Columbia River Instream Atlas Project

Washington Department of Fish and Wildlife

Final Report

Ecology Contract C1000090 - WDFW Contract 09-1471
Ecology Publication Number: 11-12-015

November 2011

WDFW CRIA Team:
Teresa Scott (Habitat Water Resources Policy Coordinator)
Jonathan Kohr (Habitat Water Science Team)
Dayv Lowry (Fish Science; Habitat Science)
Andrew Weiss (Fish Science)
Aaron Bosworth (King County District Fish Biologist)
Jim Cummins (Yakima District Fish Biologist)
Dale Gombert (Fish Science)
Paul La Riviere (Habitat Water Science Team)
Peggy Miller (Habitat Major Projects)
Brianna Murphy (Fish Science)

Acknowledgements:
The CRIA Team thanks Hal Beecher, Perry Harvester, and Bob Vadas for their ideas and support throughout project development. Thanks also go to Alex Conley, Carolyn Comeau, Dan Haller, and Rick Roeder for reviewing results with team members and providing comments.

Recommended Citation:
Scott, T., Kohr, J., Lowry, D., Weiss, A., Bosworth, A., Cummins, J., Gombert, D., La Riviere, P., Miller, P., and Murphy, B (2011) Columbia River Instream Atlas Project Final Report. Washington Department of Fish and Wildlife. Olympia, Washington. Ecology Publication No. 11-12-015. 38 pp. plus 7 appendices.

Funding provided by Ecology Office of Columbia River as part of the 2011 Columbia Basin Long-term Water Supply and Demand Forecast

Executive Summary

The Columbia River Instream Atlas (CRIA) is a compilation of existing data products and best professional knowledge that provides tools (workbooks, maps, reports, GIS data) to aid in prioritizing stream reaches for flow restoration and augmentation. CRIA provides detailed information for 189 stream reaches in eight fish- and flow-critical watersheds in Eastern Washington: Okanogan, Methow, Wenatchee, Upper Yakima, Naches, Lower Yakima, Walla Walla, and Middle Snake Rivers.

As directed in 90.90 RCW, the Washington Department of Ecology Office of Columbia River (OCR) is developing a 2011 Columbia Basin Long-term Water Supply and Demand Forecast that includes information developed through CRIA. OCR will also use CRIA to aid project funding decisions and water rights determinations as called for in statute.

CRIA brings together data on fish status, distribution, and life history utilization with information on salmonid habitat and flow conditions. An important objective is to make salmonid species and habitat information available to the lay person through interactive map products.

Independent scores for fish status/utilization, habitat condition, and flow condition were generated for each stream reach. The three scoring elements were then combined, for display and interpretation purposes, into a triplet score characterizing each reach. In this way, a broader range of stream reach information is available to the user than would be available under a single-score system.

Using the tools created with this project, it is determined that great opportunity to improve salmonid production exists by pursuing water acquisitions in smaller, lower elevation streams with good to excellent habitat. However, streams with good to excellent habitat in higher elevations or less populous areas should not be overlooked, nor should lower mainstems through which most stocks/species must migrate. Any flow augmentation could be helpful in salmonid restoration efforts, especially in smaller systems that have limited flow, in over-appropriated basins, and/or in combination with other recovery measures.

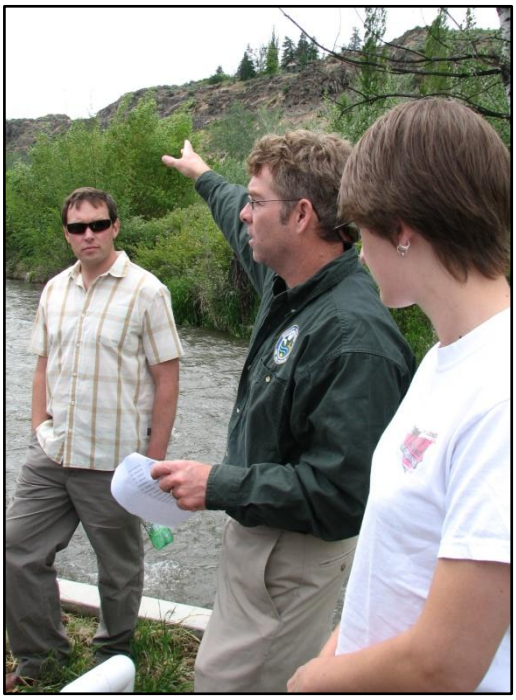
If you need this document in a format for the visually impaired, call the Office of Columbia River at (509) 575-2490. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Cover Photo: Jonathan Kohr

Table of Contents

I. Introduction 1
A. Why an Instream Atlas? 1
B. What's included? 3
C. CRIA Objectives 4
II. Intended use 4
A. CRIA benefits 4
B. CRIA limitations 5
C. Use of CRIA beyond stream flow restoration 7
D. Relationship to other planning process outcomes 7
III. Approaches to Scoring & Ranking 8
A. "The Cube" 8
B. Reaches 9
C. Fish Status/Utilization 9
D. Habitat Condition 12
E. Flow Condition 13
IV. Results 16
A. CRIA Scoring: All WRIAs Fish Status/Utilization ONLY 17
B. CRIA Scoring All WRIAs Habitat Condition ONLY 19
C. CRIA Scoring All WRIAS Flow Condition ONLY 21
D. CRIA Scoring All WRIAs Fish, Habitat, and Flow Combined 23
E. CRIA Scoring Walla Walla & Middle Snake WRIAs 32 & 35 25
F. CRIA Scoring Yakima Basin WRIAs 37, 38, 39 27
G. CRIA Scoring Wenatchee WRIA 45 29
H. CRIA Scoring Methow & Okanogan WRIAs 48 & 49 31
V. Discussion 33
A. Broad tool, narrow application 33
B. Assumptions 33
C. Topics for future consideration 34
D. "It all depends on the question…" 35
VI. For Further Information: 37
VII. Appendices and Workbooks 38

WDFW CRIA Team Members: (from left) Dale Gombert, Teresa Scott, Jonathan Kohr, Andrew Weiss, Aaron Bosworth, Dayv Lowry, Jim Cummins, Peggy Miller, and Brianna Murphy. (Missing: Paul La Riviere)



On June 2, 2010, Jon Kohr (left photo, center) and Jim Cummins led a CRIA Team tour in the Naches basin (WRIA 38) to test habitat condition scoring criteria and to do some birdwatching.

I. Introduction

The need for stream flow restoration is well established in Endangered Species Act (ESA) salmonid recovery plans, Northwest Power and Conservation Council Subbasin Plans, limiting factors analyses, local watershed plans, and others[1]. Recent legislation[2] coupled objectives to provide new water in the Columbia Basin and the need for stream flow restoration, directing Washington State Department of Ecology (Ecology) to develop new water supplies that meet both out-of-stream and instream needs. Program implementation questions include *"Where is flow restoration most needed to help instream resources?"* and *"How much water is needed, and where, to meet out-of-stream needs in the Basin?"* Chapter 90.90 RCW[3] directs Ecology's Office of Columbia River (OCR) to develop a 2011 forecast of water supply and demand for the Columbia River Basin, designed to answer some of these questions. As a component of that activity, Ecology asked the Washington Department of Fish and Wildlife (WDFW) to develop a product that would not only contribute to demand forecasting, but also help OCR select projects that are cost-effective in targeting the instream side of the water supply equation with specific focus on salmonid conservation/restoration. Thus, an interagency agreement was developed between Ecology and WDFW[4] to fund work leading to the Columbia River Instream Atlas for eight eastern Washington fish- and flow-critical watersheds.

A. Why an Instream Atlas?

As part of developing the 2011 water supply and demand forecast, OCR asked WDFW to update the stream reach prioritization presented in the 2003 *Washington Water Acquisition Program* report[5]" to incorporate more recent – and in some cases, more extensive – data on flow restoration needs. Since 2003, subbasin plans and regional ESA recovery plans, and associated salmon production modeling projects, have been completed for Columbia and Snake River tributaries. OCR also asked WDFW to integrate evaluations of salmonid habitat and flow, and the data on which they are based, into geographic information systems so the information is more readily available to a wide audience. The Columbia River Instream Atlas (CRIA) project was developed to respond to these needs.

---

1 A bibliography of references used in CRIA development and scoring is provided in Appendix A.

2 E2SHB 2860 2006 Columbia River Basin Water Supply;
E2SSB 6874 2008 Columbia River Water Delivery
2SHB 1803 2011 Columbia River Basin Management Program http://apps.leg.wa.gov/documents/billdocs/2011-12/Pdf/Bills/Session%20Law%202011/1803-S2.SL.pdf

3 Chapter 90.90 RCW. Columbia River Basin Water Supply http://apps.leg.wa.gov/RCW/default.aspx?cite=90.90

4 Ecology Agreement C1000091 (WDFW agreement 09-1470) *Columbia River Instream Atlas*

5 Washington Department of Ecology and Washington Department of Fish and Wildlife. 2003. Washington Water Acquisition Program: Finding Water to Restore Streams. Ecology Publication No. 03-11-005.

The purpose of CRIA is to evaluate stream reaches for their potential to improve salmonid (salmon, steelhead, bull trout) production through stream flow enhancement. The CRIA product, along with WDFW professional knowledge, will also help Ecology identify salmon-inhabited stream reaches for emphasis during water right permitting processes. In addition, the CRIA project will provide an updated tool for Ecology's Water Acquisition and Irrigation Efficiencies Programs to prioritize flow enhancement projects in scored watersheds, and for OCR to evaluate investments in water-supply and fish-benefit projects.

Washington State is divided into 62 Water Resource Inventory Areas[6] (WRIAs) based on geographic watershed drainage systems. The CRIA project currently centers on eight fish/flow critical WRIAs in eastern Washington (Figure 1). CRIA analyses integrate the three Yakima Basin WRIAs into one complex for simplicity of scoring.

Table 1 WRIAs Included in 2011 CRIA

WRIA NAME	WRIA NUMBER
Walla Walla Basin (Washington portion)	WRIA 32
Middle Snake River & Tributaries (Washington portions)	WRIA 35
Yakima Basin Complex	
Lower Yakima River	WRIA 37
Naches Basin	WRIA 38
Upper Yakima Basin	WRIA 39
Wenatchee Basin	WRIA 45
Methow Basin	WRIA 48
Okanogan Basin	WRIA 49

[6] Washington Administrative Code 173–500–040 Water resource inventory areas

Figure 1 CRIA focus WRIAs

B. What's included?

The project brings together several sources of information on instream resources and displays them in formats friendly to the non-fish biologist. Maps showing stream reaches prioritized for targeted flow restoration projects are the primary products, together with representations of fish stock status and life history utilization. Included are:

- Defined stream reaches in which flow restoration is possible based on the existence of surface water diversions or groundwater withdrawals within and above the reach that are capable of being acquired and transferred into the Trust Water Program;
- Salmonid Stock Inventory (SaSI) information on species, stocks, and status;
- ESA status;
- Information on fish distribution and monthly habitat utilization by life history stage;
- Stream reach habitat condition, based on key habitat attributes like flood plain connectivity and condition of riparian vegetation;
- Stream flows at key points; and
- Target flows for salmonids by stream reach, where available. Flow targets used for CRIA analysis are instream flow levels set in Washington Administrative

Code[7], and stream flow levels set for the Yakima Basin federal reclamation project[8].

C. CRIA Objectives

Objectives for the CRIA project are to:

- Update stream reach prioritization done for 2003 Water Acquisition Program
- Incorporate new information from recovery, Subbasin, and watershed plans
- Develop scoring that reflects improvements from completed restoration projects
- Improve & simplify project selection
- Screening OCR grant proposals, and proposals for Irrigation Efficiencies & Water Acquisition Programs
- Bring together fish status, distribution, and life history utilization data
- Update species/stock presence and status
- Publish product in simple format for use by permit writers
- Make both available on interactive GIS

II. Intended use

CRIA is intended as a tool to help visualize the environmental cost/benefit evaluation of capital investments for Ecology's Office of Columbia River. CRIA can aid decisionmaking for any project or program having a goal of instream flow restoration, including Ecology's Water Acquisition (Trust Water) and Irrigation Efficiencies grant programs. In addition, CRIA can be used to support permitting, mitigation analysis, project design, and water conservation project funding decisions, as long as geographic scope and data comprehensibility limitations of the CRIA project are taken into account.

A. CRIA benefits

Simple concepts, powerful presentation: One key objective is to depict elements of fish life history, habitat condition, and flow condition in a manner that is meaningful to laypeople, not just to fish biologists or hydrologists.

Data foundation: CRIA comprises data about salmonids and their habitats that are collated from established sources or using established methodologies. Fish presence, status, and life history information are collected from WDFW's Salmonid Stock

7 WAC 173-501 through 173-559 provide Instream resources protection programs for WRIAs for which instream flow rules have been developed.

8 Title XII of Public Law 103-434 on October 31, 1994 and
U.S. Department of the Interior, U.S. Bureau of Reclamation. November 2002. Interim Comprehensive Basin Operating Plan for the Yakima Project, Washington.

Inventory (SaSI) database and associated "fish distribution" spatial data. Habitat scoring criteria are based on the best available science, and though the criteria seem subjective on the surface, they are based in a firm foundation of the habitat attributes and quality most associated with high salmonid productivity. Flow data are collected from gauges maintained by the U.S. Geological Survey, U.S. Bureau of Reclamation, or Washington Department of Ecology.

Data organization: Data are organized in such a way that individual data components can be accessed using GIS. For example, while individual-reach scoring for "fish status/utilization" is based on an aggregated score for all species present, data are organized such that a user can access individual species/stock information for any given reach. Likewise, scores for individual habitat and flow attributes are accessible to the user in addition to the "roll-up" score used for decisionmaking at the broader scale.

Geographic scale: Watersheds are parsed into "reaches" based on criteria discussed below. This allows examination of data at a finer scale than basin-wide. In most cases the mainstem river(s) within a WRIA are broken into several reaches and smaller tributaries are each considered single reaches.

Flexible scoring: CRIA is designed to easily accommodate changes in scoring methodology, including the application of variable weighting factors to specific scoring attributes of interest (e.g., ESA status component of fish score).

Three-dimensional evaluation: CRIA scores for each of the three elements - fish status/utilization, habitat condition, and flow condition - are maintained separately. This allows each scoring element to be viewed separately (e.g., "I only want to look for reaches that are severely flow impaired") or combined to provide a gross overview of reach suitability for flow restoration (e.g., "Which reaches have the best habitat and fish species utilization but are severely flow impaired?").

B. CRIA limitations

Narrow objectives: The use of CRIA pre-supposes that the area of interest is already identified as being flow-impaired and having value to critical salmonid fish stocks. Indeed, to-date the atlas has been completed only for watersheds in which flow impairment has already been identified as a factor limiting salmon production. Because of this, a high CRIA score might be confusing, or conflict with, a determination on that component made with other objectives in mind.

Species limitations: Currently, CRIA is geared towards conditions for salmon, steelhead, and bull trout. Conditions and prioritization of reaches in relation to other fish and wildlife values are not included, though they are important when considering a more ecosystem-based approach to watershed restoration and protection.

Feasibility: A high CRIA score does not mean a project will successfully provide "high value for fish restoration" or "high value for flow restoration" because externalities such as legal constraints, availability of funding, and willingness to sponsor/fund a

project can render a project infeasible. Conversely, a low CRIA score doesn't mean flow restoration will not benefit fish.

Limited upstream extent: CRIA is limited because, at this time, CRIA reaches extend upstream only so far as water is available to realistically contribute to stream flow augmentation (i.e. surface water diversions or groundwater withdrawals occur within or above the reach and can be purchased and transferred into the trust water program). This means that most upper stream reaches, especially those within public lands, are excluded from CRIA analysis. This will be confusing to some users, who will note a lack of data for the uppermost stream reaches that are critical to salmonid production and/or may be flow-impaired.

Subjectivity in scoring: Many of CRIA's component scores are based on "best professional knowledge" (BPK) instead of more objective metrics. Scores for particular habitat attributes were assigned in consultation with local agency biologists, not necessarily through direct observation by a CRIA team member. Effort was taken to reduce subjectivity in scoring by obtaining input from multiple experts, but it is not eliminated altogether. This is a limiting factor most often in the context of habitat condition scores that are based on "BPK." Scoring on some habitat attributes could eventually be replaced with more objective data as those data come available.

Data limited: Employing a subjective scoring method for habitat condition is one way the CRIA Team worked around the lack of direct-observation data for many reaches. Likewise, only about 50% of reaches identified for this product include flow gauges (Table 2), so alternative data sets and scoring methods were employed to score flow condition for each reach. CRIA structure was developed with flexibility in mind, both in its application and in its data foundation – components that now are subjective can be replaced with objective data when those data come available.

Table 2 Watershed statistics for numbers of reaches, gauges, and flow targets evaluated for CRIA

WATERSHED	REACHES	GAUGES	FLOW TARGETS
Walla Walla Basin (Washington portion)	33	19	4
Middle Snake River & Tributaries	29	13	0
Yakima River Complex	50	29	See note
Wenatchee Basin	17	11	6
Methow Basin	35	9	4
Okanogan Basin	25	14	4
TOTALS	189	95	18

Note: Yakima Basin flow targets are provided in Appendix D.

Limited peer review: The timeline under which CRIA was developed prohibited broad consultation with experts internal to, and outside of, WDFW and Ecology, some of whom have superior knowledge of local stream reaches. This is a critical step (or round of steps) that should be re-traced as CRIA products become more broadly used.

Cross-watershed comparisons: CRIA component scores are based on within-basin analysis and may not be helpful for choosing between projects in two separate watersheds. For example, it will be difficult to choose between a high-scoring reach in a watershed with many fish stocks and a high-scoring reach in a watershed having fewer stocks.

Complements, not replaces, expert judgment: Finally, while CRIA was created to display as much readily-available "fish-relevant" information as possible, its availability does not eclipse the need for direct professional consultation on a project- or application-specific basis.

C. Use of CRIA beyond stream flow restoration

While some CRIA tools can help visualize benefits from types of projects beyond stream flow restoration/augmentation, exclusive use of CRIA to guide decisions for other types of projects is not advised. For example, while users can get a feel for stream reach fish passage conditions, CRIA would not be a good tool to use to determine which fish passage barriers are most important to remove (though this feature could be integrated in the future).

On the other hand, CRIA is built with flexibility in mind. Many uses beyond development of water projects can be imagined. CRIA is built on a foundation of basic salmonid fish status/utilization and habitat/flow information. Small changes or additions to the Atlas can benefit a broader range of decisions; for example, employing CRIA information at a finer scale might be helpful in determining mitigation priorities for water right permitting. CRIA's applicability to any particular project or activity type very much depends on the nature of the decision being considered in relation to the data provided through CRIA. In the end, decisions at the project-level require project-specific, on-site assessment.

D. Relationship to other planning process outcomes

CRIA tools are not intended to replace priorities set in salmonid recovery planning, water management planning, or any other consensus-building processes. CRIA provides data on a narrow set of fish life, and does not, at this time, consider other wetland values except as relevant to the salmonid focus. This means CRIA will not be very helpful to users hoping to find a broad ecosystem perspective on these eastern Washington watersheds.

So, CRIA has high value for inquiry and decisionmaking around stream flow restoration intended to improve or maintain salmonid production. CRIA can also be extremely valuable to users in a broader context as long as CRIA's limitations are kept in mind.

III. Approaches to Scoring & Ranking

Eight major Columbia Basin watersheds (tributaries) are segmented into "reaches" to facilitate scoring. Information about fish stock/species status and habitat utilization, habitat condition, and flow condition is collated for each stream reach, and attributes for each element are scored. For each of these three CRIA elements, raw scores are stratified ("binned") into three categories: high/good (3), average/fair (2), or low/poor (1). As a result, stream reaches each have three elemental "bin" scores, one each for: "fish status/utilization," "habitat condition," and "flow condition."

Previous flow restoration project prioritization efforts consolidated scores for all components into a single score for each stream reach, and then arranged scores serially to establish a ranking among reaches within a WRIA. After discussion within the project team, a decision was made not to rank CRIA stream reaches serially. Instead, scores for each of the elements – fish, habitat, and flow – are maintained independently, providing greater flexibility in the application of the information to decisionmaking. This approach avoids confusion arising from the evaluation of disparate attributes of a reach and their contribution to one "composite score unit" used for ranking.

A. "The Cube"

As noted above, scoring for the 2003 Water Acquisition Program project combined results for all scored components, and provided one final score upon which serial ranking and prioritization was based. This was a successful approach because the "right" components were chosen for scoring and the outcome desired was an ordinal ranking of reaches within a watershed. We modified that approach for CRIA, choosing to score three elements independently. By doing this, CRIA becomes more than just a flow restoration tool; it can answer general questions about salmon and habitats, and can also inform other types of decisions being considered by managers.

The three-element approach lent itself well to a common method of displaying complicated relationships – a three-dimensional array we call the "CRIA Cube" (Figure 2). The three axes (elements) are: Fish Status/Utilization (providing information on anadromous salmonid species diversity, habitat utilization by life history stage, and population status); Habitat Condition (representing instream and riparian habitat functions and values); and Flow Condition (assessing overall flow as well as potential seasonal flow regime limitations). These scores may be used by decisionmakers in awareness of a fourth dimension - feasibility and opportunity – that addresses issues like water availability, water right status, habitat restoration effects,

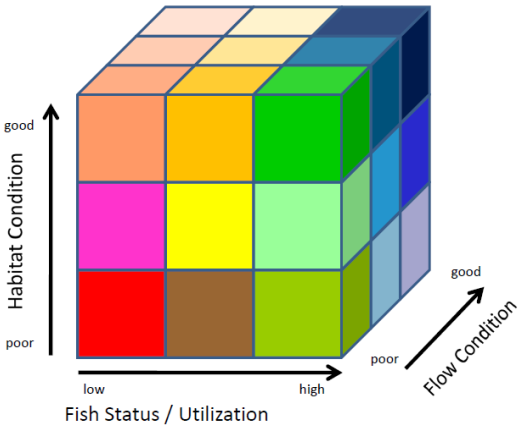


Figure 2 The CRIA Cube

funding availability, willing land owners, political will, ecosystem effects, etc.

B. Reaches

Reaches, or stream segments, were defined based on their relevance to benefit salmonid production and potential for flow restoration. Consideration was also given to having the ability to measure stream flow. Reach lengths range from a quarter-mile to almost eighty miles. Half of the identified stream reaches contain flow gauges; 95 of the 189 total reaches across eight WRIAs.

Upstream boundaries for most reaches were determined based on the nearest landmark (e.g., city, bridge, gauge, waterfall, confluence of another tributary, boundaries) above which no practical contributions to stream flow could be achieved. For example, for a stream flowing out of a national forest through private lands, the upstream terminus of the evaluated reach would be either the most upstream water diversion or the private/federal ownership boundary. Uppermost stream reaches that may be critical to salmonid production and/or may be flow-impaired are excluded from CRIA scoring because they don't contain water supply opportunities that would contribute to stream flow.

While it would be preferable to prioritize reaches entirely from a biological perspective for the entire creek to ensure maximum benefits to fish life, the opportunities to acquire water where it is most limiting to salmon restoration may be rare. Therefore, prioritizing instream flow restoration where flow benefits may be achieved is a practical approach for implementing restoration programs.

Further details about reach definitions for each WRIA are included in the appendices.

C. Fish Status/Utilization

The fish status/utilization score is a measure of the population status and life history utilization of salmonid stocks in a given stream reach. The fish scoring is organized around the eight chosen WRIAs and five species of salmonids (Chinook, coho, steelhead, sockeye and bull trout) in the Columbia Basin. Fish scoring is based primarily on information in the Salmonid Stock Inventory (SaSI) database maintained by WDFW, as well as on available literature, knowledge of WDFW regional biologists, and staff of other agencies such as the Confederated Tribes of the Umatilla Indian Reservation and Yakama Nation. These references can be found in the "references" tab of each WRIA's workbook, in SalmonScape, or in Appendix A of this report.

Species/stocks: In recognition of the biological distinctness and independence of salmonid populations, information was provided at the stock scale, instead of species scale, where possible. For bull trout, stock structure is comparatively poorly understood and annual distribution and status monitoring is limited, so while SaSI bull trout are identified at the stock scale, only species scale information is provided (i.e. "bull trout" rather than "special-name bull trout").

Life history utilization: Using information gathered for each fish stock/species present, each stream reach matrix is populated based on the monthly presence or

absence of three life stage categories (spawning/early rearing, juvenile rearing and outmigration, and adult in-migration) of each relevant stock/species. These scores are summed across all the species/stocks within a reach for each month.

Stock Status: Monthly summed presence scores are then given additional influence by altering the weighting factors associated with stock-specific ESA, SaSI, or Regional Technical Team (RTT) status determinations.

Binning: The final numeric scores for each reach, based on life-stage specific occurrence for all stocks and weighted by status, were binned into high (3), average (2), and low (1) categories after standardizing by the highest fish score within the WRIA. Scores were not standardized by the maximum theoretically possible score for the WRIA (i.e., presence of every stock at every life history stage) because attaining this value is impossible, as part of stock separation is geographic isolation. Bin separations were defined as thirds of the highest score assigned to any single reach. Scoring and binning reaches in this way means it is possible, though unlikely, to have all reaches in a WRIA fall into a single bin. In practice, this did not occur.

An important note about scoring and binning fish status/utilization in this way is that, from the composite score, it is impossible to distinguish a reach used by several life stages of a single, ESA-listed stock from a reach used by several non-listed stocks. This method of scoring is intentional in order to simplify presentation, but it is possible to isolate the contribution of a given species, stock, or life stage using the root scoring spreadsheets for each WRIA.

Table 3 provides an overview of the ESA listing units (Evolutionarily Significant Units, "ESU," or Distinct Population Segments, "DPS") in the scored WRIAs, their ESA listing status, and their associated SaSI stocks. Stocks in parenthesis were not scored for CRIA purposes, but are included on this table in order to provide a more complete picture for the region. Several stocks are not associated with ESA Units and/or aren't included in SaSI, but were scored for CRIA purposes; these are listed at the end of the table. In general, stocks that have been extirpated and reintroduced are not included in ESA Units or SaSI, but because the management intent for these stocks is to re-establish naturally-reproducing salmon runs, they are included in scoring as important components of the fish presence/utilization picture.

Table 3 ESA Unit Name, ESA Listing Status, and SaSI stock name for stocks scored for CRIA

ESA Unit Name	ESA Listing Status	SaSI stocks
Snake River Sockeye	Endangered	(Snake River Sockeye)
Snake River Basin Steelhead	Threatened	Middle Snake Summer Steelhead: Tucannon, Asotin Creek, Lower Grande Ronde, Joseph Creek
Snake River Spring and Summer Run Chinook	Threatened	Tucannon Spring Chinook, Wenaha Spring Chinook
Snake River Fall Chinook	Threatened	Snake River Fall Chinook
Snake River Bull Trout	Threatened	Middle Snake Bull Trout: Upper Tucannon, Asotin Creek, Wenaha
Touchet/Walla Walla (Oregon Recovery Unit) Bull Trout	Threatened	Touchet Bull Trout, Mill Creek Bull Trout
Middle Columbia Steelhead	Threatened	Walla Walla Summer Steelhead, Touchet Summer Steelhead
		Lower Yakima Summer Steelhead: Satus Creek, Toppenish Creek
		Naches Summer Steelhead
		Upper Yakima Summer Steelhead
Mid-Columbia River Spring Run Chinook	Not Warranted	Naches Spring Chinook, American River Spring Chinook
	Not Warranted	Upper Yakima River Spring Chinook, Naches Spring Chinook, American River Spring Chinook
Middle Columbia River Bull Trout	Threatened	Yakima River Bull Trout, Ahtanum Creek Bull Trout
		Naches Bull Trout: South Fork Tieton, Indian Creek, North Fork Tieton River, Rattlesnake Creek, American River, Crow Creek, Deep Creek
		Upper Yakima Bull Trout: North Fork Teanaway River, Cle Elum/Waptus Lakes, Box Canyon Creek, Kachess River, Gold Creek
Lake Wenatchee Sockeye	Not Warranted	Wenatchee Sockeye
Okanogan River Sockeye	Not Warranted	Okanogan Sockeye
Upper Columbia Steelhead	Threatened	Wenatchee Summer Steelhead
		Methow Summer Steelhead
		Okanogan Summer Steelhead
Upper Columbia River Spring Run Chinook	Endangered	Chiwawa Spring Chinook, Nason Creek Spring Chinook, Little Wenatchee Spring Chinook, White River (Wenatchee) Spring Chinook
		Methow Spring Chinook, Twisp Spring Chinook, Chewuch Spring Chinook, Lost River Spring Chinook

Table 3, continued

ESA UNIT NAME	ESA LISTING STATUS	SASI STOCKS
Upper Columbia River Summer and Fall Run Chinook	Not Warranted	Yakima River Bright Fall Chinook, Marion Drain Fall Chinook
		(Hanford Reach Fall Chinook)
		Wenatchee Summer Chinook
		Methow Summer Chinook
		Okanogan Summer Chinook
Upper Columbia River Bull Trout	Threatened	Wenatchee Bull Trout: Ingalls Creek, Icicle Creek, Chiwaukum Creek, Chiwawa, Chikamin Creek, Rock Creek, Phelps Creek, Nason Creek, Little Wenatchee, White River, Panther Creek
		Methow Bull Trout: West Fork Methow, Gold Creek (Methow), Beaver Creek, Twisp, West Fork Buttermilk Creek, East Fork Buttermilk Creek, Lost River, First Hidden Lake, Middle Hidden Lake, Monument Creek, Reynolds Creek, Cougar Lake, Lake Creek, Wolf Creek, Goat Creek, Early Winters Creek, Cedar Creek
No ESA Unit	n/a	Yakima Basin Sockeye
		Walla Walla Spring Chinook
		Walla Walla Coho
		Yakima Basin Coho
		Wenatchee Coho
		Methow Coho

D. Habitat Condition

The habitat score is a measure of six attributes evaluating salmonid fish habitat condition for a given stream reach. Scores are given on an annual basis rather than by month as in the fish status/utilization scoring. The score is based on four tiers of review; 1) literature, 2) best professional knowledge (BPK) of project biologists, 3) personal communication with those who have on-the-ground knowledge of specific stream reaches, and 4) actual on-the-ground site evaluations of stream reaches by CRIA team biologists. Much of the literature cited is also based on BPK.

Attributes: The six habitat attributes are: 1) Off-channel habitat, 2) Floodplain connectivity, 3) Riparian conditions, 4) Spawning suitability, 5) Rearing suitability, and 6) Passage conditions. Each of these habitat parameters are rated from 1 to 4 (1=Poor, 2=Fair, 3=Good, 4=Excellent) for each stream reach based on criteria found in Appendix A. Within many reaches, habitat quality may vary significantly in different portions of the reach. In these cases, an average score for an entire reach

would be calculated. For example, a 10 mile stream reach may have poor rearing habitat suitability in the lower end, fair habitat in the middle and good habitat at the upper half, resulting in a "fair" rating ("2" score) for rearing habitat suitability overall.

At the time of review, all present salmonid species are taken into consideration for the habitat scoring parameters. The six scores are added to get an overall habitat score for each reach. Therefore the lowest possible score is 6 (all rated as poor) and the highest is 24 (all rated excellent). For each WRIA, reaches are then binned using their total Habitat score.

Binning: For each WRIA, binning of the reach habitat scores is determined using a range between the lowest and highest scores stratified into thirds. For example, if the lowest reach habitat score is 6 and the highest score is 20, the range is 6 to 20, which when divided evenly among three units (poor, fair, good) yields bins with scores ranging from 6-10 (poor), 11-15 (fair), and 16-20 (good).

E. Flow Condition

Several approaches were tested before finalizing the flow scoring approach for CRIA. Flow data collected from stream flow gauges were loaded and summarized, and a "period of record" chosen for use when comparing monthly mean flows to flow targets. In reaches lacking gauge data, estimates of flow based on precipitation and watershed size were adapted from the National Hydrological Data "Plus"[9] database. Information was also collected from Ecology regarding permitted water withdrawals in each reach. These data were viewed from several angles to develop scoring, and while the methodology isn't perfect, the scores it yields make sense in context with the other scored components and the planned application.

Gauges: Once reach definitions were finalized, staff paired reaches with stream flow gauges. To the extent possible, we used gauges matching Ecology's stream flow "control points." Where two gauges occurred within a particular reach, we chose based on Ecology criteria for length of period-of-record. Gauge data were downloaded in their native format and summarized to "monthly mean flows" for each month within the dataset. The minimum monthly mean flow for a period of record was also calculated. Both the mean and the minimum were compared with flow targets, where they are available.

Period of Record: Most gauges in smaller stream reaches are new gauges operated by Ecology. These gauges typically have very short periods of record, primarily within the last decade. For USGS or Bureau of Reclamation gauges we examined all years of data, but typically only used the last 20 or 30 years. We attempted to use only contemporary years on reaches with known operations changes. Still, some reaches had too few records for us to use: Our criterion was a minimum of three years of data for each time-step.

---

9 NHDPlus Home Page: http://www.horizon-systems.com/nhdplus/

Missing Flow Data: In the end, ninety-four out of 189 reaches (50%) lacked flow gauge data (Table 2). This presented a difficult barrier to providing a consistent scoring scheme across all stream reaches. After consultation to ensure data source consistency with Dr. Jennifer Adams of the WSU forecast team, the CRIA team embarked upon an analysis of streamflow data from the NHD-Plus GIS-based system, which uses watershed area (upstream of a point of interest) and local precipitation information to estimate normative flow at that point. These normative flows were then adjusted to account for withdrawals and used as a basis of comparison in further scoring steps.

Flow targets: Instream flows set in administrative rule were used as "flow targets" for most analyses; the exception is Yakima basin, for which mainstem flow targets are set through federal action, and tributary flow targets have been determined by the YRBWEP work group as part of the YRBWEP water supply planning process. Flow rules or targets were matched as closely as possible with stream reach boundaries. Since flow rules are often provided on a weekly basis, the CRIA team used the highest value within a month as the flow target for that month. This method will often overstate the severity of flow deficits, but this impact was deemed acceptable given the scale at which the analysis is being conducted.

Water Rights: Late in CRIA development, team members were able to access water rights information for our eight watersheds. Rights were assigned to stream reach using latitude/longitude of place-of-use, which was believed to be more reliably helpful than point-of-diversion coordinates. Water right volumes were not available for claims at the time this scoring method was finalized[10]. However, because volumes for claims have not been evaluated for extent and validity, but it is reasonable to assume that claims indicate water is being used, we needed an approach to account for this potential additional use. The team chose the "count-of-claims" scoring method because we judged that the risk of vastly overestimating the total quantity of diversion using this method outweighed the risk of underestimating the quantity of water being diverted. Two calculations were made to aid scoring: the sum of diversion quantity for certificated water rights was compared with the flow for that reach, and the count of claims in a reach was totaled as a surrogate for the risk that withdrawals are actually higher than the database indicates. It is hoped that, as water right data become better examined and validated, some more direct scoring methods can be employed.

Scoring: Four separate scoring metrics were used: A) percentage of months when mean monthly flows were below the flow target; B) deviation of withdrawals from average monthly flow; C) number of claims in a stream reach; and D) the deviation between flow and target in August. Results for each analysis were converted to a score using the rubrics shown below (Table 4). A fifth component E) Flow volume factor was used to weight the sum of the other scores yielding the final score.

---

[10] Nor has the issue of claims in adjudicated basins been resolved "in the books."

Scoring is initially conducted using high value as "bad" ("highly impaired") and low value as "good," then reversed in the final scoring step. We started analyses by focusing on degree of flow impairment (high value is highly impaired flow condition), but when display of results showed this perspective to be confusing, we reversed the bins to be consistent with the other scoring elements (high value is good flow condition).

Component A (% of months flow<target) is helpful for scoring element because it captures the true management risk associated with underachievement of instream flow rules. Reaches having mean monthly flow below the flow target for nine months or more annually score worst.

Component B (withdrawals as a percentage of average mean monthly flow) makes sense – and might logically be the only scoring element used – if total volume of withdrawals was known with certainty and targets existed for every reach. For the current project, withdrawals over 15% of total flow were deemed worst.

Component C refers to the count of claims for a particular stream reach. As mentioned above, this metric represents the level of risk that actual withdrawals are greater than depicted in the database. Reaches having over nine claims score worst for this risk factor.

Component D (August mean monthly flow as a percentage of mean annual flow) gives us a means to determine whether the reduction in summer flow is severe: August flows more than 66% below average are worst.

Flow Volume factor E is computed using mean annual flows, either directly from gauge data or estimated using the NHD plus method. The thinking for this factor is that any of the already scored elements are less likely to be a problem in a high-flow reach than in a low-flow reach. We multiplied a bad score by three, for example, for a reach having less than 5 cfs, and halved the score for reaches of 1000 cfs or more.

Binning: Simplicity in presentation of results led us to employ "bins" with one bin containing all the "best" scoring reaches, another the worst. Binning for flow scores was done based on percentiles, with the worst (most flow impaired) 33% of scores binning as "1" and the best (least flow impaired) binning as "3," thus reversing the scores so they compare to scores for other elements.

A reach binned as "1" in one watershed will not necessarily be of the same overall priority as a reach binned as "1" in another watershed; several other factors, including fish status/utilization, habitat condition, and feasibility considerations must be considered before priorities across WRIAs can be made. Reaches binned as "1" however are the highest priority for flow restoration - based on flow condition alone – within a particular watershed.

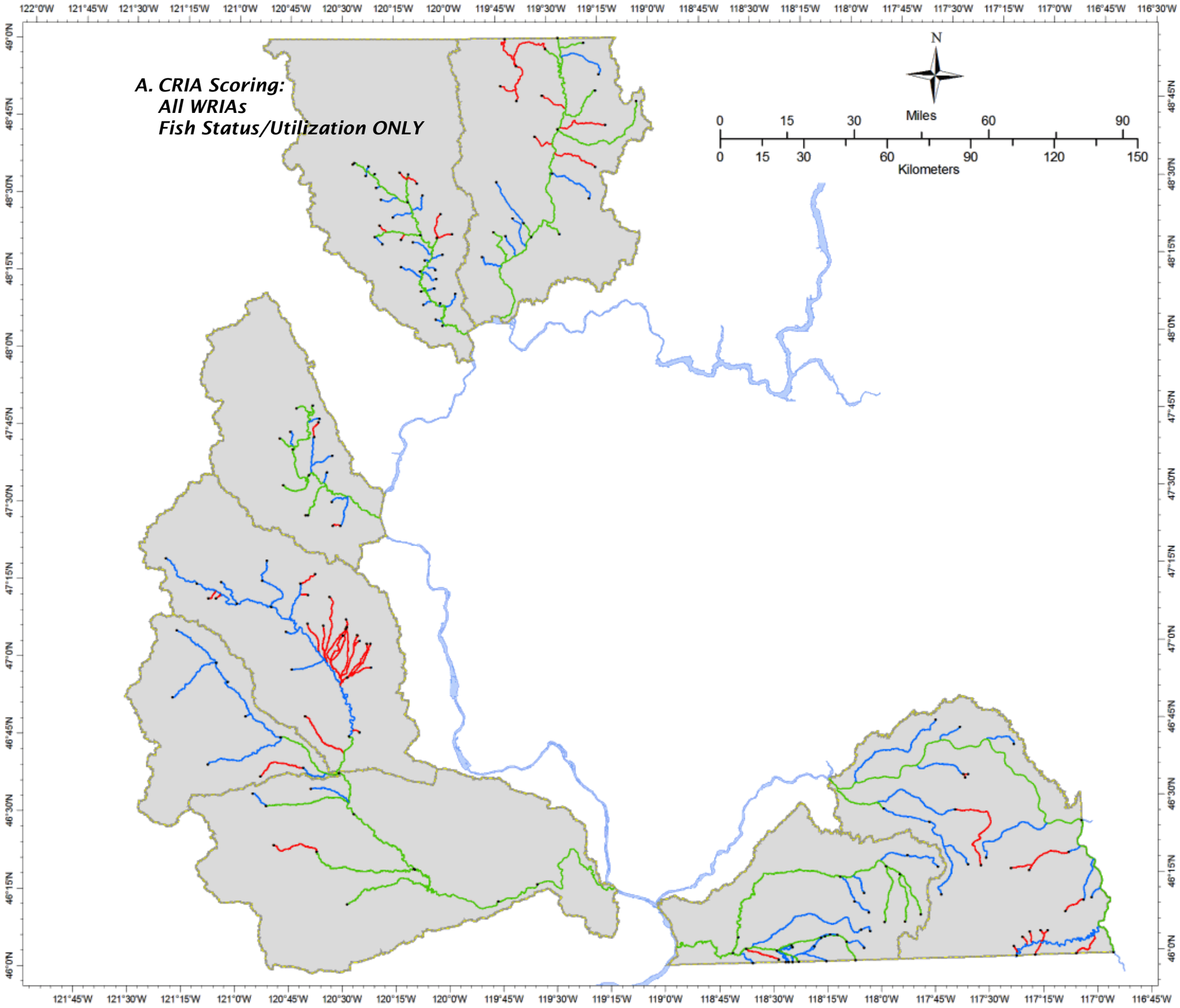
Table 4 Flow Condition Scoring Metrics

ITEM	METRIC	RUBRIC
A	Percent of months that monthly mean flow is less than target	%> .75 = 4 %>.5 = 3 %>.25 = 2 Else 1
B	Withdrawals as a proportion of mean annual flow	Qi/Flow>.15 = 3 Qi/Flow>.05 = 2 Else 1
C	Number of claims	Claims<2 = 1 Claims<9 = 2, Else 3
D	August flows as percent of mean annual flow	Aug/Avg > 66 = 3 Aug/Avg > 33 = 2 Else 1
E	Flow (mean annual flow) Volume Factor	>1000 cfs = 0.5 >100 cfs = 1 >50 cfs = 2 >5 cfs = 3 Else 4

IV. Results

Following are eight maps depicting the results of CRIA scoring. The first three maps depict the element scores individually for Fish Status/Utilization, Habitat Condition, and Flow Condition across all WRIAs. The fourth map provides the combined results for all three elements across all WRIAs, and the last four maps show combined scoring results for WRIA groups as follows: Walla Walla (32) / Middle Snake (35); Yakima Basin (37, 38, 39); Wenatchee (45); and Methow (48) / Okanogan (49). The legend for the first three maps uses a simple color scale to depict scores. The legend changes starting with the fourth map to a combination of color scale for Fish and Habitat elements and line width for the Flow element. In this way, the three-dimensionality of the scores can be conveyed while maintaining a certain level of simplicity for the reader.

Detailed descriptions of scoring methodology are found in Appendix A, and WRIA-specific details are found in Appendices B through G.



DEPARTMENT OF ECOLOGY State of Washington

Washington Department of FISH and WILDLIFE

All River Basins
All WRIAs
Prioritization Scores for Fish

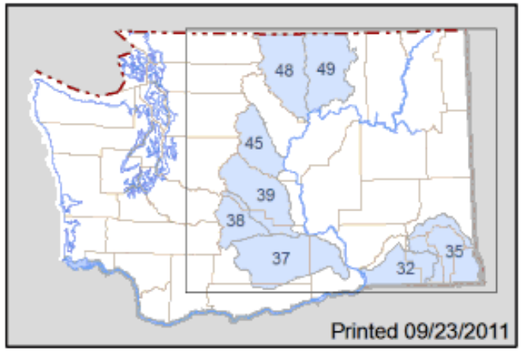
Scores for Current Fish Status and Utilization

- Low
- Medium
- High

• — Assessed Stream Reach upper extents

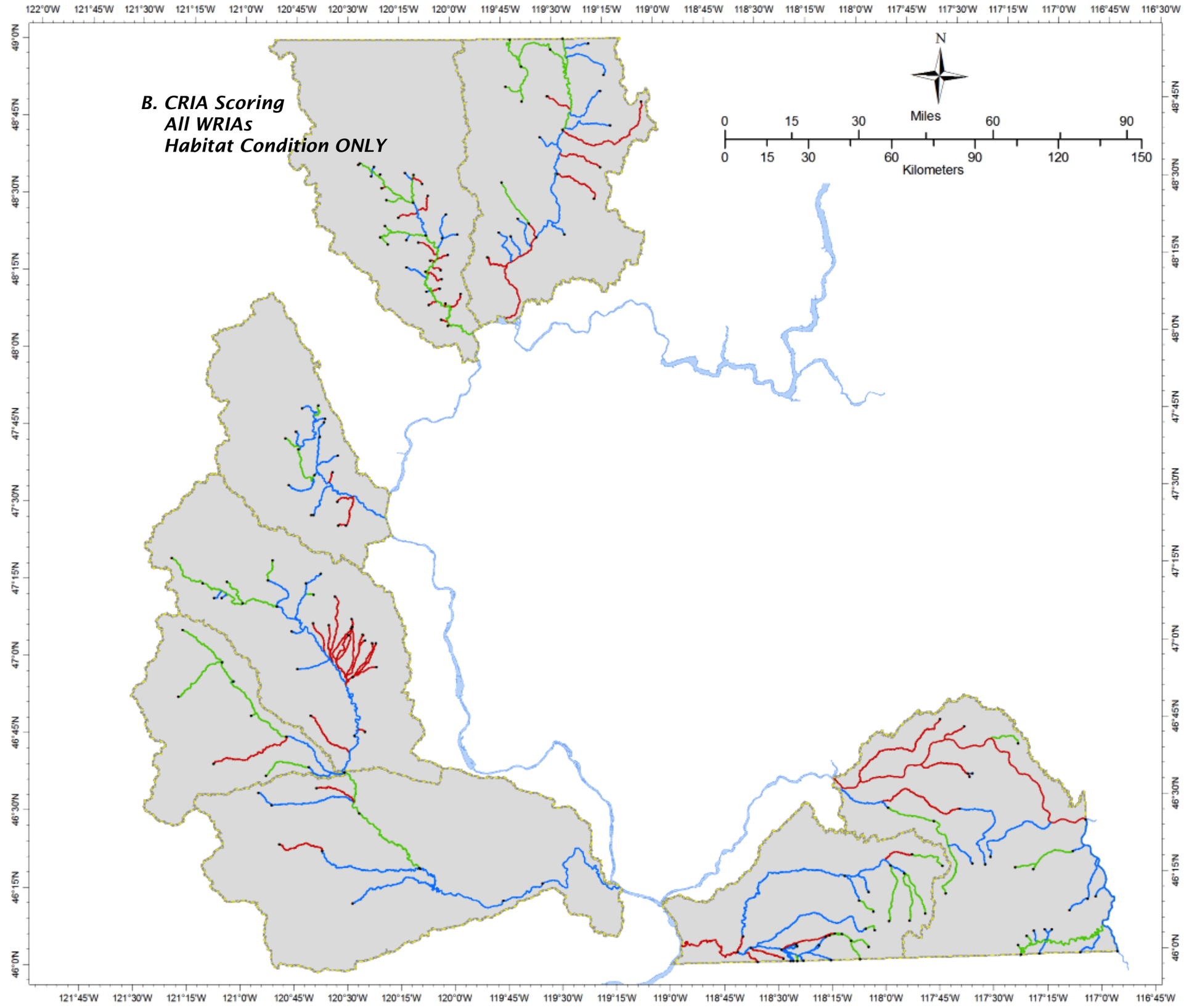
WRIA Boundary

Location of the area mapped is shown boxed.
Project WRIAs are shown in blue.



All WRIAs - Fish

[intentionally blank]



DEPARTMENT OF ECOLOGY State of Washington

Washington Department of FISH and WILDLIFE

All River Basins
All WRIAs
Prioritization Scores for Habitat

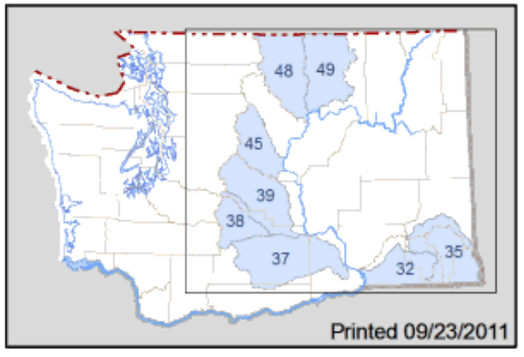
Scores for Current Habitat Condition

- Poor
- Fair
- Good

• — Assessed Stream Reach upper extents

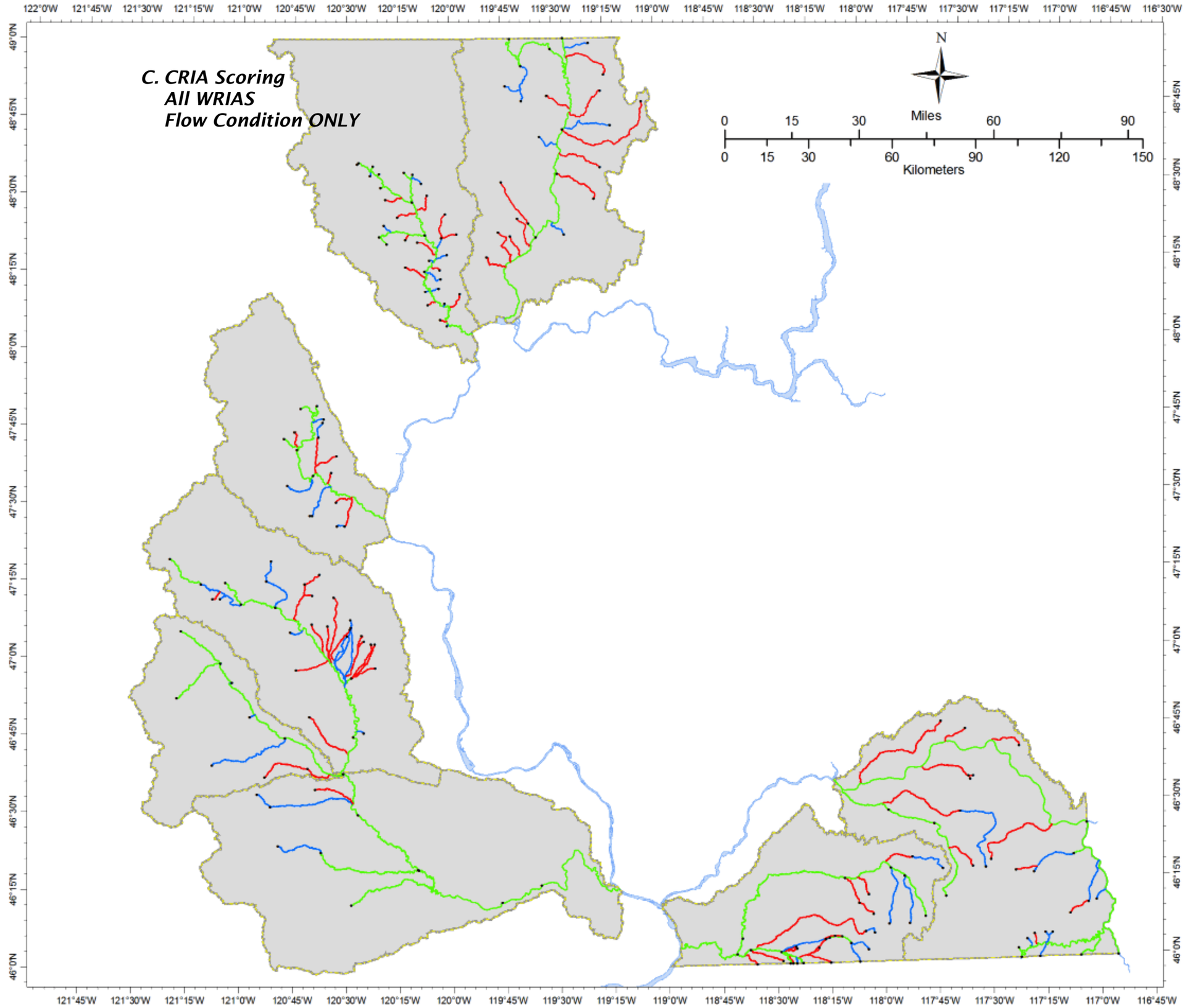
WRIA Boundary

Location of the area mapped is shown boxed.
Project WRIAs are shown in blue.



All WRIAs - Habitat

[intentionally blank]



DEPARTMENT OF ECOLOGY State of Washington

Washington Department of FISH and WILDLIFE

All River Basins
All WRIAs
Prioritization Scores for Flow

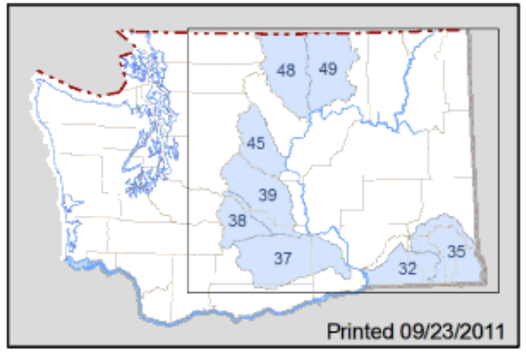
Scores for Current Flow Condition

- Poor
- Fair
- Good

• — Assessed Stream Reach upper extents

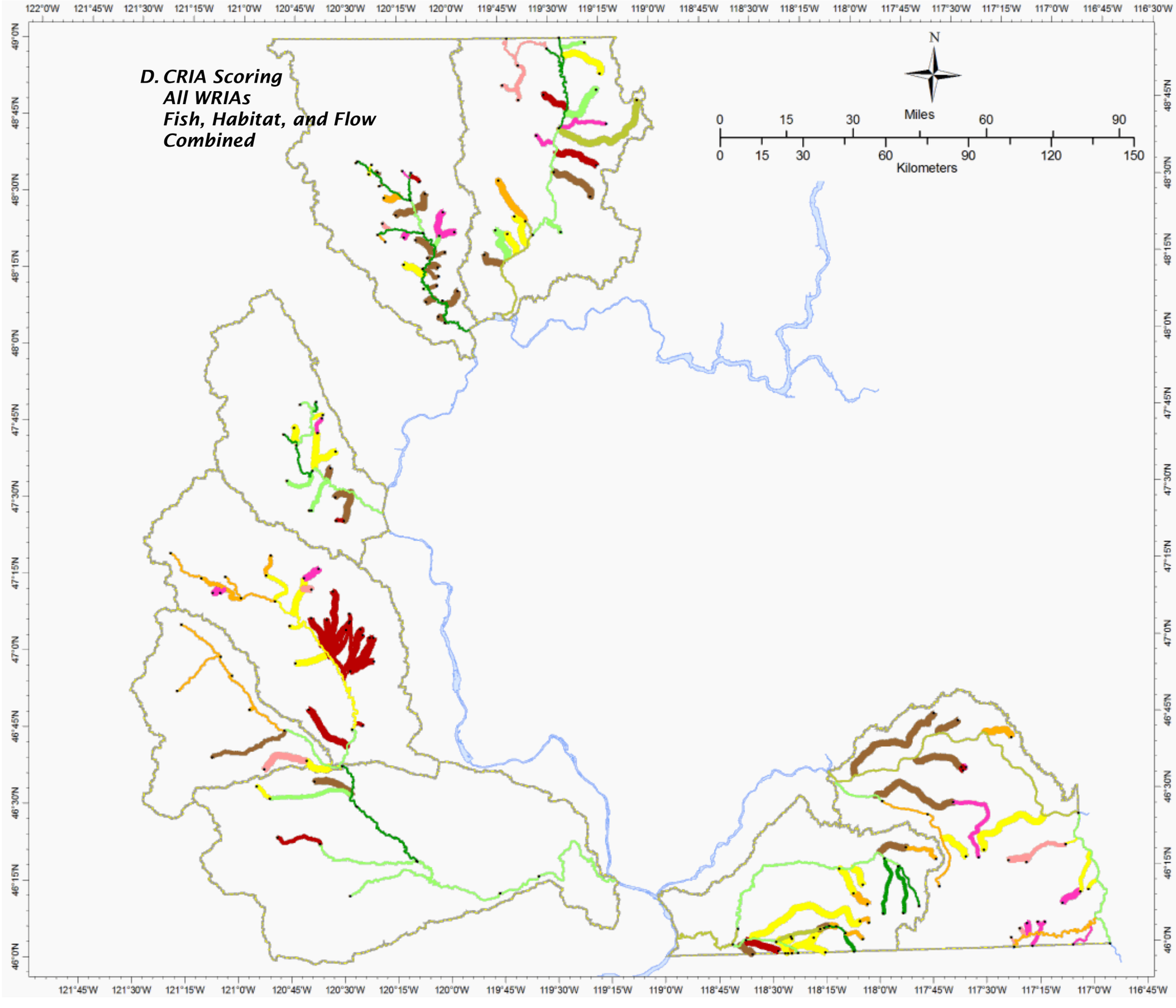
WRIA Boundary

Location of the area mapped is shown boxed.
Project WRIAs are shown in blue.



All WRIAs - Flow

[intentionally blank]



DEPARTMENT OF ECOLOGY State of Washington

Washington Department of FISH and WILDLIFE

All River Basins
All WRIAs
Combined Prioritization Scores for Fish, Habitat, and Flow

Fish Status/Utilization and Habitat Condition scores use this color scheme:

Fish Score
Low | Avg | High

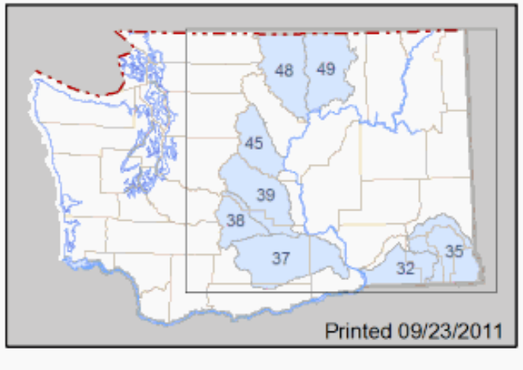
Habitat Score
Good | Fair | Poor

Flow Condition score uses line thickness
Good
Fair
Poor

• — Assessed Stream Reach upper extents

WRIA Boundary

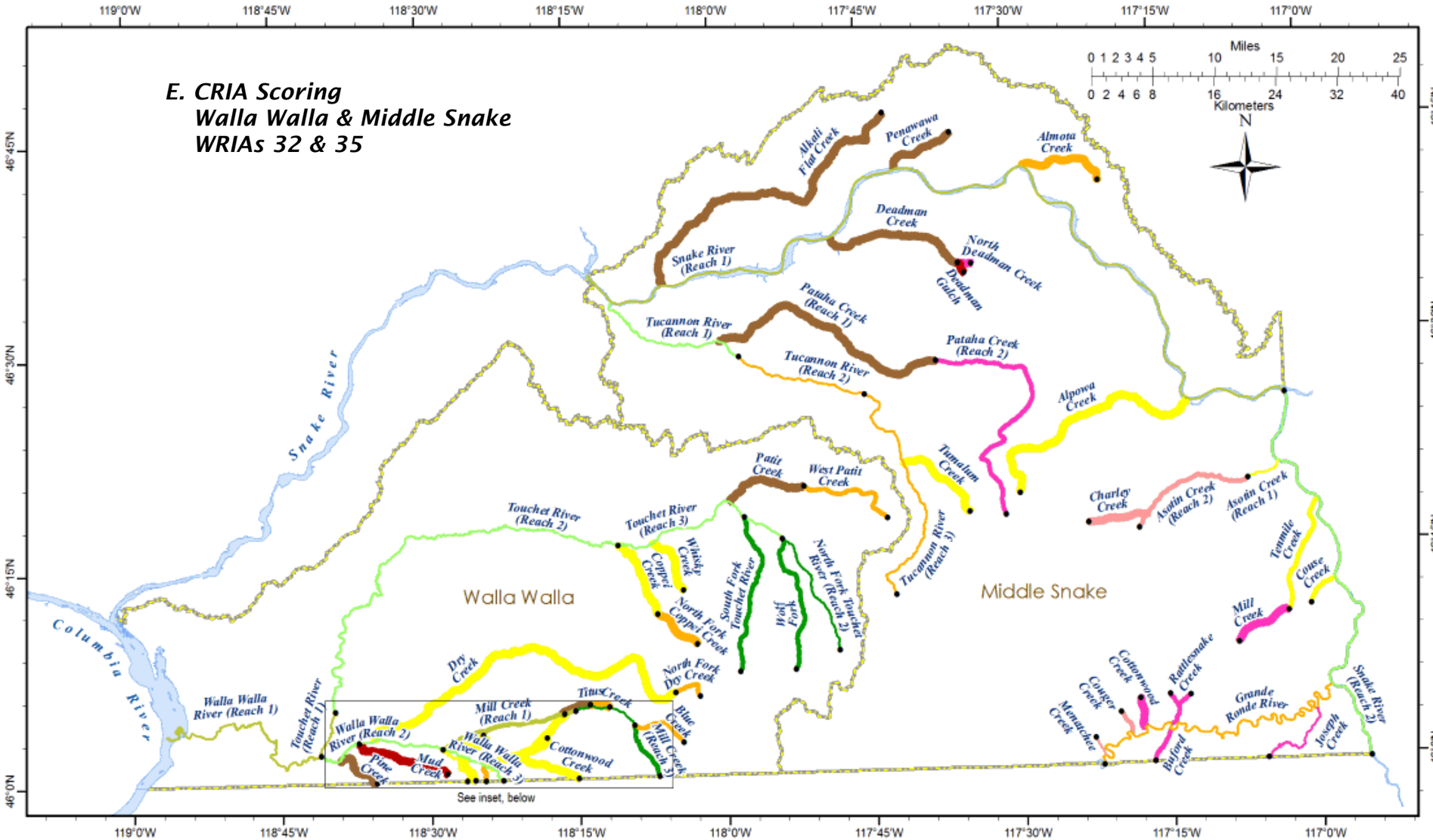
Location of the area mapped is shown boxed.
Project WRIAs are shown in blue.

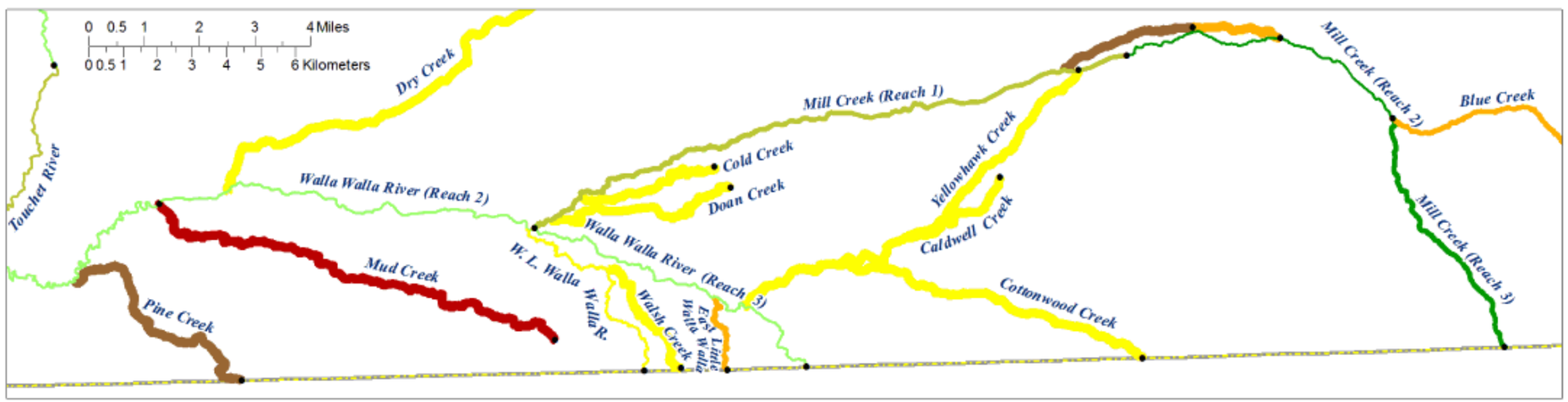


All WRIAs - Fish, Habitat, and Flow

[Intentionally blank]

E. CRIA Scoring
Walla Walla & Middle Snake
WRIAs 32 & 35





DEPARTMENT OF ECOLOGY State of Washington

Washington Department of FISH and WILDLIFE

Walla Walla and Middle Snake River Basins
WRIAs 32 and 35
Combined Prioritization Scores for Fish, Habitat, and Flow

Fish Status/Utilization and Habitat Condition scores use this color scheme:

Fish Score
Low | Avg | High

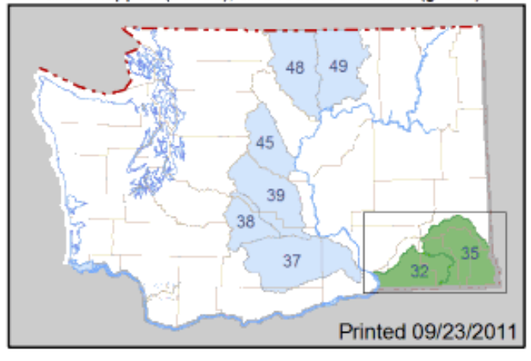
Habitat Score
Good | Fair | Poor

Flow Condition score uses line thickness
Good
Fair
Poor

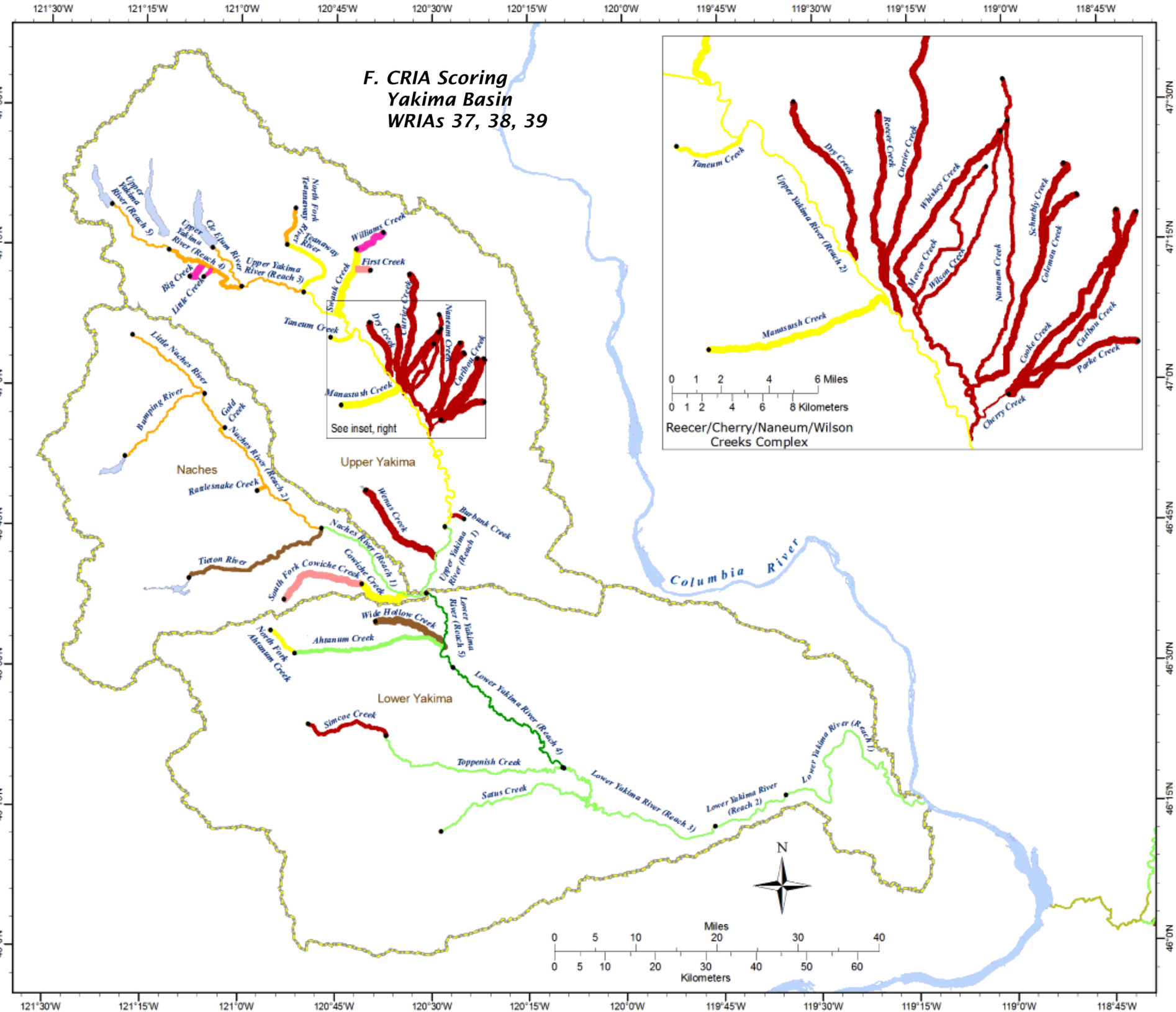
• — Assessed Stream Reach upper extents

WRIA Boundary

Location of all project WRIAs (blue), location of the area mapped (boxed), and featured WRIAs (green).



[intentionally blank]



DEPARTMENT OF ECOLOGY State of Washington

Washington Department of FISH and WILDLIFE

Yakima River Basin WRIAs 37, 38, and 39 Combined Prioritization Scores for Fish, Habitat, and Flow

Fish Status/Utilization and Habitat Condition scores use this color scheme:

Fish Score

Low | Avg | High

Habitat Score

Good | Fair | Poor

Flow Condition score uses line thickness

Good

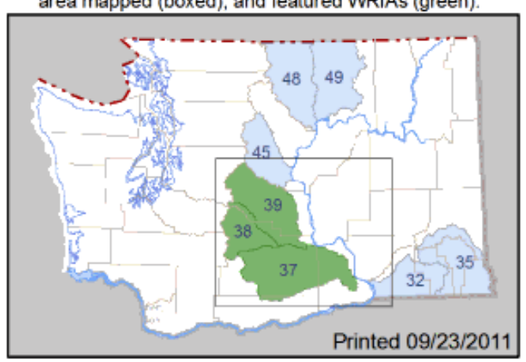
Fair

Poor

• — Assessed Stream Reach upper extents

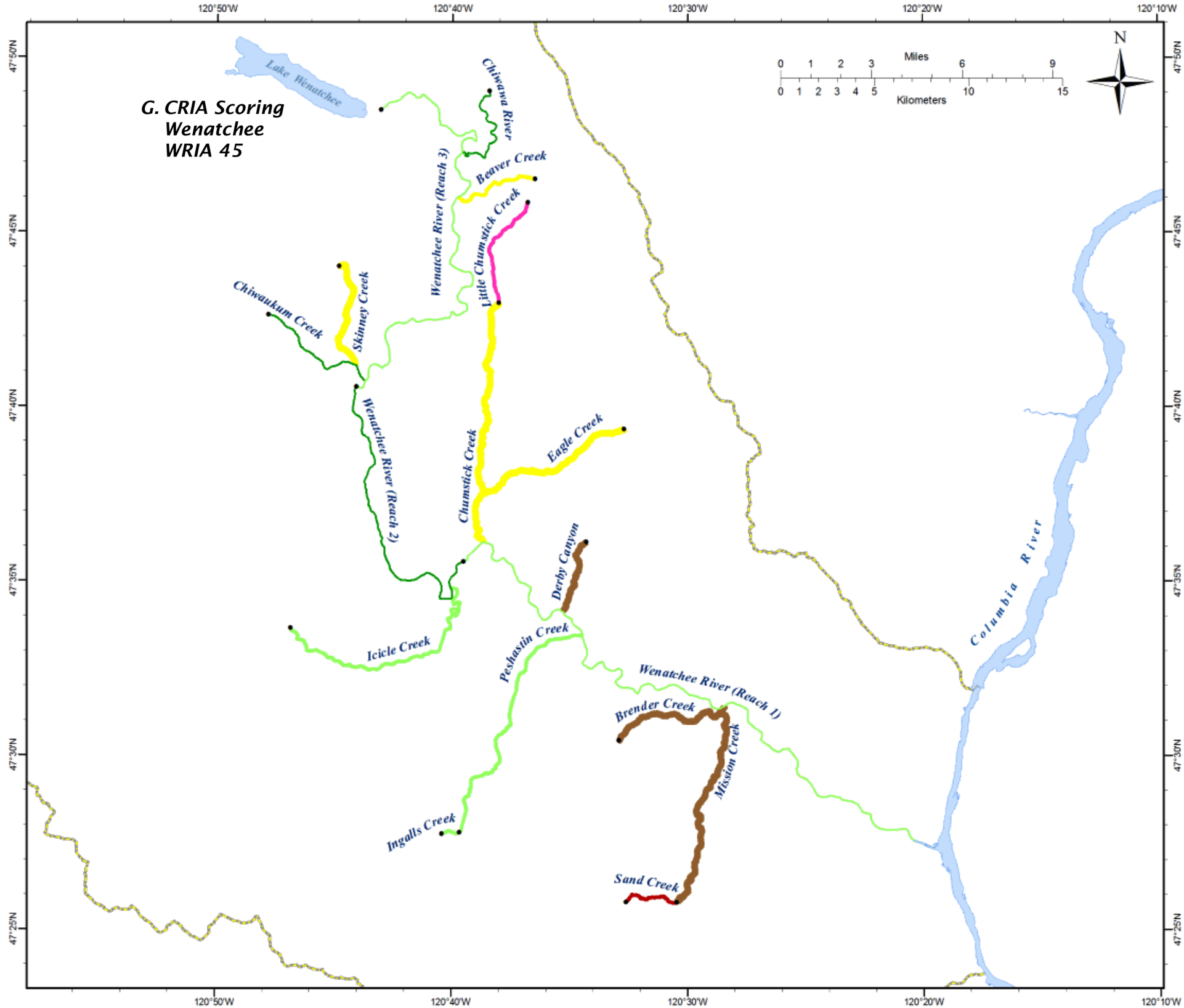
WRIA Boundary

Location of all project WRIAs (blue), location of the area mapped (boxed), and featured WRIAs (green).



WRIAs 37, 38, and 39 - Yakima River Basin - Fish, Habitat, and Flow

[intentionally blank]



DEPARTMENT OF ECOLOGY State of Washington

Washington Department of FISH and WILDLIFE

Wenatchee River Basin
WRIA 45
Combined Prioritization Scores for Fish, Habitat, and Flow

Fish Status/Utilization and Habitat Condition scores use this color scheme:

Fish Score
Low | Avg | High

Habitat Score
Good | Fair | Poor

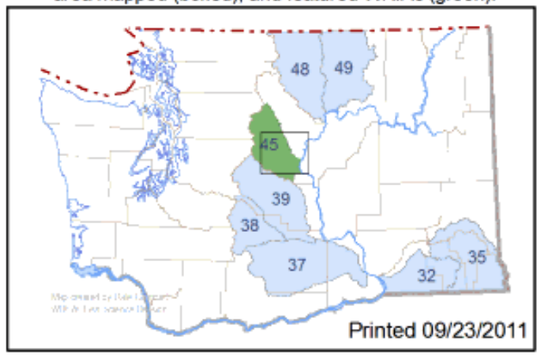
Flow Condition score uses line thickness

Good
Fair
Poor

• — Assessed Stream Reach upper extents

WRIA Boundary

Location of all project WRIAs (blue), location of the area mapped (boxed), and featured WRIAs (green).

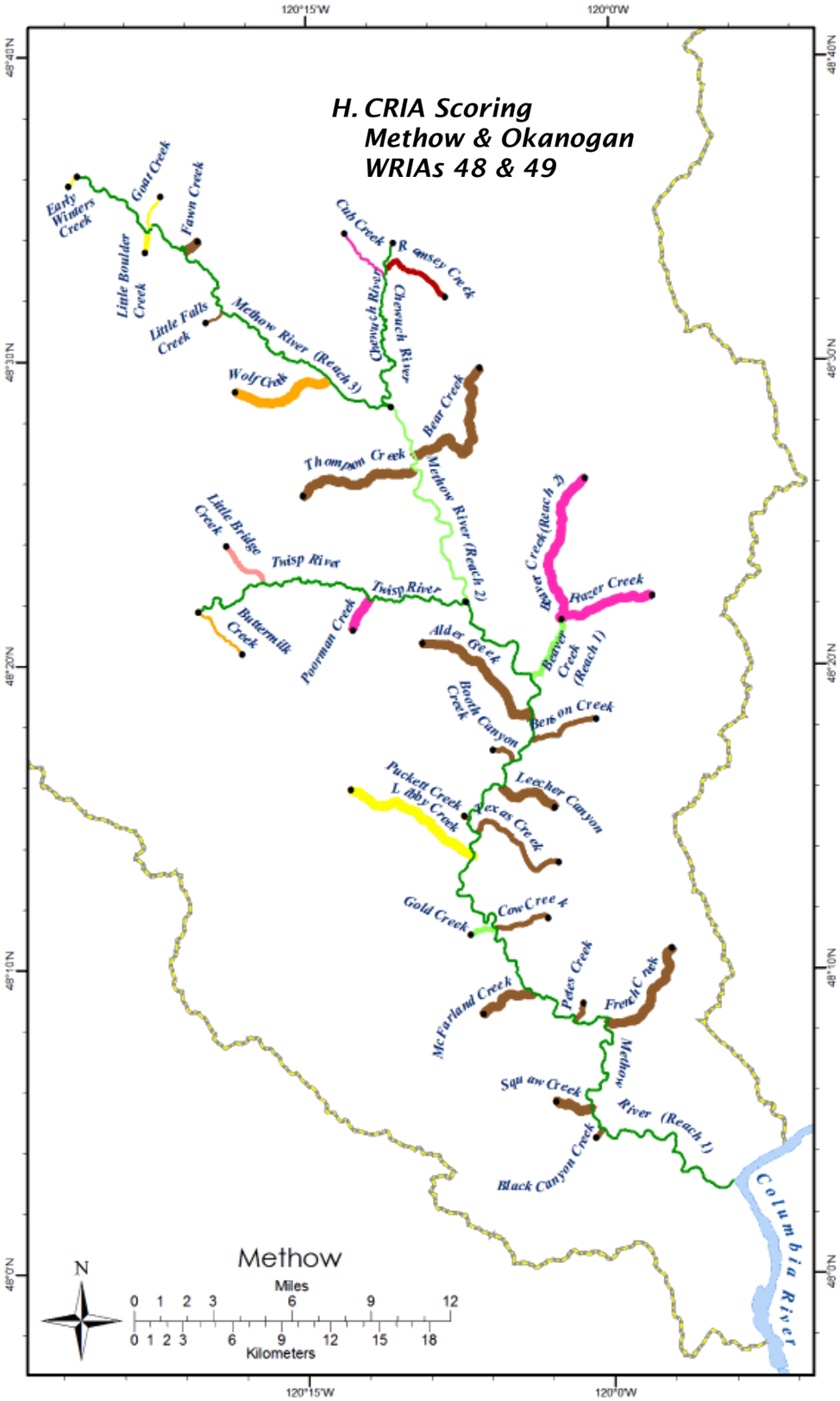


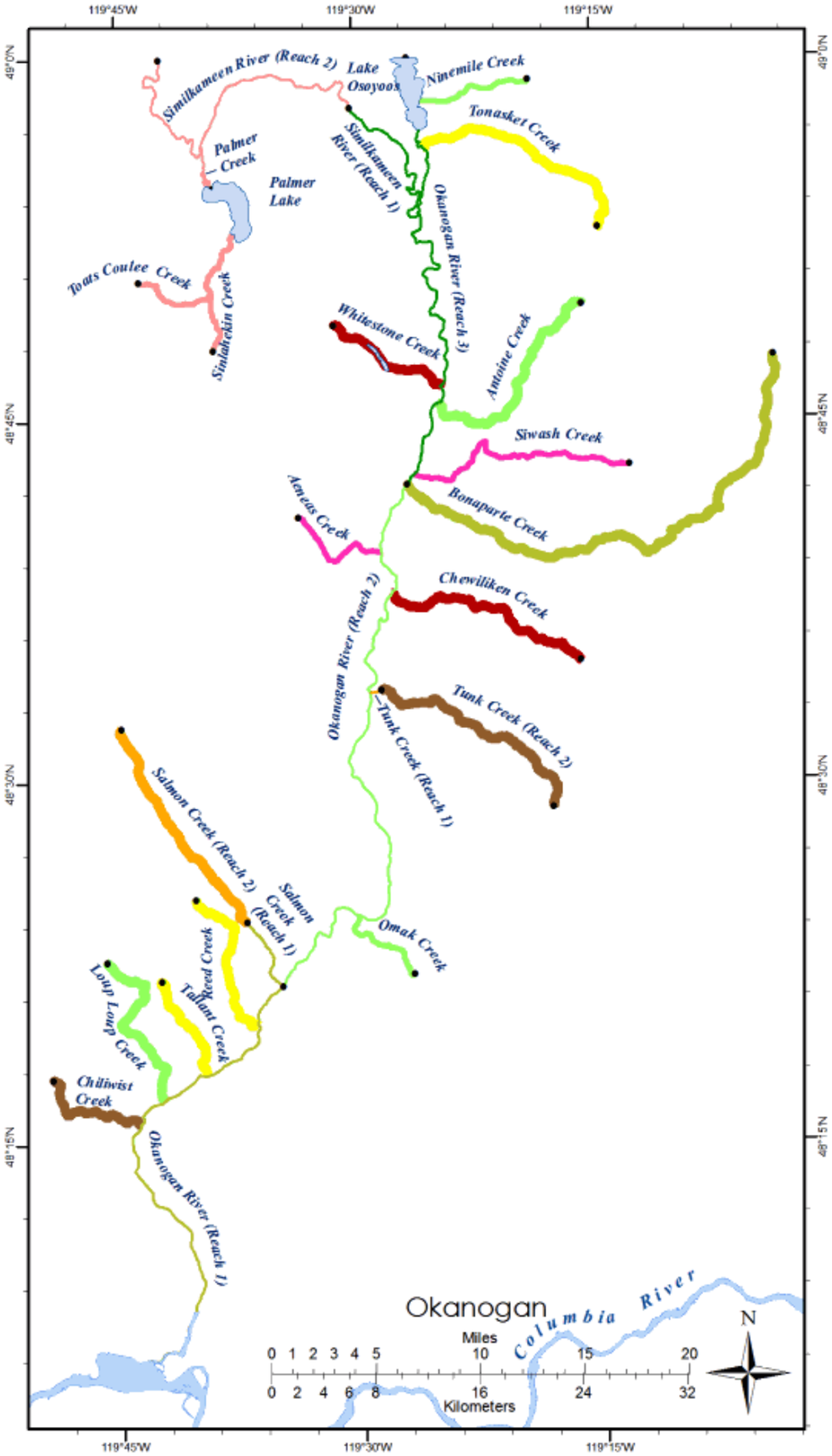
Printed 09/23/2011

WRIA 45 - Wenatchee River Basin - Fish, Habitat, and Flow

[intentionally blank]

H. CRIA Scoring
Methow & Okanogan
WRIAs 48 & 49





DEPARTMENT OF ECOLOGY State of Washington

Washington Department of FISH and WILDLIFE

Methow and Okanogan River Basins
WRIAs 48 and 49
Combined Prioritization Scores for Fish, Habitat, and Flow

Scores for Fish Status and Utilization and Current Habitat Condition are visually represented using the following color scheme:

Fish Score

Low | Med | High

Habitat Score

Good | Fair | Poor

Line thicknesses represent Flow Condition

Good

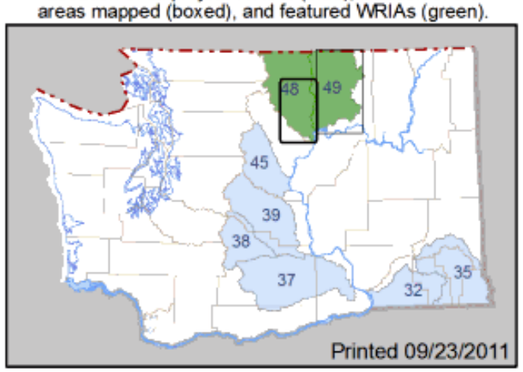
Fair

Poor

• — Assessed Stream Reach upper extents

WRIA Boundary

Location of all project WRIAs (blue), location of the areas mapped (boxed), and featured WRIAs (green).



WRIAs 48 and 49 - Methow and Okanogan River Basins - Fish, Habitat, and Flow

[intentionally blank]

V. Discussion

In general, CRIA scoring worked well, yielding results that are intuitive and consistent with existing information. For example, most of the Methow and Okanogan tributaries are depicted with fat lines, meaning they scored low for flow condition (i.e. would benefit from flow augmentation). Likewise, Upper Yakima basin tributaries upstream from Taneum Creek score low for flow (fat lines) but higher for habitat condition, as expected. On the other hand, many mainstems are shown with thin green lines, meaning they have high fish value, and good habitat and flow condition. For streams like the Okanogan, which flows through shrub steppe and suffers from high temperatures and low summer flows, this result is counterintuitive.

As expected, stream reaches that flow through heavily populated or highly irrigated agricultural areas tended to score lower for most habitat parameters. In more forested, less populous areas, stream reaches scored higher for habitat. For instance, reaches in the lower elevation areas in the Wenatchee River watershed (WRIA 45), which flow through mixed urbanization and intensive agriculture, received low to medium habitat scores overall. Reaches in the higher elevations with less agriculture and lower population density such as the Chiwawa River received higher habitat scores.

Note that the stream habitat scoring and priorities identified in the *Columbia River Instream Atlas* reflect a snapshot of conditions that existed at the time the inventories took place. Thus, the products should be reviewed and updated periodically to determine if there have been any enhancement projects or other recent changes in habitat condition within the reaches that might affect the score and priority of the streams in the CRIA project.

In addition to these comments about the scoring results, the CRIA team had a few observations about application of the tool and opportunities for improvement.

A. Broad tool, narrow application

One conclusion is that the intended application of the tool necessarily narrowed the scope of the project. In embarking on this project, team members hoped to develop a broadly applicable tool. However, while we believe the tool is excellent for its intended application, and makes best use of the elements incorporated, the potential applications are so numerous and varied that no single tool will serve them all. Our main hope as a team is that the CRIA products will become widely available, and our next steps in CRIA development will become clear based on feedback received.

B. Assumptions

Fish Presence/Distribution/Utilization: A few assumptions were necessary (noted in the scoring sheets) in order to fill out life cycle habitat utilization. For example, one assumption is that juveniles generally rear in the lower reaches of tributaries that are downstream from where they hatch but NOT upstream. We were also missing information for a few reaches because they aren't surveyed, but local wisdom was the

basis for assigning values in the absence of monitoring and we were risk-averse in adding fish to a reach (that is, if there was a reasonable chance fish could be there during a given life stage we assumed they were).

Data are accurate: The key assumption in CRIA development is that our data sources are accurate, but we were cautious. Indeed, several additions and corrections were made to SaSI as this work unfolded.

Flow data are consistent: We made a major assumption that flows obtained from the NHD Plus dataset for non-gauged reaches were comparable to our gauge data for other reaches. Staff compared NHD Plus data from known-flow reaches with the actual gauge data in order to develop a transformation methodology to align the two sources. Although this assumption is tenuous, scoring non-gauged reaches (over half the identified CRIA reaches) without employing this method would have been impossible.

C. Topics for future consideration

Is fish rearing data added-value? In many watersheds, distinguishing the rearing component of the fish score has not measurably improved scoring. This is because fish from one group or another are ALWAYS rearing. Any stock with fry that rear within the stream for 9-10 months or more will have overlaps with the next year-class such that every month has the same value for that stock. This is also true in watersheds containing multiple salmonid species. Still, distinguishing adult spawn timing and locations and juvenile rearing is an overall improvement in helping visualize salmonid life cycles.

Flow and water rights data accessibility: Ecology is progressively improving accessibility to flow and water right data. As these data become more accessible and reliable, the information on which flow scoring is based will improve. Some improvements occurred during the progression of CRIA development, however, not all data used for scoring were updated because time did not allow.

Habitat scoring for stream reaches was more difficult than first anticipated. For each attribute, time and discussion was needed to ensure the ability to score habitat equally across reaches and within WRIA's. Individual habitat attributes also garnered their own difficulties for assessments. All in all, it's difficult to develop a scheme for rating habitat attributes that does not suffer from some form of subjectivity.

Here are a few of the questions discussed for each attribute:

- Off channel habitat — Exactly how much off-channel habitat is poor to excellent?
- Floodplain connectivity — Does cover and substrate make a difference in scoring?
- Riparian conditions — What about native vs. non-native plants?
- Spawning suitability — What species are we reviewing for?

- Rearing suitability — What species are we reviewing for?
- Passage conditions — What if it's only a partial barrier to certain species at certain times of the year?

These questions and more were reviewed, discussed, and answered by creating a habitat criteria rubric that guided scoring for each stream reach.

Bull trout: Bull trout are underrepresented in CRIA because less is known about them than is known about other salmonids.

Resident fish excluded: CRIA does not include resident fish, primarily because the Columbia River water statute (Ch. 90.90 RCW) directs emphasis on salmonids. However, because the resident fish community probably doesn't vary too substantially among reaches and WRIAs in this area, scores for these WRIAs would not have changed significantly if resident fish had been included. Should CRIA be expanded into other WRIAS, species such as coastal cutthroat, Dolly Varden, sculpin, etc. would need to be included in order to reflect the different species management emphasis.

Visualization of results: Because depiction of combined scores is complex, it takes a bit of study to understand the results, and ever further thought to consider some of the seeming outliers. Again, the CRIA team hopes to get feedback from users on whether this mechanism works as a decision support tool, and/or how to improve visualization of results.

D. "It all depends on the question…"

"Which fish species/stock (or WRIA) is most important for flow restoration emphasis?" Because data for all fish species are reduced to a single score, CRIA doesn't help identify species initially (these data are available in detail in associated workbooks). CRIA doesn't help prioritize across WRIAs (at least in this initial version) because scoring and binning are not uniform across WRIAs. But even beyond that, there will be circumstances where adding water in a particular low-fish-scoring reach is critical for one life stage of a single species, which might be a high priority if that species is ESA listed. Likewise, increasing flows might be a good idea because it benefits a broad suite of species and life stages (potentially high fish score), even if some of them aren't listed under ESA. If one is looking for project locations in a WRIA that will benefit a particular species/stock, information is available through CRIA maps and workbooks to help identify those locations. But the success of those locations is also dependent on whether water is available for acquisition.

"Where should I spend my last water acquisition dollar in the eight eastern Washington critical basins?" Answering this question won't be as simple as choosing all the reaches with thick red lines (scoring "low"/"poor" for all elements) or even thin green lines ("high" for fish and habitat, "Good" for flow). This question can't be answered using CRIA alone, because it depends on which species/stock is most needy, on the extent to which flow augmentation can improve conditions for that species/stock, and on whether it is even feasible to acquire water that contributes measurably to stream flows. These are all questions that CRIA can help answer, but none of these can be answered using the CRIA products alone.

"Where can I add water to benefit the most fish during the most life stages?" CRIA without exception points to lower mainstem reaches. This sets up some potential conflicts with other analyses and recovery action plans, which point specifically to upper tributaries as the most needy for salmonid recovery. The reality is, mainstems are used by nearly every stock to get in and out of the watershed, and in most of these flow-critical watersheds there are times in which extra flow could improve migration conditions. So while the percent contribution to overall flow is likely minimal in lower mainstems (unless a huge influx of water is provided) this is still a good place to implement flow augmentation, all other considerations being equal.

"Where can I add water to create the largest percent increase in reach flow?" CRIA's answer is usually in the smaller/upper tributaries and headwaters. This is because it doesn't take much additional flow to cause a large percentage increase in overall flow. In addition, focusing flow restoration efforts on relatively small streams with functional or good-to-excellent habitat will likely provide the greatest benefits at the lowest cost. This does not always match well with the potential for water acquisition, because most diversions (potential for stream flow change) are lower in the stream systems.

It's all good: The compromise position seems to be that great opportunity for salmonid production benefits can be achieved by pursuing water acquisitions in smaller, lower elevation streams with good to excellent habitat. However, streams with good to excellent habitat in higher elevations or less populous areas should not be overlooked, nor should lower mainstems through which all stocks/species must migrate. Any flow augmentation could be helpful in restoration efforts, especially in smaller systems that have limited flow, in over-appropriated basins, and/or in combination with other recovery measures.

The reality in these eight watersheds is that flow is needed in lower mainstems AND in upper tributaries, that opportunities for water right acquisition are limited and more market-driven than resource-driven, that the easy solutions have already been implemented, and the next steps toward salmonid rebuilding will be difficult, expensive, and controversial. These truths should in no way diminish the interest and drive to provide as much flow augmentation as possible throughout eastern Washington salmon-bearing streams if for no other reason then as a hedge against climate change.

VI. For Further Information:

… on the CRIA Project:
Washington Department of Fish and Wildlife
Teresa Scott 360-902-2713 teresa.scott@dfw.wa.gov .
Jonathan Kohr 509-575-2740 X306 jonathan.kohr@dfw.wa.gov
Dayv Lowry 360-902-2558 dayv.lowry@dfw.wa.gov
Andy Weiss 360-902-2487 andrew.weiss@dfw.wa.gov

… on OCR's Columbia Basin Long-term Water Supply & Demand Forecast:

http://www.ecy.wa.gov/programs/wr/cwp/wsu_supply-demand.html

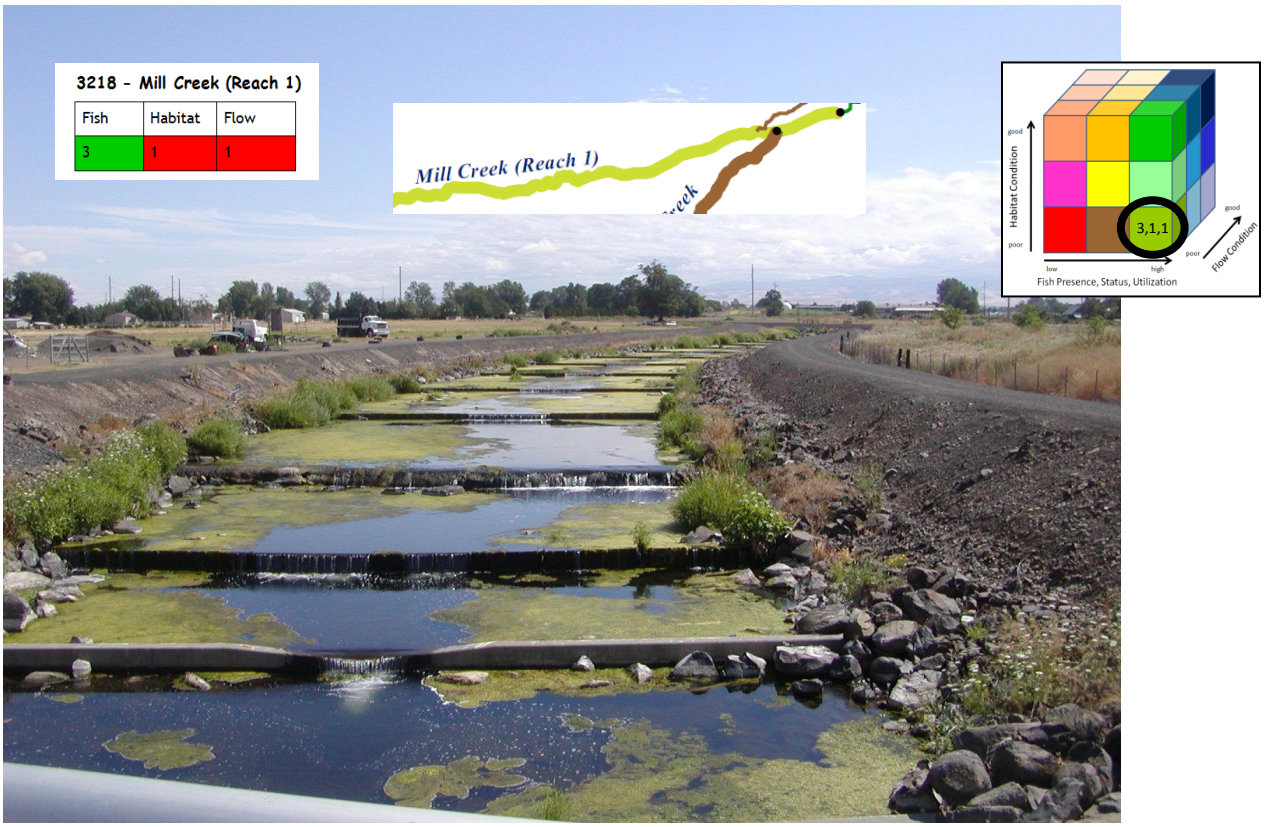


Figure 3 Mill Creek (WRIA 32) is an example of a reach having poor habitat and flow condition, but high fish utilization. This reach would be a good candidate for flow restoration along with habitat work. For more information, refer to Appendix B.

(Photo by Jonathan Kohr)

VII. Appendices and Workbooks

A. Methodology
B. Walla Walla WRIA 32
C. Middle Snake WRIA 35
D. Yakima Basin WRIAs 37, 38, 39
E. Wenatchee WRIA 45
F. Methow WRIA 48
G. Okanogan WRIA 49

Workbooks (xls, xlsx):

- All_Encompassing_Reach_Information
- CRIA Habitat Condition Scores
- Individual workbooks, as follows:

WRIA	WATERSHED	WORKBOOK/INFORMATION
32	Walla Walla	• Fish • Flow • WR (water rights)
35	Middle Snake	• Fish • Flow • WR
37, 38, 39	Yakima Basin	• Fish • Flow • WRIA 37 WR • WRIA 38 WR • WRIA 38 WR
45	Wenatchee	• Fish • Flow • WR
48	Methow	• Fish • Flow • WR
49	Okanogan	• Fish • Flow • WR