BUREAU OF RECLAMATION

Final Report No. ST-2024-20060

River Restoration Interactive Geospatial Database

Research and Development Office

Science and Technology

Research Program

U.S. Department of the Interior

September 2024

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED *(From - To)*
30-09-2024	Research	2020 - 2024

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
River Restoration Interactive Geospatial Database	F217A
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER 1541 (S&T)

6. AUTHOR(S)	5d. PROJECT ID NUMBER
Melissa Shinbein, P.E.	Final Report ST-2024-20060
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Bureau of Reclamation	

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
Science and Technology Program Research and Development Office Bureau of Reclamation U.S. Department of the Interior Denver Federal Center PO Box 25007, Denver, CO 80225-0007	Reclamation
	11. SPONSOR/MONITOR'S REPORT NUMBER(S) (if applicable)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Final Report may be downloaded from https://www.usbr.gov/research/projects/index.html

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This research project aimed to create a river restoration database to collect information about projects that have already been implemented and to inform future rehabilitation designs for fish and aquatic species recovery under the Endangered Species Act. Past river restoration projects in a variety of programs across all of Reclamation's regions were evaluated to ascertain the best method of presenting this data. At the end of this project, this data was presented to the Enterprise Asset Registry team to be incorporated to the Fish Structures Asset Class layer. As the Fish Structures Asset Class continues to develop, river restoration data will be added and continue to remain up to date as part of the Enterprise Asset Registry Project, resulting in the living dataset for all of Reclamation to use as a resource.

15. SUBJECT TERMS
Database, Asset Management, River Restoration

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Melissa Shinbein
U	U	U		27	19b. TELEPHONE NUMBER *(Include area code)* 303-445-2159

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Acknowledgements

The Science and Technology Program, Bureau of Reclamation, sponsored this research. Additionally, the author would like to thank Jennifer Bountry for her continued support, the Fish Structures Asset Class Team for providing a home for the data, and Paul Boyd and his team at USACE for their collaboration over the years.

Cover Image – Enterprise Asset Registry Dashboard page, where the data will eventually live (Bureau of Reclamation).

River Restoration Interactive Geospatial Database

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Peer Review

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Research and Development Office
Science and Technology
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Final Report ST-2024-20060

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Acronyms and Abbreviations

DOI	U.S. Department of the Interior
ft	foot/feet
N/A	not available; not applicable
S&T	Science and Technology
Reclamation	Bureau of Reclamation
TSC	Technical Service Center
USACE	United States Army Corps of Engineers
USGS	United States Geologic Survey

Contents

Page

Executive Summary 1
1.0 Introduction 1
1.1. Project Background 1
1.2. Study Partners 1
1.3. Study Objectives 2
2.0 Methods 3
3.0 Results 4
4.0 Implementation and Next Steps 6
5.0 References 7

Figures

Figure 1. Screenshot of Fish Structures Dashboard on the Asset Management Registry Dashboard page. 5

Appendices

A River Restoration Data Inventory Table

Executive Summary

This research project aimed to create a river restoration database to collect information about projects that have already been implemented to eventually inform future rehabilitation designs for fish and aquatic species recovery under the Endangered Species Act. This project began with talking to experts both internal and external to Reclamation on river restoration, asset management, and geospatial database development. Metrics were developed to inform the data schema. Afterwards, the regional data stewards provided some of their previously developed databases to compare and incorporate into the schema. Past river restoration projects in a variety of programs across all of Reclamation's regions were evaluated to compare and contrast successes and lessons learned.

At the end of this project, this data was presented to the Enterprise Asset Registry team to be incorporated to the Fish Structures Asset Class layer. As the Fish Structures Asset Class continues to develop, river restoration data will be added and continue to remain up to date as part of the Enterprise Asset Registry Project, resulting in the living dataset for all of Reclamation to use as a resource. Therefore, project- and program-wide knowledge will be obtained to help inform agency-wide knowledge on river restoration projects.

1.0 Introduction

Each year, a fifth of Reclamation's budget- approximately $250 million- is spent on river restoration projects. This need for agency knowledge was acknowledged on the Environmental Issues for Water Delivery and Management Research Roadmap and other previously funded work through Reclamation's Science and Technology (S&T) Program. During the 2019 S&T call for proposals, a river restoration database was proposed. The idea was that a comprehensive database would help disseminate local knowledge throughout Reclamation and identify characteristics of effective river restoration projects. Furthermore, the database would expand communication within the agency to advance future river restoration strategies. Therefore, the goal of this project was to provide easily accessible open data across Reclamation and improve agency knowledge such that river restoration projects can be more effective and less costly. To best utilize regional and program-based knowledge on the issue, the database should be accessible to all Reclamation employees and collaborative for those with additional information on restoration projects.

1.1. Project Background

Previous work encompasses funded projects within the S&T Program:

- River Restoration Workshop, May 1-3, 2019, funded by S&T in Sacramento: a technical information workshop related to river habitat restoration, fish monitoring, environmental flows, and adaptive management projects and research. While learning about the latest developments in these areas, participants had the opportunity to identify technical knowledge and research gaps.
- National Large Wood Manual, funded by S&T in 2013: provides a basic understanding of the role of wood in fluvial aquatic and riparian ecosystems and how it should be maintained, reintroduced, and/or managed.
- Large Wood Research Workshop, February 2012 funded by S&T in Seattle: a technical workshop on large wood applications to identify research needs in river settings.
- Stream restoration workshop May 2011 funded by S&T in Sacramento: a technical workshop that aimed to (1) review the state of science and engineering as practiced within each agency; (2) recognize pertinent science and technology gaps; and (3) identify opportunities for productive interagency cooperation and collaboration. Attended by U.S. Army Corps of Engineers (USACE) and Reclamation staff.

From these workshops, the need for consolidated data arose. This project was funded in response to this need.

1.2. Study Partners

Study partners for this project included:

- Molly Wood (USGS) – coordinated with efforts to create a geomorphology data exchange portal. Originally part of the large wood workshops for river restoration.

- Paul Boyd (USACE) – coordinated with efforts to create a geomorphology data exchange portal. Currently leading the effort for USACE.
- Adam Ricks (Reclamation) – aided in providing the structure for the data schema in a way that could be easily incorporated into already existing asset registries.
- Nick Casamatta (Reclamation) – on the Asset Management team and served as the original contact to incorporating the data into other Asset Management resources.
- Erin Bell (Reclamation) – GIS Program Analyst, originally provided access to many regional databases. Also incorporated the author into the Fish Structures Asset Class team.
- Mike Studiner (Reclamation) – main point of contact for the Fish Structures Asset Class and developer of the data schema.
- Chad Wallace (Reclamation) – regional contact on the Fish Structures Asset Class team specializing in fish passage.

1.3. Study Objectives

The first project objective focused on four main research questions: 1) what defines a river restoration project; 2) what projects does Reclamation currently have implemented; 3) what data should be collected from current projects to make a database useful; 4) what metrics can be used to define project success? Traditionally, river restoration projects were small, isolated structures. Now, typical restoration projects can stretch from 1 to 4 miles of comprehensive rehabilitations with reach scale as the defining feature of the project. This can include efforts such as channel improvements, floodplain connectivity, channel complexity, riparian plantings, or any activities with the goal of creating population-scale effects. Defining what these projects entail and where they are located is key to understanding what is effective for future designs. Understanding what types of information are useful to project designers and sponsors helps to define database entries and database presentation.

The second objective was evaluating how a database can help inform designs of future river rehabilitation projects. Data needed to be organized in a way that not only gained knowledge of specific projects but broader basin-wide information of restoration project interaction in optimal locations.

The third objective was to determine how the database could be presented to maximize applicability and utilization. Findings and data collected in the previous tasks were added to Reclamation's geospatial Enterprise Asset Registry on the Fish Structures Asset Class. While this asset class is not open to input from all users at this time, the data collected from this project is being used as the sample dataset to inform the progression of the asset class. Once the Fish Structures Asset Class is open for all Reclamation users, information on past restoration projects will be accessible. Ongoing maintenance of the database will be possible through partnerships with the Asset Management team.

2.0 Methods

During the first year of the project, frequent meetings were held with all relevant groups throughout Reclamation including Asset Management and the Technical Service Center's Geographic Applications & Analysis group. The goals of this were three-fold: 1) determine where the data will eventually live; 2) determine who will be the steward of this data to ensure it will remain a living document; 3) use already established contacts to find regional contacts. At the beginning of this project, the data was initially proposed to live in Reclamation's Tessel application. However, as will be discussed more in the following sections, a better match was found in early FY 2024. As for the steward of this data, the Asset Management was found to be the ideal team. Additional contacts were found using previously cited work funded by S&T (Project Background) and through contacting regional data managers.

Metrics were then established to build the data schema. This included determining what types of restoration projects would be of importance to this particular schema. Using the Asset Management codes and definitions of DOI Asset Types, it was decided to primarily focus on structural restoration types. This omits restoration types such as vegetation and species management. These types of restoration projects were omitted as they typically do not have geospatial data associated with them. Examples of structural restoration types are woody debris, fish passages and screens, and temperature control devices. Additionally, contacts were established outside of Reclamation including USACE and USGS to try and match their efforts.

After the metrics were established with input from both internal and external partners, the goal was to find a minimum of two sample cases to see if the metrics would capture all the necessary data. The metrics were presented to regional stewards and a call for data was issued. Two of these datasets were tested on the developed metrics to ensure that the metrics aligned well with available data. From here, the datasets tested on the schema were turned over to the Fish Structures Asset Class team as the first dataset incorporated on that Enterprise Asset Registry layer.

3.0 Results

The results of this study include creation of the data schema, initial collection of available river restoration databases throughout the regions, implementation of the data schema metrics, and incorporation of the metrics into the Fish Structures Asset Class. This initial data can be found in the Reclamation Information Sharing Environment (RISE), located at: https://data.usbr.gov/.

With the help of the Geographic Applications & Analysis group, initial metrics for the data schema were developed. The metrics are as follow:

- Region
- Site ID
- Program
- Project Name
- Project Status
- Year Completed
- Watercourse
- Latitude (Representative)
- Longitude (Representative)
- Footprint
- Objective/Driver of Project
- Description of Restoration Effort
- Location Selection Process
- Type of Restoration Features
- Number of Features
- Structural or Non-structural
- Fish Structure: Yes or No
- Anchoring: Yes or No
- Stakeholders
- O&M Contact
- Associated Documentation
- Fish Structure Type (If Applicable)

Some of these metrics are unique identifiers with text-based inputs, such as Region, Site ID, and Program. Other metrics are from a drop-down menu of options, such as Project Status and Types of Restoration Features. Many of these menu options were derived from Asset Management's existing identifications. The Watercourse metric is from a domain, which encompasses the geospatial component.

After the development of the schema, the call for data went out to the regional data stewards. This returned a total of 19 regionally created databases, only 10 of which were accessible to those that were not in the relevant offices (Appendix A). Out of these 10 databases, two were selected for matching with the schema. Many of the 10 provided databases contained raw data for restoration monitoring programs and thus were excluded from the scope of the schema. The two schema updated databases along with the 17 other databases were presented to the Fish Structures Asset Class team for incorporation into the Enterprise Asset Registry. However, the initial spreadsheet created for this data can be found at https://data.usbr.gov/.

The Fish Structures Asset Class was developed for initial editing (Figure 2) and a call for subject matter experts at each field, area, and regional office was issued. These subject matter experts will provide a list of all known fish structures in their area of expertise and a review will be conducted of the provided data. Additionally, a training webinar will be provided to the subject matter experts on how to integrate their data within the registry. .

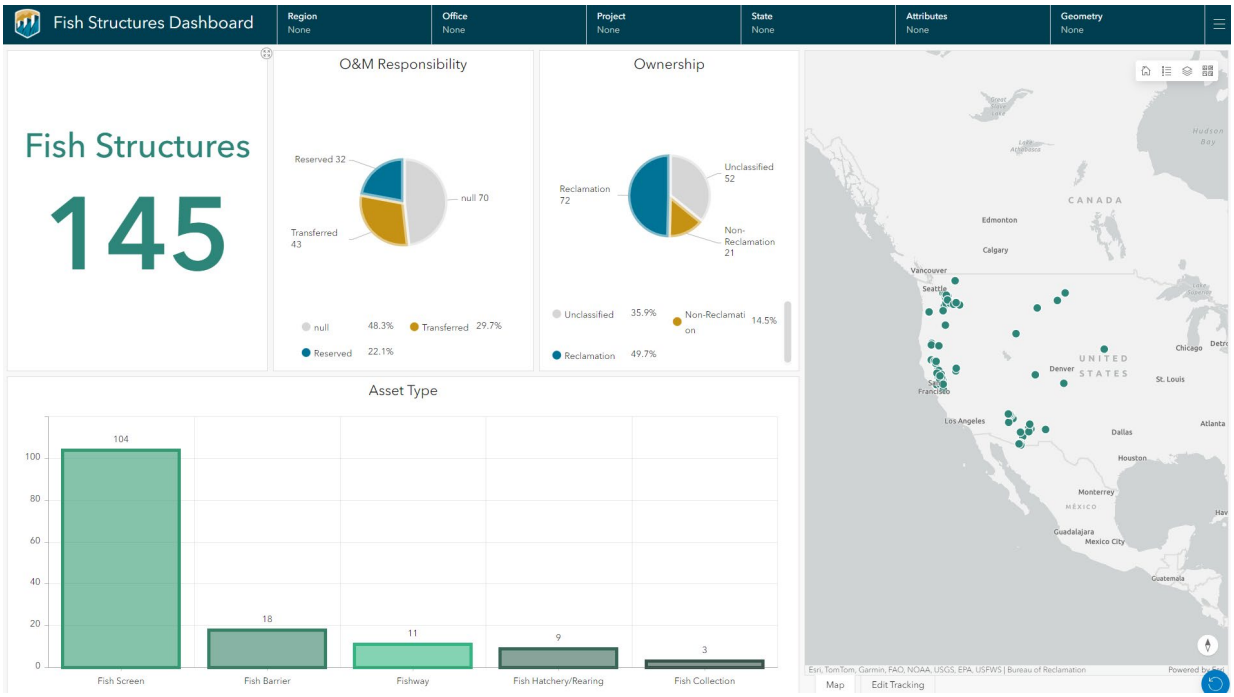

Figure 1. Screenshot of Fish Structures Dashboard on the Asset Management Registry Dashboard page.

4.0 Implementation and Next Steps

In early 2024, the Fish Structures Asset Class Development team was created to establish the class requirements and data schema for the Fish Asset Registry layer of the Enterprise Asset Registry Project. This involved weekly meetings with the team of data experts, relevant field personnel, and Asset Management, all of whom are listed in Study Partners. The establishment of the Asset Class included outlining the objectives and data review process, defining asset types and core data schema, and deciding on inventory management and reporting options. After these requirements were set, the data collected as part of this project and other similar efforts were used as a trial run to ascertain if the schema would be functional for the data requested. This is an iterative process and is in its final stages at the time of this paper.

Next steps for the Fish Structures Class of the Enterprise Asset Registry are expanding the call for data to regional data stewards and incorporating their contributions. This will eventually result in a new layer being established in the Enterprise Asset Registry Project for members of Reclamation to use as a resource. The structural river restoration data collected as part of this project will exist on that layer. As the regional partners identified as editors add to the Fish Structures Class, the data will continue to change and grow to eventually encompass all pertinent structures for fish, including river restoration projects. Therefore, while the data originally collected for this project may change over time, resources in the form of easily accessed asset management databases are available to continuously update the information surrounding the river restoration structures. This will result in a living and interactive database as opposed to a stagnant picture of the structures as they stand today.

5.0 References

Lower Colorado River Multi-Species Conservation Program Implementation Area. 2022. USBR ArcGIS [Web application]. https://services1.arcgis.com/ixD30sld6F8MQ7V5/arcgis/rest/services/LCR_MSCP_Implementation_Area/FeatureServer

CSRO Action Type Layer. 2019. USBR ArcGIS [Web application]. https://services1.arcgis.com/ixD30sld6F8MQ7V5/arcgis/rest/services/CSRO_Action_Type_Map/FeatureServer

Appendix A

River Restoration Data Inventory Table

Layer Name	Region/Office	Data Type	Dataset Location	URL to dataset, if available	Data Steward/POC	Notes	Data Access Notes
CSRO_Action_Type_Map_VIEW	CPNRO		AGOL	Here	Mitch Mumma/Erin Bell	CSRO completed restoration projects. Poor data maintenance and little to no metadata	Token Required
Fish Structures (CPN)	CPNRO		RGIS	Here	Erin Bell	Data from FBMS & CPN Facility O&M inspection tracking sheet	Links to a blank ArcGIS map
RiverSystems_TempCollector	CPNRO		AGOL	Here	Justin Nielson/Erin Bell	Only used a few times, specifically for temperature data loggers at restoration projects	Token Required
CPN Investigation Points	CPNRO		AGOL	Here	Chris Haynes/Erin Bell/Charlotte Snow	Mostly for geology group, but contains well locations that are part of restoration projects	Invalid URL
Water Volume Summary Table	CGB/NCAO/TRRP	Table	TRRP website	Here	Eric Peterson	Online table	Link works
TRRP_ESL	CGB/NCAO/TRRP	GIS (downloadable)	TRRP website	Here	Eric Peterson	Channel Rehabilitation sites past and (likely) future	Link works
Gravel Augmentation	CGB/NCAO/TRRP	Spreadsheet	TRRP office fileserver	Intended in the future	Eric Peterson	Tracks gravel augmentation amounts and locations since ca. 2000	No link?
Aerial Photography 1944 to present	CGB/NCAO/TRRP	GIS (mostly downloadable)	TRRP website	Here	Eric Peterson	Fundamental restoration design resource. Annual summer collection at 0.5 ft resolution since 2010.	This page cannot be found.
Topography/Bathymetry 2009	CGB/NCAO/TRRP	GIS (downloadable)	TRRP website	Here	Eric Peterson	Fundamental restoration design resource.	Link to 2009 terrain of Trinity.
Topography/Bathymetry 2011-12	CGB/NCAO/TRRP	GIS (downloadable)	TRRP website	Here	Eric Peterson	Fundamental restoration design resource. Detrended version also available.	Link to 2012-2015 topobathy of Trinity.
Topography/Bathymetry 2016	CGB/NCAO/TRRP	GIS (downloadable)	TRRP website	Here	Eric Peterson	Fundamental restoration design resource. Detrended version also available.	Link to a Terrain following 2016 flow peak release
AsBuilt Topography/Bathymetry (site specific)	CGB/NCAO/TRRP	GIS (downloadable)	TRRP website	Here	Eric Peterson	Channel Rehabilitation as-built conditions for performance evaluation, for all sites 2011-present	Link to 36 documents and datasets with as-built channel rehab
Hydrology and Fish Habitat Modeling (SRH2D) 2011-12	CGB/NCAO/TRRP	GIS	TRRP office fileserver	No link provided	Eric Peterson	Hydrology, salmonid habitat resource based on Topography/Bathymetry. Additional derivative data available.	No link?

Layer Name	Region/Office	Data Type	Dataset Location	URL to dataset, if available	Data Steward/POC	Notes	Data Access Notes
Hydrology and Fish Habitat Modeling (SRH2D) 2016	CGB/NCAO/TRRP	GIS (downloadable)	TRRP website	Here	Eric Peterson	Hydrology, salmonid habitat resource based on Topography/Bathymetry. Additional derivative data available.	SRH2D output; hydraulics and salmonid habitat including wetted area polygons
Sediment transport Monitoring, 2002 - 2019	CGB/NCAO/TRRP	Spreadsheets	TRRP website	Here	Eric Peterson	Highly complex datasets of numerous tables	Link to 27 documents and data sources for sediment transport monitoring
Salmon Redds	TRRP USFWS/USBR	GIS	TRRP office fileserver	Here	Eric Peterson	Developed by USFWS, data also maintained in TRRP/USBR Repository	Link to 12 documents and data sources for salmon redd locations
Salmonid Outmigration	TRRP USFWS/USBR	Access Database	TRRP office fileserver	No link provided	Eric Peterson	Developed by USFWS, data also maintained in TRRP/USBR Repository	No link?
LCR MSCP Implementation Area	LCB/MSCP	Boundary Area Map	AGOL	Here	Jimmy Knowles	See link for full data description, Lower Colorado River Multi-Species Conservation Program manages the dataset and would be the group to call for further information; moved from other spreadsheet	Link works; leads to implementation boundaries
LCR MSCP Conservation Areas and Sites: FY19	LCB/MSCP		AGOL	Here	Jimmy Knowles	See link for full data description, Lower Colorado River Multi-Species Conservation Program manages the dataset and would be the group to call for further information; moved from other spreadsheet	Don't have permission to access this resource