCPA) are approved for use in Canada. Use of chemicals near water is restricted. Consult local Agricultural Fieldman for more information. • Biological options: <ul style="list-style-type: none"> ○ Investigations concluded that several closely related species make finding suitable host-specific agents difficult.
tufted vetch (<i>Vicia cracca</i>)	CF Listed	HIG25, HIG26, HIG27	<ul style="list-style-type: none"> • Mechanical control options: <ul style="list-style-type: none"> - Tufted vetch can be removed by hand pulling or cutting to remove flowering stems. Repeated, persistent trimming can weaken the roots and eventually kill the plant. Mowing is not usually an option since this plant is a vine that entangles into native shrubs.
yellow toadflax (<i>Linaria vulgaris</i>)	Noxious	HIG25, HIG26, HIG29, HIG31	<ul style="list-style-type: none"> • Once established it is almost impossible to eradicate and is very difficult to control. • Many wildflower seed mixes contain creeping bellflower. Ensuring you know all the species in any seed mixes is the best method of prevention. • Mechanical control options: <ul style="list-style-type: none"> - Hand-pulling can be effective if the roots can be easily removed. Must be repeated to deplete seed bank and root pieces. - Mowing can assist by starving roots • Chemical control options: <ul style="list-style-type: none"> - Several chemicals (i.e. Acetic acid, Amitrole, Dichlorprop) are approved for use in Canada. Use of chemicals near water is restricted. Consult local Agricultural Fieldman for more information. • Biological options: <ul style="list-style-type: none"> - Research shows a weevil (<i>Mecinus janthinus</i>) is successfully establishing in Alberta and providing effective control.

*Source: <https://www.abinvasives.ca/fact-sheets>

7 Disturbance-Caused Herbaceous Species Management Recommendations

The high prevalence of introduced, “disturbance-caused” plants in the project area (e.g. smooth brome, Kentucky bluegrass and quack grass) is typical of riparian areas with historical agricultural and country residential land uses. Grasses like smooth brome, Kentucky bluegrass and quack grass were introduced from Europe by early settlers over 100 years ago. These species have since been extensively seeded in pastures, hayfields, and along roadside ditches or in lawns (Kentucky bluegrass) throughout the settled portions of Alberta. All of these grasses have aggressive rhizomatous growth habits and quickly colonize disturbed areas with moist soil conditions. They are “cool season” grasses that begin growth early in the spring. Although Kentucky bluegrass has shallow mat-forming roots, quack grass and smooth brome are deeper rooted and have tall growth habits, often shading out native grasses. Sites where these species represent more than 50% of the plant community are considered permanently ‘modified’ from natural conditions (Adams *et al.* 2009).



Uniform cover of smooth brome detracts from wildlife habitat heterogeneity, native plant species biodiversity and flood and drought resiliency.

Since introduced, “disturbance-caused” grasses are widespread in and around the project area, it is not possible, practical or desirable to attempt to remove these species. Instead the management priority should be to conduct strategic tree and shrub plantings to restore missing habitat structure, vegetation diversity and bank root mass protection functions. Another benefit of doing this is to improve soil moisture holding capacity. Tree and shrub roots create deeply penetrating soil infiltration pores. Variable rooting depths from improved woody species cover and diversity is thus a long-term benefit for improved drought and flood resiliency. Over time, as trees and shrubs establish, canopy shading can be limiting to grass growth and creates opportunities that favour establishment of shade-tolerant forbs and native shrubs. Mowing and/or controlled grazing can be used as tools to control litter or thatch build-up, weaken root reserves and create habitat heterogeneity.

Management priorities

- Conduct strategic native tree and shrub plantings in areas with large monocultures of smooth brome, Kentucky bluegrass and/or quack grass.
- Use mowing, haying and / or controlled grazing treatments as habitat management tools. Appropriately timed mowing or grazing treatments can help to prevent seed set and weaken the vigour of rhizomatous, cool-season grasses like smooth brome. This can in turn give a competitive advantage to tree and shrub plantings and it improves the potential for natural recovery by native herbaceous plants.

Prevention strategies:

- Use appropriate native grass seed mixes to reclaim disturbed areas (refer to Section 8.1 for more details). Use only seed mixes for which a Seed Certificate of Analysis is provided to ensure seed purity and composition (i.e. seeds should be certified to be weed free and free of undesirable agronomic grasses).
- Avoid new disturbance in areas with intact native plant communities.
- Avoid transfer of seeds from machinery (e.g. mowers) from modified or disturbed grasslands into native plant communities.

Control / management strategies:

- To weaken smooth brome and reduce potential for regrowth, grazing should be done early in the season when the stem begins to elongate (usually in early May) and then again after a short rest period of less than 20 days (Operation Grassland Community [OGC], no date). Cattle are more inclined to graze smooth brome early in the season when it has soft, highly palatable foliage with high protein content. Brome takes on a 'stemmy' appearance in the fall making it less palatable. By September, smooth brome has much reduced protein levels, increased fiber and reduced digestibility (Tannas 2003).
- Repeated mowing treatments can be used to reduce the vigour of agronomic grasses, where the goal is to reduce competition in the vicinity of native tree and shrub plantings. Areas to be mowed should be first checked for grassland nesting songbirds to avoid damage to nests. Where the goal is to prevent seed set, mowing applications should occur while grasses are in the boot stage (i.e. when flowering heads are still enclosed within the sheath). Generally, cutting annually for five years or more may decrease smooth brome grass in the seed bank. The more frequently mowing is done, the greater the potential for impact. Repeated cuttings during the growing season stresses plants by reducing carbohydrate levels (OGC, no date). Take care to avoid naturally regenerating trees or shrubs when conducting mowing.
- Periodic haying and baling could be considered to reduce heavy thatch build up in areas with large monocultures of smooth brome to reduce fuel loads and fire risk. This should be done after the peaking nesting period for grassland nesting songbirds (April 1 to July 15) (Government of Alberta 2011).
- Where tree and shrub plantings are done in smooth brome / quack grass / Kentucky bluegrass dominant areas, it is important to apply layers of cardboard and mulch around new plantings to reduce competition. A minimum depth of 15 cm of mulch is recommended to reduce competition from agronomic grasses (AMEC 2012).

8 Riparian and Bank Restoration Recommendations

8.1 Built Footprint Reclamation and Native Seed Mix Considerations

At the time of the June/July 2017 Riparian Health Inventory, reclamation works had been completed for most of the project area land parcels with the exception of land parcel nos. 4, 20, 23, 43, 65 and 31. In all other land parcels, houses and other facilities or structures had been removed and driveways / access roads had been reclaimed. Alberta Infrastructure was responsible for completing this initial reclamation work. According to Alberta Infrastructure, a standard seed mix, Seed Mix “D” was applied. Seed Mix “D” consists of the following percent by weight ratio of grass species⁹:

- 15% Hard fescue (*Festuca trachphylla*)
- 15% Sheep fescue (*Fesuca ovina*)
- 15% Green Needle grass (*Stipa viridula*)
- 10% Blue grama (*Bouteloua gracilis*)
- 15% Slender wheatgrass (*Agropyron trachycaulum*)
- 15% Northern wheatgrass (*Agropyron dasystachyum*)
- 15% Western wheatgrass (*Agropyron smithii*)

The baseline riparian health evaluation showed that some reclaimed areas had better vegetation establishment than others. Soil compaction may be a limiting factor to vegetation establishment. Where appropriate, a “rough and loose” soil surface treatment (Polster 2009) should be considered to alleviate compacted soil conditions in reclaimed areas with little to no vegetation establishment (e.g. along the access driveway into land parcel nos. 42 and 87). Using a “rough and loose” soil surface treatment helps to alleviate soil compaction issues in addition to creating topographic heterogeneity with the site. An uneven soil surface helps to control erosion and promotes moisture retention, creating improved conditions to promote natural recovery of vegetation (Polster 2009). Soil surface unevenness helps to keep seed in place and reduces seed losses from wind and water / raindrop erosion. Surface undulations also create microclimates where water can pool, promoting seed germination. Where possible, future reclamation of built features should consider application of this technique as part of the restoration design.

A possible concern with the current reclamation treatment is that it includes non-native grass species (i.e. sheep fescue and hard fescue) and it also has a high component of wheatgrasses (*Agropyron* spp.). These aggressive, fast growing grasses can slow progression of natural

⁹ Email communication from Jason Ness Jason Ness, Manager – Land Planning, Southern Region Alberta Infrastructure, March 1, 2017. More information is needed about the native species purity of native grasses in Seed Mix D (i.e. many are likely cultivars).

recovery of tree and shrub seedlings. Often, non-native wheatgrass cultivars are used in seed mixes. Future reclamation works should investigate the use of alternative native seed mixes aimed at promoting native biodiversity while also promoting natural recovery of native trees and shrubs. A useful resource for determining native seed mixes is the City of Calgary's *Seed Mix Framework Recommendations* (City of Calgary 2017¹⁰) This document is currently in draft format. It contains guidelines for "seed mixes, handling procedures, timing and methodologies for the Calgary area to inform revegetation work". Also refer to the *Native Plant Revegetation Guidelines for Alberta* (Native Plant Working Group 2000) and *Establishing Native Plant Communities* (Smreciu *et al.* 2001) for more information about how to develop appropriate native grass and forb seed mix compositions and suitable seed application rates. These references have information about seed size, dormancy, germination rates and seeding performance for native species commonly used in restoration projects in Alberta. Customized native seed mixes should be developed on a site-specific basis, taking into consideration local environmental conditions (soil type, slope, aspect, moisture regime etc.) as well as the end restoration goals of a particular site. Custom native seed mix composition (i.e. percentage species composition by dry weight) and recommended application rates should be developed by a qualified Reclamation Specialist or Professional Agrologist.

Native seed mix considerations:

i) Seed Purity

- A "Certificate of Seed Analysis" must be requested for each native seed lot ordered to ensure that the seed is free of undesirable and potentially invasive non-native species. Certificates of Seed Analysis must be examined and approved by a qualified Reclamation Specialist or Professional Agrologist prior to seed purchase.
- Generic, commercially available "Wildflower Seed Mixes" should not be used due to their potential to contain non-native and potentially invasive species.

ii) Timing

- **Early spring after ground thaw and late fall prior to ground freeze** are considered the best times to seed native species to optimize germination rate and establishment (City of Calgary 2017). If seeding is done during the mid-summer months, there is a risk that should germination occur, young plants will not have a sufficient root system to withstand dry warm conditions. This can lead to die off of target native species, allowing weed species to colonize a site (City of Calgary 2017).

¹⁰ This document is undergoing internal review by the City of Calgary and will likely be publicly released in 2018.

iii) Application Rates

- Avoid overseeding with native grasses where the goal is to restore the tree/shrub community in the long-term. Professional observations of recently installed bioengineering projects in the City of Calgary, suggests that where a grass seeding application rate of 40 kg/ha has been used, this has resulted in overly dense grass establishment, impeding the success of woody plantings¹¹.

iv) Structural variability (height)

- Structural variability is a component of a healthy plant community. Native seed mixes should consider structural variability in their design, being careful not to over-represent tall species and under-represent shorter species (City of Calgary 2017). Taller grasses often have aggressive growth habits, creating a potential for them to shade-out shorter species before they have a chance to establish.

v) Site preparation

- Ensure appropriate soil to seed contact. Avoid seeding into leaf litter, thatch or wood chips/mulch.
- Control and remove weeds (using chemical and/or mechanical means) prior to seeding. Allow for a sufficient time delay prior to seeding if a chemical weed control method is used (refer to the product labels for details). Multiple years of weed treatment may be needed where there are a high amount of weedy species in the seed bank or where there is a nearby weed infestation source (e.g. road ditches).
- Ensure the upper surface of topsoil is firm but not overly compacted to allow vegetation to easily establish. Create an uneven / roughened surface to create to promote microclimate variation and allow for water collection to occur in small surface dips to aid in seed germination.
- Rake and scarify topsoil prior to hand broadcasting seed. After applying seed, lightly rake and lightly compress the area (with a light roller or by stepping on the area) to maximize soil to seed contact.
- Be cautious with the use of annual cover crops intended for short-term erosion control purposes. Quite often, cover crops are used inappropriately and tend to persist in an area even when they are expected to die off (Calgary 2017). Inappropriate seeding rates is a contributing problematic factor.

¹¹ Pierre Raymond, Terra Erosion Control, Soil Bioengineering Specialist, personal communication (October 2017)

8.2 Ecological Restoration Definition and Attributes

The Society for Ecological Restoration (SER) International defines ecological restoration as “*an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability*” (SER 2004). An ecosystem is considered “restored” when it “*contains sufficient biotic and abiotic resources to continue its development without further assistance or subsidy. It will sustain itself structurally and functionally. It will demonstrate resilience to normal ranges of environmental stress and disturbance. It will interact with contiguous ecosystems in terms of biotic and abiotic flows and cultural interactions*” (SER 2004).

Attributes of Restored Ecosystems (SOURCE: SER 2004)

1. *The restored ecosystem contains a characteristic assemblage of the species that occur in the reference ecosystem and that provide appropriate community structure.*
2. *The restored ecosystem consists of indigenous species to the greatest practicable extent.*
3. *All functional groups necessary for the continued development and/or stability of the restored ecosystem are represented or, if they are not, the missing groups have the potential to colonize by natural means.*
4. *The physical environment of the restored ecosystem is capable of sustaining reproducing populations of the species necessary for its continued stability or development along the desired trajectory.*
5. *The restored ecosystem apparently functions normally for its ecological stage of development, and signs of dysfunction are absent.*
6. *The restored ecosystem is suitably integrated into a larger ecological matrix or landscape, with which it interacts through abiotic and biotic flows and exchanges.*
7. *Potential threats to the health and integrity of the restored ecosystem from the surrounding landscape have been eliminated or reduced as much as possible.*
8. *The restored ecosystem is sufficiently resilient to endure the normal periodic stress events in the local environment that serve to maintain the integrity of the ecosystem.*
9. *The restored ecosystem is self-sustaining to the same degree as its reference ecosystem, and has the potential to persist indefinitely under existing environmental conditions. Nevertheless, aspects of its biodiversity, structure and functioning may change as part of normal ecosystem development, and may fluctuate in response to normal periodic stress and occasional disturbance events of greater consequence. As in any intact ecosystem, the species composition and other attributes of a restored ecosystem may evolve as environmental conditions change.*

The above mentioned ecological restoration attributes should be considered when developing restoration project objectives and goals as well as monitoring indicators. In most cases, most restoration projects will not be able to achieve all attributes of a fully restored system as defined by SER 2004. Restoration usually progresses along a trajectory from reclamation → naturalization → rehabilitation → restoration (depending on the management intent and goals for a site) (City of Calgary 2014). As restoration progresses along this trajectory there is usually an increasing level of ecosystem function and native biodiversity (City of Calgary 2014). Typically, a “reference habitat” can be used to assess progression of restoration projects along this trajectory. A reference habitat usually refers to a late successional or potential natural climax community suited to grow within the environmental conditions of a site. “Habitat Types” described by Thompson and Hansen (2002) are considered riparian “reference habitats” for the Grassland Natural Region of Alberta.

8.3 Riparian Restoration Goals

Riparian restoration plans should be designed to improve one or more key ecological functions of a riparian area (Table 5). The plan should be informed by baseline riparian health inventories to identify what types of improvements are necessary (refer to Table 2 and Cows and Fish 2017 for more details). To improve ecological functions, riparian restoration plans may be designed to:

- reduce bare ground cover;
- remediate compacted soil;
- improve native plant species biodiversity;
- improve tree and shrub structural habitat layers for breeding birds;
- improve fish habitat (e.g., through improved overhanging cover and shade along the streambank);
- filter upland pollutants; and/or
- provide soil binding root systems to reduce erosion and improve bank stability.

As discussed in more detail in the following sections, restoration plans should incorporate the use of appropriate native plant species and native plant species assemblages, site preparation, weed control methods, and application of soil bioengineering techniques (where appropriate).

Riparian restoration works are suggested for the “Active Restoration” Management Zone (Appendix C). The type of restoration required must be determined on a site-specific basis, but generally will involve efforts to improve cover and diversity of preferred native tree and shrub plant species.

Table 5 Riparian Area Functions

Riparian Functions	Why Is This Function Important?
Trap Sediment	<ul style="list-style-type: none"> • Sediment adds to and builds soil in riparian areas • Sediment aids in soil's ability to hold and store moisture • Sediment can carry contaminants and nutrients - trapping it improves water quality • Excess sediment can harm the aquatic environment
Build and Maintain Banks	<ul style="list-style-type: none"> • Balances erosion with bank restoration - reduces effects of erosion by adding bank elsewhere • Increases stability and resilience • Maintains or restores profile of channel - extends width of riparian area through higher water table
Store Water and Energy	<ul style="list-style-type: none"> • Stream safety valve - stores high water on the floodplain during floods • Reduces flood damage • Slows flood water allowing absorption and storage in aquifer
Recharge Aquifer	<ul style="list-style-type: none"> • Stores, holds and slowly releases water • Maintains surface flows in rivers and streams • Maintains high water table and extends width of productive riparian area
Filter and Buffer Water	<ul style="list-style-type: none"> • Reduces amount of contaminants, nutrients and pathogens reaching the water • Uptake and absorption of nutrients by riparian plants • Traps sediment, improves water quality and enhances amount of vegetation to perform filtering and buffering function
Reduce and Dissipate Energy	<ul style="list-style-type: none"> • Reduces velocity which slows erosion and material transport • Provides erosion protection and slows meander rate • Aids in sediment capture
Maintain Biodiversity	<ul style="list-style-type: none"> • Creates and maintains habitats for fish, wildlife, invertebrates and plants • Connects other habitats to allow corridors for movement and dispersal • Maintains a high number of individuals and species
Create Primary Productivity	<ul style="list-style-type: none"> • Increases vegetation diversity and age-class structure - links to other riparian functions • Ensures high shelter and forage values • Enhances soil development • Assists nutrient capture and recycling

Source: Fitch *et al.* 2001.

8.3.1 Natural Riparian Processes (including Beaver Management Considerations)

Natural riparian ecological processes should be promoted within the project area, such as flooding, natural colonization of native plant species and wildlife utilization (in particular beaver activity). Beavers, as a keystone riparian species, have potential to beneficially influence riparian restoration by stimulating regeneration of willows and poplars and by building dams that can contribute to flooding out areas of weedy / disturbance-caused plants, favouring colonization by wetland native plants. Beaver cuttings are known to stimulate vigorous sprouting of willows and increase woody biomass (Fitch 2016). Beaver ponds help to trap and store sediment, helping to improve water quality downstream in addition to providing unique habitat for plants, insects, amphibians, fish, songbirds, waterfowl and mammals. Over time, sediment captured by beaver ponds broadens stream valleys, creating rich deposits of soil that form the foundation of lush and productive riparian zones, wetlands and meadows. Beaver dams and ponds slow stream velocity and dissipate energy laterally, decreasing potential for erosion and flood damage downstream. In addition, beaver ponds contribute to increasing surface and ground water storage, key components of flood and drought resiliency (Fitch 2016). Active beaver dams were observed in the project area during the 2017 riparian health evaluation (in land parcel nos. 46, 59, 63 and 26). Continued monitoring of beaver activity in the project area is suggested. Given the management priorities of the Spitzee Riparian Area for biodiversity conservation, flood and drought resiliency, beaver activities should be encouraged within the area. Where beaver activity is found to cause flooding issues to adjacent roadways, non-lethal management options should be explored to mitigate these impacts such as the use of pond levelling devices (Fitch 2016).

8.4 Riparian Restoration and Planting Recommendations

A brief review of some of the key considerations for planning riparian restoration and planting projects is given here. For more information, please refer to the following reference documents for more information:

- 1) Cows and Fish (2007) *Growing Restoration Fact Sheet* (available from: http://cowsandfish.org/publications/fact_sheets.html)
- 2) Cows and Fish (2014) *Planning Your Riparian Planting Project in Alberta* (available from <http://www.growingforward.alberta.ca>- see “Links and Other Resources – Riparian Planting Guideline”)
- 3) Agroforestry & Woodlot Extension Society (2017) *Manual for Riparian Forest Buffer Establishment in Alberta* (available from: <http://www.awes-ab.ca/reports.html>)

i) Site Preparation

- Conduct an Alberta One-Call line locate as part of the planning of all riparian planting projects to ensure that appropriate setbacks are maintained from buried utility lines.
- Weed control and removal is recommended to reduce competition and help improve potential for success of riparian planting projects.
- Weeds should be removed from the site prior to planting using either herbicides, mowing, tillage or manual removal. Care should be taken when using chemicals as only certain types of chemicals can be used within close proximity to a waterbody and certain chemicals can leave a harmful residue that prevents woody plant growth. All regulatory requirements must be met for herbicide application near water.
- Reduce competition from aggressive agronomic grass species prior to conducting riparian planting projects by way of mechanical controls (e.g. repeated early season mowing) (refer to Section 7 for more details). Refer to AWES 2017 for suggested solarization methods for small scale control of undesirable herbaceous plants prior to planting. Solarization involves covering small areas with transparent greenhouse plastic for an extended time to heat-kill all vegetation prior to planting. This technique is not cost effective for large areas.
- Layers of cardboard and a minimum depth of 15 cm of mulch should be installed in conjunction with planting stakes or container stock seedlings to reduce competition from non-native grasses and weeds (AMEC 2012).

ii) Permitting

- Most riparian planting projects will not require permits, unless projects will directly impact the bed and shore of water bodies like the Highwood River, Baker Creek or tributary streams in the project area. For projects conducted above the permanent vegetation line (i.e. above the bed and shore line), regulatory approvals are generally not required.
- Disturbing the shape, contour and soil exposure of the site, particularly close to the water and on the streambanks all require a careful review of any potential regulatory considerations, even if the intended outcome is for restoration purposes. Working in or near a water body generally requires at least two provincial approvals (Public Lands Act, Water Act), and possibly approval from Fisheries and Oceans Canada (federal Fisheries Act). For more information:
 - <http://aep.alberta.ca/lands-forests/shorelands/approvals-regulatory-requirements.aspx>
 - <http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>
- For all project close to water, appropriate measures must be in place for erosion and sediment control. For more information: <http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>

iii) *What to Plant*

Choosing which riparian plants are appropriate for your site is vital to the success of your riparian restoration project. Here are some important questions to ask:

- 1) Which species will grow well in your area?
- 2) Which species will provide the most benefit for riparian function?
- 3) Which species are easy to establish and grow quickly?

Plant selection considerations:

- Use locally adapted native species. Local plants and seeds are best adapted to local climatic fluctuations, soil conditions, pollinators, and predator or disease stresses.
- Select pioneer rather than later successional species. For example, willows and poplars are considered 'pioneer' species that are the first to establish in a disturbed area. White spruce is an example of a slow growing, later successional species. Willows, balsam poplars and red-osier dogwood are preferred native species for riparian planting and bioengineering projects in the Calgary region. These species are capable of vegetative propagation (i.e. they grow shoots and roots when stem cuttings are placed in contact with soil and moisture). However, red-osier dogwood propagation from cuttings can be more challenging.
- Select plant species that are adapted to your soil type, aspect, and moisture conditions. **Refer to Figure 5 on the following page for native plant species suitable for use in the Spitzee Riparian Area and their preferred moisture regime.**



Balsam poplar (left), sandbar willow (center) and red-osier dogwood (right) are abundant in the project area. These species can all be propagated from live cuttings.

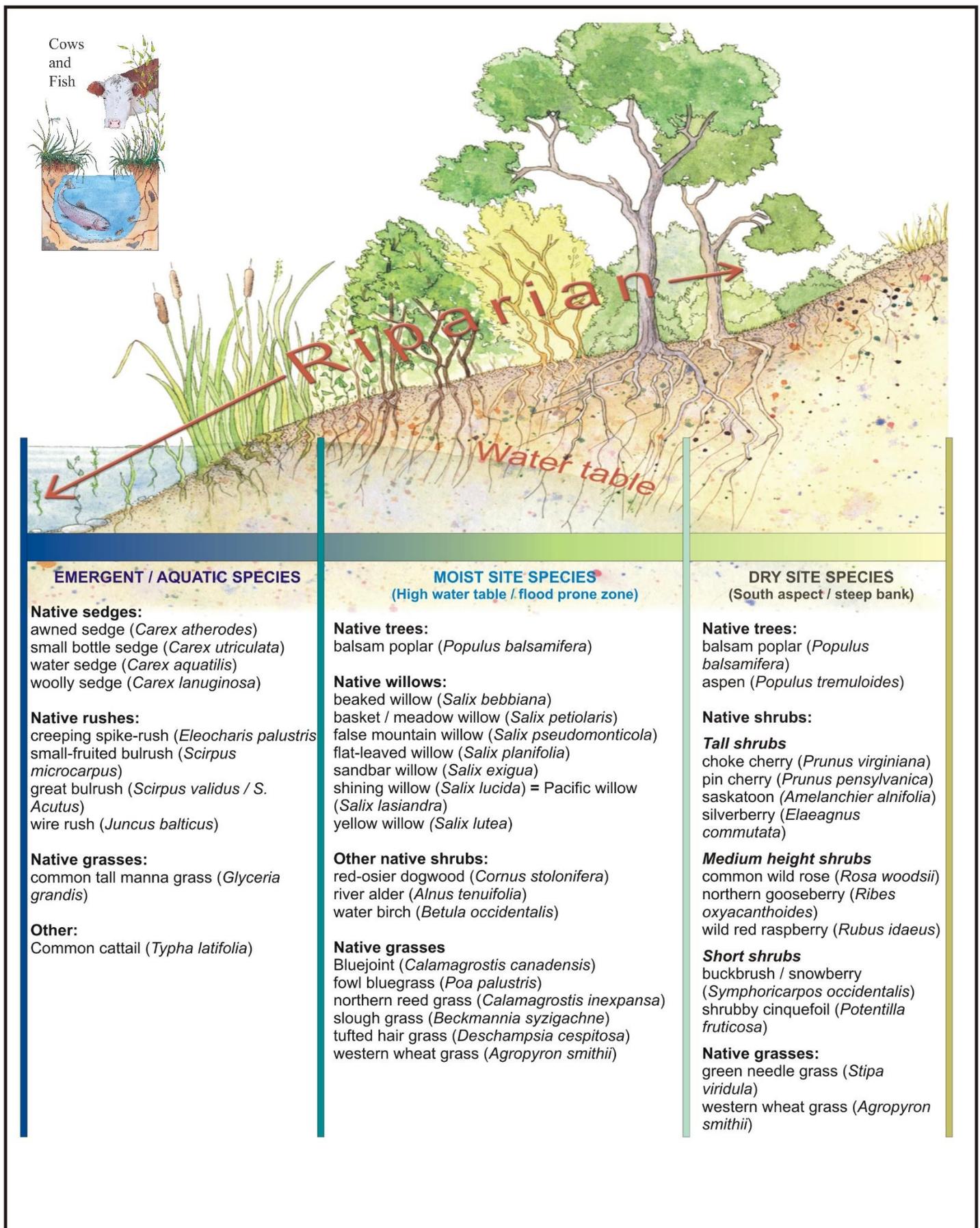


Figure 5 Suggested Native Plant Species for Spitzee Riparian Area Restoration Projects

- Select a diversity of plants to provide short, medium and tall structural height layers and varying rooting depths. Multiple height layers and rooting depths benefit fish and wildlife habitat diversity, soil infiltration capacity, soil stabilization, erosion prevention and runoff filtration functions.
- Avoid planting invasive non-native shrubs including: caragana, Russian olive, salt cedar (*Tamarix ramosissima*) and European (common) buckthorn (*Rhamnus catharticus*).
- Avoid using sod-forming grasses (e.g. smooth brome, timothy [*Phleum pratense*], reed canary grass [*Phalaris arundinacea*]) that can quickly overwhelm tree and shrub seedlings.
- Ensure all plant material is alive and healthy (i.e. disease and pest free)
- Select plants with beneficial traits. Selecting the right mix of plants for your site will in part depend on the riparian functions you hope to restore, such as:
 - Shading (trees and shrubs help to create cover and shelter for fish and wildlife);
 - Erosion resistance (willows, poplars and sedges in combination offer high erosion resistance);
 - Wildlife values (consider using berry producing shrubs like saskatoon and plants with high forage value such as red-osier dogwood and willows); and
 - Nutrient filtration (sedges, willows and cattails efficiently absorb and utilize nutrients).
- Common native forest understory shrubs in the project area include:
 - Saskatoon (*Amelanchier alnifolia*)
 - Choke cherry (*Prunus virginiana*)
 - Water birch (*Betula occidentalis*)
 - Yellow willow (*Salix lutea*)
 - Red-osier dogwood (*Cornus stolonifera*)
 - Wild rose (*Rosa woodsii*, *Rosa acicularis*)
 - Buckbrush (*Symphoricarpos occidentalis*)
 - Wild red raspberry (*Rubus ideaus*)
 - Silverberry (*Elaeagnus commutata*)

iv) Harvesting Local Native Plants

- There is an abundance of potential locally available donor sites within the Spitzee Riparian Area for harvesting balsam poplar, willow and red-osier dogwood stem cuttings and rooted seedlings.
- **All live cuttings should be harvested during the dormancy period (typically from October to March)** (AMEC 2012). When possible, it is often most cost effective to harvest and implement a planting project in the fall when live material can be immediately used without the need for cold storage.



Harvesting of native willow branches.



A planted willow stake with new growth.

- Take precautions not to damage the donor site (i.e. collect only 5% of the seed or plant material scattered over as large an area as possible).
- Ensure all harvested plant material is alive and vigorous (harvested branches should be green and soft if the bark is scraped away). Diseased limbs should be pruned off or not harvested.
- Live cuttings should be harvested as close to the ground as possible using chain saws or loppers. Cutting ends should be cut square and with a clean cut.
- A minimum apical (top end) diameter of live cuttings should be 20 mm (AMEC 2012).
- The minimum end length of live cuttings will depend on the end use objectives, but generally cuttings should be at least 80 cm long.
- Be careful to clean pruning materials so as to avoid spread of disease or fungus from one plant to another.

i) Sourcing Native Plant Material

- Where possible, use only local native species (i.e., local genotypes) that have originated in the immediate Natural Subregion for your project area. Plants and seeds of local origin are best adapted to local climatic fluctuations, soil conditions, pollinators, and predator or disease stresses (Alberta Native Plant Council 2007).
- If registered native cultivars or ecovars are used, ensure that the original plant material was collected and developed from the local Natural Subregion, where possible. Registered

native cultivars should be used sparingly since they have limited genetic variation making them less tolerant of climatic or environmental changes.

- The Alberta Native Plant Council maintains a listing of native plant suppliers in Alberta. **Refer to Appendix D** for an excerpt of this listing for native plant suppliers in the High River region.
- For large scale riparian planting projects, contractors should contact native plant suppliers directly for updated native stock availability during the project planning phase. In some, cases up to 2 years advanced notice may be needed for propagation of select native species.
- Determining what type of plant stock (e.g. container plugs, bare root, stem cuttings or seed) you would like to use will influence things such as planting method and what time of year is most appropriate (Table 6).
- Containerized and bareroot stock can be stored for approximately one week before they should be planted and have similar costs. In contrast, cuttings can be stored in a dormant stage for 2-6 months while active stock can only be stored for a week (Table 6). It has been suggested that containerized stock can have a higher survivorship than cuttings in harsh weather conditions, although there is little published data available to compare the different stock types and survivability in similar conditions.

Table 6 Characteristics of Different Stock Types¹²

Stock Type	Height	Stem Diameter	Unit Cost	Possible storage time (under ideal conditions described below)	Planting Window
CONTAINER PLUGS	15–50 cm (6–20")	0.1–0.8 cm (0.05–0.3")	\$1.00–\$5.00	One week	Overwintered stock: mid-May to mid-June Hot-lifted stock: mid-June to end of August
BARE ROOT	20–60 cm (8–24")	0.3–1.3 cm (0.1–0.5")	\$1.00–\$5.00	One week	Mid-May to mid-June
STEM CUTTINGS	0.1–2.5 m (1/2–8')	0.5–10 cm (1/4–4")	\$0.40–\$0.60/m (\$0.20–\$0.30/foot) (calculated as harvesting labour and transport)	Dormant stock: 2–6 months Actively growing stock: 1–3 days	After soil thaws but before leaf bud-out (~mid-April to mid-May). Can also be planted later in the growing season but with reduced success.
SEED	–	–	Vary greatly. Contact local native seed vendor.	1 year to several decades, depending on the species.	Spring or fall

¹² AWES 2017

iii) Live Planting Materials Handling and Storage

- Careful handling and storage of live plant materials is crucial to the success of riparian planting projects. For more details refer to Guideline K, AMEC 2012 (also see BC Ministry of Forests 2000).
- Live cuttings should be handled and transported with care so as not to damage bark. Live cuttings should never be exposed to direct sun and heat. Cuttings should be kept covered at all times during harvest and construction. Wet burlap (not plastic tarps) or silva cool tarps¹³ can be used for covering cuttings.
- Ensure live cuttings are watered as required to prevent desiccation.
- For prolonged indoor storage, live cuttings should be stored at temperatures of at least -2°C. To avoid freezer burn, cuttings should be wrapped in plastic and / or covered with wet burlap and watered regularly (AMEC 2012).
- Cold storage outdoors is only recommended in areas with consistent snow accumulation. Cuttings should be kept covered with at least 60 cm of snow and then covered with silva tarps, allowing for additional snow accumulation on top of the tarp.
- Rooted nursery stock and aquatic species must be kept cool and shaded at all times. Ensure rooted stock is not stored in sealed plastic bags or boxes to avoid over heating. Water as needed to keep seedlings moist and do not expose to direct sunlight.

iv) Planting Considerations

- It is usually recommended that plantings be conducted either in the spring (approximately March – April) or fall (approximately September – October) (DFO n.d.; BC MOE 2008, AMEC 2012). As discussed, this is especially important if using live staking and harvesting materials just before planting. Planting at other times, using bare or containerized seedlings, can be done, but the hotter months increase the risk of desiccation. A commitment to watering (described below) may increase the suitable planting window considerably.
- Live cuttings should be soaked prior to installation for a minimum of approximately 10 days (summer application), 5 days (spring application) or 3 days (fall application) (AMEC 2012). Soaking water should be allowed to become stagnant (i.e. water should be changed daily or water should flow in and out of the storage container continually). Cuttings can be soaked in a large water tight container covered with silva cool tarps or in a stream or

¹³ “Silva cool tarps” are reflective tarps that are designed to avoid heat built-up. They should be used with the reflective white side out and the silver side in. (AMEC 2012)

wetland. Covering cuttings with silva cool tarps is important to prevent sprouting during the soaking period.

- Live cuttings should be installed so that at least 80% of the cutting is below ground to ensure good stem to soil contact (Figure 6).
- To help reduce desiccation and disease, exposed portions of cuttings (top 30 cm) should be painted with a mix of 50% latex primer paint and 50% water prior to installation. This can be done more easily by bundling cuttings and dipping the tip ends into a large pail with the paint mix (AMEC 2012).

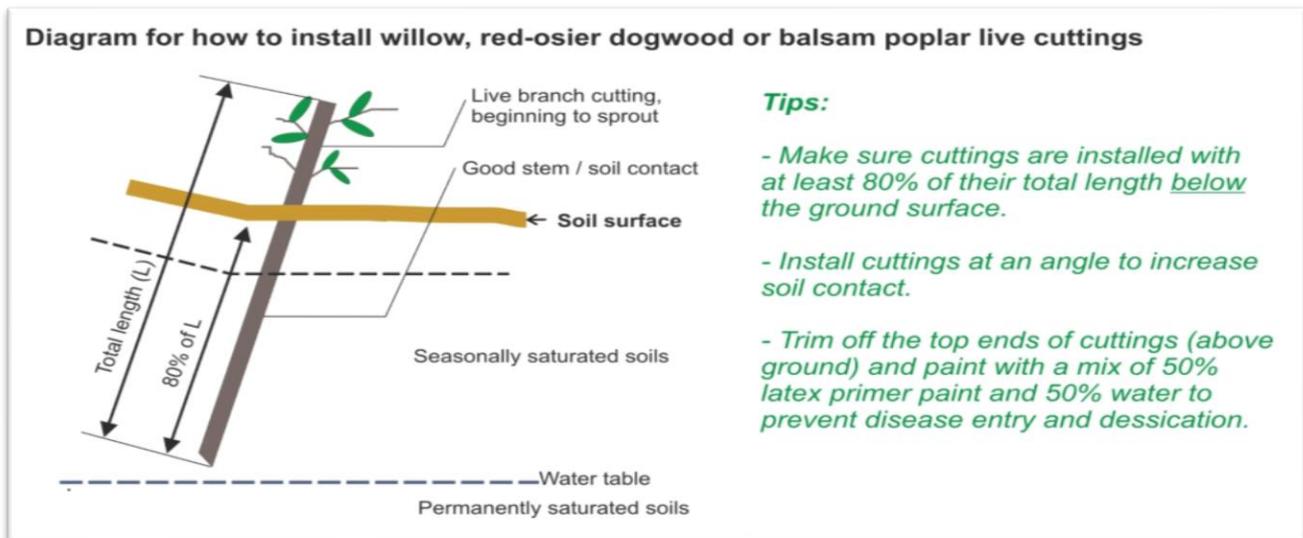


Figure 6 Live Cutting Installation Diagram

- To ensure the greatest success possible, it is important to plant seedlings appropriately. Some common mistakes are shown in Figure 7 (page 56) and include things such as physically damaging seedlings when planting, planting at a shallow depth and allowing seedlings to dry out. Extra care is needed when planting bare root stock since the roots are exposed and can be easily damaged.
- Recommendations for planting densities vary depending on objective and location. In general, it is recommended that seedlings be planted between 1.5 m and 3 m apart although some suggest they can be planted up to 4.5 m apart for larger tree species (DFO n.d.; Fox *et al.* 2005; BC MOE 2008; AWES 2017). For sites where weeds or grass competition are a problem, as is the case in the project area, it is generally recommended that plantings should be in the higher density range (AWES 2017).
- DFO (n.d.) recommends that tree stock be a minimum of 1.5 m in height when planted, however this can be cost prohibitive. Less expensive smaller plugs can be used, to achieve a trade off between lower success but higher possible planting densities.

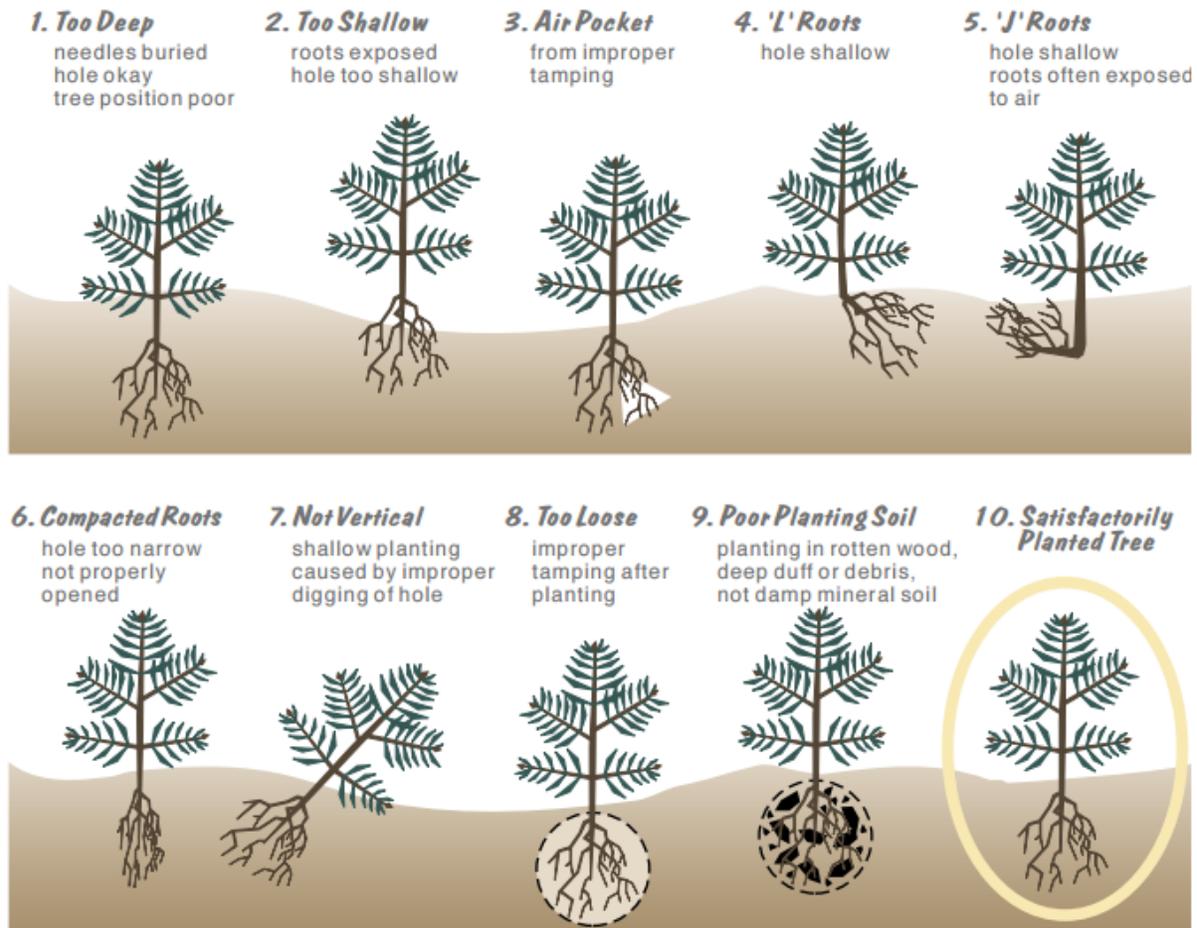


Figure 7 Depiction of Common Planting Errors¹⁴

v) Post Planting Care and Maintenance

- **Provide regular watering**, especially for the first two to three years, to help ensure healthy plant growth and establishment. The roots of the newly planted seedlings take time to become established and therefore may not be able to easily access lower water tables in the first year or two (hence the need for adequately deep planting of stakes, which have no roots).
- Watering frequency is site dependent as different types of soils retain moisture differently. If the soil is dry five to eight centimeters below the ground and no rain is expected then plants should be watered (Fox *et al.* 2005). Watering should be long and slow to promote

¹⁴ Source: Rose and Haase, 2006

deep rooting and ensure greater moisture retention of the soil with less run-off (Dumroese *et al.* 2001; Fox *et al.* 2005; Stromme 2017).

- Where possible, appropriate permits may be obtained from Alberta Environment to set-up a solar or gas-powered watering system to irrigate plants from a nearby water source.
- **Conduct frequent weed monitoring and removal for at least the first three years** (Dumroese *et al.* 2001). This includes managing competition from regulated weed species and also agronomic grasses (e.g. smooth brome, Kentucky bluegrass and quack grass). Dense tall grass growth can outcompete young seedlings and cuttings. Control of weeds is most important in the 0.9 m to 1.2 m radius around each seedling (Fox *et al.* 2005).
- Herbicide application as a weed control option should be cautiously applied so as not to negatively impact target plantings or water resources. As discussed, the use of herbicides in the riparian area is limited as there are only a few types approved for use near water (Government of Alberta 2010, *Environmental Code of Practice for Pesticides - Section 16*). It is important to research herbicides to ensure that they are specific to the types of weeds present and will not harm non-target species. To provide additional protection to seedlings during herbicide application a piece of plastic pipe can be placed around the seedling to cover it (Dumroese *et al.* 2001). Alternatively, a wiping protocol, where each weed is individually touched with a herbicide- dampened sponge, or very carefully individually sprayed (using a hand held wand) can reduce risk to non-target plants.
- Mechanical weed control options such as clipping, hand removal or mowing may be appropriate, but again mechanical control must be applied cautiously so as not to damage new plantings. The timing of mowing should be coordinated with when the roots of the target species have low carbohydrate levels to cause the most damage.
- Where appropriate, physical barriers (e.g. mulching or tree mats) can be used to prevent weeds from sprouting around newly planted seedlings. Mulching is a popular practice because it can be relatively cheap, it helps the soil to retain moisture and it moderates soil temperature in addition to preventing weed growth (Dumroese *et al.* 2001; Fox *et al.* 2005; Bennet and Ahrens 2007; Stromme 2017). Wood chips or leaf litter can be used for mulching purposes. Avoid the use of straw mulch as this may attract small rodents that could feed on new seedlings (Fox *et al.* 2005). If used, mulching should be at least 10 cm to 15 cm deep and cover a 90 cm to 120 cm radius around each plant and should be re-applied as needed (Fox *et al.* 2005; Stromme 2017). A small gap (5-10 cm) should remain between the mulch and the seedling itself to prevent the stem from rotting from increased moisture (Fox *et al.* 2005). Avoid piling up mulch around plant stems, instead apply mulch in a doughnut shape around seedlings.

- Pre-formed pulp tree mats can be used to prevent weed growth around newly planted seedlings however, they are often much costlier than using traditional mulch and only come in specific sizes (Bennet and Ahrens 2007). Pulp mats should be secured (e.g. using field staples) so they are not blown onto seedlings.
- Avoid the use of non-biodegradable landscape fabrics for weed control purposes. Landscape fabric materials can be exposed or dislodged by flooding, resulting in the material washing away and polluting streams and rivers.
- **Take appropriate precautions to prevent against wildlife herbivory** (refer to Section 8.6 for more details).

8.5 Soil Bioengineering Considerations

Soil bioengineering bank stabilization techniques should be used to improve bank stability along impacted portions of bank lacking sufficient root mass protection in land parcel nos. 42, 87, 4, 56 and 46. This includes those portions of bank within the “Active Restoration” Zone as depicted on the management zone maps in Appendix C. A qualified soil bioengineer with experience working in the Calgary region should be contracted to develop soil bioengineering design plans on a site-specific basis. Simple forms of soil bioengineering such as installation of live cuttings and wattle fences (if appropriate) could be done in consultation with experts from the local chapter of Trout Unlimited Canada and with volunteers.

The following document is a key guidelines document for soil bioengineering projects in the Calgary region: **AMEC 2012. *Design Guidelines for Erosion and Flood Control Projects for Streambank and Riparian Stability Restoration***. Available from:

<http://www.calgary.ca/UEP/Water/Pages/Watersheds-and-rivers/Riverbanks-and-Floodplains-in-Calgary.aspx>

The City of Calgary has in recent years completed more than 50 bank bioengineering projects (most of which were built to mitigate impacts from the 2013 flood). A monitoring project was conducted in 2014-2015 by Tannas Conservation Services Ltd. to assess the success of vegetation establishment on bioengineering structures in Calgary (Tannas 2016). To help improve success of riparian planting and soil bioengineering projects, the following recommendations from this study should be taken into consideration (Tannas 2016):

- Ensure project teams have appropriately qualified vegetation specialists with experience in native plant propagation and plant community restoration in a southern Alberta (chinook zone) context.
- Avoid the use of thick turf reinforcement mats that block light penetration to the ground surface, inhibiting plant growth.

- Use 100% biodegradable erosion control matting where possible.
- Appropriate erosion control materials should provide short term erosion control without compromising plant growth. Biodegradable standards must be evaluated from an Alberta climate context and should be monitored. Erosion control matting with plastic webbing should be avoided to prevent harm to snakes or other wildlife.
- Pay careful attention to selecting appropriate plant species best adapted to local site biophysical conditions (aspect, soil type, moisture regime, slope etc.). A diversity of plant species should be used with varying rooting depths and a broad range of environmental tolerances for best long-term results.
- Harvest willow live stakes prior to April 1st for best results for most species. Sandbar willow has been shown to be the most durable and can be harvested up to May 10th. Ensure early harvest (prior to April 1st for beaked willow and pussy willow [*Salix discolor*]). For fall plantings, best results have been achieved by harvesting willows after October 1st (after leaves have fallen).
- Install live non-rooted plant material prior to May 15 for best results. Non-rooted plant material will have high mortality if installed from July 15 to September 15 due to dry summer conditions and not enough time for roots to establish prior to dormancy.
- Use a combination of rooted plant material and live cuttings for better chances of successful vegetation establishment, including the use of live plugs for durable species and the use of larger materials for trees and shrubs. For dry sites, deep installations and rooted plant materials should be incorporated into the site design plan. Sandbar willow has been shown to be among the more resilient dry-site species.
- Preferred native plant species that show high survival rates and suitability to Calgary conditions include: sandbar willow, yellow willow, basket willow (*Salix petiolaris*), red-osier dogwood, silverberry (wolf willow), buckbrush, small-fruited bulrush (*Scirpus microcarpus*) and alkali cord grass (*Spartina gracilis*). Sandbar willow in particular shows good planting success, resiliency and durability in Calgary and can tolerate being submerged in water for longer periods than other willows in addition to being more tolerant of a later harvest and installation date.
- Ensure a routine watering and site monitoring and maintenance plan is put into effect. Beaver use should be closely monitored and appropriate mitigation measures implemented when necessary. Irrigation is especially critical for dry sites (e.g. steep slopes with well drained soils or a south-facing aspect).
- Choose the appropriate bioengineering technique based on site-specific conditions. The likelihood of success of the technique used will depend on meeting the plant selection, handling, harvesting and installation and maintenance/watering guidelines described

above. The following techniques have shown to be successful when these conditions were met: brush layers, fascines and vegetated gabions. The success of log crib walls has been variable and requires further long-term study. The use of wattle fences has limited suitability except for moist, north-facing sites where there is adequate irrigation and shading due to tendency for desiccation of exposed willow surfaces. The use of live pole staking has failed where short stakes (<0.7 m) have been used or installation was done late in the summer. Live pole staking has been successful with specific species (i.e. sandbar willow), where longer stakes (>0.7 m) have been used, and where there is irrigation or sub-irrigated ground.

As part of a long-term Riparian Monitoring Program, a consultant team led by Kerr Wood Leidal Associates Ltd. (KWL) will be conducting a more comprehensive effectiveness evaluation of bioengineering and riparian planting projects in Calgary. Findings from this monitoring project will add to knowledge about locally suitable bioengineering and planting techniques and design considerations within Calgary and surrounding jurisdictions. The Foothills Land Trust is encouraged to contact the City of Calgary Water Resources for more information.

8.6 Preventing wildlife herbivory of new plantings

Herbivory from beavers, deer, voles and other rodents or wildlife species can be detrimental to the success of bioengineering and riparian planting projects. Herbivory is more likely to be an issue in areas with minimal understory tree or shrub cover in close proximity. This includes tree planting projects into smooth brome pastures or into areas with Balsam Poplar / Herbaceous Community Types. Vole and hare herbivory is usually a concern during the winter months when food sources are scarce. Although often underestimated, voles and hares can cause significant mortality by girdling seedlings (i.e. scraping away a ring of bark around the base of seedlings) (AWES 2017). Appropriate prevention or deterrent techniques should be considered to exclude or deter wildlife herbivory in the short term (i.e. for at least the first 2 to 3 growing seasons). This could include habitat modification, repellent or exclusion techniques:

- Habitat modification could include things such as mowing of thick grass cover around trees to prevent voles from living in the tall grass and eating roots of the young seedlings (Wise 2017).
- There are several animal repellents commercially available to deter animal browse of young seedlings. Repellents generally work well when there are low levels of browse but often do not completely stop use and are dependent on location and species (Dumroese et al. 2001; Fox et al. 2005; Bennet and Ahrens 2007). It is recommended that repellents be applied every two weeks in the spring and early summer to protect against lighter levels of use (Bennet and Ahrens 2007).

- Natural beaver repellents include the use of scent markers (castoreum) or natural repellents such as predator urine, cayenne pepper, hot sauce or other animal hair (Fitch 2016). Scent markers can have come seasonal effectiveness when young beaver are migrating and looking to establish new territories. The aforementioned natural repellents, however, tend to have limited effectiveness and easily wash off, requiring frequent re-application. Chemical beaver repellents are also available, but these are mostly toxic and are not recommended for use near water.
- For deterring vole use, soil bioengineering practitioners in Calgary have had some success with the use of “milorganite” fertilizer (<http://www.milorganite.com>) sprinkled around the base of new cuttings or seedlings¹⁵. “Milorganite” is comprised of heat-dried microbes that have digested the organic matter (biosolids) in human wastewater.
- Another repellent option which is gaining some experience in Alberta, is using latex paint and sand, mixed¹⁶, and applying to the above ground portion of live stakes or to the base of planted trees. This is used to reduce desiccation as well as deter browsing (including beavers). This is a relatively new technique, but in the short term, seems to hold some potential for increasing survivability.
- Exclusion techniques include fencing, tree wrapping or the use of vinyl/plastic tree tubes that can be used to prevent against herbivory. Often a combination of these techniques may be appropriate, if there are multiple wildlife species in the area.
- For preventing beaver herbivory using tree wrapping, the City of Calgary Parks department has had most success with the use of 14 gauge galvanized steel wire with a 5 cm (2 inch) mesh size installed to a minimum height of 90 cm (3 feet) around the base of trees or shrubs¹⁷. Generally, 12-16 gauge wire, with a 2.5 cm (1 inch) mesh size wrapped around trees and shrubs to a minimum height of 1.2 m (4 feet) is considered effective at preventing beaver herbivory (Fitch 2016).
- In some situations, larger exclusion fences can be considered for protecting planting projects using appropriate deer-proof fencing. The need for deer proof / wildlife fencing should be determined based on monitoring of browse utilization and damage to new plantings.

8.7 Fencing and Signage

In busy urban parks, fencing and signage for at least the first 3 years is usually important for preventing trampling of the site by recreational users and/or dogs. The need for fencing and signage of soil bioengineering and riparian planting projects in the Spitzee Riparian Area should be evaluated on a site-specific basis. Restoration projects close to designated access trails likely

¹⁵ Pierre Raymond, Terra Erosion Control, Bioengineering Specialist, personal communication (October 2017)

¹⁶ A mix of 6 cups of coarse sand mixed into a gallon of latex paint is recommended as a beaver repellent (Fitch 2016).

¹⁷ Tanya Hope, City of Calgary Parks, Urban Beaver Specialist, email communication (May 2017).

should include a fencing and signage component. Interpretative signage should be done for all publicly visible / accessible restoration projects as an education strategy and to help garner improved stewardship of restoration sites.

8.8 Monitoring and Record Keeping

A key component for ensuring the success of riparian restoration and soil bioengineering projects is to conduct frequent post-implementation monitoring. Frequent monitoring will help to identify the need for adaptive management techniques to help with improving project success. For example, monitoring can help track adequacy of watering, weed control and wildlife herbivory interventions. To assist with monitoring survival of new plantings, all new plantings can be temporarily marked with pin flags, flagging tape, paint or metal pegs. Where possible, all dead cuttings / plantings that do not survive after the first growing season should be replaced. Planting success should be monitored for at least the first three growing seasons.

In the long-term, restoration sites should be assessed for success according to the goals, objectives and original intent of the restoration project. Examples of restoration success indicators and monitoring questions that can be assessed using the Cows and Fish riparian health inventory protocol are described in Table 7, below.

Table 7 Monitoring Indicators for Assessing the Success of Riparian Restoration Projects

Restoration Success Indicator	Monitoring Question	Riparian Health Inventory Parameter
Overall riparian health	Did the restoration practice improve the overall health and function of the riparian area?	Riparian health inventory overall rating
Invasive and disturbance-caused plant abundance and distribution	Did the restoration practice reduce the abundance of invasive species and non-native disturbance-caused species in the riparian community?	Canopy cover and distribution of invasive species and disturbance-caused species targeted for control
Restoration of human-caused alterations (e.g. non-designated trails)	Did the restoration practice decrease human-caused bare ground and reduce soil compaction in the floodplain?	Percentage of human-caused bare ground and percentage of bank and floodplain alterations resulting from soil compaction
Native riparian vegetation cover	Did the restoration practice improve riparian habitat structure and increase the cover of native riparian vegetation?	Overall canopy cover of native vegetation and canopy cover by life form (e.g. trees / shrubs / graminoids / forbs) and height class
Streambank root mass protection	Did the restoration practice increase cover of deeply rooted woody plants along the streambank?	Percent of the streambank with deep-rooted native trees and shrubs
Streambank stability	Did the restoration practice decrease the length of unstable streambank?	Percent unstable streambank

Keeping a comprehensive record of restoration activities applied on a site will assist with interpreting long-term monitoring results. For example records should be kept to document:

- timeline of restoration activities;
- age, source (geographic origin / greenhouse supplier) and species used for restoration plantings;
- survival rates of plantings (as determined by survival counts following one growth season);
- lessons learned and natural or human-caused factors affecting survival of plantings; and
- watering and maintenance requirements (e.g. frequency and quantity of water needed to maintain plantings).

Written monitoring records of a restoration site should be accompanied by photographic records as well to document pre-and post- restoration conditions. Restoration sites should be photographed for at least 3 to 5 years to document its progress. All photographs should be georeferenced and include a compass bearing to enable re-takes of monitoring photographs. Monitoring photographs should be re-taken at approximately the same time of year for at least the first five years. Changes are likely to be most apparent during the first five years of the restoration program. Once the site has stabilized, visible changes may be less apparent and monitoring may only need to be done on a biannual basis or once every three years thereafter, if desired. Although photographs do not provide quantitative data, time series photographs do provide an excellent visual tool to assess restoration success. Where possible, monitoring photographs should contain a skyline or permanent landscape feature (e.g. buildings, telephone poles, bridges, rock outcrops, valley slope etc.) in the background of the photograph for easy relocation.

9 Education and Ecotourism Considerations

Contingent on securing available funds, a “Spitzee Riparian Area Nature Center” could be built utilizing the existing house footprint in land parcel no. 31 or no. 65. These houses were built with foundations above the 1:100 year floodplain mark and were not damaged by the 2013 flood. Another benefit of constructing a Nature Center at this location is that it is easily accessible from 530 Ave E / 12 Ave southwest, the first point of entry into the project area from High River. The interpretative center could function as a hub for education and stewardship activities and could be tied into other ecotourism initiatives in the High River area. An interpretive trail network could be established in the vicinity of the Nature Center (refer to Appendix C, map 3). The center could also be used to showcase low-impact building designs such as incorporation of a green roof (similar to the Helen Schuler Nature Center in Lethbridge); a native plant rain garden; and a native plant pollinator / xeriscaping garden. It is recommended that the Foothills Land Trust work in

collaboration with the Town of High River, the MD of Foothills and other project partners to further investigate opportunities and potential funding sources for this type of initiative.

10 Long-term Stewardship and Community Engagement Considerations

The role of the Spitzee Riparian Area Project Coordinator (under the employment of the Foothills Land Trust) will be to work with local community groups and volunteers on riparian stewardship and monitoring activities. Involving local community members with these types of initiatives will help foster a sense of ownership and long-term responsibility and appreciation for the area. The Spitzee Riparian Stewardship Society has been created to facilitate this work.



Volunteers involved with a Fish Creek restoration project in Calgary led by the Friends of Fish Creek Provincial Park Society

Potential opportunities for involvement of community volunteers include:

- An expert led soil bioengineering hands-on workshop to build capacity for conducting simple streambank restoration works.
- Annual or bi-annual weed pull and clean-up days.
- Salvage of ornamental trees, shrubs and perennial flowering plants (near former houses) for resale and relocation outside of the project area.
- Guided interpretive wildlife / nature walks through the project area.
- Establishment of permanent photograph monitoring stations and a supporting web-based platform for volunteers to upload monitoring photographs.
- Volunteer involvement with riparian planting projects, including input from community members into the design, implementation and monitoring of these projects.
- Volunteer involvement with monitoring recreational use of the project area. This could include assistance with upkeep and maintenance of hiker self-registration booths with educational information about the project area. It could also entail documenting illegal

access / garbage dumping concerns and installation and maintenance of no-trespassing signage / fencing.

- Volunteer involvement with conducting annual spring breeding bird surveys and Christmas bird counts in the project area.
- Volunteer involvement with other citizen science environmental monitoring projects with assistance and direction from the Miistakis Institute (<http://www.rockies.ca/>).
- Volunteer involvement with re-taking baseline riparian health monitoring photos of interest.

Trout Unlimited Canada and Cows and Fish can be contacted to provide assistance with future riparian education and awareness activities.

To help fund larger scale riparian tree planting projects, the FLT should investigate collaborative partnership opportunities with municipal and/or corporate sponsors or with organizations such as the Carbon Farmer (<https://thecarbonfarmer.ca/>) and Bow Valley Habitat Development (<http://streamtender.com/>). The AgroForestry & Woodlot Extension Society may also be able to provide assistance with riparian planting projects.

11 Riparian Health Monitoring Recommendations

It is recommended that baseline riparian health inventories and assessments be repeated after approximately 5 years. This will help to assess progress made to restore key riparian health indicators in response to ongoing restoration and reclamation activities in the project area. As discussed in Table 2 (page 11), future riparian health monitoring of the HIG26 large RHI polygon should assess the eastern land parcel nos. 63, 26, 23, 7 and 20 as a separate polygon unit. These more heavily disturbed land parcels are not representative of otherwise *Healthy* conditions within this polygon and should be managed and monitored separately.

Volunteers can be trained to assist with collection of riparian health information using the *Riparian Health Assessment for Streams and Small Rivers* field workbook available from Cows and Fish (www.cowsandfish.org). Cows and Fish can be contacted to provide riparian health assessment training workshops to community group volunteers.

A geo-referenced photograph catalogue of all baseline photographs that were taken as part of the 2017 riparian health evaluation of the project area will be kept on file with the Foothills Land Trust and by Cows and Fish. Baseline photographs of features of interest should be monitored periodically by the Spitzee Riparian Area Project Coordinator (with assistance from volunteers as needed). Monitoring photograph locations are shown on the maps contained in Appendix B.

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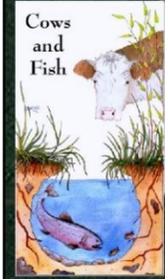
Appendix A

RHI Polygon and GIS Land Parcel ID Legal Land Location Descriptions

RHI Polygon No	GIS Land Parcel ID No	Legal Land Location	Plan, Block, Lot Nos	Land Use	Area (Acres)	Area (Ha)	Area (sq m)
HIG28 (encompasses both HIG25 and HIG27)	42	NE 32-18-29 W4	Plan 9111129 Blk 1 Lot 6	Cntry Residential	4.80	1.94	19407.71
	87	NE 32-18-29 W4	Plan 9111129 Blk 1 Lot 5	Cntry Residential	4.68	1.89	18933.36
	19	NE 32-18-29 W4	Plan 9111129 Blk 1 Lot 3	Cntry Residential	4.57	1.85	18474.30
	4	NE 32-18-29 W4	Plan 9111129 Blk 1 Lot 2	Cntry Residential	4.54	1.84	18353.34
	56	NE 32-18-29 W4	Plan 9111129 Blk 1 Lot 1	Cntry Residential	4.51	1.82	18238.42
	46	N 33-18-29 W4	Plan 8810271 Blk 1	Cntry Residential	3.50	1.42	14182.72
Total HIG28 Area					26.60	10.76	107589.85
HIG26	59	N 33-18-29 W4	Plan 8810271 Blk 1	Cntry Residential	11.95	4.84	48365.44
	84	NE 33-18-29 W4	Plan 9310684 Lot 1	Cntry Residential	5.92	2.40	23976.88
	25	NE 33-18-29 W4	Plan 9611394 Lot 5	Cntry Residential	6.18	2.50	24996.05
	43	NE 33-18-29 W4	Plan 9310684 Lot 3	Cntry Residential	5.21	2.11	21099.33
	10	NE 33-18-29 W4	Plan 9310684 Lot 2	Cntry Residential	5.35	2.16	21648.38
	27	NE 33-18-29 W4	Plan 8810271 Blk 3	Cntry Residential	11.93	4.83	48281.00
	63	NE 33-18-29 W4	Plan 8911187 Blk 5 Lot 1	Cntry Residential	4.42	1.79	17889.25
	26	NE 33-18-29 W4	Plan 8911187 Blk 5 Lot 2	Cntry Residential	4.46	1.81	18068.12
	23	NE 33-18-29 W4	Plan 8911187 Blk 5 Lot 3	Cntry Residential	4.45	1.80	17992.19
	7	NE 33-18-29 W4	Plan 9510093 Blk B Lot 1	Cntry Residential	4.87	1.97	19701.62
	20	NE 33-18-29 W4	Plan 9510093 Blk B Lot 2	Cntry Residential	4.87	1.97	19698.52
Total HIG26 Area					69.61	28.17	281716.79
HIG29	65	NW 34-18-29 W4	Plan 0010661 Lot 4	Cntry Residential	5.00	2.02	20236.27
	31	NW 34-18-29 W4	Plan 0010661 Lot 5	Cntry Residential	4.27	1.73	17284.71
	5	NW 34-18-29 W4	Plan 9011995 Lot 3	Cntry Residential	4.94	2.00	19985.29
Total HIG29Area					14.21	5.75	57506.26
HIG30	72	NW 34-18-29 W4	Plan 9111647 Lot 1	Cntry Residential	9.04	3.66	36575.83
HIG31	21	NE 33-18-29 W4	Plan 9011674 Blk 7 Lot 3	Cntry Residential	3.59	1.45	14530.05
HIG32	78	S 33-18-29 W4	Plan 9112235 Lot 9	Cntry Residential	2.84	1.15	11483.20
HIG33	47	SW 33-18-29 W4	Plan 0610168 Blk 1 Lot 1	Cntry Residential	5.00	2.03	20252.94
TOTAL PROJECT AREA					130.89	52.97	529654.93

Appendix B
RHI Polygon, Monitoring Photograph and Weed Location Maps

i) RHI Polygon no.HIG25 (includes GIS land parcel nos. 4, 19, 42, 46, 56, 87 – mainland portion)



2017 Highwood River, Foothills Land Trust Project Area
Riparian Health Inventory (RHI) Polygon No: HIG25
RHI Management Features and Monitoring Photo Locations

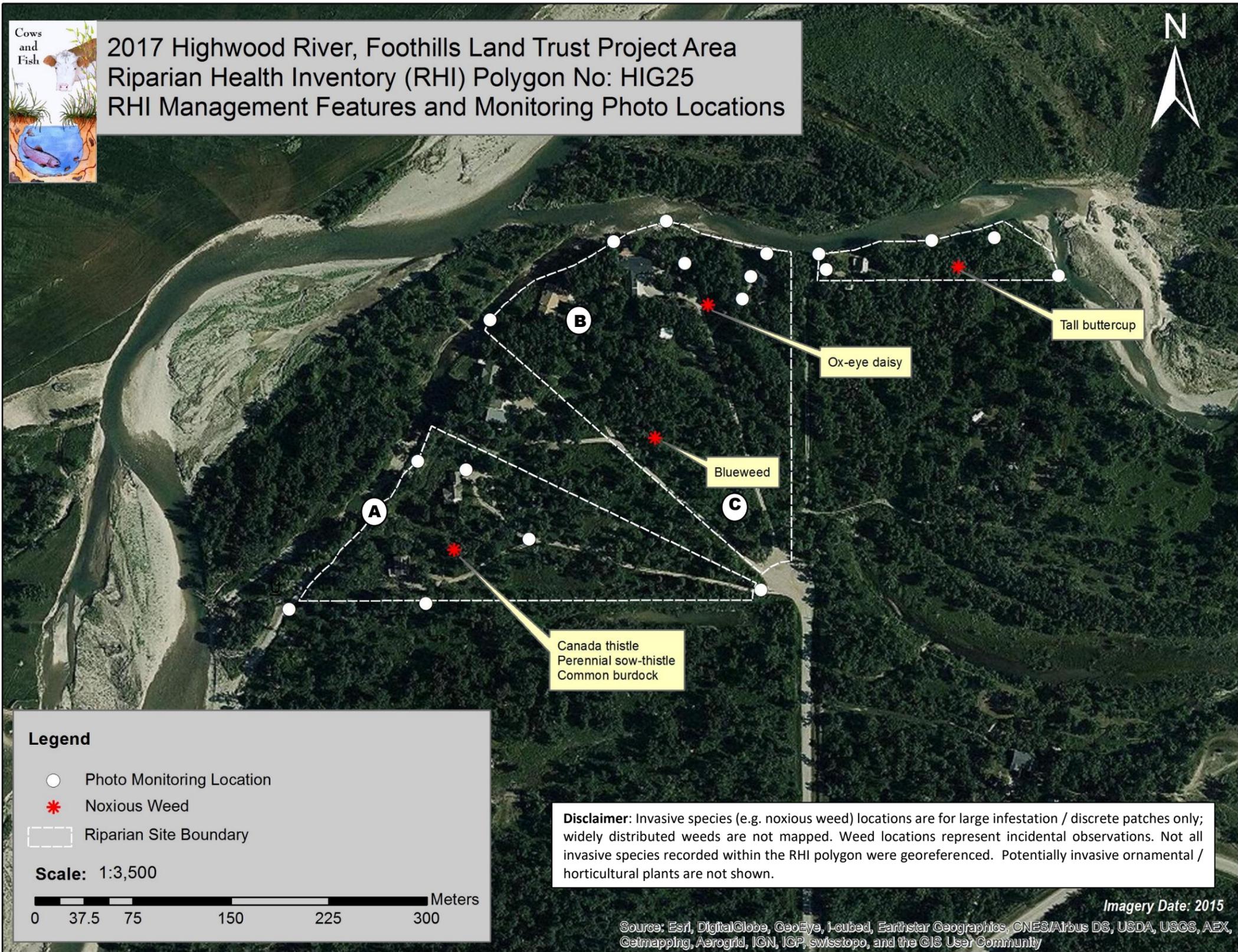


Photo A: Recent berm removal and reclamation area in land parcel no.42. This is a priority candidate for soil decompaction, soil bioengineering to improve bank stability, and riparian planting. (Photo Catalogue No. RHIP25HIG013)



Photo B: Recently reclaimed house and driveway in land parcel no.19 with high cover from annual weeds (stinkweed and tall hedge mustard). (Photo Catalogue No. RHIP25HIG030)



Photo C (approximate location): Healthy riparian habitat with a diversity of native shrub species and structural layers and an overhead canopy of balsam poplar. (Photo Catalogue No. RHIP25HIG047)

ii) RHI Polygon no.HIG27 (includes GIS land parcel nos. 4, 19, 42, 46, 56, 87 – island portion)



2017 Highwood River, Foothills Land Trust Project Area
Riparian Health Assessment (RHA) Polygon No: HIG27
RHA Management Features and Monitoring Photo Locations

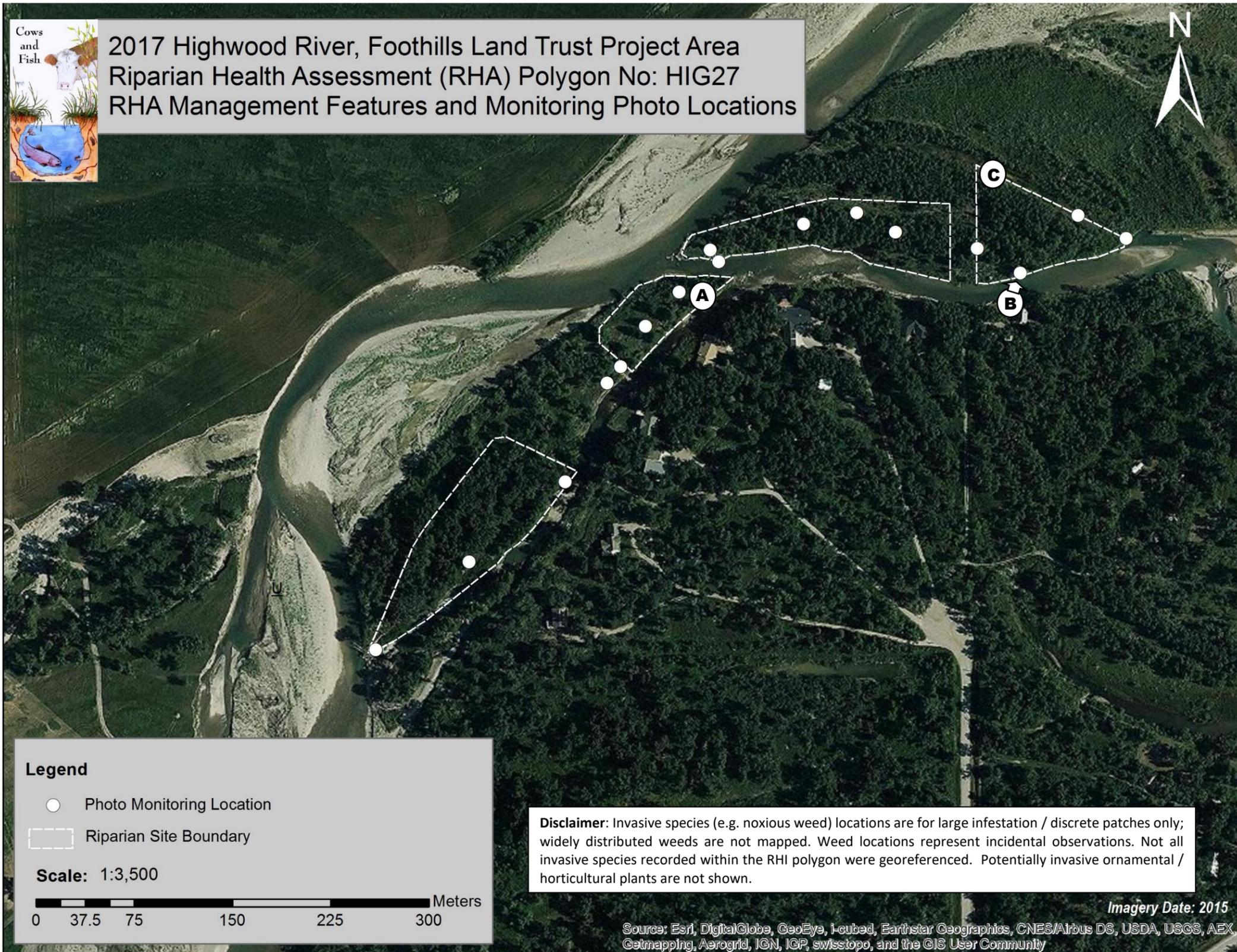


Photo A: High cover from willows and balsam poplars provides overhead cover for fish and wildlife and excellent bank stabilization functions. (Photo Catalogue No. RHIP27HIG025)

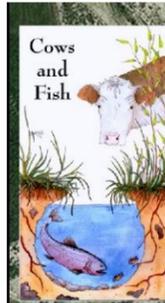


Photo B: View from the opposite shore in land parcel no.46 to a beaver lodge and a remnant small wood shed on the island. (Photo Catalogue No. RHIP27HIG029)



Photo C: Lentic riparian habitat within the back edge of the island (excellent potential amphibian habitat) with diverse native plants including a back edge of regenerating willows and balsam poplars. (Photo Catalogue No. RHIP27HIG034)

iii) RHI Polygon no.HIG26 (includes GIS land parcel nos. 7, 10, 20, 23, 25, 26, 27, 43, 59, 63, 84)



2017 Highwood River, Foothills Land Trust Project Area
Riparian Health Inventory (RHI) Polygon No: HIG26
RHI Management Features and Monitoring Photo Locations

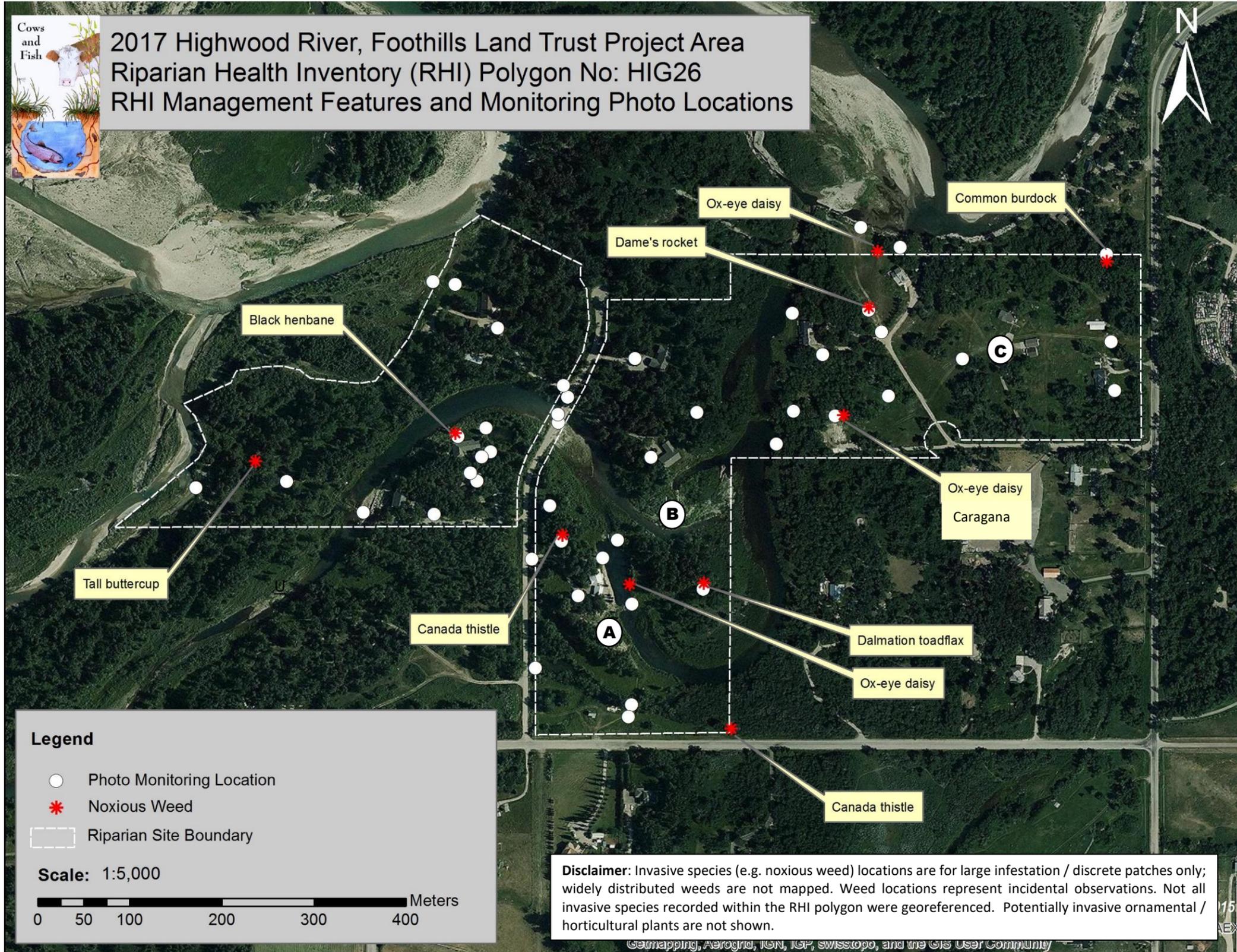


Photo A: Localized bare ground and soil compaction from concentrated active horse use within the south end of land parcel no.27. (Photo Catalogue No. RHIP26HIG006)

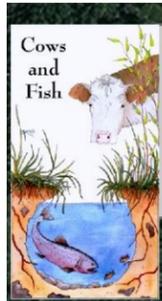


Photo B: A recent alluvial bar with regenerating balsam poplar seedlings. (Photo Catalogue No. RHIP26HIG023)



Photo C: A recently reclaimed driveway in land parcel no.7 with partial grass establishment and annual weeds. Disturbed adjacent balsam poplar / herbaceous habitat dominated by smooth brome. (Photo Catalogue No. RHIP26HIG064)

iv) RHI Polygon no.HIG29 (includes GIS land parcel nos. 5, 31, 65)



2017 Highwood River, Foothills Land Trust Project Area
Riparian Health Inventory (RHI) Polygon No: HIG29
RHI Management Features and Monitoring Photo Locations

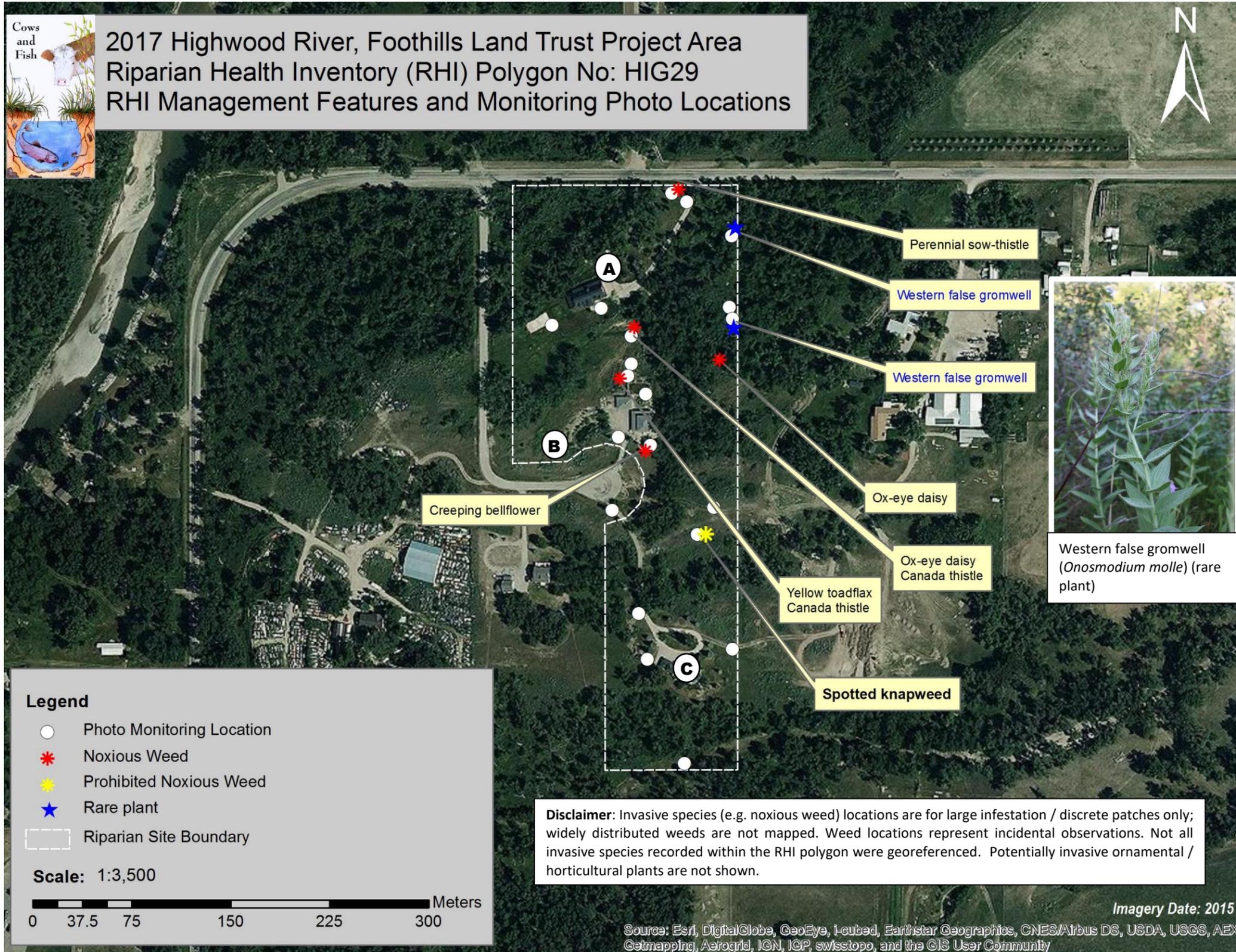


Photo A: Potential location of a future Nature Center using the footing of an existing building (built above the 2013 flood level). (Photo Catalogue No. RHIP29HIG011)



Photo B: A man-made naturalized wetland feature west of the house in land parcel no.5, a potentially important wildlife habitat feature. (Photo Catalogue No. RHIP29HIG029)



Photo C: The reclaimed house footprint in land parcel no.5 has good vegetation establishment from seeded grasses but also high cover from annual weeds. (Photo Catalogue No. RHIP29HIG039)

v) RHI Polygon no.HIG30 (includes GIS land parcel no. 72)

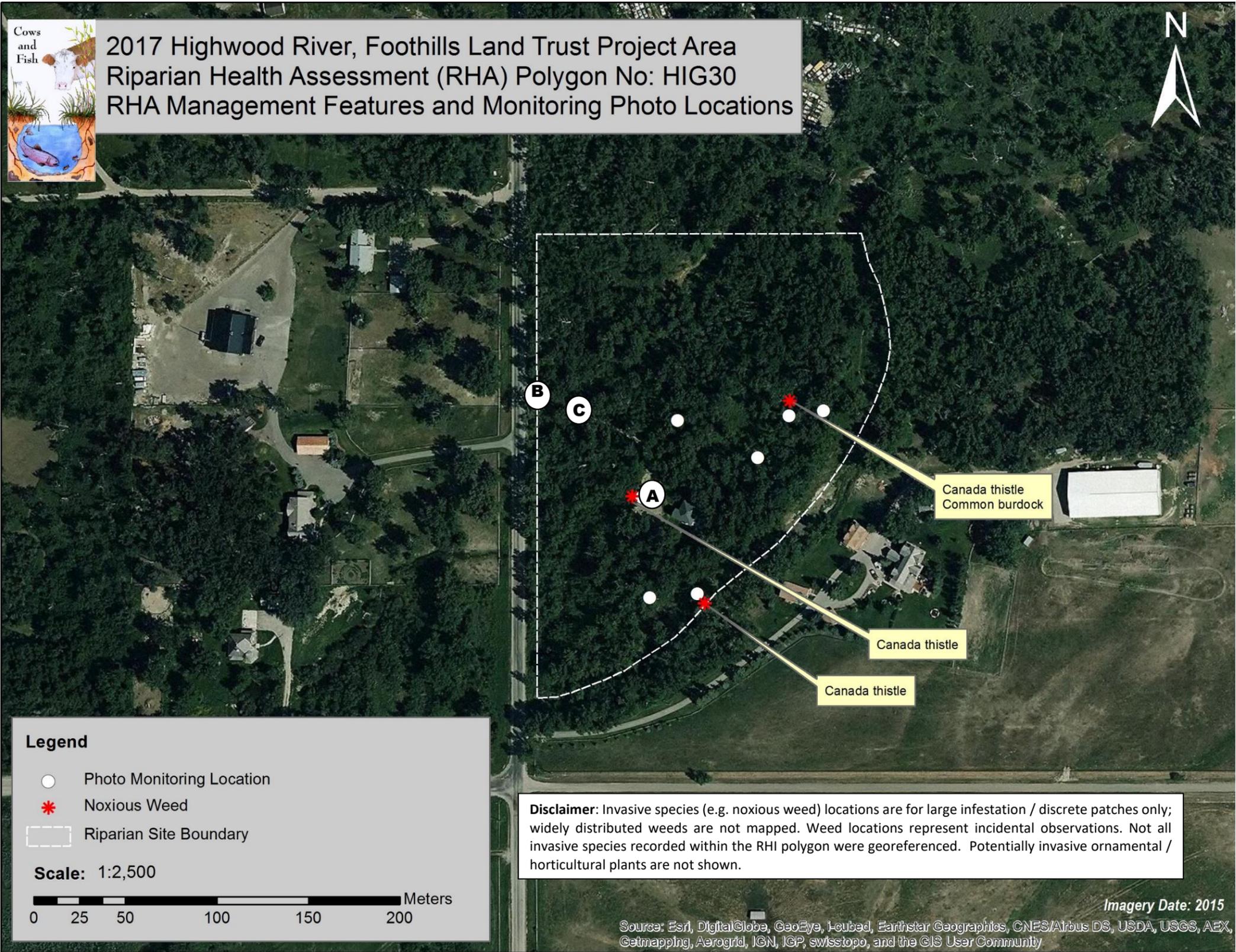


Photo A: The reclaimed house footprint in land parcel no.72 has good vegetation establishment from seeded grasses but also high cover from annual weeds. Some native shrubs are colonizing this disturbed area. (Photo Catalogue No. RHIP30HIG004)

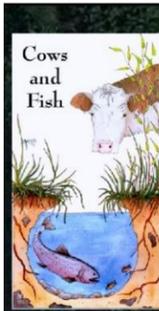


Photo B: The reclaimed house driveway into parcel no.72 with good cover from seeded grasses. (Photo Catalogue No. RHIP30HIG001)



Photo C: A well vegetated tributary drainage channel with high floristic and structural diversity from native shrubs. (Photo Catalogue No. RHIP30HIG002)

vi) RHI Polygon no.HIG31 (includes GIS land parcel no. 21)



2017 Highwood River, Foothills Land Trust Project Area
Riparian Health Assessment (RHA) Polygon No: HIG31
RHA Management Features and Monitoring Photo Locations

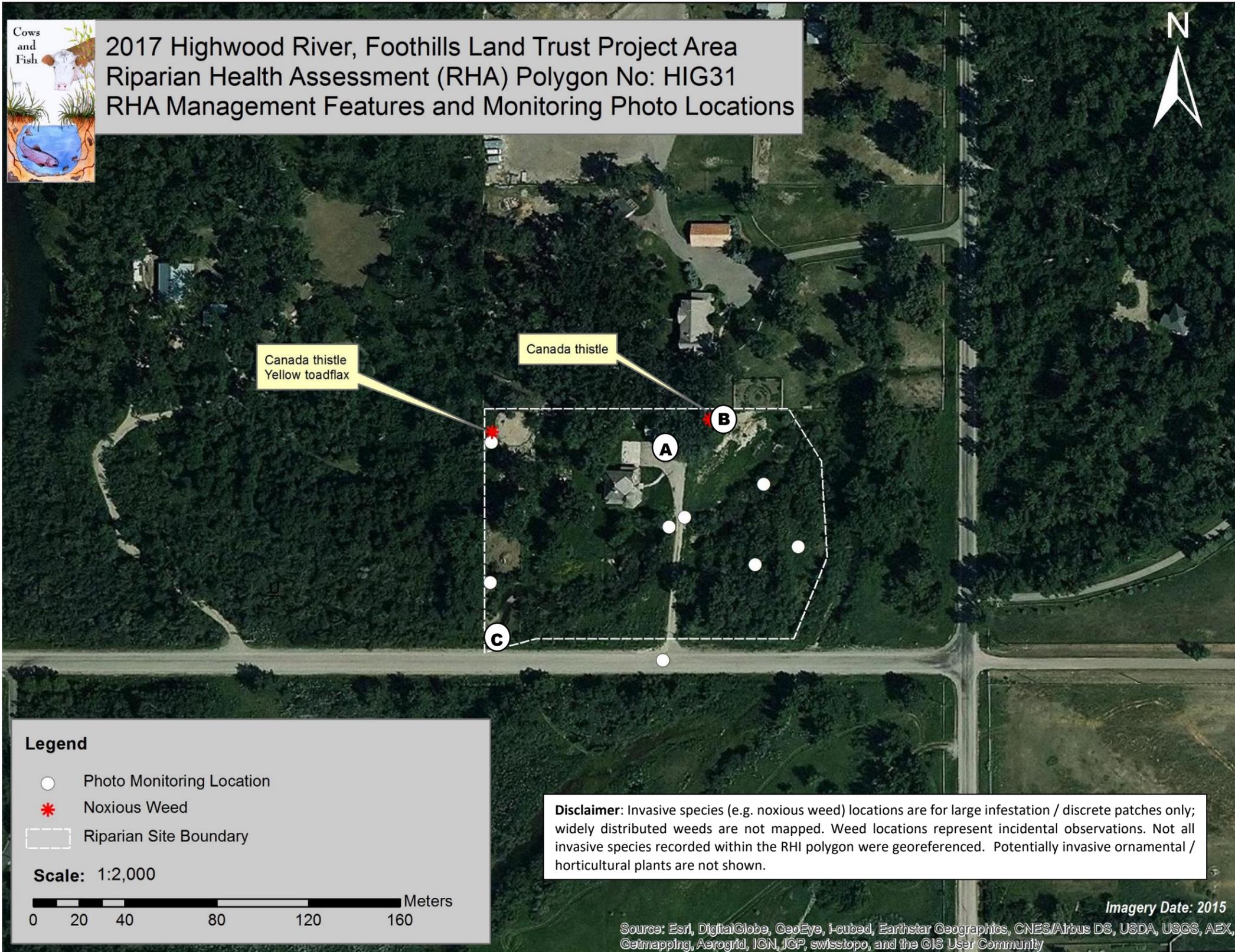


Photo A: Horse use impacts (bare ground, trampling soil compaction and absence of understory shrubs) in the NW corner of land parcel no.21. (Photo Catalogue No. RHIP31HIG008)



Photo B: A large spoil pile infested with Canada thistle and other weeds in the NE corner of land parcel no.21. (Photo Catalogue No. RHIP31HIG013)



Photo C: Bare ground and soil compaction at a horse watering access point along Baker Creek. (Photo Catalogue No. RHIP31HIG015)

vii) RHI Polygon no.HIG32 (includes GIS land parcel no. 78)



2017 Highwood River, Foothills Land Trust Project Area
Riparian Health Assessment (RHA) Polygon No: HIG32
RHA Management Features and Monitoring Photo Locations

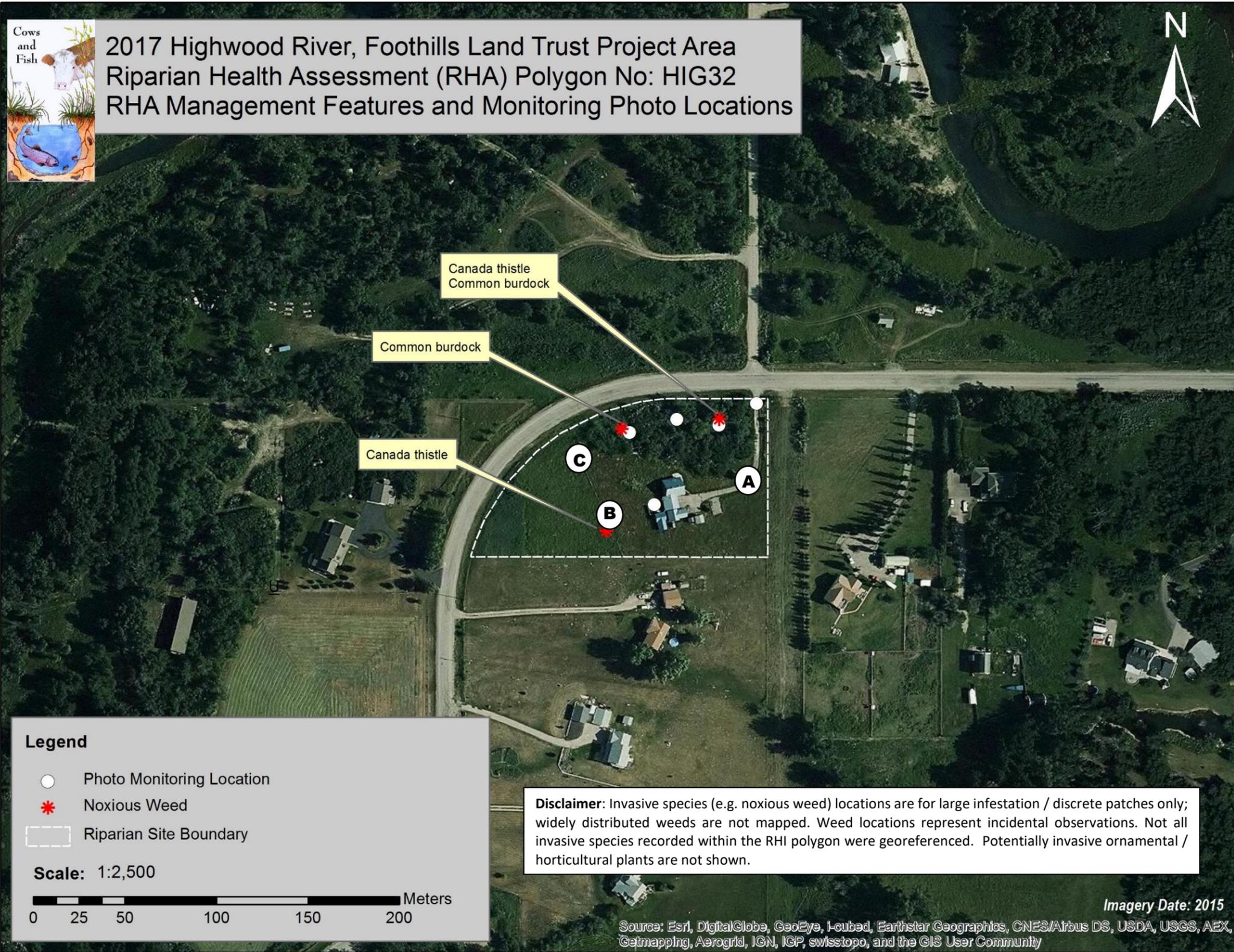


Photo A: Reclaimed driveway and house footprint in land parcel no.78, with good cover from seeded grasses but also annual forbs. (Photo Catalogue No. RHIP32HIG004)



Photo B: Canada thistle infestation within the brome meadow in the south half of the site. (Photo Catalogue No. RHIP32HIG007)



Photo C: Tall choke cherry native shrubland along the north portion of the site, with some shrub colonization into the adjacent brome meadow. (Photo Catalogue No. RHIP32HIG008)

viii) RHI Polygon no.HIG33 (includes GIS land parcel no. 47)



2017 Highwood River, Foothills Land Trust Project Area
Riparian Health Assessment (RHA) Polygon No: HIG33
RHA Management Features and Monitoring Photo Locations

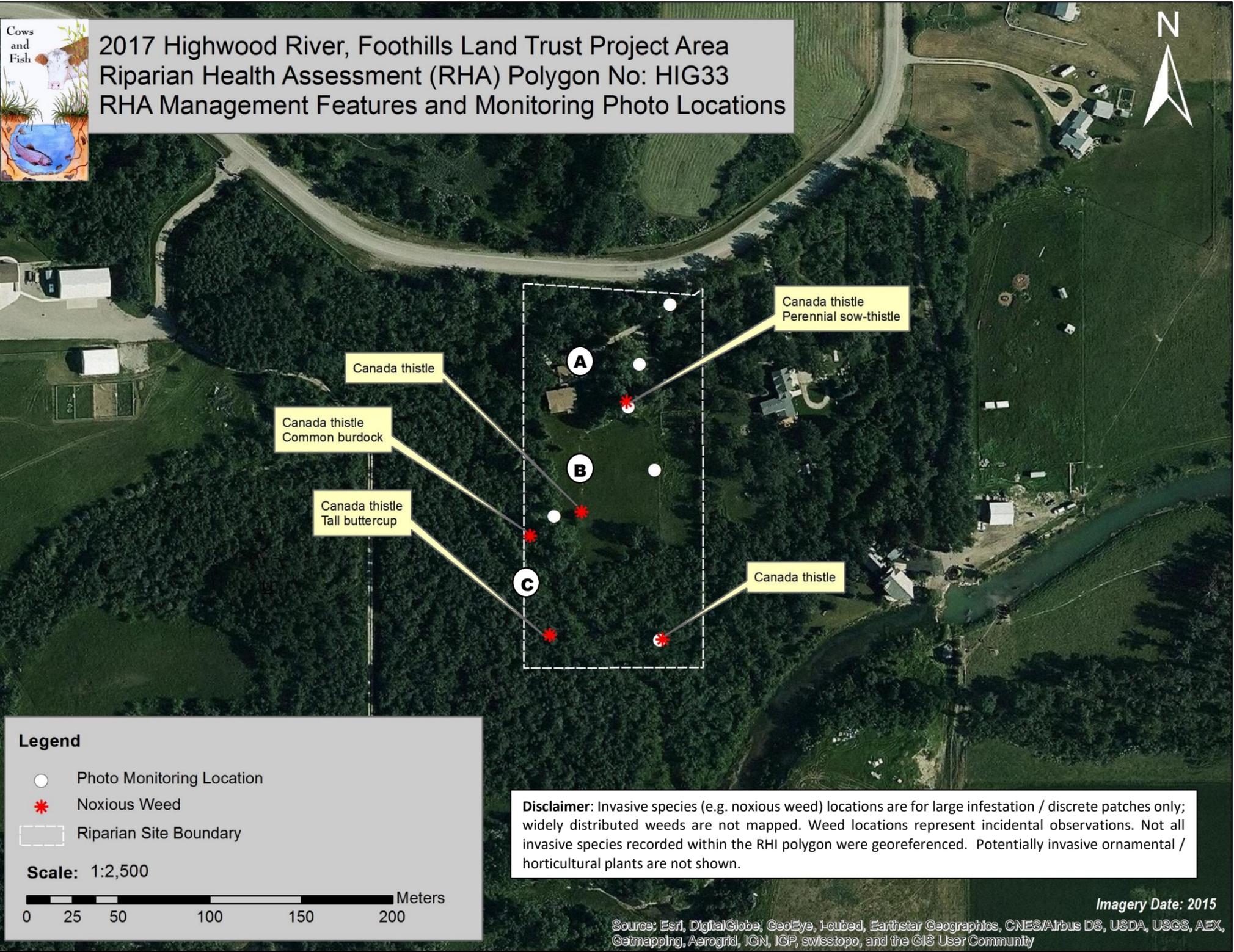


Photo A: Partially reclaimed driveway with some compacted, unvegetated bare ground portions requiring additional restorative works. (Photo Catalogue No. RHIP33HIG006)



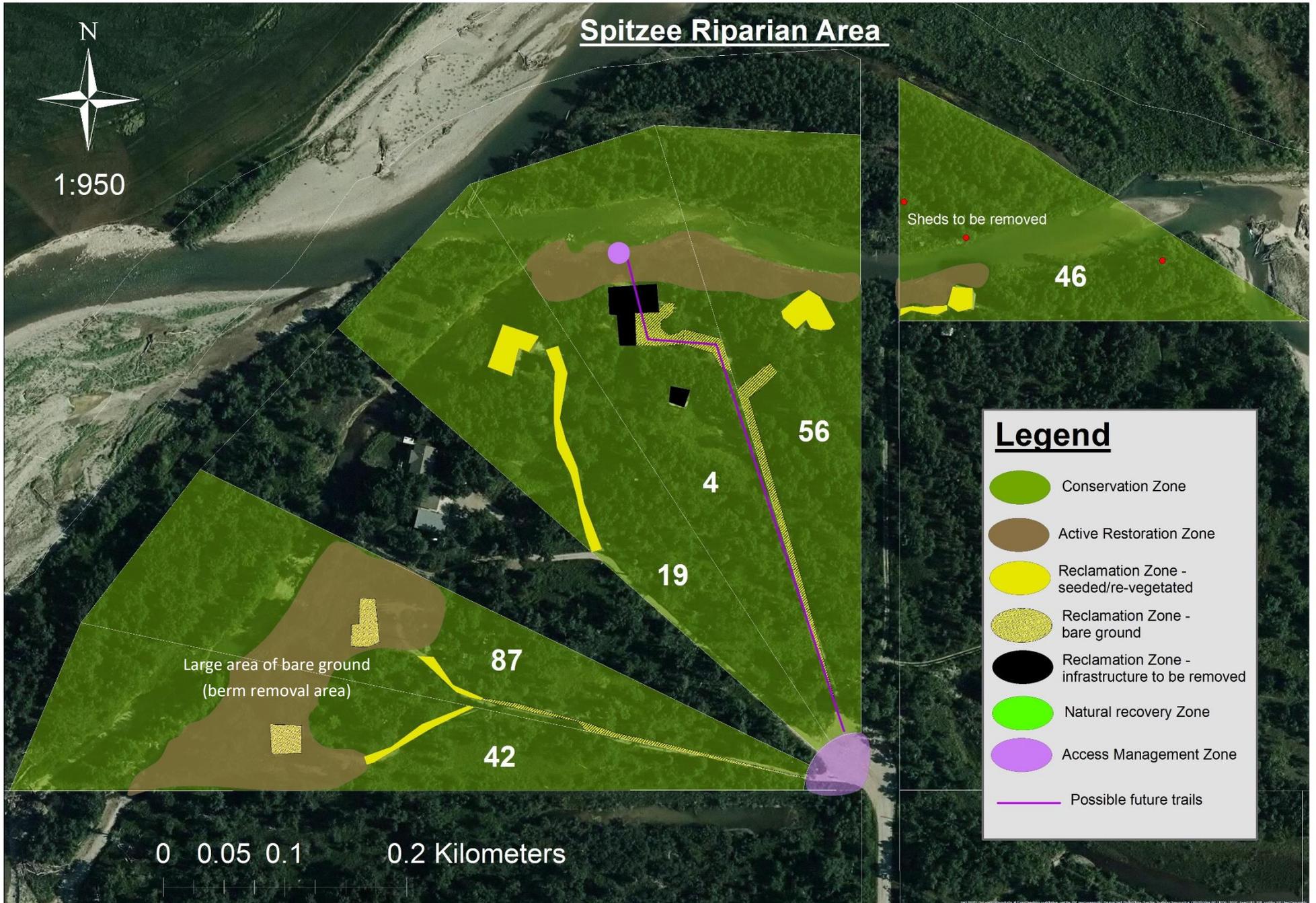
Photo B: A modified tame pasture / former hayland south of the former house. This area may have natural recovery potential as it is surrounded by native balsam poplar/shrubland communities. (Photo Catalogue No. RHIP33HIG010)



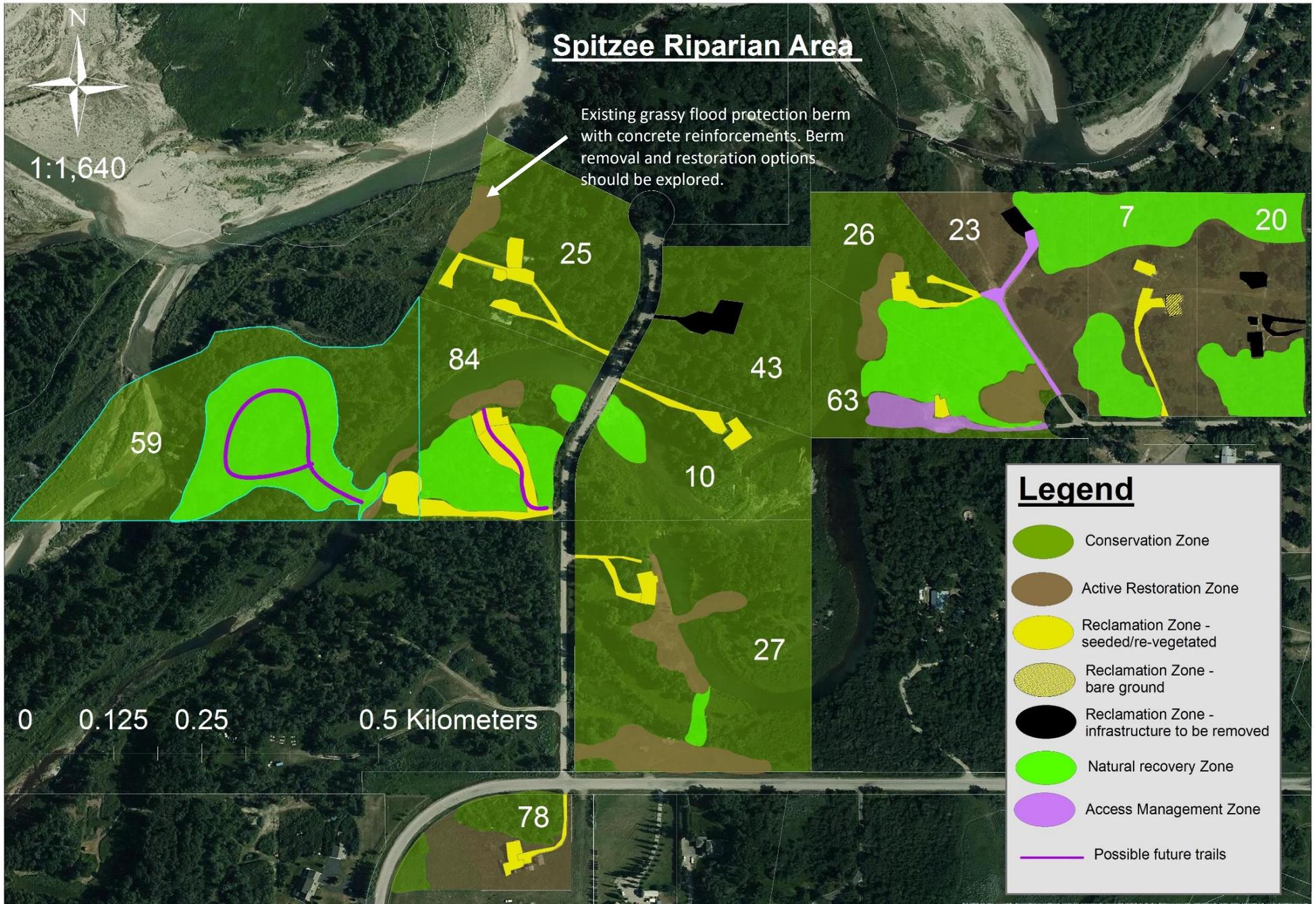
Photo C: Baker Creek unnamed tributary in the southwest corner of this site with high cover from native sedges and shrubs, providing ample cover and forage habitat for wildlife. (Photo Catalogue No. RHIP33HIG014)

Appendix C
Project Area Management Zone Maps

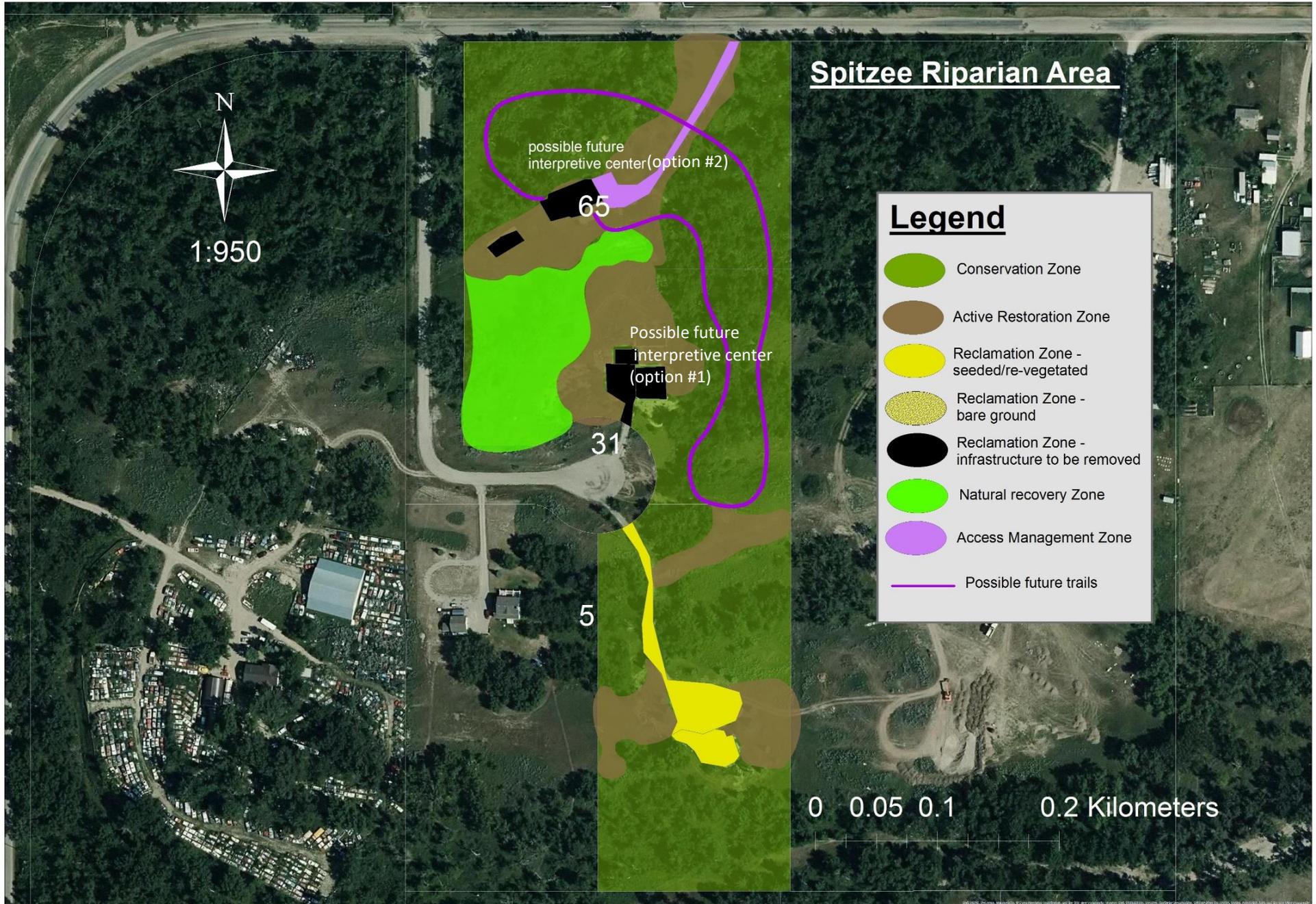
i) Management Zone Map 1: GIS land parcel nos. 4, 19, 42, 46, 56, 87



ii) Management Zone Map 2: GIS land parcel nos. 7, 10, 20, 23, 25, 26, 27, 43, 59, 63, 84



iii) Management Zone Map 3: GIS land parcel nos. 5, 31, 65



Spitzee Riparian Area



1:550

Legend

-  Conservation Zone
-  Active Restoration Zone
-  Reclamation Zone - seeded/re-vegetated
-  Reclamation Zone - bare ground
-  Reclamation Zone - infrastructure to be removed
-  Natural recovery Zone
-  Access Management Zone
-  Possible future trails

72

21

0 0.04 0.08 0.16 Kilometers

v) Management Zone Map 5: GIS land parcel no. 21

Spitzee Riparian Area



1:290

Legend

-  Conservation Zone
-  Active Restoration Zone
-  Reclamation Zone - seeded/re-vegetated
-  Reclamation Zone - bare ground
-  Reclamation Zone - infrastructure to be removed
-  Natural recovery Zone
-  Access Management Zone
-  Possible future trails

21

0 0.02 0.04 0.08 Kilometers

Spitzee Riparian Area

27



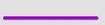
1:325

High density of Canada thistle

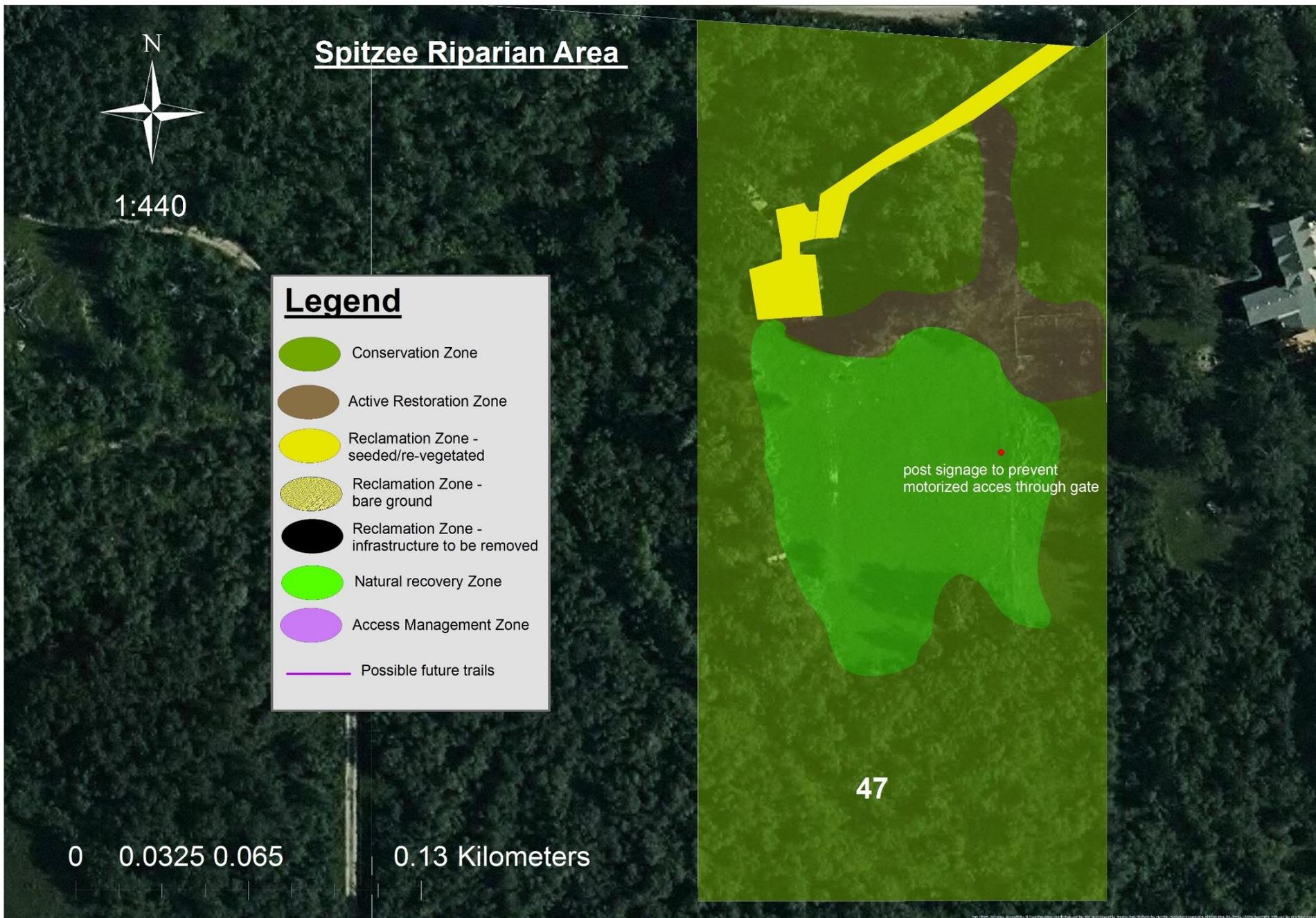
Buried gas pipeline

78

Legend

-  Conservation Zone
-  Active Restoration Zone
-  Reclamation Zone - seeded/re-vegetated
-  Reclamation Zone - bare ground
-  Reclamation Zone - infrastructure to be removed
-  Natural recovery Zone
-  Access Management Zone
-  Possible future trails

0 0.02 0.04 0.08 Kilometers



Appendix D

Native Plant Suppliers in the High River Region

Company Name	Contact	Phone Number	Email	Fax	Address	Website	Seeds (Y/N)	Plants (Y/N)	Categories	Notes
ALCLA Native Plant Restoration Inc.	Pat & Al Fedkenheuer	(403) 282-6516	ALCLA@telus.net	(403) 282-6515	3208 Bearspaw Drive NW Calgary, Alberta T2L 1T2	http://www.alclanativeplants.com/	Y	Y	Grasses, forbs, shrubs	ALCLA sells seeds and plants of Alberta's wildflowers, grasses, and shrubs. They provide germination information, or will grow container plants to customer specifications. The business offers consulting, and on-site seeding or planting to re-establish native plant communities and experience in "roof top" plantings of native species. Free species list available. Sells seeds and plants wholesale and retail.
Alberta Nurseries (Alberta Shelterbelt Program)	Chris Berggren	(403) 224-3544	---	(403) 224-2455	PO Box 446, Bowden (1134 TWP RD 344, Red Deer County) Alberta T0M 0M0	www.marketland.net	N	Y	Tree, shrubs	In business 80 years, Alberta Nurseries produces container-grown native trees, shrubs and vines. They will custom collect source specified seed or cuttings in Alberta. They will custom grow woody plants, wildflowers, grasses and wetland species. Free catalogue available. Sells plants wholesale and retail.
Bow Point Nursery Ltd.	Ken & Pam Wright	(403) 686-4434	info@bowpointnursery.com	(403) 242-8018	244034 Range Rd 32 Calgary, Alberta, T3Z 2E3	www.bowpointnursery.com	N	Y	Trees, shrubs	Bow Point Nursery is a grower of native woody plants of southern Alberta propagated from source identified seed and cuttings. They offer custom seed collecting and propagating. Motto: Survival of the Fittest.
Eagle Lake Nurseries Ltd.	Anita Heuver, Tony Heuver	(403) 934-3622 (retail) (403) 934-3670 (wholesale)	gardencenter@eaglelakenurseries.com (retail) wholesale@eaglelakenurseries.com (wholesale)	(403) 934-3626	Box 2340 Strathmore, Alberta T1P 1K3	www.eaglelakenurseries.com	N	Y	Trees, shrubs	Native and ornamental woody plants are produced in containers at Eagle Nurseries or purchased from other prairie sources. Some plants are available in bare-root form in spring. Sells shrubs and trees wholesale and retail.
Eastern Slopes Rangeland Seed Ltd.	Eileen Tannas	(403) 437-9052	eileen.tannas@esrseeds.com	(403) 637-2724	Box 273 Cremona, Alberta T0M 0R0	www.nativeplantproducer-esrs.com	Y	Y	Grasses, forbs, shrubs, trees,	Eastern Slopes Rangeland Ltd. specializes in bulk seed and plug sales of grasses. They deal in some species of wetland plants, shrubs and trees. Sells some seed retail, but the focus is mainly on wholesale grass seed sales.

Company Name	Contact	Phone Number	Email	Fax	Address	Website	Seeds (Y/N)	Plants (Y/N)	Categories	Notes
									wetland plants	
HenDen Earth Stabilization Inc.	Susan Hoy	403 264-9369	shoy@itsnotjustdirt.ca	403 264-8796	Suite 601, 1040 - 7th Avenue SW Calgary, Alberta T2P 3G9	www.itsnotjustdirt.ca	N	Y	Wetland plants	HenDen Earth Stabilization Inc provides Wetland Sod. Our sod is comprised of native species either pre-vegetated or grown to specifications in biodegradable mats. The purpose is to easily establish vegetation in and around wetlands, stream & creek banks vegetated drainage courses and storm water ponds.
Knutson & Shaw Growers	Ray Shaw, Bev Knutson-Shaw	(403) 485-6321	knshaw@wildroseinternet.ca	(403) 485-6323	Box 295 Vulcan, Alberta T0L 2B0	---	Y	Y	Wetland plants	Knutson & Shaw Growers specialize in propagating wetland plants and wetland reclamation. They also grow wildflowers, grasses, shrubs, and trees. Offers consultation and installation services. Sells plants wholesale.
The Professional Gardener Company Ltd.	Burke Wilson	(403) 263-4200	progar@telusplanet.net	(403) 237-0029	915-23 Avenue S.E. Calgary, Alberta, T2G 1P1	---	Y	N	Grasses, forbs	The wholesale horticultural supply company carries grass and wildflower seed. Availability depends on volume and suppliers. Sells seed wholesale.
Rangeland Seeds	Warden & Sylvia Budd	(403)485-6448	---	(403)485-6448	Box 928 Vulcan, Alberta T0L 2B0	---	Y	N	Grasses	Rangeland Seeds grows species of native grass seed for wholesale and retail markets. The grasses are Indian ricegrass, slender wheatgrass, and 'Basin' wild rye. The parent stock for the seed originates in the northern U.S. There is a 50 lb. minimum order. Sells grass seed wholesale and retail.
Vale's Greenhouse Ltd.	---	(403) 933-4814	---	---	301- 3rd Street NW Black Diamond, Alberta T0L 0H0	www.valesgreenhouse.com	N	Y	Grasses, forbs	Vale's Greenhouse specializes in hardy plants for the Chinook zone, including many native wildflower and grass species from the surrounding region. Local sales only. Sells plants retail.
Water Valley Forest Nursery	Ray & Brenda Pereversoff	(403) 637-3912	wvfn@wildroseinternet.ca	(403) 637-3912	Box 480 Cremona, Alberta T0M 0R0	---	N	Y	Trees	Water Valley Forest Nursery grows white spruce and lodgepole pine seedlings for use in reforestation and reclamation projects. Custom growing orders accepted. Sells plants wholesale and retail.
Wild About Flowers	Arden Nering	(403) 933-3903	contactus@wildaboutflowers.ca	(403) 933-3903	Site 15, Box 22, RR1 Okotoks, AB T1S 1A1	www.wildaboutflowers.ca	Y	Y	Forbs	Wild About Flowers sells seed and plants of native Alberta wildflower species. Their seed is collected in southwestern Alberta. Plants are grown as plugs outdoors, and are fully acclimatized. Retail store open by appointment. Mail orders shipped via Canada Post or Greyhound. Will custom grow large orders. Sells wildflower seeds and plants wholesale and retail.

Table Source: <http://anpc.ab.ca/>