Tarryall Creek Ranch 2009 Riparian Restoration Project

Project summary and initial monitoring results

Mark Beardsley, M.S. EcoMetrics LLC October 16, 2009

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Introduction

The guiding image for the Tarryall Creek Ranch 2009 Riparian Restoration Project is to restore the natural riparian condition along this acutely disrupted portion of Tarryall Creek. We posit that the condition of this reach was extremely degraded and that prior to disturbance, the habitat would have been characterized by a lush cover of native willow shrubs within a beaver dam-influenced aquatic and riparian wetland ecosystem. Our long term vision is to see this pristine condition restored to the reach. The project area was seen as a "gap" in an otherwise continuous belt of well-functioning riparian shrub habitat extending along Tarryall Creek from its headwaters in the mountains down into South Park. From a landscape perspective, successful restoration of this reach means repairing the gap and reestablishing connectivity and improving an important migration corridor. (Figure 1).

The primary means for accomplishing restoration of the reach is to eliminate the harmful land use practices that caused degradation in the first place by protecting the riparian area and establishing a new management strategy that is consistent with riparian health. On this front, more than a mile and a half of permanent riparian fencing was constructed and a new management plan was implemented in 2008 to safeguard a riparian corridor roughly 1/2 mile wide. More importantly, the land has been secured for protection under a conservation easement.

But because the degree of impairment was so severe, we recognized that passive recovery would be uncertain and slow. Our restoration plan also includes a mechanical component in the form of large-scale willow transplanting. This is intended to jump-start the establishment of a willow-shrub community and to direct plant succession towards the desired climax condition

while also providing immediate habitat benefits. Several segments of stream bank were re-graded and stabilized with willow and sod transplants to arrest rapid erosion and protect new vegetation. The channel was also treated by reshaping bed material to decrease near-bank stress and to provide instant in-stream fish habitat benefits such as more pool area.

The mechanical restoration work was carried out over three separate periods. In May of 2008, we planted 200 large mature willow shrubs and 650 dormant willow stems. This work was used as a pilot project to gain support for additional efforts which were accomplished as the "Tarryall Creek 2009 Riparian Enhancement Project." The 2009 work was phased to accommodate a mandatory stream channel work closure period. In May, most of the off-channel work was completed as "phase 1" which included 380 more large adult willow transplants, 2100 more willow stem plantings, 12 willow stem bundle plantings, construction of 3 bankfull benches along 270 feet of stream bank with about 2000 ft^2 of planted sod and seeding. The phase 1 efforts are summarized in a separate report attached here as appendix 1. "Phase 2" work completed the mechanical treatments component of the project in August with the construction of three more bankfull benches, about 20 additional adult willow plantings, stream bank toe construction, and channel shaping. (Figures 2-3).

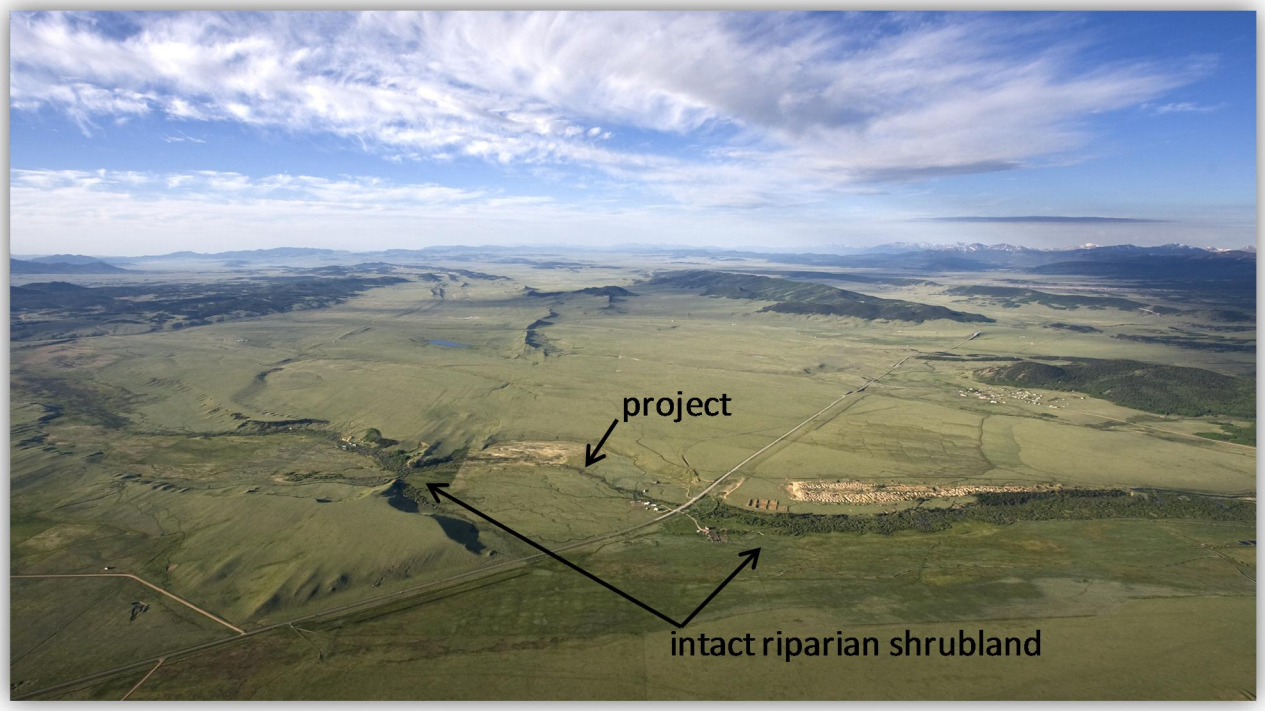


Figure 1: Project area seen from the north. If successful, the project will fill the gap between the intact riparian shrublands seen upstream and downstream to restore an uninterrupted wetland habitat corridor from the headwaters of Tarryall Creek into the heart of South Park. Note the fence line contrast at the downstream end of the project (near the left arrowhead) formed by harmful land management above and better management below. The first order of business in restoring the project area is to protect it with favorable management.

Figure 2: Channel shaping and bank toe treatments were completed in phase 2. The bank toes are constructed of streambed gravel and cobble that can be moved by the stream within a few seasons of high flow. They serve as protection for the banks while planted sod and willows take hold. The channel was gently reshaped to enhance the thalweg, to make the channel deeper and narrower at low flow, and to create pool area. Only native bed materials were used, so the channel is still free to readjust and adapt naturally.

Figure 3: A new bench was created on this rapidly eroding bank during phase 2. The bench was planted with willows and wetland sod, and the channel was realigned to decrease near-bank stress. The bank will eventually continue to erode, but at a slower natural rate now that the appropriate vegetation will be in place.

Monitoring plan and success criteria

Details of the monitoring plan for the Tarryall Creek Ranch 2009 Riparian Restoration Project are provided in appendix 2 with explanation of the monitoring philosophy, data collection, and criteria for the evaluation of long-term and short-term success.

2009 Monitoring results

Fate of transplanted willows

Individual willows were counted at the time of planting and again towards the end of the 2009 season. The proposed number of planted willows is shown along with actual numbers planted in both 2008 and 2009. Adult willows showed signs of stress, but 99% were clearly alive at the end of 2009. Most willow stems survived and grew through 2009 as well, and most of the observed mortality is from the individuals that were planted in 2008 without the use of a hydro-drill (stinger). A small portion of 2009 plantings were made too close to the edge of eroding banks and lost to active bank erosion.

transplanted adult willows	
2008 (actual/proposed)	200/200
2009 (actual/proposed)	400/400
total planted	600
survivors after 2009	594
survival at end of year 1	99%

transplanted willow stems	
2008 (actual/proposed)	650/500
2009 (actual/proposed)	2100/1600
total planted	2750
survivors after 2009	2410
survival at end of year 1	88%

Streamside vegetation (greenline surveys)

Approximately 1500 feet of stream length was surveyed along the greenline of both banks to classify vegetation among 7 functional guilds both before the project and soon after construction. The 7 functional guilds include 4 categories of woody plants based on plant height (< 1 ft, 1-3 ft, 3-5 ft, and > 5 ft) and 3 categories of herbaceous plants based on root depth and density (weak, moderate, and strong). The proportion of bare ground was also measured.

survey	vegetation functional guild								
	woody <1	woody 1-3	woody 3-5	woody >5	herb. wk.	herb. mod	herb. str.	bare ground	**woody total**
before	4%	4%	0%	1%	19%	36%	13%	18%	**9%**
as-built	10%	8%	11%	8%	4%	14%	37%	9%	**37%**

Riparian vegetation (transect surveys)

The 4 monumented cross sections surveys were sampled as vegetation transects, and 4 additional vegetation transects were set perpendicular to the valley, across the creek. All transects were sampled along the floodplain between high terrace elevations both before the project and soon after construction to measure the proportion of woody plant cover. The observed increases in woody plant cover are mostly due to the placement of transplants; however, an explosion of growth from existing willows when released from grazing is also an important factor on some transects.

Percent woody species cover on XS transects									
XS ID	340	450	600	770	1100	1298	1500	1800	**MEAN**
before	20%	14%	5%	0%	5%	5%	4%	10%	**8%**
after	60%	48%	48%	33%	47%	39%	46%	49%	**46%**

Cross section surveys

4 cross section surveys were made across segments where bankfull benches and channel shaping treatments were planned. These were surveyed before treatment (May 2008), after phase 1 (August 2008), and after phase 2 (August 2009). Results are plotted as overlays so that alterations to channel dimension and bank shape are documented at each location. Continued monitoring of these cross sections and two additional ones installed in 2009 will continue to show how the channel and banks adjust over time. (Figures 5-13).

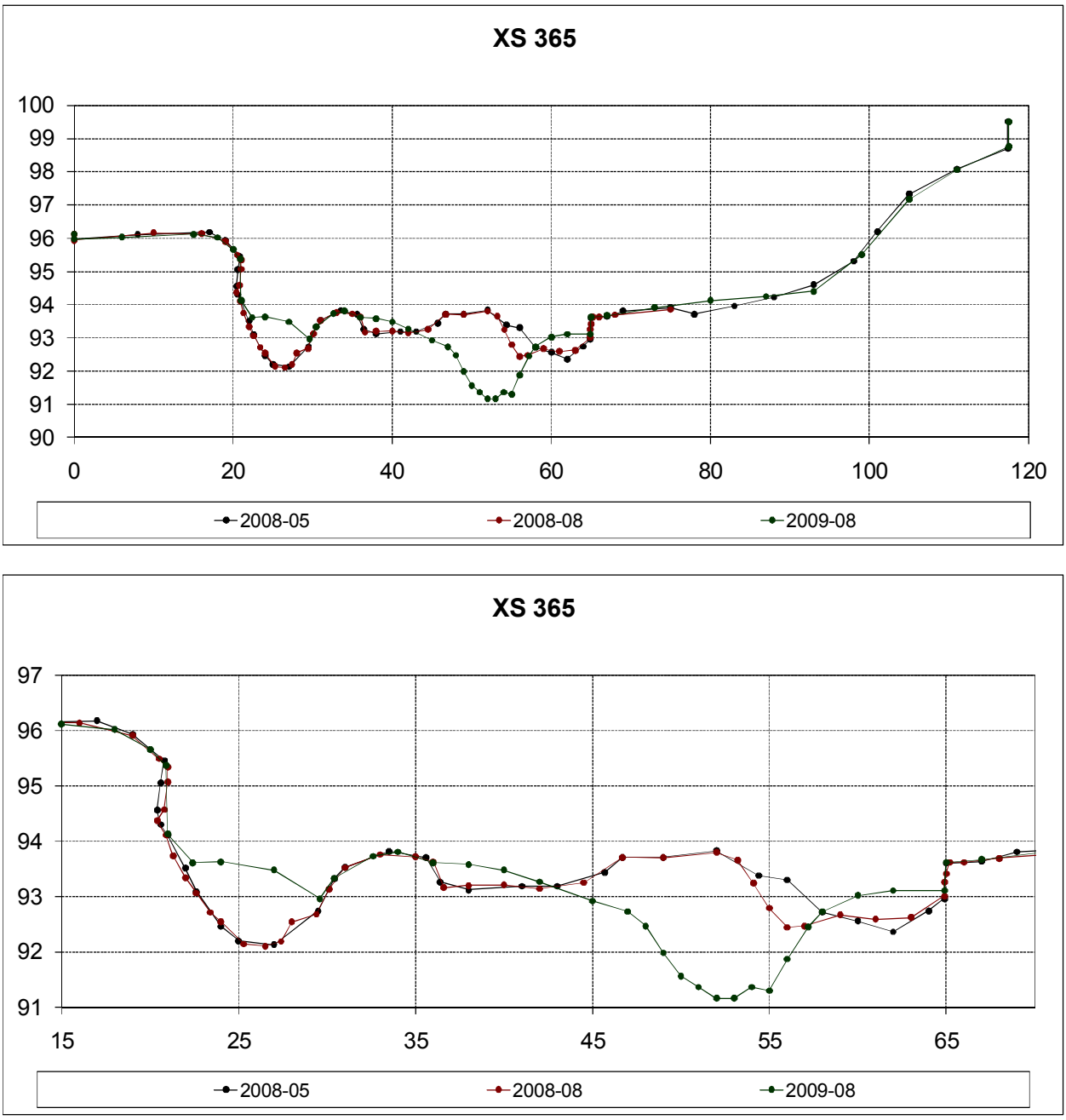


Figure 4: Cross section surveys from XS 365, with axes units in feet. Surveys from May 2008, Aug 2008 and Aug 2009 are overlaid so that changes to dimension can easily be seen. The changes from May to Aug 2008 are channel adjustments from erosion, scour and deposition during runoff. The Aug 2009 survey shows changes that were made during treatment in phase 2. A mid-channel bar was removed and pool formed between 43 and 58. A bench was constructed and planted between 21 and 43, and a mid-flow berm 58 and 65. Annual surveys of all the cross sections will be made to monitor natural response of the channel.

Figure 5: Before and after photos of the treatments on XS 365 (described in the phase 1 report as "bench 0280").

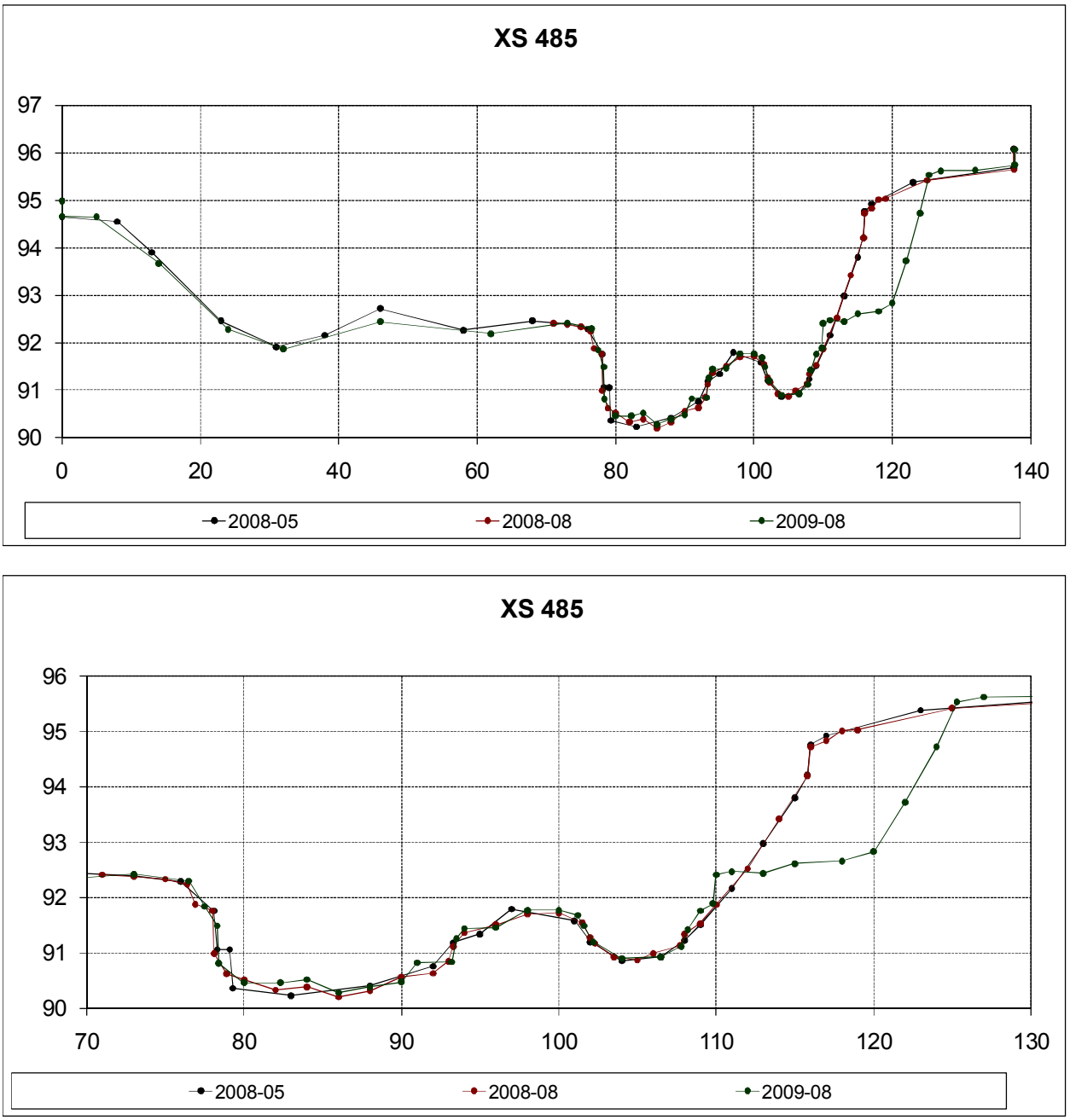


Figure 6: Cross section surveys from XS 485. The slight changes from May to Aug 2008 are channel adjustments from erosion, scour and deposition during runoff. The Aug 2009 survey shows changes that were made during treatment in phase 2. A bench was constructed and planted between 110 and 125, and channel shaping was minimal at this location.

Figure 7: Before and after photos of the treatments on XS 485 (described in the phase 1 report as "bench 0340").

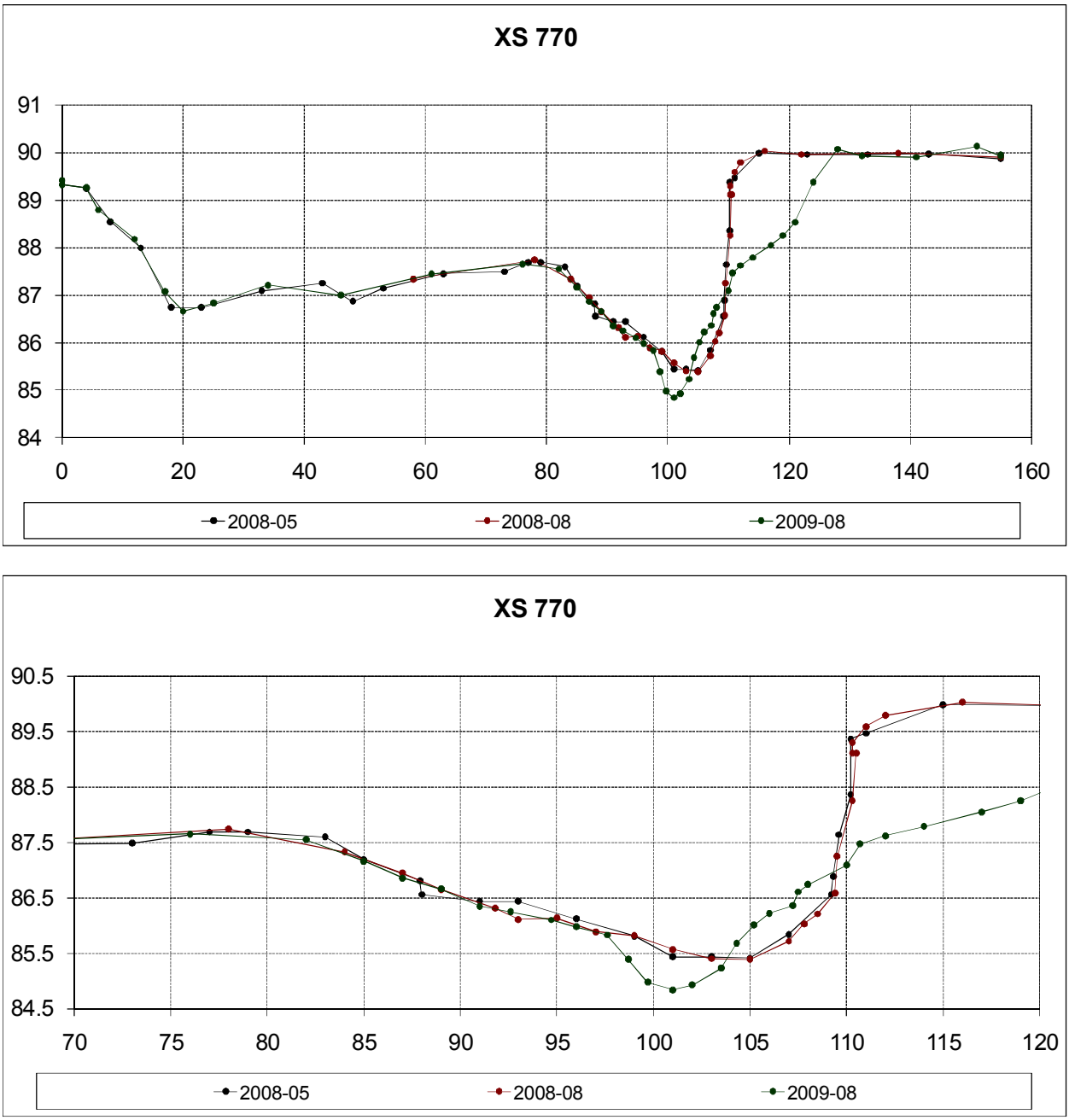


Figure 8: Cross section surveys from XS 770. The slight changes from May to Aug 2008 are channel adjustments from erosion, scour and deposition during runoff. The Aug 2009 survey shows changes that were made during treatment in phase 2. A bench was constructed and planted between 110 and 130. The thalweg was enhanced and cheated to the left to create a narrower and deeper low flow channel and to decrease near-bank stress.

Figure 9: Before and after photos of the treatments on XS 770 (described in the phase 1 report as "bench 0650").

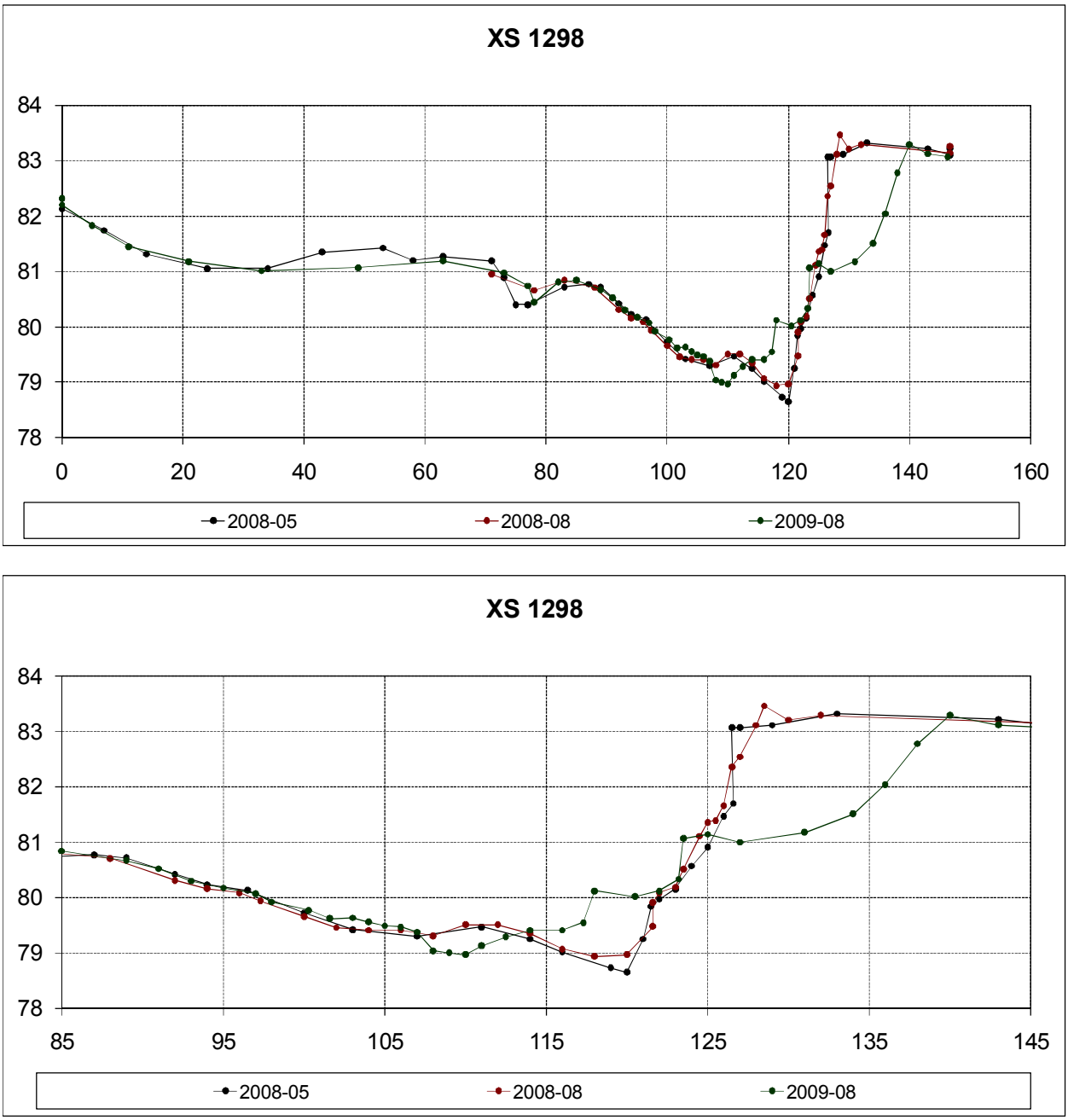


Figure 10: Cross section surveys from XS 1298. The slight changes from May to Aug 2008 are channel adjustments from erosion, scour and deposition during runoff. The Aug 2009 survey shows changes that were made during treatment in phase 2. A bench was constructed and planted between 122 and 140. The toe is between 118 and 122, and the thalweg was moved away from the bank towards the left.

Figure 11: Before and after photos of the treatments on XS 1298 (described in the phase 1 report as "bench 1150").

Figure 12: Before and after photos of the treatments near XS 1298 seen from downstream.

Bank erosion estimates (BANCS model)

BANCS model erosion estimates were made for both banks along a 1500 ft segment prior to treatment in May 2008 and after treatment in Aug 2009. The volume of estimated erosion was summed over the entire reach and normalized as volume per 100 ft stream length. Also, the proportion of banks falling into each of four categories was measured: low (0.0 - 0.3 ft/yr), moderate (0.3 - 0.6 ft/yr), high (0.6 - 0.9 ft/yr), very high (> 0.9 ft/yr). Most of the banks which previously assessed as moderate to high were treated, and now they rate lower.

survey	volume of erosion		proportion of bank length in category			
	total	per 100 ft	low	moderate	high	very high
before	1057	68	76	13	9	2
as-built	227	15	98	0	2	0

Pool area surveys

The area of pool habitat meeting residual depth criteria of 1.5 and 2.0 feet was surveyed prior to treatment in Aug 2009. Total pool area meeting each of these criteria was summed over the entire reach and also normalized as pool area per 100 ft stream length.

survey	pool area (RPD >1.5 ft)		pool area (RPD >2.0 ft)	
	total	per 100 ft	total	per 100 ft
before	197	13	0	0
as-built	2015	130	1160	75

Evaluation of long-term goals

2009 monitoring results are used to evaluate progress towards long term goals in the immediate time frame by comparing results for specific parameters to predetermined performance criteria (appendix 2). In terms of these objective criteria, immediate project performance is excellent for all stated goals. Transplants were successfully made and surviving; and woody cover was improved beyond expectations both along the stream edge and throughout the riparian area. We did not observe beaver activity on the reach in this first season, but beavers are present and active on reaches up and downstream.

goal	parameter	before	after	criteria	evaluation
transplant success	number of surviving adult willows	0	594	> 570	Excellent
	number of surviving willow stems	0	2310	> 1900	Excellent
streamside vegetation	greenline % woody plant cover	9%	37%	> 30%	Excellent
riparian area vegetation	mean transect % woody plant cover	8%	46%	> 15%	Excellent

Continued monitoring of these and other factors for several seasons is necessary to establish trends in plant survival and woody cover so that progress can be evaluated further.

Evaluation of short-term goals

2009 monitoring results are also used to evaluate success in meeting immediate expectations for short term goals including decreased bank erosion and increased pool area. Criteria for excellent performance were met in both bank erosion parameters. Overall estimated volume of bank erosion was decreased by nearly 80% and the proportion of banks with erosion rates in the "high" category or greater was also reduced by about 80%.

Overall pool area with RPD > 1.5 ft was increased 900% from 13 to 130 ft^2 per 100 ft of stream, but the level of pool area is still fairly low compared to similar reaches which is not surprising given the position of the reach on an alluvial fan. Performance in this parameter falls into the acceptable category when compared to the predetermined expectations. For deep pool area, on the other hand, the treatments exceeded expectations for an evaluation of excellent. No deep pool area was present on the reach prior to treatment, and 75 ft^2/100 ft was created.

goal	parameter	before	after	criteria	evaluation
reduced bank erosion	Bank erosion volume	68 ft^3	15 ft^3	< 35 ft^3	Excellent
	% banks with high erosion rate	11%	2%	< 5%	Excellent
increased pool area	pool area >1.5 RPD	13	130	100 - 200	Acceptable
	pool area >2.0 RPD	0	75	> 50	Excellent

We will continue to monitor these parameters to evaluate whether the observed improvements are sustaining for the short and long terms.

Summary

The Tarryall Creek Ranch 2009 Riparian Restoration Project appears to be on track towards meeting the long term goal of restoring a native shrubland riparian condition. Transplanted willows are well established and growing, and existing shrubs are thriving with the release from grazing pressure. Consequently, streamside and aerial shrub cover values are improved far more than expected at this early stage. The project is performing excellently in all of the factors that were preselected to evaluate success. If trends hold true and we are successful at restoring a riparian shrubland that is eventually fit for beaver habitation, then many factors of water quality, terrestrial habitat, and aquatic habitat will improve exponentially. In the meantime, target factors of pool area and bank erosion were directly improved by the channel shaping and bank treatments that were applied. While the signs of success in both long and short term goals are very positive at this point, we will carry on with monitoring to evaluate how treatments continue to perform through the seasons to come.

Project Partners

- *Beartooth Capital*
- *Colorado Open Lands*
- *Park County*
    - *Office of Tourism and Community Development*
    - *Land and Water Trust*
- *Colorado Water Conservation Board*
    - *Watershed Restoration Program*
- *US Fish and Wildlife Service*
    - *Partners for Fish and Wildlife Program*
- *Colorado Division of Wildlife*
- *Gillilan and Associates*
- *EcoMetrics LLC*
- *Barrett Excavating*
- *Westward Hoe Excavating*

Appendix 1. Tarryall Creek Ranch 2009 Riparian Restoration Project Phase 1 Report

Tarryall Creek Ranch
Riparian Restoration Project
2009 Phase 1

Mark Beardsley, M.S.
EcoMetrics, LLC
May 31, 2009

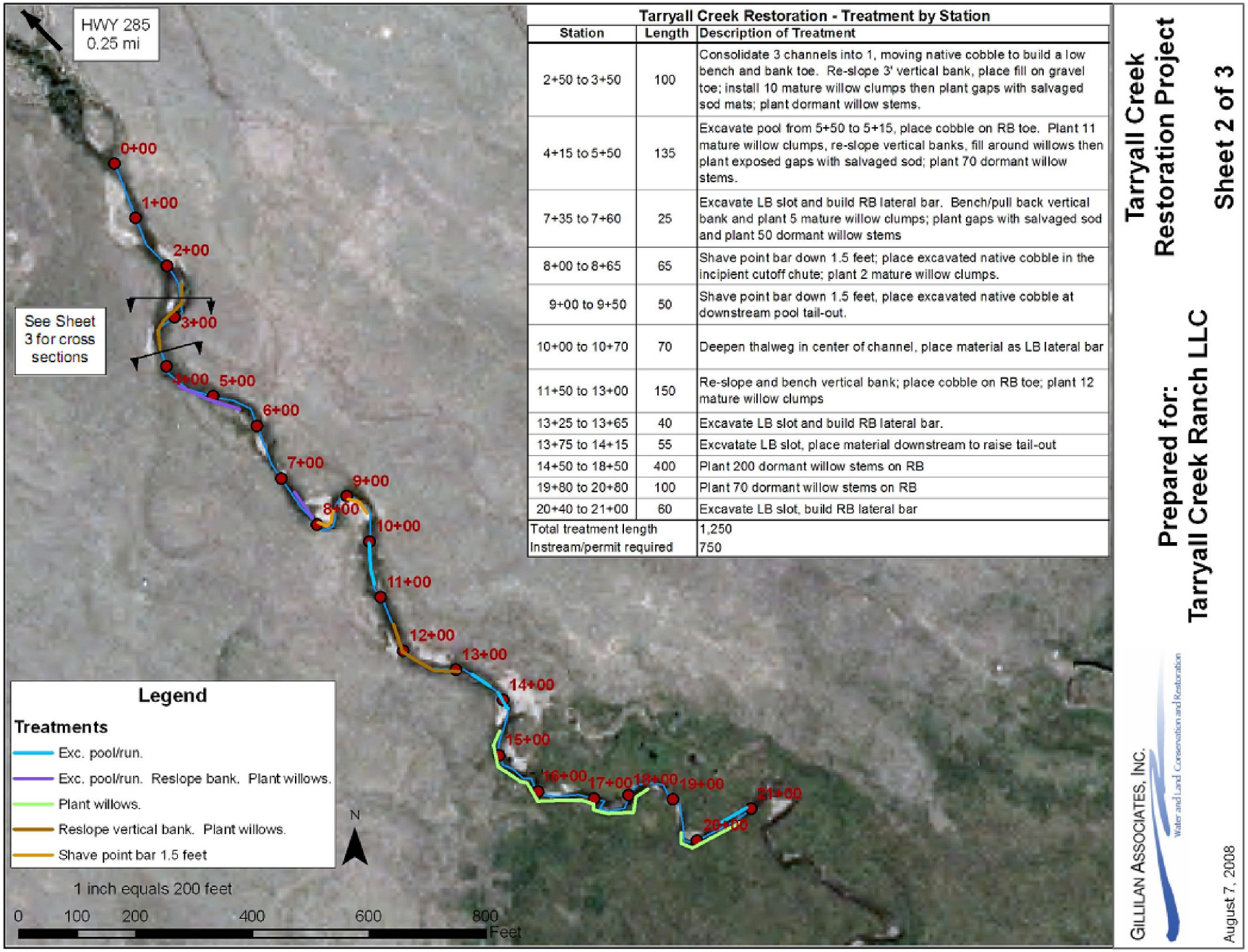
Summary

Phase 1 of the 2009 portion of the Tarryall Creek Ranch Riparian Restoration Project was completed May 29, 2009. 400 full adult willow shrubs with root balls 1/3 to 1/2 cubic yard were harvested from upstream sites on the west side of the property. 380 were planted on the riparian corridor along Tarryall Creek on the East side of the property (the project reach). 2400 willow stems were also harvested, and from these, approximately 2100 were planted on the project area. 12 bundles of long willow stems were also planted as an experiment. As of May 29, 2009, a total of 580 whole willows, 2750 stems, and 12 bundles have been planted on the project reach. This takes into account both the plantings done as part of phase 1 as well as plantings completed during the 2008 pilot project.

Approximately 270 feet of high, vertical, eroding streambank was pulled back to form three separate bankfull benches during phase 1. Benches were planted with sod, whole willows, willow stems and native grass or wetland seed mix. Additionally, the borrow sites and disturbed areas were reclaimed, the access road on the north side of the creek was repaired, and spoils were hauled to a dump site in the mine tailings on the west side of the property. All transplants were repeatedly watered.

No work was completed within the stream channel as part of phase 1. Phase 2 is planned for sometime during summer, 2009, after a mandatory stream channel work closure period is lifted and water levels subside. During this phase, one small channel realignment and some minor channel shaping is planned, along with completion of the three constructed benches. We also plan to construct one more bankfull bench at station 280L and transplant additional willows during phase 2.

Tarryall Creek Ranch Riparian Restoration Project – 2009 Design Plan



Tarryall Creek Restoration - Treatment by Station

Station	Length	Description of Treatment
2+50 to 3+50	100	Consolidate 3 channels into 1, moving native cobble to build a low bench and bank toe. Re-slope 3' vertical bank, place fill on gravel toe; install 10 mature willow clumps then plant gaps with salvaged sod mats; plant dormant willow stems.
4+15 to 5+50	135	Excavate pool from 5+50 to 5+15, place cobble on RB toe. Plant 11 mature willow clumps, re-slope vertical banks, fill around willows then plant exposed gaps with salvaged sod; plant 70 dormant willow stems.
7+35 to 7+60	25	Excavate LB slot and build RB lateral bar. Bench/pull back vertical bank and plant 5 mature willow clumps; plant gaps with salvaged sod and plant 50 dormant willow stems
8+00 to 8+65	65	Shave point bar down 1.5 feet; place excavated native cobble in the incipient cutoff chute; plant 2 mature willow clumps.
9+00 to 9+50	50	Shave point bar down 1.5 feet, place excavated native cobble at downstream pool tail-out.
10+00 to 10+70	70	Deepen thalweg in center of channel, place material as LB lateral bar
11+50 to 13+00	150	Re-slope and bench vertical bank; place cobble on RB toe; plant 12 mature willow clumps
13+25 to 13+65	40	Excavate LB slot and build RB lateral bar.
13+75 to 14+15	55	Excvatate LB slot, place material downstream to raise tail-out
14+50 to 18+50	400	Plant 200 dormant willow stems on RB
19+80 to 20+80	100	Plant 70 dormant willow stems on RB
20+40 to 21+00	60	Excavate LB slot, build RB lateral bar
Total treatment length		1,250
Instream/permit required		750

Tarryall Creek Restoration Project

Sheet 2 of 3

Prepared for:
Tarryall Creek Ranch LLC

Gillilan Associates, Inc.
Water and Land Conservation and Restoration

August 7, 2008

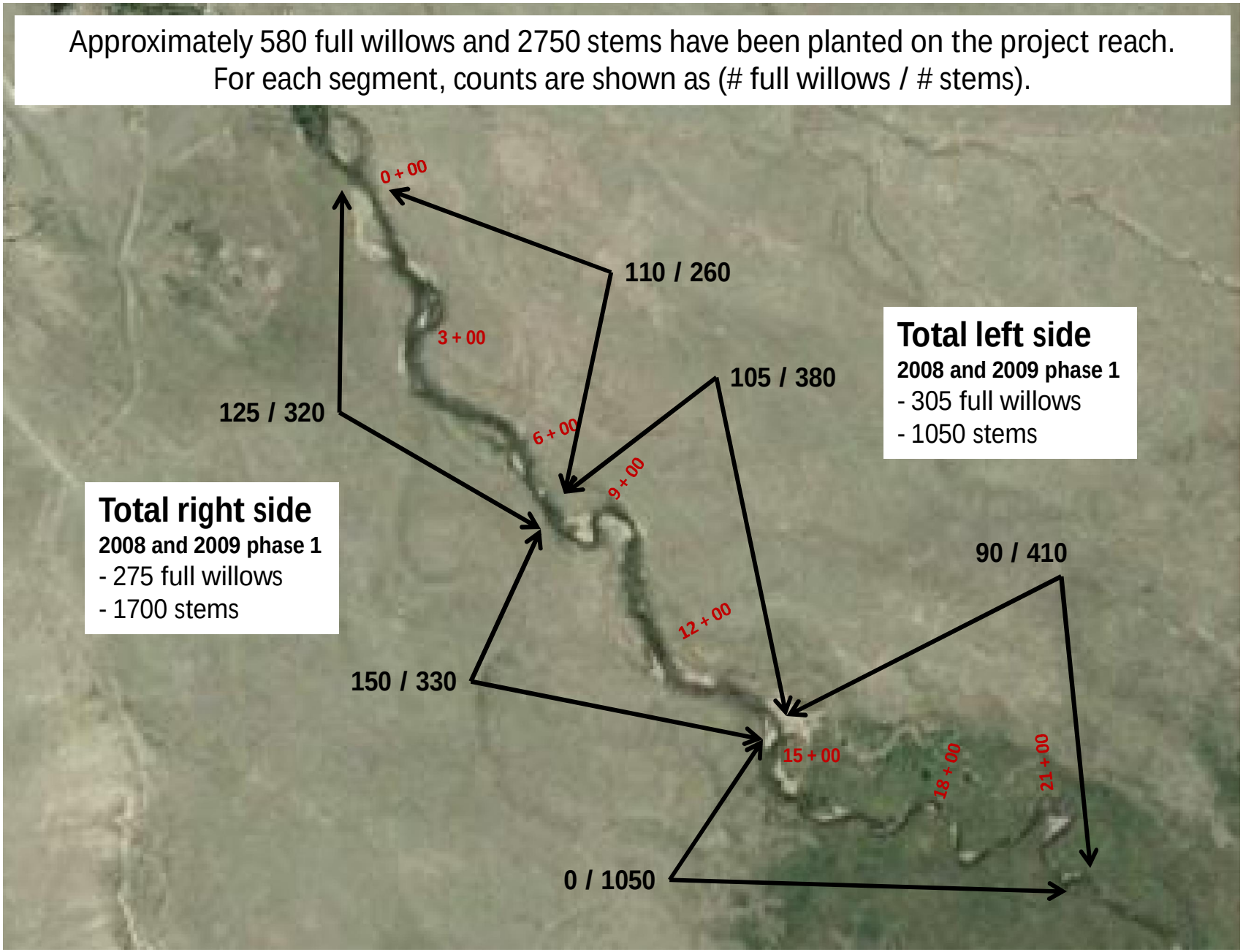
Phase 1: May 2009

- Riparian planting
- Cut bankfull benches
- Reclaim disturbed areas

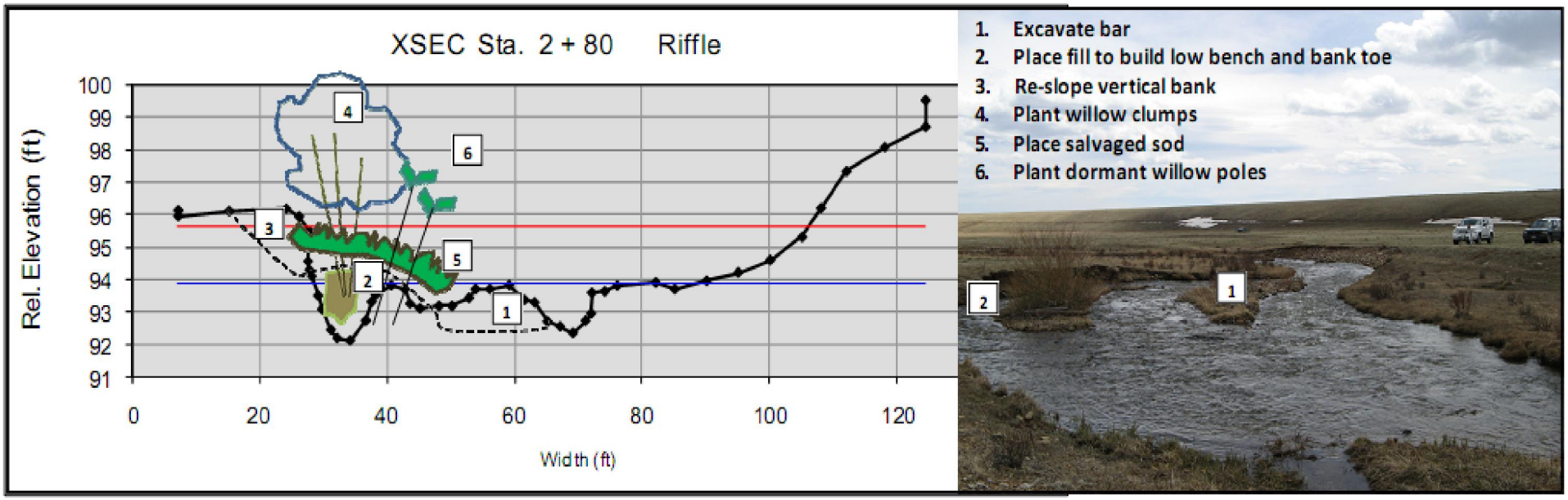
Phase 2: Summer 2009 after mandatory closure period

- In-channel work
- Complete bankfull bench construction
- Additional riparian planting

Actual willow plantings completed during 2008 pilot phase and 2009 phase 1



Bankfull bench 280L



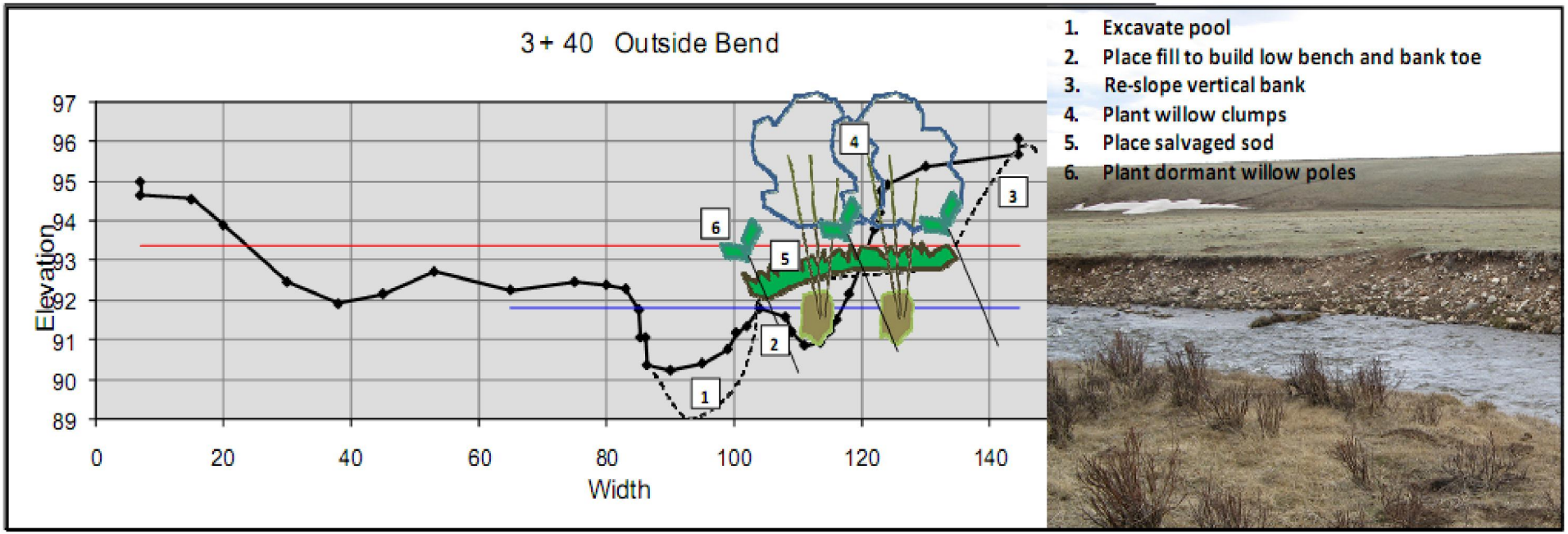
No work was completed on this cross section during phase 1.

No part of this design could effectively be completed without altering the streambed, so we plan to do all of the construction here during phase 2.

Bankfull bench 0280R

Before-after photos show that no alterations were made at this location during phase 1.

Bankfull bench 0340R



During phase 1, we cut a bankfull bench into the high terrace on the right bank, planted 20 full willows and 12 willow stem bundles, and finished it with transplanted wetland sod. All bare areas were seeded, and erosion-control fabric was added to parts of the new back-slope.

Pool excavation, low bench, and bank toe construction is planned for phase 2 to finish work at this cross section when streambed disturbance is allowed.

Bankfull bench 0340R

Before-after photos (left) show how cutting a bench into the steep terrace on the right bank provided space to plant willows and wetland sod. Note that no alterations were made to the stream bed or low banks during phase 1.

The sequence of photos on the right show stages (from top to bottom) in the construction of the bench. The bench was later completed (5-29-09) with additional sod, seed, and fabric on the backslope.

All planned channel aterations and bank toe construction will take place during phase 2.

Willow Stem Bundles

On bench 340R, rocky soil made it difficult to plant dormant willow stems deep enough to be effective. As an alternative, 60 dormant 8-foot willow stems were harvested to make 12 bundles that could be planted with the excavator.

Planted bundles were backfilled with top soil, covered by transplanted riparian sod, and trimmed at the top.

Bankfull bench finishing

Where quality sod was not available, top soil was placed on bench backslopes. These and other disturbed areas were seeded twice with a mix of native high altitude erosion-control grasses. Seeds were raked in, compacted, and watered.

Where deemed necessary (Bench 340R), erosion-control fabric was placed over seeded backslopes for protection.

Bankfull bench 0650R

Before-after photos show bench construction, and planting of sod, willows and stems on the right bank near 0650R. Channel work and toe construction is planned for phase 2.

Seen from upstream

Seen from downstream

Bankfull bench 0650R

A shaped bench at 650R is shown after placement of one layer of sod. This bench was completed by planting 24 whole willows and 100 willow stems, and sodding and seeding the backslope. In phase 2, we will gently shape the bed to form a gravel toe.

Bankfull bench 1150R

Before-after photos show bench construction, and planting of sod, willows and stems on the right bank near 1150R. Channel work and toe construction is planned for phase 2.

Seen from upstream

Seen from downstream

Bankfull bench 1150R

Willow planting in progress on bench 1150R. New plantings are saturated as they go in. A first layer of sod is already in place, and additional sod is added after willows are all in place.

Hauling with an end-dump allowed for transport of 9-12 large willows per load

Planting dormant willow stems

Everything you need for a day of planting willow stems.
Equipment includes soaked stems, pump, hoses, waterjet stingers, loppers, fuel, rain gear, water and lunch (aussies optional).

Harvested willow stems are soaked for 2-7 days prior to planting to promote root growth.

Planting willow stems with a waterjet stinger.

Watering trasnsplants

A 6.5 hp pump was used to charge three hoses for watering transplanted willows and sod. All transplanted willows were saturated at least twice during the project. Last years transplants were saturated once, and newly transplanted sod was saturated three times.

Transplants were saturated while planting using either a hose or excavator bucket.

Additional watering was done using water pumped from the stream.

Willows along the side channel

To extend shrub cover down valley, willow plantings were made along a side channel north of the creek.

Stem plantings

Most stem plantings were made on the banks along outside bends, densely planted from the stream edge, overhanging the channel, to about 30 feet away.

Complimentary work

Prior to completion of phase 1, the borrow site was graded and seeded. This area was prepared as a stream access to the upper end of the property. Foot access trails within this "jungle" area were also identified to make it useable for anglers.

In addition to reclaiming disturbed areas and the borrow site, completing phase 1 involved repairs on the neighbor's driveway which was thankfully offered as access to the north side of the project area. The haulage road saw dozens of semi-load passes during construction.

A few before-after shots

A few more before-after shots

And a few more before-after shots

Appendix 2. Tarryall Creek Ranch 2009 Riparian Restoration Project Monitoring Plan

Monitoring Plan

Philosophy

The Tarryall Creek Ranch Riparian Enhancement Project (2009) is monitored and evaluated as part of the Park County Stream Conservation Program (PCSCP) by EcoMetrics, LLC. This plan was developed prior to construction in 2009 to provide objective criteria to use in the evaluation of project performance. To evaluate progress towards the ultimate goal of restoring a fully functional willow-dominated, beaver-driven stream and riparian ecosystem, we established a set of specific parameters to be monitored for several seasons. Establishing trends in these parameters over several years will help us determine whether the system is moving towards our desired long-term endpoint or not. In addition to the parameters used for monitoring progress towards the long-term goal, the plan also includes several monitoring parameters to evaluate improvement in several short-term objectives such as bank erosion and in-stream pool habitat.

Data collection

To obtain parameter values, the following data collection methods are employed:

- Photos from monumented points pre-project, as-built, and several times seasonally afterwards
- 6 monumented cross sections located on treatment areas surveyed pre-project, as-built, and seasonally afterwards.
- 3 vegetation transects across riparian area pre-project, as-built, and again after 3 seasons.
- Greenline vegetation surveys pre-project, as-built, and again after 3 seasons.
- Reach-wide BANCS model bank erosion estimates pre-project, as-built, and again after 2 and 4 seasons.
- 6 test banks to measure annual bank erosion (bank profiles and BANCS model parameters)
- Pool area surveys measured pre-project, as-built, and again after 3 seasons.

Evaluation of long-term goals

The following outline was provides a set of objective criteria to evaluate trends in parameters important for the long-term goal of restoring a willow-dominated riparian system suitable for beaver inhabitation.

Transplant establishment

- Adult willow transplants
    - Immediate success
        - EXCELLENT - Number of transplanted adult willows alive at the end of the 2009 season is greater than 95% of proposed (> 570 total)
        - ACCEPTABLE - Number of transplanted adult willows alive at the end of the 2009 season is between 75% and 95% of proposed (450-570 total)
        - POOR - Number of transplanted adult willows alive at the end of the 2009 season is less than 75% of proposed (< 450 total)
    - Short-term success
        - EXCELLENT - Number of transplanted adult willows alive at the end of the 2012 season is greater than 75% (> 450 total)
        - ACCEPTABLE - Number of transplanted adult willows alive at the end of the 2012 season is between 60% and 75% (360-570 total)
        - POOR - Number of transplanted adult willows alive at the end of the 2012 season is less than 60% (< 360 total)
- Willow stem transplants
    - Immediate success
        - EXCELLENT - Number of transplanted willow stems alive at the end of the 2009 season is greater than 95% of proposed (> approx. 1900 total)
        - ACCEPTABLE - Number of transplanted adult willows alive at the end of the 2009 season is between 75% and 95% of proposed (1500-1900 total)
        - POOR - Number of transplanted adult willows alive at the end of the 2009 season is less than 75% of proposed (< 1500 total)
    - Short-term success
        - EXCELLENT - Number of transplanted adult willows alive at the end of the 2012 season is greater than 60% (> 1200 total)
        - ACCEPTABLE - Number of transplanted adult willows alive at the end of the 2012 season is between 40% and 60% (800-1200 total)
        - POOR - Number of transplanted adult willows alive at the end of the 2012 season is less than 30% (< 800 total)

Streamside vegetation

- Streamside shrub cover
    - Immediate success
        - EXCELLENT - Proportion of woody species cover on greenline increased more than 100% (> 30% in 2009)
        - ACCEPTABLE - Proportion of woody species cover on greenline increased more than 50% (22% - 30% in 2009)

        - POOR - Proportion of woody species cover on greenline increased less than 50% (< 22%) in 2009
    - Short-term success (trend towards final goal)
        - EXCELLENT - Trend in proportion of woody species cover on greenline increasing and projected to meet target reference density (approx. 50%) by 2015
        - ACCEPTABLE - Trend in proportion of woody species cover on greenline increasing but not projected to meet target reference density (approx. 50%) by 2015
        - POOR - Proportion of woody species cover on greenline not significantly increasing

Riparian area vegetation

- Riparian area shrub cover
    - Immediate success
        - EXCELLENT - Mean proportion of woody species cover on riparian area transects between terrace elevations increased to ≥ 15% in 2009
        - ACCEPTABLE - Mean proportion of woody species cover on riparian area transects between terrace elevations increased significantly but not ≥ 15% in 2009
        - POOR - Mean proportion of woody species cover on riparian area transects between terrace elevations not significantly increased in 2009
    - Short-term success (trend towards final goal)
        - EXCELLENT - Trend in proportion of woody species cover on transects increasing and projected to meet target density (approx. 50%) by 2015
        - ACCEPTABLE - Trend in proportion of woody species cover on transects increasing but not projected to meet target density (approx. 50%) by 2015
        - POOR - Trend in proportion of woody species cover on transects not significantly increasing

Other long-term factors

- Beaver activity
    - Documented beaver activity within the monitoring timeframe is considered a sign of success towards the final goals of the project, but not necessarily a requirement of success. The project is deemed successful as long as the conditions for beaver occupation are created (improved shrub cover).

Evaluation of short-term goals

The following outline contains a set of objective criteria for evaluating success of the project in secondary, short term goals of reducing of stream bank erosion and the creating in-stream pool habitat.

Bank erosion

- Volume of sediment produced by bank erosion
    - Immediate success
        - EXCELLENT - Estimated annual bank erosion decreased by more than 50% (from approx. 70 ft^3 per 100 ft stream length to ≤ 35) in 2009
        - ACCEPTABLE - Estimated annual bank erosion volume decreased 10% - 50% (2009 estimate 35 - 60 ft^3/100ft)
        - POOR - Estimated annual bank erosion volume not significantly decreased (2009 estimate ≥ 60 ft^3/100ft)
    - Short-term success
        - EXCELLENT - Estimated annual bank erosion decreased by more than 50% (2012 estimate ≤ 35 ft^3/100ft)
        - ACCEPTABLE - Estimated annual bank erosion volume decreased 10% - 50% (2012 estimate 35 - 60 ft^3/100ft)
        - POOR - Estimated annual bank erosion volume not significantly decreased (2012 estimate ≥ 60 ft^3/100ft)
- Percent of stream bank length with high bank erosion
    - Immediate success
        - EXCELLENT - Percent bank length with high erosion rate (> 0.6 ft/yr) decreased to less than 5% in 2009
        - ACCEPTABLE - Percent bank length with high erosion rate (> 0.6 ft/yr) decreased to between 5% and 10% in 2009
        - POOR - Percent bank length with high erosion rate (> 0.6 ft/yr) not significantly decreased (remaining > 10% in 2009)
    - Short-term success
        - EXCELLENT - Percent bank length with high erosion rate (> 0.6 ft/yr) decreased to less than 5% in 2012
        - ACCEPTABLE - Percent bank length with high erosion rate (> 0.6 ft/yr) decreased to between 5% and 10% in 2012
        - POOR - Percent bank length with high erosion rate (> 0.6 ft/yr) not significantly decreased (remaining > 10% in 2012)
- Bank erosion long-term outlook

- Changes to streamside vegetation and bank and channel morphology will be assessed for observable trends through 2012 to determine judge whether bank erosion can be expected to increase, decrease, or remain stable for long-term.
    - EXCELLENT - Trends in bank erosion factors (bank height, bench width, bank angle, root depth and density, surface protection, or near-bank stress) are relatively stable or positive so that future bank erosion estimates will not likely increase significantly.
    - ACCEPTABLE - Trends for bank erosion factors on some banks suggest future increase in bank erosion above 2009-2012 estimates, but these rates are still expected to remain below pre-project levels through 2020.
    - POOR - Trends for bank erosion factors clearly suggest that future bank erosion estimates will be greater than or equal to pre-project levels within by 2020.

In-stream pool habitat

- Overall pool area (RPD > 1.5 ft)
    - Immediate success
        - EXCELLENT - Pool area with RPD > 1.5 ft increased from 13 ft^2 per 100 ft stream length to > 200 ft^2/100ft in 2009
        - ACCEPTABLE - Pool area with RPD > 1.5 ft increased significantly but still low (2009 RPD>1.5 pool area 50-200 ft^2/100ft)
        - POOR - Pool area with RPD > 1.5 ft remains very low (2009 RPD>1.5 pool area < 50 ft^2/100ft)
    - Short-term success
        - EXCELLENT - Pool area with RPD > 1.5 ft remains greatly improved (2012 RPD>1.5 pool area > 200 ft^2/100ft)
        - ACCEPTABLE - Pool area with RPD > 1.5 ft remains moderately improved (2012 RPD>1.5 pool area 50-200 ft^2/100ft)
        - POOR - Pool area with RPD > 1.5 ft remains unimproved (2012 RPD>1.5 pool area < 50 ft^2/100ft)
- Deep pool area (RPD > 2.0 ft)
    - Immediate success
        - EXCELLENT - Pool area with RPD > 2.0 ft increased from none to > 50 ft^2/100ft in 2009
        - ACCEPTABLE - Pool area with RPD > 2.0 ft increased significantly but still low (2009 RPD>2.0 pool area 20-50 ft^2/100ft)
        - POOR - Pool area with RPD > 2.0 ft remains very low (2009 RPD>2.0 pool area < 20 ft^2/100ft)

- Short-term success
  - EXCELLENT - Pool area with RPD > 2.0 ft remains greatly improved (2012 RPD>2.0 pool area > 50 ft^2/100ft)
  - ACCEPTABLE - Pool area with RPD > 2.0 ft remains moderately improved (2012 RPD>2.0 pool area 20-50 ft^2/100ft)
  - POOR - Pool area with RPD > 2.0 ft remains unimproved (2012 RPD>2.0 pool area < 20 ft^2/100ft)

Tarryall Creek Ranch Riparian Restoration Project
Final Budget Summary

USES

Riparian Revegetation		
Supervision (time, travel, etc.)	$8,152	13%
Heavy Equipment (transplanting, hauling, etc.)	$32,420	51%
Labor (dormant pole planting)	$6,080	9%
Materials	$7,080	11%
Subtotal Riparian Vegetation	$53,732	84%
Bank Stabilization and In-Channel Work		
Supervision (time, travel, etc.)	$3,298	5%
Heavy Equipment	$3,840	6%
Materials	$420	1%
Subtotal Bank Stabilization	$7,558	12%
Data Collection and Report Preparation	$1,280	2%
Project Administration	$1,500	2%
Grand Total - Use of Funds	**$64,070**	100%

SOURCES

Park County Land and Water Trust Fund	$10,000	15.6%
Tarryall Creek Ranch, LLC	$15,550	24.3%
US Fish and Wildlife Services, Partners Program	$10,000	15.6%
Colorado Water Conservation Board	$28,520	44.5%
Grand Total - Funding Sources	**$64,070**	100%