Therriault Creek Riparian Revegetation 2012 Monitoring and Maintenance Report

Contract #130013

Prepared for:

Montana Fish, Wildlife and Parks
385 Fish Hatchery Road
Libby, MT 59923

Prepared by:

Geum Environmental Consulting, Inc.
307 State Street
Hamilton, MT 59840

GEUM
ENVIRONMENTAL
CONSULTING, INC

This page left intentionally blank

Table of Contents

This page left intentionally blank.

Introduction

This report describes work completed in 2012 at the Therriault Creek restoration project site under Fish, Wildlife and Parks Contract #130013. A total of four tasks were included in contract #130013:

- Monitoring
- Maintenance
- Revegetation Treatments
- Reporting

Work completed in 2012 represents the continued commitment of project stakeholders to the long-term success of the Therriault Creek Riparian Revegetation Project. As described in previous reports, successfully converting the riparian vegetation along Therriault Creek at the site to a mosaic of native riparian shrubs and trees requires a multi-year, phased approach that includes maintenance and monitoring during the establishment period while vegetation becomes adapted to site conditions. The intention of the initial phase, completed in fall 2007, was to implement a range of treatments based on a detailed evaluation of existing site conditions and ecological processes driving vegetation succession at the site. Effectiveness monitoring of the treatments installed in 2007 was completed in 2008 and 2009. The results were used to determine maintenance needs for 2007 treatments and identify additional revegetation treatments based on how effective the 2007 treatments were at achieving project goals and objectives. A small number of additional revegetation treatments were implemented in September and October 2009 (Phase II). Monitoring continued in 2010 and the results of this and previous monitoring were used to determine treatments for the downstream portion of the project (Phase III). Phase III treatments were implemented during October 2010 and are reported in *Therriault Creek Riparian Revegetation 2010 Implementation and Monitoring Report* (Geum Environmental Consulting, Inc. 2010). All treatments were monitored in 2011 and maintenance was completed in 2011 based on the results of 2011 monitoring.

The purpose of this report is to describe the results of 2012 effectiveness monitoring, describe maintenance activities completed in 2012 based on the results of 2012 monitoring, and provide recommendations for continued monitoring and maintenance at the site. 2012 represents the fifth year since implementation of the initial revegetation treatments at the site. This report also evaluates progress towards meeting the goals of riparian revegetation and overall site trends. Table 1 describes the tasks completed under Contract #130013.

Table 1. Tasks completed at Therriault Creek restoration site under Contract #130013 in 2012.

Task	Description and Quantity
Monitoring	
Phase I and II	
Photo documentation	Photos were taken of all treatments. Treatments include: 16 containerized planting units, 2 long term planted solarization units, 3 temporary solarization units, 2 vegetated soil lifts, 800 feet of willow fascine, 400 feet of coir log fascines, and 5 woody debris structures.
Plant survival	Survival monitoring was completed for 3 containerized planting units not monitored in 2011.
Vegetation composition transects	Three vegetation composition transects established in the woody debris structure area were monitored.
Record qualitative observations	Observations were recorded for all revegetation treatments, plant community development, channel conditions, and other ecological processes influencing plant community succession and site conditions.
Document maintenance needs	Maintenance needs were recorded for all treatments.
Phase III	
Survival monitoring	Survival monitoring was completed for approximately 400 containerized plants (40 percent of total installed) in nine planting units.
Photo documentation	Photos were taken of all treatments. Treatments include: 21 planting units and 1 planted solarization unit.
Documentation of maintenance needs	Maintenance needs were recorded for all treatments.
Entire Project Area	
Vegetation community mapping	Plant community mapping of the project site was completed.
Weed mapping	Weed mapping of the project site was completed.
Maintenance	
Watering	Watering of select plants in Phase 1 planting units 1, 2, 3, and 14 was completed once in August.
Browse protectors	Expansion of approximately 24 browse protectors and removal of approximately 217 browse protectors due to plant size or mortality was completed in Phase I. Fourteen additional browse protectors were added to residual shrubs. Twenty small exclosures were installed around groups of shrubs in Phase I. Browse protectors in Phase III were straightened and re-secured. No browse protectors were removed from Phase III.
Straighten shrubs	Some shrubs have gotten so large that they are leaning or falling over. These shrubs were secured using wooden stakes and twine. Approximately 10 shrubs were secured.

Task	Description and Quantity
Monitoring	
Solarization fabric	Edges of fabric were re-secured and weeds hand-pulled at the base of plants at one long term planted solarization plot in Phase III.
Revegetation Treatments	
Willow cutting and exclosure installation	Willow cuttings were installed in the remaining area of Solarization Plot 2 and in Solarization Plot 1. Browse exclosures were constructed around both solarization plots using 7.5 foot high deer netting.
Herbicide application	Herbicide was applied in late July and targeted four species and approximately 25 acres.
Reporting	
Reporting	This report was prepared to summarize the results of monitoring, maintenance and revegetation activities, progress towards meeting project goals, and provide adaptive management recommendations for future years.

2012 Effectiveness Monitoring

This section describes the results of effectiveness monitoring completed in July 2012. Effectiveness monitoring was completed for treatments installed in Phase I (2007), Phase II (2009), and Phase III (2010) of the project. Details on the Therriault Creek riparian revegetation project including: previously implemented revegetation strategies and treatments; effectiveness monitoring methods; results of 2008, 2009 and 2010 effectiveness monitoring; and the adaptive management framework for the project can be found in six separate documents:

- *Therriault Creek Riparian Revegetation Plan* (Revegetation Plan) prepared for Kootenai River Network (Geum Environmental Consulting, Inc. 2007a);
- *Therriault Creek Riparian Revegetation Plan Implementation Report* (2007 Implementation Report) prepared for Montana Fish, Wildlife and Parks (Geum Environmental Consulting Inc. 2007b);
- *Therriault Creek Riparian Revegetation 2008 Monitoring Report* prepared for Kootenai River Network (2008 Monitoring Report) (Geum Environmental Consulting, Inc. 2008);
- *Therriault Creek Riparian Revegetation Maintenance and Monitoring 2009 Report* (2009 Monitoring Report) prepared for the Kootenai River Network (Geum Environmental Consulting, Inc. 2009);
- *Therriault Creek Riparian Revegetation 2010 Implementation and Monitoring Report* (2010 Monitoring Report) prepared for Montana Fish, Wildlife and Parks (Geum Environmental Consulting, Inc. 2010) and
- *Therriault Creek Riparian Revegetation 2011 Implementation and Monitoring Report* (2011 Monitoring Report) prepared for Montana Fish, Wildlife and Parks (Geum Environmental Consulting, Inc. 2011).

As described in the monitoring reports, three types of monitoring are necessary components of the integrated monitoring and adaptive management program. These include: baseline, as-built, and effectiveness monitoring. ***Baseline monitoring*** documents the pre-restoration condition and is described in the Revegetation Plan prepared for the project (Geum 2007a). ***As-built monitoring*** documents completed treatments and for the treatments implemented in fall 2007, is described in the 2007 Implementation Report (Geum 2007b). ***Effectiveness monitoring*** addresses whether project objectives are being met, determines maintenance needs, and provides inputs into decision pathways for adaptive management. The results of 2008 effectiveness monitoring are provided in the 2008 Monitoring Report (Geum 2008). The 2009 report provides the results of 2009 effectiveness monitoring for treatments implemented in 2007, compares those results with 2008 effectiveness monitoring results, and describes results of as-built monitoring for revegetation treatments implemented in September and October 2009 (Geum 2009). The results of 2010 effectiveness monitoring, compared with the results of previous years' monitoring and the determination of 2010 maintenance needs and Phase III revegetation treatments, are provided in the 2010 Monitoring Report (Geum 2010). The 2011 Monitoring Report (Geum 2011) provides the results of 2011 monitoring, compares these results with previous year's results, and describes the maintenance activities completed in 2011. This report provides the results of 2012 monitoring, describes the maintenance and revegetation treatments implemented as a result of the 2012 monitoring, and describes how the site is progressing

towards meeting project goals and objectives. This report also provides recommendations for continued monitoring and maintenance activities at the site.

The focus of 2012 effectiveness monitoring was to continue to evaluate treatment effectiveness observed since 2008; determine maintenance needs; and determine overall trends towards meeting project goals and objectives. Figure 1 shows an overview of revegetation treatments installed at the project site. Figure 2 shows the locations of monitored treatments in Phase I and Phase III. Phase II treatments included removal of solarization fabric, protection of residual shrubs, and installation of dormant willow cuttings within the Phase I area. Effectiveness monitoring completed in 2012 included:

- General observations of all revegetation treatments in Phase I, II and III;
- Photographs of all revegetation treatments;
- Repeat survival monitoring of four containerized planting units in Phase I;
- Survival monitoring of 400 plants in nine planting units representing 40 percent of plants installed in Phase III;
- Repeat monitoring of three vegetation composition transects near woody debris structures;
- Mapping of weeds in the project area;
- Mapping of vegetation communities in the project area; and
- Documentation of maintenance needs for all revegetation treatments.

Table 2 provides a summary of the results of 2012 effectiveness monitoring, the decision making pathway for making adaptive management recommendations based on results of monitoring, and a summary of the recommendations, such as maintenance needs or continued monitoring, based on monitoring results. The following sections discuss the results of 2012 monitoring and compare those results with previous years' effectiveness monitoring results where possible.

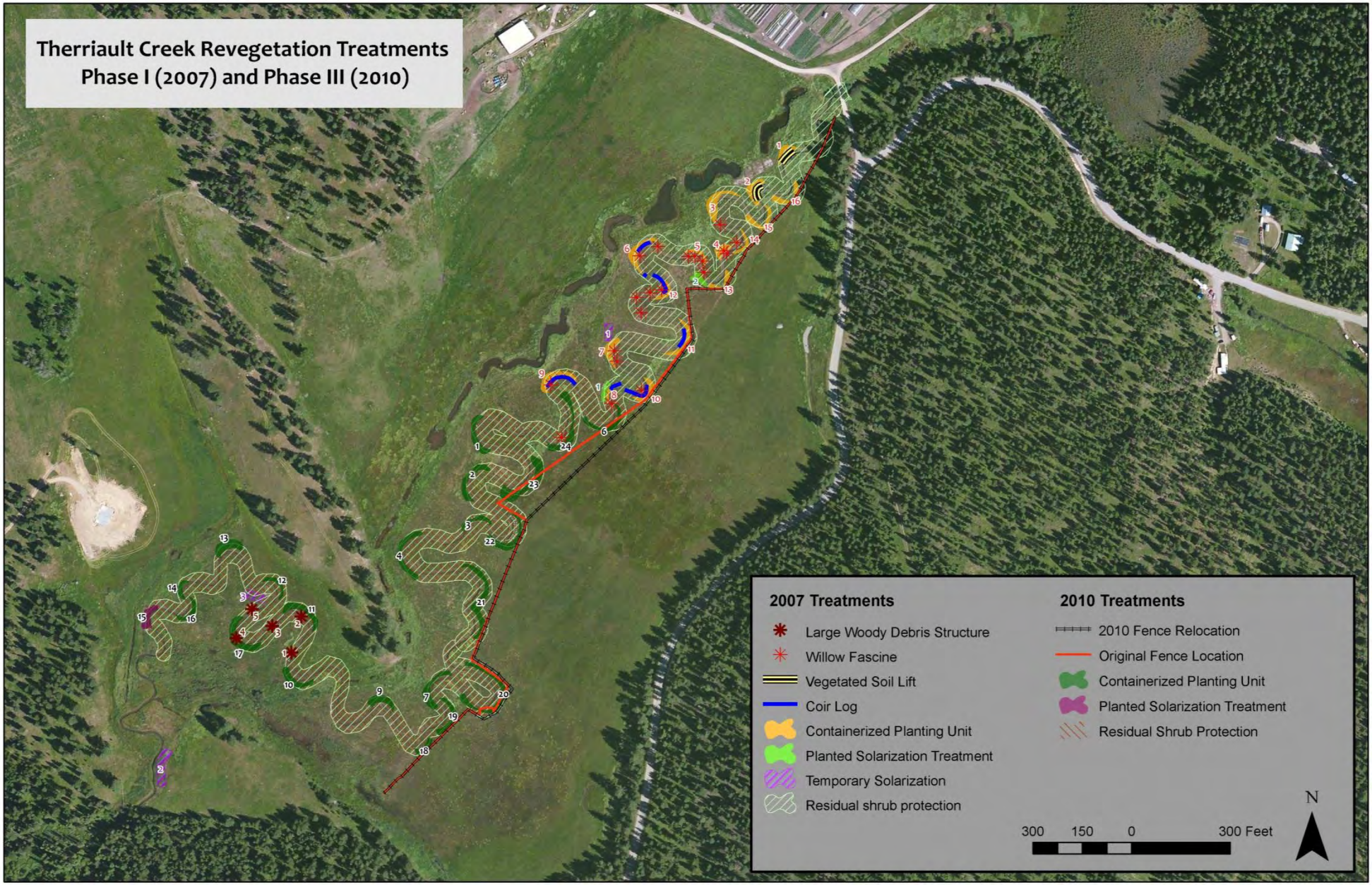


Figure 1. Overview figure showing riparian revegetation treatments installed in 2007 and 2010 at the Therriault Creek Riparian Revegetation project site.

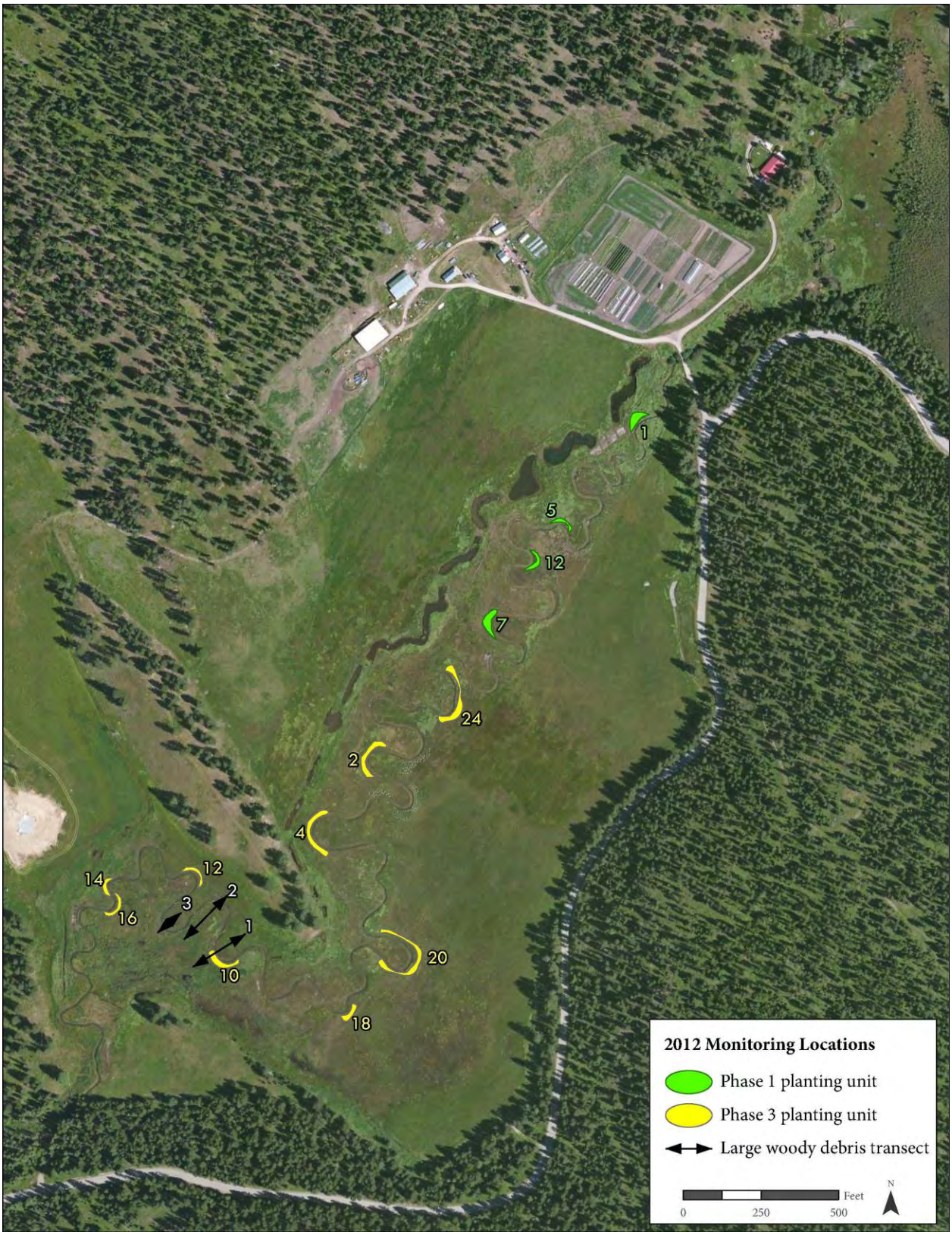


Figure 2. Effectiveness monitoring overview figure showing the locations of planting units monitored in 2012 at the Therriault Creek Riparian Revegetation project site.

Table 2. Summary of results of 2012 effectiveness monitoring, decision pathway for making adaptive management decisions based on the results of monitoring, and recommendations made for 2012 riparian revegetation treatments installed at the Therriault Creek Riparian Revegetation project site.

Treatment[1]	Decision Pathway for Maintenance and Adaptive Management[2]	2012 Effectiveness Monitoring Results	Adaptive Management, Completed Actions and Future Recommendations Based on Monitoring
Residual Shrub Protection	(1) If protected shrubs are greater than 3 feet above the height of the browse protector, browse protectors should be removed. If plants are less than 3 feet above the height of the browse protector, leave the protector in place. (2) If protected shrubs have filled greater than 80% of the capacity of the browse protectors, expand protector to accommodate growth. (3) If hedging of protected shrubs is occurring at the height of the browse protector, evaluate the effects on the health of the plant. If the plant appears healthy, no action is needed. If the plant appears stunted or otherwise unhealthy, additional measures for protection may need to be evaluated.	Residual shrubs protected in 2007, 2009, 2010, and 2011 continue to thrive compared to unprotected residual shrubs which remain stunted and browsed. In general, sandbar willows have grown greater than 3 feet above browse protectors. Red-osier dogwood, birch and other willow species vary in the height they have grown above browse protectors, but most plants are robust and have filled more than 80% of the browse protector capacity. Hedging at height of the protector is common on red-osier dogwood but plants appear healthy.	In 2012, repaired and re-secured any damaged protectors still needed to protect shrubs. Removed browse protectors from individual plants that had outgrown protectors by greater than 3 feet in height for willows or 1 foot in height for other species or more than 80% of the capacity of the protector. Where shrubs occur in clumps, used recycled browse protectors to create a small fence around the clump of plants to allow plant expansion but continue to protect the plants from browse and damage. In 2013, continue to remove protectors around shrubs that no longer need protection and create small exclosures where possible.
Containerized Planting	(1) If survival of containerized shrubs in Phase III is greater than 80%, reduce the frequency of monitoring at the site. Continue to conduct annual maintenance site visits and implement necessary maintenance. (2) If survival is less than 80%, determine if additional irrigation or weed suppression measures are needed or if other site conditions are precluding growth (e.g. soils). If limitations to survival are identified, consider re-planting poor survival areas.	The drop in survival recorded at two planting units in 2011 has not occurred at other Phase I planting units. Overall survival is greater than 80% and surviving plants are generally very robust and beginning to provide riparian function. Browse and ungulate damage remain a limiting factor but many plants have grown to a height and diameter that can withstand some browse pressure. In Phase III, survival dropped to 75% as a result of prolonged inundation in 2011. Plants are still very small and further decline in survival may occur.	In 2012, expanded or removed browse protectors on shrubs that have filled the capacity of the protectors. Recycled browse protectors to create small fences around planting units or clumps of plants where browse protectors are limiting expansion of shrubs. Very little supplemental watering was necessary. Four units in Phase I were watered. In 2013, continue to remove browse protectors from shrubs that have out grown them. Continue to monitor Phase III plants for both survival and growth to determine if re-planting is needed. Re-evaluate Phase I and III plants for maintenance needs.

Treatment[1]	Decision Pathway for Maintenance and Adaptive Management[2]	2012 Effectiveness Monitoring Results	Adaptive Management, Completed Actions and Future Recommendations Based on Monitoring
Solarization: Planted	(1) If survival remains above 80%, reduce the frequency of monitoring at the site. Continue to conduct annual maintenance site visits and implement necessary maintenance. (2) If survival remains above 80% begin fabric removal around select shrubs in Phase I sites. Leave fabric installed in Phase III in place. (3) If survival drops below 80%, try to determine causes. Consider removing fabric and re-planting once causes are determined.	Survival was not monitored in 2012 but may have declined as a result of fabric removal and loss of stability. Some shrubs were knocked over in these units and one unit was impacted by 2012 spring flooding. The exposed soil surfaces have been colonized by a mix of seeded species, and naturally colonizing species including pasture grasses and willows. Planted solarization unit in Phase III was not monitored for survival. Grasses and grass roots are still viable under fabric.	In 2012, additional browse protectors were removed and plants, where knocked over, were straightened and secured where possible. Small reed canarygrass plants were hand-pulled to the extent feasible. In 2013, continue to evaluate natural recruitment and cover of seeded species in two plots where fabric was removed. Evaluate browse or other damage to released plants and potential to remove additional protection measures. Evaluate the potential to remove fabric from planted solarization plot in Phase III. Consider herbicide treatment for undesirable grasses and protection measures for naturally colonizing shrubs.

Treatment[1]	Decision Pathway for Maintenance and Adaptive Management[2]	2012 Effectiveness Monitoring Results	Adaptive Management, Completed Actions and Future Recommendations Based on Monitoring
Solarization: Temporary	(1) If percent cover of seeded or other desirable species is greater than 70%, expand plots to treat additional area and continue to evaluate sites each year for maintenance needs. (2) If percent cover of seeded or other desirable species is less than 70% and undesirable species are not present or less than 10% total cover, re-seed with native species. Consider adding soil amendments such as compost or mulch if appropriate. (3) If percent cover of seeded or other desirable species is less than 70% and undesirable species are present and greater than 10% total cover, try to determine causes and consider re-treatment with solarization fabric or chemical control once causes have been identified.	All fabric remaining in temporary solarization plots was removed in 2011. Both undesirable and desired species are present in all temporary solarization plots. Cover of undesirable species, including reed canarygrass and quackgrass continues to increase and is greater than 10% in plot 3. Desirable species are still present but are being out-competed by non-native grasses. The newly exposed surfaces are being colonized by a mix of seeded and non-seeded grass species. Desirable species in plot 1 are still present but redtop is now the dominant species and has cover greater than 10%. A number of sandbar willow and dogwood seedlings are also present in the site but are browsed by deer. Plot 2 has been colonized by a mix of seeded and non-seeded grass species. Willow cuttings are alive but heavily browsed by deer.	In 2012, no additional actions were taken at plot 3. Sites 1 and 2 were planted with additional willow cuttings and protected with 7.5 foot high deer exclosures. In 2013, continue to evaluate germination and colonization of desirable species in temporary solarization plots 1, 2, and 3. Re-seed, add additional cuttings, hand weed, or apply herbicide as needed in all plots.
Vegetated Soil Lift	(1) If willow shoot height remains below 3 feet and overall percent cover is not increasing, apply chemical barriers to browse. (2) If willow shoot height is greater than 3 feet or density appears the same or increasing take no further action.	Willow cover is near 100 percent on both soil lifts. Browse was greater than in 2011 but cover remains high and willow cuttings appear robust. Willows are providing bank stability and in-stream shade and cover.	In 2013, continue to evaluate structures but no additional monitoring or maintenance is anticipated.

Treatment[1]	Decision Pathway for Maintenance and Adaptive Management[2]	2012 Effectiveness Monitoring Results	Adaptive Management, Completed Actions and Future Recommendations Based on Monitoring
Willow Fascines	Take no further action.	Intact willow fascines have trapped sediment and debris and are functioning to build depositional features within the channel margins and provide substrate for colonizing vegetation. Most fascines are buried with gravels and fine sediment. Some fascines have grown into small willow clumps within the channel margins.	In 2013, continue to evaluate structures but no additional monitoring or maintenance is anticipated.
Large Woody Debris Structures	(1) If species composition adjacent to structures appears to have shifted, repeat transect monitoring to evaluate trend. (2) If species composition adjacent to structures appears not to have changed, continue to make annual visual observations of treatment effectiveness. Repeat transect monitoring in 2012.	Wood structures are promoting prolonged floodplain inundation during high flow events and elevating the water surface during base flows. Species composition adjacent to structures has shifted to an overall wetter species composition based on re-monitoring of vegetation transects. Due to water turbidity at the time of monitoring other intended functions of these structures such as trapping debris and sediment and providing fish habitat could not be observed. Some natural colonization of woody species was observed.	In 2013, continue to evaluate structures but no additional monitoring or maintenance is anticipated.
Coir Logs	(1) If willow shoot height remains below 3 feet and overall percent cover is not increasing, apply chemical barriers to browse to allow willows to grow and become more resistant to browse. (2) If willow shoot height is greater than 3 feet or density appears the same or increasing take no further action.	Willow cover continues to be variable overall, but has increased at most sites. Some sites have formed continuous dense bands of willows along the channel margin. Coir logs remain structurally intact and the channel is deepening below the logs at many sites. The channel filled with gravel at some sites but willow cuttings appear intact.	In 2013, continue to evaluate structures but no additional monitoring or maintenance is anticipated.

Treatment[1]	Decision Pathway for Maintenance and Adaptive Management[2]	2012 Effectiveness Monitoring Results	Adaptive Management, Completed Actions and Future Recommendations Based on Monitoring
Herbicide Application	(1) If noxious weed infestations are documented, continue to treat infestations. (2) Continue to monitor for new infestations of Canada thistle, reed canarygrass, yellow toadflax, houndstongue, sulfur cinquefoil and any new weed species.	Herbicide applications have been effective at controlling most target species. Weed mapping completed in 2012 indicates that yellow toadflax has been eradicated from the site, houndstongue is still present but has not spread, and isolated patches of reed canarygrass continue to be present and have increased in the upper half of the project area. Within the project area Canada thistle density has been greatly reduced but large infestations remain upstream of the road, at the downstream end of the project, and along the eastern edge of the project. The infestation in the hayfield to the east of the project has increased significantly.	In 2012, treated houndstongue, yellow toadflax, isolated patches of reed canarygrass and Canada thistle at the site. In 2013 continue to aggressively treat Canada thistle including areas outside of the project limits, isolated patches of reed canarygrass and all other occurrences of noxious weeds.

[1] See Figure 1 for treatment locations, and see previous reports for descriptions of treatments.
[2] From 2010 Report Adaptive Management Recommendations section.

Residual Shrub Protection

General observations of shrubs that were planted in 2003 during channel restoration and fitted with browse protectors in subsequent years were made in July 2012. Browse protectors were added to residual shrubs in 2008, 2009, 2010, and 2011. In 2010 and 2011, many of the residual shrubs fitted with browse protectors had outgrown the protectors, so protectors were either removed, expanded, or small exclosures were constructed around clumps of residual shrubs to allow them to continue to grow and expand. In 2012, continued growth of previously protected shrubs was observed. On a number of inside meander locations in the Phase I project area, new sandbar willow plants were observed, indicating that the residual shrubs are successfully reproducing in these areas. The new plants are likely both from suckering and seed. Clumps of residual shrubs that were protected with small exclosures showed significant expansion in size. Based on these observations, previous year's monitoring results, and the pathway for maintenance and adaptive management, the following recommendations were made and implemented for residual shrub protection:

- Individual browse protectors were removed from sandbar willow shrubs growing more than three feet above the protector.
- Individual browse protectors were removed from red-osier dogwood, alder, and birch shrubs growing more than one foot above the protector.
- Individual browse protectors were expanded if the shrub had filled the browse protector but had less than one foot of growth above the top of the protector.
- Newly located residual shrubs were fit with 4-foot tall by 18-inch wide browse protectors.
- For residual shrubs found in clumps of multiple plants, individual browse protectors were removed and small exclosures were constructed around the group of shrubs. The purpose of the small exclosures is to continue to protect shrubs from browse and damage while reducing the need for continued annual expansion and removal of browse protectors and to allow multi-stemmed shrubs more growth freedom.

Figures 3 through 6 provide examples of the various growth stages of shrubs and the browse protection that was implemented during 2012 maintenance.

Figure 3. Young sandbar willow plants (photo foreground) that have colonized from seed and suckering from residual protected shrubs (photo background).

Figure 4. Residual dogwood shrub located and protected in 2012.

Figure 5. Examples of residual shrubs where browse protectors were removed in 2012. The top left photograph shows a sandbar willow on the left bank that is greater than three feet above the top of the browse protector. The top right photograph shows a group of residual shrubs where individual browse protectors were removed and a small exclosure was constructed around the group of shrubs. The bottom photograph shows a dogwood that has filled the browse protector but has less than one foot of growth above the top of the protector.


Figure 6. Photographs of clumps of residual shrubs fit with small exclosures in 2011. The shrubs in these exclosures have grown taller and expanded in width to provide additional cover.

Containerized Planting

In 2012, survival monitoring of containerized plants was conducted in four planting units in Phase I and nine planting units in Phase III. Planting units monitored in Phase I included two plots that were monitored in 2011 (unit 1 and 7) and two plots that had not been monitored since 2009 (unit 12 and 5). These plots were selected to determine if the decrease in survival recorded in planting units 1 and 14 in 2011 is also occurring in other units. Survival in unit 12 decreased from 94 percent in 2009 to 81 percent in 2012. Survival in unit 5 decreased from 95 percent in 2009 to 86 percent in 2012. While survival decreased in both of these units, the decrease is not as significant as it was in units 1 and 14 between 2009 and 2011 where there was more than a 30 percent decrease in survival. Planting unit 1 was monitored in 2012 and survival remained the same as 2011 (Table 3). A discussion of possible reasons for the decline in survival is provided in the 2011 Monitoring Report. Overall, surviving shrubs in Phase I continue to grow both in height and diameter (Figure 7). Appendix A provides a photo series of Phase I planting units for 2008 through 2012.

Table 3. Survival within monitored Phase I planting units. Percent survival reported for each year is based on the original number of plants installed in each unit.

	Survival				
Planting Unit	**2008**	**2009**	**2010**	**2011**	**2012**
Planting Unit 1	100%	98%	77%	66%	66%
Planting Unit 12	96%	94%	N/A	N/A	81%
Planting Unit 5	98%	95%	N/A	N/A	86%
Planting Unit 7	96%	90%	93%	90%	86%

*N/A = planting unit not monitored for that year.

Table 4 shows the results of Phase III survival by planting unit. Within the nine plots monitored, total survival ranged from a high of 100 percent to a low of 51 percent. Overall survival dropped from 96 percent in 2011 to 75 percent in 2012. In 2011, most planting units in Phase III had standing water late into the growing season. The prolonged inundation in 2011 is most likely the reason for decreased survival recorded in these units in 2012 (Figure 9). Table 5 shows survival

data by species. Serviceberry had the lowest survival at 0 percent. Mountain alder and river birch both showed significant declines in survival between 2011 and 2012. Both wet and dry species showed decreased survival between 2011 and 2012. Some of the shrubs in Phase III have grown 2 to 3 feet since installation but most shrubs remain very small and contained completely within browse protectors (Figure 8). Appendix D provides a photo series of Phase III planting units between 2010 and 2012.

Table 4. Phase III survival by planting unit. Percent survival for each year is based on the original number of plants installed in each unit.

Phase III Planting Unit	2011 Survival	2012 Survival
Planting Unit 2	100%	58%
Planting Unit 4	102%*	80%
Planting Unit 10	100%	93%
Planting Unit 12	92%	51%
Planting Unit 14	100%	90%
Planting Unit 16	88%	74%
Planting Unit 18	105%*	100%
Planting Unit 20	90%	57%
Planting Unit 24	95%	80%
Total Survival	**96%**	**75%**

*One extra plant was counted in each of these units in 2011.

Table 5. Phase III containerized planting survival by species in the nine monitored planting units.

Species		2011 Survival	2012 Survival
Alnus incana	Mountain alder	91%	45%
Amelanchier alnifolia	Serviceberry	75%	0%
Betula occidentalis	River birch	95%	36%
Cornus sericea	Red-osier dogwood	100%	77%
Populus tremuloides	Quaking aspen	83%	58%
Salix bebbiana	Bebb willow	97%	64%
Salix boothii	Booth's willow	108%*	58%
Salix drummondiana	Drummond's willow	90%	85%
Salix exigua	Sandbar willow	100%	97%
Symphoricarpos occidentalis	Snowberry	100%	80%

*Due to the difficulty of identifying willows during dormancy, it is possible that some willows were misidentified during fall 2010 as-built documentation resulting in more willows of a certain species recorded during effectiveness monitoring.

The herbaceous vegetation in both Phases I and III remains a mix of pasture grasses, sedges, rushes, native grasses, and native forbs. The lower end of Phase I and upstream portion of Phase III support large areas dominated by sedges and wetter species continue to increase in planting areas (Figure 10). The cover of native, wetter species is increasing in both Phases I and III.

In Phase I, 2012 is the fifth growing season for planted shrubs and trees. Many of the shrubs are very large and have outgrown protection measures. Browse protectors have been removed from most of the large shrubs in Phase I. Some continued browse of these shrubs was observed in 2012. Many shrubs have filled the capacity of the browse protector but continue to be browsed down to the height of the browse protector. On many of these shrubs, the browse protectors are beginning to restrict horizontal growth of the shrubs. Some shrubs are still small and well contained within the existing browse protector. The vole protectors have worked very well at preventing damage by rodents; however, for some fast-growing multi-stemmed shrubs such as alder the stems have filled the vole protector and in some cases the vole protectors have damaged some of the stems. The vole protectors and mulch continue to help maintain high moisture content near the base of the plant.

Figure 7. Shrub growth in Phase I planting area.

Figure 8. Shrubs in Phase III planting area.

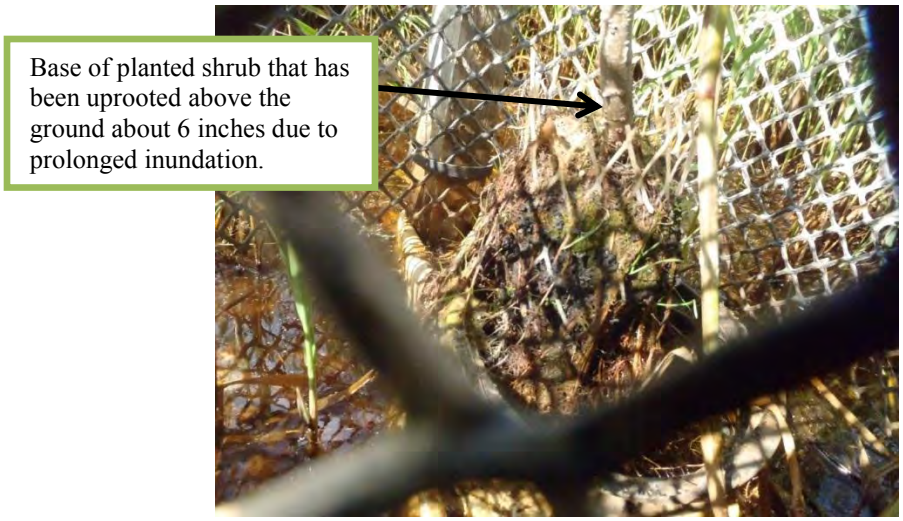


Figure 9. Plant in Phase III that was uprooted due to prolonged inundation.

Figure 10. Expansion of sedges in Phase III planting area.

Figure 11. Alder stems that are being restricted by the vole protector.

Based on 2012 effectiveness monitoring and observations, previous year's monitoring results, and the pathway for maintenance and adaptive management, the following recommendations were made for containerized planting:

- Very few planting units had plants that showed signs of stress from lack of soil moisture. Both 2011 and 2012 had high streamflows that inundated planting units for a period of time likely resulting in high soil moisture. For this reason, very little supplemental watering was needed during the summer. Four planting units within the Phase I planting area were watered in late August.
- In Phase I, individual browse protectors were removed from any shrubs exceeding the height of the browse protector by more than three feet (approximately 217 removed).
- In Phase I, individual browse protectors were expanded for shrubs that have filled the capacity of the browse protector but continue to be browsed to the height of the browse protector (approximately 24 expanded).
- In Phase I, for planting units where multiple shrubs were close to out-growing their browse protectors, individual browse protectors were removed and a small exclosure was constructed around the planting unit or a portion of the planting unit. Twenty small exclosures were constructed. The purpose of the small exclosures is to continue to protect shrubs from browse and damage while reducing the need for continued annual expansion and removal of browse protectors and reducing growth restriction of multi-stemmed shrubs.
- No browse protectors were removed in Phase III and only minimal maintenance of browse protectors was needed.

Planted Solarization

General observations of planted solarization plots were made in 2012. In 2011, fabric was removed from both planted solarization plots in Phase 1. The exposed soil was seeded with American mannagrass (*Glyceria grandis*), fowl bluegrass (*Poa palustris*), tufted hairgrass (*Deschampsia cespitosa*), sawbeak sedge (*Carex stipata*), small-winged sedge (*Carex microptera*), and daggerleaf rush (*Juncus ensifolius*). The exposed soil was also seeded with sterile triticale to provide rapid cover and reduce habitats available for reed canarygrass to

colonize. In August 2012, herbaceous cover in Planted Solarization Plot 1 was high (Figure 12). Species included both seeded and naturally colonizing species. Most of the sedges and grasses were very small and could not be identified. Species that could be identified included: willow herb (*Epilobium angustifolium*), forget-me-not (*Myosotis laxa*), common timothy (*Phleum pratense*) and reed canarygrass (*Phalaris arundinacea*). Only a few small reed canarygrass plants were observed and these were hand-pulled at the time of observation. Numerous sandbar willow seedlings were observed in Planted Solarization Plot 1 indicating that the bare substrate provided suitable substrate for natural colonization of woody species (Figure 13). Planted Solarization Plot 2 is located on an outside meander bend where a channel avulsion is occurring. The channel at this location has filled with gravels and most of the water is flowing overland through this plot. As a result, most of the bare substrate in this plot has either been eroded or covered with small gravels (Figure 14). No natural colonization was observed on the new gravel but that is probably because water is flowing through this area. If water is returned to the channel this gravel should support rapid colonization of woody and herbaceous species.

In 2011 survival of shrubs in Planted Solarization Plot 1 was 80%. In 2012, survival was not monitored but appears to have decreased slightly. A number of shrubs, primarily hawthorne, have fallen over (Figure 15). This is probably a result of how effectively the fabric killed the grasses under the fabric which resulted in a slightly lower surface overall in this plot. Both the fabric and browse protectors were likely supporting these plants and both were removed in 2011. Although these shrubs have fallen over most are still alive and have re-sprouted from the base. The planted solarization plot in Phase III has only been in place for one growing season and the grasses have not yet been effectively killed at this site. During spring 2012 high flows this plot was covered with fine sediment and grasses have begun to grow in the deposited silts (Figure 16). In 2011, this plot had standing water in it until late in the growing season. Survival in this plot is not monitored but some plants are dead likely due to the standing water in 2011.

Appendix A provides a photo series of planted solarization plots from 2008 through 2012.

Based on 2012 effectiveness monitoring observations, previous year's monitoring results, and the pathway for maintenance and adaptive management, the following recommendations were made for planted solarization plots:

- Remove browse protectors on plants greater than three feet above browse protectors or robust enough to resist browse.
- Straighten and secure collapsed shrubs where possible.
- Continue to observe and monitor natural colonization in Phase I planted solarization plots.
- Continue to observe and monitor the Phase III planted solarization plot.

Figure 12. Planted solarization plot 1 in August 2012. Photograph on the left provides an overview of plot conditions. Photograph on the right shows the species colonizing the exposed mineral soil.

Figure 13. Sandbar willow colonization in Planted Solarization Plot 1.

Figure 14. Planted Solarization Plot 2 showing deposition of gravels.

Figure 15. Shrubs in Planted Solarization Plot 1 that have fallen over as a result of loss of grass sod under the fabric.

Figure 16. Phase III planted solarization plot showing deposition of fine sediment from overbank flows in 2011 and 2012.

Temporary Solarization Plots

In 2012, general observations were made of all temporary solarization plots. Solarization fabric was removed from plot 3 in fall 2009 and fall 2010. Solarization fabric was removed from plot 1 in fall 2010. Solarization fabric was removed from plot 2 in fall 2011 and half of this plot was planted with dormant willow cuttings.

In plot 1, the bare mineral soil has been colonized by a range of species (Figure 17). In 2011, grasses observed in this plot included a mix of seeded species (tufted hairgrass, fowl mannagrass, and slender wheatgrass), and pasture grasses present adjacent to the plot (quackgrass, redtop, smooth brome, and timothy). Other seeded species observed in the plot included: red-osier dogwood, chokecherry, and Baltic rush. Other species observed in plot 1 include both native species (sedges, sandbar willow, field mint, violet, common willowherb, cattail and knotweed) and invasive species (reed canarygrass and Canada thistle). This plot had standing water in it until the middle of August 2011. In 2012, most of the same species were present but the plot

was dominated by redtop. This shift was expected as a similar shift was seen in plot 3 two years after fabric removal. Numerous sandbar willow plants are present in the plot and are approximately the same height as the redtop. A few small dogwood seedlings are also still present in the plot but were only a few inches tall. All of the small seedlings had been browsed and it is likely that there were more seedlings but they were uprooted by deer or elk.

In plot 3, the remaining fabric was removed in fall 2011. The exposed soil was seeded with American mannagrass, fowl bluegrass, tufted hairgrass, sawbeak sedge, small-winged sedge, and daggerleaf rush. The exposed soil was also seeded with sterile triticale to provide rapid cover and reduce habitats available for reed canarygrass to colonize. Very few of these species were observed growing on the newly exposed surfaces (Figure 18). Redtop was the dominant species on the newly exposed surface. No natural colonization of woody species was observed in this plot. The surface that was exposed in 2009 in this plot continues to transition to pasture grass species. This surface has transitioned from a mix of wet grass and graminoid species to increasing dominance by pasture grasses over the period of three years.

In plot 2, the fabric was removed in 2011 and the exposed soil was seeded with American mannagrass, fowl bluegrass, tufted hairgrass, sawbeak sedge, small-winged sedge, daggerleaf rush, and sterile triticale. Half of the plot was planted with dormant willow cuttings collected from on site. In 2012, a number of grass species were observed colonizing this plot but it was not possible to identify them due to their small size (Figure 19). All of the willow cuttings were alive but all had been browsed down to the stem.

Figure 17. Photograph of temporary solarization plot 1 in July 2011 (photo left) and in August 2012 (photo right). Black lines in the figure represent the approximate extents of where the solarization fabric covered the plot.

Figure 18. Photograph of temporary solarization plot 3 in 2011 (photo left) and in 2012 (photo right). In the left photo the area between the standing water is the original plot location that was exposed and seeded in fall 2009. The areas of standing water have fabric under the water that was placed around the original plot. This fabric was removed in fall 2011 and that exposed soil area is shown in the photo on the right.

Figure 19. Photograph of temporary solarization plot 2 located at the downstream end of the project site prior to fabric removal and seeding in fall 2011 (A), in August 2012 (B), willow cuttings installed in fall 2011(C), and browse of willow cutting growth (D).

Based on 2012 and previous year's observations and the pathway for maintenance and adaptive management, the following recommendations were made for temporary solarization plots:

- Install willow cuttings in the rest of plot 2 and in plot 1.
- Construct temporary exclosures around these plots to prevent browse of willow cuttings.
- Continue to monitor species composition of temporary solarization plots.

Vegetated Soil Lifts

In 2012, general observations were made of both vegetated soil lifts. Percent cover of willows continues to increase resulting in a dense band of cover immediately along the channel at both sites (Figure 20). Willows at both sites continue to be stunted by browse. Appendix B provides a photo series for each site from 2008 through 2012.

Based on 2012 and previous years' observations and the pathway for maintenance and adaptive management, the following recommendation was made for vegetated soil lifts:

- Continue to observe function of the structures but no future maintenance or monitoring is anticipated because the dense growth and associated deep binding root mass is providing the desired function of bank stability.

Figure 20. Photograph of vegetated soil lift 1 (right bank in the left photo) and vegetated soil lift 2 (right bank in the right photo) showing dense but browsed bands of willows.

Willow Fascines

In 2012, general observations were made of all willow fascines that could be relocated. Observations in 2012 were similar to previous years. Willow fascines that are still intact continue to function for trapping debris and sediment. Most fascines have significant sand or gravel deposition on them but willow clumps continue to grow from the exposed ends along the channel margins (Figure 21). All willows in intact fascine structures are suppressed by browse, limiting some of the function they could provide such as instream shade.

Based on 2012 and previous years' observations, and the pathway for maintenance and adaptive management, the following recommendations were made for willow fascines:

- No maintenance of structures is necessary. The fascines are functioning to trap sediment and debris and establish vegetation within the channel margins.
- Continue to observe the function of the willow fascines but no future maintenance or monitoring is anticipated.

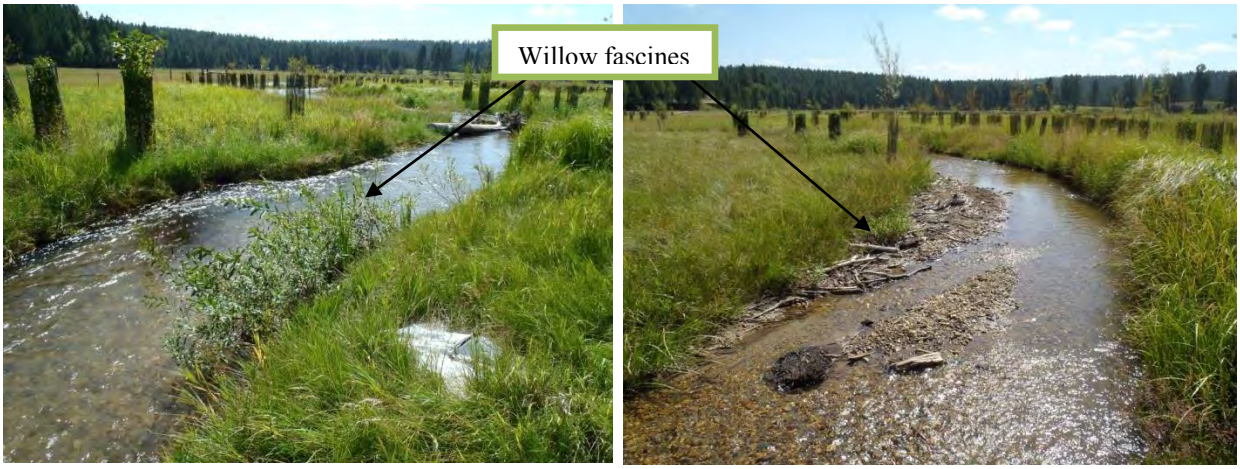


Figure 21. Photographs showing various conditions of willow fascines.

Large Woody Debris Structures

In 2012, general observations were made of all large woody debris structures. In addition, three vegetation transects established in 2008 were re-monitored to evaluate shifts in species composition in the floodplain adjacent to the woody debris structures. The intent of the large woody debris structures was to create hydrologic conditions in the floodplain that would support more diverse native vegetation. Tracking shifts in the cover of wetland species provides a good indication of whether or not the debris jams are functioning to increase hydrology in the rooting zone and enhance hydrologic connectivity.

It was difficult to observe some of the intended functions of the large woody debris structures, such as sediment, debris and seed recruitment, due to turbidity in the stream at the time of monitoring (Figure 22). Some sediment deposition was observed along with natural colonization of woody vegetation (Figure 23).

Figure 22. 2012 photos of woody debris structures: structure 1 (A), structure 2 (B), structure 3 (C), structure 4 (D), and structure 5 (E).

Figure 23. Sediment deposition and willow colonization at woody debris structure.

To evaluate if species composition in the floodplain has shifted in response to the woody debris structure treatment, three floodplain transects were relocated and species composition recorded according to the methods described in the 2008 Monitoring Report (Geum Environmental 2008). To evaluate shifts towards a composition of wetter species composition the hydrologic indicator status of species recorded in 2008, 2009, and 2012 were used. The National Wetland Plant List (NWPL) is the standard reference for plant species wetland indicator status ratings (Lichvar 2012). The five indicator status rating categories are described as:

- **OBL** (Obligate Wetland Plants) -- Almost always occur in wetlands. With few exceptions, these plants (herbaceous or woody) are found in standing water or seasonally saturated soils (14 or more consecutive days) near the surface.
- **FACW** (Facultative Wetland Plants) -- Usually occur in wetlands, but may occur in non-wetlands. These plants predominately occur with hydric soils, often in geomorphic settings where water saturates the soils or floods the soil surface at least seasonally.
- **FAC** (Facultative Plants) -- Occur in wetlands and nonwetlands. These plants can grow in hydric, mesic, or xeric, habitats. The occurrence of these plants in different habitats represents responses to a variety of environmental variables other than just hydrology, such as shade tolerance, soil pH, and elevation, and they have a wide tolerance of soil moisture conditions.
- **FACU** (Facultative Upland Plants) -- Usually occur in non-wetlands, but may occur in wetlands. These plants predominately occur on drier or more mesic sites in geomorphic settings where water rarely saturates the soils or floods the soil surface seasonally.
- **UPL** (Upland Plants) -- Almost never occur in wetlands. These plants occupy mesic to xeric non-wetland habitats. They almost never occur in standing water or saturated soils. Typical growth forms include herbaceous, shrubs, woody vines, and trees.

Only herbaceous species with a wetland indicator status rating of OBL or FACW were compared among years. Planted vegetation was not included in this assessment but covers were recorded and can be seen in Appendix E. Table 6 shows the percent cover of OBL and FACW species along each transect for each year of monitoring. The percent cover is the total cover of all species with a rating of OBL or FACW. As shown in Table 6, there has been an increase in

percent cover as well as distribution of wetland species along all transects. In 2008 non-native pasture grasses, such as quackgrass, smooth brome, and common timothy, dominated all three transects. Four years later in 2012, there are more wetland species, such as various sedges and mannagrass. The cover of these species has increased as well as the amount of area along the transect in which they occur. Shrubs were also recorded along transects in 2012 as a result of Phase III planting and some natural colonization. Appendix E provides percent cover by species recorded on each transect.

Table 6. Comparison of total percent cover of OBL or FACW species found along vegetation transects in 2008, 2009 and 2012.

	Transect 1			Transect 2			Transect 3[1]		
Transect Distance (ft)	**2008**	**2009**	**2012**	**2008**	**2009**	**2012**	**2008**	**2009**	**2012**
0-10	0%	0%	0%	0%	0%	19%	0%	0%	20
10-20	0%	0%	0%	0%	0%	50.5%	0%	0%	0%
20-30	0%	0%	0%	Channel	Channel	Channel	Channel	Channel	Channel
30-40	0%	0%	0%	0%	0%	40%	0%	0%	0%
40-50	0%	0%	13%	0.5%	3.5%	63%	0%	0%	0%
50-60	1.5%	40%	46%	50%	20%	103%[2]	0%	0%	0%
60-70	10%	33%	0.5%	10%	79%	106.5%[2]	0%	0%	0%
70-80	0%	0%	0.5%	0%	49%	63%	0%	0%	10%
80-90	Channel	Channel	Channel	0%	0.5%	0%	0%	0%	0%
90-100	0%	0%	0%	0%	0%	0%	0%	0%	0%
100-110	1%	3%	53%	0.5%	3%	40%			
110-120	0.5%	0%	10%	0.5%	6.5	20%			
120-130	0%	0%	0%	0%	20.5	0%			
130-140	0%	0%	0%	0%	0%	10%			
140-150	0%	0%	0%	0%	0%	0%			
150-160	0%	0%	0%	0%	0%	0%			
160-170	0%	0%	0%	0%	0%	0%			
170-180	0%	0%	0%	0%	0%	0%			
180-190	0%	0%	0%	0%	0%	0%			
190-200	0%	0%	0%	0%	0%	0%			

[1]Transect 3 is only 100 feet long

[2] Total cover exceeds 100% at these distances because of dense vegetation resulting in overlapping cover

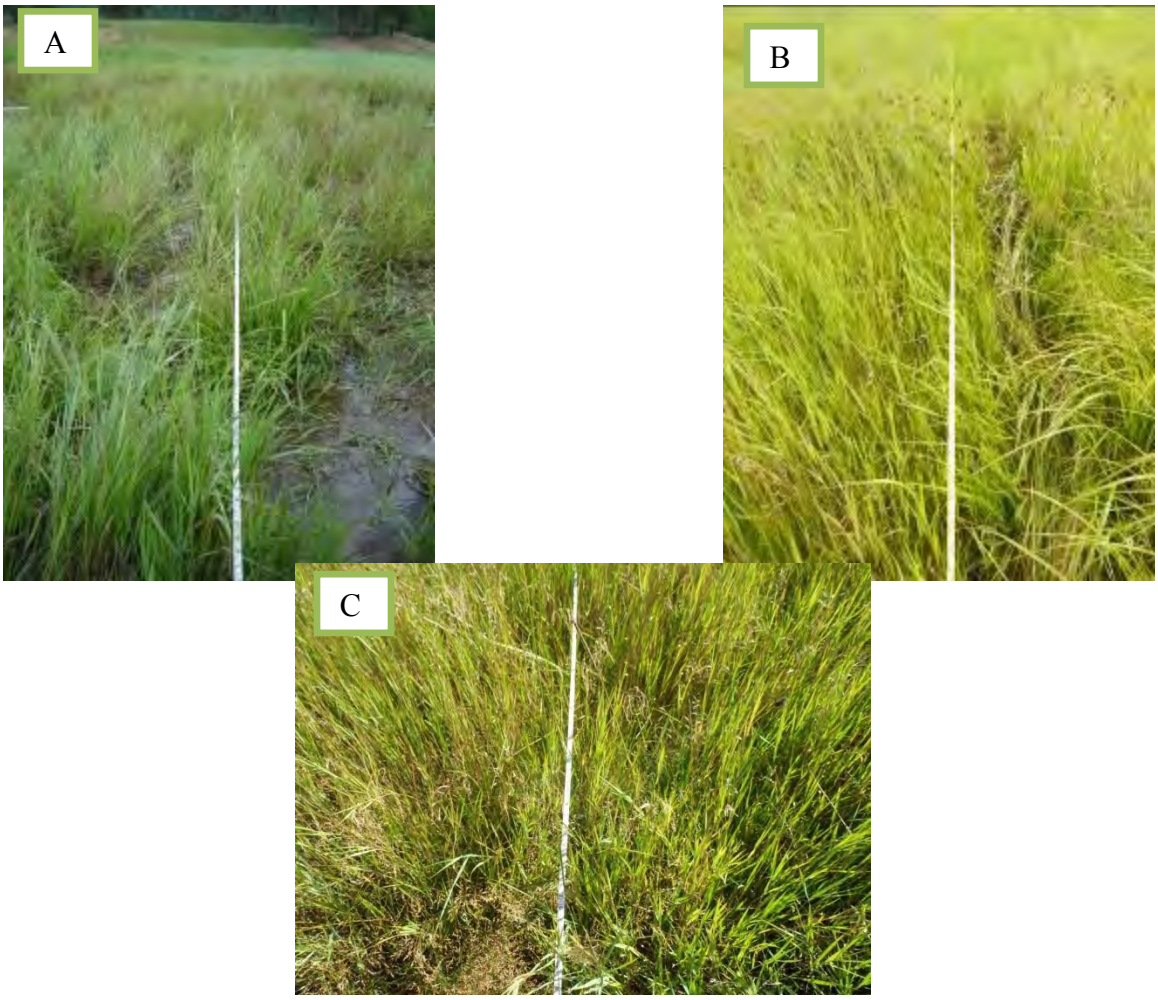


Figure 24. Photographs of Woody Debris Transect 1 at the 50-60' interval in 2008 (A) 2009 (B), and 2012 (C)

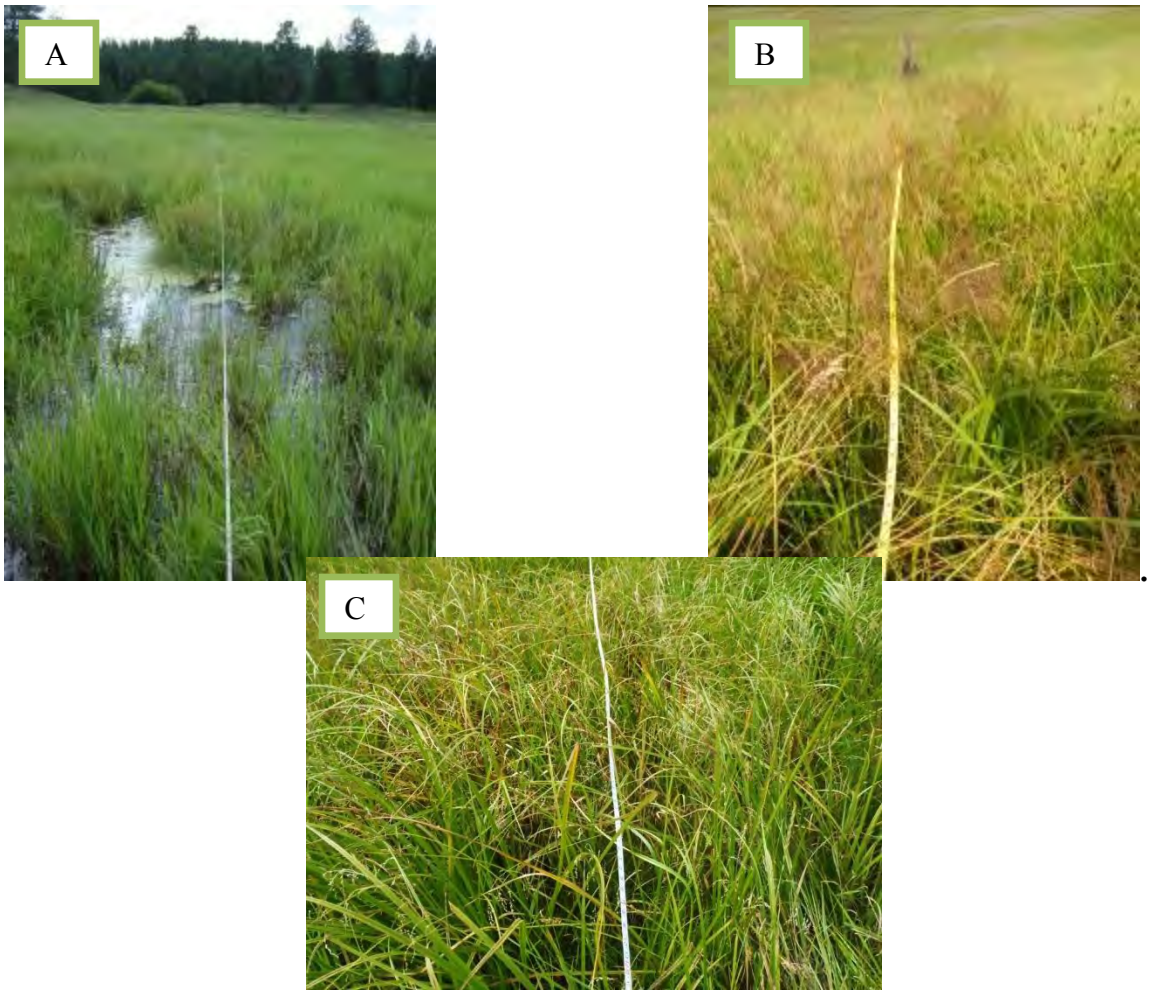


Figure 25. Photographs of Woody Debris Transect 2 at the 50-60' interval in 2008 (A), 2009(B) and 2012 (C).

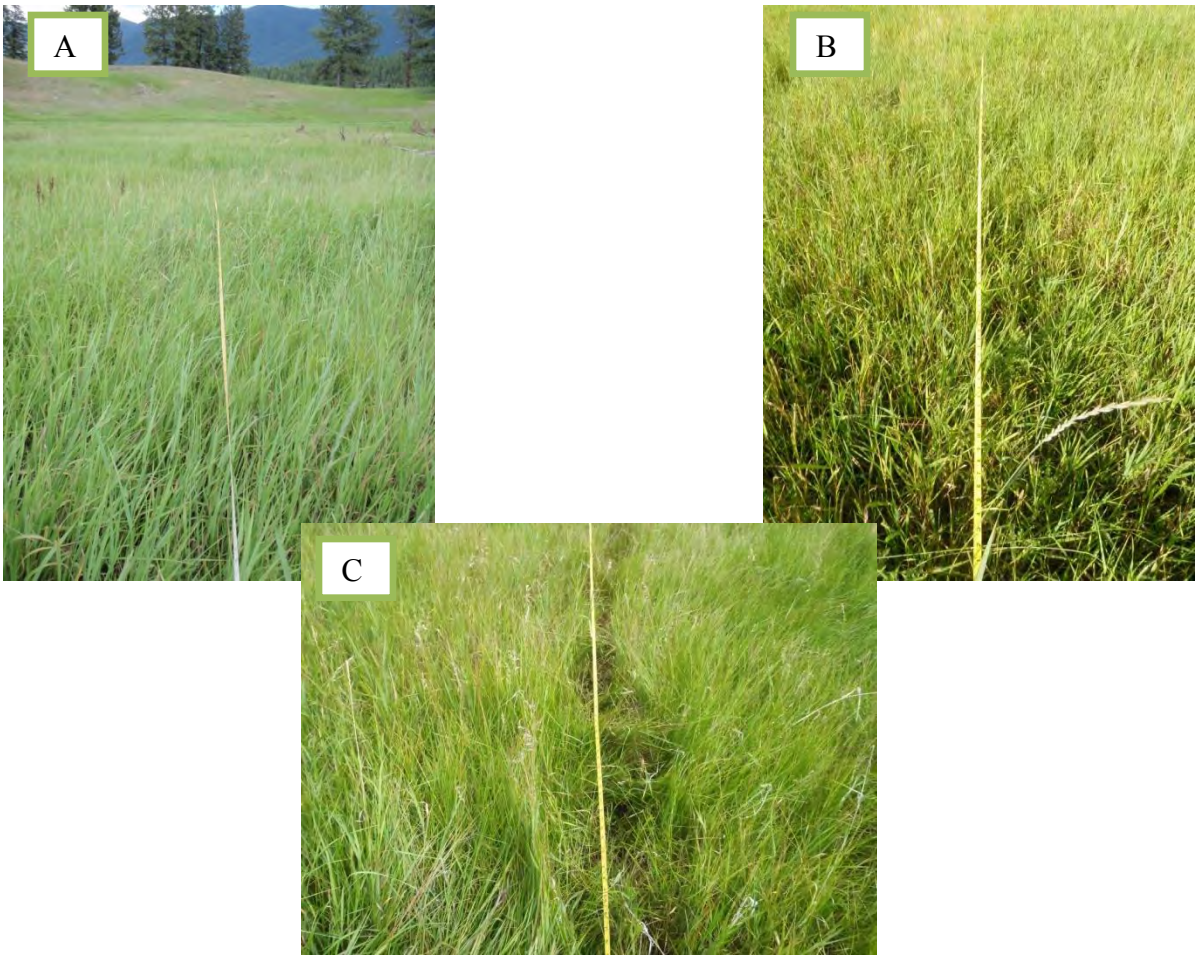


Figure 26. Photographs of Woody Debris Transect 3 at the 60-70' interval in 2008(a), 2009(B), and 2012 (C).

Based on 2012 and previous years' observations and the pathway for maintenance and adaptive management, the following recommendations were made for large woody debris structures:

- No maintenance of structures is necessary.
- Continue to observe the function of woody debris structures but no future maintenance or monitoring is anticipated. In general, the floodplain near woody debris structures is shifting toward wetter, native vegetation which is the desired function of these structures.

Coir Logs

In 2012, general observations were made of all coir log structures. Overall survival, percent cover and willow height are consistent with observations made in 2011. In general, willow cuttings are beginning to form a dense band of woody vegetation along the streambank (Figure 27). The 2012 spring flood caused some changes at coir log installation sites. A number of coir logs are no longer visible due to deposition of gravels in the channel (Figure 28). No lateral migration of the channel was observed at any of the coir log sites as a result of 2012 spring floods; however, the channel both deepened and filled to varying degrees. More browse was observed on willow cuttings compared with 2011. At coir log site 4 willows from the coir log and a willow fascine on the opposite bank are beginning to provide instream cover (Figure 27).

Figure 27. Coir log site 4 with consistent growth of willows along right bank. Most willows showed some signs of browse.

Figure 28. Coir log site where gravel deposition in the channel buried the coir log.

Figure 29. Coir log site 7 showing dense willow growth on the left bank from the coir log and willow cover on the right bank from a willow fascine structure.

Based on 2012 and previous years' observations and the pathway for maintenance and adaptive management, the following recommendations were made for coir logs:

- No maintenance of structures is necessary.
- Continue to observe the function of coir logs but no future maintenance or monitoring is anticipated. Willow survival and percent cover is adequate at all sites to expect willows to maintain streambank and floodplain stability once the coir logs degrade.

Weed Control

In July 2012, general observations of remaining weed infestations in the project area were made. These observations were used to guide 2012 weed treatments. Weeds in the project area were mapped in August 2012. Effectiveness of summer 2012 herbicide application was observed during weed mapping.

Weed control has been completed annually at the site since 2008. Weed management has consisted of primarily herbicide application due to the extent of infestations and the presence of multiple target species. In 2012, weed control targeted all occurrences of Canada thistle, yellow toadflax, houndstongue and isolated patches of reed canarygrass. In addition, weed control was prioritized for large infestations of Canada thistle located in the hayfield east of the project area and upstream of the project area. Transline® was applied at a rate of 0.5 ounces/gallon and 40 gallons per acre to treat thistle, toadflax and houndstongue. Roundup® was used to treat reed canarygrass. Brash® was used to treat yellow toadflax and houndstongue at a rate of 1 ounce/gallon and 45 gallons per acre. Figure 30 shows a small isolated patch of reed canarygrass after treatment with herbicide. Figure 31 shows Canada thistle plants after treatment. Figure 32 shows the extents of 2012 herbicide application. A total of 26 acres were treated.

Figure 33 shows the location of existing weeds in the project area. This map includes all occurrences of living weed species but also includes some plants or infestations of plants that showed signs of herbicide treatment in 2012. Most of the spot infestations shown on the weed map consist of a single plant. Some spot infestations consist of areas no greater than 50 square feet. In these areas density is low to moderate. No sulfur cinquefoil was observed in 2012 indicating that this species has been effectively eradicated from the site. Yellow toadflax remains isolated to the area near the bridge. Houndstongue continues only to be present in small patches near the road at the upstream end of the project area and near the newly constructed livestock water gap. Oxeye daisy was recorded in the project area in a few isolated locations. Cheatgrass and bull thistle were also recorded just outside of the fence boundary delineating the revegetation treatment area. Reed canarygrass is still widely distributed throughout the project area, but continues to be present only in small isolated patches in the upper reaches of the project site. A number of patches have been effectively controlled but new patches continue to occur. Reed canarygrass remains dense and widespread near the downstream extent of the project area. These downstream populations have not been treated due to their proximity to the channel and the extent of the infestation. Canada thistle remains the primary target species at the site. Thistle has been effectively controlled in most of the project area and the spot infestations shown on the weed map typically consist of a few immature plants. Phase III planting units 19, 20, and 21 all have numerous immature and mature plants present. In addition, three large infestations of Canada thistle remain in or near the project area (Figure 34). All of these infestations were treated to some extent in July 2012. Thistle density continues to increase in the hayfield to the

east of the project area. This infestation is encroaching onto the eastern boundary of the project and is likely the reason for the increase of thistle in planting units along the eastern edge of Phase III.

Figure 30. Isolated patch of reed canarygrass treated with herbicide in July 2012.

Figure 31. Canada thistle plants treated in July 2012.

Figure 32. Extent of July 2012 herbicide treatments.

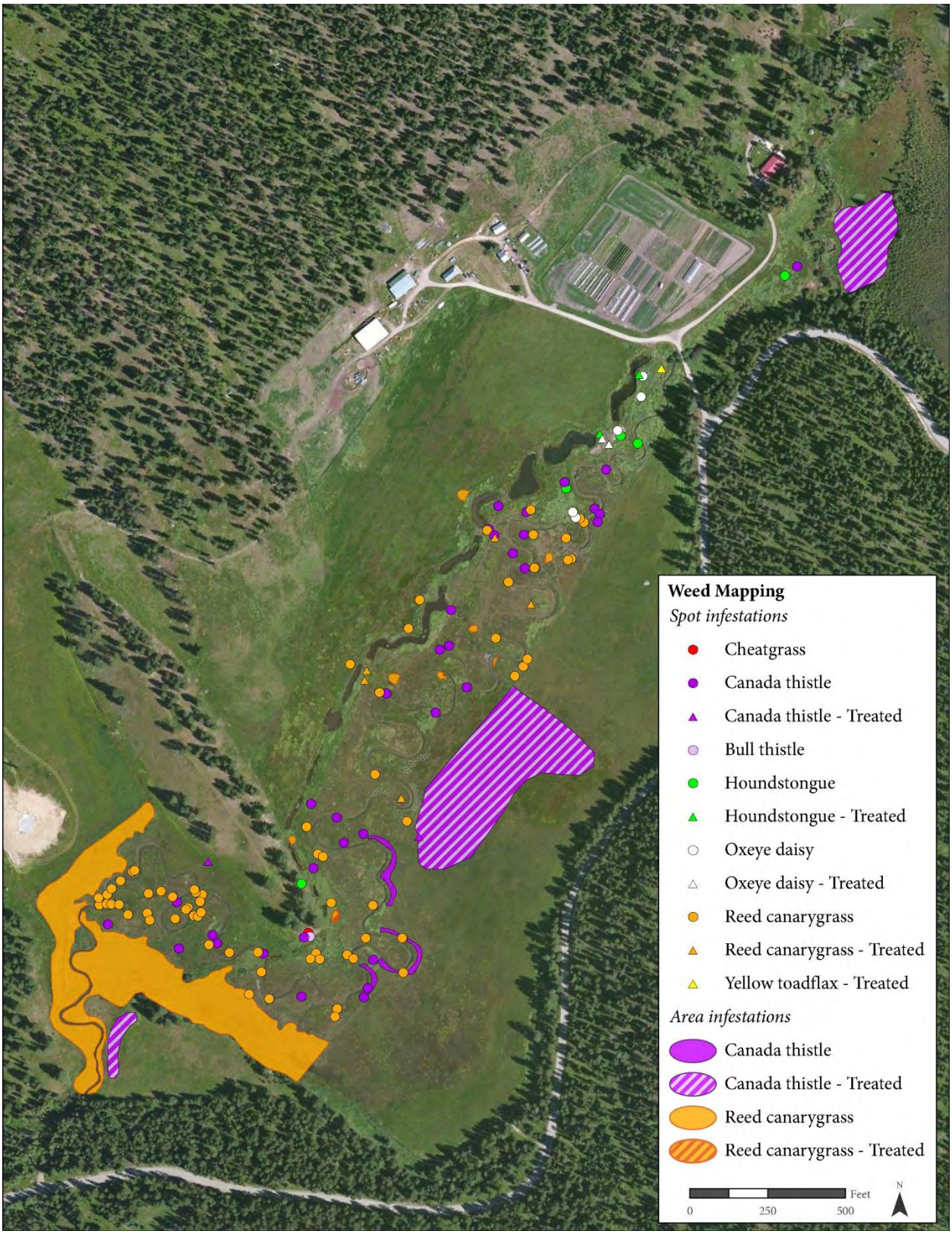


Figure 33. Locations of weeds within and immediately adjacent to the Therriault Creek project area.

Figure 34. Remaining Canada thistle infestations within and immediately adjacent to revegetation treatment areas including within planting units in Phase III along the east side of the channel (A); the hayfield to the east of the project (B); on the east side of the channel upstream of the road (C); and along the east side of the channel at the downstream end of the project area (D).

Based on 2012 and previous years' observations and the pathway for maintenance and adaptive management, the following are weed treatment recommendations for the project site:

- Continue active weed control and herbicide applications until Canada thistle seed sources are exhausted. Canada thistle has been effectively controlled within the revegetation treatment area, but large infestations adjacent to the project continue to be a threat to achieving revegetation goals. Future weed control needs to include treatment of the entire infested areas adjacent to the project. Weed control should continue for a minimum of five more years.
- Use the 2012 mapping as a guide for 2013 weed control to ensure all occurrences of weeds are treated.
- Continue to treat isolated patches of reed canarygrass in the project area. Reed canarygrass cannot be eradicated from the site and despite on-going control of small patches in the upstream portion of the project site, it continues to spread to new areas. Re-treating isolated patches in the fall after summer application may increase control.

Vegetation Communities

Vegetation communities were broadly mapped in 2006 prior to implementation of the riparian revegetation project. In 2006, five distinct vegetation communities were present in the project reach area (Figure 35). These vegetation communities are described in the *Therriault Creek Revegetation Plan* (Geum Environmental 2007). Vegetation communities mapped in 2006 included:

- Bebb Willow
- Pasture Grass
    - Drier Pasture
    - Wetter Pasture
- Quackgrass
- Pond associated plant communities
- Wetter quackgrass
- Sedges/rushes
- Spruce/Red-osier dogwood

Vegetation communities were mapped again in 2012. In 2012, weed mapping was completed by walking the entire project area and recording distinct vegetation breaks either on 2011 aerial photos or using a resource-grade GPS unit. Figure 36 shows the vegetation communities mapped in the project area in 2012. Plant communities upstream of the road (Shrub and Dry Pasture Grass) and downstream of the channel reconstruction area (Spruce/Red-osier dogwood) have remained similar in the last six years. The upstream portion of the revegetation area is still predominantly drier pasture grasses but there are numerous small inclusions of sedges along the channel and many of the planting units and residual shrub treatment areas have sufficient shrub cover to be mapped as Shrub vegetation communities (Figure 37). The middle portion of the project area is where the most significant shifts in vegetation communities have occurred in the last six years. There are large areas dominated by sedges in the middle portion of the project area (Figure 38). Pond associated plant communities have remained similar in the last six years. The downstream extent of the project area remains dominated by wetter pasture grass species and quackgrass but as shown in the woody debris structures vegetation transects (Table 6 above) there has been a subtle shift towards wetter species. Reed canarygrass has expanded significantly in the downstream portion of the project area.

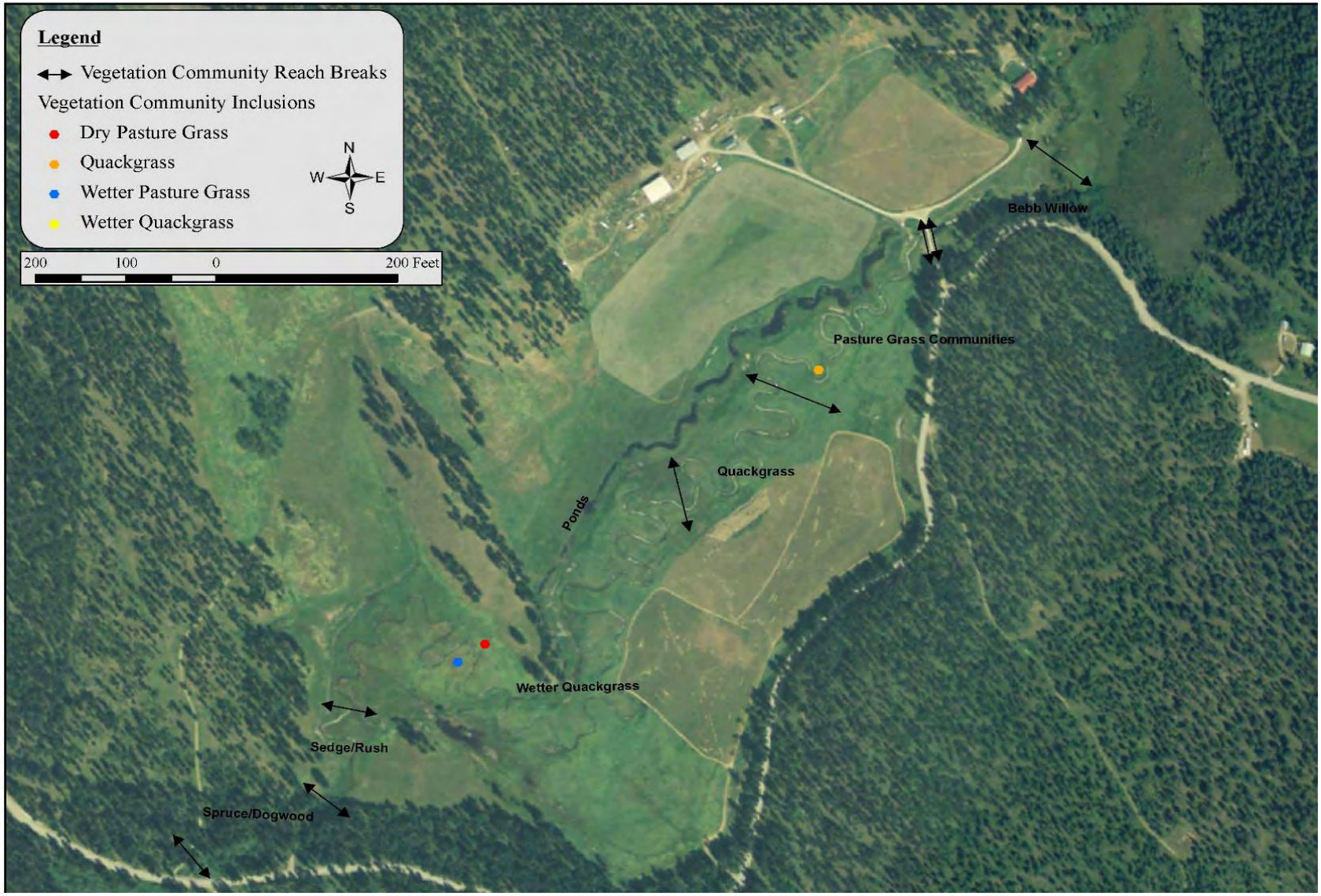


Figure 35. Vegetation communities mapped in the project area in 2006.

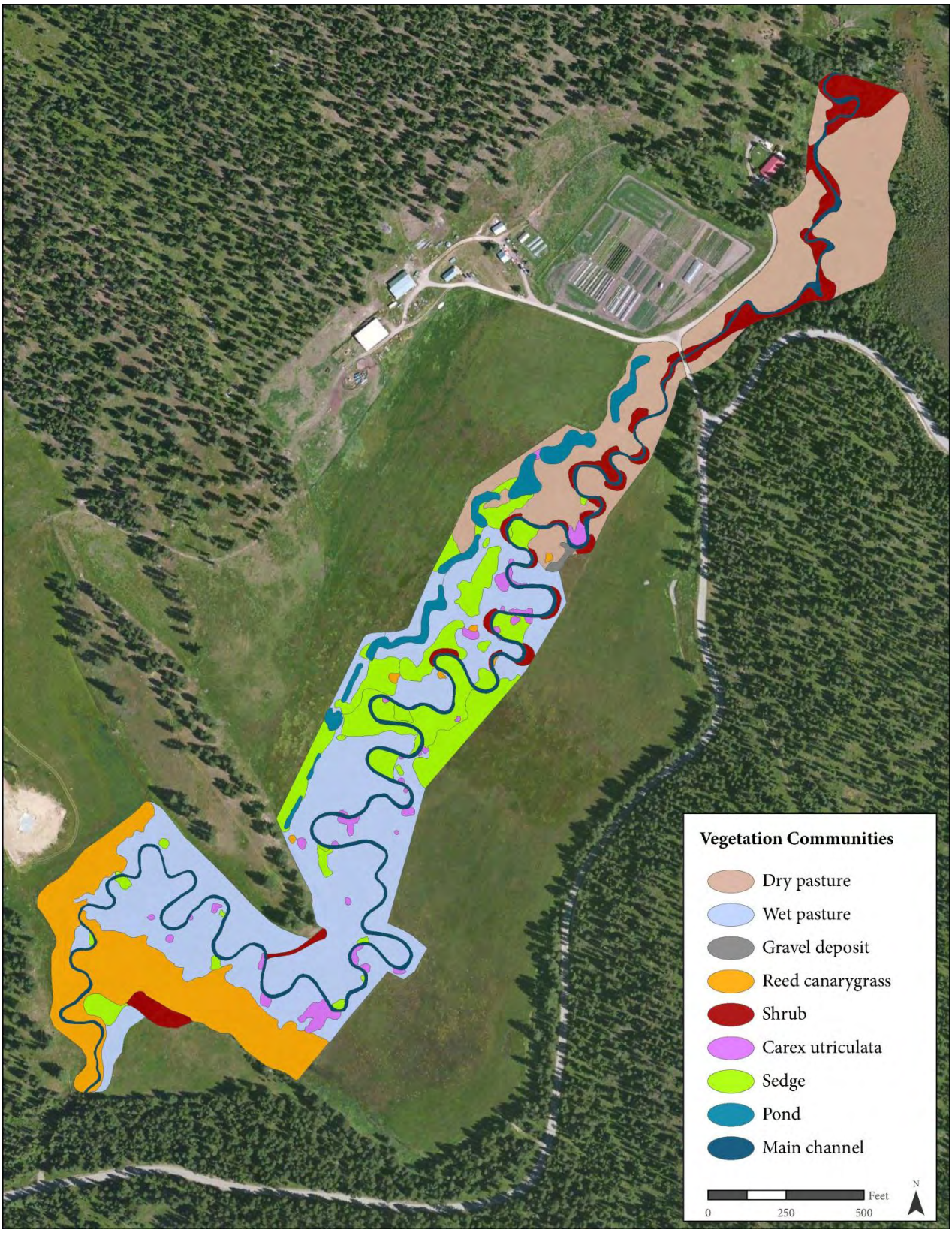


Figure 36. Vegetation communities mapped in the project area in August 2012.

Figure 37. Development of shrub vegetation communities in Phase I.

Figure 38. Expansion of sedges in middle portion of project reach.

Progress Towards Meeting Project Goals and Objectives

The goal of the Therriault Creek Riparian Revegetation project is to create a diverse mosaic of native woody riparian plant communities within the project area. The objectives for revegetation of the Therriault Creek restoration project reach area include:

- Protect the stability of the restored channel using native woody vegetation.
- Enhance habitat for native fish populations through use of native woody vegetation.
- Limit invasion and continued spread of Canada thistle and other noxious weeds.
- Protect surviving containerized plantings from initial revegetation efforts.
- Create conditions that will promote natural revegetation by native species.

Each of these objectives is discussed below:

Protect Stability of Restored Channel

Treatments installed in the project area to protect the stability of the restored channel have included: vegetated soil lifts, coir log treatments, and planting of outer meander bends. The channel has remained very stable since construction. Deepening of pools has been observed on outside meander bends over the last six years but riffles and the more uniform channel habitat in the lower half of the project have shown little change. Very little deposition of gravels, sands, or fines has occurred outside of the active channel. The constructed channel dimensions and planform and dense herbaceous vegetation in the floodplain have been the primary factors protecting channel stability in the last six years but soil lifts and coir logs have supported channel stability while allowing habitat to develop. Shrubs planted in Phase I and III will provide long term stability of the restored channel.

The spring 2012 flood resulted in some changes to the channel including areas of localized erosion, scour, and deposition. A 1,000 foot long section of channel filled with gravel during the 2012 spring flood resulting in the majority of flows being routed over the floodplain (Figure 39). Figure 40 shows the route of the overland flows, return point, and gravel deposition in the floodplain as a result of overland flows. Project partners plan to restore the channel dimensions through this reach to ensure stability of the restored channel. Riparian vegetation should benefit from the gravel deposition and prolonged saturation of the floodplain that occurred.

The site is well on its way to achieving the objective related to protecting stability of the restored channel. As shrubs continue to grow and mature, channel stability will increase while allowing natural disturbance regimes to create and maintain riparian and aquatic habitat.

Figure 39. Channel filled with gravel from 2012 spring flood.

Figure 40. Channel overflow return point and view of channel overflow route and gravel deposition on the floodplain.

Enhance Habitat for Native Fish

Treatments implemented in the project area to enhance habitat for native fish include vegetated soil lifts, coir logs, willow fascines, residual shrub protection, outer meander planting, and woody debris structures. All of these treatments directly enhance aquatic habitat by providing shade, instream cover, and support for aquatic food web functions. The degree to which treatments currently enhance aquatic habitat varies. In some areas planted shrubs are not big enough to provide substantial thermal cover but in other areas, such as where coir logs, soil lifts or willow fascines were installed, shrubs are over-hanging the stream and providing both thermal and physical cover (Figure 41). To evaluate this objective, solar radiation measurements were recorded in select planting units in Phase I and III using a Solar Pathfinder ™. Table 7 shows the results of solar radiation measurements. Planting units in Phase III had the highest solar radiation with an average 97.6 percent available solar radiation. The Phase I planting units, where shrubs are larger, had an average of 82.1 percent available solar radiation. Solar radiation in the channel adjacent to vegetated soil lifts where dense woody vegetation is over-hanging the channel had the lowest available solar radiation with 71.3 percent. This indicates that as woody vegetation establishes it is effectively reducing the amount of solar radiation reaching the channel. Woody debris structures appear to have enhanced habitat for native fish and large numbers of fish are regularly observed moving in and out of these structures during annual monitoring.

Treatments installed at the site are beginning to support this objective. As shrubs continue to grow and mature, habitat for native fishes will continue to improve.

Figure 41. Instream cover provided by willows installed in coir log and willow fascine structures.

Table 7. Percent solar radiation at select planting units in Phase 1, Phase 3, and in the channel at vegetated soil lift sites. Percent radiation is reported for summer months (April through August).

Unit	Summer Radiation	Average
Phase 3 Unit 24	98.20%	97.6%
Phase 3 Unit 20	95.80%	
Phase 3 Unit 18	96.60%	
Phase 3 Unit 16	98.40%	
Phase 3 Unit 14	100.00%	
Phase 3 Unit 12	97.40%	
Phase 3 Unit 10	99.40%	
Phase 3 Unit 4	93.40%	
Phase 3 Unit 2	99.20%	
Phase 1 Unit 12	86.40%	82.1%
Phase 1 Unit 7	73.40%	
Phase 1 Unit 5	76.80%	
Phase 1 Unit 1	91.80%	
Phase1 VSL 2	83.00%	71.3%
Phase1 VSL 1	59.60%	

Limit Invasion and Spread of Noxious Weeds

Treatments implemented in the project area to limit invasion and spread of noxious weeds include annual weed treatments with herbicide. Weed treatments have effectively reduced the large infestations of Canada thistle that were present in the project area prior to treatment. Weed treatments have also effectively reduced the spread of other noxious weed species that occur in the project area. Weed treatments have been somewhat successful in limiting the spread of reed canarygrass in the project area. Numerous isolated patches of reed canarygrass have been effectively controlled but new patches appear every year.

Although previous treatments have been effective at controlling existing infestations and limiting the spread of most weeds in the project area, there are still existing infestations within and adjacent to the project area that may compromise the goal of riparian revegetation at the site.

Protect Surviving Containerized Plants

Treatments installed in the project area to protect plants planted during channel construction include residual shrub protection measures. More than 200 residual shrubs have been protected with individual browse protectors in the last five years. This treatment has been very effective and residual shrubs are some of the largest plants in the project area (Figure 42). In addition, residual shrubs have begun to expand through suckering and seed production on a number of inside meanders in Phase I.

Treatments installed at the site support this objective and protected residual shrubs are beginning to provide a number of ecological benefits including habitat, channel stability, and thermal cover.

Figure 42. Residual protected shrubs at the upstream end of the project area.

Create Conditions to Promote Natural Revegetation

Treatments installed in the project area to create conditions to promote natural revegetation include solarization treatments and woody debris structures. Solarization has effectively created conditions necessary to promote natural revegetation but natural revegetation of these sites has been variable. In most cases early colonization of exposed mineral soils by desired grass, sedge, rush, and forb species has occurred the first year after exposure, but the following year the site begins to be recolonized by undesirable grasses due to the extensive seed sources of these species surrounding the sites. At some sites, exposing the bare mineral soil has allowed for colonization of desirable woody species from seed. Woody debris structures have effectively enhanced floodplain hydrology and helped convert the floodplain to wetter plant species. These structures are also beginning to create areas that support natural colonization of woody species. The original channel restoration project resulted in increased channel sinuosity and reconnected the channel with the floodplain which set the stage for other riparian revegetation-focused treatments to further improve conditions supporting natural processes. Restoring floodplain hydrology has resulted in the rapid expression of a dormant seedbank consisting of a diverse mix

of sedge, rush, forb, and grass species. Over time, the site should continue to transition to a diverse mosaic of shrubs and herbaceous plant communities.

Treatments installed at the site have created conditions that promote natural revegetation. The wetter floodplain resulting from channel restoration and woody debris structures is transitioning the site to a more diverse mix of native herbaceous species. Planted shrubs are beginning to successfully reproduce at the site. Solarization has effectively killed undesirable species and created the necessary conditions to support native riparian and wetland species but recolonization of undesirable species continues to be a challenge in these areas. However, the large-scale transition to more diverse native species may indicate that these sites will naturally transition over time.

Adaptive Management: Next Steps

This section summarizes recommendations for continued monitoring, maintenance and revegetation activities at the Therriault Creek restoration project site. The revegetation plan for the Therriault Creek restoration project was prepared in 2007. The first phase of implementing the revegetation plan was completed in the fall of 2007. Since that time, monitoring, maintenance and additional phases of revegetation have been implemented using an adaptive management framework. As described above, the site is clearly trending towards meeting the goal and objectives of the riparian revegetation plan developed for the site. While most of the objectives are long term, monitoring data and observations indicate that the site is trending towards meeting all of them. Observations indicate that the site continues to trend toward the desired conditions with woody riparian vegetation establishing along the streambanks and conversion of the herbaceous vegetation from predominantly pasture grass to a more diverse mix of native sedges, rushes, forbs and grasses. For this reason, very few additional active revegetation treatments are anticipated to be necessary at the site to meet project objectives. Continued evaluation of site conditions and maintenance of installed treatments will be necessary for a few more years. The decision making pathway for revegetation treatments in Table 2 will continue to apply to decision making in 2013. Recommendations for 2013 are provided below.

The following monitoring should be completed in 2013:

- Monitor a select number of Phase III planting units to evaluate survival and growth.
- Repeat photo monitoring of all treatments.
- Record observations of all treatments.
- Determine maintenance needs for all revegetation treatments.

The following maintenance is anticipated in 2013:

- Continue maintenance and removal of browse protectors in Phase I and Phase III if monitoring observations indicate that plants with removed browse protectors are withstanding browse pressure.

The following revegetation activities are anticipated in 2013:

- Continue to aggressively treat Canada thistle and other noxious weeds in the project area.

- Coordinate with the landowner or allocate funds to treat dense infestations of Canada thistle in the hayfield to the east of the project area.
- Continue to treat isolated patches of reed canarygrass in the project area but increase treatment to twice a year.
- Remove solarization fabric in Phase III if monitoring data indicate grass has been effectively killed and there is potential to revegetate with desirable species.

References

Geum Environmental Consulting, Inc. 2007a. Therriault Creek Riparian Revegetation Plan. Internal report prepared for Kootenai River Network, Libby, Montana.

Geum Environmental Consulting, Inc. 2007b. Therriault Creek Revegetation Plan Implementation Report. Internal report prepared for Montana Fish, Wildlife and Parks, Libby, Montana. Contract #080067.

Geum Environmental Consulting, Inc. 2008. Therriault Creek Riparian Revegetation Monitoring Report Contract #0803. Internal Report prepared for Kootenai River Network, Libby, Montana.

Geum Environmental Consulting, Inc. 2009. Therriault Creek Riparian Revegetation Maintenance and Monitoring 2009 Report Contract #0709. Internal Report prepared for Kootenai River Network, Libby, Montana.

Geum Environmental Consulting, Inc. 2010. Therriault Creek Riparian Revegetation Maintenance and Monitoring 2010 Report Contract #110032. Internal Report prepared for Montana Fish, Wildlife and Parks, Libby Montana.

Lichvar, R.W. 2012. The National Wetland Plant List. ERDC/CRREL TR-12-11. Hanover, NH: U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory. http://acwc.sdp.sirsi.net/client/search/asset:asset?t:ac=$N/1012381

Appendix A: Phase I Planting Units Photograph Documentation 2008 through 2012

This page left intentionally blank.

Planting Unit 1





2008 **2009** **2010** **2011** **2012**

Planting Unit 3

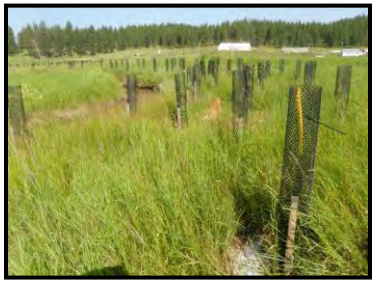




2008 **2009** **2010** **2011*** **2012**

*2011 photo taken from upstream viewing downstream. All other photos view upstream.

Planting Unit 5


2008 **2009** **2010** **2011** **2012**

Planting Unit 7





2008 **2009** **2010** **2011** **2012**

Planting Unit 12





2008 **2009** **2010** **2011** **2012**

Planting Unit 14





2008 **2009** **2010** **2011** **2012**

Planting Unit 16

2008 **2009** **2010** **2011** **2012**

Planted Solarization Unit 1

2008 **2009** **2010** **2011** **2012**

Planted Solarization Unit 2

2008 **2009** **2010** **2011** **2012**

This page left intentionally blank.

Appendix B: Phase I Vegetated Soil Lift Photograph Documentation 2008 through 2012

This page left intentionally blank.

Vegetated Soil Lift 1

2008 **2009** **2010** **2011** **2012**

Vegetated Soil Lift 2

2008 **2009** **2010** **2011** **2012**

This page left intentionally blank.

Appendix C: Phase I Coir Log Photograph Documentation 2008 through 2012

This page left intentionally blank.

Coir Log 1


2008


2009


2010


2011


2012

Coir Log 2


2009


2010


2012

Coir Log 3


2008


2009


2010


2011


2012

Coir Log 4


2008


2009


2010


2011


2012

Coir Log 5


2008


2009


2010


2011


2012

Coir Log 6


2008


2009


2010


2011


2012

Coir Log 7

2008

2009

2010

2011

2012

This page left intentionally blank.

Appendix D: Phase III Planting Units Photograph Documentation Fall 2010 through 2012

This page left intentionally blank.

Planting Unit 1

2010

2011

2012

Planting Unit 2

2010

2011

2012

Planting Unit 3

2010

2011

2012

Planting Unit 4

2010

2011

2012

Planting Unit 6

2010

2011

2012

Planting Unit 7

2010

2011

2012

Planting Unit 9

2010

2011

2012

Planting Unit 10

2010

2011

2012

Planting Unit 11

2010

2011

2012

Planting Unit 12

2010

2011

2012

Planting Unit 13

2010

2011

2012

Planting Unit 14

2010

2011

2012

Planting Unit 15

2010

2011

2012

Planting Unit 16

2010

2011

2012

Planting Unit 17

2010

2011

2012

Planting Unit 18

2010

2011

2012

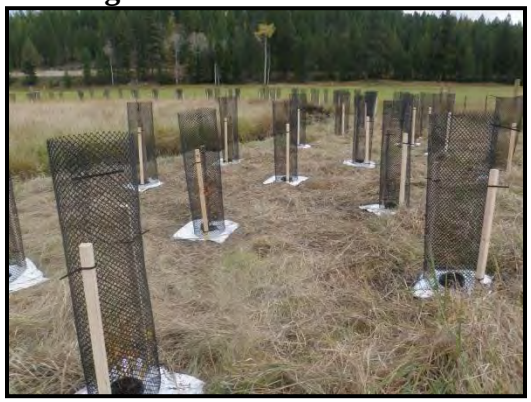
Planting Unit 19

2010

2011

2012

Planting Unit 20



2010

2011

2012

Planting Unit 21

2010

2011

2012

Planting Unit 22

2010

2011

2012

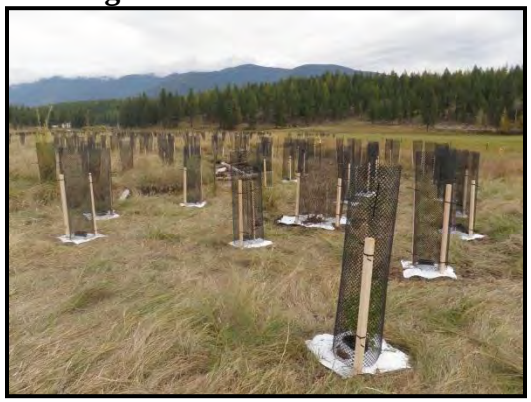
Planting Unit 23

2010

2011

2012

Planting Unit 24



2010

2011

2012

This page left intentionally blank.

Appendix E: Species Recorded on Vegetation Transects in August 2012

This page left intentionally blank.

Distance	Scientific Name	Common Name	Percent Cover	Wetland Indicator Status Rating	Water Depth (in)
Vegetation Transect 1					
0-10	*Phleum pratense*	common timothy	40	FAC	saturated
	Elemus repens	quackgrass	40	FAC	
	Poa pratensis	Kentucky bluegrass	20	FAC	
10-20	*Phleum pratense*	common timothy	60	FAC	saturated
	Elemus repens	quackgrass	30	FAC	
	Poa pratensis	Kentucky bluegrass	10	FAC	
20-30	*Phleum pratense*	common timothy	50	FAC	saturated
	Poa pratensis	Kentucky bluegrass	30	FAC	
	Elemus repens	quackgrass	20	FAC	
	Polygonum	smartweed	0.5	N/A*	
	Agrostis stolonifera	redtop	0.5	FAC	
30-40	*Phleum pratense*	common timothy	40	FAC	saturated
	Poa pratensis	Kentucky bluegrass	20	FAC	
	Agrostis stolonifera	redtop	10	FAC	
	Elemus repens	quackgrass	30	FAC	
	Polygonum	smartweed	3	N/A	
40-50	*Elemus repens*	quackgrass	30	FAC	saturated
	Poa pratensis	Kentucky bluegrass	10	FAC	
	Agrostis stolonifera	redtop	20	FAC	
	Carex utriculata	Northwest Territory sedge	10	OBL	
	Carex stipata	owlfruit sedge	3	OBL	
	Polygonum	smartweed	3	N/A	
	Carex bebbii	Bebb's sedge	3	OBL	
	Glyceria spp	mannagrass species	0.5	OBL**	
	Phleum pratense	common timothy	20	FAC	
50-60	*Glyceria spp*	mannagrass species	20	OBL	saturated
	Agrostis stolonifera	redtop	10	FAC	
	Carex bebbii	Bebb's sedge	20	OBL	
	Poa pratensis	Kentucky bluegrass	10	FAC	
	Elemus repens	quackgrass	10	FAC	
	Phleum pratense	common timothy	10	FAC	
	Carex utriculata	beaked sedge	3	OBL	
	Carex stipata	owlfruit sedge	3	OBL	
60-70	*Poa pratensis*	Kentucky bluegrass	30	FAC	saturated
	Elemus repens	quackgrass	30	FAC	
	Phleum pratense	common timothy	10	FAC	
	Populus balsamifera	black cottonwood	3	FAC	

Distance	Scientific Name	Common Name	Percent Cover	Wetland Indicator Status Rating	Water Depth (in)
	Salix bebbiana	bebb willow	3	FACW	
	Agrostis stolonifera	redtop	20	FAC	
	Cornus sericea	red-osier dogwood	3	FACW	
	Carex bebbii	bebb sedge	0.5	OBL	
70-80	*Poa pratensis*	Kentucky bluegrass	30	FAC	saturated
	Agrostis stolonifera	redtop	40	FAC	
	Elemus repens	quackgrass	20	FAC	
	Polygonum	smartweed	0.5	N/A	
	Phalaris arundinacea	reed canarygrass	0.5	FACW	
	Phleum pratense	common timothy	10	FAC	
81-92		*channel*			
92-100	*Elemus repens*	quackgrass	20	FAC	saturated
	Agrostis stolonifera	redtop	20	FAC	
	Poa pratensis	Kentucky bluegrass	30	FAC	
	Phleum pratense	common timothy	10	FAC	
100-110	*Carex stipata*	owlfruit sedge	40	OBL	N/A
	Nepeta cataria	catnip	3	FACU	
	Glyceria spp	mannagrass species	10	OBL	
	Poa pratensis	Kentucky bluegrass	40	FAC	
	Elemus repens	quackgrass	3	FAC	
	Carex bebbii	Bebb's sedge	3	OBL	
110-120	*Carex stipata*	owlfruit sedge	10	OBL	N/A
	Nepeta cataria	catnip	10	FACU	
	Poa pratensis	Kentucky bluegrass	60	FAC	
	Elemus repens	quackgrass	20	FAC	
120-130	*Poa pratensis*	Kentucky bluegrass	30	FAC	N/A
	Elemus repens	quackgrass	20	FAC	
	Bromus inermis	smooth brome	40	FAC	
130-140	*Bromus inermis*	smooth brome	40	FAC	N/A
	Poa pratensis	Kentucky bluegrass	30	FAC	
	Elemus repens	quackgrass	20	FAC	
140-150	*Bromus inermis*	smooth brome	30	FAC	N/A
	Poa pratensis	Kentucky bluegrass	60	FAC	
	Elemus repens	quackgrass	10	FAC	
150-160	*Bromus inermis*	smooth brome	10	FAC	N/A
	Poa pratensis	Kentucky bluegrass	70	FAC	
	Elemus repens	quackgrass	20	FAC	
160-170	*Bromus inermis*	smooth brome	90	FAC	N/A
	Cirsium arvense	Canada thistle	0.5	FAC	

Distance	Scientific Name	Common Name	Percent Cover	Wetland Indicator Status Rating	Water Depth (in)
	Poa pratensis	Kentucky bluegrass	10	FAC	
170-180	*Bromus inermis*	smooth brome	90	FAC	N/A
	Cirsium arvense	Canada thistle	0.5	FAC	
	Poa pratensis	Kentucky bluegrass	10	FAC	
180-190	*Bromus inermis*	smooth brome	70	FAC	N/A
	Poa pratensis	Kentucky bluegrass	30	FAC	
	Cirsium arvense	Canada thistle	0.5	FAC	
190-200	*Poa pratensis*	Kentucky bluegrass	70	FAC	N/A
	Bromus inermis	smooth brome	20	FAC	
	Cirsium arvense	Canada thistle	3	FAC	
	Elemus repens	quackgrass	10	FAC	
Vegetation Transect 2					
0-10	*Poa pratensis*	Kentucky bluegrass	40	FAC	saturated
	Glyceria spp	mannagrass species	10	OBL	
	Phleum pratense	common timothy	30	FAC	
	Polygonum	smartweed	0.5	N/A	
	Carex bebbii	Bebb's sedge	3	OBL	
	Carex stipata	owlfruit sedge	3	OBL	
	Agrostis stolonifera	redtop	10	FAC	
	Juncus arcticus	arctic rush	3	FACW	
10-20	*Glyceria spp*	mannagrass species	10	OBL	saturated
	Agrostis stolonifera	redtop	30	FAC	
	Poa pratensis	Kentucky bluegrass	20	FAC	
	Carex stipata	owlfruit sedge	20	OBL	
	Carex bebbii	Bebb's sedge	20	OBL	
	Polygonum	smartweed	0.5	N/A	
	Epilobium ciliatum	fringed willowherb	0.5	FACW	
	Salix exigua	sandbar willow	0.5	FACW	
	Cirsium arvense	Canada thistle	0.5	FAC	
	Phleum pratense	common timothy	3	FAC	
20-28.5		*channel*			
28.5-30	*Salix exigua*	sandbar willow	30	FACW	saturated
	Phleum pratense	common timothy	40	FAC	
	Poa pratensis	Kentucky bluegrass	50	FAC	
	Elemus repens	quackgrass	10	FAC	
30-40	*Phleum pratense*	common timothy	10	FAC	saturated
	Agrostis stolonifera	redtop	10	FAC	
	Poa pratensis	Kentucky bluegrass	20	FAC	
	Elemus repens	quackgrass	20	FAC	

Distance	Scientific Name	Common Name	Percent Cover	Wetland Indicator Status Rating	Water Depth (in)
	Carex stipata	owlfruit sedge	30	OBL	
	Glyceria spp	mannagrass species	10	OBL	
40-50	*Glyceria spp*	mannagrass species	30	OBL	saturated /1 inch
	Elemus repens	quackgrass	20	FAC	
	Carex stipata	owlfruit sedge	20	OBL	
	Agrostis stolonifera	redtop	20	FAC	
	Carex utriculata	Northwest Territory sedge	10	OBL	
	Carex bebbii	Bebb's sedge	3	OBL	
50-60	*Glyceria spp*	mannagrass species	20	OBL	saturated/ 1 inch
	Carex utriculata	Northwest Territory sedge	80	OBL	
	Carex bebbii	Bebb's sedge	3	OBL	
60-70	*Carex utriculata*	Northwest Territory sedge	80	OBL	saturated /1 inch
	Carex stipata	owlfruit sedge	3	OBL	
	Glyceria spp	mannagrass species	20	OBL	
	Mentha arvensis	mint	0.5	FACW	
	Carex bebbii	Bebb's sedge	3	OBL	
70-80	*Carex utriculata*	Northwest Territory sedge	60	OBL	saturated
	Poa pratensis	Kentucky bluegrass	40	FAC	
	Phleum pratense	common timothy	0.5	FAC	
	Carex bebbii	Bebb's sedge	3	OBL	
	Polygonum	smartweed	3	N/A	
80-90	*Polygonum*	smartweed	10	N/A	saturated
	Poa pratensis	Kentucky bluegrass	10	FAC	
	Elemus repens	quackgrass	70	FAC	
	Agrostis stolonifera	redtop	10	FAC	
90-100	*Elemus repens*	quackgrass	3	FAC	saturated
	Poa pratensis	Kentucky bluegrass	70	FAC	
	Polygonum	smartweed	10	N/A	
	Phleum pratense	common timothy	20	FAC	
100-110	*Phleum pratense*	common timothy	10	FAC	saturated
	Carex bebbii	Bebb's sedge	20	OBL	
	Polygonum	smartweed	0.5	N/A	
	Agrostis stolonifera	redtop	10	FAC	
	Carex utriculata	Northwest Territory sedge	20	OBL	
	Elemus repens	quackgrass	20	FAC	
	Poa pratensis	Kentucky bluegrass	20	FAC	
110-120	*Agrostis stolonifera*	redtop	10	FAC	saturated
	Carex utriculata	Northwest Territory sedge	20	OBL	
	Poa pratensis	Kentucky bluegrass	40	FAC	

Distance	Scientific Name	Common Name	Percent Cover	Wetland Indicator Status Rating	Water Depth (in)
	Elemus repens	quackgrass	20	FAC	
	Phleum pratense	common timothy	10	FAC	
	Polygonum	smartweed	3	N/A	
120-130	*Agrostis stolonifera*	redtop	30	FAC	saturated
	Poa pratensis	Kentucky bluegrass	20	FAC	
	Elemus repens	quackgrass	30	FAC	
	Phleum pratense	common timothy	20	FAC	
	Polygonum	smartweed	0.5	N/A	
130-140	*Phleum pratense*	common timothy	20	FAC	N/A
	Carex bebbii	Bebb's sedge	10	OBL	
	Agrostis stolonifera	redtop	20	FAC	
	Poa pratensis	Kentucky bluegrass	20	FAC	
	Elemus repens	quackgrass	30	FAC	
140-150	*Phleum pratense*	common timothy	20	FAC	N/A
	Poa pratensis	Kentucky bluegrass	30	FAC	
	Elemus repens	quackgrass	20	FAC	
	Agrostis stolonifera	redtop	30	FAC	
	Cirsium arvense	Canada thistle	0.5	FAC	
	Polygonum	smartweed	0.5	N/A	
150-160	*Phleum pratense*	common timothy	40	FAC	N/A
	Poa pratensis	Kentucky bluegrass	20	FAC	
	Elemus repens	quackgrass	30	FAC	
	Polygonum	smartweed	3	N/A	
	Agrostis stolonifera	redtop	10	FAC	
160-170	*Phleum pratense*	common timothy	40	FAC	N/A
	Poa pratensis	Kentucky bluegrass	20	FAC	
	Agrostis stolonifera	redtop	20	FAC	
	Elemus repens	quackgrass	20	FAC	
	Polygonum	smartweed	0.5	N/A	
170-180	*Phleum pratense*	common timothy	30	FAC	saturated
	Elemus repens	quackgrass	50	FAC	
	Agrostis stolonifera	redtop	10	FAC	
	Poa pratensis	Kentucky bluegrass	10	FAC	
180-190	*Poa pratensis*	Kentucky bluegrass	20	FAC	N/A
	Elemus repens	quackgrass	40	FAC	
	Phleum pratense	common timothy	40	FAC	
190-200	*Phleum pratense*	common timothy	40	FAC	N/A
	Poa pratensis	Kentucky bluegrass	10	FAC	
	Elemus repens	quackgrass	30	FAC	

Distance	Scientific Name	Common Name	Percent Cover	Wetland Indicator Status Rating	Water Depth (in)
	Agrostis stolonifera	redtop	10	FAC	
Vegetation Transect 3					
0-10	*Agrostis stolonifera*	redtop	30	FAC	N/A
	Poa pratensis	Kentucky bluegrass	30	FAC	
	Phleum pratense	Common timothy	20	FAC	
	Carex bebbii	Bebb's sedge	10	OBL	
	Polygonum	smartweed	0.5	N/A	
	Glyceria spp	mannagrass species	10	OBL	
10-20	*Salix bebbiana*	bebb willow	3	FACW	N/A
	Phleum pratense	common timothy	20	FAC	
	Poa pratensis	Kentucky bluegrass	40	FAC	
	Agrostis stolonifera	redtop	40	FAC	
	Salix drummondiana	Drummond's willow	3	FACW	
20-30	*Salix drummondiana*	Drummond's willow	3	FACW	N/A
	Cornus sericea	red-osier dogwood	3	FACW	
	Poa pratensis	Kentucky bluegrass	40	FAC	
	Phleum pratense	common timothy	20	FAC	
	Agrostis stolonifera	redtop	40	FAC	
30-41		*channel*			
41-50	*Poa pratensis*	Kentucky bluegrass	90	FAC	N/A
	Polygonum	smartweed	3	N/A	
	Phleum pratense	common timothy	10	FAC	
	Agrostis stolonifera	redtop	3	FAC	
50-60	*Poa pratensis*	Kentucky bluegrass	80	FAC	N/A
	Polygonum	smartweed	0.5	N/A	
	Phleum pratense	common timothy	20	FAC	
60-70	*Poa pratensis*	Kentucky bluegrass	60	FAC	N/A
	Elemus repens	quackgrass	20	FAC	
	Phleum pratense	common timothy	20	FAC	
	Polygonum	smartweed	0.5	N/A	
70-80	*Phalaris arundinacea*	reed canarygrass	10	FACW	N/A
	Poa pratensis	Kentucky bluegrass	40	FAC	
	Polygonum	smartweed	3	N/A	
	Elemus repens	quackgrass	30	FAC	
	Phleum pratense	common timothy	20	FAC	
	Cirsium arvense	Canada thistle	0.5	FAC	
80-90	*Agrostis stolonifera*	redtop	40	FAC	N/A
	Poa pratensis	Kentucky bluegrass	30	FAC	
	Phleum pratense	common timothy	10	FAC	

Distance	Scientific Name	Common Name	Percent Cover	Wetland Indicator Status Rating	Water Depth (in)
	Elemus repens	quackgrass	20	FAC	
90-100	*Polygonum*	smartweed	10	N/A	saturated
	Agrostis stolonifera	redtop	30	FAC	
	Phleum pratense	common timothy	10	FAC	
	Poa pratensis	Kentucky bluegrass	20	FAC	
	Elemus repens	quackgrass	20	FAC	

***N/A given to species that were not identified to the species and therefore could not be accurately assigned a status rating.**

****Glyceria spp. is either striata or grandis, both of which are OBL.**