Watershed Analysis Framework

1. Introduction

This paper discusses the process used to create two maps that the BLM is sharing during our Preliminary Alternatives Outreach Period (available online):

- Watershed Aquatic Resource Values in BSWI Map
- Watershed Condition Indicator Rating for BSWI Map

The BLM welcomes your feedback during this outreach period regarding the use of this process in developing management alternatives for the future Bering Sea-Western Interior Draft Resource Management Plan/Environmental Impact Statement (BSWI RMP/EIS).

BLM Manual H-1601-1 provides guidance on Land Use Planning, including what types of resource decisions that should be made at the Land Use Plan (LUP) level. For fish and wildlife resources the manual provides the following required LUP decisions:

- Designate priority species and habitats,
- Identify desired outcomes using BLM Strategic Plans, State Plans, and other similar sources,
- Identify desired habitat conditions, and
- Identify actions and areawide use restrictions needed to achieve desired population and habitat conditions while maintaining a thriving natural ecological balance and multiple-use relationships.

To meet these plan requirements for aquatic resources, BLM took a systematic approach which included:

- Identifying priority fish species (Section 2)
- Identifying priority habitats (Section 3)
- Determining watersheds that function at risk (Section 4)
- Prioritizing management of watersheds that provide for priority fish species and aquatic habitats in the development of alternatives (Sections 5 and 6)

This was done through the analysis and modeling of existing Geographic Information System (GIS) information as described below.

2. Priority Fish Species

To identify priority species, BLM fish biologists considered fish species that are important for subsistence or recreation within the planning areas (Table 1).

Table 1. Draft List of Priority Fish Species

Common Name	Scientific Name	Priority Status
Chinook salmon	*Oncorhynchus tshawytscha*	Subsistence, recreation
Chum salmon	*Oncorhynchus keta*	Subsistence
Coho salmon	*Oncorhynchus kisutch*	Subsistence, recreation
Arctic grayling	*Thymallus arcticus*	Subsistence, recreation
Broad whitefish	*Coregonus nasus*	Subsistence
Humpback whitefish	*Coregonus pidschian*	Subsistence
Round Whitefish	*Prosopium cylindraceum*	Subsistence
Whitefish	Coregoninae spp.	Subsistence
Least cisco	*Coregonus sardinella*	Subsistence
Sheefish	*Stenodus leucichthys*	Subsistence, recreation
Northern pike	*Esox lucius*	Subsistence, recreation
Burbot	*Lota lota*	Subsistence, recreation
Alaska Brook Lamprey	*Lampetra alaskense*	BLM sensitive

3. Priority Habitats

To identify priority habitats and conditions across the vast planning areas, the BLM utilized a landscape level approach to evaluating Aquatic Resource Values, Watershed Conditions, and Watershed Vulnerability using GIS technologies. This approach was adapted from one that was used in the Eastern Interior RMP process, as well as from guidance in the U.S. Forest Service Watershed Condition Framework (FS-977) manual and Trout Unlimited' s Conservation Success Index (Williams et al. 2007). One of the key policy considerations in the use of a landscape approach to identify priority habitats, as outlined in BLM Instruction Memorandum (IM) 2009-141. This policy outlines BLM's commitment to the National Fish Habitat Action Plan and establishes four goals:

1. Protect and maintain intact and healthy aquatic systems.
2. Prevent further degradation of fish habitats that have been adversely affected.
3. Reverse declines in the quality and quantity of aquatic habitats to improve the overall health of fish and other aquatic organisms.
4. Increase the quality and quantity of fish habitats that support a broad natural diversity of fish and other aquatic species.

This planning approach is consistent with the National Fish Habitat Action Plan goals and provides managers and the public with a clear understanding of fisheries resource values at the watershed scale and their spatial arrangement within the planning area.

4. Watershed Process

The first step in the process was the identification of all sixth level (12-digit) Hydrologic Unit Code (HUC) watersheds that contained BLM-managed lands within the Planning Areas. The BSWI planning area contains 733 watersheds that meet the defined criteria. These watersheds were assessed using several GIS models.

4.1 Watershed Condition Model

The BLM-Alaska fisheries staff worked with GIS analysts to create a spatial model to evaluate these watersheds based on water quality conditions, aquatic and terrestrial habitat conditions, aquatic species diversity, riparian function, soil conditions, and invasive species presence/absence. This spatial model categorized the 733 watersheds in the BSWI planning area into two primary groups; Conservation and Restoration.

4.1.1 Conservation Watersheds

These watersheds have processes and functions that occur in a relatively undisturbed and natural landscape setting. Hydrologic function, such as sediment amounts and stream flow regimes resulting from disturbance, are within a natural range of frequency, duration, and intensity. Waters are meeting designated or existing beneficial uses. Land uses and human activities do not strongly influence aquatic and hydrologic functions, as indicated by low road density and few stream crossings. Based on these criteria, 714 watersheds were placed in this category.

Management strategies in these watersheds would emphasize natural disturbance regimes as the primary drivers for resource condition change, recognizing that active management may be required to conserve physical and biological processes and patterns. For example, road and trail maintenance to minimize erosion and the resulting sediment additions to nearby streams and waterbodies is essential within conservation watersheds.

4.1.2 Restoration Watersheds

These watersheds are those where biological and physical processes and functions do not reflect natural conditions because of past and long-term human caused land disturbances. The common effects of these disturbances are a long-term (decades) increase of sediment deposition in streams, loss of large woody debris recruitment to stream channels, and abnormal hydrologic patterns (water flows). Additive impacts from human disturbances and periodic natural events, such as large wildland fires, landslides, and floods, exacerbate abnormal watershed and biological conditions. Based on these criteria, 19 watersheds were placed in this category.

Active management will generally be required to restore the physical and biological function to their natural range of frequency, duration, and intensity. Identifying and assessing the impacts on habitat will allow managers to focus restoration efforts in the most effective manner to achieve hydrologic and biological recovery. The fisheries staff will need to review the restoration

watersheds and verify that any restoration needs are on BLM-managed lands before finalizing the results of the model.

4.2 Watershed Aquatic Resource Value Model

To identify the highest resource value aquatic habitats for conservation and restoration, a priority ranking system was developed using a combination of automated GIS modeling and professional judgment. Priority ranking for each conservation or restoration watershed was based on a variety of factors. Primary issues considered in ranking status were priority fish species presence (diversity), habitat conditions, and productivity. Table 2 outlines these ranking criteria and associated point system.

Table 2. Rank Criteria and Scoring Used to Identify Aquatic Resource Values.

Value	Definition	Score
ESA Aquatic Resources	Federally listed aquatic species are present	3 Points
Essential Fish Habitat (EFH) Present	ADF&G Anadromous Waters Catalog (AWC) GIS data served as the basis for determining if anadromous species occur in the watershed.	2 Points
Fish Species Diversity	Based on reports and/or professional knowledge, determine the number of fish species occurring in the watershed.	1-2 Species = 1 Point 3-4 Species = 2 Points 5-6 Species = 3 Points 7-8 Species = 4 Points > 9 Species = 5 Points
Non-Salmon Anadromous Species Present	Using the AWC GIS data select watersheds that contain non-salmon species (whitefish, lamprey, etc).	1 Point
Unique or Rare Fishery Resource or Habitat (incl. BLM SSS/Watch sp.)	All known spawning areas for priority species based on the AWC GIS data and professional judgment.	5 + 5 Points

Following the evaluation of the 733 sixth level HUC watersheds, the numeric scores were summed for each watershed and basic statistics were computed within the BSWI planning area (Table 3). These results may also be examined at the 5th level HUC since they encompass 5-7 sixth level HUCs and may offset the aspects of the model which are skewed toward larger rivers while undervaluing headwater areas that are often equally important.

Table 3. Numeric Watershed Scores for the BSWI Planning Area.

Planning Area	# Watersheds[1]	Min Score	Max Score	Mean Score	Standard Deviation
BSWI	733	0	19	6.79	5.07

A conceptual framework was developed for the BSWI planning area to determine Aquatic Resource Value categories at the watershed level (Table 4).

Table 4. Aquatic Resource Watershed Value Categories for the BSWI Planning Area.

Planning Area	Low (mean - 0.5 SD)	Medium (mean)	Medium-High (mean + 0.5 SD)	High (mean +1.0 SD)	Very High (Mean + 2 SD)
BSWI	<4.25	>4.25-9.33	>9.33-11.87	>11.87-16.95	>16.95

The highest scoring watersheds were reviewed by fisheries staff and recommended for consideration as Riparian Conservation Areas or High Priority Restoration watersheds.

4.2.1 Riparian Conservation Areas

Riparian Conservation Areas (RCAs) are specific conservation watersheds that contain the highest fisheries and riparian resource values within the planning area. In these watersheds, riparian-dependent resources receive primary emphasis and management activities are subject to specific required operating procedures that limit impacts to riparian and aquatic resources. These watersheds are designed to be managed using a variety of techniques which may be essential to achieving or maintaining desired riparian and aquatic conditions.

4.2.2 High Priority Restoration Watersheds

These watersheds are priority areas for active restoration practices. In these areas, management activities will be designed to accelerate the development of self-sustaining, ecologically healthy riparian and aquatic ecosystems.

5. Aquatic Resource Value Model Results & Alternative Formulation

Based on the conceptual framework outlined in Table 4 , the number of watersheds in the BSWI planning area are shown below:

Table 5. Number of Watersheds in the BSWI Planning Area

Planning Area	Low (# of sheds)	Medium (# of sheds)	Medium-High (# of sheds)	High	Very High
BSWI	314	146	120	128	25

Based on this information, BLM could develop a range of alternatives for determining Riparian Conservation Areas or High Priority Restoration watersheds. For example, one alternative could include only those watersheds that scored at the high or very high level, whereas another alternative could include watersheds that scored at the medium-high level. Currently, for the BLM's range of alternatives, the BSWI RMP Team is considering watershedscoring and delineation of RCAs as follows:

Alternative: High to Very High = RCA (20% of watersheds in BSWI planning area)

Alternative: Medium-High, High, Very High = RCA (37% of watersheds in BSWI planning area)

The fisheries staff will need to review watersheds scoring greater than medium-high to verify that BLM-managed lands occur along waters with elevated aquatic resource values.

6. Watershed Vulnerability Model

The last model integrates spatial data related to projected climate change (permafrost melt, vegetation community shifts, relative vegetation flammability increases, etc.) as well as non-natural influences (land stewardship protections, development potential, etc.) to predict overall watershed vulnerability. This model is based in large part on Trout Unlimited's Conservation Success Index (Williams et al. 2007). This GIS model is still under development and may be split to separate climate and land use related drivers of change.

Initial results highlight watersheds that may experience greater levels of change over time. It is anticipated that the vulnerability results could be overlapped with aquatic resource value scores for the watersheds and provide significant insight into future management needs and the identification of watersheds needing enhanced protections as part of a climate adaptation strategy in the land use plan.

7. References

Williams, J. E., A. L. Hank, N. G. Gillespie, and W. T. Colyer. (2007) The conservation success index: synthesizing and communicating salmonid condition and management needs. Fisheries 32:477-492.

U.S. Department of Agriculture (USDA) Forest Service (2011). Watershed Condition Framework (FS-977). Washington, DC: U.S. Department of Agriculture, Forest Service, Watershed, Fish, Wildlife, Air, and Rare Plants Program.