Rocky Mountain Field Institute

Enhancing Resiliency in Critical Riparian Areas through Continuation of Willow Propagation Program – Final Report

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815 South 25th Street, Suite 101
Colorado Springs, CO 80904
www.rmfi.org

Dedicated to the conservation and stewardship of public lands in Southern Colorado

Description of Project

The following narrative is a report of the *Enhancing Resiliency in Critical Riparian Areas through Continuation of Willow Propagation Program,* a partnership program between the Rocky Mountain Field Institute (RMFI) and the United States Forest Service (USFS) and made possible with financial support from the Colorado Watershed Restoration Program, an initiative of the Colorado Water Conservation Board (CWCB). The *Willow Propagation Program* is divided into three phases comprised of six total tasks, outlined below. The 2017 program is the continuation of a willow propagation and planting program first piloted in 2016, targeting a high priority riparian area within the Waldo Canyon burn scar where post-fire vegetation recovery using traditional willow staking and other methods have not been successful in improving watershed health and stream function. The number of willows was increased from 1,000 in 2016 to 2,850 in 2017. RMFI completed two willow plantings in 2017, one in May (2,000 plants) and another in August (850 plants). RMFI introduced a new planting location in 2017, Waldo Canyon, in addition to planting in the same location as the pilot program in 2016 (Camp Creek).

An additional component of this program is to continue hillslope stabilization and erosion control treatments to complement riparian plantings and overall watershed health in the Waldo Canyon burn scar. Work objectives include increasing the composition of native riparian plants, vegetative cover, structural diversity, and promoting bank and channel stability.

This report is a follow-up to the final report submitted on December 21st, 2017. This report includes a spring 2018 monitoring update for the Camp Creek and Waldo Canyon planting locations.

Phase 1: Complete site visits, scope of work, and identify/prioritize work locations. Project planning, logistics, contracting with Mile High Youth Corps. Utilizing RMFI and USFS staff, harvest dormant willows and transport cuttings to nursery.

a. *Task 1 -* ***COMPLETE*** *(February 13- 28, 2017): Identify high priority riparian areas that are currently contributing sediment and continuing to pose downstream risks to life and safety.*

- RMFI worked with Leah Shipstead, Hydrologist for the U.S. Forest Service (USFS) Pikes Peak Ranger District to identify and prioritize high priority riparian areas within the Waldo Canyon burn scar. Several parameters were utilized to identify potential planting areas including access, prior work, level of recovery, water table/water source, and sediment contribution. The southern end of the Waldo Canyon drainage was identified as the priority location for willow planting (Figure 1a, 1b). It is an area where heavy machinery had been used in prior years to construct sills and other channel stabilizing features. In addition, the riparian area draining Waldo Canyon was still contributing downstream sediment and lacked diverse composition of native riparian plants as well as structural diversity. In addition to a spring planting in Waldo Canyon, 850 willows were planted in mid-August of 2017 in the same stretch of Camp Creek that willows were planted in 2016.

b. *Task 2 -* ***COMPLETE*** *(February 13-18, 2017):* Harvest dormant willow cuttings from select locations and transport to nursery for propagation and preparation for spring transplanting.

- On January 19, 2017, RMFI and USFS staff harvested dormant willow cuttings along the Pikes Peak Highway north and south of the Crow Gulch Picnic Area (Figure 2).

Approximately 800 cuttings measuring approximately 3 feet long were harvested. Species included narrowleaf willow (*Salix exigua*), scouler willow (*Salix scouleriana*), bebb willow (*Salix bebbiana*), and Rocky Mountain willow (*Salix monticola* Bebb). Willows were tied together in bundles and prepped for overnight shipping to the Charles E. Bessey Nursery located in Halsey, Nebraska. The willows arrived at the nursery the next day where they were cut from 3-foot segments to approximately 1-foot segments and placed in potting containers (Figure 3). In March 2017, the willows were transplanted into individual pots (Figure 4) to continue growth and root maturation. The willows were tended to by Richard Gilbert, Bessey Nursery Manager for the USFS.

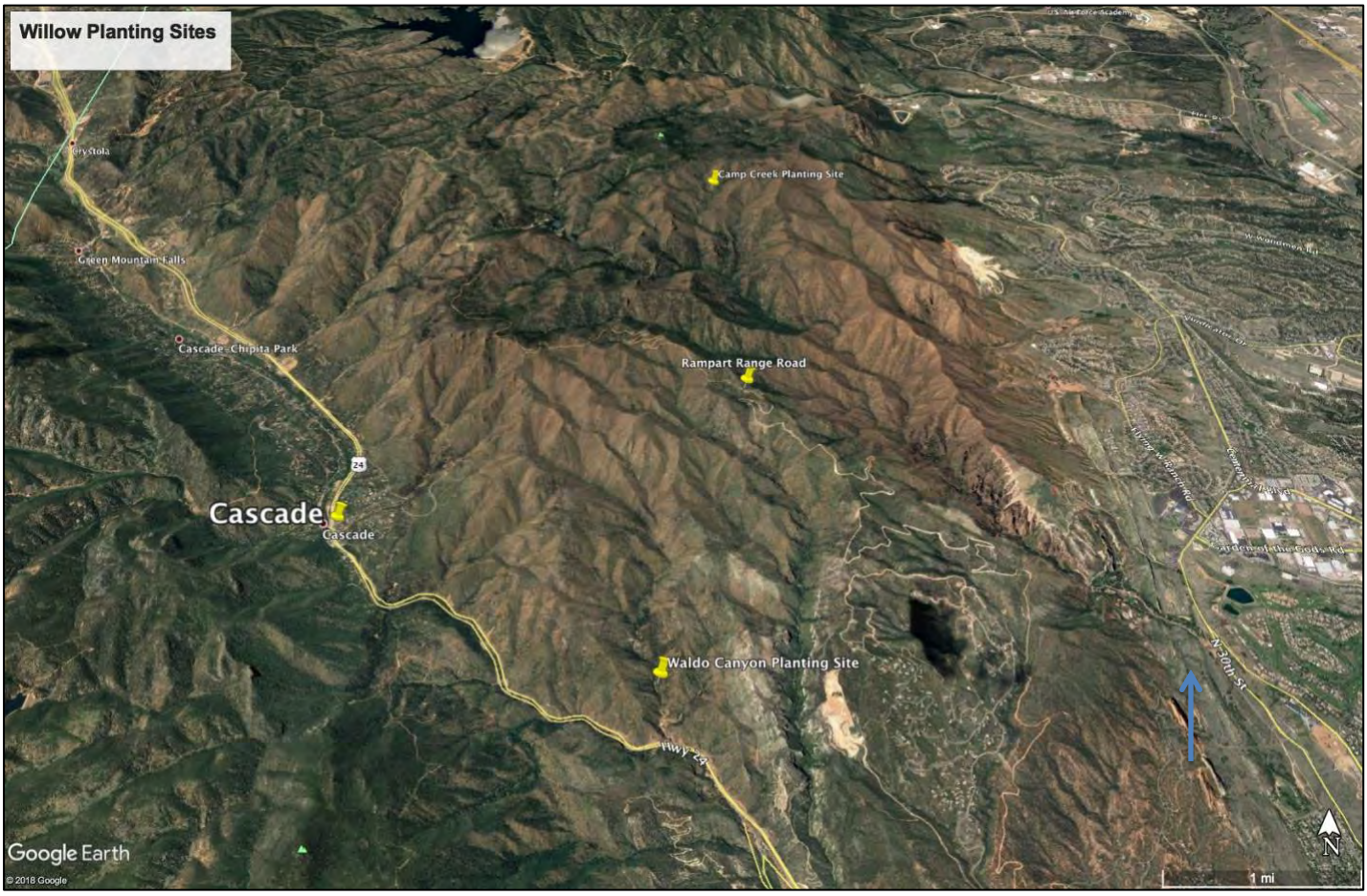


Figure 1. Planting areas within the Waldo Canyon Fire burn scar. Highway 24 can be viewed immediately south of the planting areas. The City of Manitou Springs is located approximately 2 miles southeast of the Waldo Canyon planting location.

Figure 2. Willows cut to 1-foot segments and planted in containers at the Bessey Nursery in Halsey, Nebraska.

Figure 3. Willows transplanted into individual pots to continue growth and root maturation.

Phase 2: Complete work objectives. RMFI will oversee 2 weeks of youth corps to conduct willow transplants in selected high priority riparian areas. RMFI and crew will also construct and install erosion control and stabilization treatments.

a. *Task 3 - **COMPLETE** (May 15-June 15, 2017):* Transplant rooted nursery plants back on-site in selected critical riparian areas.

- On May 31, 2017, RMFI, the USFS, a Mile High Youth Corps (MHYC) crew, and 15 community volunteers transported 2,000 willows from the staging area off of Highway 24 and into the Waldo Canyon drainage (Figure 4). The drainage was divided into 11 sections over approximately 1,321 ft. to facilitate future monitoring efforts measuring willow survivability. The start and end of each segment was recorded with GPS waypoints. Leah Shipstead, USFS Hydrologist, completed a willow planting demonstration with all on-hand to ensure adequate planting depth and contact with the water table (Figure 5). The group then split up and began planting the willows within each of the 7 drainage sections. Approximately 600 plants were planted on May 31; the MHYC completed the willow planting that same week.

  The second planting of 850 willows took place over the course of two volunteer events in late August. This planting took place in the same section of the Camp Creek drainage as the planting in 2016. Leah Shipstead, again completed a willow planting demonstration to ensure adequate planting depth and contact with the water table (Figure 5). On August 18th, 13 volunteers planted 400 willows and on August 19th, 26 volunteers planted the remaining 450 willows (Figure 6) in addition to removing 40, 22-gallon bags of Canadian thistle (*Cirsium arvense*). Over the course of the two volunteer events, 39 volunteers worked for a total of 332 hours.

Figure 4. MHYC members help transport willows to the planting location in Waldo Canyon.

Figure 5. During the August planting, Leah Shipstead, USFS District Hydrologist, instructs volunteers on how to effectively plant the willows in the Camp Creek drainage to ensure adequate planting depth and contact with the water table.

Figure 6. During the August planting, volunteers plant in Reach 0 in the Camp Creek drainage.

b. *Task 4 – **COMPLETE** (May 15, 2017-June 30, 2018)*: Monitor planting location(s) to determine success of revegetation efforts.

- As mentioned in Task 3, the Waldo Canyon drainage was subdivided into 11 sections and pre-photos were taken looking upstream and downstream from each segment start. RMFI visited the drainages in fall of 2017 and again in spring of 2018 to assess current conditions and measure survivability. An example Data Sheet is included in this document as Appendix B.

  During the September visit to Waldo Canyon, RMFI and USFS personnel observed an estimated 100% survival rate. While this high survivability rate seems unlikely, no plant mortality was observed. At the time of observation, some plants were going into dormancy (leaves changing color) and some significant plant growth had occurred since the May planting. One area of concern was the persistence of insect activity that caused deformation to the leaves of the plants, however the overall plant health did not appear to be affected. See pre/post photos below and *Field Monitoring Data Sheet* on Page 17.

2018 Waldo Canyon Monitoring

The following observations were made by USFS personnel during a late June site visit to the Waldo Canyon planting site:

- A total of 8 dead willows were found in Waldo Canyon, 7 of which were at Site 10 and the other one at Site 6. The dead stalks were very dark and woody. Many had evidence of where they were cut back in the nursery. After comparing the dead willows to other dead plants at the sites they became more evident.

- Some of the willows in Waldo appeared dead but, their roots were still holding the soil well. Although they may not survive another year, they were not yet considered dead.

- One single dead willow was found at Site 6, likely because of its placement (located between rocks far away from any soil or water). The others found at Site 10 are is likely due to the low water table but, may also have something to do with the abundant knapweed. Site 10 is the location with a sediment detention basin. The water had flowed subsurface through the majority of the reach.

- Additionally, there was evidence of higher flows with sediment and debris transport but only one willow was found that had been uprooted and transported downstream. It was still alive and was re-planted.

After close observation by USFS and RMFI staff, it was determined the mortality rate for Waldo Canyon is less than 5%. At Site 10, the mortality rate is closer to 5% and will likely increase into the fall and next year. Monitoring will continue after the CWCB grant expires in June 2018 as willow survivability cannot be adequately assessed until 3 years post-planting. See pre/post photo of planting in Figure 8 and 9.

Figure 7. Before and after photo showing the bottom of Reach 10 in the Waldo Canyon drainage. Photos were taken on the day of the planting, May 31, 2017.

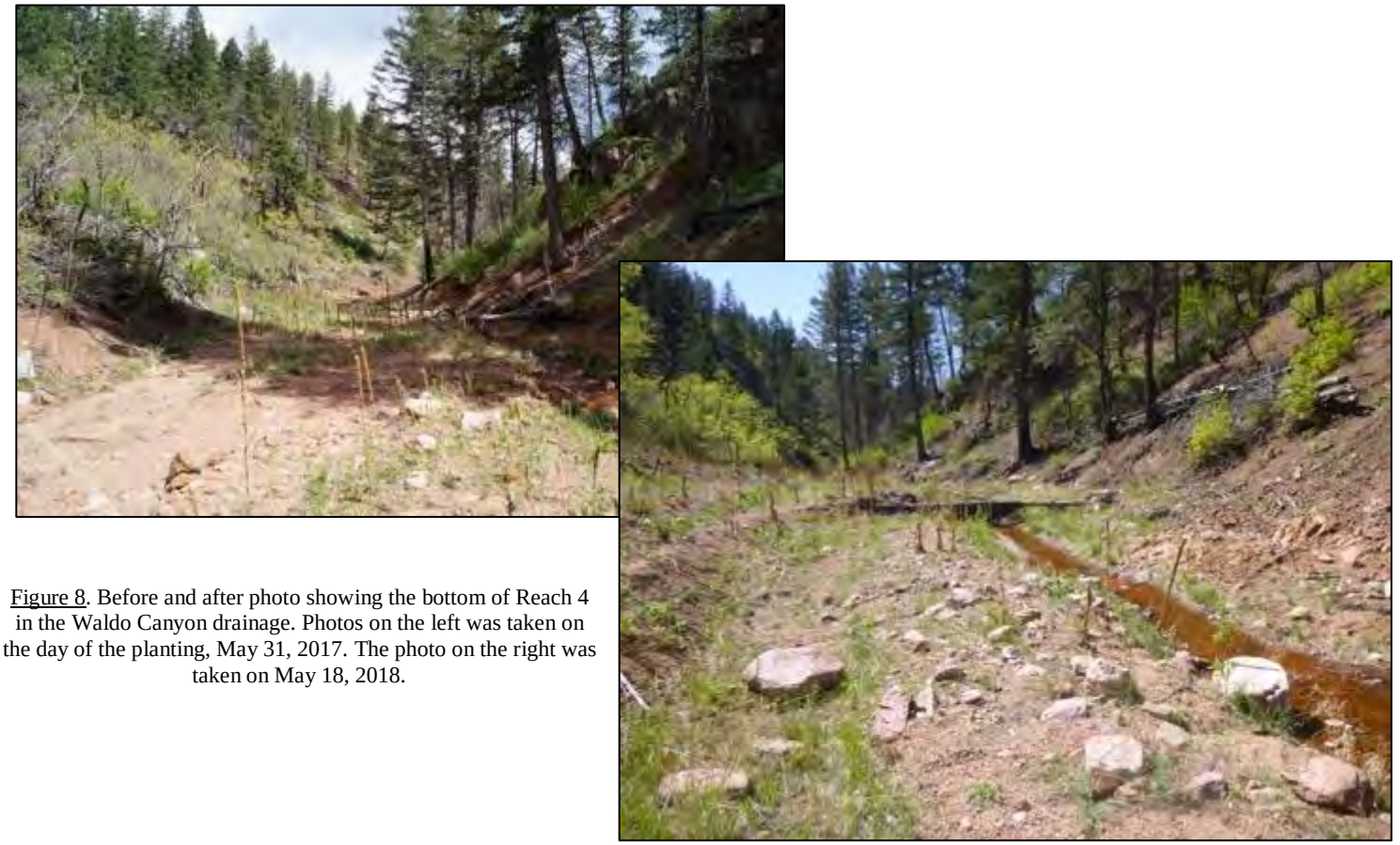


Figure 8. Before and after photo showing the bottom of Reach 4 in the Waldo Canyon drainage. Photos on the left was taken on the day of the planting, May 31, 2017. The photo on the right was taken on May 18, 2018.

2018 Camp Creek Monitoring

As previously mentioned, an additional 850 willows were planted in the Camp Creek drainage in August of 2017. These willows were planted in reaches above and below the 2016 reaches. The following observations were made during a May 2018 visit to the Camp Creek drainage:

- The farther down the drainage (downstream), the more vegetation is growing. Vegetation is extremely dense below Reach 10. The willows planted in 2016 are doing well, as there was no observed mortality in the 2016 reaches.

- The willows planted on the edge of the top basin (Reach 0) are struggling due to the low water depth. When the willows were planted in August of 2017, the water line was higher. Now that the water level is lower (due to a low snow year and less than average spring precipitation), the willow roots may not be in the water table.

- With all of the natural vegetation growth, it is difficult to see the willows. However, after close observation by USFS and RMFI staff, it was determined the mortality rate for Camp Creek is less than 1%.

Figure 9 (left): Willow plant that appears dead however still has intact root system. This willow may likely send out shoots from the roots.

Figure 10 (right): Healthy willow growth in Reach 2.

Figures 11 & 12: Reach 1 at Camp Creek Drainage. Above photo taken in May of 2016. Below photo taken in June of 2018.

Figures 13 & 14: Reach 8 at Camp Creek Drainage. Above photo taken in May of 2016. Below photo taken in June of 2018.

*Task 5 - **COMPLETE**: (May 31-November 15, 2017)*: Implement hillslope stabilization and erosion control treatments including log erosion barriers, native species reseeding, cross veins, crib walls, and others.

- RMFI contracted 2 weeks of MHYC beginning on May 30 and ending on June 9, 2017. In addition to planting willows in the Waldo Canyon drainage, the crews stabilized 3 head cuts and built 9 additional erosion control and stabilization structures including debris filters and log step falls, (Figures 15 - 20). In total, 10 MHYC crew members and 4 RMFI staff were engaged in the project during the 2 weeks of contracting. The MHYC crew and RMFI staff spent a combined total of 918 hours on the stabilization project over the course of 8 workdays.

Final work and volunteer statistics for the second year of the Willow Propagation Program include:

- 54 volunteers
- 422 volunteer hours
- $10,175 volunteer value (per independentsector.org)
- 10 Mile High Youth Corps members
- 638 youth corps hours
- 218 RMFI staff hours
- 250 invasive plants removed
- 3 head cuts stabilized
- 11 debris filters constructed
- 2,850 propagated willows utilized in restoration efforts

Phase 3: Post-project evaluation, assessment, and reporting.

*Task 6 – **COMPLETE**: (December 1, 2017-June 30, 2018)*: Develop final report/presentation detailing project outcomes and results.

- In 2018, RMFI and USFS were awarded a third year of funding for the *Willow Propagation Program*. That program is underway and an interim progress report was submitted in late June of 2018.

Project Conclusion

Just as with the 2016 Willow Propagation Program, results from this project are very encouraging and demonstrate the potential for increasing survival rates through the propagation of ecotypic species that have had time to develop more mature root systems in a nursery setting. In addition, results also suggest the erosion control and stabilization treatments utilized within the Upper Camp Creek and Waldo Canyon drainages are functioning to minimize downstream sedimentation and secure steep, bare slopes. Challenges noted in this second phase of the project include the presence of drought in Southern Colorado which likely will affect the viability of the willows.

Figures 15 & 16. Before and after photo (top and bottom) showing construction of a debris filter within an eroded drainage of Waldo Canyon.

Figures 17 & 18. Before (above) and after (below) photos showing log step-fall construction to stabilize an eroding head-cut in the Waldo Canyon drainage.

Photos 19 & 20. Before and after photo (top and bottom) showing construction of a debris filter within an eroded drainage of Waldo Canyon.

APPENDIX A
WILLOW MONITORING FIELD DATA SHEET

Date: _____ Planting Location: _____ Name of Observers: _____

Temperature (°F): _____ Elevation (ft.): _____ Average Monthly Precipitation (in.):_____

A Zone #	**B** # Willows Planted	**C** # Surviving Willows	**D** # Mortality Observed	**E** % Estimated Survival Rate (C/B)*100	**F** Willow Species Observed	**G** Observations/Notes

PHOTOPOINT DATA SHEET

Reach/Zone #	Coordinates of Photopoints	Corresponding Photo Name/Number(s)	Number of Photos Taken Per Reach/Zone	Observations/Notes

*Please use the diagram on page 3 to indicate photopoint locations within each planting zone as well as other pertinent information.

DIAGRAM OF MONITORING ZONES AND PHOTOPOINT LOCATIONS

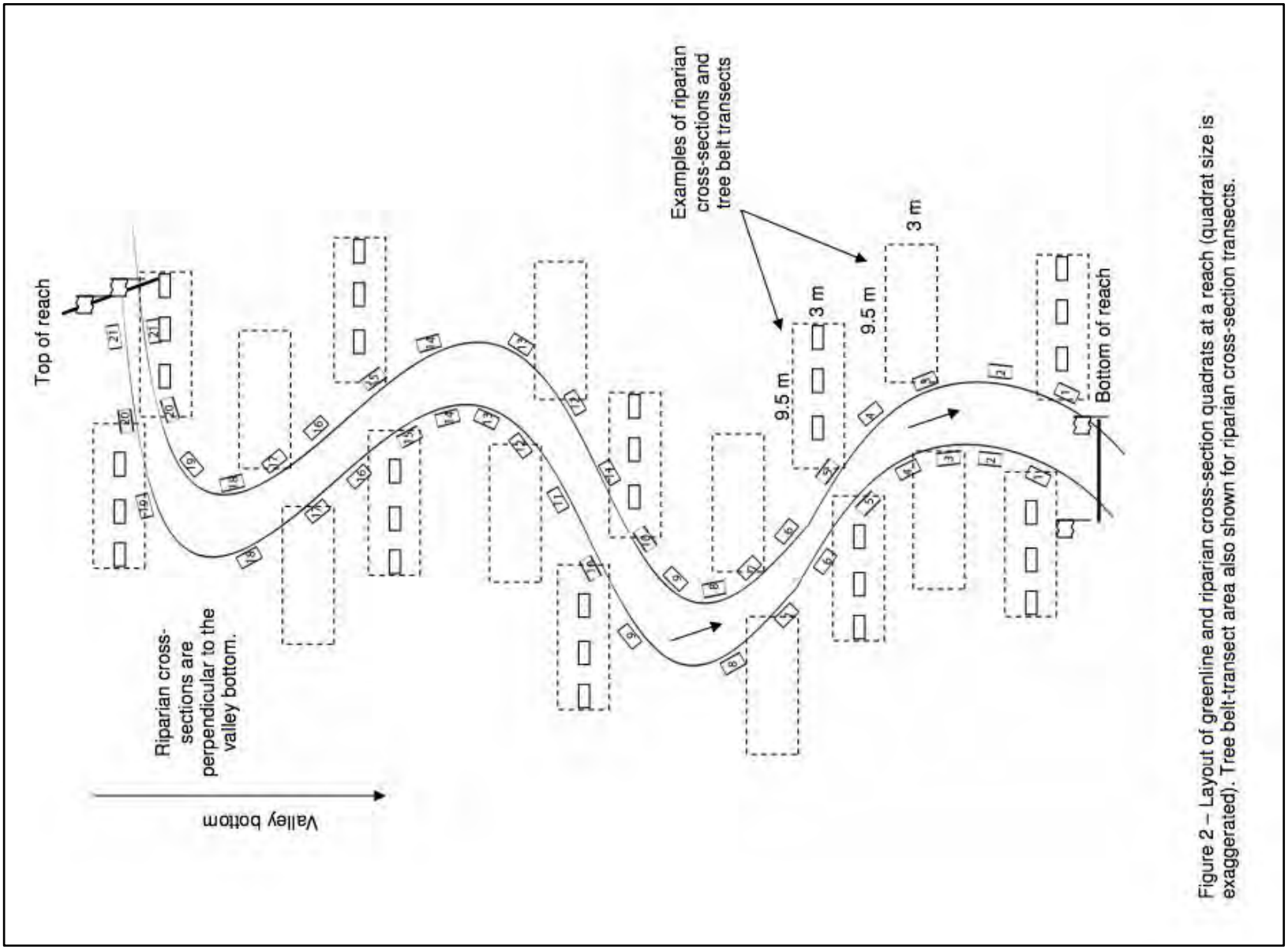


Figure 2 – Layout of greenline and riparian cross-section quadrats at a reach (quadrat size is exaggerated). Tree belt-transect area also shown for riparian cross-section transects.

OTHER OBSERVATIONS/NOTES

1. Are willows expanding and producing additional limbs and leaves?

2. If not, do the roots appear the be anchored and expanding?

3. Is surface water observed at each site?

4. Is there evidence of grazing?

5. Is there evidence of other disturbances (i.e. mass movement, erosion, or tampering)?

6. What is the estimated survival/mortality rate?

7. Other remarks…

Narrowleaf Willow (*Salix exigua*)

Bebb Willow, Long-Beaked Willow (*Salix bebbiana*)

Scouler Willow (*Salix scouleriana*)

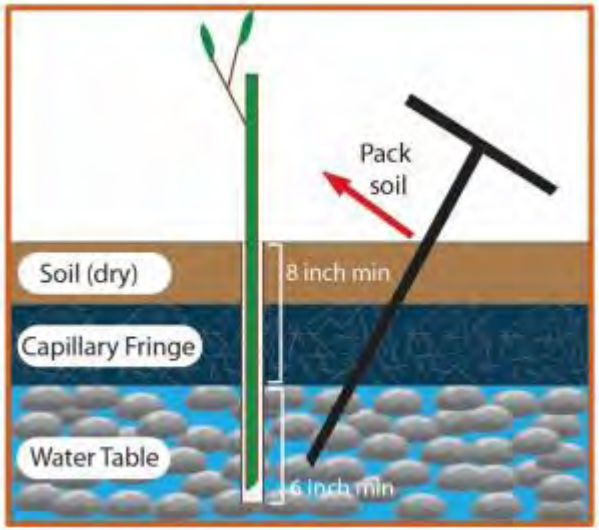
Rocky Mountain Willow (*Salix monticola* Bebb)

Photopoints

Photopoint monitoring is a standardized procedure, developed largely by Dr. Fred Hall of the U.S. Forest Service for taking precisely replicable photographs of resources that require long-term management (Hall, 1997). Photopoint monitoring is both a qualitative and quantitative tool that can assist resource managers in detecting unacceptable conditions in target resources before severe or irreversible changes occur, and allow time to implement corrective actions. The technique can also be used to assess the success or failure of management decisions based on the use of clearly defined indicators and standards. The photopoint monitoring technique can be used as an early warning system in conjunction with other quantitative approaches or as an independent monitoring procedure. At each willow planting zone intersection, photopoints were established as follows: from left bank looking to right bank; from right bank looking to left bank; from above the intersection looking downstream; and from below the intersection looking upstream. Additional photopoints were established at other appropriate locations where the channel could be observed.

Importance of Willows in Restoration

In arid regions of the Rocky Mountains, willows and cottonwoods provide important wildlife cover for nesting birds and small mammals, and forage for elk, moose, and other herbivores. Willows and other riparian vegetation provide effective soil stabilization through the large web of underground roots that bind soil particles together. The above-ground biomass of riparian vegetation slows water velocities and therefore aids in reducing shear stress along stream banks, road embankments, and other erosion-prone areas. Willows have a number of characteristics that make them resilient to high-velocity flood waters, burial by sediments, long periods of inundation, high winds, and heavy browsing by wildlife.



APPENDIX B – COMPLETED DATA SHEET

WILLOW MONITORING FIELD DATA SHEET

Date: 9/20/17 Planting Location: WALDO CANYON Name of Observers: LEAH, KELLY, JOE

Temperature (°F): 82°F Elevation (ft.): 6,729' Average Monthly Precipitation (in.): 1.1"

A Zone #	B # Willows Planted	C # Surviving Willows	D # Mortality Observed	E % Estimated Survival Rate (C/B)*100	F Willow Species Observed	G Observations/Notes
1	175		0%	100%	Bebb & Exigua	gone into dormancy. Not too much growth.
2	200		0%	100%	" "	Some clumping size grazing observed
3	100		0%	100%	" "	grazing ↓
4	100		0%	100%	" "	
5	200		0%	100%	" "	
6	50		0%	100%	" "	
7	100		0%	100%	" "	Some doubled in size
8	213		0%	100%	" "	least: show evidence of bugs found one uprooted still alive
9	75		0%	100%	" "	
10	525		0%	100%	" "	evidence of bugs. Additionally fluctuating water table may cause mortality in future
11	262		0%	100%	" "	~~bottom~~ 62 willows planted below bottom stake.

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PHOTOPOINT DATA SHEET

Reach/Zone #	Coordinates of Photopoints	Corresponding Photo Name/Number(s)	Number of Photos Taken Per Reach/Zone	Observations/Notes
Top 1		2017		
Bottom 1		2018		
Top 2		2019		
Bottom 2		2021		
Top 3		2022		
Bottom 3		2023		
Top 4		2024		
Bottom 4		2025		
T 5		2026		
B 5		2027		
T 6		2028		
B 6		2029		
T 7		2030		
B 7		2031		

*Please use the diagram on page 3 to indicate photopoint locations within each planting zone as well as other pertinent information.

T 8 2032
B 8 2034
T 9 2035
B 9 2036
T 10 2037

Top 11 2039
Bottom 11 2040

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