PAP-776

Muddy Creek Demonstration Stream Restoration Research Project

Final Report

Spring 1998

by
Dr. Rodney J. Wittler

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CRDA-96-1

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INTRODUCTION

This final report summarizes progress on the part of the Reclamation Water Resources Research Laboratory (WRRL) through December 31, 1997. Dr. Rodney J. Wittler is the Principal Investigator. This report includes details on the consolidation of all field data, progress on the three dimensional CAD drawing/database for the project, and a list of publications or reports issued by project participants.

Background

The Muddy Creek Task Force is a partnership of private interests, Federal and local government agencies solving the water quality problems associated with the incision of Muddy Creek near Great Falls, Montana. Mr. Alan Rollo is the Muddy Creek Task Force Coordinator. The United States Bureau of Reclamation (Reclamation) and Greenfield Irrigation District (GID) are collaborating to reduce return flow to Muddy Creek. Reclamation, Cascade County Conservation District (CCCD), and the Muddy Creek Task Force (MCTF), are collaborating to stabilize the gradient and plan form of the stream. Funding for the original partnership came from a grant by the State of Montana to the Cascade County Conservation District. Funding for the new partnership comes partially from a State of Montana grant ($10,000) and a grant by the National Fish and Wildlife Foundation ($41,000) to the Cascade County Conservation District. Reclamation and the MCTF partner via Cooperative Research & Development Agreement (CRDA) 96-1 and its amendments between Reclamation and the CCCD.

Muddy Creek extends roughly 40 river miles upstream from its confluence with the Sun River. Figure 1 shows selected structure sites of the demonstration project along Muddy Creek. The project proceeded in two phases designated by two longitudinal reaches of Muddy Creek. Phase I focused restoration activity on a roughly four mile reach of the creek from the USACE sill to upstream of the Wohlgemuth buildings along the railroad. This reach is shown in Plates 6 thru 9. Phase II focused on two areas, the first upstream and adjacent to the Phase I reach and the second upstream of Gordon. Structure types include chevron weir rock ramp grade control structures, barbs, revetments, cutoff-revetments, rechannelization, and revegetation. The structure inventory includes:

- Eleven grade control structures named 1-A through 1-F, 2-A through 2-F.
- A sill constructed by the US Army Corps of Engineers. The sill, constructed in February, 1994, was designed for zero drop. Incision in Muddy Creek below the sill has led to a substantial drop across the sill at the present time. The total drop measured across the grade control structures, including the Corps sill, at a flow between 45 ft^3/s and 63 ft^3/s is 15.16 feet as of October, 1996. The total design drop for the 11 structures was 17 feet. Not including the Corps sill, the total drop is 15.16-1.19 or 13.97 feet. Therefore, the total drop is 13.97/17 or 82% of the design head, at the flow rate of roughly 45 ft^3/s. Including the Corps sill increases the measured drop to 87% of the design drop.
- More than 160 barbs installed on Muddy Creek between Gordon and Vaughn, roughly 8 river miles. The task force installed roughly an equal number of barbs in this reach during the Fall of 1997. There are more than 33 barbs installed above Gordon, primarily in conjunction with the cutoff revetments in this reach. There are seven revetments and three cutoff revetments installed on Muddy Creek.
- In December 1996 Reclamation designed and supervised construction of a low-cost culvert crossing for Muddy Creek. The crossing demonstrates dual functionality as a grade control structure and

Muddy Creek. The crossing demonstrates dual functionality as a grade control structure and stream crossing. The crossing is in the vicinity of buildings owned by the Wohlgemuth family.

The drainage area above the Gordon gage is 282 square miles, and the drainage area above the Vaughn gage is 314 square miles. Ninety percent of the natural Muddy Creek drainage area is above the Gordon gage. The Vaughn gage is at river mile 1.3 and the Gordon gage is at river mile 14.6.

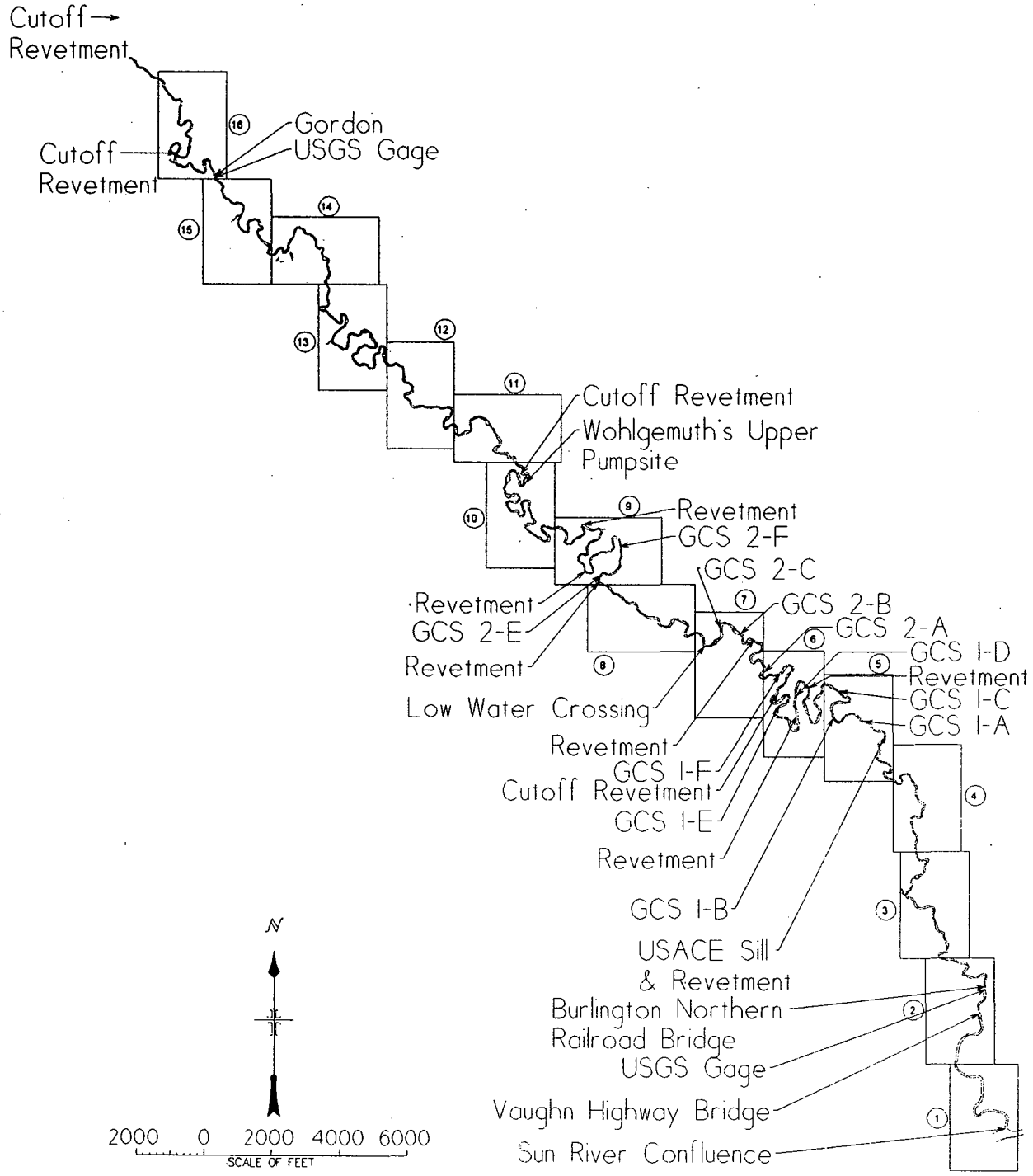

Figure 1. Selected sites along Muddy Creek.

TASK SUMMARY

Task A1 - Progress Reports and Invoices

Reclamation shall produce progress reports on all tasks described in this agreement to the Cascade County Conservation District. Reports shall accompany invoices.

Reclamation has produced and submitted the following reports and invoices satisfying Task A1.

Cooperative Research and Development Agreement 96-1 August 26, 1996

Originating Invoice

Fall 1996 Progress Report PAP 753
Fall 1996 Invoice

Winter 1996-97 Progress Report PAP 761
Winter 1996-97 Invoice

Spring 1997 Progress Report PAP 767
Spring 1997 Invoice

Spring 1998 Final Report

Task A2 - Final Report on Demonstration Project

Reclamation shall produce a final report describing all aspects of the Muddy Creek Demonstration Stream Restoration Research Project. This report will be submitted to the Cascade County Conservation District, the Montana Area Office and the Office of the Research Director, US Bureau of Reclamation by September 30, 1997.

This final report completes Task A2.

Task A3 - Individual Structure Evaluation and Inventory

Reclamation shall produce an inventory of all structure installations on Muddy Creek that are part of the restoration project. The inventory shall include location, description, drawing with dimensions, photo if available, and an evaluation of performance and endurance of each structure.

This task is on-going. Currently Reclamation and the MCTF are maintaining separate data bases of photographs. Reclamation is producing a massive collection of project photographs in digital format that is too large to include in this final report. The collection is continuing to evolve as photographs are transmitted from the MCTF to Reclamation and digitized. The inventory will span both the length of the demonstration project and the duration of the project. Reclamation is attempting to show the creek before construction, during construction, and following construction, in as many years as photographs are available. Finding the photographs and verifying the dates and locations is proving to be an overwhelming task. Also, selection of the proper format, GIS, or otherwise, for the inventory is not final.

Table 1 is a list of the grade control structures installed on Muddy Creek and the drop at each structure as of the Fall of 1996.

Table 1. Grade control structure inventory.

GCS	Measured Drop (ft)	Design Drop (ft)	% of Design Drop
Sill	1.19	0	N/A
1-A	1.27	1.0	127%
1-B	0.78	1.0	78%
1-C	1.11	1.0	111%
1-D	1.09	1.0	109%
1-E	0.90	1.0	90%
1-F	0.99	2.0	49%
2-A	2.08	2.0	104%
2-B	1.79	2.0	90%
2-C	1.93	2.0	96%
2-D (LWC)	N/A	2.0	N/A
2-E	1.10	2.0	55%
2-F	0.93	2.0	46%
Total	15.16	17.0	Mean 87%

Reclamation and the MCTF are currently in the progress of inventorying the barbs and revetments installed since the previous inventory in 1996.

Task A4 - CAD Based Three-dimensional Model of Project Area

Reclamation will incorporate all surveying data provided by the NRCS into a three-dimensional CAD based model of the project area. The basis of the model is the 1995 topographic survey of the demonstration reach by the Muddy Creek Task Force. The model should include pre-construction cross-sectional surveys, water surface profiles, and the exhaustive cross-sectional survey completed by NRCS in the spring of 1995.

Task A4 requires Reclamation to incorporate all surveying data provided by the NRCS into a three-dimensional CAD based model of the project area. The basis of the model is the 1995 topographic survey of the demonstration reach by the Muddy Creek Task Force. Table 2 lists the status of certain survey data components slated for inclusion in the model. Plates 1 thru 17 show the status of the CAD based model.

Table 2. Types and years of surveys.

Year	Type of Survey	Incorporated into CAD?
1993	Water Surface Profile (Phase I Reach)	No
1993-94	Selected Cross Sections (Phase I Reach)	No
1994	Water Surface Profile (Phase I Reach)	No
1995	Aerial Topographic (Mouth to above Gordon)	Yes
1995	Cross Section (Phase I Reach)	Yes
1995	Water Surface Profile (Phase II Reach)	No

As of the end of 1998 the following steps are complete towards accomplishing Task A4:

1. Receipt of the 1995 aerial topography from the contractor in three-dimensional, AutoCAD R13 format.

2. Transformation of all survey data to the SPCS.

3. Receipt of the expanded 1995 aerial topography from the contractor. Includes topography not included in the original delivery.

4. Combining Hydraulic modeling data, HEC-2 or HEC-RAS, with aerial topography.

5. Locations of grade control structures.

6. Locations of barbs, revetments, cutoff revetments, and other restoration structures.

7. Comparison of water surface profiles from 1993 and 1994.

8. Preliminary delineation of MCTF named sub-reaches in Muddy Creek corridor.

9. All structures added to CAD.

10. RAS model for Phase I reach (95 X-section extents) This River Analysis System (RAS) model will supersede the HEC-2 model currently in use by the Task Force.

11. Report on water quality based upon USGS data analysis - Initial analysis was delivered to the Task Force by the USGS in 1997. The Task Force evaluation of the data is in the paper [11] titled *Initial Analysis of Water Quality Changes on Muddy Creek*. The data is for a very short period of time. Conclusions should be tempered by the statistical significance of this data.

The following sub-tasks remain, and also point towards additional field based tasks for supporting construction and restoration activities.

1. Location of cultural resources (CAD).

2. As-builts for GCS.

3. Comparison of 77 or earlier, 90, & 95 topography - This task is underway. The first step is to scan and vectorize the 1977 topography. The TSC Remote Sensing group is performing this step. Then the 1977 and 1995 data will be overlayed onto the same drawing, contrasting the changes in the creek over that period. Analysis includes changes in sinuosity, amount of incision, and volume of erosion.

4. Updated field data plan including:

    a. Water surface profile (Corps sill to above Gordon?)
    b. X-section survey (repeat)
    c. Close the traverse
    d. Selected X-sections above and below Phase I reach

Additional field and analysis activities include:

1. Bank stability modeling
2. Barb design guidance (Expand US Army Corps of Engineers guidance)
3. Construction planning (Coordinate with Sun River Watershed Planning Group and GID)
4. Construction activities (Contingent upon Greenfield Irrigation District availability)

Task A5 - Design Low Cost Culvert Crossing

Reclamation shall provide a demonstration design for a low-cost culvert crossing for Muddy Creek and supervise construction by October 31, 1996. The crossing shall demonstrate dual functionality as a grade control structure and crossing. The crossing shall be in the vicinity of buildings owned by the Wohlgemuth family. The design shall be suitable for permitting by responsible agencies. The target cost for the construction of the crossing shall be less than $5,000.

In February, 1997, during a warm weather period, snowmelt runoff overtopped and severely damaged the low water crossing. The crossing had been in place since December, 1996. Large ice sheets contributed to the damage of the crossing.

The failure of the crossing was due to blockage of the culverts and insufficient anchorage of the armoring on the roadway. The overflow channel on the left abutment was insufficiently excavated to protect the crossing. Once the ice flows blocked the culverts flow overtopped the roadway. The left abutment should have been excavated enough to capture the high flow. Instead flow over the roadway eroded the roadbase and removed the 24 inch riprap armor on top of the culverts.

After review of the damage, the Task Force is contemplating the following remedial measures:

1. Further excavate a high-flow channel on the left abutment of the crossing. Include armoring to protect the downstream groin of the crossing.
2. Construct a concrete cutoff wall incorporating the culvert tubes at the downstream end of the tubes.
3. Replace the riprap armor on top of the tubes buttressed by the cutoff wall.
4. Replace the roadbase material.

These measures will require extension of the permits for the original crossing. Planning and construction of the remedial measures is dependent upon Greenfield Irrigation District.

Task A6 - Sight and Install Barbs

Reclamation shall continue to provide construction supervision to Greenfields Irrigation District, a Muddy Creek Task Force member for the purpose of installing barbs. Arrangements for specific types and dates for supervision shall be determined and specified in writing by the Team Leader, the MCTF Coordinator, and the Greenfields Irrigation District Manager.

Contingent upon Greenfield Irrigation District, construction of barbs and other structures will begin in September, 1997. Several sites are identified, rock material is in place and ready for construction.

Task A7 - Engineering Design of Future Structures for Muddy Creek

As the resources for this agreement near exhaustion, Reclamation shall provide a generalized plan for future structural modifications necessary for the continued restoration of Muddy Creek. The plan can include proposals for additional funding resources.

On December 17, 1997, the Muddy Creek Task Force met in Great Falls, Montana, to review the existing status of the restoration project, to discuss plans for selecting future structural projects on the stream, and to discuss other issues and concerns. The task forces judges that the existing project elements are functioning well, including during high flows and ice jams. Grade control structures have stopped the headcuts from continuing to move on the Wohlgemuth reach of the creek. The barbs in this reach and elsewhere are stopping excessive lateral migration. Healthy vegetation is returning, reducing erosion yield from the banks of the creek.

Reclamation explained that there still remains a significant amount of work to control the sediment yield from the demonstration and other reaches of the creek. The emphasis now is to prioritize future structural modifications to the creek including grade control, lateral control (barbs), longitudinal stone toe dikes to control slip failures, cutoff prevention, erosion suppression, and revegetation in riparian areas. The Task Force is creating criteria for prioritizing potential sub-projects focusing on reducing sediment yield, stabilizing the creek, serving as many of the land owners as possible, and effectively applying resources. The Task Force plans the following tasks to facilitate the prioritization process:

1. Water surface profile from Vaughn to the USACE sill.

2. Inventory active erosion sites for prioritization.

3. Pursue financial resources.

4. Assign high priority status to the following sites/tasks - Slip failures on Durocher property; Slip failure on Neuman property; Cutoff on Wohlgemuth property; Maintenance of existing structures; Water surface profile; continue to assess and prioritize future efforts.

Completion and continuation of Task A3 will contribute to the success and progress of these new tasks.

Task A8 - Miscellaneous

The Reclamation Team Leader shall provide as necessary reports, papers, proposals, and scope development as directed by the MCTF Coordinator. The CCCD may request the presence of the Reclamation Team Leader at meetings of the MCTF. The miscellaneous tasks are secondary to all other tasks. and are assignable only within the financial resources specified in Section 3.2.A1

This task is complete.

CONCLUSIONS

This stream restoration project with assistance from the National Fish & Wildlife Foundation has been successful in reducing sediment pollution in the Sun and Missouri Rivers. The project has produced exceptional reductions in sediment yield from Muddy Creek, several scientific advancements, and two distinct structural methods useful for other stream restoration projects, namely the chevron weir rock ramp and the stream barb. The following conclusions regarding the Muddy Creek Demonstration Stream

Restoration Research Project are drawn from the experience and publications of the Task Force participants.

1. Reducing peak flows appears to have had the effect of reducing overall sediment yield since 1982. Restoration activities since 1994 will continue to reduce sediment yield by increasing overall roughness in the reach between Gordon and Vaughn. The upper reach above Gordon appears to have sufficient natural controls, with the exception of bank stability.

2. Greenfield Irrigation District (GID) instituted water conservation measures and policies beginning in the 1980's. The maximum discharge decreased by roughly 26 ft^3/s per year during the period of 1986-1996.

3. The effective discharge in the demonstration reach of Muddy Creek is roughly 320 ft^3/s. Effective discharge is that discharge that transports the most sediment and is similar to the bankfull or channel forming discharge. This flow is significant for restoration planning in that reducing the duration of 320 ft^3/s and greater flows or increasing the roughness for the 320 ft^3/s flow will significantly reduce sediment yield.

4. Sediment transport data may indicate two phenomena at work in the demonstration reach between the two gaging stations and the upper portion of Muddy Creek above Gordon. First, the overall sediment yield is decreasing with time. Reasoning leads to the conclusion that the majority of incision may be past and sediment transport is trending downwards as gravels accumulate and hard points are uncovered and come into hydraulic significance. Observations support this conclusion in the upper reach of Muddy Creek. The sediment yield data also supports this conclusion in that the percentage gain in the latest year is 430% compared to an average of 181% in the preceding years. That is, more sediment, as a proportion of the total is entering the system in the reach between Gordon and Vaughn now as compared to the period between 1972-1982. This indicates that the upper reach is stabilizing and that grade control in that reach has marginal hydraulic value.

5. The second phenomenon relates to the frequency of flows above the 320 ft^3/s effective discharge that produces the greatest sediment discharge. The water conservation efforts implemented by GID are reducing the frequency of flows that exceed 320 ft^3/s. Thus, the overall sediment yield is declining. The theoretical analysis and the physical data collected at the gaging stations support each other and reinforce the thesis that the solution to sediment yield on Muddy Creek is highly dependent upon the frequency and duration of flows above 320 ft^3/s.

6. The grade control structures and barbs are functioning exceptionally well. Maintenance on the grade control structures is minimal, and not necessary on the barbs. The creek bed is stabilized in the demonstration reach, negating more than fifteen feet of head cuts that would have propagated upstream destabilizing many more miles of Muddy Creek. The barbs are stabilizing thousands of yards of bank, producing bedding for new riparian vegetation.

The National Fish & Wildlife Foundation grant, in addition to existing grants from the State of Montana, and supplemental funding from the US Bureau of Reclamation and the Cascade County Conservation District via EPA Section 319 funds, facilitated activity on Muddy Creek during 1996 and 1997. The NFWF grant sustained engineering support and on-the-ground supervision of construction activities as well as engineering analysis of the data derived from the project.

The Muddy Creek Task Force utilized the National Fish & Wildlife Foundation grant to accomplish the installation of more than one-hundred barbs, two grade control structures, and one low-water crossing. The results of these installations and others include:

- Sediment yield reduction from Muddy Creek, meaning less pollution in the Sun and Missouri Rivers
- Enhanced riparian vegetation
- Enhanced fishery and wildlife habitat
- Increased awareness of need and benefits of water conservation
- A watershed plan not only for the Muddy Creek watershed, but also the Sun River watershed.
- Improved technology that is already being applied in other areas of the country
- Translation of the technology from Muddy Creek to nearby smaller water courses and watersheds.

PUBLICATIONS & REPORTS

Gradient and Plan Form Stabilization of an Incising Stream

R.J. Wittler, S.D. Keeney, B.W. Mefford, S.R. Abt, C.C. Watson

INTRODUCTION

This paper describes the efforts of a partnership of Federal and local government agencies and a local citizen task force to solve the water quality problems associated with the incision of Muddy Creek near Great Falls, Montana. The US Bureau of Reclamation and Greenfields Irrigation District are collaborating to reduce return flow to Muddy Creek. Reclamation, Cascade County Conservation District, and the Muddy Creek Task Force, are collaborating to stabilize the gradient and plan form of the stream.

Siting Low Profile Grade Control Structures for the Muddy Creek Demonstration Stream Restoration Research Project

R.J. Wittler, D.R. Eby, S.D. Keeney, C.C. Watson, S.R. Abt

ABSTRACT

In the Fall of 1993 Reclamation began a demonstration stream restoration research project on Muddy Creek, near Great Falls, Montana. Muddy Creek captures return irrigation flow from a nearby irrigation district. The return flows increase the average discharge in Muddy Creek to eight times the historical mean. The increase in discharge in Muddy Creek since the 1930's has led to severe incision of the channel. In the lower reaches of the creek incision approaches ten meters in elevation.

The demonstration stream restoration project includes grade control and lateral control using chevron weir rock ramps and barbs. This paper describes the process of siting the rock ramps based upon a water surface profile of the reach and a site reconnaissance. Siting criteria include discontinuities in the low-water surface profile, identification of a stable reach of the creek for emulation, access for construction, and economics of the project.

Features of a Chevron Weir Rock Ramp

R.J. Wittler

ABSTRACT

This paper presents the features of a new type of low profile grade control structure, the chevron weir rock ramp. As the name infers, the planform of the structure is in the shape of a chevron. The weir crest angles with the vertex of the angle pointing upstream. The constituent material is angular rock, sized according to standard riprap sizing criteria. Downstream of the rock weir crest is a ramp of rock, angling the flow towards the center of the structure at its toe. The first implementation of this type of grade control structure is by Reclamation on the Muddy Creek Demonstration Stream Restoration Research Project. After two seasons in place, nine grade control structures are performing within expectations. In late 1995 Reclamation installed two grade control structures using an evolved design based upon observations and performance of the original design.

Management of Landscapes Disturbed by Channel Incision, Stabilization, Rehabilitation, Restoration

In May 1997 the Task Force and Reclamation presented five papers at the conference "Management of Landscapes Disturbed by Channel Incision, *Stabilization, Rehabilitation, Restoration,"* May 20-22, 1997, Oxford, Mississippi. Reclamation and the Muddy Creek Task Force hosted a session at the conference titled "Western Incised Channel Restoration: Engineering, Biology, and Cultural Resources." The titles, authors, and abstracts from the papers are listed below. Attendance at this conference was funded by Reclamation, not this project.

Case Study: Muddy Creek, Montana

R.J. Wittler, S.D. Keeney, A.W. Rollo, C.C. Watson

ABSTRACT

The Muddy Creek Task Force under the auspices of the Cascade County Conservation District began a Stream Restoration Project on Muddy Creek in 1993. The Task Force is using the latest stream restoration and watershed planning technology to enhance water quality, fisheries, and wildlife habitat in the Muddy Creek watershed. Reclamation, the Natural Resources Conservation Service, Greenfield Irrigation District, and the Muddy Creek Task Force, are collaborating on the project. This report summarizes progress to date while illustrating the successful implementation of some advanced restoration technology.

Cultural Resources Considerations for Stream Restoration Projects

R.J. Wittler, M. Andrews, E.I. Friedman

ABSTRACT

Cultural resources are remnants of previous cultures. Traditional methods of archaeology are useful for discovering and investigating cultural resources. Stream restoration projects on public lands or by state or federal officials must by law consider the consequences of disturbing cultural resources during restoration activities. This paper discusses the management of cultural resources applied to stream restoration projects. Two case studies illustrate cultural resources considerations for stream restoration projects.

Field Data Plan for Muddy Creek

R.J. Wittler, D.R. Eby, D.L. Burgett, A.W. Rollo

ABSTRACT

This paper describes the evolution of the field data plan for the Muddy Creek Stream Restoration project. The paper includes descriptions of the various types of data collected over the course of the three year project. An overall view of the project at the beginning is the characteristic of a good field data plan. The overall view should include a thorough search for all previous aerial photography and topography. A search for photographs by local citizens, newspapers, and agencies is very valuable for establishing the condition of the stream and watershed before, during, and after disturbance. Of great use is a high-resolution aerial survey of the project reach at the smallest affordable contour interval. Cross-sectional data, both current and historical, is very valuable from an analysis standpoint. Hydraulic analysis requires cross-sectional data along the reach.

Building Banks on Muddy Creek With Barbs

R.J. Wittler, S.D. Keeney, D.R. Eby, D.L. LaGrone

ABSTRACT

Barbs are jetties that extend from the bank and angle down into the channel, and upstream into the thalweg. Barbs vary in size depending upon channel size, shape and flow levels. Typical barb construction uses rock whose size primarily depends on stream velocity. Barbs are an effective alternative for bank stabilization problems. Barbs build stream banks and create riparian areas by trapping bedload and suspended sediments. Other names of barbs include jetties, toe dikes, groins, habitat sills, and bendway weirs.

Barbs displace high-velocity flow in the outside of bends away from the bank and create back flow cells at the base of the stream bank. At low flow, eddying between barbs causes sediment deposition. During higher flows, turbulence against vertical or overhanging banks causes bank collapse into areas between barbs. Bank collapse stops once the banks have reached a threshold slope. Low flow eddying maintains sediment between barbs. Sediment accumulation between barbs eventually results in riparian development. Over time the barbs become less visible as sediment accumulates and riparian vegetation develops.

The Muddy Creek Partnership: How to Restore a Stream

A.W. Rollo, D.L. Burgett, R.J. Wittler, S.D. Keeney

ABSTRACT

The Muddy Creek Demonstration Stream Restoration Research Project near Great Falls, Montana began in 1993. The Project is the result of a cooperative effort and partnership between Federal, State, and County agencies, and a local citizen task force. Together this interagency, interdisciplinary group is working to find solutions to the water quality problems originating in Muddy Creek. Muddy Creek is a tributary of the Sun River in the Upper Missouri River Basin. The Creek drains approximately 314 square miles of agricultural land. Muddy Creek borders the downstream edge of the Greenfield Irrigation District. The creek intercepts return and waste flow increasing base flow, causing extensive erosion of the fine grained alluvial soils. The primary erosion mechanism is incision followed by large scale bank slumping in the creeks lower reaches. The sediment transported by Muddy Creek decreases water quality in the Sun and Missouri Rivers.

In 1993, the state of Montana stepped in at the request of concerned citizens to look at ways to resolve the massive erosion problem of Muddy Creek. They were able to bring together a significant number of interested parties that were willing to work together to resolve the water quality problem. At the outset, the partners knew that they could not restore Muddy Creek overnight. They also knew that large amounts of federal dollars would not be available. Thus they would need new innovative ideas and cost-effective approaches. The partners established a task force as part of a consensus building process. The process allowed for open discussion, and contributes to a feeling of ownership for the outcome of the project. The Muddy Creek Task Force now gives progress reports to a larger group of interested individuals, communities and agencies, concerned with the Muddy Creek sediment issue.

Muddy Creek Restoration and Sun River Watershed Plan Coordination

Alan W. Rollo, Rodney J. Wittler, Sean D. Keeney

ABSTRACT

Muddy Creek is a tributary to the Sun and Missouri Rivers near Great Falls, Montana, USA. This paper discusses the coordination issues between the Muddy Creek Stream Restoration Task Force and the Sun River Watershed Planning group. Muddy Creek intercepts run-off from Greenfield Irrigation District increasing the mean creek flow many times over the natural flow. Increased discharge causes channel incision, stream bank erosion, and significant water quality problems in Muddy Creek, the Sun and Missouri Rivers. In the past, the erosion contributed more than 200,000 tons of sediment annually to the Sun River. Recent conservation and restoration efforts have reduced that amount to 40,000 tons per year.

Watershed groups and stream restoration projects like Muddy Creek owe their success to the dedication of volunteers and the effectiveness of the project or group coordinator. The Muddy Creek project and Sun River Watershed group are true success stories due to the selfless works of people willing to take chances and coordinate efforts. The major objective of the Muddy Creek Task Force and Sun River Watershed group is to implement solutions. The focus remains on small victories, as each becomes an important asset for accomplishing long term goals. Dedication to the cause by the representatives of the various interests is necessary. Building public and congressional interest is essential for receiving government support.

The Sun River Watershed Planning Group began with the wave of watershed planning groups springing up across the western states. Montana in particular has been very progressive in supporting and implementing watershed planning groups. The Muddy Creek Task Force was the first step towards watershed planning and soon became a subset of the Sun River Watershed Planning Group. The larger effort built upon the local success of the Muddy Creek Task Force. Placing the Muddy Creek restoration in the larger context of a watershed plan has buttressed the goals of the restoration; increased the base of support and the urgency of successful completion. In conclusion, from task force to planning group, the lesson is to start small, gain incremental support, achieve short term goals, and attract a diverse populace to the effort.

Restoration and Historic Preservation: Protecting Cultural Resources along a Meandering Stream

R.J. Wittler & M. Andrews

ABSTRACT

Reclamation proposes to preserve archaeological site 24BE529 from erosion by the Red Rock River in southwestern Montana. The Red Rock river is naturally meandering towards site 24BE529, slowly eroding the bank containing the resource. Federal historic preservation laws require Reclamation to address the impact. The preservation plan calls for the installation of three or four Bendway Weirs, also called Thalweg Displacing Barbs. The order of construction excludes all equipment activity in the stream. The barb materials will be large stones, up to 24 inches (61 cm) in diameter, quarried nearby. The bank buttressing material will be smaller stones, less than 12 inches (30 cm) in diameter. A top soil will be placed on both the finished barbs and the bank buttressing material. The soil will be seeded with native grasses and willows, forming a natural looking bank.

Initial Analysis of Water Quality Changes on Muddy Creek

R.J. Wittler, S.D. Keeney, & A.W. Rollo

ABSTRACT

The Muddy Creek Task Force and the US Bureau of Reclamation constructed eleven grade control structures and more than three-hundred bank stabilization structures between 1994 and 1996 as part of the Muddy Creek Demonstration Stream Restoration project. Under Reclamation sponsorship, the US Geological Survey operates a water quality sampling station at Vaughn, Montana, below the restoration reach of Muddy Creek, and since 1995 at Gordon, Montana, above the restoration reach. Initial water quality data indicates a decline in sediment transport in Muddy Creek over the past 25 years. This paper is an analysis of the initial sediment transportation data from these two gaging stations.

References

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7. Wittler, R.J., Keeney, S.D., Eby, D.R., LaGrone, D.L., "*Building Banks on Muddy Creek With Barbs.*" Proceedings, Management of Landscapes Disturbed by Channel Incision: Stabilization, Rehabilitation, Restoration. Ed. S.S.Y. Wang, E.J. Langendoen, F.D. Shields. University of Mississippi, Center for Computational Hydroscience and Engineering. May 1997.

8. Rollo, A.W, Burgett, D.L., Wittler, R.J., Keeney, S.D., "*The Muddy Creek Partnership: How to Restore a Stream.*" Proceedings, Management of Landscapes Disturbed by Channel Incision: Stabilization, Rehabilitation, Restoration. Ed. S.S.Y. Wang, E.J. Langendoen, F.D. Shields. University of Mississippi, Center for Computational Hydroscience and Engineering. May 1997.

9. Wittler, R.J., Keeney, S.D., Rollo, A.W., "*Muddy Creek Restoration and Sun River Watershed Plan Coordination.*" Proceedings of the Water Environment Federation conference on Watershed Management: Moving From Theory to Implementation, May 3-6, 1998, Denver, CO.

10. Wittler, R.J., Andrews, M., "*Restoration and Historic Preservation: Protecting Cultural Resources along a Meandering Stream.*" Proceedings of the ASCE Wetlands and River Restoration conference, March 22-27, 1998, Denver, CO.

11. Wittler, R.J., Keeney, S.D., Rollo, A.W., "*Initial Analysis of Water Quality Changes on Muddy Creek.*" Proceedings of the ASCE Wetlands and River Restoration conference, March 22-27, 1998, Denver, CO.

DELIVERABLES

The Reclamation Team Leader shall deliver the following items to the CCCD:

- *Progress Report and Invoices* - Complete.
- *Four additional conference proceedings papers or refereed journal papers published before June 1, 1997.* - Complete.
- *Travel Reports* - Complete.
- *Data analysis in the form of a Project Data Book including photos, videos, drawings, reports, papers, computer files, and all related documentation.* - On-going.
- *Demonstration Project Final Report* - Complete.
- *Individual Structure Evaluation and Inventory* - On-going.
- *CAD based 3-D model of project area* - Complete & On-going.
- *Design of low cost culvert crossing* - Complete.
- *Plans for future structures on Muddy Creek* - Complete & On-going.

Muddy Creek Demonstration
Stream Restoration
Project

June 1, 1995

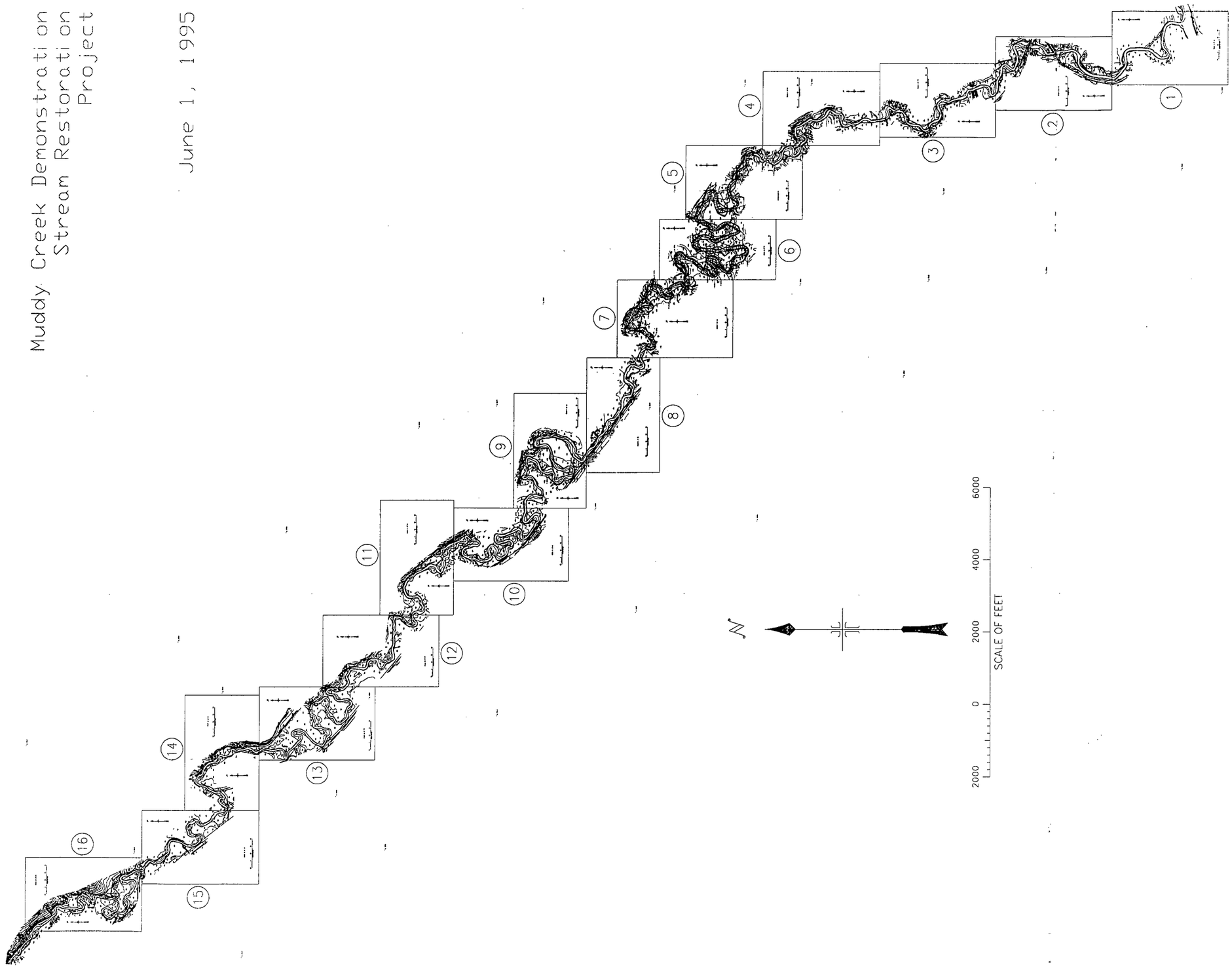


Plate 1. Plan view of Muddy Creek above confluence with Sun River.

Plate 2. Sheet 1 of 16. Confluence of Muddy Creek and the Sun River below Vaughn, Montana.

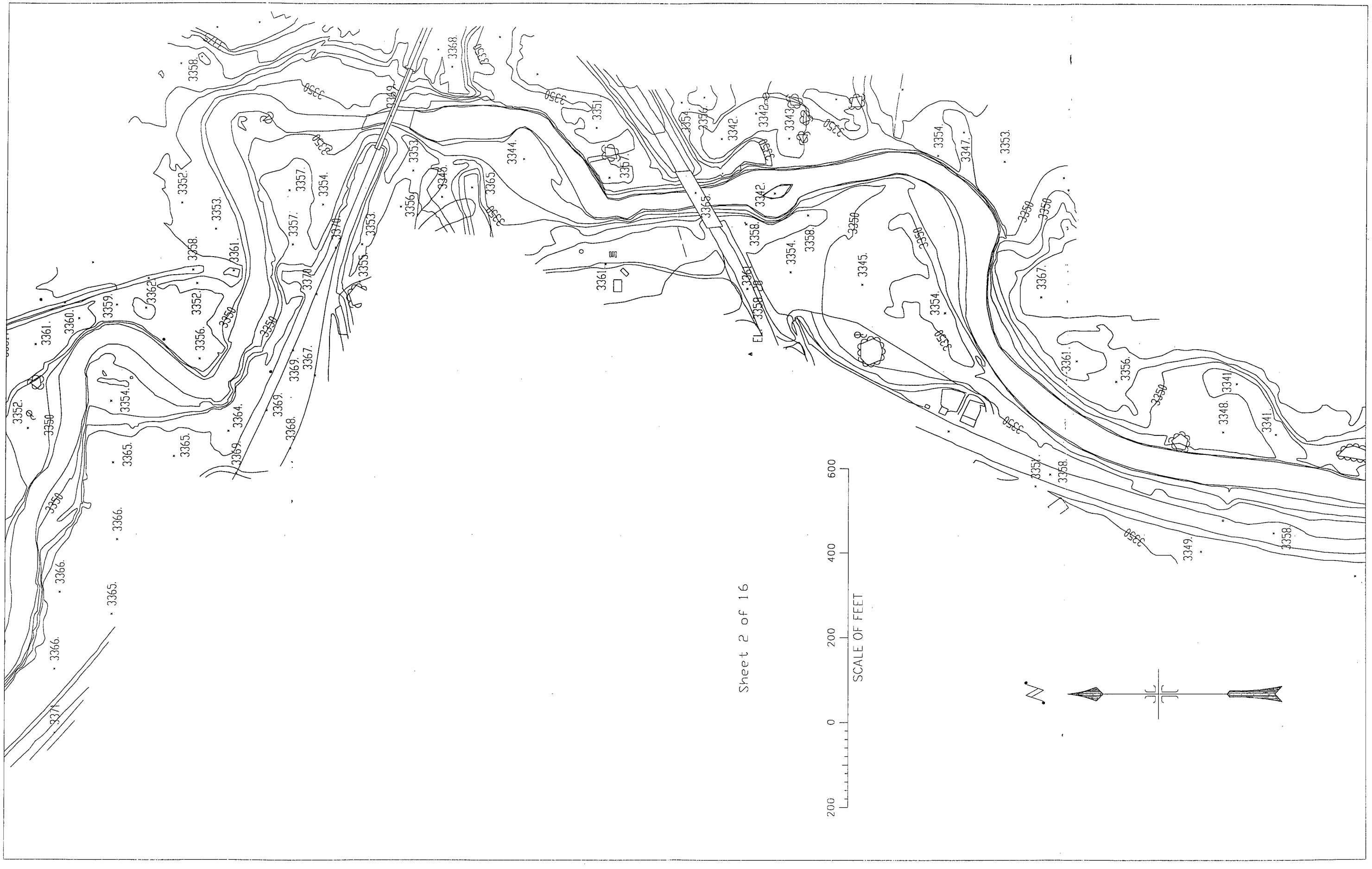


Plate 3. Sheet 2 of 16. Vaughn, Montana, area.

Plate 4. Sheet 3 of 16. Railroad grade and Sun River ditch outfall above Vaughn, Montana.

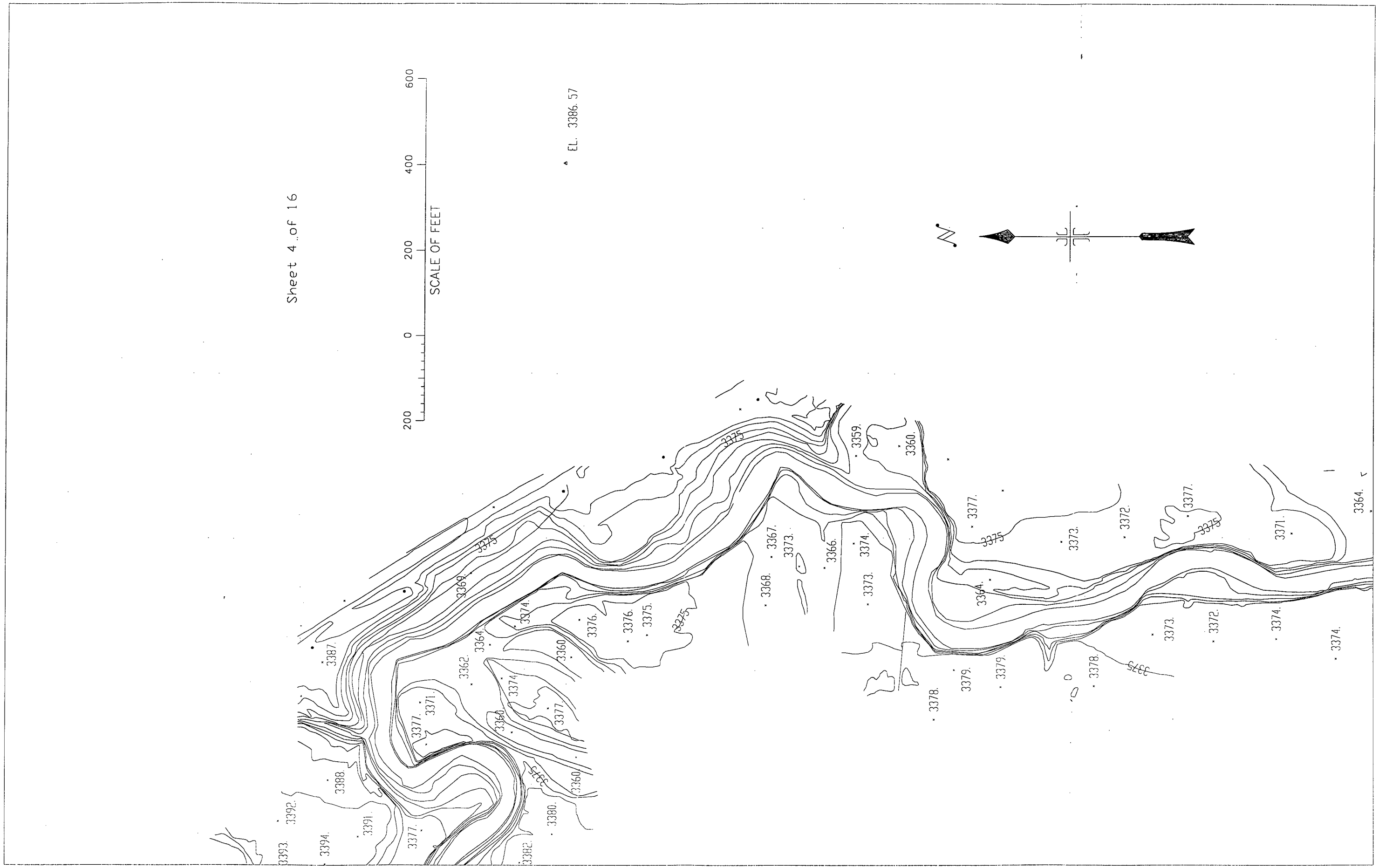


Plate 5. Sheet 4 of 16. Area between Vaughn and USACE sill.

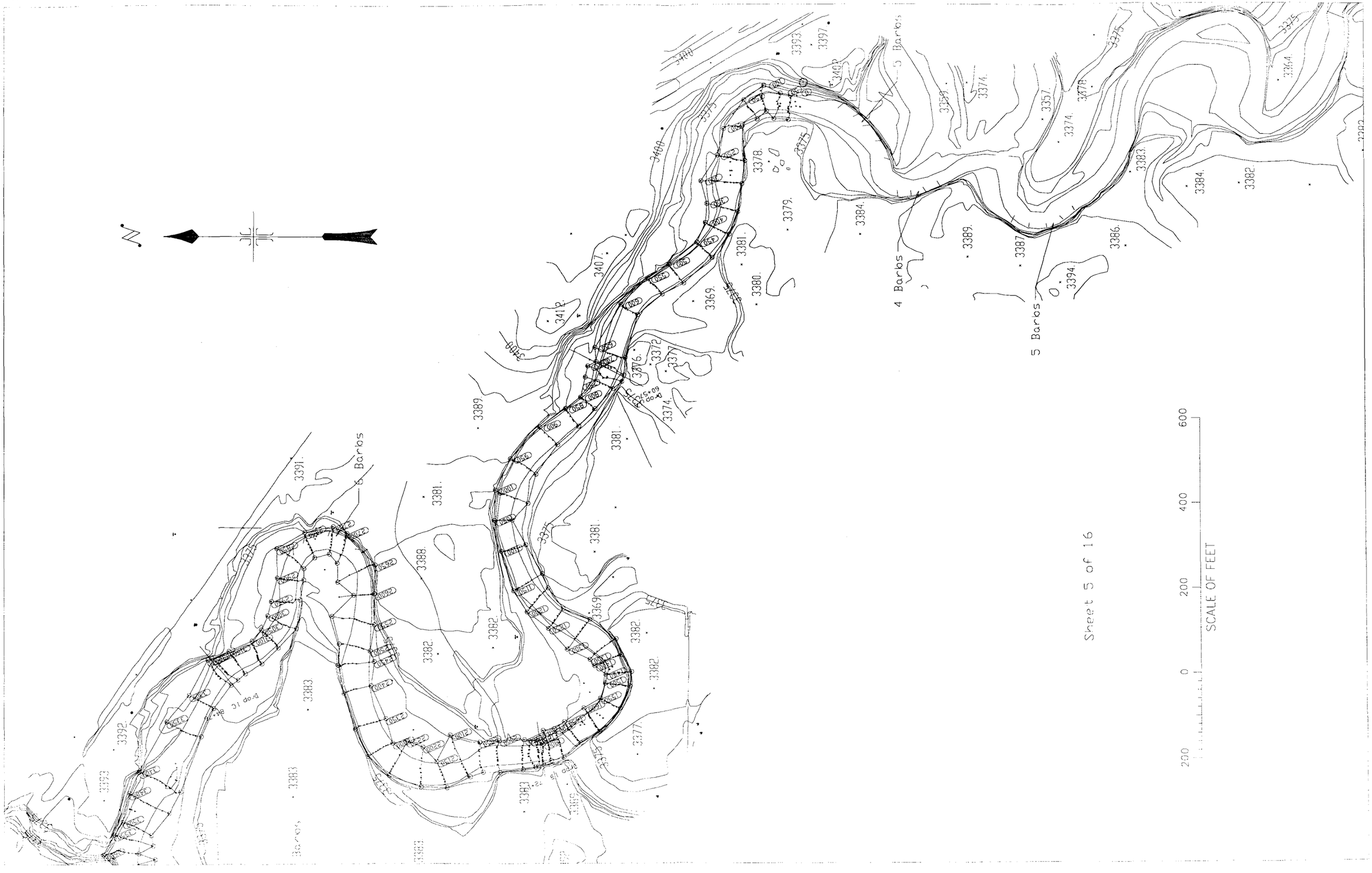


Plate 6. Sheet 5 of 16. USACE sill and revetment; GCS 1-A, 1-B, 1-C. Lower third of Demonstration Reach.

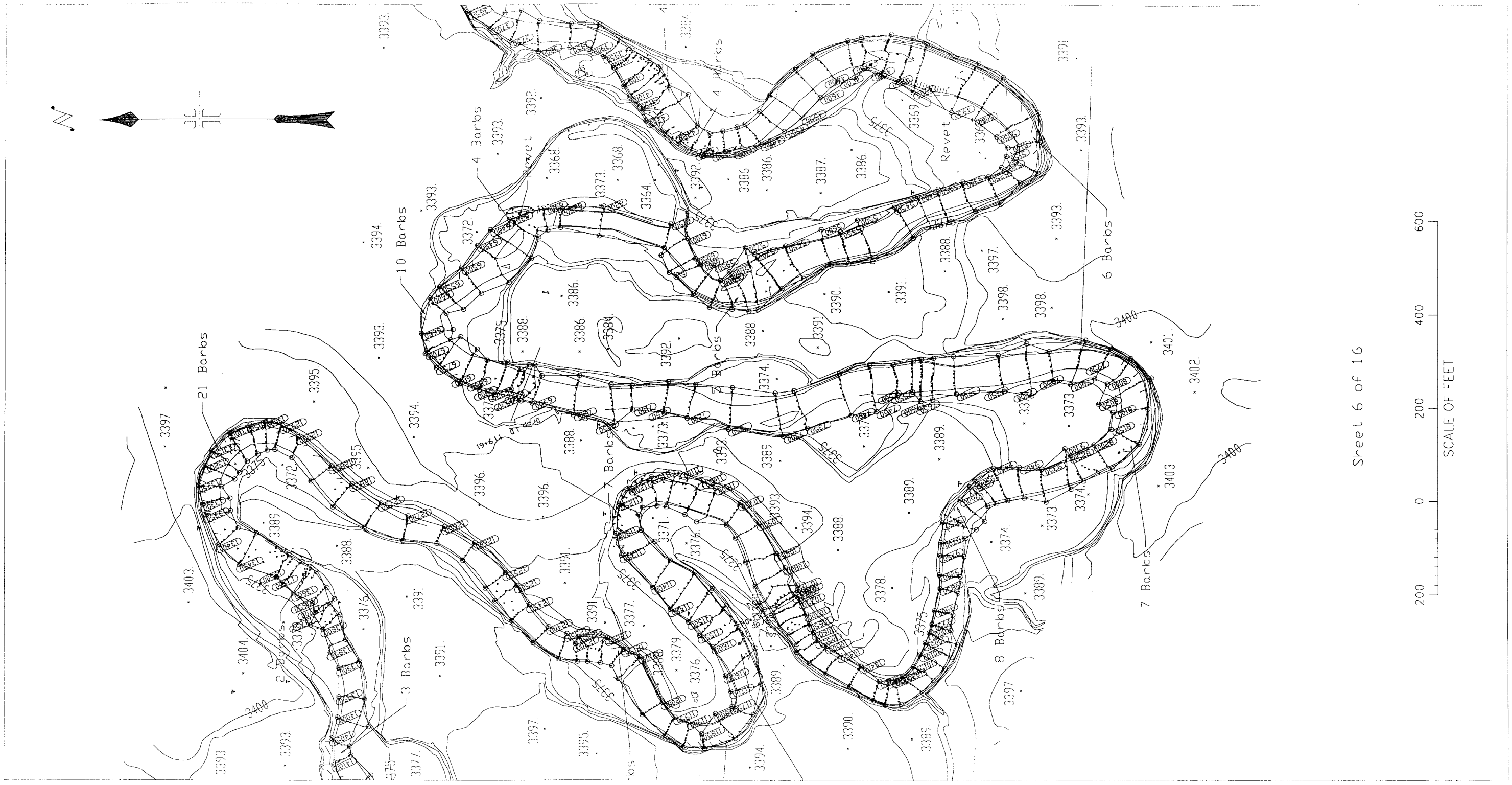


Plate 7. Sheet 6 of 16. Realigned channel; GCS 1-D, 1-E, 1-F. Middle third of Demonstration Reach.

Plate 8. Sheet 7 of 16. GCS 2-A, 2-B, 2-C. Low Water Crossing. Upper third of Demonstration Reach.

Plate 9. Sheet 8 of 16. Railroad reach NW of Wohlgemuth buildings.

Plate 10. Sheet 9 of 16. GCS 3-A, 3-B.

Plate 11. Sheet 10 of 16. Cutoff revetment Number 1 above upper loops.

Plate 12. Sheet 11 of 16. Area above NW boundary of Wohlgemuth property.

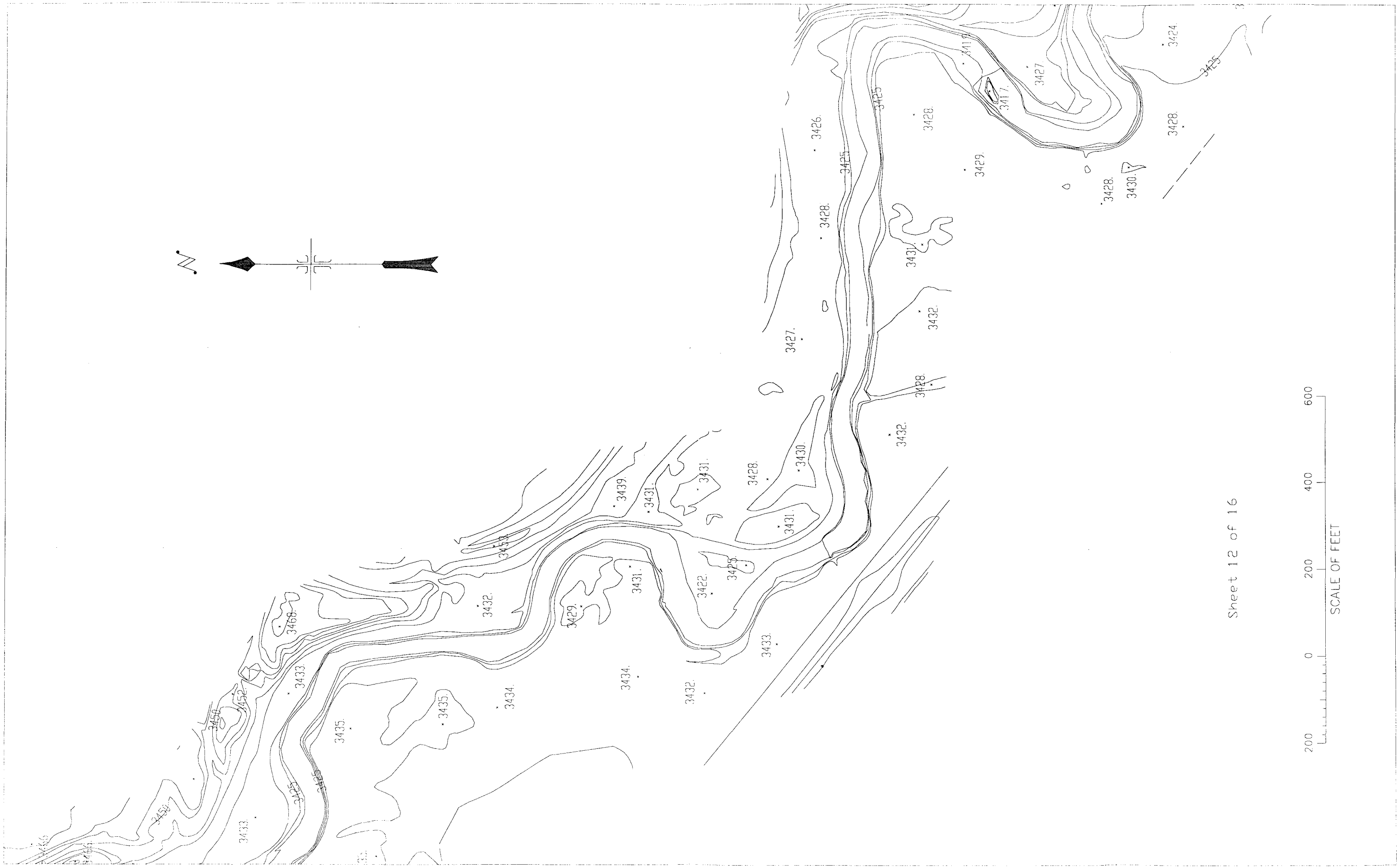
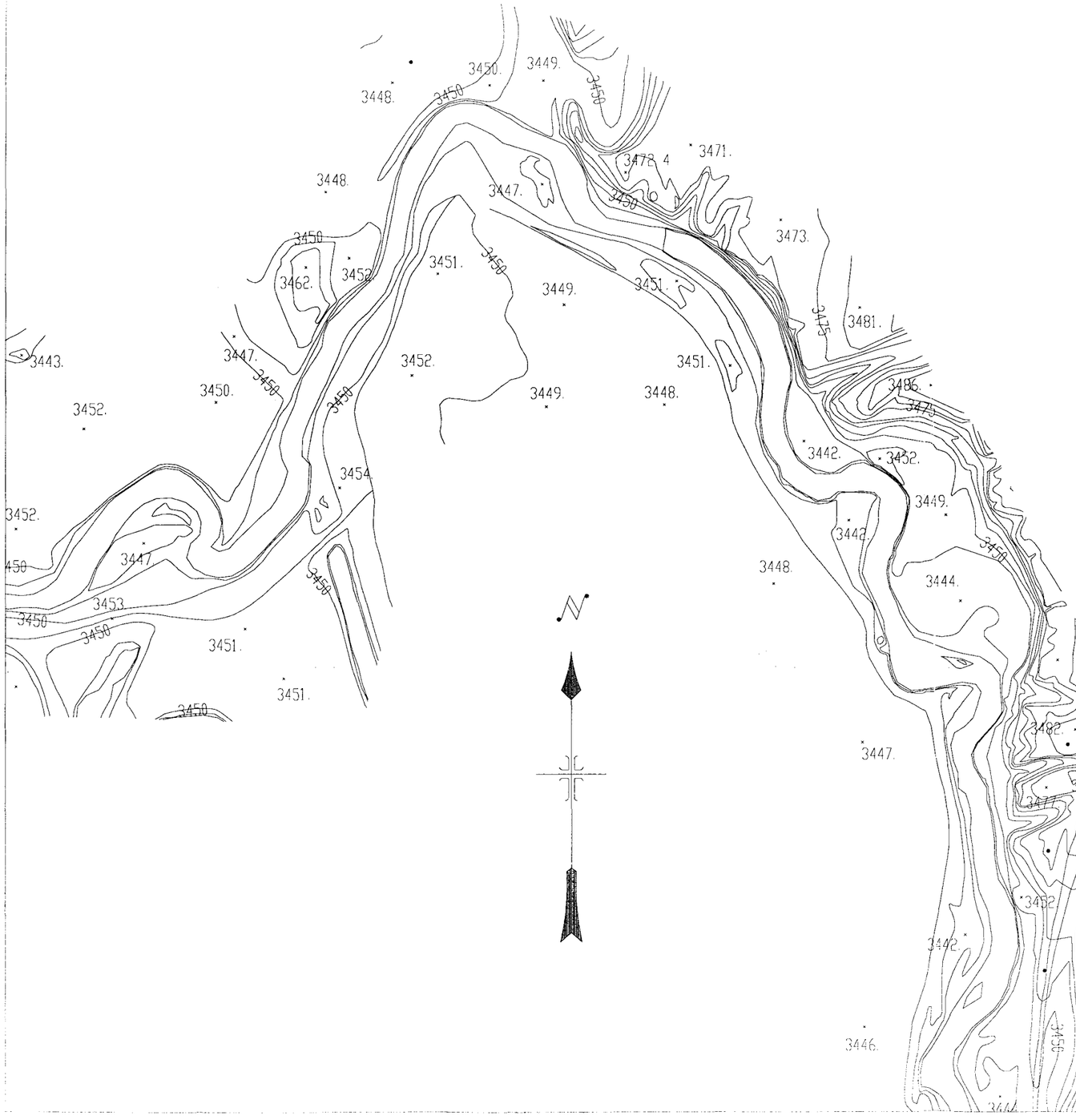


Plate 13. Sheet 12 of 16.

Plate 14. Sheet 13 of 16.



Sheet 14 of 16

200 0 200 400 600

SCALE OF FEET

Plate 15. Sheet 14 of 16.

Plate 16. Sheet 15 of 16. Below Gordon.

Plate 17. Sheet 16 of 16. Gordon and above Gordon. Cutoff revetment Number 2.