Fish Passage Barrier and Fish Habitat Distribution Project Completion Report February, 2012

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Overview

This project set out to fill gaps in fish passage barrier and fish habitat distribution data and to integrate the two datasets together for analyzing fish passage restoration opportunities. The deliverables from this project were envisioned as a "first step" in a long-term process to compile barrier and habitat distribution data and to improve upon the quality and completeness of those data.

Fish Passage Barrier Data Enhancements

Barrier datasets were compiled and standardized from 7 watershed councils, 1 county, 1 tribe, 2 soil and water conservation districts, 4 state agencies and 1 federal agency. A total of 13,649 barrier records were added to the Oregon Fish Passage Barrier Data Standard database.

Fish Habitat Distribution Data Enhancements

Fish habitat distribution data were compiled from multiple Oregon Department of Fish and Wildlife (ODFW) research projects, ODFW districts, and two federal agencies. Habitat additions (miles) were as follows: coho (297), steelhead (164), green sturgeon (66), pacific lamprey (3,931) and redband (9,147). Previously developed historical distribution data were standardized and built into the Oregon Fish Habitat Distribution Data Standard (OFHDDS) database and new historical distribution data were developed for coho, chinook, steelhead, redband and lamprey.

Data Integration

Data integration efforts to date include linear referencing approximately 95% of barriers to the National Hydrography Dataset (NHD) and approximately 95% of the habitat distribution to the NHD. A geometric network was built for the lower Snake River sub-region and a methodology was developed for quantifying anadromous fish habitat upstream of barriers. Network analyses were run for 174 unique barrier sites, identifying species-specific miles of upstream habitat, as well as the presence of upstream barriers. Additionally, a classification scheme was developed to describe the various scenarios that exist between barriers and existing fish habitat distribution data.

Metadata and Data Management Plans

Metadata have been developed for published datasets including barriers, redband trout, pacific lamprey, coho, chinook, steelhead, chum and bull trout. Data management plans have been developed for fish passage barriers and fish habitat distribution.

Fish Passage Barrier Data Enhancements

Local Barrier Inventories

Fish passage barrier inventory data from numerous "local" originators were acquired. These originators included: 7 watershed councils, 1 county, 1 tribe and 2 soil and water conservation districts. Through a process of data / metadata review and assessment, as well as collaboration with the originators, crosswalk documents were developed for each source dataset. These documents served to inform the conversion of the data from its original format into the Oregon Fish Passage Barrier Data Standard (OFPBDS) database. **Table 1** summarizes the originators from which barrier data were acquired and incorporated into the OFPBDS database, as well as the number of features by originator.

Table 1. Local Barrier Inventory Additions

Originator	Area	# of barrier features
Clackamas Watershed Council	Clackamas Basin	467
Calapooia Watershed Council	Calapooia Basin	68
Santiam Watershed Council	Santiam Basin	18
Siuslaw Watershed Council	Siuslaw Basin	555
Bear Creek Watershed Council	Bear Cr / Rogue Basin	71
Rogue Basin Fish Access Team	Rogue Basin	218
Scappoose Watershed Council	Scappoose Creek	110
Washington County	Tualatin Basin	217
Nez Perce Tribe	Wallowa county	196
Benton SWCD	Benton county	474
Douglas SWCD (Umpqua)	Mid Umpqua basin	1,592
Total		**3,986**

State Agency Barrier Inventories (ODF, OWRD, ODFW, OWEB)

Fish presence survey data from the Oregon Department of Forestry (ODF) were acquired in June 2010. These data describe both stream survey-based observations of fish presence, as well as modeled areas of fish presence related to site specific needs under the forest practices act. ODFW conducts some fish presence surveys, but ODF stewards these data, thus the reason the Originator Name field (fpbONm) is denoted by "ODF-ODFW". As surveyors encounter them, fish passage barriers are recorded on survey forms and are identified in the fish presence survey GIS datasets that ODF publishes. ODFW worked with ODF over the course of several months to address concerns with incorporating these data into the OFPBDS database and ultimately gained approval to move forward with this effort. While the data were acquired from the ODF state office, substantial coordination occurred between ODFW GIS technicians and ODF district staff to uphold data accuracy and currency to the greatest degree possible. A total of 738 barrier records were added to the OFPBDS database from ODF fish presence survey GIS data.

The Oregon Water Resources Department (OWRD) maintains an inventory of large Oregon dams. Large dams include structures that are 10 feet or greater in height or contain 9.2 acre feet or more of water storage capacity. While ODFW had previously incorporated records for some of these dams into the first version of the OFPBDS database (from ODFW's Barrier database – originally populated from the National Inventory of Dams), OWRD had made some significant updates to the major dams data since 2009. The OFPBDS specifies that data to be incorporated into the standard database be provided by the primary data steward. Therefore, an effort was made to "re" populate the major dams in the OFPBDS database based on the newest data from OWRD. Version 1 of the OFPBDS database included 1,183 records for dams that were submitted by ODFW. Because of the shift in stewardship of dams data that had been submitted to OFPDS, ODFW is now responsible for a total of 1,087 dam records with 516 records that were maintained from version 1 and 571 new dam records derived from ODFW's Aquatic Inventory Project database. There were 667 dams which originated from ODFW in version 1 but now have their originator as OWRD. Version 3 has a total of 1,262 dams submitted by OWRD.

ODFW's Aquatic Inventory Project (AIP) has conducted extensive stream habitat surveys since 1990. The AIP habitat unit-level data describe both artificial and natural obstructions to fish passage. Natural barriers were included as they help to inform the extent of historical fish habitat distribution in cases where there are artificial obstructions downstream. Efforts were made to convert the data from the original linear format to a point format consistent with other OFPBDS records. Due to the limited nature of the AIP schema in relation to barriers, comments were extensively mined to identify barrier features. These features have the same originator name as other barrier records developed by ODFW, but their feature ID's are 19 digits in length vs. 5 or less for non-AIP features.

During ODFW's 1:24K Fish Habitat Distribution Mapping project that was carried out from 2000 to 2002, hardcopy fish presence survey datasheets were acquired from ODFW and ODF district offices and entered into an MS Access database. While these data originate from the same fish presence survey effort mentioned above, the database that resulted from this effort is stewarded by ODFW, thus the reason the Originator Name field (fpbONm) is denoted by "ODFW-ODF". Many of the survey datasheets identified fish passage barriers that are supplementary to those found in the ODF fish presence survey GIS datasets. A total of 751 barrier records were added to the OFPBDS database from the fish presence survey database stewarded by ODFW.

The barrier data maintained by the Oregon Watershed Enhancement Board (OWEB) within the Oregon Watershed Restoration Inventory (OWRI) are described in greater detail in the OWRI Reconciliation section below. For replaced barriers, a total of 118 new records were added to the OFPBDS database describing the new "passable" features (e.g. where a bridge replaced a culvert).

Table 2 summarizes the total number of barriers added to the OFPBDS database from state agencies.

Table 2. State Agency Barrier Inventory Additions

Originator	Area	# of barrier features
ODF	Statewide	738
OWRD	Statewide	1,262
ODFW – Aquatic Inventories	Statewide	4,232
ODFW – Fish Presence Survey Database	Statewide	751
OWEB	Statewide	118
Total		**7,101**

US Forest Service (USFS) Barrier Inventory

Initial work with the USFS barrier inventory included the acquisition of a regional dataset and the development of a preliminary OFPBDS crosswalk in June of 2010. Upon review and discovery of substantive flaws in the positional accuracy of the barrier features, efforts were made to coordinate with USFS staff to address this issue. The USFS embarked on an effort in the summer of 2010 to correct the positional accuracy of the features and a decision was made to wait until they completed this effort before proceeding further with incorporation of USFS data into the OFPBDS database. The issues with positional accuracy of the USFS data were addressed and thirteen unique "forest-level" datasets were made available to ODFW between February and April of 2011. This represented a substantial departure from the original plan of converting a single, regional dataset to the OFPBDS. The schemas and the degree of attribution varied substantially between the datasets. Additionally, two separate tables were needed to supplement the primary forest-level datasets for meeting both the minimum and optional elements of the standard. Consequently, the original estimate of 1-1.5 months of staff time to complete the conversion of USFS barrier data did not prove to be an accurate assessment. Actual staff time to convert the USFS barrier data to the OFPBDS was closer to 6 months and involved the use of some funding from StreamNet. All USFS datasets were ultimately incorporated into the OFPBDS database by December 2011 and were included in the publication dataset that was released at that time. The additional time required to process USFS barrier data resulted in less time going toward other components of the overall project (e.g. migration of fish habitat data to the NHD). A total of 2,562 USFS barrier records were added to the OFPBDS database (**Table 3**).

Table 3. US Forest Service Barrier Inventory Additions

Forest	# of Barrier Features
Deschutes	65
Fremont	380
Malheur	377
Hood	241
Ochoco	105
Rogue	96
Siskiyou	87
Siuslaw	178
Umatilla	274
Umpqua	69
Wallowa-Whitman	258
Willamette	393
Winema	39
Total	**2,562**

Statewide Overview of the Oregon Fish Passage Barrier Standard Dataset

Version 3 of the OFBPDS statewide dataset was published in December 2011. Data have now been compiled and standardized from most known federal and state sources of fish passage barrier data, as well as from many "local" sources. Additional datasets that have yet to be built into the standardized dataset are identified in the Future Work section below. A total of 30,780 barrier features at 29,507 unique barrier sites are found within the updated OFPBDS dataset (**Figure 1**).

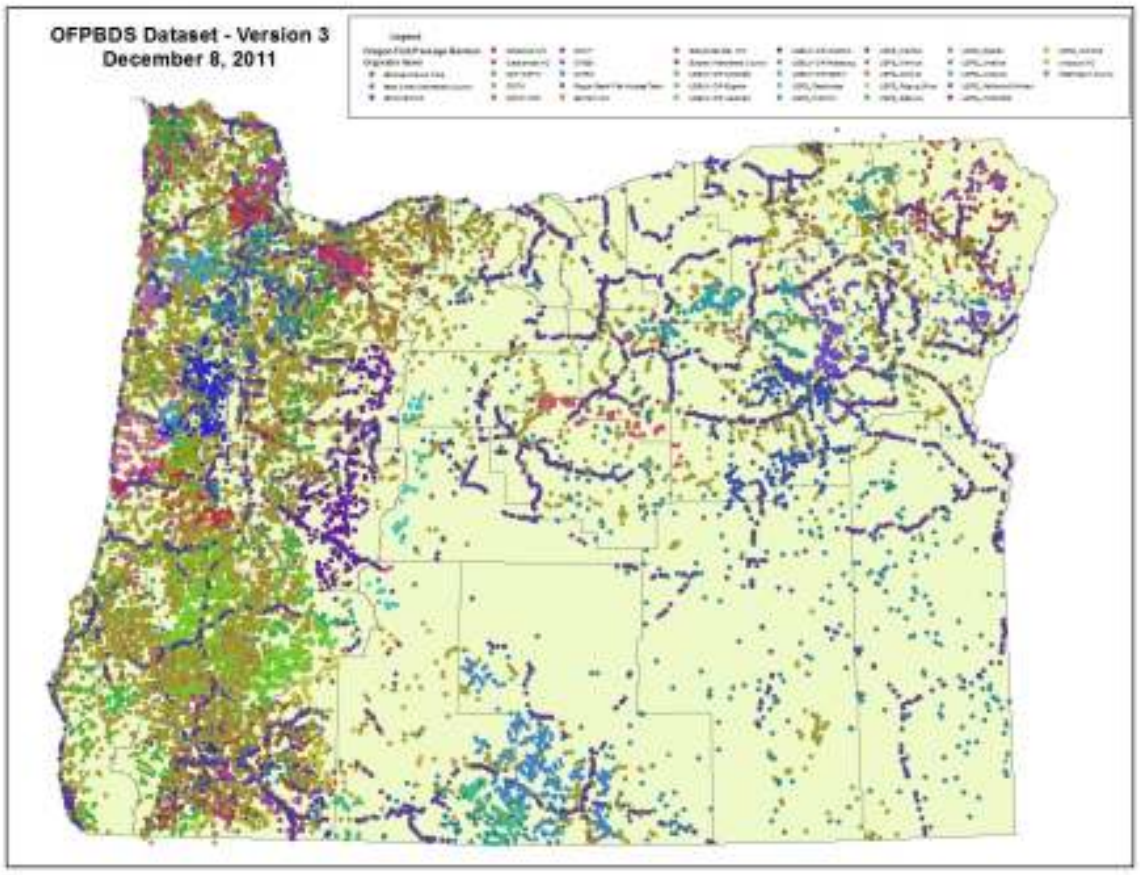

Figure 1. Statewide overview of the Oregon Fish Passage Barrier Standard Dataset.

Key attributes of the OFBPDS dataset include barrier identification, type (**Table 4**) and passage status (**Figure 2**). Both originator and statewide identifiers for each barrier feature and each barrier site are tracked.

Table 4. Summary of Barriers by Type

Barrier Type	Number of Features	Percent of Total
Bridge	751	2.44
Cascade – Gradient	281	0.91
Culvert	23,812	77.36
Dam	2,572	8.36
Ford	119	0.39
Falls	2,699	8.77
Other	339	1.1
Tidegate	79	0.26
Unknown	50	0.16
Weir-Sill	78	0.25
Total	**30,780**	

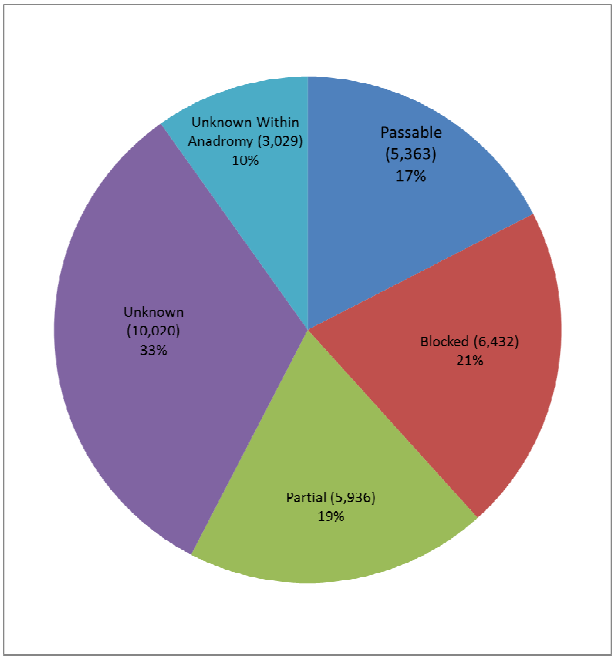

Figure 2. Summary of Barriers by Passage Status

Two published datasets are available at: https://nrimp.dfw.state.or.us/nrimp/default.aspx?pn=fishbarrierdata :

- Current Fish Passage Barrier Dataset
- Removed / Replaced Fish Passage Barrier Dataset

OWRI and OFPBDS Reconciliation

As part of the standard process for incorporating new barrier datasets into the OFPBDS database, each barrier is compared to the OWRI database. The objective of this comparison is to ensure that passage restoration projects are accurately reflected within the OFPBDS database. Where definitive matches are made between a pending new barrier record and an OWRI record, there are 3 possible scenarios:

1) Passage Barrier Removed: In cases where a barrier feature is removed but not replaced, the old record is maintained and the Removed Date attribute is populated. The record is included within the "removed / replaced" publication barrier dataset and no record appears in the "current" publication barrier dataset.

2) Passage Barrier Replaced: When a barrier feature is replaced, the Removed Date attribute of the original record is populated and a new record is created in the database for the feature that is currently in place. OWEB is listed under the Originator Name attribute for the new record. In general, one record will appear in the "removed / replaced" publication barrier dataset and one in the "current" barrier publication dataset with the exception of road-stream crossings with multiple culvert pipes. The Passage Status attribute of the new feature is described as "passable" and the Passage Status Evaluation Method attribute is described as "by evaluation of design plans".

3) Passage Barrier Modified: When an existing barrier has been modified (e.g. addition of baffles to a culvert), there are 3 attributes (Modification Date, Modification Type and Modification Description) that store the specifics of the modification. The Passage Status attribute is updated to "passable" unless available information indicates an ongoing passage problem. No new records are created and the feature continues to be included in the "current" barrier publication dataset.

For replaced barriers, a total of 118 new records were added to the OFPBDS database describing the new "passable" features. OWEB is listed as the originator for these records. For modified barriers, there are 29 records that had their passage status updated based on OWRI data. These records originate from a source other than OWEB; however the Passage Status Originator Name attribute identifies OWEB as the source for that information.

Two key factors limited the number of barrier features that could be reconciled:

1) The OWRI database structure allows multiple barrier features to be tied to one project (and typically only one spatial location). This does not mesh with the OFPBDS structure where the spatial location of each barrier feature is tracked.
2) The positional accuracy of OWRI project points often limited the definitive matches that could be made with fish passage barrier features from other originators. Numerous OWRI features need to have their locations adjusted to more accurately reflect their true locations on the ground.

ODFW is actively working with OWEB to address the incompatibilities between the OWRI and OFPBDS databases.

Duplicate Barrier Reconciliation

Previous to the project, ODFW along with input from OWEB and OSU's Institute for Natural Resources developed a Duplicate Reconciliation Methodology document to describe the overall process to identify and resolve duplication between existing OFPBDS records and new candidate records to be added to the database. During the project, an ArcGIS geoprocessing model (Duplication Analysis Model or DAM) was created to facilitate these data processing steps. The Duplication Analysis phase consists of a set of procedures to determine if duplication exists between the targeted data and the OFPBDS. The Duplication Analysis occurs after the data are converted into the OFPBDS format. Proximity is the most effective indicator in determining duplication, followed by attribute comparison. Some effort was also made to develop an 'index of similarity' between features, utilizing key descriptive attributes such as barrier type, subtype, height, width and length. This process facilitated the weighting of some attributes differently in the attribute comparison process to come up with a threshold of similarity. Records below a certain threshold of similarity were reviewed on a case-by-case basis by GIS Technicians. Where duplicates were confirmed, only one record was retained in the database. Record currency and completeness was considered when choosing which record to maintain. In cases where critical information was spread across multiple records, a process of attribute transfer was followed and the secondary data originator (e.g. passage information) was tracked.

ODFW can make all documentation related to Duplicate Reconciliation available, including geoprocessing models, python scripts and Visual Basic code.

Fish Habitat Distribution Data Enhancements

Current Habitat Distribution

The project identified the development of habitat distribution datasets for anadromous salmonids as key deliverables, including coho, steelhead, chinook and chum salmon. Once the project was initiated however, it became apparent that understanding the habitat distribution of other species and life histories was equally important for supporting key stakeholder business needs such as fish passage barrier improvement planning. Consequently, efforts were also made to identify and describe areas of habitat distribution for resident O. mykiss species (redband trout) and other, non-salmonid anadromous species, including green sturgeon and pacific lamprey (**Table 5**). Efforts were focused on identifying and incorporating habitat data outside of previously compiled data. Data from numerous originators including multiple ODFW monitoring projects, USFS, BLM, the Siletz and Grande Ronde tribes were compiled, converted into the OFHDDS format and loaded into the OFHDDS database. Additionally, habitat distribution data extents were adjusted as part of data quality assurance efforts in relation to fish passage barrier data.

For anadromous species, substantial additions were made to coho, steelhead and pacific lamprey habitat. No additional habitat was mapped for chinook or chum, as recently compiled data all fell within currently mapped habitat distribution.

In order to better describe the variability of resident fish habitat use, the OFHDDS was revised to expand the Habitat Use attribute domain. Data were compiled for the entire range of redband within Oregon with the exception of the closed basins and the upper Deschutes which had been compiled previously. Additionally, opinion-based data were developed through a process of map creation, review and input from ODFW biologists in the Mid-Columbia, Umatilla, John Day, La Grande, Wallowa, Klamath and Southeast fish districts. Summer steelhead habitat was also used to identify redband presence within the range of anadromy. The Life History attribute was used to track whether the fish are primarily anadromous, primarily resident or a mix of the two. Redband mapping efforts were coordinated

with Idaho and Washington as part of the Western Governors Association Wildlife Decision Support System, Columbia Plateau pilot project.

Table 5. Current Fish Habitat Distribution Additions

Species	Miles
Summer Steelhead	60
Winter Steelhead	104
Coho Salmon	297
Pacific Lamprey	3,931
Redband Trout	9,147
Green Sturgeon	66
Total	**13,605**

Published data are available at: https://nrimp.dfw.state.or.us/nrimp/default.aspx?pn=fishdistdata

Historical Habitat Distribution

The conceptual plan for developing historical habitat distribution data, as outlined in the Framework Proposal, was to compile existing intrinsic potential (IP) data and build it into the OFHDDS database. Before that was possible, the OFHDDS Framework workgroup was reconvened to expand the scope of the standard to include historical habitat. Amongst workgroup participants, concerns arose regarding the consistency between existing IP datasets and the plausibility of using them for direct creation of historical habitat distribution data. The IP models are run in different watersheds, using a variety of input parameters that can vary depending upon the particular needs of the users who apply the models. The group decided to allow for the use IP data for mapping historical habitat distribution data, but also required review and refinement by biologists with local knowledge of the stream(s) in question.

Historical habitat may be identified with a corresponding record created in the OFHDDS database using either of the following approaches:

1) The same approaches as when developing current distribution data that are described by the Basis attribute field (e.g. documented observation)
2) Modeling of presumed, species-specific historical habitat distribution derived from intrinsic potential (IP) models along with local biologist review / refinement

Additionally, some lessons learned from an ODFW led multi-species Coastal Conservation Plan process pointed toward a low level of local biologist acceptance for direct use of IP data for mapping historical habitat. This also influenced the eventual approach that was taken for mapping historical habitat distribution data. A more selective approach was taken in order to improve the biologists' confidence in the resultant data. As a result, newly identified "presumed" historical habitat data were not mapped as comprehensively as was envisioned at the outset of the project. Newly mapped historical habitat were primarily identified upstream of significant blocking barriers with very little identified upstream of smaller barriers (e.g. blocking culverts).

With the scope of the data standard now inclusive of historical habitat, previously compiled historical habitat distribution data were converted into the OFHDDS format and loaded into the database (**Table 6**).

Table 6. Historical Fish Habitat Distribution Additions

Species	Previously Compiled Historical FHD Converted to OFHHDS	Newly Developed Historical FHD	Total Miles
Coho Salmon	464	4	468
Fall Chinook	84	445	529
Spring Chinook	145	462	607
Summer Steelhead	415	768	1,183
Winter Steelhead	321	18	339
Chum Salmon	201	0	201
Sockeye Salmon	101	0	101
Redband Trout	0	247	247
Bull Trout	1,288	4	1,292
Pacific Lamprey	0	106	106
Total			**5,074**

Published data are available at: https://nrimp.dfw.state.or.us/nrimp/default.aspx?pn=fishdistdata

Data Integration

Fish passage barrier and fish habitat distribution data can be integrated in different ways, including through linear referencing and geometric network data models:

- Linear referencing enables the registration of multiple datasets to a single "route" system. In the context of this project, that translates into assigning route identifiers (stream ID's)_and measures along those streams to the barrier and habitat data. Once datasets are linear referenced on the same route system, certain relationships between the features can be analyzed (e.g. where on a stream a certain barrier is located).
- The geometric network takes this a step further and builds connectivity and flow direction into the stream dataset, enabling analysis up or down the stream network. Additionally, barriers can be built into the network and can be used to initiate or stop network tracing operations. Questions such as, "how many miles of coho habitat are located upstream from this barrier?" can be answered by analyzing the data on a geometric network. While this data model supports the measurement of habitat gains at any particular barrier and other barrier prioritization metrics, it also requires that data inputs meet stringent criteria in order to provide viable results.

Linear Referencing Barrier Data

At the inception of the project, the OFPBDS included optional attributes for linear referencing barriers to the Framework Hydrography. The OFPBDS Framework workgroup met between June and August of 2010 and revised the data standard to linear reference barrier data against the NHD instead. The NHD provides a data model that better supports network analysis than the previous Framework data model due to its connectivity and flow attribution.

Where barrier records were located in close proximity (5 meters) to the NHD geometry, the NHD-based optional linear referencing attributes were populated. Features outside of the 5m tolerance were reviewed manually and in cases where definitive matches could be made, their linear referencing attributes were populated as well. Out of 30,780 barrier features, 29,098 features (94.5%) are referenced to the NHD. The remaining 1,682 records (5.5%) are located greater than 5 meters from the NHD geometry and they could not be definitively assigned to an existing

stream feature. In nearly all of these cases the barrier features are located on very small streams that have yet to be added to the NHD Flowline dataset.

Linear Referencing Fish Habitat Distribution Data

The OFHDDS linear referencing attributes are required elements that are based on the Framework Hydrography. The OFHDDS has not been revised to match the NHD for two primary reasons. First, the NHD is not yet the official Oregon Framework Hydrography Standard, but should be established as such some time during 2012. Second, the steward of the OFHDDS data plans to complete the migration of the habitat distribution data to the NHD format before working to revise the OFHDDS to match the NHD.

During the project, a high percentage (~95%) of the fish habitat distribution data were successfully migrated to the NHD via automated transformation routines. A small percentage (~5%) of the data have yet to be migrated due to the existence of discrepancies between the Framework and NHD geometries. The time consuming task of manual clean-up of the remaining 5% could not be completed during the scope of the project. Two areas where major discrepancies exist are in the Portland Metro area and the Kilchis River watershed where Lidar projects resulted in significant updates to the NHD geometry. Migrating habitat distribution data for these areas will require first transforming the data to an older version of the NHD, then using the Hydrography Event Mgt. tools to synchronize the events with the current version of the NHD.

Geometric Network Pilot

Fish habitat distribution data for the lower Snake River subregion (Grande Ronde, Wallowa, Imnaha and Hells Canyon subbasins) were migrated in their entirety to the NHD. Historical and current anadromous habitat distribution data, plus fish passage barriers within or at the end of that distribution were then built into a geometric network. Artificial barriers within distribution having a passage status of unknown or passable (e.g. functioning culvert) and natural barriers at the end of distribution were excluded from the network. Network analyses were run for 174 unique barrier sites, identifying by species the quantity of upstream habitat. The ID of the next upstream barrier was identified, enabling assessment of the configuration of multiple barriers in conjunction with each other. The total number of both partial and complete upstream barriers was also tabulated. Each barrier was categorized based on its location relative to species specific habitat distribution. The classification of barriers relative to species specific habitat distribution identifies cases where barrier and/or distribution records may need further quality assurance in order to bring greater consistency between the two datasets (e.g. blocking barriers within current habitat distribution). For the purposes of this analysis, blocking barriers within current distribution were treated as partial barriers as a large majority of these barriers are most likely only partial barriers that need their passage status attribute updated.

This pilot analysis also pointed out the need to clarify the rules and requirements for data driven habitat quantification relative to a particular barrier. One example needing further clarification is when upstream habitat branches and there are barriers up each branch. Specific rules are needed that dictate the identification of the next upstream barrier. It is also necessary to determine the appropriate threshold for categorizing barriers as falling at the end of species specific distribution. No attempt was made to quantify habitat for resident species relative to barriers, however there is a need to develop rule sets for running this type of analysis.

Table 7 outlines various scenarios that exist between barriers, their passage status and their relationship to species-specific anadromous habitat distribution. This list is focused on artificial obstructions that may be candidates for passage restoration. It excludes most natural barriers and artificial obstructions described as passable. Depending

upon the combination of factors, habitat quantification may be possible with existing data, additional data may need to be developed or further barrier and/or habitat data QA may be required.

Table 7. Barrier Categories Relative to Anadromous Species Specific Habitat Distribution

Category	Artificial / Natural	Passage Status	Description of Location Relative to Habitat Distribution Data	Habitat Quantification / Data QA
1	Artificial	Blocked	At end of species distribution (+/- 40 ft.) with historical habitat mapped upstream	Measure historical species distribution.
2	Artificial	Blocked	At the end of species distribution with **no** historical habitat mapped upstream	No data to measure currently. May need historical species distribution mapped.
3	Artificial	Blocked	Within current species distribution	Treat as partial barrier. Measure to the end of current species distribution, as well as to the end of any historical distribution and track separately. Review passage status and correct either FPB or FHD data as necessary.
4	Artificial	Blocked	Within historical species distribution	Measure remaining historical species distribution.
5	Natural	Blocked	Within current species distribution	Treat as partial barrier. Measure to the end of current species FHD. Review passage status and correct either FPB or FHD data as necessary.
6	Artificial	Partial	Within current species distribution	Measure to the end of current species distribution as well as to the end of any historical distribution and track separately.
7	Artificial	Partial	At the end of species distribution with **no** historical habitat mapped upstream	No data to measure currently. Review passage status. May need historical FHD mapped.
8	Artificial	Partial	Within historical species distribution	Measure remaining historical species distribution.
9	Artificial	Partial	At the end of species distribution (+/- 40 ft.) with historical habitat mapped upstream	Measure historical FHD. Review passage status and correct either FPB or FHD data as necessary.
10	Artificial	Unknown	At the end of species distribution (+/- 40 ft.) with historical habitat mapped upstream	Measure to the end of current species distribution. Review passage status and correct either FPB or FHD data as necessary.
11	Artificial	Unknown	At the end of species distribution with **no** historical habitat mapped upstream	No data to measure currently. Review FPB passage status. May need historical FHD mapped.
12	Artificial	Unknown	Within current species distribution	Resolve passage status before proceeding.
13	Artificial	Unknown	Within historical species distribution	Resolve passage status before proceeding.

Measuring Potential / Actual Habitat Gains at Barriers

The Utility Network Analyst toolbar in ArcMap was used to trace the geometric network (GN) upstream from each artificial obstruction and select the habitat distribution reaches for summer steelhead (**Table 8**) and spring chinook (**Table 9**). Once the reaches were selected the length of upstream habitat was quantified, the closest upstream barrier was identified and the total number of upstream barriers was summarized. At ArcGIS 10.0 the geometric network tools require manual input for setting trace start points and for running traces. ArcGIS 10.1 geometric network tracing capabilities are built so they will support improved automation of tracing from each barrier.

Table 8. Summary of Summer Steelhead Barriers in the Lower Snake Subregion

Barrier Category	# Barrier Sites	Average Current Habitat Quantity (Miles)	Maximum Current Habitat Quantity (Miles)	Average Historical Habitat Quantity (Miles)	Maximum Historical Habitat Quantity (Miles)
1	3	-	-	0.881 (637*)	1.473 (1,909*)
2	4	-	-	0	0
3	7	6.577	19.132	0	0
4	1	-	-	7.189	7.189
6	150 (2**)	6.05	38.448	2.099	3.12
7	5	0	0	0	0
8	3	-	-	1.324	1.91

* Includes Hells Canyon Dam with draft historical habitat distribution.

** Category 6 has 2 barriers with both current and historical upstream habitat.

Table 9. Summary of Spring Chinook Barriers in the Lower Snake Subregion

Barrier Category	# Barrier Sites	Average Current Habitat Quantity (Miles)	Maximum Current Habitat Quantity (Miles)	Average Historical Habitat Quantity (Miles)	Maximum Historical Habitat Quantity (Miles)
1	1	-	-	1927*	1,927*
3	1	0.018	0.018	0	0
4	2	-	-	2.372	4.554
6	42 (4**)	6.527	25.719	9.386	13.062
8	3	-	-	2.353	1.864

* Includes Hells Canyon Dam with draft historical habitat distribution.

** Category 6 has 4 barriers with both current and historical upstream habitat.

Table 10 provides an example of the number of barriers, by category (as outline in table 7) that are found in relation to coho habitat distribution data. The analyses required to populate this table will most likely be completed after the data from the ODFW Barrier Data Quality Assurance Review are entered into the OFPBDS database.

Table 10. Species Specific Barrier Classification Example

Barrier Category	Coho	Summer Steelhead (pending*)	Winter Steelhead (pending*)	Spring Chinook (pending*)	Fall Chinook (pending*)	Chum (pending*)
1	11	-	-	-	-	-
2	58	-	-	-	-	-
3	121	-	-	-	-	-
4	-	-	-	-	-	-
5	30	-	-	-	-	-
6	1,307	-	-	-	-	-
7	29	-	-	-	-	-
8	-	-	-	-	-	-
9	8	-	-	-	-	-
10	12	-	-	-	-	-
11	47	-	-	-	-	-
12	1,278	-	-	-	-	-
13	3	-	-	-	-	-
Total	2,904	-	-	-	-	-

* Expected to be complete by June 2012.

Data Quality and Completeness

The compilation and further development of FHD and FPB data during this project resulted in significant progress from the versions of these datasets before the project. However, there are deficiencies that remain in both datasets.

Key shortcomings of the barrier data include accuracy and/or currency of the passage status information. There is a need for a passage status confidence measure to inform the usability of the information. Additionally, gaps in the coverage still exist with several local, county and federal agency inventories that still need to be incorporated.

Gaps within the habitat distribution data include large scale, site specific “presumed” historical habitat upstream of smaller blocking barriers such as culverts. Additionally, gaps in coverage for some species (coastal cutthroat in particular) still exist.

The integration of the FHD and FPB data pointed out the "noise" that exists between the two, or the various scenarios where there are inconsistencies. Historical habitat does not always neatly begin at blocking barriers and some barriers with a passage status of "completely blocking" are located within current fish habitat distribution. This is a likely result of both the variability of the barrier and habitat conditions these datasets attempt to describe and also speaks to the quality and currency of the data itself.

In most cases the blocking barriers within current FHD are likely only partial barriers that present passage issues only to juveniles or to both adults and juveniles seasonally. There are likely some cases where records describing fish habitat distribution may need to be adjusted based on the conflicting information, especially if the barrier can be confirmed as completely blocking to all life stages at all times.

Data Quality Assurance Review and Identification of Known Priority / Other Significant Barriers

Beginning in October 2011 an effort was initiated to provide the FHD and FPB data to ODFW biologists for a quality assurance review. The goal of this effort was to improve the quality and usefulness of the data. Significant effort was put toward the creation of pdf maps at an approximately 1:30,000 scale or larger for each 5th field watershed in the state. Within the anadromous zones, the maps included existing current and historical habitat for all anadromous species, plus some draft historical habitat in coastal basins. They also included most barriers found in the database with the exception of "passable" features and barriers with unknown passage within anadromy. Outside the anadromous zones (Central and SE Oregon), resident species habitats (e.g. redband, bull trout) were included. Accompanying spreadsheets included barriers sorted by 5th field watershed and organized as, within or outside of anadromy. Feedback was solicited on barrier passage status (confirmation or correction), historical fish habitat distribution and also on the identification of priority or other significant barriers.

The time that was invested in this effort came at the expense of migrating more of the fish habitat distribution data to the NHD. A decision was made that it was essential to first improve the quality of the barrier data before focusing on data integration and analysis efforts. Had this effort been skipped, more anadromous fish habitat upstream of barriers could have been quantified during the project, however the confidence in those numbers would have been lower than it will be post data QA efforts. Consequently, the somewhat time consuming "clean-up" of the last 5% of the FHD to NHD migration has only been completed for the lower Snake subregion. The creation of a geometric network with the FHD data as a component part requires 100% migration and connectivity between all of the stream features.

The input from the *Data Quality Assurance Review* has yet to be entered into the FHD and FPB databases. The data were not obtained until after all funds from this project were expended. ODFW has identified funds to enter these data, however the current hiring freeze has prevented us from moving forward with this effort. Over 500 priority or significant barriers were identified during this process. The passage status was either confirmed as accurate within the database or it was revised based on field-based knowledge of ODFW district staff. Additionally, if a priority barrier was not present in the database then information describing the barrier was provided to support the creation of a new record in the database.

Metadata and Data Management Plans

The following datasets have been published with Federal Geographic Data Committee (FGDC) compliant metadata to the ODFW Natural Resources Information Management Program web site:

- Current barriers
- Removed / Replaced barriers
- Current and historical coho habitat distribution
- Current and historical spring chinook habitat distribution
- Current and historical fall chinook habitat distribution
- Current and historical summer steelhead habitat distribution
- Current and historical chum salmon habitat distribution
- Current and historical pacific lamprey habitat distribution
- Current and historical redband trout habitat distribution
- Current and historical bull trout habitat distribution

Data management plans have been written for both the fish passage barrier and fish habitat distribution databases. The plans outline operational standards for data development, quality control and maintenance to ensure that best practices are followed during the complete data life cycle. Additionally, issues relating to data access and governance are addressed. Business rules that outline the requirements for complying with the Framework barrier and habitat distribution data standards are found within each of the respective data standards documents. Data management plans can be made available upon request.

Future Work

Incorporate all OWRI fish passage barrier features directly into the OFPBDS database. We are waiting until the 2 issues listed in the OWRI section are addressed before an effort is made to broadly incorporate OWRI data directly in to the OFPBDS database.

Additional barrier datasets to incorporate:

- Tidegates
- Drift / Neskowin Creeks
- ODFW Western Oregon Rearing Project Barriers
- Clackamas county

Other pending tasks related to barrier inventory and prioritization:

- Complete migration of all FHD data to the NHD
- Ongoing QA / cleanup of inconsistencies between FHD and FPB data
- Additional mapping of finer resolution historical habitat distribution upstream of smaller dams and culverts
- Submit proposed edits to the NHD to support all FHD and FPB data
- Compare barriers against BPA and NOAA restoration databases and update data accordingly (similar to OWRI reconciliation)
- Enter data obtained from ODFW barrier data quality assurance review
- Complete barrier classification in relation to habitat distribution data
- Automate running network analysis from each barrier
- Determine severity of partial barriers and build into database
- Database Maintenance (working with data originators to keep data current)