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Klamath Basin Fish Screen Inventory,

Wood River Subbasin

Prepared for:

Oregon Department of Fish and Wildlife
Fish Passage and Screening Program
3604 Cherry St. N. E.
Salem, OR 97303-4924
Contract No. 63506656

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1.0 INTRODUCTION

Fish resources in Oregon have undergone decreases in numbers over the past 100 years or so. Decreases have been attributed to many causes, including urbanization, industrialization, over-harvest, and agricultural activities. Among the agricultural activities that have contributed to decreases in fish abundance is the continued use of water diversions that do not provide fish protection to keep fish from entering the diversion. Installation of fish protection for diversions is of paramount importance to minimize the adverse impact of unscreened diversions on fish numbers.

The State of Oregon through the Oregon Department of Fish and Wildlife (ODFW) predecessor agencies has implemented activities to protect fish resources since the 1800's. Since the early 1990s, ODFW has supported fish screening projects through a cost-share program. The cost-share program provides technical assistance and funding opportunities for landowners desiring to install fish screens at water diversions. For projects where funding assistance is not available or limited, the ODFW provides limited technical assistance and resource overview at no cost to the landowner. Projects that request funding or technical assistance are accepted as the landowner makes a formal request. A shortcoming of this approach is that there is no systematic evaluation of screening needs in the whole basin (or subbasin) so that a priority can be assigned to the landowner request for funding or technical assistance.

Assigning a priority to water diversions that need screens is a humbling experience. There are over 55,000 water diversions in Oregon, and most are unscreened. Before a priority can be assigned to a water diversion, certain technical characteristics need to be known about the diversion and the fish resources that may be affected by the diversion. The resource information is generally known, at least the basic information such as species of fish that may be in the vicinity of the water diversion. Other information regarding location of water diversion, amount of diversion, and landowner information resides in the water rights databases at the Oregon Water Resources Department (OWRD).

This project was undertaken as a "pilot project" to evaluate the feasibility of using available information from the OWRD to develop an inventory of diversion numbers and locations, flows diverted, and ownership. Then, the available database from OWRD would be evaluated based on site visits to gather additional information on location and characteristics of each diversion. Based on this information, a priority list of projects would be developed and funding sought to support fish screen construction.

The Wood River subbasin (Appendix A, Figure 1) was selected for the pilot study because it is a relatively small basin, the project team was familiar with the basin, and there are a number of diversions of various sizes, from less than 1 cfs up to 200 cfs. Depending on the success of the pilot project, the intent was to expand the project to other subbasins.

2.0 OBJECTIVES

The objectives of the project are to:

- Develop geographical information systems (GIS) base maps for the basin and the stream systems (Wood River, Sevenmile Creek and Canal, Fort Creek, Crooked Creek, Sun Creek, and Annie Creek).
- Compile information from the OWRD for a GIS database.
- Develop a map showing the streams and the location of diversions.
- Ground truth the OWRD database by collecting GPS locations in the field and comparing the results to the OWRD database.
- Compile the number of diversions by stream system and diversion size.
- Develop a strategy to estimate costs for providing screens to each diversion.
- Identify screen priorities for the Wood River subbasin.

3.0 DESCRIPTION OF WOOD RIVER BASIN

3.1 General

The Wood River subbasin is located in Klamath County, Oregon approximately 40 miles north of Klamath Falls (Appendix A, Figure 1). The subbasin is bounded on the west by the Cascade Mountain Range, on the north by Crater Lake, and on the east by Sun Mountain and other topographic features. Stream systems that originate in the mountainous areas drain to the low relief Wood River Valley that is approximately 4,000 feet mean sea level (msl); however several stream systems originate in the valley. Land ownership is Federal and/or State of Oregon outside of the Wood River Valley. Land in the valley is private ownership; however there is Federal land (Bureau of Land Management and Bureau of Reclamation) in the lower valley near Agency Lake.

The Wood River subbasin is sparsely populated. Most residents in the area are landowners that use the valley as spring, summer, and fall pasture for cattle production. Prior to the harsh winter months, cattle are sold or moved to other areas in Oregon, California, or other states and are virtually absent from the valley. The valley is not cultivated cropland, and the land is flood irrigated for meadow grasses that cattle graze.

Highway 62 is the primary access to the only community, Fort Klamath, and the only route from the south to Crater Lake approximately 20 miles to the north. There are other secondary roads that lead to Fort Klamath. The Fort Klamath community consists of approximately 100 people during irrigation season (April 1 to October 31) when most cattle production activities are occurring.

The main waterways in the subbasin are the Wood River and Sevenmile Creek/Canal (Appendix A, Figure 1). The Wood River has several tributaries including Fort Creek, Sun Creek, and Annie Creek. Crooked Creek likely was once a tributary, but presently it appears to flow into Wood River Marsh. All waterways eventually make their way to Agency Lake. Other

waterways that appear to be stream systems on USGS Quadrangle maps are actually irrigation canals for conveyance of diverted flows or for irrigation return flows (i.e., drainage ditches) that empty into the Wood River or Sevenmile Creek/Canal.

The presence of a unique system of irrigation canals and drainage ditches allows water use to be maximized and waste to be minimized especially in the lower Wood River and lower Sevenmile. The system of canals and ditches also provides habitat for fish at various times of the year, however the value of the canals and ditches for habitat and the fate of fish that enter the canals and ditches has not been documented.

3.2 Fish Resources and Distribution

Fish resources that are reported from the Wood River and Sevenmile Canal/ Creek are shown in Table 1. Species reported from Klamath Lake also are shown since the backwater from the Klamath/Agency Lakes enters Sevenmile Canal and the lower reaches of Wood River up to Crooked Creek. The relatively few species actually reported from Crooked, Fort, Annie, and Sun Creeks likely does not reflect the other species, such as sculpins, dace, and other species that likely are present in the system, but that have not been reported.

Three species of fish protected under the Federal Endangered Species Act are present in the Wood River system. The Lost River and Shortnose suckers are reported as well as the Bull Trout. Although Lost River and Shortnose suckers are not reported from Sevenmile Canal/Creek, they likely are present at least in the lower reaches where Agency Lake backwaters into Sevenmile Canal.

4.0 GIS ANALYSIS

4.1 Development of Base Maps

The construction of an accurate base map for the each stream and river is fundamental to an accurate interpretation of any spatial analysis done with GIS. A good base map enables the viewer, or analyst, to place features pertinent to the analysis in context with neighboring geographic features. Depiction of the local roads, hydrologic features, settlements, and PLSS data of Township/Range were considered pertinent for inclusion into the base map for the current study.

The projection/coordinate system adopted by the Oregon Geospatial Data Clearinghouse (OGDC) was selected for use in the current study. The parameters defining this system are given below (http://www.sscgis.state.or.us/data/format.html):

Lambert Conformal Conic
False Easing: 1,312,335.958 ft; False Northing: 0.0 ft
Central Meridian: -120.5° longitude
1st Std. Parallel/2nd Std. Parallel: 43° 00’ 0.000”/45° 30’ 0.000” N latitude
Latitude of Origin: 41° 45’ 0.000” N latitude
Linear Unit: 0.3048 (International feet)
Datum: NAD 1983
Spheroid: GRS 1980

Table 1. Fish Species Reported from the Wood River and Sevenmile Creek/Canal Drainage.

Species	Common Name	Klamath Lake	Wood River*	Crooked Creek*	Fort Creek	Annie Creek	Sun Creek	Sevenmile Creek/Canal
Perca flavescens	yellow perch	x	x					
Pimephales promelas	fathead minnow	x	x					
Lepomis gibbosus	pumpkinseed	x	x					
Ameiurus nebulosus	brown bullhead	x	x					
Rhinichthys osculus klamathensis	speckled dace	x	x	x				
Gila coerulea	blue chub	x	x					
Gila bicolor	tui chub	x	x					
Deltistes luxatus	Lost River sucker **(E)**	x	x					
Chasmistes brevirostris	shortnose sucker **(E)**	x	x					
Catostomus snyderi	Klamath largescale sucker	x						
	unidentified sucker			x				
Oncorhynchus mykiss	redband trout		x	x	x	x	x	x
Salmo trutta	brown trout		x	x	x	x	x	x
Salvelinus fontinalis	brook trout			x	x	x	x	x
Salvelinus confluentus	bull trout **(T)**						x	
Lampetra spp	unidentified lamprey	x	x	x				
Lampetra lethophaga	lamprey		x	x				
Cottus spp	unidentified sculpin		x	x				
Cottus tenuis	slender sculpin	x						
Cottus princeps	Klamath Lake sculpin	x						
Acipenser transmontanus	sturgeon	x						

*Note: The species reported from Klamath Lake also can be found in Wood River to the flooded confluence of Crooked Creek.
E: Species protected as Endangered under the Federal Endangered Species Act (ESA); T = Species protected as Threatened under the ESA.
Source: Information provided by William Tinniswood, Assistant District Fish Biologist, ODFW, Klamath Falls, Oregon. July 12, 2004.

Data used in construction and verification of the study's base map are identified below along with their individual sources:

Primary Data:

1. Roads – selected from Klamath County MIS road dataset (6/17/03).
2. Township/Range/Section – obtained from Oregon State GIS Service Center (http://www.sscgis.state.or.us/data/alphalist.html): PLSS (Public Land Survey System).
3. Parcel Data – parcel lots and owner data obtained from Klamath County MIS department (6/17/03).
4. Public ownership data obtained from Oregon State GIS Service Center: Land, Public Ownership.
5. Watershed delineation data obtained from Regional Ecosystem Office (http://www.sscgis.state.or.us/data/k100.html).
6. Stream data obtained from the U.S. Bureau of Land Management (http://www.or.blm.gov/gis/data/catalog/dataset.asp?cid=81; 8/22/2003).
7. Hydrologic features of Crater Lake, Agency Lake, Upper Klamath Lake dataset obtained from US Bureau of Reclamation.
8. Fort Klamath location obtained by screen digitizing location from USGS quadrangle map and reprojecting to OGDC projection using the NADCON transformation.

Verification Data:

1. Digital Raster Graphs (DRG) were obtained from the Regional Ecosystem office for each of nine USGS quadrangles found to encompass the Wood River watershed.
2. Digital Orthoquad (DOQ) data were obtained from the Klamath County MIS Department, circa 1994.

Verification of primary data was accomplished by reprojecting the datasets into UTM, NAD27 zone 10 for verification against USGS data as well as into the standard OGDC projection for verification against aerial photography. This process resulted in the graphic displayed in Figure 1 of this report (Appendix A).

4.2 GIS Methods/Difficulties Encountered for Identifying Points of Diversion

GIS data processing began by downloading POD data for the Klamath Basin from the OWRD website. There are basically two datasets available to the general public from this website (i.e., ftp://ftp.wrd.state.or.us/pub/water_right_data/kla/). One dataset provides GIS data in terms of either a shapefile or coverage format. In either of these formats a database is provided with a variety of information that is associated to each geographic feature that can be seen on a map display, in our case PODs. The structure of GIS data is such that the data associated with a feature are contained in unique records within the database so that there is a one-to-one correspondence between a feature and its associated information. Documentation regarding the contents of this database can be viewed at: ftp://www.wrd.state.or.us/pub/water_right_data/documentation/giswrdoc.pdf .

The second dataset provided by OWRD is entitled the Water Rights Information System (WRIS). This is a .dbf file that is essentially a table containing the information on PODs. Documentation regarding the contents of this database can be viewed at: ftp://www.wrd.state.or.us/pub/water_right_data/documentation/wrisdbfdoc.pdf.

Many of the problems encountered in this analysis stems from the fact that these two datasets, which are intended to provide identical information in differing formats, are in fact not identical. This leaves the analyst with the question of which dataset to believe. The following outlines the process used to determine those data that are identical in both datasets. The process also provides an error code that can be used to determine the nature of the misalignment between the datasets.

The following definitions will be used in the current document in order to distinguish between the two databases:

- Shp-dbf will refer to the database that is associated with the downloaded shapefile of PODs for the Klamath Basin. Note that the shapefile has a visual/geographic component thus enabling GIS analysis techniques to be employed.
- WRIS-dbf will refer to the WRIS database relevant to the Klamath Basin.

The PODs that are within the Wood River watershed were extracted from the POD shapefile using an outline of the 5th field Wood River watershed (HUC 1801020301) obtained from the Oregon Geospatial Data Clearinghouse (http://www.sscgis.state.or.us/data/alphalist.html). The following hydrologic features were extracted from the hydrological dataset obtained from the BLM's website (http://www.or.blm.gov/gis/data/catalog/dataset.asp?cid=81) and saved to a separate shapefile to serve as the project's base set of hydrologic features:

- Wood River
- Crooked Creek
- Fort Creek
- Annie Creek
- Sun Creek
- Seven Mile Creek and Sevenmile Canal

A preliminary examination of the Shp-dbf database indicated several inconsistencies between where the POD was physically located on the map and what stream/hydrologic feature it was associated with. This resulted in the following two basic error conditions:

1. The POD was located on a stream, but the stream in closest proximity does not correspond to the source specified in the shp-dbf database.
2. The shp-dbf database indicated that the POD should be associated with one of the above streams, but in fact none of the above mentioned streams were in close proximity to the POD.

In order to highlight these possible inconsistencies for later analysis, the PODs used in the current analysis were selected on the following conditions:

1. Based on their spatial proximity to each of the above hydrologic features.
2. Based on an indication in the database that their source was one of the above hydrologic features.

Hence, all PODs within 1,200 feet of one of the above hydrologic features were selected. This selection was then added to the selection of all PODs having one of the above hydrologic features identified as its source, as specified within the shp-dbf. The resulting selection served as the base set of PODs to be used in the assessment from the original shapefile dataset.

Each POD is identified by certificate, permit, and POD numbers. The combination of these alphanumeric codes provides a unique code (i.e., CPPN) with which an individual POD can be identified. Using the set of CPPN codes identified in the shapefile base dataset, the WRIS dataset was searched for a set of matching CPPN codes, thus providing the base set of PODs to be used in the assessment from the original WRIS dataset.

The data for each POD within the shapefile was then examined and compared to the corresponding data in the WRIS-dbf using the CPPN as the identifier. The following set of error codes was generated and stored with each POD within the shapefile:

- 25 – POD located on/near stream, but the location is not consistent with the source specified within the shp-dbf
- 50 – POD not located on/near stream, but shp-dbf indicates that it should be
- 1xx – POD located on/near stream, but not consistent with source named in WRIS-dbf
- 2xx – shp-dbf contains data inconsistent with the same data in WRIS-dbf
- 3xx – CPPN entry non-existent in WRIS-dbf
- 1xxx – multiple identical CPPN entries in shapefile, but data in shp-dbf show differences between entries
- 2xxx – multiple identical CPPN entries in WRIS-dbf, but data in WRIS-dbf show differences between entries
- 3xxx – multiple identical CPPN entries in both shp-dbf and WRIS-dbf, but data in databases show differences between entries
- 4xxx – duplicate data in shapefile.
- 1xxxx – multiple identical CPPN entries. Shp-dbf data identical, but POD locations for different entries do not coincide

Examples of error codes:

- 200 – there is a mismatch between the data in the shp-dbf and the WRIS-dbf
- 1200 – there were multiple entries in the shapefile with the same CPPN, although there were differences between the entries for at least one attribute (e.g., rate priority, status, category). Also, there is a mismatch in the data between the shp-dbf and WRIS-dbf for at least one attribute.

- 4000 – there appears to be a total duplication of data. Such entries should not be included in any analysis since the current record of data is a duplicate of another record with the same CPPN.

Table 2 is a summary of the various types of errors encountered. In summary, out of the 244 entries of data in the shp-dbf on PODs within the Wood River watershed, only 90 of these entries were found to be identical with the WRIS-dbf database. The availability of these two datasets to the public however implies that the same information is available in either format. The results of this study indicate that this is an incorrect assumption.

Table 2. Occurrences of POD Error Codes Encountered.

POD Error	Occurrences
0	90
50	4
125	5
200	10
250	2
1000	1
1125	2
1200	16
1250	2
2000	3
2200	1

POD Error	Occurrences
3000	1
3200	5
4000	65
10000	26
10050	2
10125	1
10200	3
10225	1
10350	1
13200	1
13225	2

As indicated in Table 2, there are many types of data errors present in both databases. The GIS analysis provided by the current study provided a valuable means for examining the agreement, or lack thereof, between the datasets. These results indicated several instances in which the physical location of the POD did not correspond with the location specified within the database. Such an assessment would not have been possible without the use of GIS. The results of this study also indicate that even a simple structured query language (SQL) query to determine the amount of water withdrawn from any given stream in the current study would yield different results depending on which database was accessed.

5.0 FIELD VERIFICATION OF OWRD DATA

5.1 Methods

The information compiled from the OWRD database (Appendix B) was verified by field visits to the Wood River subbasin. Prior to the field visit, 7 ½ minute USGS Quadrangle maps for the area were used to prepare a field map to locate water diversion locations based on the OWRD database that listed township, section, and range. In addition, prior knowledge by the project team also was used to tentatively locate PODs on the maps. For the field records, separate notebooks were prepared for each stream with predetermined information that was to be completed during the field visit.

The field visits consisted of attempting to locate PODs based on tentative locations shown on the maps. For the Wood River and Sevenmile Canal, a canoe was used to access points of diversion. For Annie Creek, Sun Creek, Fort Creek, Crooked Creek, and Sevenmile Creek, access was by walking to the point of diversion from the nearest public road.

Once the location where the point of diversion was anticipated to be located was reached, a determination was made as to the accuracy of the location on the field map. The information compiled for each point of diversion that was located consisted of the following:

- GPS location (latitude and longitude)
- Presence or absence of a headgate control
- Presence or absence of a fish screen
- Photographs of the diversion recorded
- Other comments that might help explain the field situation

If a POD was not found or several were found in the same vicinity, a notation was made for each stream.

5.2 Correlation of OWRD Database Information with Field Results

Using the above procedure the 'best-fit' correlation was found between the OWRD database and the GPS field data (Table 3). The notation used for each entry in the GPS # in Table 3 uses a letter designation for each stream as well as a longitudinal distance indicator. The following provides the code for the letter designations:

WR:	Wood River
CC:	Crooked Creek
FC:	Fort Creek
AC:	Annie Creek
SC:	Sun Creek
SVNC:	Sevenmile Creek/Canal

The longitudinal distance indicator is given in terms of hundredths of miles from the mouth of the creek or river. Hence, the entry AC172 represents a photo point taken along Annie Creek, 1.72 miles from its mouth.

The codes used for the CCG index use the same letter designations for each creek as the GPS #, but the numeric entry represents the ordinal value, or POD count, starting from the mouth of the stream.

Table 3. Correlations between the OWRD Database (CCG Index) and GPS Field Data (GPS #).

	GPS #	CCG Index	Use	Rate (cfs)
Wood River	WR460	WR1	IR	22.9800
	WR814	WR2	IS	0.4700
	WR814	WR3	IS	71.3100
	WR814	WR4	IR	6.5300
	WR814	WR5	IR	200.5000
		WR6	IR	8.2600
	WR1231	WR7	IR	5.2520
	WR1508			
	WR1520			
		WR8	RW	0.4444
	WR1604			
	WR1792	WR9	IR	0.2400
	WR1792	WR10	I*	12.8700
	WR1792	WR11	IR	0.7500
	WR1792	WR12	I*	1.3300
	WR1792	WR13	IR	3.0000
	WR1792	WR14	IR	0.5100
	WR1839	WR15	IS	0.0300
	WR1839	WR16	IR	26.8700
	WR1839	WR17	IS	3.1700
	WR1839	WR18	IS	3.2000
	WR1839	WR19	IS	3.1700
		WR20	IR	0.0400

	GPS #	CCG Index	Use	Rate (cfs)
Crooked Creek		CC1	FW	8.0000
	CC153			
	CC309	CC2	IR	0.0600
	CC309	CC3	IS	14.4000
	CC309	CC4	IS	14.4000
	CC633	CC5	IS	6.1200
	CC633	CC6	RW	1.0000

	GPS #	CCG Index	Use	Rate (cfs)
Fort Creek		FC1	IR	0.3400
	FC217	FC2	IS	1.0300
	FC217	FC3	IR	0.4800
	FC217	FC4	IR	0.3400
	FC300	FC5	IR	4.3600
	FC300	FC6	IR	0.9300
	FC300	FC7	IR	0.6900
	FC300	FC8	FI	44.7000

Table 3. Continued.

	GPS #	CCG Index	Use	Rate(cfs)
Annie Creek	AC60	AC1	FI	9.0000
	AC60	AC2	WI	9.0000
		AC3	I*	1.5600
	AC172	AC4	I*	0.2500
	AC172	AC5	I*	0.5000
	AC172	AC6	I*	0.8300
	AC172	AC7	IR	0.3500
	AC172	AC8	I*	0.6300
	AC172	AC9	I*	1.0000
	AC172	AC10	IR	0.4620
	AC316	AC11	I*	3.9400
	AC324			
	AC364	AC12	I*	2.0000
	AC364	AC13	I*	2.0000
	AC364	AC14	IR	0.7500
	AC364	AC15	I*	1.2500
	AC364	AC16	I*	3.1720
	AC364	AC17	I*	0.8500
	AC378	AC18	I*	0.1500
	AC378	AC19	I*	3.2600
	AC433	AC20	IR	3.5000
	AC433	AC21	I*	2.3250
	AC492	AC22	IR	2.7400
	AC492	AC23	IR	1.8500
	AC492	AC24	IR	0.3600
	AC492	AC25	IC	2.8100
	AC492	AC26	IR	1.8500
	AC492	AC27	IR	4.2000
	AC492	AC28	IL	0.3600
	AC492	AC29	IR	1.7400
	AC492	AC30	IR	0.2600
	AC571	AC31	I*	1.5750
	AC571	AC32	RW	0.4444

	GPS #	CCG Index	Use	Rate(cfs)
Sun Creek	SC48	SC1	I*	10.6980
	SC48	SC2	I*	2.6240
	SC48	SC3	I*	4.3060
	SC84			
	SC116			
		SC4	I*	2.3940

	GPS #	CCG Index	Use	Rate(cfs)
Sevenmile Creek/Canal	SVNC005		IR	100.0000
	SVNC197			
	SVNC235		FW	50.0000
	SVNC318			
	SVNC406			
	SVNC539			
	SVNC604			
	SVNC614	SVNC1	IR	43.2200
	SVNC853	SVNC2	IR	2.0000
	SVNC853	SVNC3	IR	5.7020
	SVNC1060	SVNC4	IR	5.1020
	SVNC1060	SVNC5	IR	1.5860
	SVNC1060	SVNC6	I*	2.8160
	SVNC1060	SVNC7	IR	3.1720
	SVNC1060	SVNC8	IR	0.2500
	SVNC1351	SVNC9	I*	3.3460
	SVNC1351	SVNC10	IL	3.0000
	SVNC1351	SVNC11	IL	3.1440
	SVNC1351	SVNC12	IR	3.6080
	SVNC1351	SVNC13	IR	7.2000
	SVNC1351	SVNC14	IL	3.1440
	SVNC1553	SVNC15	IR	3.1720
	SVNC1553	SVNC16	IR	7.9560
	SVNC1553	SVNC17	IR	0.8400
	SVNC1553	SVNC18	IR	4.7200
	SVNC1553	SVNC19	IR	1.0000

5.3 Difficulties Encountered in the Field

There were several difficulties encountered in the field. These were the ability to access the sites and identification of the specific diversion once located. In some instances the diversions could not be located, while in others there were several apparent diversions. In the situation where several PODs were clustered, the OWRD database was not adequate to separate the diversions to determine exactly which one we were reviewing in the field.

The following two types of errors were encountered in the process of correlating the location of each POD from field GPS measurements with the location of the POD as specified in the OWRD database:

- a POD was located on a stream in a location that had no reasonable correspondence with any entry in the OWRD database. These situations were left "blank" in the CCG Index field in the above table.
- no POD was found within a reasonable distance up/downstream of an expected POD location as given by the OWRD database. These situations were left "blank" in the GPS row in the above table.

6.0 SUMMARY OF WATER DIVERSION DATA

6.1 Base Maps

The base maps for each waterway are shown in Appendix A. Figures 2 through 7 illustrate the location of diversions based on the OWRD database as well as GPS locations for each of the waterways evaluated. Figures 2 through 6 illustrate diversion locations for the Wood River and each of its tributaries. Figure 7 illustrates diversion locations for Sevenmile Canal/Creek. Appendix C contains photographs taken at each diversion location.

6.2 Water Diversions by Water Course

A total of 91 diversions were evaluated (Appendix D, Table 1). Seventy-nine of the diversions (87%) were 10 cfs or less; 4 (4%) diversions were between 10.1 and 20 cfs; 5 (5%) diversions were between 20 and 70 cfs; and 3 diversions (3%) were above 70 cfs (Table 1). The amount of water diverted (cfs) for each diversion in each watercourse is shown in Appendix D, Tables 2 through 7. The distribution of diversions by water course is as follows:

Water Course	Number	Percent Contribution
Wood River	20	22
Crooked Creek	6	7
Fort Creek	8	9
Annie Creek	32	35
Sun Creek	4	4
Sevenmile Creek/Canal	21	23
Total	**91**	**100%**

Water rights information for two diversions on Sevenmile Canal could not be confirmed by the OWRD database evaluation. These diversions were for the Bureau of Land Management diversion at approximately SVNC235 (approximately 50 cfs) and the Bureau of Reclamation diversion at SVNC005 (approximately 100 cfs). Discussions with both agencies and field verification indicate that the diversions exist.

6.3 Characteristics of Each Diversion

The characteristics of each diversion (Appendix E) was noted in the field by observing the following:

- Pump or gravity diversion
- Presence of a headgate
- Presence of a fish screen
- Type of screen
- Does screen meet criteria for screening

Appendix E, Table 1 summarizes the diversion information based on the field evaluation. Most diversions were gravity diversions rather than pump diversions and most have a headgate of some sort. Headgates of some design were usually present or could be installed as needed by the landowner to distribute water.

Most diversions were unscreened. In the field evaluation, many diversions could not be identified with a specific water right in the OWRD database. This could have been a result of several either movement of the POD, abandonment of water rights, or a combining of water rights at a single POD. The relatively high number of screened diversions shown in Table 1 is a result of several small diversions having a single POD.

Appendix E, Tables 2 through 5 summarize the information for each diversion on the Wood River and its tributaries. Appendix E, Table 6 summarizes the information for Sevenmile Creek/Canal. A common GPS point for several diversions indicates that the diversions could not be separated in the field, although the OWRD database indicates that there are several water rights associated with that geographical location.

7.0 FISH SCREEN PRIORITIES

7.1 Basis for Assigning Priority to Screen Diversions

The basis for assigning screening priorities is based on:

- size of diversion
- location of diversion within the system
- species present in the system.

For purposes of this evaluation, diversions that were located in the system where species listed under the Endangered Species Act were present should have top priority for screening. For example, Bull Trout are present in the Wood River system, but are not reported from the Sevenmile Canal/Creek system. Fish protection should be given priority in the Wood River system rather than the Sevenmile Canal/Creek system, although fish screening for the Sevenmile Canal/Creek system should also be considered as opportunities become available especially at the drainage ditches that allow water to flow from the Sevenmile Canal to other areas (i.e., West Canal).

The shortcoming in this approach for assigning priorities is that there is only rudimentary information from fish surveys conducted in the Wood River subbasin, thus the information on distribution and abundance of fish species is sparse. Additional surveys in the mainstem of Sevenmile Creek/Canal and Wood River and their tributaries as well as the drainage ditches would add considerable knowledge on distribution and abundance of various species of fish.

7.2 Priority List

Although all diversions should be screened to prevent fish loss, the priority for fish screens and re-evaluation of existing screens should focus on certain diversions in the Wood River and Sevenmile Canal/Creek complex to minimize fish loss to irrigation systems.

7.2.1 Wood River Diversions

1. Wood River (Melhase), WR9 –WR14 – See photographs in Appendix C for WR9 – WR14. These diversions are already screened, however the screen should be inspected to evaluate its effectiveness and any maintenance issues.

2. Wood River Pump Ditch, WR15-WR19 – See photographs in Appendix C for WR15 – WR19. These diversions are already Screened, however the screen should be inspected to evaluate its effectiveness and maintenance issues.

3. Wood River, WR2 – This diversion is on the east side of the Wood River and is screened and operated by a solar panel. The screen should be inspected to evaluate its effectiveness and maintenance issues.

4. Wood River, WR3, WR4, and WR5 – The "Hawkins diversions" on the west side of the Wood River are not screened and divert a total of approximately 280 cfs (Appendix E, Table 2). These 3 diversions have a common diversion point from the Wood River provided by a low dam (with a walkway) on the Wood River. Although the diversions have a common diversion point, the shallow area, dense growth of rooted aquatic vegetation, low gradient, and differential elevations for the diversion canals are impediments to combining the flows and providing one screen and fish bypass system.

One of the diversions, the Wood River Canal (WR5), diverts approximately 200 cfs and parallels the Wood River. This diversion may be amenable to a fish screen and fish return to the Wood River. The other two diversions (approximately 71 and 7 cfs) divert flows in a westerly direction and would be more difficult to screen and provide fish return flows to the Wood River.

7.2.2 Sun Creek Diversions

All Sun Creek diversions should have a high priority for fish screens because of the presence of bull trout in the upper watershed of the Wood River subbasin.

7.2.3 Crooked Creek Diversions

CC3, 4, and 10 should have a high priority because of the amount of diverted water (14.4, 14.4, and 10.0 cfs, respectively).

7.2.4 Fort Creek Diversions

1. FC6 – This site is the old Anadromous fish hatchery. A new screen system has been installed since the field survey was conducted. Other sites on Fort Creek are of lesser priority, however there is one diversion (FC7) that is 4.36 cfs and should have a high priority for screening.

7.2.5 Annie Creek Diversions

1. AC1-AC2 – The siphon in Annie Creek (see photograph in Appendix C) should have a high priority for screening because of the location in the upper watershed in the vicinity of the presence of bull trout.

7.2.6 Sevenmile Canal/Sevenmile Creek Diversions

The two largest diversions on Sevenmile Canal are those owned by the Bureau of Reclamation (SVNC005) and Bureau of Land Management (SNVC235). Both diversions are screened. Other drainage ditches (not irrigation diversions), for example the North Canal/Ditch, Central Canal, and West Canal, potentially divert fish away from the Sevenmile system.

1. West Canal (SVNC1) – This diversion appears to be a direct diversion of water from Sevenmile Creek/Canal to the West Canal, while the North Canal/Ditch and Central Canal are drainages ditches for return flows. All three systems should be considered for screening or evaluated to determine if they should be left unscreened to provide fish habitat at various times of the year.

2. SVNC4 –SVNC8 – This diversion at SVNC4-SVNC8 where the creek is "gated" while the creek flow is diverted through culverts should be evaluated to determine if this area is a barrier to fish migration, and to determine if the existing fish screen can be rehabilitated.

7.3 Recommendation for Additional Evaluations of Diversion Sites

Immediate evaluations are recommended for the three Hawkin's diversions on the Wood River because of the size of the diversions. The three Hawkins diversions on the Wood River should be further evaluated to determine if the diversions can be combined and one screen and fish bypass system installed. Based on the field review, a rotary drum screen and/or a fixed panel screen may be the best solution at this location. Electrical power is not available at the site, however solar panels could likely provide power, if needed.

A fixed panel screen (vertical or horizontal plate) may be appropriate for the Wood River Canal (WR5). The elevation drop from the upstream to the downstream side of the canal culverts appears to provide a high velocity cleaning function, and a fish return bypass system to the Wood River likely can be accommodated.

A rotary drum screen may be most appropriate for the WR3 and WR4 diversions, however a fish return to the Wood River may not be possible because of the elevation differences in the downstream outfall of the diversion and the Wood River. If a fish return bypass system cannot be designed, the screen should be designed with very low approach velocities.

The following tasks are recommended for these diversions:

1. Topographic survey from 200 feet upstream and 300 feet downstream of the diversion structure on the Wood River, and for approximately 300 feet west of the Wood River to include the existing three diversions.
2. Survey should be focused to determine if the diversions can be combined with one screen and fish return flows emptied to the Wood River.
3. Determine if the offchannel area where the three diversions are located needs to be dredged to remove sediments and provide a deeper area to minimize growth of aquatic plants that may interfere with screen operation.

8.0 RECOMMENDATIONS FOR USE OF OWRD DATABASE

8.1 Value of OWRD Database

In its intended state the OWRD database should be a very useful database. The intended dataset could be used to either determine the proximity of diversions to any given set of features, e.g., via a GIS interrogation of the shp-dbf dataset or to perform a standard attribute SQL query using the WRIS-dbf dataset. Although the GIS format offers distinct advantages for managing diversion allocations, both structures would provide significant value to the user.

The current study has found, however, a wide variety of errors in the publicly available datasets. A significant product of the current study is a specific classification of the variety of errors found within the dataset. Although these errors currently place severe limitations on the usefulness of the datasets for conducting thorough quantitative studies, many of the errors may appear to have a straightforward solution.

For example, the current study indicates that 65 of the POD entries within the shp-dbf database have duplicate database entries. This single error category represents 42% of the PODs in question for the current project area. Since the current study has tagged which PODs have this type of error, a solution for entries with this error type would appear to be straightforward.

Another 26 entries (18%) within the shp-dbf database not only have multiple database entries for the same POD, the current study has found that multiple locations have been assigned to the same POD as well. Again, since the current study has tagged which PODs have this type of error, a solution should again be straightforward.

Therefore although the value of the OWRD database in its current form is somewhat dubious, the current study has found that 60% of the errors may have a straightforward solution. Solutions applied to the above mentioned error types would dramatically enhance the usefulness of the OWRD database.

8.2 Procedure for use of OWRD database in Future Projects

Based on the randomness in the errors found within the current study, it is likely that errors of a similar nature are likely to be found elsewhere within the OWRD database. Based on this assumption, we propose that future projects be linked more closely with OWRD database personnel. An alternative is to only use the OWRD database as an indication of where projects are located and to provide actual location information from field siting with GPS measurements.

It also is proposed that future projects be started with the assumption that a similar set of errors to those found in the current study would be found for any other geographical region contained within the OWRD database. As such, a computer algorithm would be developed and applied to the pertinent dataset in order to interrogate the veracity of the dataset. This algorithm would use a unified set of error codes (possibly similar to those outlined above, but in any case the error codes would be arrived at in concert with OWRD database personnel). The findings would then be communicated to OWRD personnel in a manner previously agreed upon. OWRD personnel would then correct the dataset until a desired accuracy threshold is achieved. This threshold would be defined internally by the OWRD and would be subject to personnel and resource availability as well as any internal priority that may have been set for the project. Having met the accuracy threshold, quantitative assessments and field investigations as performed in the current study would then be carried out. PODs whose characteristics and/or data are still in doubt would be tagged for later review.

A cooperative engagement between the current project staff and OWRD personnel would therefore yield a quantitative assessment whose limits of accuracy could be well defined and easily modified as time evolves.

9.0 DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE COSTS

The ability to provide fish screens at all diversions in the Wood River subbasin will depend on the availability of funds from landowners and public (federal, state, and local jurisdictions) and private sources. An estimate of costs to provide fish screens is made to determine the magnitude of funding that will be needed and to provide a basis to request funding.

The basis for costs for design, construction, screen materials, operation, and maintenance is shown in Appendix F, Table 1. A summary cost for each waterway is shown in Table 2, with Tables 6 through 11 showing additional details. The estimated costs for both the basis of costs and the summaries by waterway are "first cut" and somewhat arbitrary estimates that will need to be refined.

Appendix A

Figures

Appendix B

Screen Inventory Data

Appendix C

Diversion Photographs

Appendix D

Summary of Diversion Rate (cfs) for
Selected Water Courses in Wood River Subbasin

Appendix E

Diversion Characteristics

Appendix F

Design, Construction, Operation, and Maintenance Costs for Fish Screens in Wood River Subbasin