10-2007

Humboldt Bay Water Control Structure Inventory, Assessment, and Mapping, Final Report

Greg Goldsmith

Paula Golightly

U.S. Fish & Wildlife Service

Final Report

Humboldt Bay Water Control Structure Inventory, Assessment, and Mapping

October 2007

Humboldt Bay Water Control Structure Inventory, Assessment, and Mapping Project
Final Report

U.S. Fish and Wildlife Service
Arcata Fish and Wildlife Office
1655 Heindon Road
Arcata, CA 95521
(707) 822-7201
FAX (707) 822-8411

October 30, 2007

Primary Authors: Greg Goldsmith, Fish and Wildlife Biologist; Paula Golightly, Fish and Wildlife Biologist

Approved: Michael M. Long
Field Supervisor, Arcata Fish and Wildlife Office

Date: 10/30/07

Acknowledgements

We would like to thank The Humboldt Bay Harbor, Recreation, and Conservation District, and the California Department of Fish and Game for their cooperative efforts with the U.S. Fish and Wildlife Service in funding this project. Thanks to the following individuals for field assistance: Nicholas Simpson, Rebecca Studebaker, Jason Ogawa, and Steve Gough. This project received enthusiastic support and suggestions for its application to restoration from Jeff Robinson, Conservation Division Director, Humboldt Bay Harbor, Recreation, and Conservation District.

Project Background

The U. S. Fish and Wildlife Service (FWS), other agencies, land managers, community members and those interested in providing benefits for fish and wildlife identified the need to gain a common understanding of the location and function of tidegates, culverts, and other water control structures in wetlands surrounding Humboldt Bay. The need was identified as part of several planning efforts involving Humboldt Bay and also was discussed casually through the years at agency and community meetings concerning natural resource issues. This information was considered important for the development of a strategic approach to estuarine restoration, and for the development of improved management strategies for operation, replacement, or modification of the structures where needed. The information was also considered critical in planning for protection of property and habitats in the event of an oil spill.

During the past several years, tidegate and water control structure locations were known by individual agencies within their jurisdiction. Until recently, no comprehensive survey or data collection effort had been completed or mapped for Humboldt Bay and the surrounding wetlands. In addition, existing information had not been compiled in a comprehensive manner or been made easily available. This project began from the identification by the community of a known data gap. The FWS staff at the Arcata Fish and Wildlife Office identified their interest and had technical expertise to seek funding and implement this needed project.

Previous efforts to collect information about water control structures comprehensively for Humboldt Bay resulted in a limited range of data collection and at the time Geographical Information System (GIS) capabilities were not as advanced as they are now. The current project was designed to allow for collection of data that could be used to develop or initiate the following landscape level efforts:

- Development of future cost-effective estuary restoration and conservation projects that have connectivity and result in habitats that support key biological resources while balancing the needs of landowners.

- Provide information to assist existing efforts to characterize palustrine and estuarine wetland habitats.

- Gain a common knowledge of structure locations, functionality and other important data critical to understanding existing hydrologic conditions and wetland habitats at a landscape scale.

- Allow restoration practitioners to prioritize improvements or modifications to these structures.

Funding Support

The staff at the FWS in Arcata worked with the Humboldt Bay Harbor, Recreation and Conservation District, and California Department of Fish and Game (CDFG), to fully develop this proposal and project. Within the FWS, staff of the Information Technology/GIS program, Fisheries Program and Conservation Partnerships Program worked together to design, implement and complete the project.

Funds were obtained from the Humboldt Bay Harbor, Recreation, and Conservation District (Harbor District) through Agreement Number HBHRCD2006-101, as well as the California Department of Fish and Game (CDFG) through Agreement Number AWI-NCR-7. Total funding included $15,000.00 from the District and $10,870.00 from CDFG. The FWS contributed in excess of $20,000.00 in in-kind contributions of personnel, equipment, and supplies.

Project Setting

Humboldt Bay is one of the largest and most significant estuaries in California, second in size only to San Francisco Bay. The bay and the surrounding wetlands contain a rich diversity of habitat types, from mudflats and eelgrass beds, to salt, brackish, and freshwater marshes, as well as seasonally flooded agricultural fields. Humboldt Bay and the surrounding lowlands cover an area of approximately 75 square miles (195 square kilometers).

Ownership within and around the bay and surrounding wetlands is a matrix of federal, state, county, Harbor District, city, and private lands. Public landowners of the bay and its margins include the U.S. Fish and Wildlife Service; Bureau of Land Management; California Department of Fish and Game; the Humboldt Bay Harbor, Recreation and Conservation District; Humboldt County; the City of Eureka; and the City of Arcata. A common thread spanning these ownerships is the historic pattern of tidal wetland conversion to agricultural use and development. Two features on the landscape that result from this conversion are levees, and water control structures, which include tidegates, culverts, and standpipes.

Project Need

Recent planning efforts completed for Humboldt Bay acknowledged the need to locate and assess tidegates and water control structures and also to know more about them for planning purposes. These efforts included the following:

- The Humboldt Bay Management Plan, Humboldt Bay Harbor, Recreation, and Conservation District, 2007, identifies the need to develop standards for new and existing shoreline protection along the bay in Chapter 3, Section 3.3, Shoreline Management. This section identifies the need to develop an inventory of shoreline protection devices which includes culverts and tidegates.

- The document titled "Conservation Prospects for the North Coast," The Conservation Fund, 2005, identifies the following data gap and recommendation:
    - Inventory and prioritize treatment prescriptions of migration barriers for salmonids other than county culverts (e.g. private roads, and tide gates).

- The document titled "Humboldt Bay Watershed Salmon and Steelhead Conservation Plan", Humboldt Bay Watershed Advisory Committee, 2005, identifies the following goal and associated objective:
    - Maintain and restore estuary processes that benefit salmonids and map all tidegate locations.

The project also meets goals of the Recovery Strategy for the California Coho Salmon within the Eureka Plain Hydrologic Unit (California Department of Fish and Game, 2004) and facilitates the ability of the FWS to meet goals in the Recovery Plan for the Tidewater Goby (U.S. Fish and Wildlife Service, 2005).

Project Objective

The objective of this project was to develop a GIS database containing spatial data for all tidegates, culverts, and other water control structures surrounding Humboldt Bay. The database was to be designed for ease of updating as new structures were installed, removed, or modified and also was designed to be shared with anyone who wished to use it. In addition, we planned for users to be able to easily query and search the database thus enhancing the user's ability to prioritize the structures according to a number of database attributes. Therefore, we envisioned making the data available on a website with built-in mapping capabilities so that the interested public would not need to purchase GIS software to see and use the database. In order to accomplish this task, we began discussions with the California Cooperative Anadromous Fish and Habitat Data Program (CalFish), a multi-agency cooperative program designed to maintain and disseminate data of this type.

Project Methods

The project area is located in the estuarine and palustrine wetlands surrounding Humboldt Bay, within the bounds of the Arcata South, Eureka, Cannibal Island, and Fields Landing U.S.G.S. 7.5' quadrangle maps. The area of interest extends from Mad River Slough in the north, to the east approximately to Old Arcata Road and including Freshwater Slough, along the Eureka waterfront, and along the South Bay perimeter to Table Bluff Road.

First, we attempted to locate any existing information, digital or hardcopy, regarding the culverts and tidegates surrounding the bay. At one time, a spatial dataset was developed by the CDFG Office of Spill Prevention and Response (OSPR), but was subsequently lost due to a computer failure. We reviewed existing datasets produced by the California Department of Transportation (Caltrans) and the Redwood Community Action Agency (RCAA). The Caltrans dataset was a Humboldt County culvert inventory, primarily consisting of culverts that intersect with highways. This dataset identified a point for

each end of an individual culvert, based on the highway post mile linear referenced database. The RCAA dataset reflected approximate locations from descriptions in a paper publication produced in 2000. The spatial accuracy was quite variable for many of the features.

We developed a data dictionary to use in the collection of the water control structure location and other features. The data field attributes included spatial coordinates, physical characteristics, structure functionality, as well as photographs of the structures. Categories were developed for the attributes to ensure consistency in describing the feature, and to assist with data quality assurance. Data attributes are listed in the following table.

Table 1. Data attributes collected for water control structures

Field Definition	Attribute Name	Format	Purpose
Longitude	Longitude	Decimal Degrees (DD)	Spatial information
Latitude	Latitude	Decimal Degrees (DD)	Spatial information
Type	Type	Text	Culvert, tidegate, flash board, other
Subtype	Type_2	Text	Top-hinge round, side-hinge, rubber duckbill, etc.
Material	Material	Text	Concrete, steel, aluminum, plastic, wood
X Dimension	X_Size	Numeric	Structure opening size
Y Dimension	Y_Size	Numeric	Opening size for non-round structures
Current Status	Current_St	Text	Functional, broken-open, broken-closed, leaking
Ownership	Owner	Text	Agency name (or “private”)
Up-channel habitat	Habitat_up	Text	Fresh water, brackish, marine
Fish passage - adult	Adult_fish	Text	Suitable, limited, none for salmonids
Fish passage – juvenile	Juv_fish	Text	Suitable, limited, none for salmonids
Photograph link	Photo_numb	Text	Hyperlink to photos by filename
Comments		Text	
Field Crew initials	Crew_initi	Text	Identify who collected data

Field collection was accomplished with a two-person crew of FWS Fisheries biologists, using global positioning system (GPS), measuring rod, and a digital camera. For collection of GPS data, we used a Trimble™ GeoXT handheld GPS unit. The water control structure data were collected as point features and converted to an ESRI shapefile format with metadata fully documenting the data development procedure. A Federal Geographic Data Committee (FGDC) compliant metadata document is included in this report as Attachment A.

Results

The resulting database includes a total of 371 point features each representing a water control structure. Of these, 164 were field inventoried using the GPS techniques described above and photographed by FWS biologists (Figure 1). A total of 12 point features were identified from the RCAA dataset. Data obtained from Oscar Larson and Associates included 11 structures in the McDaniel Slough area of Arcata Bay. The remaining 184 points were imported from the Caltrans dataset. These imported features were lacking some of the FWS attribute data, as well as photographs.

Figure 1. Example of a concrete pipe culvert with failed (missing) tidegate.

Table 2. Dataset feature origins.

Source of Features	Number of Features
FWS	164
RCAA	12
CalTrans	184
Oscar Larson and Associates	11
Total All Sources	371

Culverts were the most common structure type identified, with 282 total culverts. A total of 79 tidegates were also identified. The remaining 10 features included 9 flash board weir structures and one standpipe.

A total of 158 structures were determined to be fully functional. In addition, the status of 191 structures was specified as "unknown". This resulted from the features being imported from either the CalTrans culvert data or RCAA data, and therefore not inventoried by the FWS field crew. The remaining 22 features inventoried were determined to be either "broken," "leaking," "crushed," or "impeded."

The water control structures in and around the bay are managed by various entities, including private landowners. Participation in this project by all landowners was voluntary, and because of the timeframes of the project, we did not have adequate resources to contact all landowners for permission to access their properties. As a result, some structures could not be accounted for because we did not have access to the properties. A few of the locations for these features, where known, were added using aerial imagery. It is likely that additional relationships will continue to be formed around the bay with private landowners that will lead to increased access to additional areas for water control structure inventory.

Database Maintenance

The FWS recognized that maintenance needs to be addressed to ensure that future use of the database will yield accurate information. Modifications to some of the structures that might change information in the status, type, size, and/or fish passage fields was considered a certainty due to several restoration grant programs and projects active in the Humboldt Bay area as well as other types of projects, (e.g. highway projects). Fortunately, the FWS determined that the workload associated with the maintenance task would be minimal, so the FWS staff in Arcata agreed to be the point of contact for this maintenance. The update process will consist of an individual submitting a database change request to FWS. Submitted forms will then be used to update the database at least quarterly.

We began discussions with CDFG and representatives from CalFish to find a suitable site to host the database. We reached a tentative agreement with CalFish to have the data hosted on their internet map server website at http://www.calfish.org. If the funding agencies approve the hosting of the data with CalFish, then the delivery of data to the website will occur by January 1, 2008. The contact at CalFish is currently Ms. Karen Wilson with CDFG in Fortuna. Any Database Change Requests submitted to the FWS will be incorporated and then coordinated with CalFish staff.

Database Use

One value of a database is the ability to filter and extract a desired subset from the entire dataset using query and report tools. This database is designed to be queried on any of the attribute values shown in Table 1. By using a query tool on the website hosting the database, the user selects the fields of interest, the operators, and the values for each field in the query (Figure 2). The output table can then be viewed online, or exported to a database table or text file to be stored locally on the user's computer. In addition, the

selected records will be shown on a map of Humboldt Bay as highlighted point features (Figure 3).

This database can be easily used by agencies and the general public to prioritize replacement or repair of these structures based on the attributes and photographs contained within. In the example query in Figure 2, we selected structures that are "tidegates" with a current status that includes "broken–closed," and with "no adult fish passage." The resulting output table only lists those structures that are tidegates with a status of broken-closed and that do not allow passage of adult salmonid fish. It is our hope that the information in this database will be useful and helpful in planning efforts for prioritization of restoration as well as other types of projects in the tidal waters surrounding Humboldt Bay.

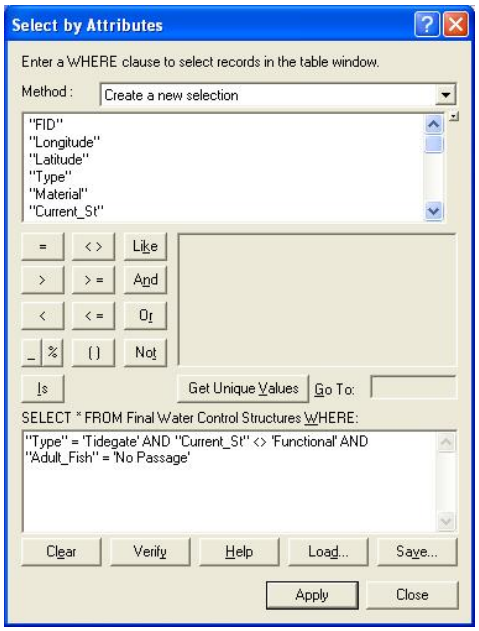

Figure 2. Query selection example.

Figure 3. Map showing results from query in Figure 2.

References

California Department of Fish and Game. 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission. 594 pp.

The Conservation Fund. 2005. Conservation Prospects for the North Coast: A Review and Analysis of Existing Conservation Plans, Land Use Trends and Strategies for Conservation on the North Coast of California. 503 pp.

Humboldt Bay Harbor, Recreation, and Conservation District. 2007. Humboldt Bay Management Plan. 221 pp. + Appendices.

Humboldt Bay Watershed Advisory Committee. 2005. Humboldt Bay Watershed Salmon and Steelhead Conservation Plan. Natural Resources Services, RCAA. 213 pp. + Appendices

U.S. Fish and Wildlife Service. 2005. Recovery Plan for the Tidewater Goby (Eucyclogobius newberryi). U.S. Fish and Wildlife Service, Portland, Oregon. vi + 199 pp.

Attachment A. Metadata for water control structure GIS shapefile

Final Water Control Structures

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: U.S. Fish and Wildlife Service

Publication_Date: June 15, 2007

Title: Final Water Control Structures

Geospatial_Data_Presentation_Form: vector digital data

Online_Linkage:

\\ifw8afwogis\GISData\Public\Goldsmith\Tidegates\Final Water Control Structures.shp

Description:

Abstract:

This data set is a point feature class inventory of water control structures obtained from existing sources, and captured using GPS and photo acquisition. Structures include culverts, tidegates, standpipes, and flash boards. The inventory was funded by the U.S. Fish and Wildlife Service, the Humboldt Bay Conservation, Recreation, and Harbor District, and the California Department of Fish and Game

Purpose:

This data set was developed for a broad range of uses, which may include oil spill prevention, wetland restoration, and fish passage improvement.

Supplemental_Information:

The data set is not complete, due to land access limitations, and incomplete knowledge of structure locations. It is anticipated that as additional structures are located, updates will be made.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: June 15, 2007.

Currentness_Reference: publication date

Status:
Progress: In work
Maintenance_and_Update_Frequency: Quarterly
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -124.230324
East_Bounding_Coordinate: -124.075750
North_Bounding_Coordinate: 40.910421
South_Bounding_Coordinate: 40.669115
Keywords:
Theme:
Theme_Keyword: Water Control Structures
Place:
Place_Keyword: Humboldt Bay
Access_Constraints: none
Use_Constraints: none
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Greg Goldsmith
Contact_Organization: U.S. Fish and Wildlife Service
Contact_Position: GIS Coordinator
Contact_Address:
Address_Type: mailing and physical address
Address: 1655 Heindon Road
City: Arcata
State_or_Province: CA
Postal_Code: 95521
Country: USA
Contact_Voice_Telephone: (707) 822-7201
Contact_Facsimile_Telephone: (707) 822-8411
Contact_Electronic_Mail_Address: greg_goldsmith@fws.gov
Hours_of_Service: M-F, 0800-1630
Security_Information:
Security_Classification: Unclassified
Native_Data_Set_Environment:
Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:
Logical_Consistency_Report: All point features are independent of each other.
Completeness_Report:
All known point features are included, however additional features may exist that were not recorded due to lack of knowledge of feature location.
Positional_Accuracy:
Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
Data acquired from GPS units were within 4 meter horizontal position. Trimble GeoXT GPS units were used to collect point features, provided with a data dictionary for attribute definition
Quantitative_Horizontal_Positional_Accuracy_Assessment:
Horizontal_Positional_Accuracy_Value: 4 meter
Horizontal_Positional_Accuracy_Explanation: Trimble GeoXT point collection
Lineage:
Source_Information:
Source_Scale_Denominator: unknown
Type_of_Source_Media: paper map
Source_Citation_Abbreviation:
Figure 2 Map. Drainage patterns along the Eureka/Arcata Corridor
Source_Contribution:
This map was obtained from the Eureka Office, California Department of Transportation
Source_Information:
Source_Scale_Denominator: unknown
Type_of_Source_Media: Paper map
Source_Time_Period_of_Content:
Source_Currentness_Reference: publication date
Source_Contribution:
Oscar Larson and Associates CAD drawing of McDaniel Slough water control structures
Process_Step:
Process_Description:
Attributes combined from CalTrans, CDFG, and structures obtained from GPS
Source_Used_Citation_Abbreviation:
N:\Public\Goldsmith\Goby_CH\Export_Output
Process_Step:
Process_Description: Dataset copied.
Process_Step:
Process_Description: Dataset copied.
Source_Used_Citation_Abbreviation:
N:\Public\Goldsmith\Tidegates\GPS_and_Caltrans2

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Entity point
Point_and_Vector_Object_Count: 509

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:

Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 10
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -123.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000000
Ordinate_Resolution: 0.000000
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Final Water Control Structures
Attribute:
Attribute_Label: FID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: Shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.
Attribute:
Attribute_Label: Longitude
Attribute_Definition: Longitude (Decimal Degrees)
Attribute:
Attribute_Label: Latitude
Attribute_Definition: Latitude (Decimal Degrees)
Attribute:

Attribute_Label: Type
Attribute_Definition: The Type of Structure
Attribute_Definition_Source: Culvert, Tidegate, Standpipe, Flash Board
Attribute:
Attribute_Label: Material
Attribute_Definition: Construction Material of Structure
Attribute_Definition_Source: Concrete, Wood, Plastic, Steel
Attribute:
Attribute_Label: Current_St
Attribute_Definition: Current Status of Structure
Attribute:
Attribute_Label: Owner
Attribute_Definition: Agency that owns or manages structure
Attribute:
Attribute_Label: Habitat_Up
Attribute_Definition: Primary habitat above structure
Attribute:
Attribute_Label: Adult_Fish
Attribute_Definition: fish passage for adult salmonids
Attribute:
Attribute_Label: Juv__Fish
Attribute_Definition: fish passage for juvenile salmonid/small fish
Attribute:
Attribute_Label: Photo_Numb
Attribute_Definition: photo number, where applicable
Attribute:
Attribute_Label: Comments
Attribute_Definition: Miscellaneous comments
Attribute:
Attribute_Label: Crew_Initi
Attribute_Definition: Crew initials
Attribute:
Attribute_Label: Point_ID
Attribute:
Attribute_Label: Type_2
Attribute_Definition: additional information on structure type
Attribute:
Attribute_Label: rte
Attribute:
Attribute_Label: pm
Attribute_Definition: CalTrans postmile reference
Attribute:
Attribute_Label: Size_in
Attribute_Definition: size of structure (x-dimension, or diameter)
Attribute:
Attribute_Label: X_Size

Attribute:
Attribute_Label: Y_Size
Attribute:
Attribute_Label: Elev_MLLW
Overview_Description:

Distribution_Information:
Resource_Description: Downloadable Data
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Transfer_Size: 0.014
Fees: none

Metadata_Reference_Information:
Metadata_Date: 20070810
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Fish and Wildlife Service
Contact_Person: Greg Goldsmith
Contact_Position: GIS Coordinator
Contact_Address:
Address_Type: mailing and physical address
Address: 1655 Heindon Road
City: Arcata
State_or_Province: CA
Postal_Code: 95521
Contact_Voice_Telephone: (707) 822-7201
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Time_Convention: local time
Metadata_Extensions:
Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
Profile_Name: ESRI Metadata Profile

Generated by mp version 2.8.6 on Fri Aug 10 08:16:13 2007