North Fork Gunnison River-Midway Stabilization and Riparian Improvements Project

Final Report

December 14, 2011

Project Description

The Midway Stabilization and Riparian Improvement Project will focused on a critical reach of the North Fork of the Gunnison River between Paonia and Hotchkiss. The quarter mile reach addressed in this project proposal is congruent with a 2001 319 Phase I restoration project on this reach of the river. Phase I of the Midway project realigned a braided channel into a single-thread meandering channel. This project is considered a portion of the Phase II Midway project and will use “adaptive management” techniques to stabilize eroding banks, correct a channel avulsion by re-establishing a meander bend, revegetate the floodplain, and re-establish backwater riverine wetlands.

The project installed 800 linear feet of a log and root wad stabilization structures never used on this river before. The project is a demonstration of a cost-effective method designed to reduce on-going accelerated bank erosion, promote the natural recruitment of sustainable native riparian species, and reduce sediment and nutrient loads in the North Fork. The demonstration project substantially reduced cost by eliminating expensive large rock structures and utilized abundant native tree material to accomplish the project’s goals. The bank stabilizing structures captured floating woody debris during the high spring runoff and formed a natural barrier to floodwaters that allowed for sediment and seed deposition on the floodplain while diverting the primary flow of the river back into the historic meandering channel. The structures encouraged natural floodplain processes and provided in-stream habitat features and hydraulic complexity while stabilizing the riverbanks.

Large overbank areas were re-vegetated using natural recruitment methods, including the placement of energy dissipating live willow silt fences and secured logs in the floodplain to encourage natural deposition of debris and sediment on the floodplain. Floodwaters from the North Fork are loaded with native seeds and, if given the chance, have shown they will germinate naturally on their own. New regeneration of cottonwoods and willows has sprouted across the active floodplain after the first runoff season.

Re-vegetation of the floodplain with native plants will increase floodplain function, allowing for more infiltration during high flow events and subsequent sustained ground water release to the river during dry periods. Floodplain re-vegetation will also help re-establish riparian wetland habitat destroyed by river channel straightening during the second half of the 20th century. The proposed combination of easily established willow plantings and natural seed deposition has already begun to establish a sustainable riparian area requiring limited maintenance as demonstrated by previous projects.

Project Goal

The goal of this restoration project was to demonstrate a cost-effective approach to stabilize an 800’ reach of the North Fork of the Gunnison River and suspend accelerated bank erosion, reduce sedimentation and nonpoint source pollution into the river, re-establish a riverine wetland and reinvigorate natural riparian vegetation. This was achieved by installing root wad and log bank stabilization structures that reduced streambank erosion, repair the avulsion of the existing channel and allow for natural regeneration of a healthy riparian zone that will result in reduced sediment and nutrient loads into the North Fork. This has also allowed for natural sediment deposition and regeneration of native riparian vegetation in a floodplain that is hydraulically connected to the river.

Background

The Midway Enhancement Project was constructed in 2001 and is located on the North Fork of the Gunnison River between Paonia and Hotchkiss. The goal was to reduce human intervention in the active channel and return natural function to a 4 ½ -mile stretch of the river. Decades of floodplain encroachment by agriculture, residential development, and gravel mining have resulted in extreme bank erosion, loss of prime agricultural land, and substantial loss of aquatic and riparian habitat. In years past, methods to protect private property and public investments along the river included the use of bulldozers to straighten the channel and divert irrigation water, the construction of dikes and levees within the active floodplain, and armoring of the riverbanks with rock rip-rap, car bodies, used tires, cabled trees, broken concrete, or anything else available at the time. It eventually became an annual practice by the county to bulldoze the channel prior to the spring runoff.

The Midway Enhancement Project was designed to return natural function to the ecosystem by utilizing the full potential of the floodplain to reduce erosion, improve water quality, enhance fish and wildlife habitat, and recharge groundwater storage. Agricultural and residential property on the edges of the floodplain was protected by stabilizing the banks with large boulders placed at the toe of the streambank and a variety of natural vegetative treatments. In high velocity areas, upstream-pointing jetties, known as rock veins, were used to slow the water down while providing additional fish habitat in the channel. Although this type of treatment holds the outside banks of the channel in place and prevents natural movement of the river, it cost-effectively protects private property, economic investments, and serves the social and political agendas of the community while providing additional habitat, an aesthetically pleasing natural streambank, and improved recreational potential.

Early written accounts by the first homesteaders in the valley in 1882 indicate that the floodplain was wide and very thickly vegetated. Development and in-channel activity throughout the last century had removed much of the energy-dissipating vegetation that reduces erosion and replaced it with bare gravel bars. A major component of this project is to re-establish that native vegetation. In many cases that means slowing the river down by increasing meanders throughout the full extent of the floodplain and thereby reducing the overall slope of the channel. It is currently unknown whether a single-thread meandering channel existed in the valley prior to the 1880’s but it is certainly possible that the system has always been a braided. However, there are specific benefits to creating a non-entrenched single-thread channel. Not only does it reduce slope and velocity to allow for the re-establishment of native vegetation but also consolidates several small channels into one larger one capable of sustaining fish populations during summer low-flow conditions.

It is important to note that the creation of a single-thread meandering channel does not necessarily mean that it is designed to remain that way in perpetuity. Rivers are dynamic and in order to meet the goal of returning natural function to the ecosystem it was engineered in a manner that allowed for movement and change while protecting private property. The stabilization of outside bends on the periphery of the floodplain was necessary to meet the objectives of individual landowners but in no means suggested that the intent of the project is to channelize the river into a hard and fast meandering stream. The reconstruction of the channel was intended to act as a “head-start” program to give the river the opportunity to “restore itself” after one or several competent floods.

The project met the objectives of several competing interests between farmers, ranchers, hunters, fishermen, residential property owners, irrigation companies, environmentalists, gravel miners, and boating enthusiasts. While difficult to accomplish, several years of meeting with these groups have provided substantial insight and optimism. The project’s four primary objectives were to meet the needs of each of these interest groups. They remain today:

Channel Reconstruction – Reconstruct portions of the channel to replicate geometric patterns from historical information and undisturbed reference reaches consistent with basic geomorphic principles. The new single-thread primary channel was designed for a bankfull flow of 3,000 cfs to allow for safe overbank flooding throughout the full extent of the floodplain without damaging adjacent property. Regular flooding recharges wetlands and groundwater tables, deposits sediment, and re-establishes native riparian vegetation. The new channel utilizes many existing channels in the floodplain to minimize the loss of existing established riparian vegetation while maximizing the full width of the floodplain to reduce overall slope and stream velocity.

Revegetation – Re-established diverse native riparian vegetation along streambanks and disturbed portions of the floodplain. Vegetation has a profound effect on the stability of soils. It serves as a buffer between the water and the underlying soil and increases the effective roughness of the land thereby dissipating erosive energy during high flow events. The vegetation enhances aquatic habitat by providing shade to reduce water temperatures and summertime evaporation rates. Diverse native wetland vegetation improves water quality by enhancing the filtering capabilities of riparian wetlands. The riparian areas provide habitat for 75% of all western wildlife species.

Irrigation Diversion – Rebuilt two irrigation diversions to provide reliable and efficient irrigation water. Sustainable agriculture and the rural quality of life are top priorities in the community and agriculture is dependent on irrigation. However, the unstable nature of the river has caused extensive damage to irrigation facilities and farmers cannot afford to repair them properly. This project eliminated the need for ditch companies to hire a bulldozer for a few hours to construct a temporary gravel dams in the river to divert the water. This project constructed permanent, low-head, rock diversion structures with concrete headgates at the point of diversion. This conserves water and reduces maintenance by diverting a full decree of water and leaving the rest in the river. Fish are able to migrate upstream while recreational boats can safely pass downstream. The channel was allowed to stabilize and vegetation to re-establish with the elimination of the bulldozer.

Education – This project educated the community, elected officials, other watershed or conservation organizations, and appropriate government agencies about the value of riparian conservation and the degree of success found from various techniques and methods used throughout the project. The continued success of this project and other ones like it hinge upon illustrating and demonstrating the economic, social, and environmental importance of such work. The education component of this project included published accounts of the project description; monitoring results in the organization’s newsletter and local media; interpretive signs along the river; posters and brochures; presentations to local schools and civic groups; exhibits at community and appropriate statewide events, and the development of a website.

NFRIA put together a large and diverse group of partners to fund the project:

1. Colorado Department of Public Health and Environment (319)– awarded $150,000
2. Colorado Water Conservation Board– awarded $50,000 38,000
3. Colorado State Soil Conservation Board – awarded $15,000 matching grants
4. National Fish & Wildlife Foundation- awarded $100,000
5. Colorado Dept. of Transportation- in-kind rock donation-$72,335
6. National Park Service– awarded $27,000
7. Sickles Construction- $15,000 in-kind equipment donation
8. Sheppard-Wilmot and Short Ditch Companies- $22,000 cash and in-kind
9. Colorado River Water Conservation District- awarded $13,000 cash
10. General Service Foundation- awarded $15,000 cash
11. Watershed Assistance Grant from River Network– awarded $28,000 cash

12. National Forest Foundation- awarded $50,000 cash
13. Landowners in-kind rock donations - $125,000
14. Membership donations - $6,193

Total Project Cost **$688,528** 676,528

Phase II Design and Installation

It has always been assumed that certain reaches of the 4 ½ mile project would require some adaptive management due to the nature of the project designed to encourage natural channel movement. Over the last ten years the river has naturally adjusted. In most cases the movement was within the normal limits of natural morphological processes and did not threaten agricultural properties or the re-establishment of riparian vegetation and riverine wetlands. However, in the reach encompassing this demonstration project the river continued to be excessively mobile and in 2008 developed an avulsion from the meandering channel and cut off the meander. This created accelerated erosion and destroyed a new riverine wetland established by the 2001 Midway project.

Sustainability of the goals for river rehabilitation on the North Fork will be primarily the responsibility of landowners and therefore heavily dependent on cost. The primary objective of this project is to reduce nonpoint source pollution in the form of sediment in the river but another important aspect is to demonstrate simple and cost-effective techniques that individual landowners can incorporate to meet these goals. This project accomplished both of those.

Stabilizing with large boulders is expensive but trees are plentiful and cheap in the North Fork. Cottonwood trees in the floodplain are common and easy to collect therefore this project was designed to utilize the wood resource. In this particular case cottonwood trees collected around the project site was supplemented with aspens from nearby.

Between 2008 and 2010 approximately 6,600 cubic yards or 9,900 tons of sediment washed away from about 390 linear feet of streambank as measured from permanent cross sections established prior to the 2001 Midway project. Furthermore, the avulsion located downstream and adjacent to the bank erosion site, has scoured approximately another 550 cubic yards or another 825 tons of sediment in the past two years and destroyed approximately ½ acres of riverine wetlands.

Avulsion channel 2010

Two different types of techniques were used to stabilize an existing bank and to divert water away from the avulsion and back into the original meander. The first was a log retaining wall type of structure along the bank erosion reach. Horizontal logs were secure on vertical posts with rebar and dovetail joints. The back side of the structure was planted with willow cuttings and cottonwood poles before backfilling. The reach along the avulsion also utilized horizontal logs but the posts were installed at varying angles to act as a trap for woody debris. A trench behind the structure was used to plant a live willow silt fence designed to slow down rising waters and settle out sediment and the natural seed base found in the water.

First Year Results

Immediately following construction it became apparent that the project was already reducing stress on the streambanks. Ice began forming along the structures. The faster moving water remained ice-free. The structures were reducing shear stress by reducing velocities which was a result of increased friction at the streambanks. Several random logs were installed along the structure from the top down into the thalweg to break up primary flow patterns along the bank and create secondary cells that have reduced shear stress capabilities. The evidence is in the ice.

The 2011 spring runoff was high. A peak discharge was measured at the Somerset gage of over 4,000 cfs which is approximately 30% above the bankfull elevation. The runoff was also extended into mid-July due to cold temperatures in May which resulted in an extended and more gradual runoff. As a result the project site was inundated for over 90 days. Overtopping resulted all along the structures and velocities were quite high.

Avulsion channel blocked by woody debris caught in log structures

The structures held up well throughout the above-average spring runoff and actually strengthened itself throughout the process. Tons of woody debris was caught in these structures and created a beaver dam type of structure that allowed small amounts of water through but diverted the flow of the river back into its original meander. Much of the live willow silt fence became buried under mounds of woody debris but 2 months after the runoff subsided willow starts began to sprout up throughout the structure. The avulsion channel began to receive deposition of silt and native riparian seeds and cottonwoods starts sprouted up all across the previous active channel.

The avulsion channel that was created when the river cut through the meander bend can now act as a part of the active floodplain. Floodwaters are still allowed to overtop the structure during the runoff events which will help dissipate erosive fluvial energy, allow for deposition of sediment and the regeneration of riparian vegetation to absorb nutrients. (*Photo at right shows avulsion channel in Sept 2011 with sprouts in recent silt deposition*)


Regeneration of native cottonwoods and willows following the high runoff event of 2011

As with most stream restoration projects there are usually some unanticipated results. This project was no exception. Following the runoff the thalweg of the channel moved toward river left and developed a more direct line toward the avulsion channel (*see the plan view drawing-sheet 1 of 7 in the appendix*). The structures held well but the river skirted around the downstream terminus of the structures and began to develop another active channel. An adaptive management plan was implemented in September 2011 and as a result the length of the structure was extended another 150 feet and the secondary channel was then abandoned. The entire river is in the original meander and expected to remain that way (*Photo on right shows construction of the extension*). The new floodplain on river right received large quantities of sediment and has already begun sprouting sedges, rushes, cottonwoods and willows (*shown below*).

Prior to the Phase I Midway project of 2001 the river was extremely braided throughout this reach. The active channel consisted of multiple channels approximately 600 feet across. Since the Phase I project that active channel area had been reduced down to approximately 150 feet and previous braided channels have become healthy active floodplains with cottonwood stands 20 to 30 feet tall accompanying a thick understory of native grasses, sedges, rushes and willows. The same is expected of the avulsion channel. Furthermore, over time this reach is expected to continue to narrow as it continues to balance morphologically as the riparian vegetation continues to expand.


Project Monitoring and Assessment

This project has been closely monitored since the year 2000 prior to construction of Phase I. Seventy nine (79) cross sections were established for the original 4 ½ mile construction project. Of those, eleven (11) cross sections were re-surveyed for this Phase II project. The monitoring includes pre-construction 2001, proposed design channel 2001, post construction 2002, preconstruction Phase II 2010, and post construction 2011 (*see cross section sheets 4 through 7 in appendix*).

In addition to the cross sections, four (4) photo points were established at each cross section. They were taken beginning at the end points on river left and moved in a clockwise direction around the cross section. The second photo was taken downstream looking up, the third was taken at the river right end point and the fourth was taken upstream looking down. All of the photos are included in the appendix.

Wolman pebble counts were also established at three (3) cross sections as well. One at the project site, one upstream and one downstream. The data showed no appreciable change from pre to post construction conditions.

The cross sections demonstrate a river channel still in flux in a highly mobile environment situated in a broad valley floodplain with multiple alluvial river terraces positioned laterally with a gentle down-valley elevation relief. There are no hard features such as rock canyons that contain the river. Well-established riparian vegetation is the primary stabilization force and the long term solution to accelerated bank erosion and increased nonpoint source pollution caused by anthropogenic influences.

The 390 linear feet of streambank that lost nearly 10,000 tons of sediment in two years showed no loss in the high water runoff of 2011. The avulsion channel began a regeneration process with the deposition of fine sediments on the new floodplain and the establishment of new riparian vegetation. The wetlands previously destroyed by the active channel also began to rehabilitate itself with new wetland plants.

A 400 foot reach of the river shifted from left to right but did not contribute to any new floodplain erosion. It was an unanticipated but natural adjustment in the active river channel. The erosion of the new channel was compensated by increased deposition in the old channel and resulted in a balanced relocation of bedload.

Lessons Learned

Sustainable solutions require simple cost-effective solutions that can be replicated by landowners in place of heavy equipment in the river. This project demonstrates the use of cheap and plentiful materials found on site and installed with light-duty equipment that can effectively protect private property while enhancing the natural ecosystem services provided by native riparian vegetation in a healthy floodplain. Cross sectional monitoring and the natural regeneration of riparian vegetation indicates that excessive streambank erosion has been abated and nonpoint source pollution has been substantially reduced along the project site.

However, the success of this demonstration project will be marginalized if the results are not properly documented, recognized and promoted nor will this specific technology get sufficiently implemented or improved upon by others. Local citizen watershed groups have a large role to play in getting the message out to respective communities and agencies could further support local outreach efforts and new technology promotion. Outreach is vitally important to continue to find low-cost solutions that can make a substantial difference on a large scale.

APPENDIX

Cross Section 177+00

Post-construction October 23, 2011

Left
Bank

Looking
Upstream

Looking
Downstream

Right
Bank

Cross Section 175+50

Post-construction October 23, 2011

Left Bank

Looking Upstream

Looking Downstream

Right Bank

Cross Section 173+50

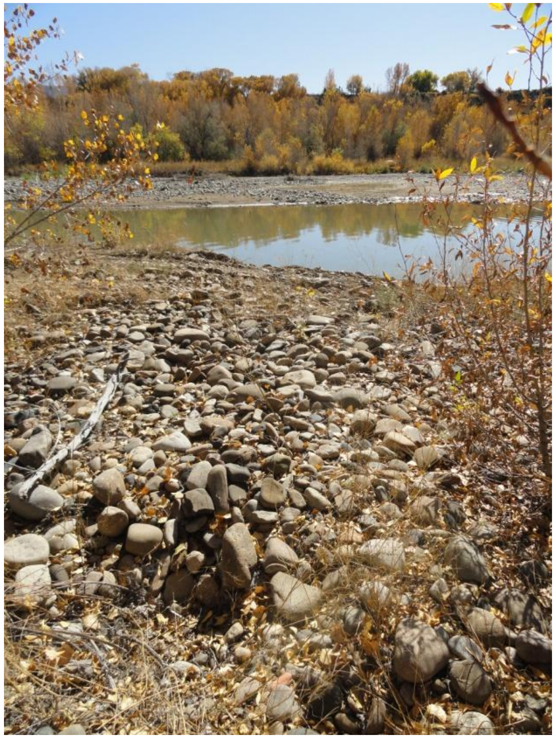
Post-construction October 23, 2011

Left
Bank

Looking
Upstream

Looking
Downstream

Right
Bank



Cross Section 171+50

Post-construction October 23, 2011

Left
Bank

Looking
Upstream

Looking
Downstream

Right
Bank

Cross Section 170+00

Post-construction October 23, 2011

Left
Bank

Looking
Upstream

Looking
Downstream

Right
Bank

Cross Section 168+50

Post-construction October 23, 2011

Left
Bank

Looking
Upstream

Looking
Downstream

Right
Bank

Cross Section 166+00

Post-construction October 23, 2011

Left Bank

Looking Upstream

Looking Downstream

Right Bank

Cross Section 164+00

Post-construction October 23, 2011

Left Bank

Looking Upstream

Looking Downstream

Right Bank

Cross Section 161+75

Post-construction October 23, 2011

Left
Bank

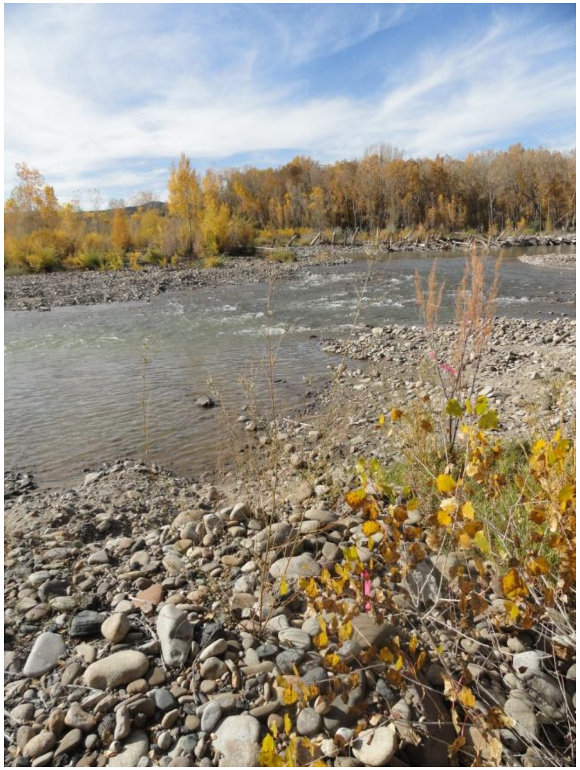
Looking
Upstream

Looking
Downstream

Right
Bank

Cross Section 159+50

Post-construction October 23, 2011



Left Bank

Looking Upstream

Looking Downstream

Right Bank

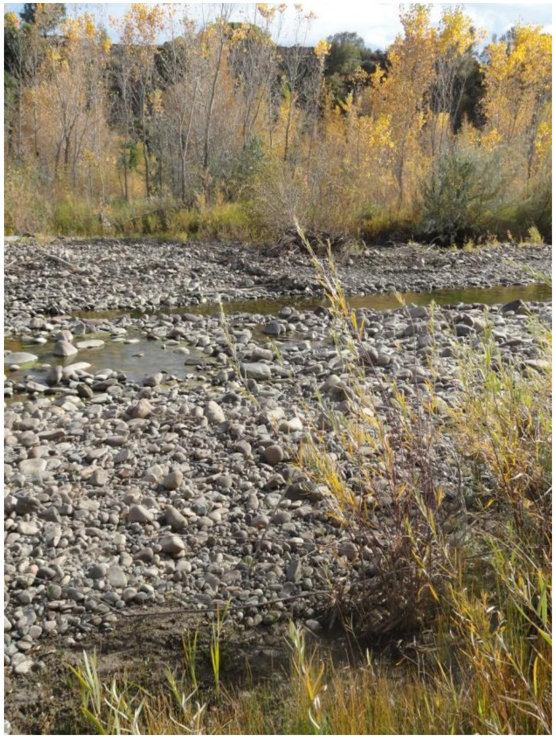
Cross Section 155+50

Post-construction October 23, 2011

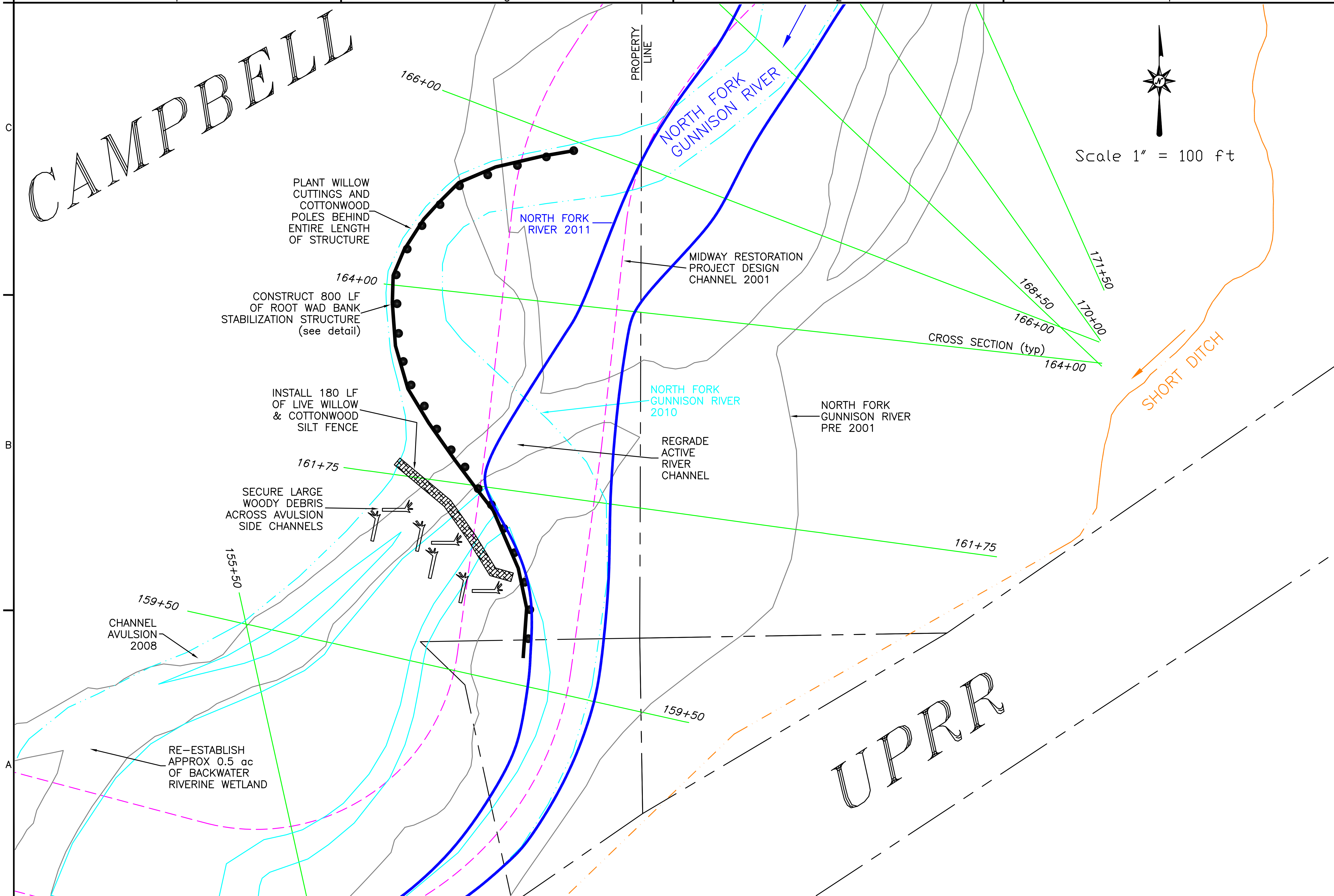
Left
Bank

Looking
Upstream

Looking
Downstream



Right
Bank



MIDWAY BANK STABILIZATION DEMONSTRATION PROJECT
NORTH FORK GUNNISON RIVER
DELTA COUNTY, COLORADO
OVERALL PLAN VIEW

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Submitted by:
Date: Jan, 2011
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Sheet 1 of 7

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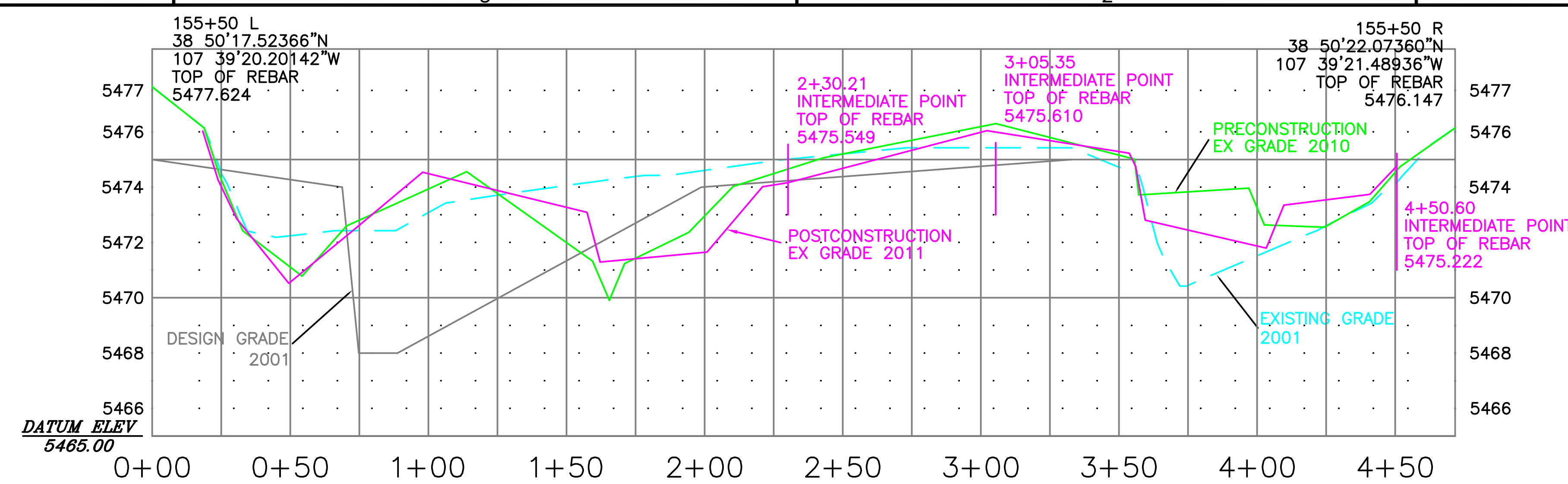

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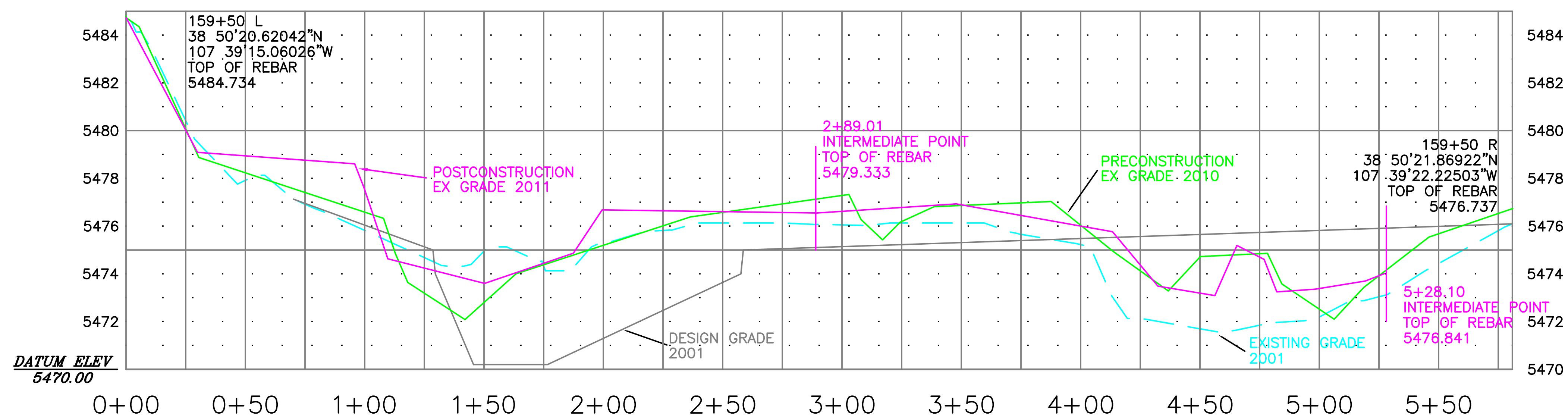

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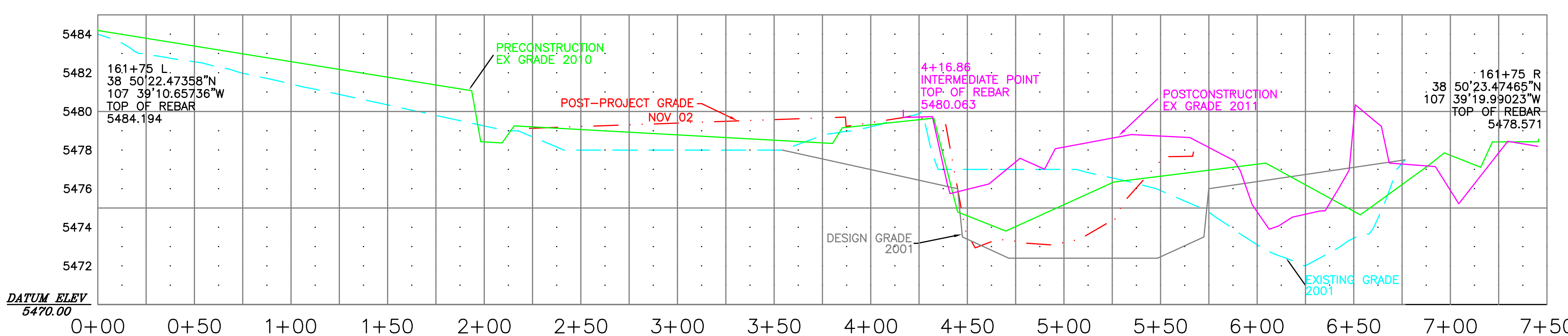

STA 161+75

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MIDWAY BANK STABILIZATION
DEMONSTRATION PROJECT
NORTH FORK GUNNISON RIVER
DELTA COUNTY, COLORADO
MONITORED
CROSS SECTIONS

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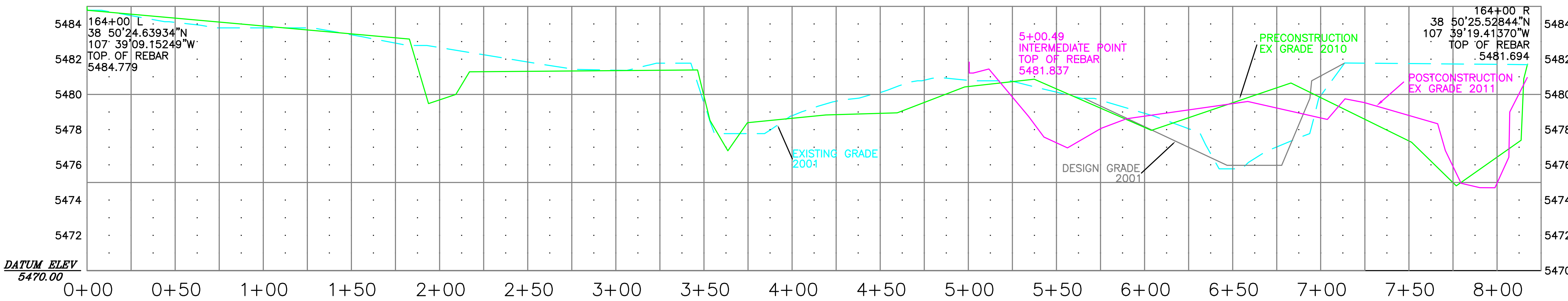

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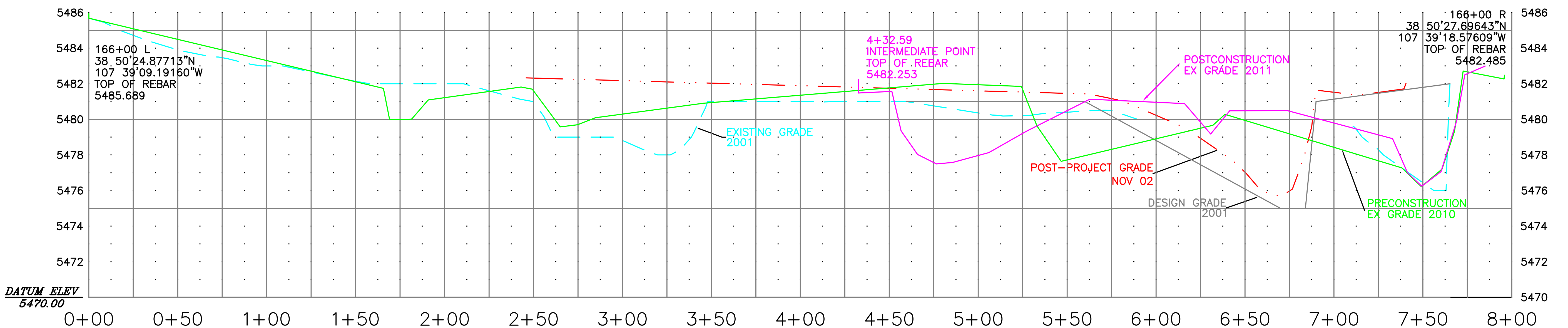

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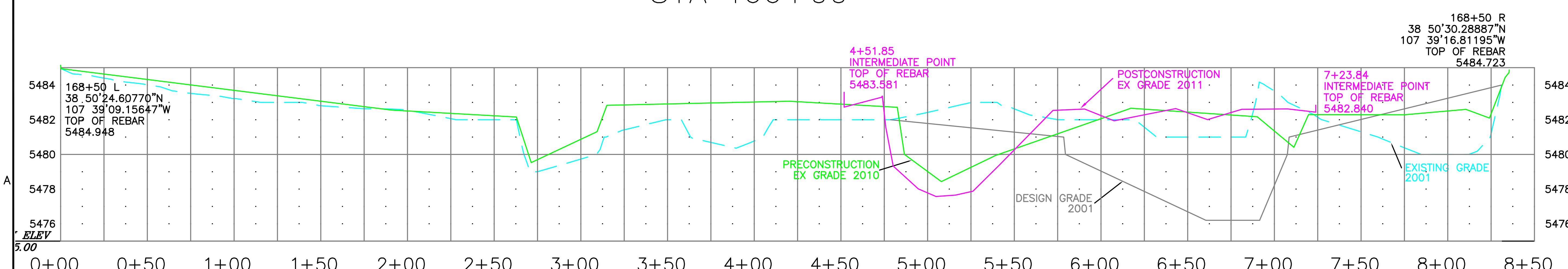

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Sheet 5 of 7

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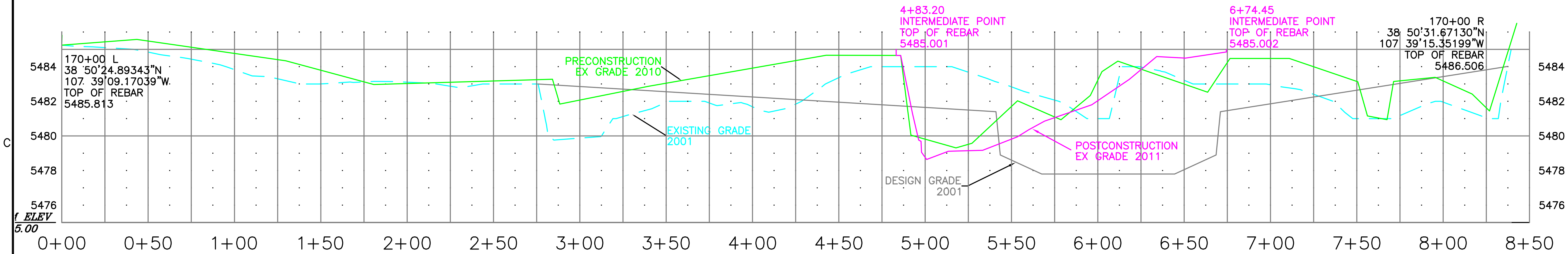

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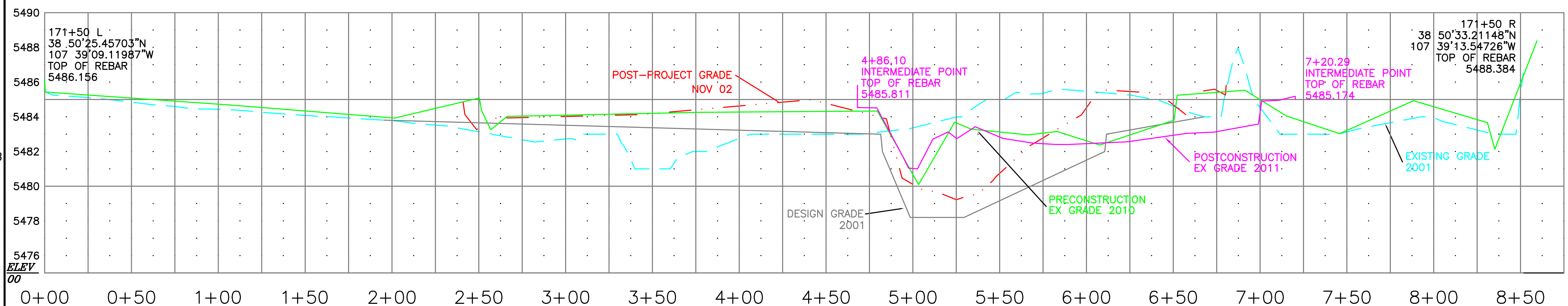

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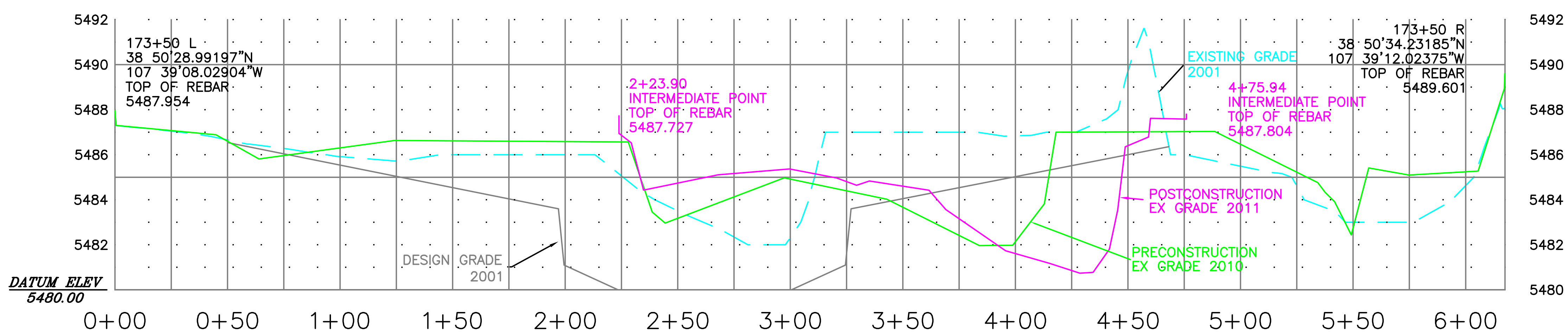

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NORTH FORK GUNNISON RIVER
DELTA COUNTY, COLORADO
MONITORED
CROSS SECTIONS

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Sheet 6 of 7

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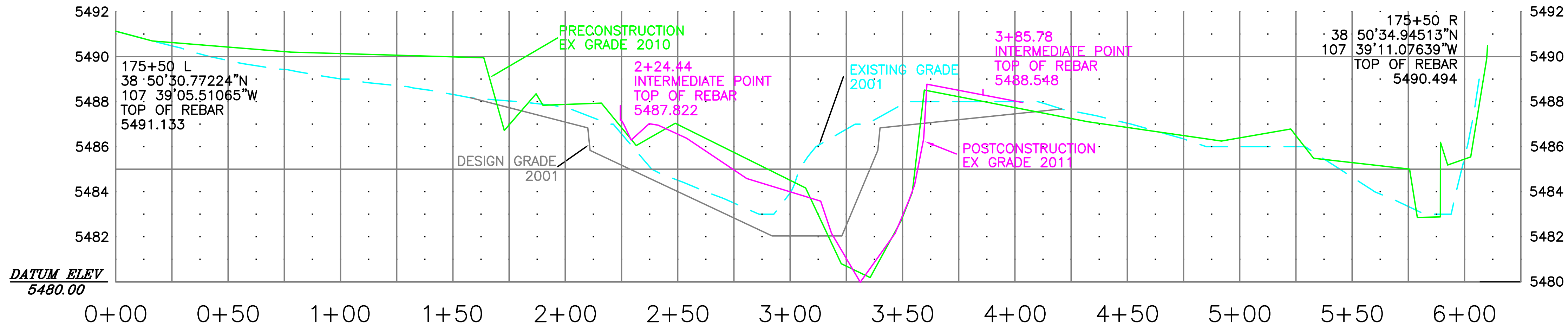

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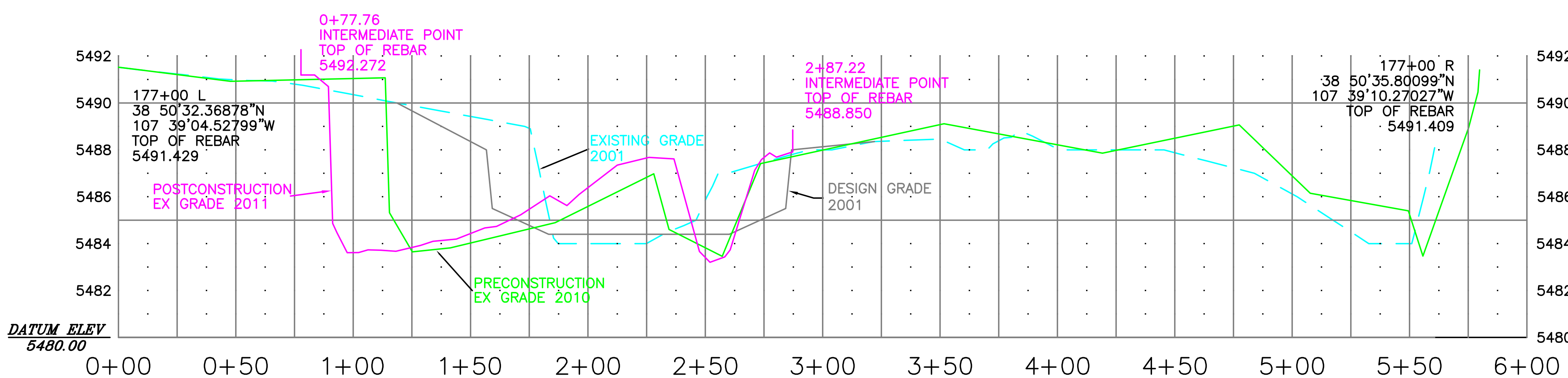

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Sheet 7 of 7

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