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Project fact sheets and links to all previous work, including technical reports and reference documents can be found at http://whatcomcounty.us/2260/Agricultural-Watershed-Pilot-Project

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Abbreviations used in this document

AU	Assessment Unit/Analysis Unit (Puget Sound Watershed Characterization Project)[1]
AWCA	Agriculture-Watershed Characterization Area
CDID	Consolidated Drainage Improvement District
DID	Drainage Improvement District
DO	Dissolved oxygen
NRCS	Natural Resource Conservation Service
PDR	Purchase of Development Rights
PSWC	Puget Sound Watershed Characterization
RSA	Rural Study Area
USDA	United States Department of Agriculture
WCD	Whatcom Conservation District
WCPDS	Whatcom County Planning & Development Services
WCPW	Whatcom County Public Works
WDFW	Washington Department of Fish & Wildlife
WID	Watershed Improvement District
WRIA 1	Water Resource Inventory Area 1

[1] In earlier pilot documents, AUs were also referred to as "Analysis Units"

1 Introduction

1.1 Background and purpose of agriculture-watershed characterization and mapping

Agricultural operations and watershed features have long been key components of Whatcom County's distinct landscape. Both are critical for our community's economy and health. While it may seem that agriculture and watershed functions are at odds with one another after decades of regulations and planning, there are in fact many locations where protection of agricultural lands and enhancement of watershed functions can result in mutual benefits.

Healthy watersheds provide a wide range of watershed ecosystem services. These include: surface and ground water supply and recharge; water storage and flood protection; production of food, fish, fiber and building materials; soil processes and sediments; cycling of nutrients, transport of pollutants; and protection against natural hazards such as floods, droughts and landslides. These many watershed services rely on processes involving water flow and storage, water quality, plants and animals.

Farming relies on watershed services as part of the "natural infrastructure" for production. Agricultural production requires enough water of suitable quality for irrigation, livestock and processing; healthy high-quality soils; drainage of fields and protection from flooding. In addition, agricultural systems require: a large enough land base to sustain a vibrant agricultural economy; access to labor, markets and additional "built infrastructure".

However, farms are also providers of watershed services, the most obvious being food production. The preservation of open space, wildlife corridors, protection of soils and flood water storage are other watershed services that can be provided on actively farmed land. Landowners and farmers who participate in strategic actions to maintain, repair or protect larger-scale watershed processes can help to improve watershed health and enhance critical watershed services.

Definitions: for the purposes of the Ag-Watershed Project,

- *agricultural enhancement* entails maintaining the land base, soil, water, air, plants, animals, production capacity and natural infrastructure necessary to keep farmers farming over the long term as land uses and economic situations change over time. Thus "agricultural enhancement" and "agricultural protection" include but are not limited to agricultural land protection alone.
- *watershed enhancement* actions are those actions which improve the ability of the watershed to provide its natural benefits and services to communities. Watershed enhancement includes the idea of "repairing" major landscape processes related to hydrology and ecosystems, in order to maintain, protect or improve the delivery of watershed services.

The agriculture-watershed characterization maps and tables combine existing spatial data with field experience and farmers' local knowledge to identify agricultural priorities and needs in the lowland areas of Whatcom County and to bring those into the planning conversation with watershed priorities and needs. The results of this work are intended to support integrated land and water planning at watershed scale, and to support the identification and prioritization of agricultural and watershed enhancement actions at farm and reach scale. These products will be provided to the Watershed Improvement Districts (WIDs) and Special Districts to inform and complement their current comprehensive planning work.

The characterization and mapping results presented in this report have been derived from multiple information sources. The information is provided for planning purposes only, is not for use in regulatory actions, and is intended to contribute to ongoing Whatcom County Planning and Development Services efforts to improve agricultural and watershed conditions.

1.2 About the Ag-Watershed Project

The Ag-Watershed Project is examining ways to reward the good things that farmers already do ¾ those beneficial actions that go beyond existing regulation to maintain, repair or protect large-scale watershed processes, while also strengthening agriculture in Whatcom County.

The Ag-Watershed Project is a research and development project funded by a National Estuary Program Watershed Protection and Restoration Grant (June 2012 to June 2016) to Whatcom County Planning & Development Services, administered by the Washington Department of Commerce. Project partners include: Whatcom Farm Friends–Community Education, Whatcom Conservation District and Washington State Department of Fish & Wildlife.

Project fact sheets and links to all previous work, including technical reports and reference documents can be found at http://whatcomcounty.us/2260/Agricultural-Watershed-Pilot-Project

1.3 What is in this document

This document contains the reference information, work session information and results of the agriculture-watershed characterization and analysis conducted in 2016. The document is arranged into sections that allow easy access to specific categories of information. An overview of the document contents is also provided in the color-coded table in the front of this document.

Sections 1 and 2 provide background information about the Ag-Watershed Project, the characterization and mapping task, and the Sumas Watershed Improvement District.

Section 3 is a summary of the overall methodology and results. It can be read as a stand-alone resource to obtain an overview of the process and the outcomes.
Section 4 contains a detailed description of the agricultural characterization methodology, and includes the agricultural prioritization maps and the detailed tables of information about agricultural priorities.
Section 5 contains a detailed description of the watershed characterization methodology, and includes the watershed prioritization maps and the detailed tables of information about watershed priorities.
Section 6 contains the set of agricultural and watershed reference maps that were used in generating the agriculture-watershed characterization results.
Sections 7 and 8 contain the bibliography and glossary of key terms. Sources of information cited in the text of the report are included in the bibliography but are also provided in footnotes for easy reference.
Appendices contain additional supporting information for future reference by the WID.

This document is one of a series of six reports. A customized report has been prepared for each of the Watershed Improvement Districts in Whatcom County. Reports for other Watershed Improvement Districts can be accessed through the WID websites[2] or through the Ag-Watershed Project page.[3] The results of the characterization and mapping have also been incorporated into an online story map that can be accessed at http://arcg.is/29MYdYu[4]

[2] Links to each WID website can be found at http://www.agwaterboard.com/
[3] See http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project
[4] Whatcom County Agriculture-Watershed Project (2016). Agriculture-Watershed Characterization & Mapping, Whatcom County. Story map prepared for the Whatcom County Agriculture-Watershed Pilot Project, Whatcom County Planning & Development Services, Bellingham, using ArcGIS® software by Esri. http://arcg.is/29MYdYu

2 Overview of the Sumas Watershed Improvement District

The Nooksack River watershed and certain adjacent basins (including Lake Whatcom) which discharge to the marine waters of Georgia Strait and Puget Sound and to the Fraser River system in Canada are included in Water Resource Inventory Area 1 (WRIA 1), as designated by the State of Washington. The majority of Whatcom County is in WRIA 1 with a portion of the WRIA 1 extending into neighboring Skagit County (see Figure 1 and Figure 2).

Each Watershed Improvement District (WID) is a unique agricultural neighborhood in Whatcom County's broader farming community. Natural characteristics of the soil, locations of surface and ground waters and topography of the area help to delineate viable areas for the many types of agricultural production taking place. The boundaries of the WIDs have been selected not only to reflect the characteristics and interests of different agricultural neighborhoods, but also to align where possible with the geographic boundaries of water management areas used in mapping and planning of water resources by local and state governments and the agricultural land classifications used by local land use planners and agricultural specialists.

The Sumas Watershed Improvement District (see Figure 3) is located in the eastern lowland area of Whatcom County, to the north and east of the main Nooksack River within WRIA 1. The area is predominantly agricultural, being bounded by the foothills of the North Cascades Range on the east, and the USA-Canada border to the north. A significant proportion of the soils in the Sumas WID has been classified by the USDA Natural Resources Conservation Service as Prime or Prime if managed[5] (see Prime Soils reference map).

The WID area encompasses 18,563 acres in total, and covers much of the Sumas River watershed, part of which is shared with Canada. The WID area also includes portions of significant tributaries to the Sumas River: Johnson Creek, Breckenridge Creek, Swift Creek and Dale Creek as well as a small portion of Smith Creek and the Saar drainage east of the City of Sumas. These tributaries and other drainages are included in Water Resource Inventory Area 1 (WRIA 1) and all except Smith Creek drain north to the Fraser River system.

The WID contains two other special purpose districts within its boundaries, whose primary purpose is to improve and maintain drainage of agricultural land within those portions of the WID. These are Drainage Improvement District #15 and Consolidated Drainage Improvement District #31 (see Special Districts reference map).

More information about the Sumas WID can be found at their website http://www.sumaswid.com/

[5] U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054242

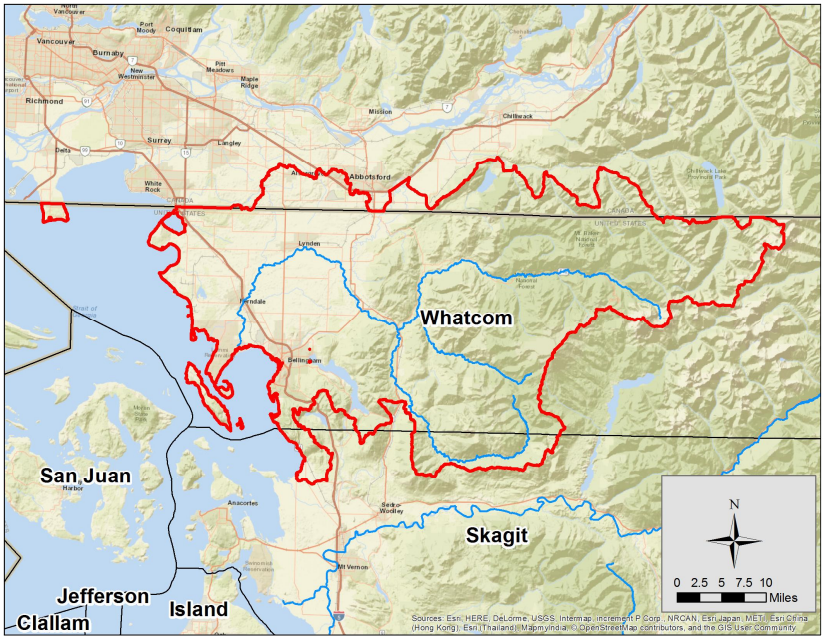

Figure 1. Regional map showing general location of Whatcom County and Water Resource Inventory Area 1 (red boundary)

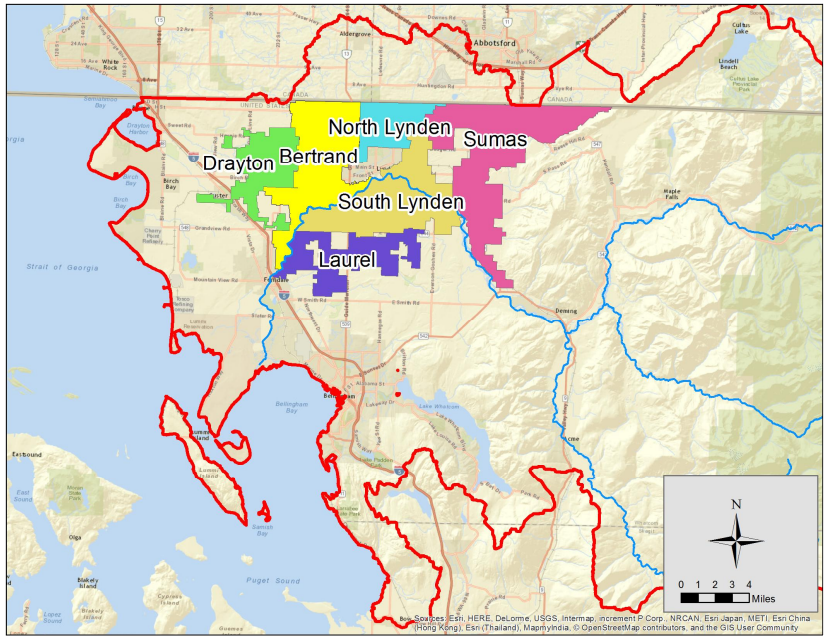

Figure 2. Map showing Water Resource Inventory Area 1 and the Sumas Watershed Improvement District

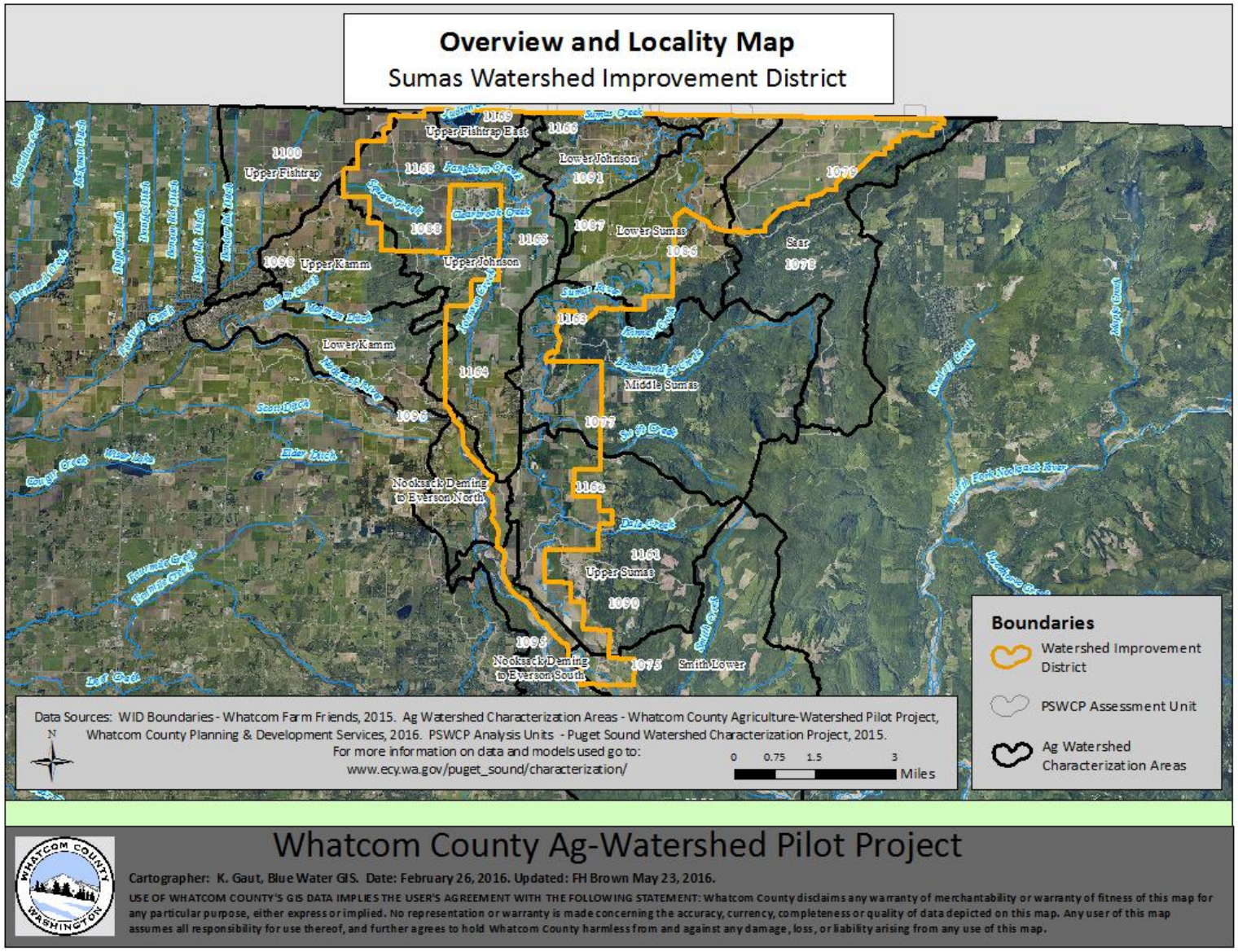

Figure 3. Sumas WID: Overview and locality map

3 Summary results and approach used for agriculture-watershed characterization

3.1 Pilot characterization and mapping (2012)

The methodology for agriculture-watershed characterization and mapping was developed and pilot-tested during Phase 1 of the Ag-Watershed Project. The pilot focus area covered the Bertrand, Fishtrap and Kamm watersheds. The pilot results are reported in the Phase 1 report on mapping and characterization (Gill, 2013).[6] Project Fact Sheet 2 provides additional background information on the agriculture-watershed characterization and mapping process.[7]

Information that was gathered during the pilot study in 2012 was reviewed and updated and has been incorporated into the 2016 agriculture-watershed characterization reports for the Bertrand, North Lynden and South Lynden Watershed Improvement Districts.

3.2 Methodology used for the 2016 WID characterization and mapping

Areas within the Sumas Watershed Improvement District (WID) have been prioritized for both watershed and agricultural enhancement. This work has used an approach of structured combination and integration of local field knowledge and experience with a series of reference maps and tables, all of which draw on existing information and data.

A work session was held with Sumas WID members and technical staff of local agencies in January 2016, during which participants used maps to identify and prioritize the type and location of agricultural and watershed services that could potentially be enhanced on agricultural land where there is potential for mutual benefit to both agricultural and watershed systems.

3.2.1 Watershed analysis

The results of the watershed characterization and mapping for the Sumas WID include tables and summary maps which describe the watershed services that are most needed for a healthy watershed (including the restoration of salmon populations) and where they could be enhanced in the watershed.

In order to generate these tables and summary maps for the Sumas WID, the information contained in the watershed reference maps (see section 6.2 of this report) was combined with the results of watershed characterization[8] (water flow assessments for WRIA 1 provided by the Department of Ecology in a series of maps showing the areas which are most in need of either restoration or protection of larger-scale water flow processes). The work session participants reviewed this information, provided additional local field knowledge on site-specific watershed priorities, and identified potential actions or projects that could help to achieve watershed priorities. A more detailed description of the watershed characterization methodology is provided in section 5.1 of this report.

[6] Gill P (2013). *Agriculture-Watershed Characterization and Mapping Report for the North Lynden watersheds*. Prepared for the Whatcom County Agriculture-Watershed Pilot Project, Whatcom County Planning & Development Services, Bellingham. http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project

[7] Ag-Watershed Project fact sheets can be downloaded from http://whatcomcounty.us/2260/Agricultural-Watershed-Pilot-Project

[8] Watershed 'characterization' is a set of water and habitat assessments that compare areas within a watershed for restoration and protection value. It is a coarse-scale tool that supports decisions regarding where on the landscape should efforts be focused first, and what types of actions are most appropriate to that place. See http://www.ecy.wa.gov/puget_sound/characterization/index.html

3.2.2 Agricultural analysis

The results of the agricultural characterization and mapping for the Sumas WID include tables and summary maps which describe the agricultural services that are most needed for the long term success of agriculture, and where they could be enhanced in the watershed. The primary focus was on the "natural infrastructure" for agriculture: soils, water, adequate drainage and flood protection, and long-term protection of the agricultural land base.

Methods used to prioritize agricultural needs are based on a combination of: information from (i) existing agricultural land protection programs in Whatcom County, (ii) available GIS data contained in the agricultural reference maps (see section 6.1of this report) and (iii) local knowledge provided at the WID work session.

At the WID work session, participants assisted the project team to collate and evaluate information on agricultural system needs and priorities in the WID area, and to locate the different agricultural system needs and priorities on base maps of the WID area.

A more detailed description of the methodology is provided in section 4.1 of this report.

3.3 Application: How to use the results of the agriculture-watershed characterization and mapping

The WID can use the characterization maps and tables of agricultural and watershed priorities to support their land and water planning, management, and project funding.

The characterization maps and tables should help the WID to identify, prioritize, and strategically locate practical beneficial projects and actions at the farm or reach-scale, and to enhance agricultural operations and watershed functions in the WID area.

The characterization maps and tables should also help the WID identify project opportunities that enhance watershed processes while strengthening agriculture where agricultural and watershed priorities are complementary, and to find acceptable trade-offs where they compete.

These results, which incorporate local knowledge and farmer insights, may also be used to communicate the WIDs' priority enhancement needs to planners for consideration in broad scale planning such as Whatcom County's Comprehensive Planning Process. More information on how to use these results in planning can be found in the Ag-Watershed Project Fact Sheet 5, included as Appendix D of this report.

3.4 Summarized results for the Sumas Watershed Improvement District

The summary table below (Table 1) and the summary maps in Figure 4 highlight the most significant watershed and agricultural enhancement opportunities within the Sumas WID area. Check marks in Table 1 indicate where a specific enhancement priority was identified during the characterization and mapping process. Detailed descriptions of priorities, the sources for data and information on priorities, and descriptions of opportunities for enhancement through specific actions can be found in Table 3 and Table 5 of this report.

Table 1. Summary results of agriculture-watershed characterization and mapping for the Sumas WID
(See locality map in Figure 3 for locations of agriculture-watershed characterization areas)

	Johnson Creek			Lower Sumas		Middle Sumas		Upper Sumas		Nooksack River	
Agriculture-Watershed Characterization Area:	Upper Johnson	Lower Johnson	Upper Fishtrap E	Saar	Lower Sumas River	Brecken-ridge	Swift	Dale & Upper Sumas River	Smith	Nooksack main channel (S)	Nooksack main channel (N) & lower Smith
Agricultural Enhancement Priority (See Table 2 for details)											
Prime agricultural soils	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü
Water quality for crops and livestock	-	ü	-	ü	-	ü	ü	-	-	-	-
Water quantity	ü	ü	ü	ü	ü	ü	-	ü	-	ü	-
Agricultural drainage	ü	ü	-	-	ü	ü	-	ü	-	-	-
Flood protection	ü	ü	ü	-	ü	ü	ü	ü	ü	ü	ü
Agricultural land base:											
Important agricultural land	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü
Protection from development pressure	ü	-	-	-	-	-	-	ü	ü	-	-
Other	-	-	-	-	-	-	-	-	-	-	-
Watershed Enhancement Priority (See Table 5 for details)											
Water Quality:											
Nutrients, Ammonia-N	-	-	-	-	-	-	-	-	-	-	
Bacteria	ü	ü	-	-	ü	ü	-	-	-	ü	
Temperature	-	-	-	-	-	-	-	ü	-	-	
Dissolved oxygen	ü	ü	-	-	ü	-	-	-	ü	ü	
Other:	-	-	-	-	-	ü (bioassessment)	ü asbestos (natural)	ü (bioassessment)	-	-	
Habitat:											
Salmon spawning (current, documented)	ü	-	-	ü	-	ü	-	ü	ü	ü	
Anadromous fish	ü	ü	-	ü	ü	ü	ü	ü	ü	ü	
Wildlife	ü	-	ü	ü	ü	ü	ü	ü	-	-	
Wetland	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	
Water flow processes:[9]											
Delivery	ü	ü	ü	ü	ü	ü	ü	ü	-	ü	
Discharge	-	-	ü	-	-	ü	-	-	ü	ü	
Recharge	ü	ü	ü	ü	ü	ü	ü	ü	-	ü	
Storage	ü	-	-	-	ü	-	-	-	ü	ü	
Other											

[9] Check marks are shown in the summary table if the recommendation for any water flow process is indicated as highest restoration/restoration/highest protection/protection.

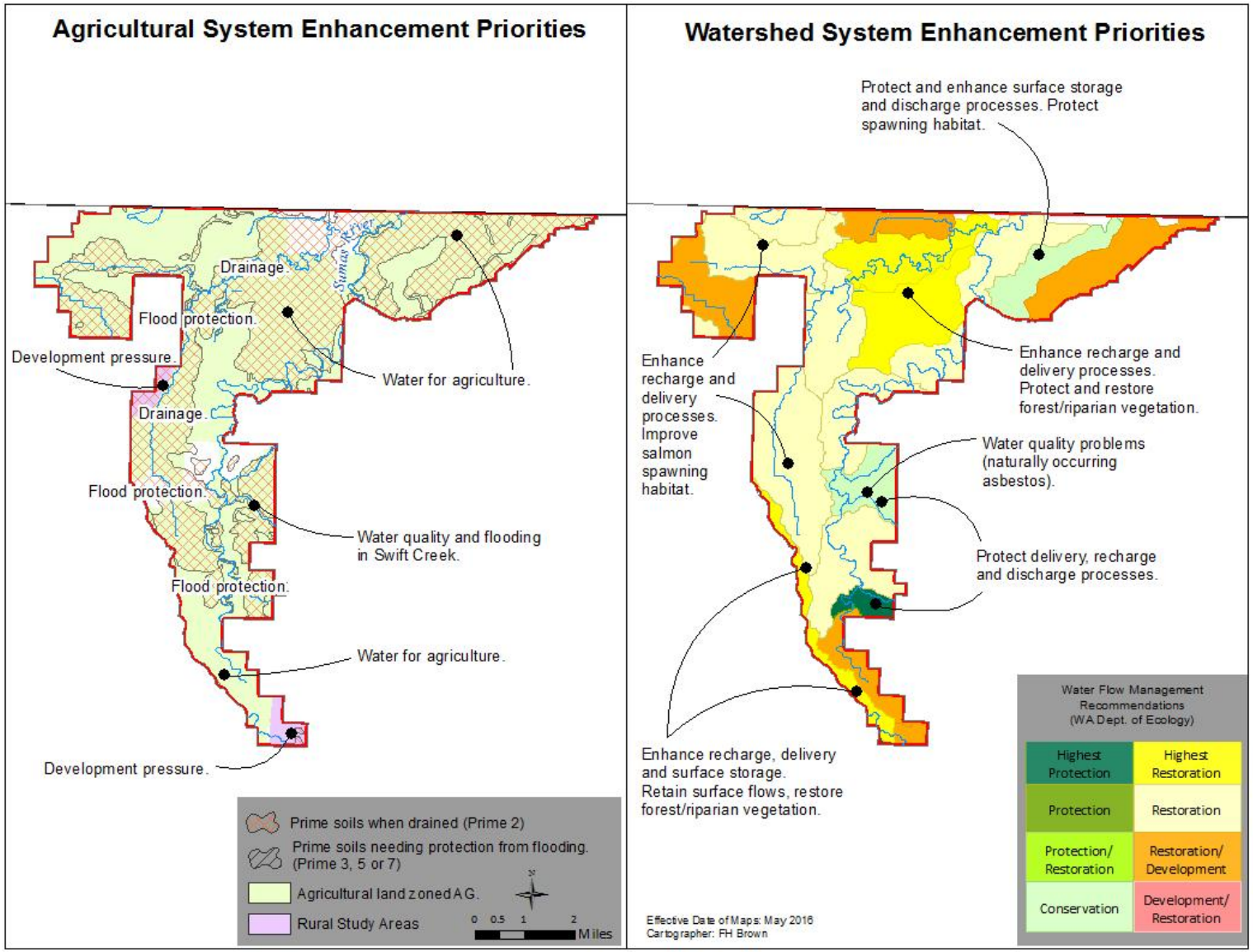

Figure 4. Sumas WID: Summary maps of agricultural and watershed enhancement priorities

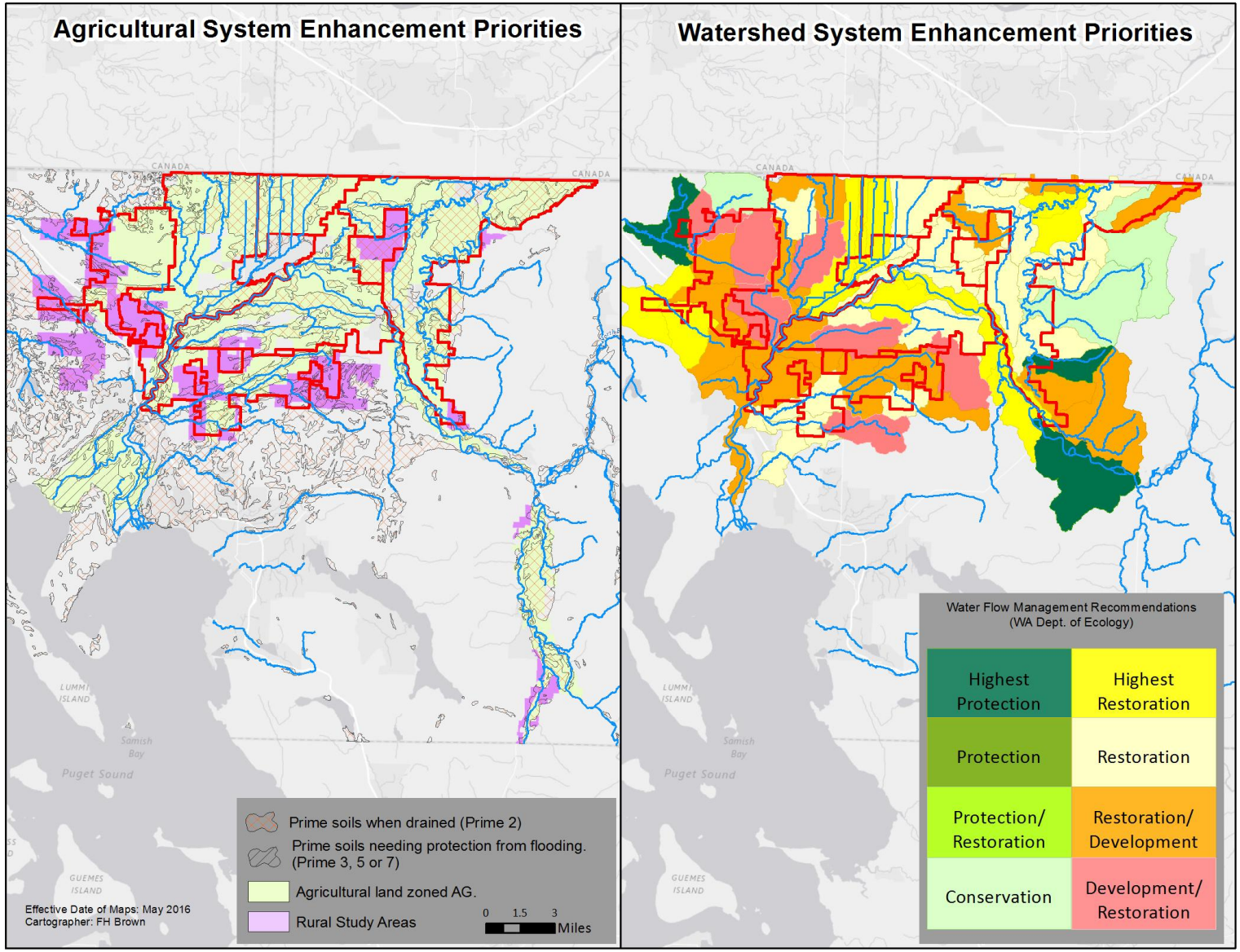

Figure 5. General agricultural and watershed enhancement priorities for the lowland areas of Whatcom County

3.5 Possible future challenges and priorities

Future challenges (1- 10 years) may include issues listed below. See Table 1 for the full summary results of agriculture-watershed characterization and mapping for the Sumas WID.

- Water quantity: Access to legal irrigation water is a key priority in 8 of the 11 sub-basins within the Sumas WID (87 new applications have been filed in the WID area). Johnson Creek and the Sumas River are closed year-round to further appropriations unless mitigated. Smith Creek is closed to new withdrawals from May 1 to October 31 each year.[10] Restrictions on irrigation from creeks, tributaries, and other surface water sources are in place until instream flows levels are met during critical periods for fish per the existing Nooksack Instream Flow Rule.[11] Some Group A public water suppliers do not have adequate water rights in proper locations to meet projected future demand.[12]
- Protection of agricultural land from development pressure: All 11 sub-basins within the Sumas WID area contain important agricultural land and prime agricultural soils. Land in the Sumas is WID is largely zone Agriculture (AG). Additional residential growth is projected in small sections of the Upper Johnson and Smith sub-basins.
- Water quality: Eight sub-basins have reported surface water quality impairments due to either high levels of fecal coliform bacteria, low dissolved oxygen, temperature, bio-assessment, or a combination of these. Naturally occurring asbestos is present in Swift Creek sediments. Groundwater in the Sumas-Blaine aquifer, which underlays much of the Sumas WID, is contaminated with nitrates and there are high iron concentrations in the Sumas Valley area.
- Drainage & flood management: Six sub-basins contain prime if drained soils. Flood protection is a priority throughout most of the WID area, and drainage is important in the central WID area, north of Smith and west of Saar (excluding Upper Fishtrap East). Maintaining the effectiveness of drainage ditches is important for drainage, flooding and water quality.

[10] WA Dept. of Ecology, 2012. *Focus on Water Availability, Publication 11-11-006.* https://fortress.wa.gov/ecy/publications/documents/1111006.pdf [last accessed June 3, 2016]

[11] WAC 173-501 (1985). Instream Resources Protection Program – Nooksack Water Resource Inventory Area 1.

[12] Whatcom County Coordinated Water System Plan Update (2016) http://www.whatcomcounty.us/1035/Coordinated-Water-System-Plan-Update

4 Agricultural characterization & mapping for the Sumas Watershed Improvement District

4.1 Methodology

4.1.1 General approach

The general approach used in this work has been to identify and characterize

- what the priority agricultural needs are in the WID area, and why these are priorities for farming,
- where these are most needed in the WID area for the long term success of agriculture,
- what are the potential opportunities for agricultural enhancements that can address these needs, and
- which specific actions at reach-scale or farm-scale might be most effective in meeting agricultural enhancement needs in the WID.

The method used to characterize, prioritize and map agricultural enhancement needs within the area of the Watershed Improvement District (WID) was developed and used in the pilot study,[13] and has since been adapted and refined as described here. The methodology relies on the structured combination of information derived from

(i) existing agricultural land protection programs in Whatcom County,

(ii) available GIS data used to prepare the agricultural reference maps, and

(iii) local knowledge provided by participants in the WID work session.

[13] Gill P (2013). *Agriculture-Watershed Characterization and Mapping Report for the North Lynden watersheds.* Prepared for the Whatcom County Agriculture-Watershed Pilot Project, Whatcom County Planning & Development Services, Bellingham. http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project

4.1.2 What are the priorities for agriculture and why are these needed?

A viable agricultural system relies on three kinds of infrastructure:

- Natural infrastructure including available land, soils, water, air, plants and animals;
- Built infrastructure including product packing and processing facilities, livestock shelter and management facilities, transportation and water conveyance systems for irrigation, land drainage and flood protection;
- Supporting socio-cultural-economic infrastructure including research capacity, cultural value, knowledge and information transfer, labor, regulations and governance, business structures, access to markets.

The agricultural characterization has been focused on those aspects of agricultural infrastructure that are considered to be priorities for maintaining a viable agricultural industry in Whatcom County, and that are suited to mapping. These general priorities were initially identified in the pilot agricultural characterization and mapping workshop held in Lynden in October 2012[14] with farmers, agriculture professionals, planning and conservation agency staff:

- Availability of prime agricultural soils for all crop types and rotations;
- Water quantity for agricultural activities (irrigation, livestock and agricultural processing);
- Water quality for agriculture (livestock, crops, processing);
- Land drainage including timing of drainage for soil preparation, crop growth and harvesting;
- Protection of fields from flooding at critical times in the growing season;

[14] Gill, P. (2013). *Ibid.*

- Protection of the agricultural land base from conversion for non-farming land uses;
- Protection from development pressure and agricultural-residential conflicts.

4.1.3 Detailed description of process for characterizing and mapping agricultural enhancement priorities

Step 1: Delineation of Agriculture-Watershed Characterization Areas. The WID area was divided into several smaller "Agriculture-Watershed Characterization Areas" (AWCAs), based on a combination of the WRIA 1 water management areas[15] and the Puget Sound Watershed Characterization Project Assessment Units (see section 5 in this report for explanation of the assessment units). The AWCAs reflect hydrological and agricultural characteristics in the landscape, are recognizable for WID members and are of a size that is practical for the WIDs to utilize in their planning processes. Importantly, the AWCAs represent common areas within which to characterize and map both agricultural and watershed enhancement priorities.

Step 2: Agriculture priority maps. The project team assembled a series of agriculture priority maps based on analysis of GIS data from Whatcom County's existing Agriculture Program and other relevant sources. The agriculture priority maps included, for each agriculture-watershed characterization area (AWCA) associated with the WID:

- Proportion of prime soils (Figure 6);
- Drainage needs for agricultural land (Figure 7);
- Flood protection needs for agricultural land (Figure 8);
- Important agricultural land and needs for protection of the agricultural land base (Figure 9);
- Water quantity needs for agricultural activities (Figure 10).

Step 3: Agriculture reference maps. The project team prepared a series of agriculture reference maps to provide background information for the characterization and mapping process, using GIS data from Whatcom County and other relevant sources. The agriculture reference maps included:

- Agriculture priority areas identified in the County's Agriculture program as important agricultural land,[16] including land within the Agriculture District (AG), land in the Rural Study Areas, and land on which agricultural conservation easements have been placed through the Purchase of Development Rights program (Figure 17);
- Agricultural land use inventory,[17] showing current land cover on agricultural lands in the WID (Figure 18);
- Location of Prime farmland soils as defined by the USDA (Figure 19);
- Potential residential development rights on agricultural land (Figure 20);
- Water right points of diversion – existing water rights and new applications (Figure 21);
- Special Districts that are wholly or partially within the WID area, including drainage, diking and flood control districts (Figure 22);
- Surface water quality impairments (Figure 27).

[15] Surface Water Delineation Boundaries in WRIA 1 (November 2002). http://wria1project.whatcomcounty.org/uploads/PDF/Maps/WRIA%201%20Watersheds%20&%20Streams%20V3_draftscreen.pdf

[16] *Whatcom County Agricultural Strategic Plan*. 2011. Planning & Development Services Published May 17, 2011; Re-Published July 27, 2011 http://www.whatcomcounty.us/DocumentCenter/View/3630

[17] Whatcom County Agricultural Land Cover Analysis 2013. Whatcom County Planning & Development Services: Agricultural Program, May 2013 http://www.co.whatcom.wa.us/DocumentCenter/View/3989

Step 4: WID work session. The WID commissioners hosted a work session to bring together participants with local knowledge of agriculture in the WID area, including farmers and residents, agency staff and agriculture professionals. At the work session, participants gathered around several large printed maps of the WID area and discussed the agricultural and watershed priorities in the WID. Participants were provided with a set of the reference maps to use in the discussion as needed. Participants' inputs on agricultural priorities and specific actions were compiled by the project team as notes in a series of tables (see Table 3 in this report) and as notes on the large desk-top maps.

Step 5: Characterization and determination of agricultural enhancement priorities and specific actions. The project team added information from the agricultural priority maps and other reference documents to the detailed agricultural enhancement tables, along with the information provided by the work session participants (see Table 3). Agricultural priorities were determined for each Agriculture-Watershed Characterization Area (AWCA) by combining the reference information and the work session information as shown in Table 2 below. Where specific actions at specific locations were suggested by work session participants, these were included in the Agriculture Priority Actions Map (see Figure 11).

Step 6: Mapping of agricultural enhancement priorities. A summary agricultural enhancement map was prepared (Figure 4) to show, as far as possible in a single map, the locations of agricultural priorities including prime farmland soils, important agricultural land, flood protection and agricultural drainage.

Table 2. Methodology for determination of agricultural enhancement priorities in the Sumas WID.

1. Primary indicator of priority: Refer to the reference maps and reference documents for a substantiated agricultural priority in each agriculture-watershed characterization area according to the criteria below. If a criterion is met for indicating an agricultural priority, then add this in yellow highlight to the detailed agricultural characterization tables, and put a check mark in the summary table of agricultural and watershed enhancement priorities (Table 1).		
2. Modifiers: Refer to the work session participants' comments for this area to see whether their comments might modify the indicator of priority or would support a priority being added to the table, as explained below. Modify the agricultural priority indicators in summary Table 1 and detailed Table 3 as needed.		
3. Specific actions/opportunities: If the participants recommended specific actions to address priority needs, then record these in the "possible actions" column in the detailed agriculture characterization tables. Specific actions that can be tied to a specific location should be placed on the agricultural priority actions map. Specific actions that are more general can be listed in the possible actions column of the detailed agricultural characterization tables.		
Priority	Criteria for indicating priority	Modifiers
Prime agricultural soils	>50% of the area is Prime farmland (any prime soils category 1-10 according to USDA definitions for prime farmland)	-
Water quality for crops and livestock	Note WA Dept. of Ecology water quality impairments in category 5, 4a or 4b where these might affect use of the water for agricultural activities.	If work session participants noted a specific water quality issue that could affect the use of water for agricultural purposes (e.g. iron causes blockage of irrigation pipes; nitrate can be a problem for livestock), then indicate as "priority for agriculture" and crosscheck with reference documents or reference maps to substantiate if possible.
Water quantity for agricultural activities	More than 1 new application for water right in the area.	Refer to participants' comments and reference maps. If number of new applications is <3 and participants stated, with supporting evidence, that water quantity for agriculture is currently sufficient, then the priority indicator can be removed.
Agricultural drainage	>50% of the area contains Prime 2 soils (Prime if drained) Note presence of drainage district – not a modifier but indicates that drainage needs ongoing maintenance to remain effective.	Refer to participants' comments to see whether they consider drainage to be a priority (if they do not, that does not necessarily mean that drainage is not needed in the area, but probably means that if drainage infrastructure is present then it is adequately maintained). If specific actions were recommended at specific locations, then add those to the actions column.
Flood protection	Contains >5% soils that are Prime if protected from flooding, OR Contains 1 in 100-year flood area, OR Contains floodway	If only a small portion of the area contains one of the 3 criteria at left, then refer to participants' comments and if they did not consider flood protection to be a general need for the area, then the priority indicator can be removed.
Agricultural land base: · *Important agricultural land*	>50% of the area is any combination of AG zoned, Rural Study Area or PDR easement.	-
· *Protection from development pressure*	Reference maps: If a Rural Study Area is present (see ag priority areas reference map), OR If the area contains parcels with more than 2 potential additional dwelling units (development rights reference map)	Refer to participants' comments to see if they are experiencing residential-ag conflicts or pressure for conversion of agricultural land in the area and consider this to be a priority.
Other:	Refer to participants' comments. Crosscheck with reference documents or reference maps to substantiate if possible.	-

4.2 Agricultural characterization tables

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Table 3. Agriculture characterization tables for Sumas WID

NOTE: Possible actions include: Specific actions identified by WID Actions Map # location (e.g. S2) and Assessment Unit (AU), and general actions which do not have locations specified. Some of these actions do not appear on the WID Priority Actions Map due to: (i) action is general in description no location is noted; (ii) action is specific in description but no location noted; (iii) action is general in description, located outside the WID area; (iv) action is specific in description, located outside the WID.

3A. Agricultural Enhancement Priorities: Upper Johnson Creek							
	Water quantity: Irrigation, stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Upper Johnson AU 1164 AU1165 AU1088 AU1168 Notes from reference maps and other documents	>25 new water right applications in Upper Johnson – See Ag Priorities maps: Water Quantity Water quantity priority	Widespread nitrate contamination documented in groundwater over large areas of the Sumas-Blaine Aquifer for over 40 years.[18] [19] Johnson Creek is in category 4a for bacteria & DO.[20]	>50% of soils are prime if drained in Upper Johnson. – See Ag Priorities maps: Drainage Ag drainage priority CDID #31 occupies Upper Johnson watershed.[21]	Area adjacent to Johnson Creek in Upper Johnson watershed is in the 100-year flood zone. Southern tip of watershed is in floodway. – See Ag Priorities maps: Flooding Ag flood protection priority	96% of soils are prime 1-10 in Upper Johnson – See Ag Priorities maps: Prime Soils Ag prime soils priority 94% of land is Ag Zoning and Rural Study Area. Ag land base priority A rural study area occupies land in the center of Upper Johnson. –See Ag Priorities maps: Ag Land Base Protection from development pressure		
Upper Johnson AU 1164 AU1165 AU1088 AU1168 Notes from work session January 2016.	AU 1168: Peat soils in area north & south of Halverstick Road stay wet – less irrigation needed here. Clearbrook Creek does not dry up. Canadian drilling for ag water use found no fresh water at 340', salt water at 300'. Laxton Lake on Canadian side has an overflow into the western part of Judson Lake. The overflow is west of the Holmquist Rd and east of where 0 Avenue turns north. A Canadian landowner deepened Laxton Lake a few years ago put the spoils up on the land. Some of the spoils ended up filling Judson Lake's western part. Water flows from Judson Lake underground to Pangborn Lake. Gravel pit in Canada that may be affecting the level of Judson Lake as the water level for this time of year is not as high as historically, or possibly Abbotsford airport has diverted surface water into another drainage. Former Ag West Gravel Pit is seeking permit for additional 60' depth, below groundwater table W of Van Buren Rd. between Clearbrook X Hwy 546. Clay layer in the area may protect from impacts to groundwater & group wells.	-Water quality for agriculture is acceptable though peat soils influence water quality. -Meadowbrook and Sumas water quality is good but the well on May Rd has high nitrate concentrations. Nitrate levels have been falling over the years due to corrective actions.	-In upper west area, soils contain gravel and drain well. -This area also receiving drainage from the hillside to the east. -There is a wet area west of Judson Lake, mainly on Canadian side between Judson Lake, w. of Holmquist Rd, and Laxton Lake. -The Lake outflow is privately managed. -West of Van Buren Rd. between Clearbrook X Hwy 546 forested area in Clearbrook creek receives outflow, is boggy.	AU 1168: Flow out of Pangborn Lake used to move water west toward Squaw Creek. Pangborn Lake was much bigger than it is today and it had two outlets, one to the west that flowed into Squaw Creek and one to Johnson Creek. Pangborn Creek, which was a big bog, was straightened out in 1948 - the last part near the lake was blown with dynamite and Pangborn Lake was lowered at least 4 to 6 feet. - West of Van Buren Rd. between Clearbrook X Hwy 546, high volume drainage into Squaw. Many springs along Squaw Creek, especially on the hillsides.		AU 1088: Commercial Pollination used in blackberry and black current crops located west of Trapline Rd. between Birch Bay Lynden and Pangborn Rd.	

[18] Category 4a - has a TMDL: water bodies that have an approved TMDL in place and are actively being implemented. WA Department of Ecology, 2015. *Water Quality Assessment Categories.* http://www.ecy.wa.gov/programs/wq/303d/WQAssessmentCats.html (Accessed March 28, 2016)

[19] Ecology, 2012. *Sumas-Blaine Aquifer Nitrate Contamination Summary. Pub #12-03-026.* < https://fortress.wa.gov/ecy/publications/documents/1203026.pdf >

[20] Department of Ecology, 2012. *Water Quality Assessment for Washington.* http://www.ecy.wa.gov/programs/wq/303d/index.html

[21] WCD, 2014. *Agricultural Drainage for Drainage Districts.* http://www.whatcomcd.org/ag-drainage-districts

3B. Agricultural Enhancement Priorities: Lower Johnson Creek							
	Water quantity: Irrigation, stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Lower Johnson AU1166 AU1086 portion of AU1078 Notes from reference maps and other documents	1-10 new applications for water rights in Lower Johnson. – See Ag Priorities maps: Water Quantity Water quantity priority	Widespread nitrate contamination in Sumas Blaine Aquifer.[22] Johnson Creek is in category 4a[23] for bacteria and DO.[24]	>50% of soils are prime if drained in Lower Johnson. – See Ag Priorities maps: Drainage Ag drainage priority CDID #31 occupies Lower Johnson watershed. [25]	Area adjacent to Johnson Creek in Lower Johnson is in 100-year flood zone. – See Ag Priorities maps: Flooding Ag flood protection priority	83% of soils are prime 1-10 in Lower Johnson – See Ag Priorities maps: Prime Soils Ag prime soils priority 73% of land is Ag zoning in Lower Johnson. – See Ag Priorities maps: Ag Land Base Ag land base priority		
Lower Johnson AU1166 AU1086 portion of AU1078 Notes from work session January 2016.		AU 1166: Johnson Creek sediment higher after rain events. AU 1086 & 1166: Some contribution to sediment loads from ag fields. Improved attention to cover crops could reduce this. Nitrate in groundwater. Ag water quality priority	Low gradient here. Some drainage issues. Canary grass invasion and sediment buildup in ditches.	Landowners in this area (as in the Saar) have historically assessed themselves to pay for & attend to drainage and minor flood issues.		AU 1086: about 50 dairies were historically located along the hillsides in this area.	(S2/4) AU 1086: Gas plant moved ditch. Doesn't drain as well now. (S8/5)- AU 1166 Beaver management needed, floodway area.

[22] Ecology, 2012. *Sumas-Blaine Aquifer Nitrate Contamination Summary. Pub #12-03-026.* < https://fortress.wa.gov/ecy/publications/documents/1203026.pdf >

[23] Category 4a - has a TMDL: water bodies that have an approved TMDL in place and are actively being implemented. WA Department of Ecology, 2015. *Water Quality Assessment Categories.* http://www.ecy.wa.gov/programs/wq/303d/WQAssessmentCats.html (Accessed March 28, 2016)

[24] Department of Ecology, 2012. *Water Quality Assessment for Washington.* < http://www.ecy.wa.gov/programs/Wq/303d/index.html >

[25] WCD, 2014. *Agricultural Drainage for Drainage Districts.* http://www.whatcomcd.org/ag-drainage-districts

3C. Agricultural Enhancement Priorities: Upper Fishtrap East							
	Water quantity: Irrigation, stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Upper Fishtrap East AU1169 Notes from reference maps and other documents	1-10 new applications for water rights in Lower Fishtrap East. – See Ag Priorities maps: Water Quantity Water quantity priority	Widespread nitrate contamination in Sumas Blaine Aquifer.[26]	<25% of soils are prime if drained in Upper Fishtrap East. – See Ag Priorities maps: Drainage.	An area of Upper Fishtrap East adjacent to the US Canada border is in the 1:100-year flood zone. – See Ag Priorities maps: Flooding Ag flood protection priority	84% of soils are prime 1-10 in Upper Fishtrap East – See Ag Priorities maps: Prime Soils Ag prime soils priority 100% of land is AG zoning in Upper Fishtrap. – See Ag Priorities maps: Ag Land Base Ag land base priority		
Upper Fishtrap East AU1169 Notes from work session January 2016.						AU 1169: Primarily berries in upper, west area. AU 1169: There is an old gold mine area west of Terpstra's.	

[26] Ecology, 2012. *Sumas-Blaine Aquifer Nitrate Contamination Summary. Pub #12-03-026.* < https://fortress.wa.gov/ecy/publications/documents/1203026.pdf >

3D. Agricultural Enhancement Priorities: Lower Sumas (Saar Creek)							
	Water quantity: Irrigation, stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Saar AU1079 AU 1078 Notes from reference maps and other documents	1- 10 new applications for water rights in Saar. – See Ag Priorities maps: Water Quantity Water quantity priority	Widespread nitrate contamination in Sumas Blaine Aquifer.[27] Iron found in most areas of Sumas aquifer in the Lynden-Everson-Nooksack-Sumas study area, and concentrations greater than or equal to 3000 micrograms/liter were found in most wells in the Sumas Valley.[28] Ag water quality priority	25 - 50% of soils are prime if drained in Saar. See Ag Priorities maps: Drainage. DID #15 occupies northern part of Saar watershed.[29]	Much of the northern part of Saar watershed is in the 1:100-year flood zone. - See Ag Priorities maps: Flooding Ag flood protection priority	36% of soils are prime 1-10 in Saar overall, but the portion of Saar that is within the WID is almost entirely Prime soils – See Agriculture reference map: Prime Soils Prime soils priority 33% of land is Ag zoning in Saar overall, but the portion of Saar that is within the WID is entirely AG zoning. – See Agriculture reference map: Agriculture priority areas. Ag land base priority		
Saar AU1079 AU 1078 Notes from work session January 2016.	AU 1079: As timber harvest area regrows, there is less water in the creek each year. Saar Creek ran completely dry last summer. Plenty of groundwater. AU 1079: Sumas Lake used to be located at the north east end of the Saar sub-basin. AU 1079: The hillside to the east of Saar sub-basin has many natural springs.	There is iron in the groundwater. Residents the area rely on city water for drinking and stock watering. AU 1086: Only well without iron in the water is located west end of Bishop Road.	AU 1079: Drainage is good on higher ground. Further away from the hills farmers have installed tile drains. AU 1078: Creek northeast of Hillview Rd has sand accumulation. Ever-greens were planted to shade out canary grass. AU1079: Where willows have been planted along creeks there can be more localized flooding as the willows fall in. Ongoing beaver management is required. Sediment accumulation is improving. Lower flows but less sediment coming down Saar Creek as timber in the harvest area upstream regrows. Farm field along base of hillside at south end of Saar sub-basin is too wet to work in the spring, Fields west of Clarke Rd have some drainage issues. Hillview Rd fields have good drainage.	Work session participants reported that they had no problems with flooding currently. There is some puddling on the fields after a heavy rain. Bowen has created new flow toward Fraser River. Water backs up behind Sumas train trestle.	This is some of the best farm land in the County. There are no residential conflicts to speak of. Land still largely in farms, currently grass, dairy and berries. Improve development codes so that urban growth does not impact ag lands and prime soils in this part of the Sumas WID.	Occasionally bears come out of the hills and trample and eat the corn. There is poor visibility for farm equipment traveling to the highway from Hillview Road toward Telegraph Road.	(S1/1) AU 1079: Culvert half full of gravel. (S7/2) AU1079: Perhaps a sediment capture pond could be built if Saar Creek could no longer be sprayed. (S16/3) AU1079: Traffic Issue: poor visibility for farm machinery on the highway. (S9/7) AU 1079: Sediment pond at base of Reese Hill Rd and systems require regular maintenance by DID.

[27] Ecology, 2012. *Sumas-Blaine Aquifer Nitrate Contamination Summary. Pub #12-03-026.* < https://fortress.wa.gov/ecy/publications/documents/1203026.pdf >

[28] Cox, S. E., and Kahle, S. C., 1999. *Hydrogeology, Ground-Water Quality, and Sources of Nitrate in Lowland Glacial Aquifers of Whatcom County, Washington, and British Columbia, Canada; Water-Resources Investigations Report 98-4195.* USGS. <http://pubs.usgs.gov/wri/1998/4195/report.pdf> (last accessed 4/4/2016).

[29] WCD, 2014. *Agricultural Drainage for Drainage Districts.* http://www.whatcomcd.org/ag-drainage-districts

3E. Agricultural Enhancement Priorities: Lower Sumas (Sumas River)							
	Water quantity: Irrigation, stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Lower Sumas AU1086 AU1087 + small portion of AU1078 Notes from reference maps and other documents	10 – 25 new applications for water rights in Lower Sumas. – See Ag Priorities maps: Water Quantity Water quantity priority	Widespread nitrate contamination in Sumas Blaine Aquifer. [30] Sumas River in Lower Sumas is in category 5[31] (polluted water that requires TMDL or other WQI project) for DO, and 4a (has a TMDL) for bacteria.[32]	>50% of soils are prime if drained in Lower Sumas. – See Ag Priorities maps: Drainage. Ag drainage priority CDID #31 occupies northwestern portion of Lower Sumas watershed.[33]	Northern area in Lower Sumas watershed is in the 1:100-year flood zone. Area adjacent to Sumas Creek in southern part of watershed is in floodway. – See Ag Priorities maps: Flooding Ag flood protection priority	82% of soils are prime 1-10 in Lower Sumas – See Ag Priorities maps: Prime Soils Ag prime soils priority 77% of land is Ag zoning in Lower Sumas.– See Ag Priorities maps: Ag Land Base Ag land base priority		
Lower Sumas AU1086 AU1087 + small portion of AU1078 Notes from work session January 2016.							(S4/9) AU 1087: Bone Creek: Needs dredging to improve drainage.

[30] Ecology, 2012. *Sumas-Blaine Aquifer Nitrate Contamination Summary. Pub #12-03-026.* < https://fortress.wa.gov/ecy/publications/documents/1203026.pdf >

[31] Category 5 - Polluted waters that require a TMDL (total maximum daily load) or other WQI (water quality Improvement) project: the traditional list of impaired water bodies traditionally known as the 303(d) list. Starting with the 2008 Water Quality Assessment, Washington's 303(d) list of polluted waters were placed under Category 5 in the approved assessment. Placement in this category means that Ecology has data showing that the water quality standards have been violated for one or more pollutants, and there is no TMDL or pollution control plan. WA Department of Ecology, 2015. *Water Quality Assessment Categories.* http://www.ecy.wa.gov/programs/wq/303d/WQAssessmentCats.html (Accessed March 28, 2016)

[32] Ecology, 2012. *Water Quality Assessment for Washington.* http://www.ecy.wa.gov/programs/Wq/303d/index.html

[33] WCD, 2014. *Agricultural Drainage for Drainage Districts.* http://www.whatcomcd.org/ag-drainage-districts

3F. Agricultural Enhancement Priorities: Middle Sumas (Breckenridge Creek & Swift Creek)							
	Water quantity: Irrigation, stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Breckenridge Creek (northern part of AU1077), mid Sumas River (AU1163) and Swift Creek (southern part of AU1077) Notes from reference maps and other documents	10 - 25 new applications for water rights in Middle Sumas AWCA. See Ag Priorities maps: Water Quantity Water quantity priority Only 1 new application in the WID area that includes Swift Creek.	Widespread nitrate contamination in Sumas Blaine Aquifer.[34] Section of middle Sumas River is in category 5 for bacteria.[35] Swift Creek has history of sediment loading and naturally occurring asbestos in sediment.[36] Ag water quality priority	<25% of soils are prime if drained in this area but in the portion within the WID the soils are prime 1 & some prime 2 - See Ag Priorities maps: Drainage.	Area around confluence of Breckenridge Creek with Sumas River is in 1:100-year flood zone. See Ag Priorities maps: Flooding Swift Creek has long history of sediment loading and reduced hydraulic capacity. A natural landslide in Swift Creek has resulted in increased localized flooding.[37] Ag flood protection priority	37% of soils are prime 1-10 in the Middle Sumas but in the portion within the WID the soils are all prime 1 & prime 2. See Ag Priorities maps: Prime Soils Ag prime soils priority 17% of land is Ag zoning in the middle Sumas area but the area within the WID is mostly AG zoning. See Ag Priorities maps: Ag Land Base. Ag land base priority		
Breckenridge Creek (northern part of AU1077) and mid Sumas River (AU1163) Notes from work session January 2016.		Sumas River and tributaries have problems with sediment loading in runoff from farms, and there are complaints about runoff. Swift Creek water flows into Sumas River bringing asbestos north.		AU 1163: Floodway & overflow area along Nooksack flooded when water overtopped the Nooksack levee - first event couple of inches over, 2nd event 3" over, water flowed into field, did not reach farm at Nooksack River south bank Fekkes Dairy. During this event the water in Johnson Creek only got to 2/3rds full.		More than 50 dairies used to be located along the hillside and farmland south of Sumas toward Nooksack. Land is now converting to berries and fewer, larger dairies.	(S10/8) AU 1163: In 2015, levee was overtopped 3" on Nooksack River.
Swift Creek (southern part of AU1077) Notes from work session January 2016.		Swift Creek water has high turbidity, and sediment is high in asbestos. Participant(s) surmise that logging upstream is a potential source of sediment.	A major problem in this sub-watershed is sediment from the Swift Creek slide entering Sumas River. It creates drainage issues upstream and downstream from Canada border upstream to Massey Rd. Ag drainage priority	Swift Creek channel has historically overtopped during runoff events and deposited sediment on farmland.		Sediment loading within Swift Creek creates conditions that inhibit animal life and growth of vegetation in and adjacent to the Creek.[38]	(S11/11) AU 1077 Swift Creek needs a long term action plan for sediment management.

[34] Ecology, 2012. *Sumas-Blaine Aquifer Nitrate Contamination Summary. Pub #12-03-026.* < https://fortress.wa.gov/ecy/publications/documents/1203026.pdf >

[35] Ecology, 2012. *Water Quality Assessment for Washington.* http://www.ecy.wa.gov/programs/Wq/303d/index.html

[36] Whatcom County River & Flood < http://www.whatcomcounty.us/513/Swift-Creek >

[37] Whatcom County River & Flood. < http://www.whatcomcounty.us/513/Swift-Creek >

[38] Swift Creek Sediment Management Action Plan Staff report, June 25, 2013. Whatcom County Public Works. http://www.whatcomcounty.us/DocumentCenter/View/1077

3G. Agricultural Enhancement Priorities: Upper Sumas (Dale Creek and upper Sumas River)							
	Water quantity: Irrigation, stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Upper Sumas River (AU1162) and Dale Creek (AU1090) Notes from reference maps and other documents	10 - 25 new applications for water rights in Upper Sumas. See Ag Priorities maps: Water Quantity Water quantity priority	Widespread nitrate contamination in Sumas Blaine Aquifer. [39] Section of Upper Sumas River is in category 5 for bioassessment and Hoff Creek is category 5 for temperature.[40]	<25% of soils are prime if drained in Upper Dale, but the area within the WID contains mostly prime 2 (prime of drained) and some prime 1 soils. See Ag Priorities maps: Drainage and Ag Reference map: Prime soils. Ag drainage priority	Area immediately adjacent to Sumas Creek in Upper Sumas is in 1:100-year flood zone. – See Ag Priorities maps: Flooding	45% of soils are prime 1-10 in Upper Sumas, but the area within the WID is almost all prime soils. See Ag Priorities maps: Prime Soils Ag prime soils priority 41% of land in the Upper Sumas area is AG zoning, but the area within the WID is almost entirely Ag zoning with a small portion of Rural Study Area in the south See Ag Priorities maps: Ag Land Base and Ag Reference map: Ag Priority Areas. Ag land base priority Protection from development pressure		
Upper Sumas River (AU1162) and Dale Creek (AU1090) Notes from work session January 2016.	Participants considered that water quantity was not a top priority.	Some sediment delivery to the river, possibly from logging in forested foothills. Nutrients and sediment concentrations have become higher in Sumas River, possibly due to berry fields.	Dale Creek has sediment problems, possibly due to logging activities upstream. Drainage impaired due to Swift Creek sediment build-up.	Backwater and sediment from Swift Creek impacting the Sumas River from Oat Coles Road to Lawrence Road south toward Hughes Road. Ag flood protection priority			(S12/12) AU 1161: Flood Protection. Beaver management needed to keep ditches cleared and reduce flooding. (S13/13) AU 1161: Lower Dale Creek blockage. (S14/14) AU 1162: Plugged drainage due to sediment. (S6/16) AU 1162: Drainage impaired both upstream and downstream.

[39] Ecology, 2012. *Sumas-Blaine Aquifer Nitrate Contamination Summary. Pub #12-03-026.* < https://fortress.wa.gov/ecy/publications/documents/1203026.pdf >

[40] Ecology, 2012. *Water Quality Assessment for Washington* < http://www.ecy.wa.gov/programs/Wq/303d/index.html>

3H. Agricultural Enhancement Priorities: Upper Sumas (Smith Creek)							
	Water quantity: Irrigation, stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Smith Creek AU1075 Notes from reference maps and other documents	No new applications for water rights in this portion of Smith. See Ag Priorities maps: Water Quantity	Widespread nitrate contamination in Sumas Blaine Aquifer. [41]	<25% of soils are prime if drained in Smith. The area that is within the WID contains mostly prime 1 soils with a small area of prime 2 soils. See Ag Priorities maps: Drainage and Ag Reference Map: Prime soils.	The area within the WID is within the flood way and the 1:100-year flood zone. A flood control district occupies a small area of the Smith watershed. – See Ag Priorities maps: Special Districts Ag flood protection priority	22% of soils are prime 1-10 in the lower Smith but the area within the WID is almost all prime soils. – See Ag Priorities maps: Prime Soils and Ag Reference Map: Prime soils. Ag prime soils priority 11% of land in the lower Smith area is in AG zoning, but the area that is within the WID is a combination of AG zoning and Rural Study Area. – See Ag Priorities maps: Ag Land Base and Ag Reference Map: Agriculture Priority Areas. Ag land base priority. Protection from development pressure.		
Lower Smith Creek AU1075 Notes from work session January 2016.	No notes were added at the work session.						

[41] Ecology, 2012. *Sumas-Blaine Aquifer Nitrate Contamination Summary. Pub #12-03-026.* < https://fortress.wa.gov/ecy/publications/documents/1203026.pdf >

3I. Agricultural Enhancement Priorities: Nooksack main channel Deming to Everson							
	Water quantity: Irrigation, stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Nooksack main channel Deming to Nugent's Corner AU1074 Notes from reference maps and other documents	1-10 new applications for water rights in this area (3 of these are within the WID). See Ag Priorities maps: Water Quantity and Ag Reference Map: Water rights. Water quantity priority	Widespread nitrate contamination in Sumas Blaine Aquifer. [42] Nooksack River mainstem is in category 5 for pH and temperature in this area.[43]	<25% of soils are prime if drained in this area. The area that is within the WID contains mostly prime 1 soils with a small area of prime 2 soils. See Ag Priorities maps: Drainage and Ag Reference Map: Prime soils.	Nooksack River in this area is in the floodway. – See Ag Priorities maps: Flooding Ag flood protection priority	32% of soils are prime 1-10 in this area but in the portion within the WID all soils are prime. See Ag Priorities maps: Prime Soils and Ag Reference map: Prime soils. Ag prime soils priority 24% of land is in AG zoning in this area, but in the portion within the WID the land is all in AG zoning. – See Ag Priorities maps: Ag Land Base. Ag land base priority		
Nooksack main channel Nugent's Corner to Everson AU1095 AU1096	1 new application for water right in this area. See Ag Priorities maps: Water Quantity and Ag Reference Map: Water Rights.	Smith Creek in this area is in category 5 for DO, and 4a for bacteria.[44]	<25% of soils are prime if drained in this area. The area that is within the WID contains mostly prime 1 soils with a small area of prime 2 soils. See Ag Priorities maps: Drainage and Ag Reference Map: Prime soils.	Nooksack River in this area is in the floodway. – See Ag Priorities maps: Flooding Ag flood protection priority	81% of soils are prime 1-10 in this area. See Ag Priorities maps: Prime Soils Ag prime soils priority 65% of land is AG zoning in this area. See Ag Priorities maps: Ag Land Base. Ag land base priority		
Nooksack main channel Deming to Everson AU1074 AU1095 AU1096 Notes from work session January 2016.				Bank erosion and channel migration threaten farmland. Nooksack River flow could potentially divert into Sumas R. during extreme flood event downstream of Hopewell Rd. Active Nooksack River Bank erosion south of HWY 9: river could redirect north in historic flow channels toward Sumas River.			(S15/15) AU 1096: Active bank erosion. Rip rap needed on right bank of Nooksack River main channel below end of existing project.

[42] Ecology, 2012. *Sumas-Blaine Aquifer Nitrate Contamination Summary. Pub #12-03-026.* < https://fortress.wa.gov/ecy/publications/documents/1203026.pdf >

[43] Ecology, 2012. *Water Quality Assessment for Washington* < http://www.ecy.wa.gov/programs/Wq/303d/index.html >

[44] Ecology, 2012. *Water Quality Assessment for Washington* < http://www.ecy.wa.gov/programs/Wq/303d/index.html>

4.3 Agricultural priorities: Summary maps

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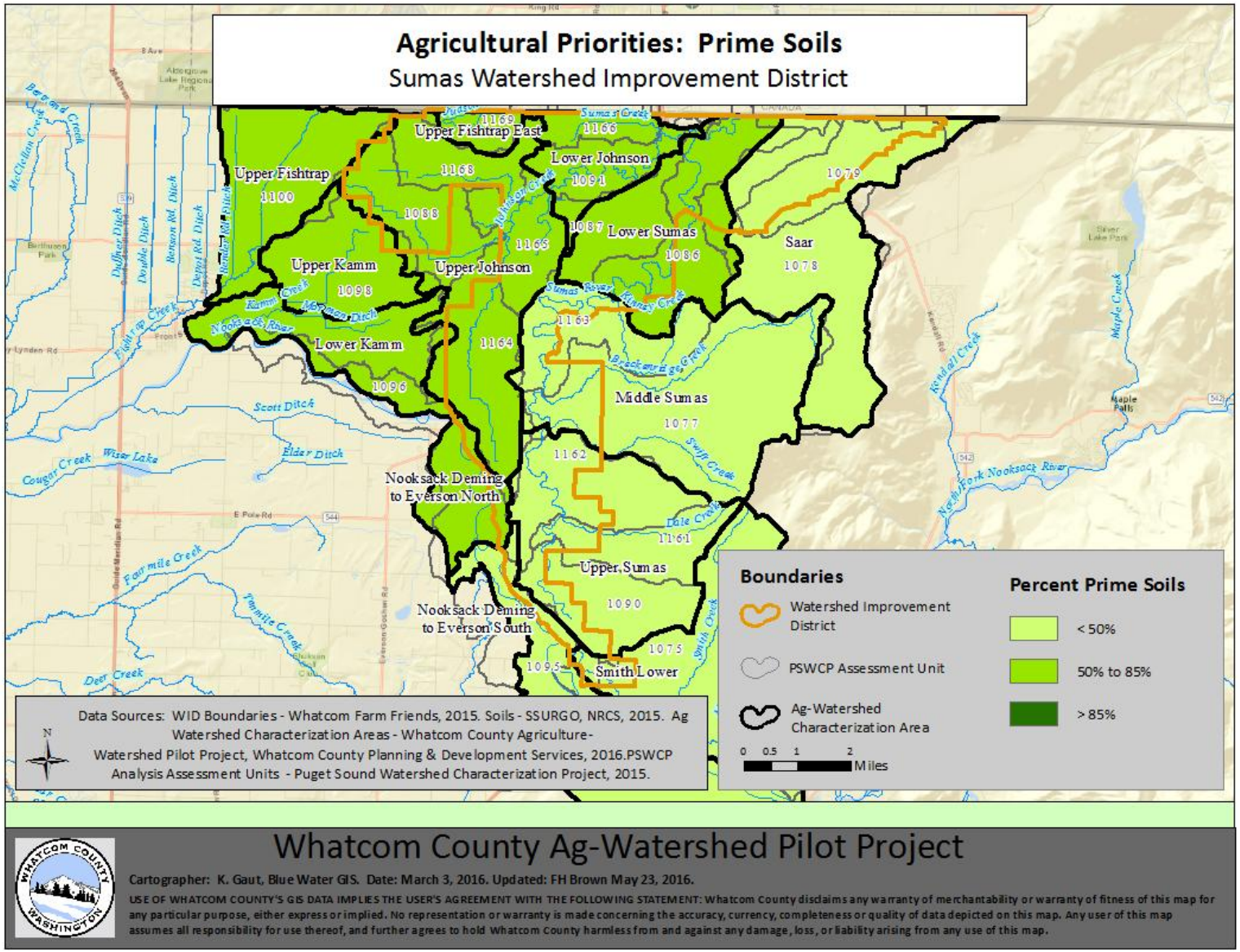

Figure 6. Sumas WID agricultural priorities: Proportion of prime soils. Data from reference map of prime soils.

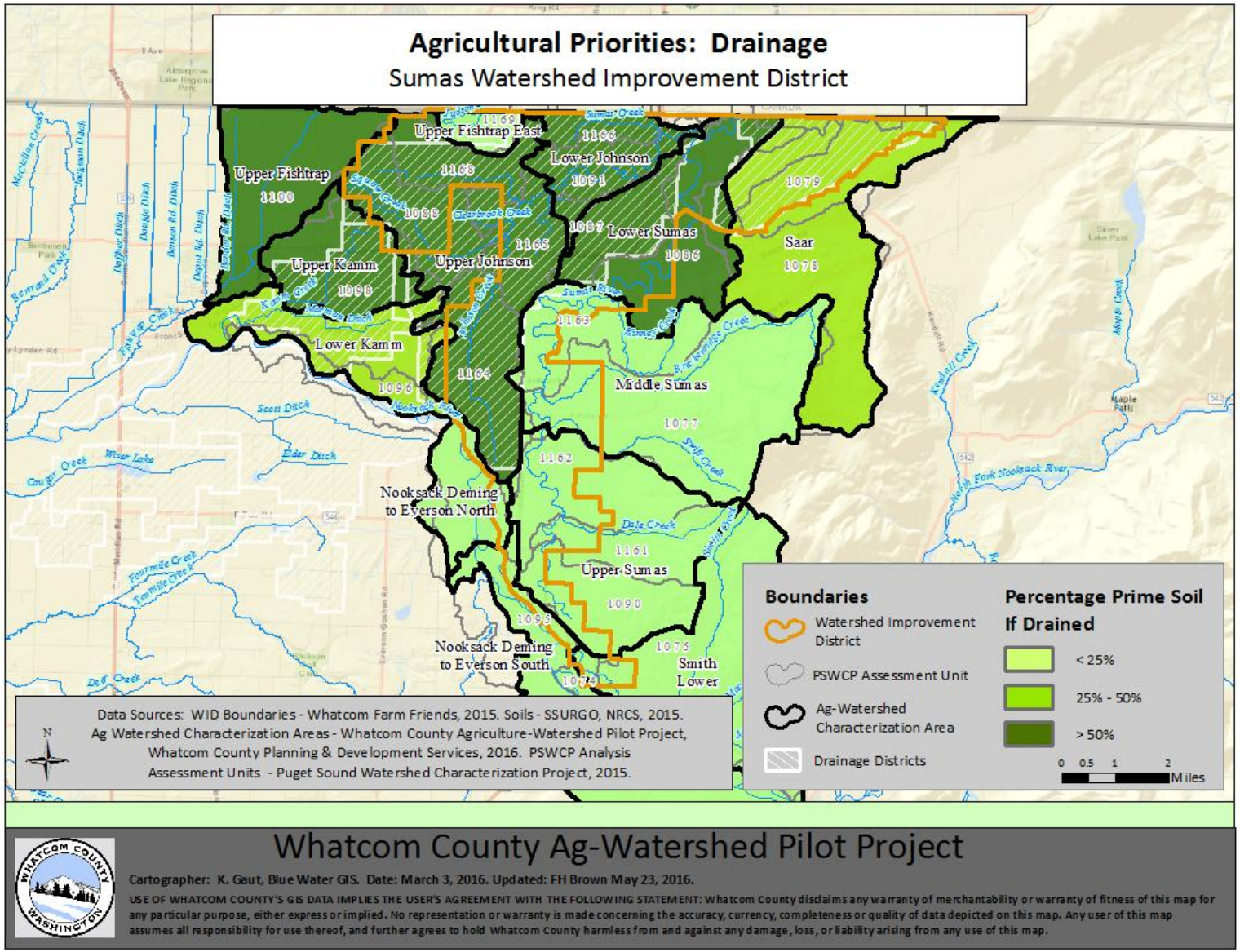

Figure 7. Sumas WID agricultural priorities: Drainage of agricultural land. Data from reference maps of prime soils and special districts.

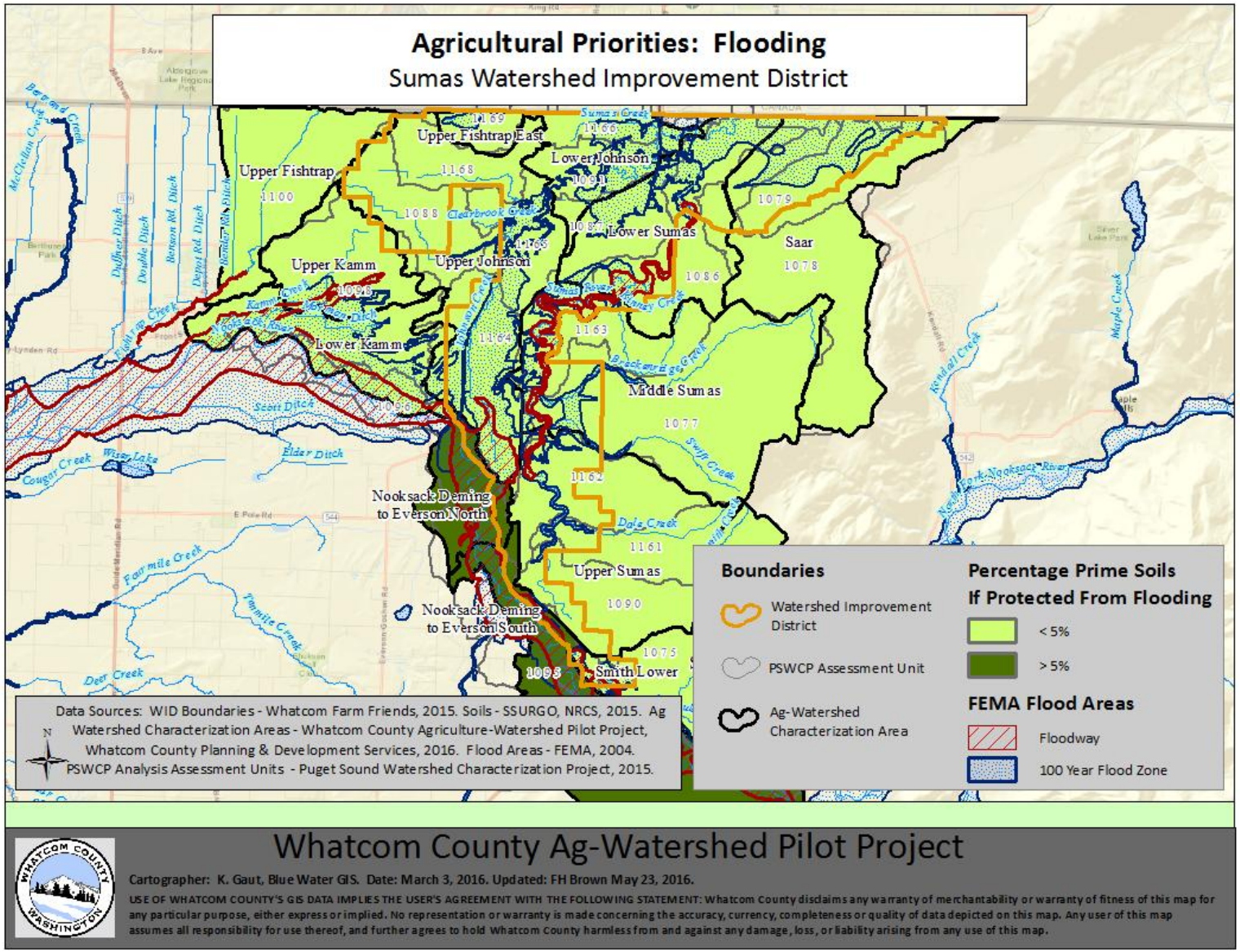

Figure 8. Sumas WID agricultural priorities: Protection of agricultural land from flooding. Data from reference maps of prime soils and special districts plus Whatcom County GIS data on FEMA flood areas.

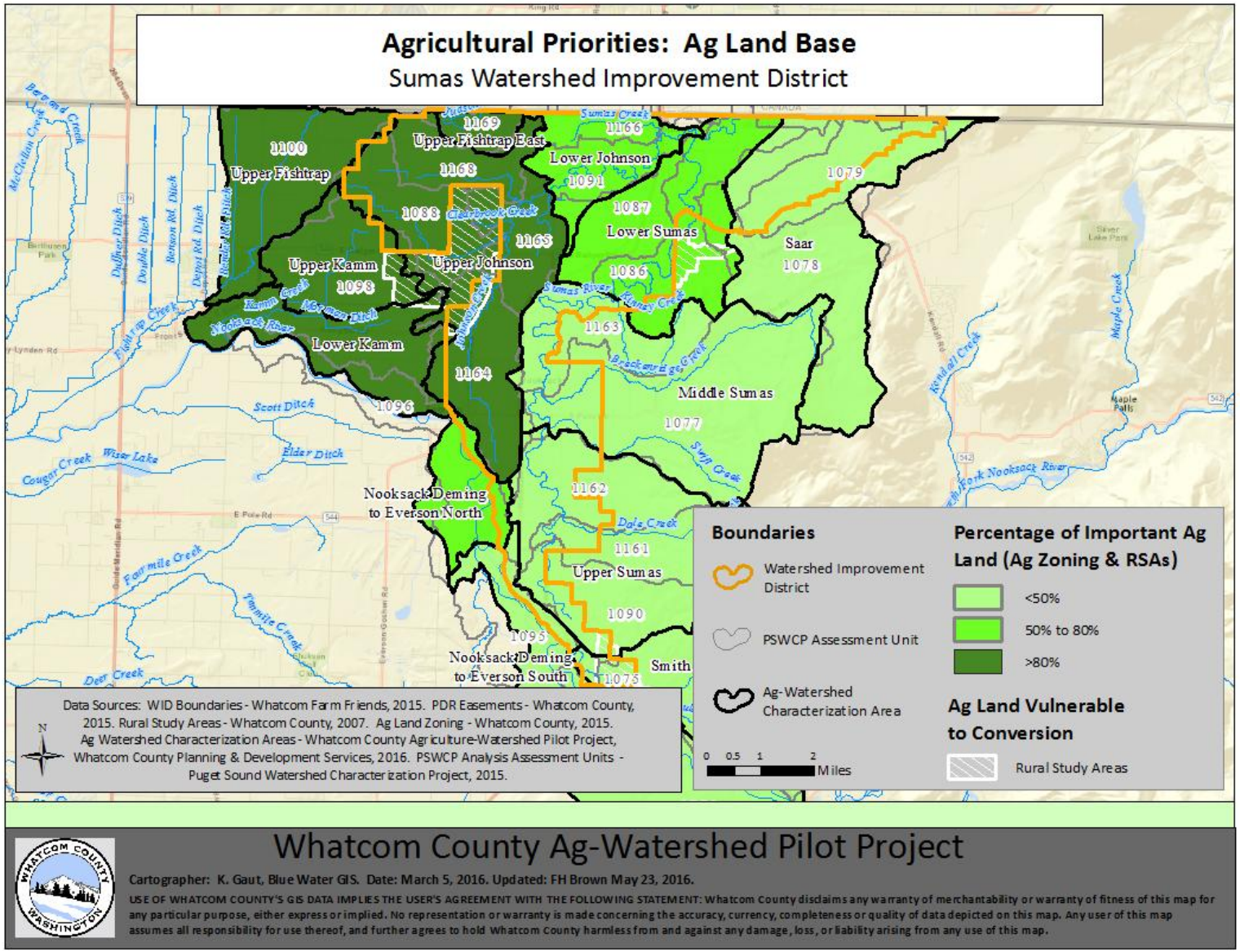

Figure 9. Sumas WID agricultural priorities: Protection of the agricultural land base. Data from reference map of agriculture priority areas.

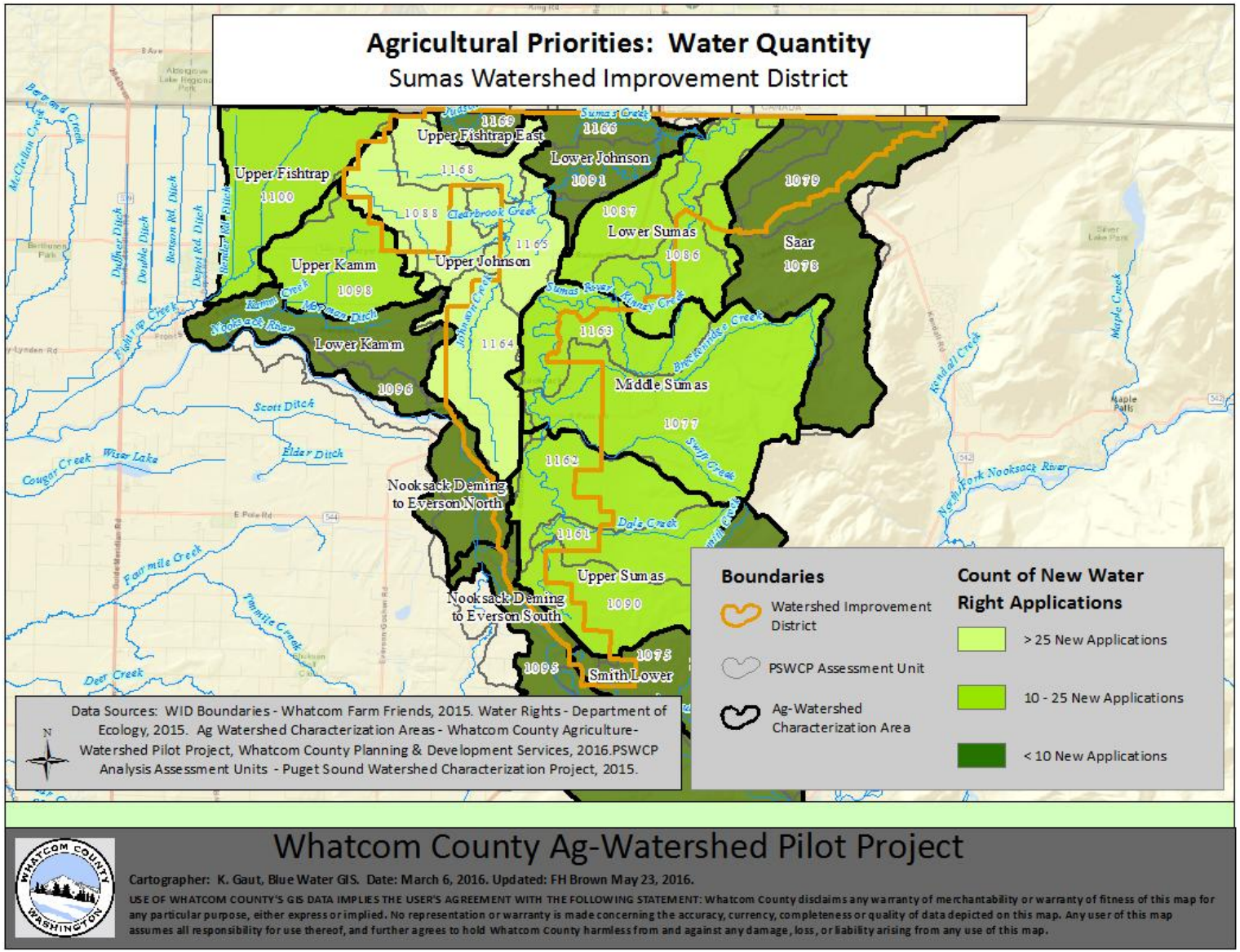

Figure 10. Sumas WID agricultural priorities: Water for agricultural activities. Data from reference map on water right points of diversion.

4.4 Agricultural priorities: Specific actions map

Table 4. Key for actions on agricultural priorities specific actions map

Action number[45] on Figure 11	Assessment unit #	Agricultural priority	Notes
1	1079	Drainage	Culvert half full of gravel (see also action #9).
2	1086	Drainage	Gas plant moved ditch. Doesn't drain as well now.
4	1087	Drainage	Bone Creek: Needs dredging to improve drainage.
6	1162	Drainage	Drainage impaired both upstream and downstream.
7	1079	Flooding	Perhaps a sediment capture pond could be built if Saar Creek could no longer be sprayed.
8	1166	Flooding	Beaver management needed, floodway area.
9	1079	Flooding	Sediment pond at base of Reese Hill Rd and systems require regular maintenance by DID.
10	1163	Flooding	Nooksack levee broke in 2015, overtopped 3" and flooded here.
11	1077	Flooding	Swift Creek needs a long term action plan for sediment management.
12	1161	Flooding	Beaver management needed to keep ditches cleared and reduce flooding.
13	1161	Flooding	Lower Dale Creek blockage.
14	1162	Flooding	Plugged drainage due to sediment.
15	1096	Flooding	Active bank erosion. Rip rap needed on right bank of Nooksack River main channel below end of existing project.
16	1079	Other	Traffic Issue: poor visibility for farm machinery on the highway.

[45] Actions #3 and #5 were deleted after review of the draft map by the WID board in May 2016.

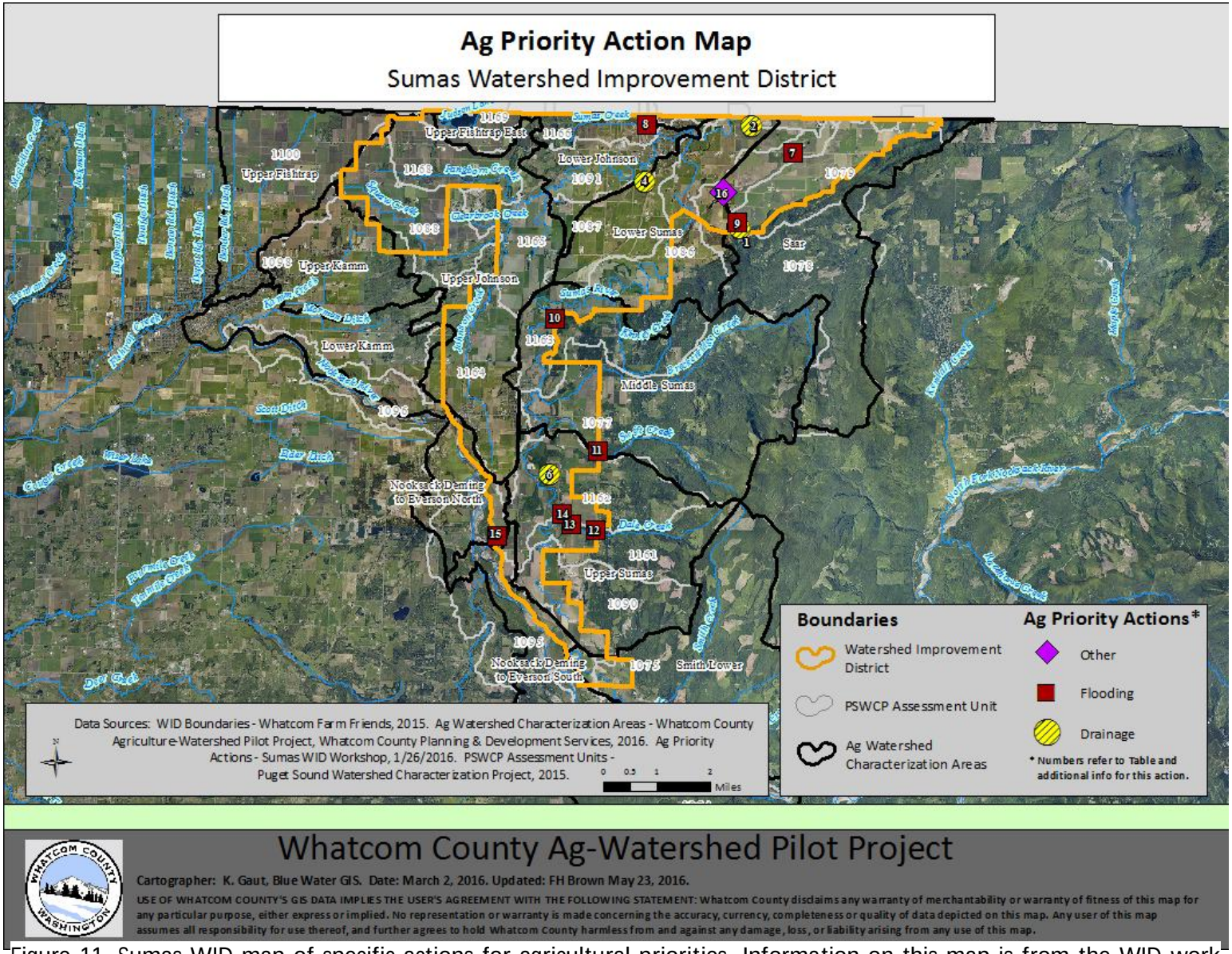

Figure 11. Sumas WID map of specific actions for agricultural priorities. Information on this map is from the WID work session in January 2016.

5 Watershed characterization and mapping for the Sumas Watershed Improvement District

5.1 Methodology

The following description of the watershed characterization methodology has been adapted from that provided in the Appendix to the pilot Agriculture-Watershed Characterization and Mapping Report.[46]

5.1.1 General approach

The watershed characterization assessment uses methods developed by the Puget Sound Watershed Characterization Project.[47] The results of the watershed characterization assessment are intended to assist the WIDs in identifying high priority opportunities for watershed enhancement projects on agricultural land in the lowland areas of Whatcom County, with a focus in areas where watershed and agricultural priorities could be mutually reinforcing.

The *Puget Sound Watershed Characterization (PSWC)* is a set of water and habitat assessments that compare areas within a watershed for relative restoration and protection value. It is a coarse-scale decision-support tool that provides information for regional, county, and watershed-based planning. The information it provides allows local and regional governments, as well as NGOs, to base their land use decisions on a systematic analytic framework. It prioritizes specific geographic areas for protection, restoration, and conservation of our region's natural resources, and identifies where best to focus new development. Application of this method should result in future land-use patterns that protect the health of terrestrial and aquatic resources while directing limited financial resources to the highest priority areas for restoration and protection.

The objective of the PSWC assessment is to "characterize" the watershed in a way that helps to identify priority enhancement opportunities. The relative comparison of assessment units (AUs) for water flow processes across the lowland watersheds allows for a coarse-level snapshot of which areas are relatively important or degraded for water flow. From this snapshot we suggest possible enhancement actions that could contribute to improving or protecting water flow processes at the AU scale. Actual site location of those actions within an assessment unit would require different analyses not described here.

The assessment results in this document address the following primary questions for the Whatcom County lowland watersheds:
(1) *Where on the landscape* should management efforts be focused first to benefit water flow processes in the watersheds that are part of the Watershed Improvement District?
(2) *What types of activities and actions* are most appropriate to that place based on the assessment results?

The assessment results therefore address both the "where" and the "what" to focus on, in terms of water flow processes. This integrated approach offers a systematic framework for identifying more important areas within the lowland watersheds and those which are more degraded for water flow processes and water quality, with the intent of identifying areas that offer the most potential for enhancement.

[46] Hume C & Stanley S (2013). *Summary of water flow assessment results for Bertrand, Fishtrap and Kamm watersheds.* Appendix A in Gill P (2013). *Agriculture-Watershed Characterization and Mapping Report for the North Lynden watersheds*. Prepared for the Whatcom County Agriculture-Watershed Pilot Project by the Washington Department of Ecology Shorelands and Environmental Assistance Program.
http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project

[47] See http://www.ecy.wa.gov/puget_sound/characterization/index.html

5.1.2 Limitations

Care should be taken to use the Puget Sound Watershed Characterization as intended. It is a coarse-scale assessment and is not intended for site-specific application or decision-making at the site scale. Finer scale data, local information and technical expertise is needed for those decisions. In addition:

- The Puget Sound Watershed Characterization is for planning purposes only. This does not affect or alter existing land use/environmental regulations although it may be used to help inform future land use and regulatory decisions.
- For the water flow assessment, the rankings for any single AU are relative only to other AUs in the area of analysis. This means it is only appropriate to compare the WID results with results in other AUs in the lowland area of WRIA 1.
- Results at the AU scale represent land-use planning-level information. At the project- or site scale, each AU will have a combination of on-the-ground challenges and opportunities. Just because an AU is rated as a low priority for restoration does not mean there are no suitable restoration sites or opportunities in that AU. Similarly, not every site in an AU that is a high priority for restoration will be suitable for restoration.
- The assessments are landscape-scale and consequently do not address site-specific issues. These are best addressed through finer-scale studies, which will remain essential to the success of local conservation efforts. When developing site-level plans, the WID should evaluate the need for finer-scale information and collect it where needed.
- The watershed characterization assessment is not intended to address compliance with state or federal water quality law, nor describe the actions necessary to achieve compliance with those laws. It is a violation of state law when activities are shown to cause or have the substantial potential to cause nonpoint source pollution. If the reader has questions about the water quality laws, they can contact Whatcom County Public Works or the WA Department of Ecology for additional information.

5.1.3 Fundamental concepts of watershed characterization

Watershed processes are defined as the dynamic physical and chemical interactions that form and maintain the landscape and ecosystems on a geographic scale of watershed to basins. This includes the movement of water, sediment, nutrients, pathogens, chemicals and wood. Watershed process are controlled and influenced by natural attributes and human actions. Natural controls on watershed processes include physical attributes of the ecosystem such as geomorphology, geology, and soils. Many human actions influence watershed processes. For example, timber harvest may reduce the amount of wood entering streams. Shoreline armoring can reduce sediment input from bluffs and alter the erosion, movement, and deposition of sediments along beaches. Urban development can increase the amount and amplitude of stormwater runoff. Watershed characterization attempts to model these watershed processes such that areas of the landscape can be identified which are relatively more important (presence of natural controls) or degraded (due to human impacts).

5.1.4 Understanding the water flow assessment results

The water flow assessment uses two models to compare the *importance* and *degradation* of water flow processes in a watershed. Together, they identify areas that are relatively more suitable for protection or restoration of water flow processes. Each model provides a ranking from low to high for how important and how degraded each assessment unit is *relative* to the other units in the watershed.

Water flow importance

The *importance* model evaluates the watershed in its "unaltered" state. This model combines the delivery, surface storage, recharge, and discharge components to compare the relative *importance* of assessment units in maintaining overall water flow processes in a non-degraded setting. When precipitation is "delivered" as either rain or snow, there are physical features that control the surface and subsurface movement of that precipitation within an assessment unit.

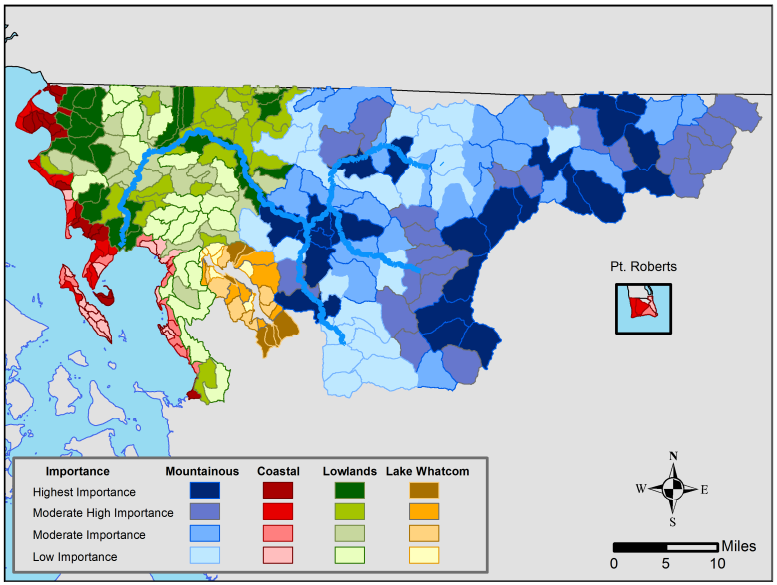

Figure. Overall importance to water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA 1. Darkest colored assessment units are considered highest *importance* relative to other assessment units in the same landscape group of WRIA 1.

These physical features include land cover, storage areas such as wetlands and floodplains, areas of higher infiltration and recharge, and areas that discharge groundwater. These areas are considered "important" to the overall water flow processes.

In the figure to the left, each landscape group is displayed in a different color gradient (i.e. shades of blue, green, red or tan), which allows for direct comparison within the extent of that landscape group only. Dark green assessment units would be considered *highly important* for overall water flow processes *only* within the lowland area of WRIA 1, and are not comparable to AUs outside of that extent. However, this does allow one to determine which AUs throughout the lowland areas of WRIA 1 are *relatively more important* than others in that same extent.

Water flow degradation

In the water flow *degradation* model the watershed is evaluated in its "altered" state to consider the impact of human actions on water flow processes. The *degradation* model calculates the degree of alteration to those controls that regulate the delivery, movement and loss of water, such as forest clearing and impervious surfaces. This model combines the delivery, surface storage, recharge, and discharge components to compare the relative *degradation* to overall water flow processes in assessment units. Degradation to these processes generally accelerates the movement of surface flows downstream. This accelerated delivery increases downstream flooding and erosion and subsequently degrades aquatic habitat over time.

The figure below displays the results of the *degradation* to water flow processes for all of WRIA 1. Since degradation is not controlled by landscape, we compare assessment units within the entire extent of the WRIA. A dark pink unit along the coast is comparable in level of degradation to a unit in the lowland area.

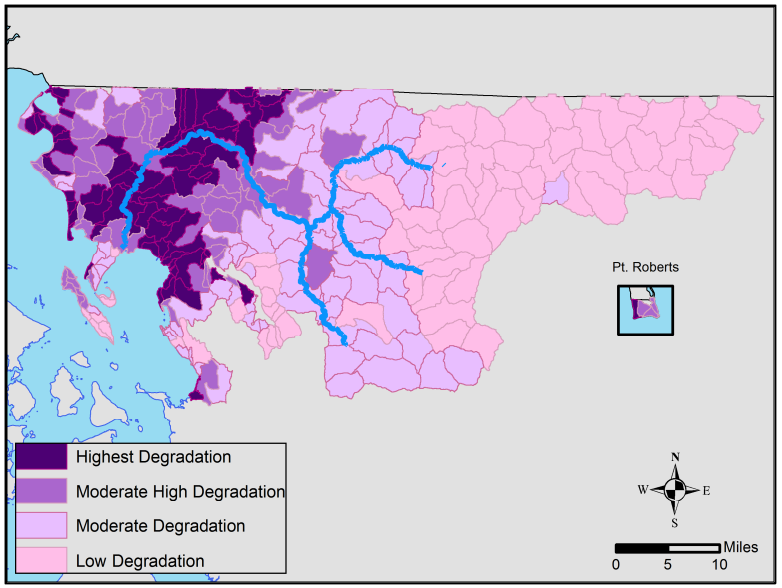

Figure. Overall degradation of water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA 1. Dark pink assessment units are considered to have the highest *degradation* relative to other assessment units in WRIA 1.

Management matrix for water flow

Combining the results of the *importance* and *degradation* models yields a simple categorical matrix that planners can use, along with other science-based information, to inform land management strategies and actions. At its simplest, this management matrix conveys which areas are relatively important and/or degraded, and what actions might be most appropriate there:

Highly important – low degradation = protect
Highly important – high degradation = restore
Low importance – low degradation = conserve
Low importance – high degradation = develop

The Puget Sound Watershed Characterization project generally prioritizes restoration or enhancement actions in watersheds which are both highly important and are relatively more degraded for watershed processes (yellow boxes in the Management Matrix Figure below; yellow assessment units in the map below). This does not mean that there are not important areas or necessary restoration actions in assessment units that are not highly important and highly degraded. Rather, given limited funding these might be the first places to focus on in order to increase the likelihood of improving watershed processes.

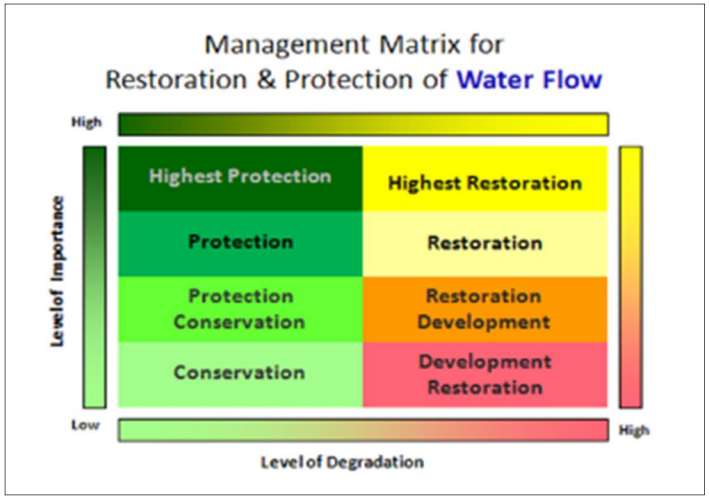

Figure. Management matrix for water flow, indicating relative priorities for restoration and protection of processes

By accounting for both the relative level of *importance* and the relative level of *degradation* of an Assessment Unit one can begin to prioritize which areas of a watershed to apply management strategies which protect water flow processes, and which areas to prioritize restoration of water flow processes.

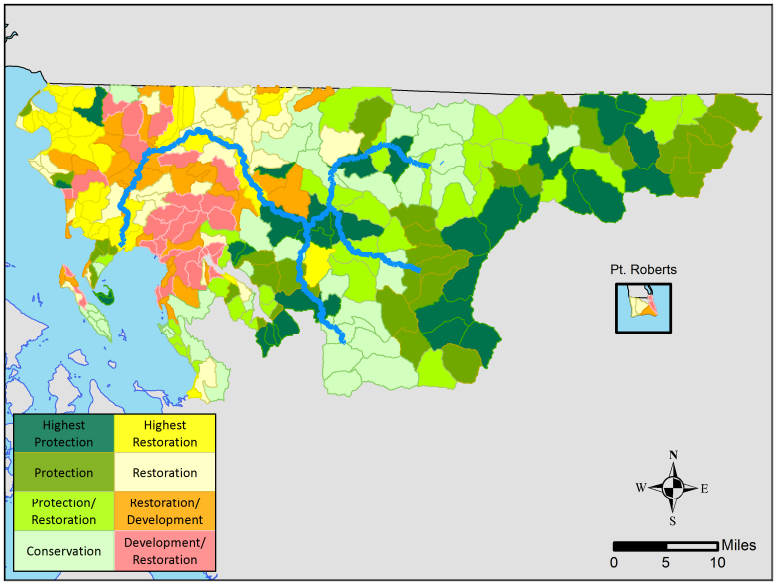

Figure. Overall priorities for restoration and protection of water flow processes in WRIA 1: Results of Puget Sound Watershed Characterization assessment.

5.1.5 Using the results of the water flow assessment

For water flow process enhancement or restoration, actions should be directed towards reducing the degradation to controls that regulate the delivery and movement of water through the watershed. These controls include forest cover, areas of surface storage, areas of permeable deposits, areas of slope wetlands and areas of floodplains with permeable deposits.

The terms "restoration" and "protection" as used in this document do not mean a return to historic land cover conditions or retaining 100% forested land cover. Restoration and protection actions should be done in a manner that recognizes and works within the constraints of the existing land use activities. For example, restoration in agricultural areas could mean consideration of measures that enhance a critical portion of water flow processes such as surface storage. This could involve the retention of water on fields for a longer period to avoid harmful peak flows within streams during the winter months. Restoration and protection measures are, therefore, always proposed here in the context of both the landscape setting and the current land use activities.

There are actions which can offer mutual benefits to both water flow and water quality. For example, there are some areas where wetland restoration or enhancement to surface storage processes could provide some improvements for both. The potential enhancement actions suggested in Table 5 may have additional benefits to other watershed processes and functions particularly in the area of riparian habitat and structure which are critical to salmonid habitats throughout the Whatcom County lowland watersheds.

5.2 Watershed characterization tables

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Table 5. Watershed characterization tables for the Sumas WID

NOTE: Possible actions include: Specific actions identified by WID Actions Map # location and Assessment Unit (AUs), and General actions which do not have locations specified. Some of these actions do not appear on the WID Priority Actions Map due to: (i) action is general in description no location is noted; (ii) action is specific in description but no location noted; (iii) action is general in description, located outside the WID area; (iv) action is specific in description, located outside the WID.

5A. Watershed Enhancement Priorities: Upper Johnson Creek				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Upper Johnson AU 1164 AU1165 AU1088 AU1168 Notes from reference maps and other documents	Critical Habitat: Band tailed pigeon, great blue heron, waterfowl concentrations, trumpeter swan and wetland. Sandhill crane[48] in AU1088. (See Watershed reference map: Priority Habitats & Species) Rare Plant: soft-leaved willow[49]	Coho, cutthroat[50] (See Watershed reference map: Fish presence & fish barriers) Documented coho spawning in Upper Johnson[51]	Johnson Creek in AU1164 is in category 4a[52] for bacteria and Dissolved Oxygen.[53] Clearbrook Creek in AU1165 is in category 4a for bacteria.[54] Pangborn Creek in AU1168 is in category 4a for DO and bacteria.[55] Squaw Creek in AU 1088 is in category 4a for bacteria.[56]	Results of PSWC water flow assessment: AU1164: An area of high importance for recharge and delivery processes and moderately high importance for surface storage. AU1165: An area of high importance for recharge and delivery processes and moderate importance for surface storage. AU1168: An area of high importance for delivery and recharge processes and moderately high importance for discharge. AU1088: An area of high importance for recharge and delivery processes and moderate importance for surface storage. Summary: Much of this area is of moderate-high importance for water flow processes, particularly recharge and delivery processes, but overall water flow processes are highly degraded. Several water quality impairments are listed (bacteria and dissolved oxygen). Potential for enhancement Actions should focus on improving recharge by preventing additional impervious surface cover and reducing existing impervious cover; improving delivery by protecting and restoring forest and riparian cover, and finding opportunities to retain surface flows for longer particularly in the headwaters of Johnson Creek (AU1164). These actions can be expected to have additional benefits of improving water quality and salmon habitat in the area.
Upper Johnson AU 1164 AU1165 AU1088 AU1168 Notes from January 2016 work session	NF Johnson is one of the more productive spawning areas according to WDFW. (Comment from WID work session.)	Salmon spawning occurs in Sumas, Pangborn[57] (used to be called Cummings), Clearbrook and Squaw Creeks. Salmon used to be very abundant in Sumas Creek. All of these creeks need salmon habitat improvement. (Work session participant comment.)		

[48] Sandhill Crane designation appears to be based on a sighting in 1994. Joel Ingram, WDFW. Pers. comm. April 2016.
[49] WA Department of Natural Resources (2015). *Washington Natural Heritage Program*. http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html
[50] Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.
[51] WDFW, n.d. SalmonScape [interactive webmap] <http://apps.wdfw.wa.gov/salmonscape/> [last accessed May 04, 2016]
[52] Category 4a - has a TMDL: water bodies that have an approved TMDL in place and are actively being implemented. WA Department of Ecology, 2015. *Water Quality Assessment Categories.* http://www.ecy.wa.gov/programs/wq/303d/WQAssessmentCats.html (Accessed March 28, 2016)
[53] Department of Ecology, 2012. *Water Quality Assessment for Washington.* < http://www.ecy.wa.gov/programs/Wq/303d/index.html >
[54] Department of Ecology, 2012. *Water Quality Assessment for Washington.* < http://www.ecy.wa.gov/programs/Wq/303d/index.html >
[55] Department of Ecology, 2012. *Water Quality Assessment for Washington.* < http://www.ecy.wa.gov/programs/Wq/303d/index.html >
[56] Department of Ecology, 2012. *Water Quality Assessment for Washington.* < http://www.ecy.wa.gov/programs/Wq/303d/index.html >
[57] Video of salmon spawning in Pangborn/Cummings Creek can be found at < https://www.youtube.com/watch?v=umbOHHz6MK0 >. Provided by R. Perry, April 2016.

5B. Watershed Enhancement Priorities: Lower Johnson Creek				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Lower Johnson AU 1166 AU1091 Portion of AU1087 Notes from reference maps and other documents	Critical Habitat: Wetland (See Watershed reference map: Priority Habitats & Species)	Chinook, chum, coho, cutthroat, sockeye & steelhead[58]	Sumas Creek is in AU1166 is in category 4a for DO and bacteria.[59] Most of Johnson Creek in AU1091 is in category 4a for DO and bacteria.[60]	Results of PSWC water flow assessment: AU1166: An area of high importance for delivery and moderately high importance for discharge and recharge processes. AU1091: An area of high importance for recharge and delivery processes and moderate importance for discharge and surface storage processes. AU1087: An area of high importance for recharge and delivery processes and moderately high importance for surface storage. Summary: This is one of the areas of highest importance for water flow in the Sumas watershed, particularly for recharge and delivery processes, but overall water flow processes are highly degraded. Water quality is impaired in much of this area (dissolved oxygen and bacteria). Potential for enhancement The urban area of Sumas covers the eastern portion of this area, which somewhat limits the options for restoration of water flow processes at a larger scale. Actions should focus on improving recharge by preventing additional impervious surface cover and reducing existing impervious cover; improving delivery by protecting and restoring forest and riparian cover. These actions can be expected to have additional benefits of improving water quality.
Lower Johnson AU 1166 AU1091 Portion of AU1087 Notes from January 2016 work session			Meadowbrook and Sumas have good water quality but the well on the May Rd is high in nitrates, supposedly from chicken farms north of the border some years ago. The May Rd well water is pumped to the co-generation plant and over the years the nitrate levels are becoming lower from that well. (Participant comment)	

[58] Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.
[59] Department of Ecology, 2012. *Water Quality Assessment for Washington.* http://www.ecy.wa.gov/programs/Wq/303d/index.html
[60] Department of Ecology, 2012. *Water Quality Assessment for Washington.* http://www.ecy.wa.gov/programs/Wq/303d/index.html

5C. Watershed Enhancement Priorities: Upper Fishtrap East				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Upper Fishtrap (East) AU1169 Notes from reference maps and other documents	Critical Habitat: Trumpeter swan, waterfowl concentrations and wetland (See Watershed reference map: Priority Habitats & Species)	None listed	None listed	Results of PSWC water flow assessment: AU1169: An area of high importance for discharge and moderately high importance for recharge. Summary: Overall water flow processes are highly degraded, but this is one of the areas of lower relative importance for water flow processes. Potential for enhancement Decreasing the rate and quantity of subsurface drainage will help to improve discharge processes, while preventing additional impervious cover and reducing existing impervious cover will improve recharge processes.
Upper Fishtrap (East) AU1169 Notes from January 2016 work session	No notes were added at the work session.			

5D. Watershed Enhancement Priorities: Lower Sumas (Saar Creek)				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Saar Creek AU1079 AU 1078 Notes from reference maps and other documents	Critical Habitat: Bald eagle (1), trumpeter swan (1) and wetland (1) (See Watershed reference map: Priority Habitats & Species)	Chinook, chum, coho, cutthroat, pink, sockeye, steelhead[61] Documented coho spawning in Saar[62]	None listed	Results of PSWC water flow assessment: AU1078: An area of high importance for surface storage and moderately high importance for discharge. AU1079: An area of high importance for surface storage and moderately high importance for discharge. Summary: This is an area of lower to moderate importance overall for water flow processes, relative to other sub-basins in the Sumas River watershed. However, a number of springs and streams enter the lowland area from the foothills above and contribute to streamflow in Saar Creek and smaller tributaries. Overall water flow processes are moderately degraded. Potential for enhancement: Actions should focus on retaining surface flows longer and decreasing the rate and quantity of drainage of subsurface waters where possible.
Saar Creek AU1079 AU 1078 Notes from January 2016 work session	Trumpeter swans and eagles are abundant in AU1079.	No major fish barriers. Bridges could affect habitat (participant comment).		[S9] AU1079 Lots of salmon in Saar Creek. Thousands of fish can collect in the sediment trap (sediment trap is marked on map: Figure 11). [S1] AU1079 One culvert half full of gravel.

[61] Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.
[62] WDFW, n.d. SalmonScape [interactive webmap] <http://apps.wdfw.wa.gov/salmonscape/> [last accessed May 04, 2016]

5E. Watershed Enhancement Priorities: Lower Sumas River				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Lower Sumas River AU1086 AU1087 Notes from reference maps and other documents	Critical Habitat: Wetland (See Watershed reference map: Priority Habitats & Species)	Chinook, chum, coho, cutthroat, steelhead, sockeye (AU1086 only) [63]	Sections of the Sumas River in AU1086 are in category 5[64] for DO, and 4a for DO and bacteria.[65]	Results of PSWC water flow assessment: AU1086: An area of high importance for recharge and delivery processed and moderate importance for discharge and surface storage processes. Surface storage processes are highly degraded. AU1087: An area of high importance for recharge and delivery processes and moderately high importance for surface storage. Both delivery and surface storage processes are highly degraded. Summary: This is one of the areas of highest importance for water flow, but overall water flow processes are of moderately-high to highly degraded, particularly storage and delivery processes. Water quality impairments are listed for dissolved oxygen and bacteria. Potential for enhancement: Restoration of recharge and delivery processes is important in this area. Consider improving recharge through preventing additional impervious cover and reducing existing impervious cover. Protection and restoration of forest cover and riparian cover will help to improve delivery processes. Part of the City of Sumas is contained within this area, which somewhat limits the options for restoration of water flow processes.
Lower Sumas River AU1086 AU1087 Notes from January 2016 work session	No notes were added at the work session.			

[63] Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

[64] Category 5 - Polluted waters that require a TMDL (total maximum daily load) or other WQI (water quality Improvement) project: the traditional list of impaired water bodies traditionally known as the 303(d) list. Starting with the 2008 Water Quality Assessment, Washington's 303(d) list of polluted waters were placed under Category 5 in the approved assessment. Placement in this category means that Ecology has data showing that the water quality standards have been violated for one or more pollutants, and there is no TMDL or pollution control plan. WA Department of Ecology, 2015. *Water Quality Assessment Categories.* http://www.ecy.wa.gov/programs/wq/303d/WQAssessmentCats.html (Accessed March 28, 2016)

[65] Department of Ecology (2012). *Water Quality Assessment for Washington.* http://www.ecy.wa.gov/programs/Wq/303d/index.html

5F. Watershed Enhancement Priorities: Middle Sumas (Middle Sumas River & Kinney Creek)				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Middle Sumas River & Kinney Creek AU1163 Notes from reference maps and other documents	Critical Habitat: Band tailed pigeon, wetland (See Watershed reference map: Priority Habitats & Species)	Chinook, chum, coho, cutthroat & steelhead[66]	Section of Sumas River in AU1163 is in category 5 for bacteria.[67]	Results of PSWC water flow assessment: AU1163: An area of high importance for recharge and delivery processes, which are degraded at a moderate-high level. The area is of moderately high importance for discharge, which is highly degraded. Summary: This is an area of moderate-high importance overall for water flow processes, but water flow processes are of moderately-high degradation. Water quality is listed as impaired (bacteria) in the main channel of Sumas River. Potential for enhancement: Actions should focus on restoring surface storage and discharge processes, by retaining surface flows for longer and by decreasing the rate and quantity of drainage of subsurface waters.
Middle Sumas River & Kinney Creek AU1163 Notes from January 2016 work session	No notes were added at the work session.			

[66] Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.
[67] Department of Ecology, 2012. *Water Quality Assessment for Washington.* < http://www.ecy.wa.gov/programs/Wq/303d/index.html >

5G. Watershed Enhancement Priorities: Middle Sumas (Breckenridge & Swift Creeks)				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Breckenridge & Swift Creeks AU1077 Notes from reference maps and other documents	Critical Habitat: Bald eagle, great blue heron, wetland (See Watershed reference map: Priority Habitats & Species)	Chum, coho, cutthroat & steelhead[68] Documented coho spawning in Breckenridge Creek[69]	Section of Sumas River in AU1077 is in category 5 for bioassessment.[70]	Results of PSWC water flow assessment: AU1077: An area of high importance for discharge and surface storage processes. Surface storage processes are moderate-highly degraded, but other water flow processes are only moderately degraded. Summary: Overall water flow processes are moderately degraded. This is an area of lower importance for water flow processes overall, but there is naturally occurring asbestos in Swift Creek due to a landslide upstream. Potential for enhancement: Consider actions to retain surface flows for longer in order to restore surface storage processes. Decreasing the rate and quantity of sub-surface drainage will help to restore discharge processes.
Breckenridge & Swift Creeks AU1077 Notes from January 2016 work session			Low dissolved oxygen in Swift Creek. Nothing grows along Swift Creek, possibly due to high calcium and magnesium levels in the water? (Participant comment from WID work session.)	

[68] Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.
[69] WDFW, n.d. SalmonScape [interactive webmap] <http://apps.wdfw.wa.gov/salmonscape/> [last accessed May 04, 2016]
[70] Department of Ecology, 2012. *Water Quality Assessment for Washington.* < http://www.ecy.wa.gov/programs/Wq/303d/index.html >

5H. Watershed Enhancement Priorities: Upper Sumas (Dale Creek)				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Dale Creek AU1161 Notes from reference maps and other documents	Critical Habitat: Wetland (See Watershed reference map: Priority Habitats & Species)	Coho, cutthroat [71]	None listed.	<u>Results of PSWC water flow assessment</u>: AU1161: An area of high importance for recharge and delivery processes and lower importance for surface storage and discharge processes. Recharge and delivery processes are moderately degraded. <u>Summary</u>: This area is one of the most important for water flow processes overall and is only moderately degraded. Much of the headwater area is forested. There are no water quality impairments listed. <u>Potential for enhancement:</u> Actions should focus on protection of water flow processes generally in this area, but with specific attention to preventing additional impervious cover in order to maintain recharge processes, and to protecting forest and riparian cover in order to ensure continued delivery of water to streams in the area.
Dale Creek AU1161 Notes from January 2016 work session	No notes were added at the work session.			

[71] Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

5I. Watershed Enhancement Priorities: Upper Sumas River				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Upper Sumas River AU1162 & portion of AU1090 Notes from reference maps and other documents	Critical Habitat: Great blue heron and wetland	Coho & cutthroat[72] Coho spawning documented in Upper Sumas[73]	Section of Sumas River is in category 5 for bioassessment in AU1162.[74] Hoff Creek is category 5 for temperature in AU1090.[75]	Results of PSWC water flow assessment: AU1162: An area of high importance for recharge and delivery processes and moderately important for surface storage and discharge processes. Surface storage processes are highly degraded; other flow processes show moderate-high degradation. AU1090: An area of high importance for recharge and delivery processes, low importance for surface storage and discharge. All water flow processes show moderate-high degradation. Summary: This area is of moderate-high importance for water flow processes. Overall water flow processes show moderate-high degradation. There are impairments listed for temperature and bioassessment. Potential for enhancement: Actions should focus on improving recharge and delivery processes by reducing impervious cover and preventing additional impervious cover, and by protecting and restoring forest and riparian cover. Improving riparian shading cover should also have the added beneficial effect of reducing water temperature in smaller streams.
Upper Sumas River AU1162 & portion of AU1090 Notes from January 2016 work session		Salmon-bearing stream – Comment from WID work session Salmon use tributaries along Goodwin Rd from Cabrant to Gilmore Rds. – Comment from WID work session		

[72] Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.
[73] WDFW, n.d. SalmonScape [interactive webmap] <http://apps.wdfw.wa.gov/salmonscape/> [last accessed May 04, 2016]
[74] Department of Ecology, 2012. *Water Quality Assessment for Washington.* http://www.ecy.wa.gov/programs/Wq/303d/index.html
[75] Department of Ecology, 2012. *Water Quality Assessment for Washington.* http://www.ecy.wa.gov/programs/Wq/303d/index.html

5J. Watershed Enhancement Priorities: Upper Sumas (Smith Creek)				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Smith Creek AU1075 Notes from reference maps and other documents	Critical Habitat: Wetland	Chinook, chum, coho, cutthroat & steelhead[76] Coho and Winter steelhead spawning documented in Macaulay, and Mitchell Creeks. Winter steelhead spawning documented in Smith Creek[77]	No listings in this AU1075, but a section of Smith Creek downstream in AU1095 is in category 5 for dissolved oxygen and category 4a for bacteria.	Results of PSWC water flow assessment: AU1075: An area of high importance for discharge and surface storage processes, but both of these processes show moderate-high levels of degradation. Summary: Overall water flow processes are moderately degraded, but this area is of moderate importance overall for water flow processes. Much of this area is forested, with agriculture being confined to the lower reaches where the land is flatter. Potential for enhancement: Actions should focus on protecting discharge and surface storage processes and restoring these where possible, by decreasing the rate and quantity of subsurface drainage and by retaining surface flows for longer.
Smith Creek AU1075 Notes from January 2016 work session	No notes were added at the work session.			

[76] Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.
[77] WDFW, n.d. SalmonScape [interactive webmap] <http://apps.wdfw.wa.gov/salmonscape/> [last accessed May 04, 2016]

5K. Watershed Enhancement Priorities: Nooksack River main channel (Deming to Everson)				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Nooksack River - Deming to Everson (South) AU1095 (includes lower portion of Smith Creek to confluence) Notes from reference maps and other documents	Critical Habitat: Wetland	Char, Chinook, chum, coho, cutthroat & steelhead[78] Fall Chinook, winter steelhead, and odd year pink. Salmon spawning documented in Nooksack Deming to Everson South[79]	A section of Smith Creek is in category 5 for dissolved oxygen, and 4a for bacteria, and sections of Anderson Creek are in category 5 for fine sediments and dissolved oxygen and category 4a for bacteria in AU1095.[80]	Results of PSWC water flow assessment: AU1095: An area of high importance for recharge, delivery and discharge processes and moderately high importance for surface storage. All water flow processes show moderate-high levels of degradation. Summary: This is one of the areas of highest importance for water flow processes, and is particularly important for salmonids moving upstream to spawning grounds in the Nooksack River tributaries. Overall water flow processes show moderate-high level of degradation, and there are water quality problems (dissolved oxygen, bacteria and fine sediments) in the lower reaches of the tributaries where the most intensive agricultural activity is located. Potential for enhancement: Restoring forest and riparian cover should help to improve delivery and recharge processes and to reduce the amount of sediment reaching the streams.
Nooksack River - Deming to Everson (North) AU1096 Notes from reference maps and other documents	Critical Habitat: Wetland Rare Plant: Soft-leaved willow[81]		A section of the Nooksack mainstem is in category 5 for dissolved oxygen in AU1096.[82]	Results of PSWC water flow assessment: AU1096: An area of high importance for recharge and surface storage processes and moderately high importance for delivery and discharge processes. Surface storage processes are highly degraded. Summary: This is an area of moderate-high importance overall for water flow processes, but water flow processes are highly degraded. The area is also important for salmonids moving upstream to spawning grounds in the Nooksack River tributaries. Water quality is impaired in this area (dissolved oxygen). Potential for enhancement Actions should focus on improving surface storage by retaining surface flows for longer, and on improving recharge by reducing impervious cover and preventing additional impervious cover.
Nooksack River - Deming to Everson Notes from January 2016 work session	No notes were added at the work session.			

[78] Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.
[79] WDFW, n.d. SalmonScape [interactive webmap] <http://apps.wdfw.wa.gov/salmonscape/> [last accessed May 04, 2016]
[80] Department of Ecology, 2012. *Water Quality Assessment for Washington.* http://www.ecy.wa.gov/programs/Wq/303d/index.html
[81] WA Department of Natural Resources (2015). *Washington Natural Heritage Program*. http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html
[82] Department of Ecology, 2012. *Water Quality Assessment for Washington.* <http://www.ecy.wa.gov/programs/Wq/303d/index.html>

5.3 Watershed priorities: Summary maps

The water flow assessment maps contained in this section were prepared using data from the Puget Sound Watershed Characterization Project, provided by the WA Department of Ecology. See http://www.ecy.wa.gov/puget_sound/characterization/index.html

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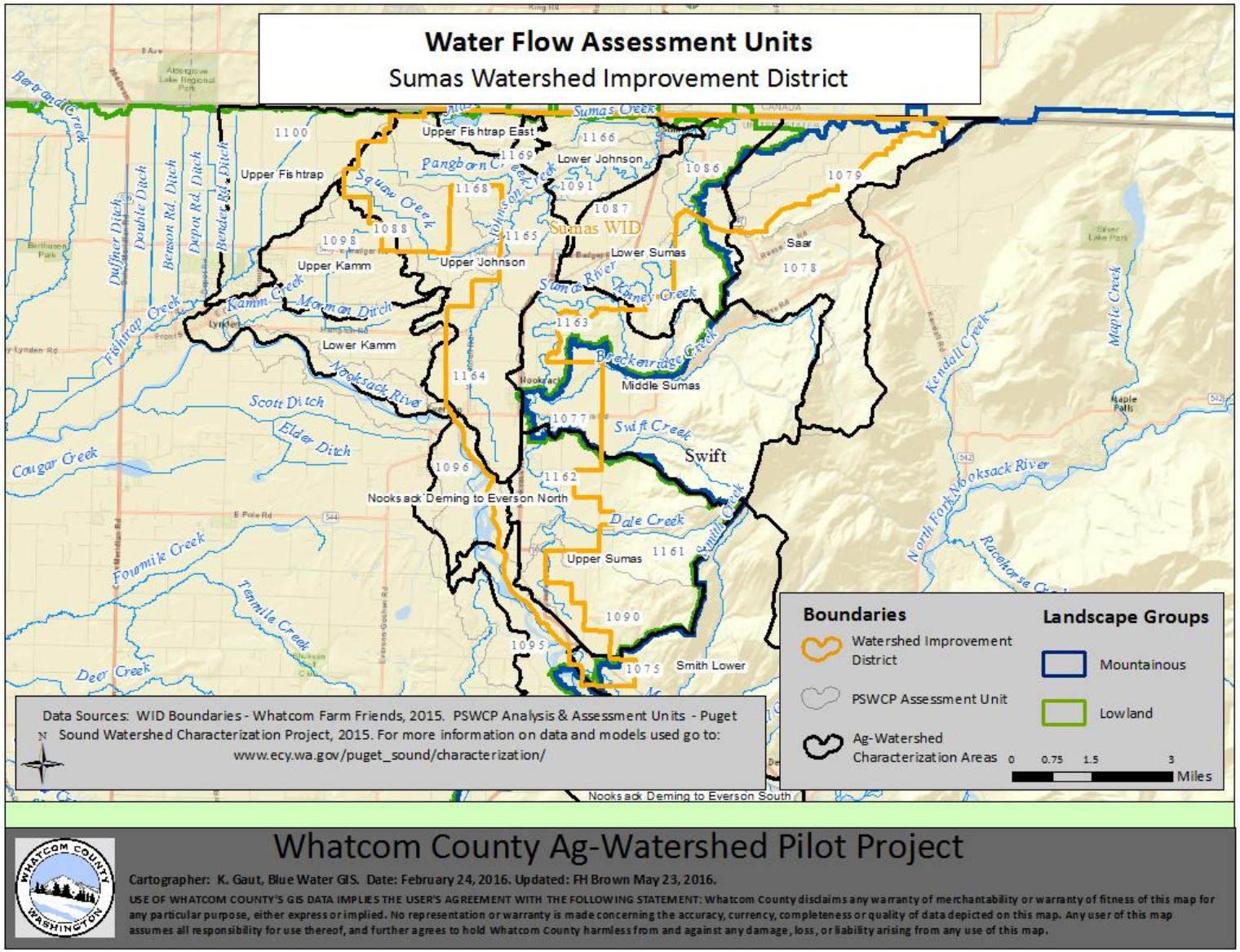

Figure 12. Sumas WID: Water flow assessment units in relation to the WID area

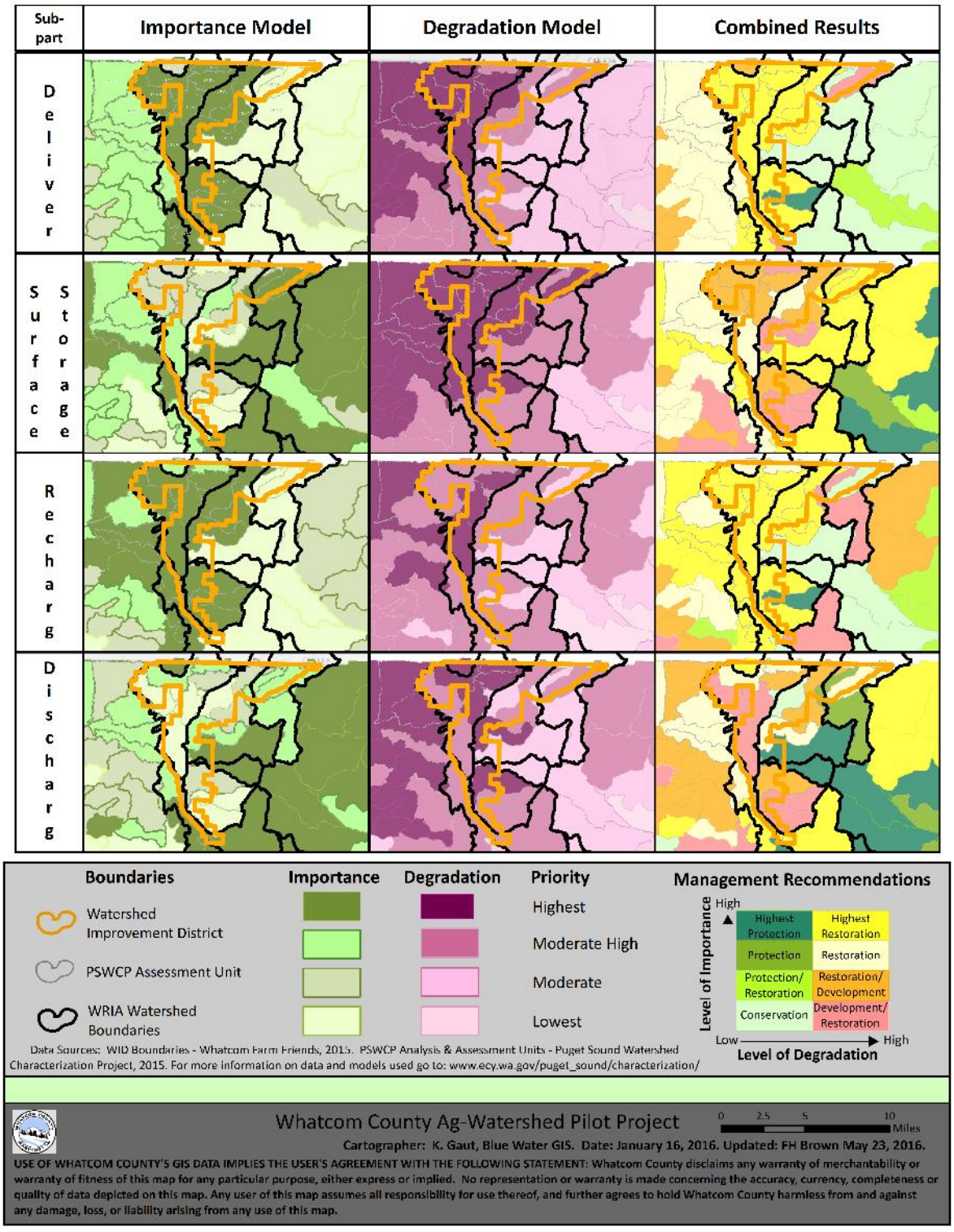

Figure 13. Sumas WID: Water flow process assessment results

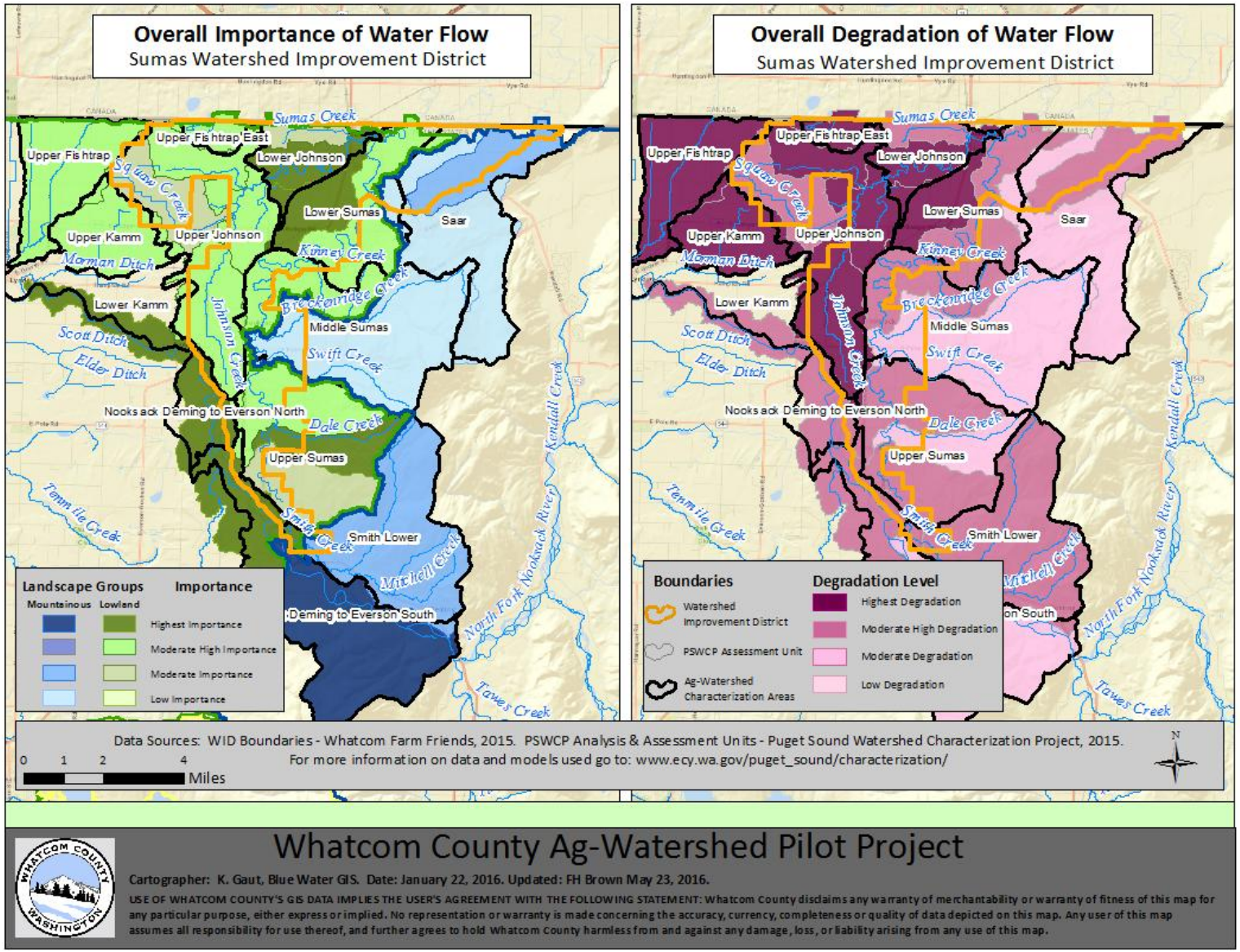

Figure 14. Sumas WID: Overall importance and degradation of water flow processes

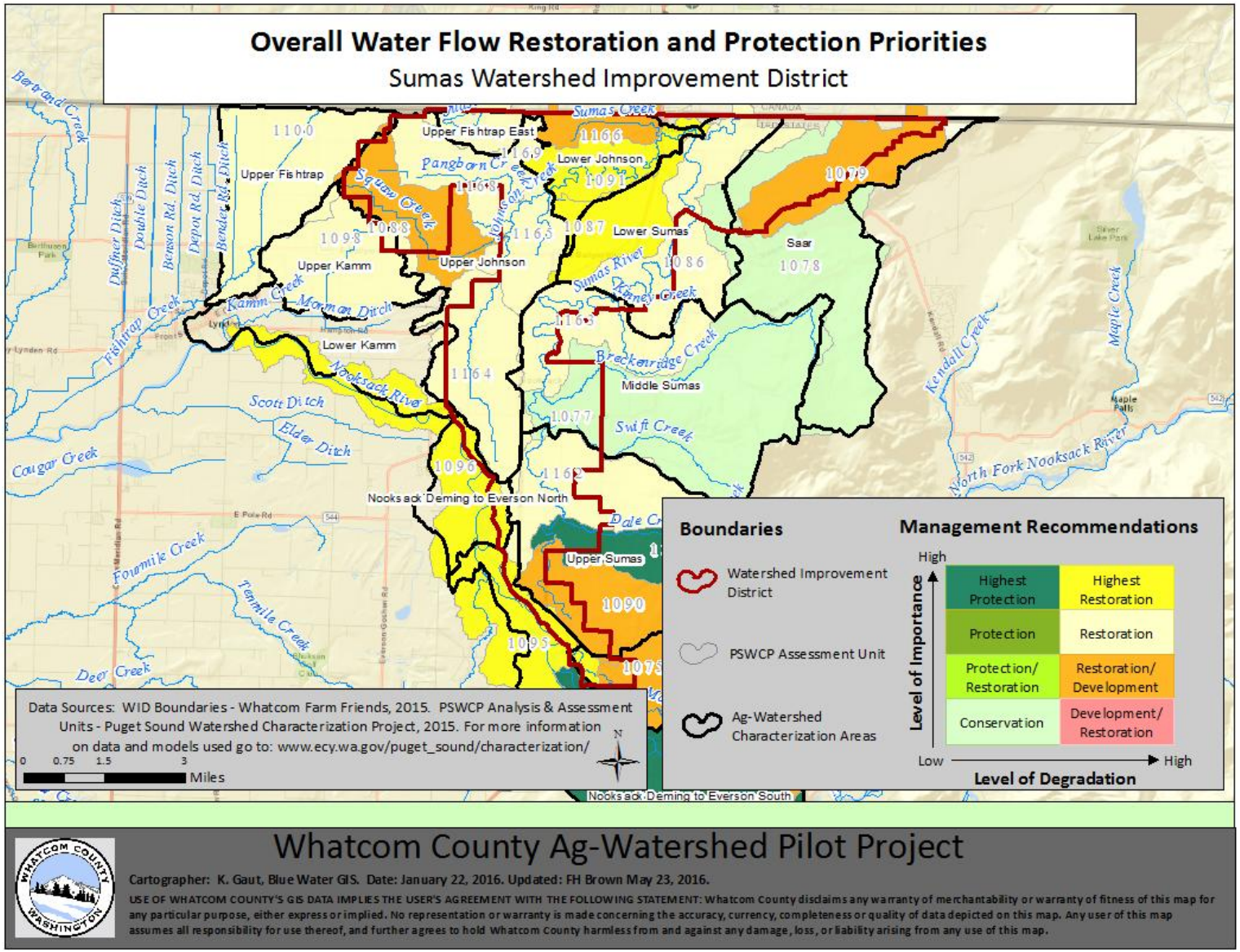

Figure 15. Sumas WID: Overall water flow restoration and protection priorities

5.4 Watershed priorities: Specific actions map

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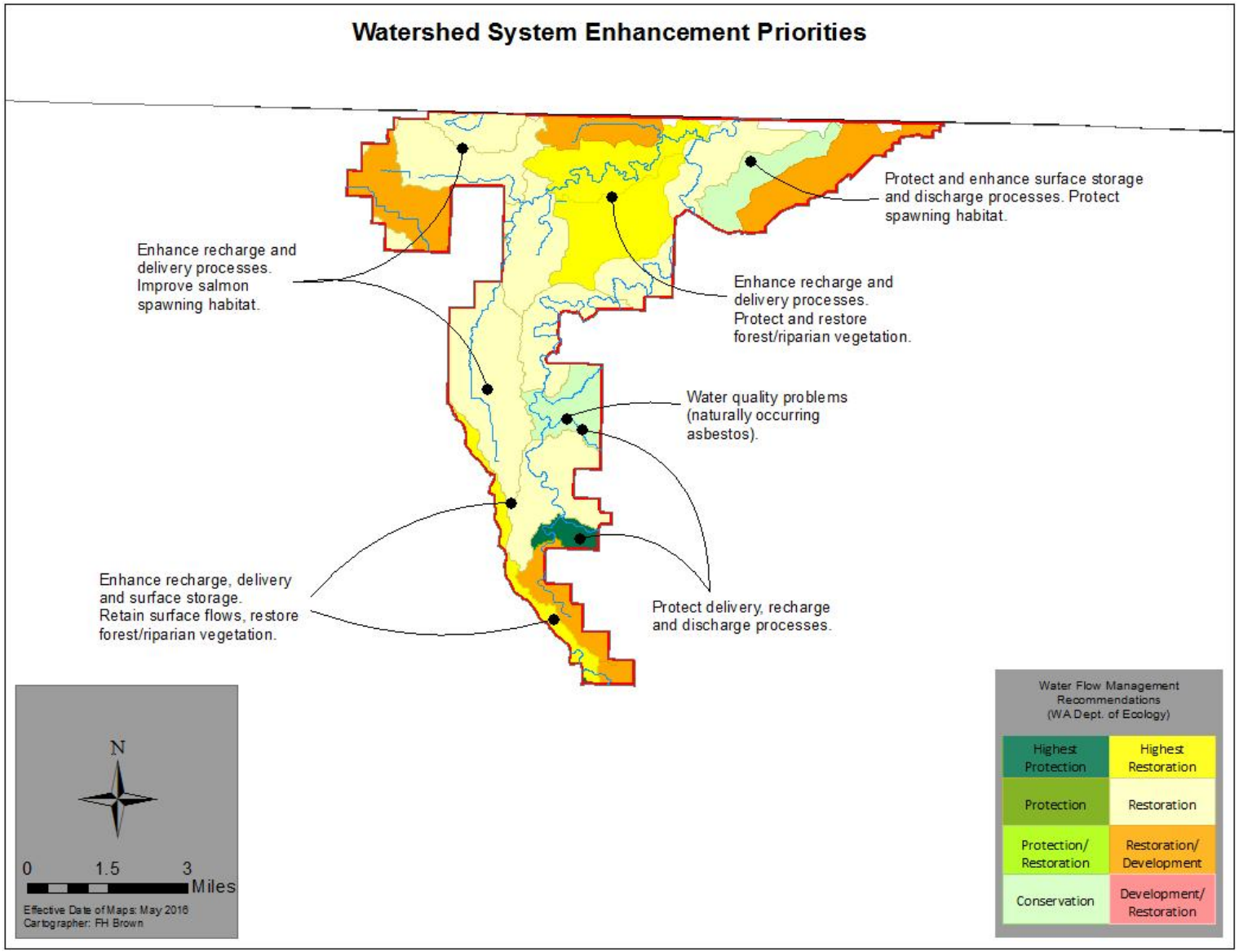

Figure 16. Sumas WID: Summary watershed system enhancement priorities and specific actions

6 Reference maps for the Sumas Watershed Improvement District

6.1 Agriculture reference maps

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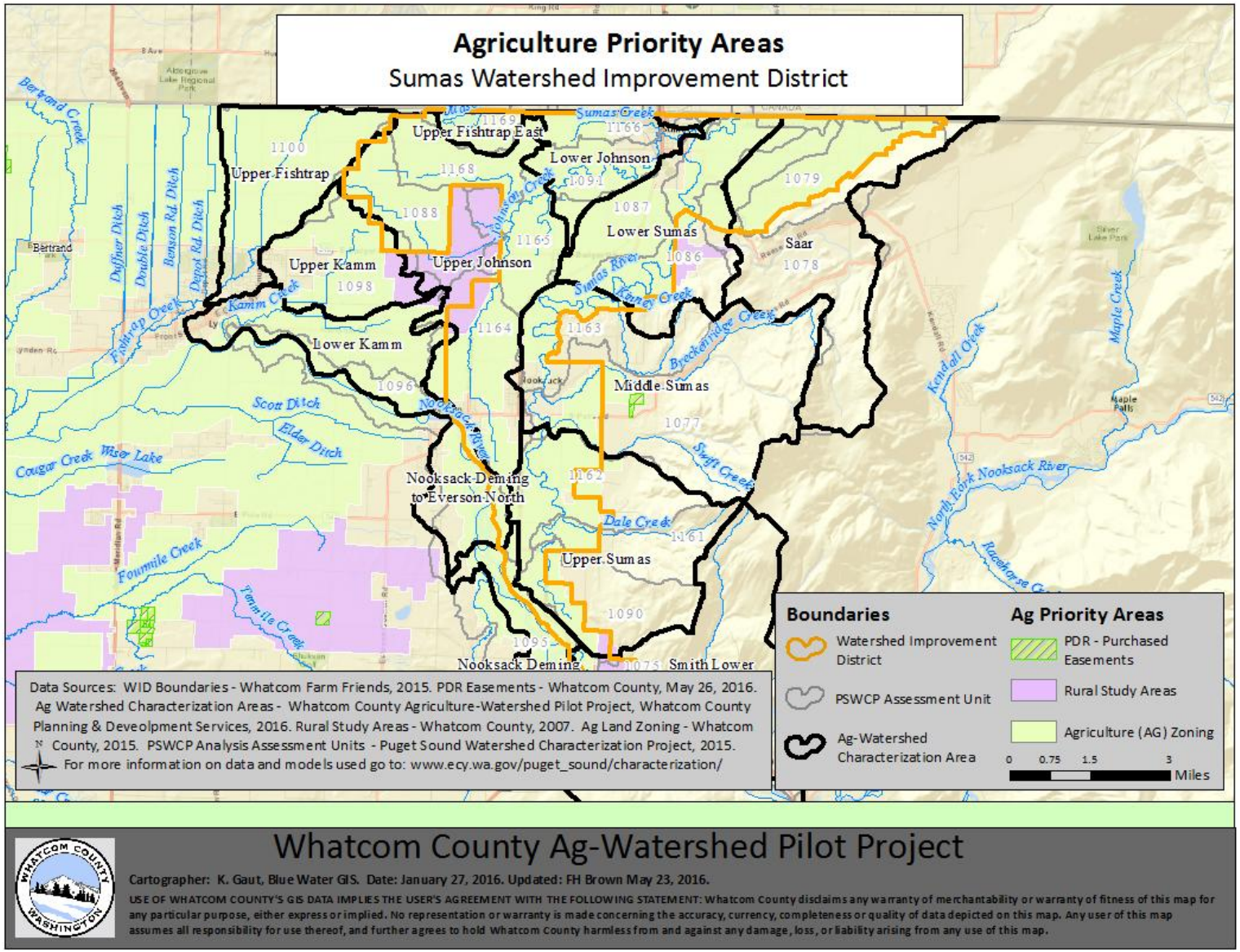

Figure 17. Sumas WID Reference map: Agriculture priority areas

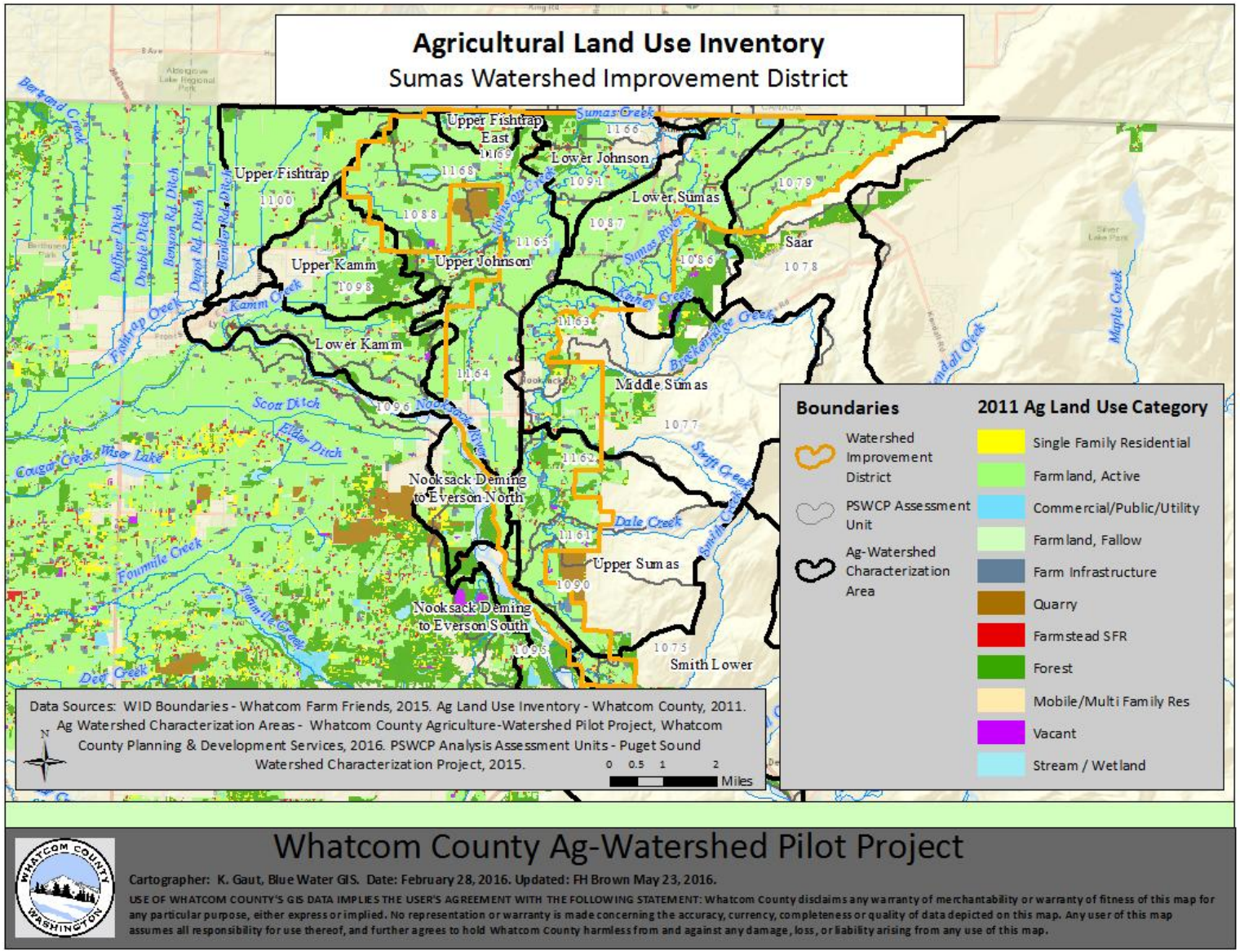

Figure 18. Sumas WID Reference map: Agricultural land use inventory

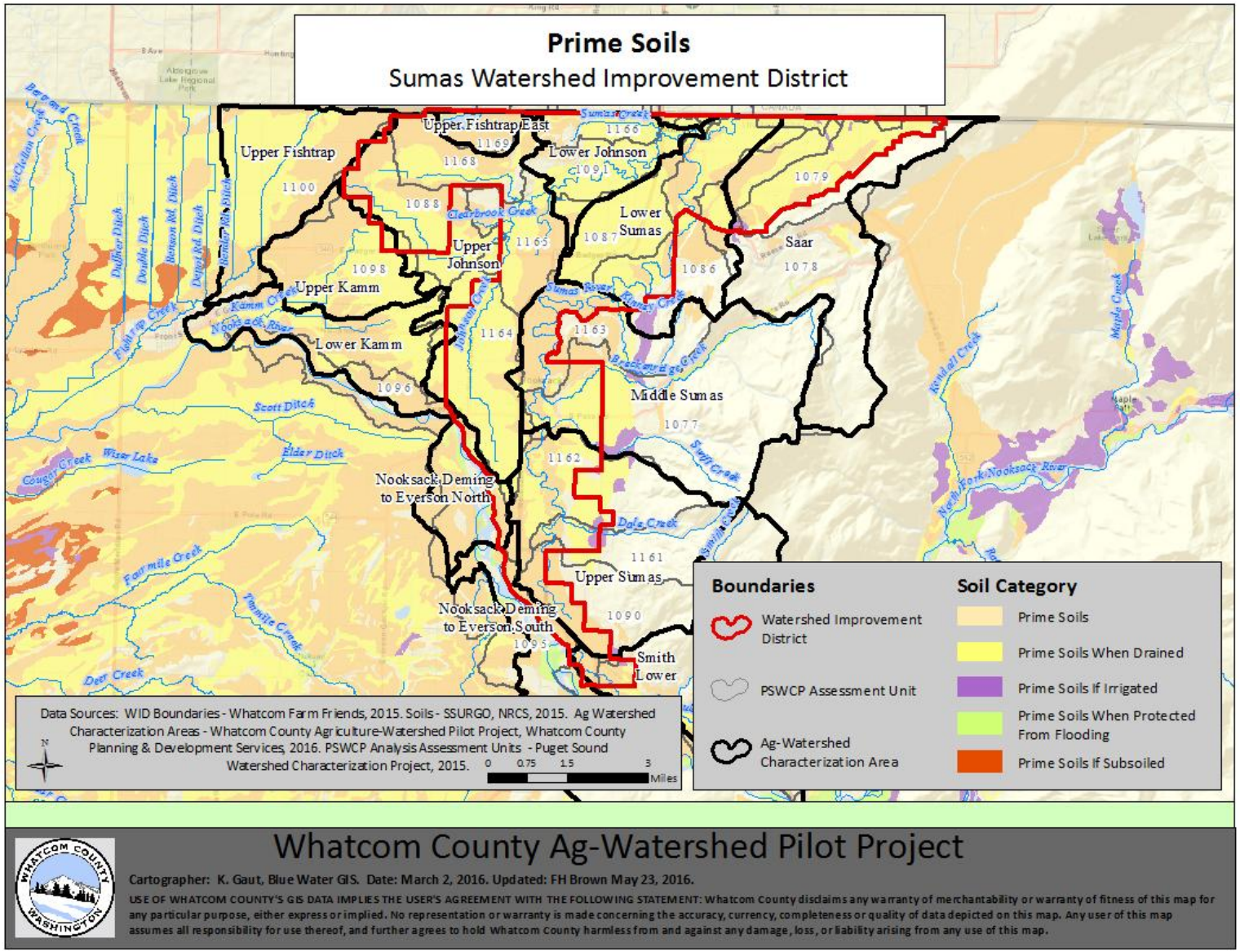

Figure 19. Sumas WID Reference map: Prime soils

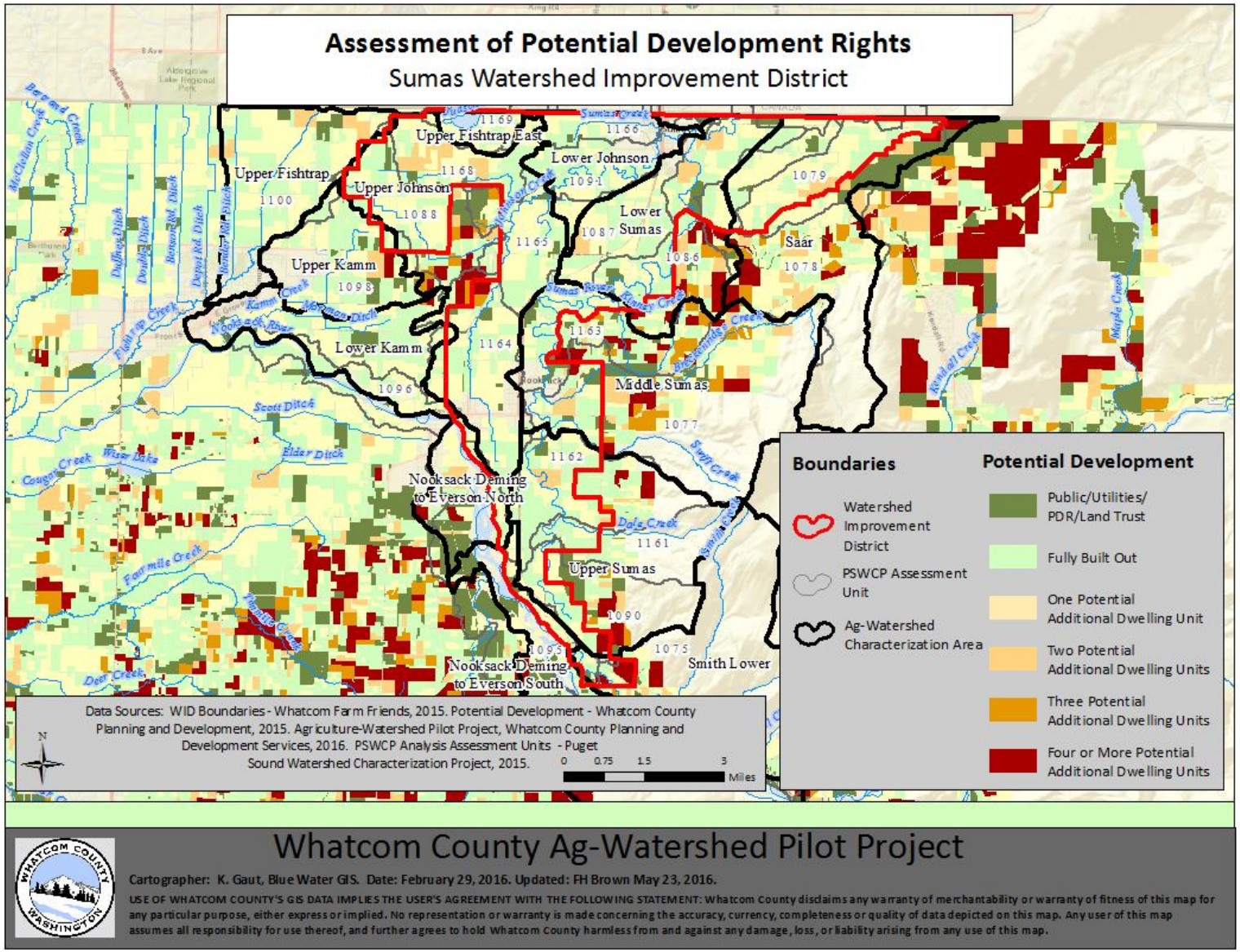

Figure 20. Sumas WID Reference map: Assessment of potential development rights

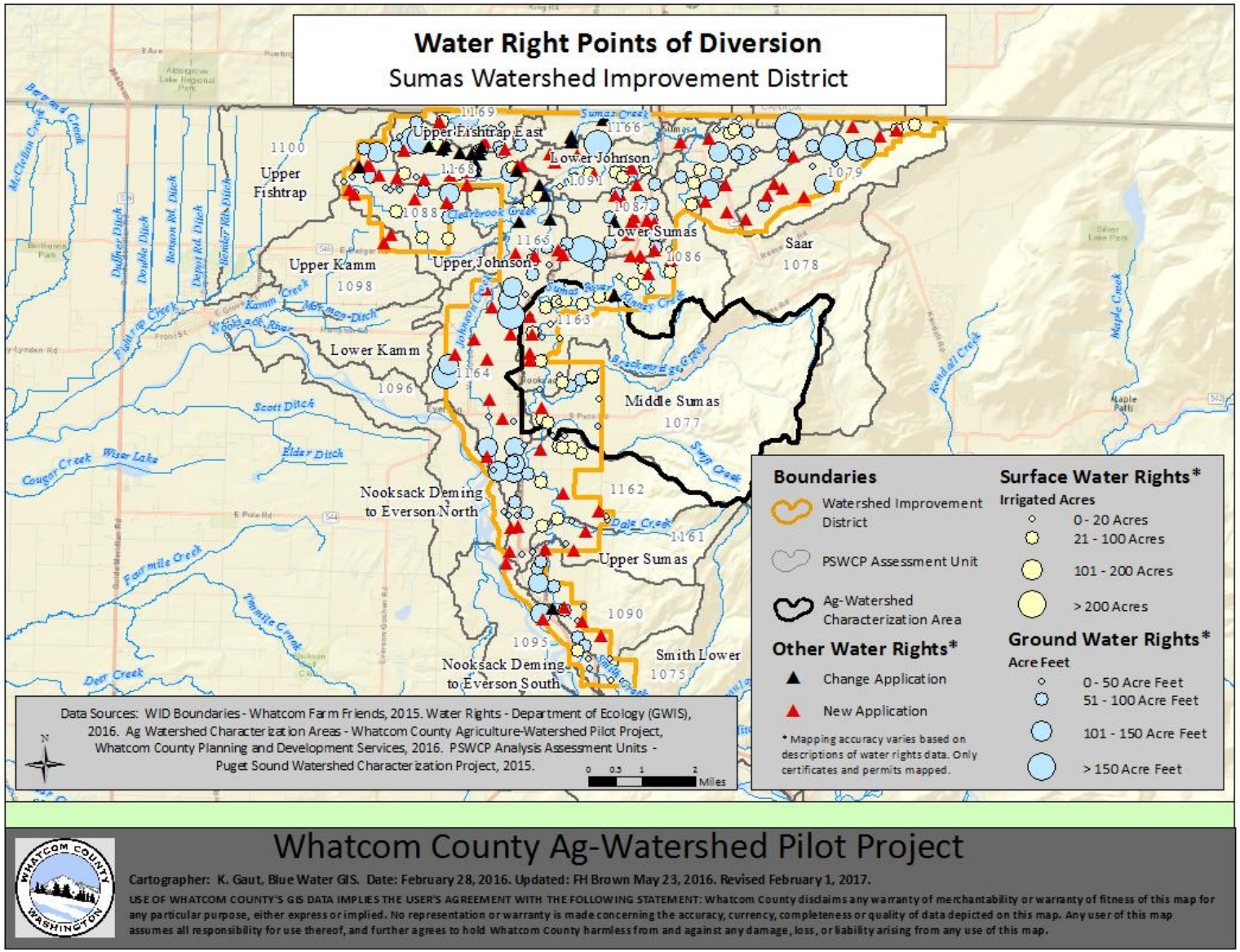

Figure 21. Sumas WID Reference map: Water right points of diversion

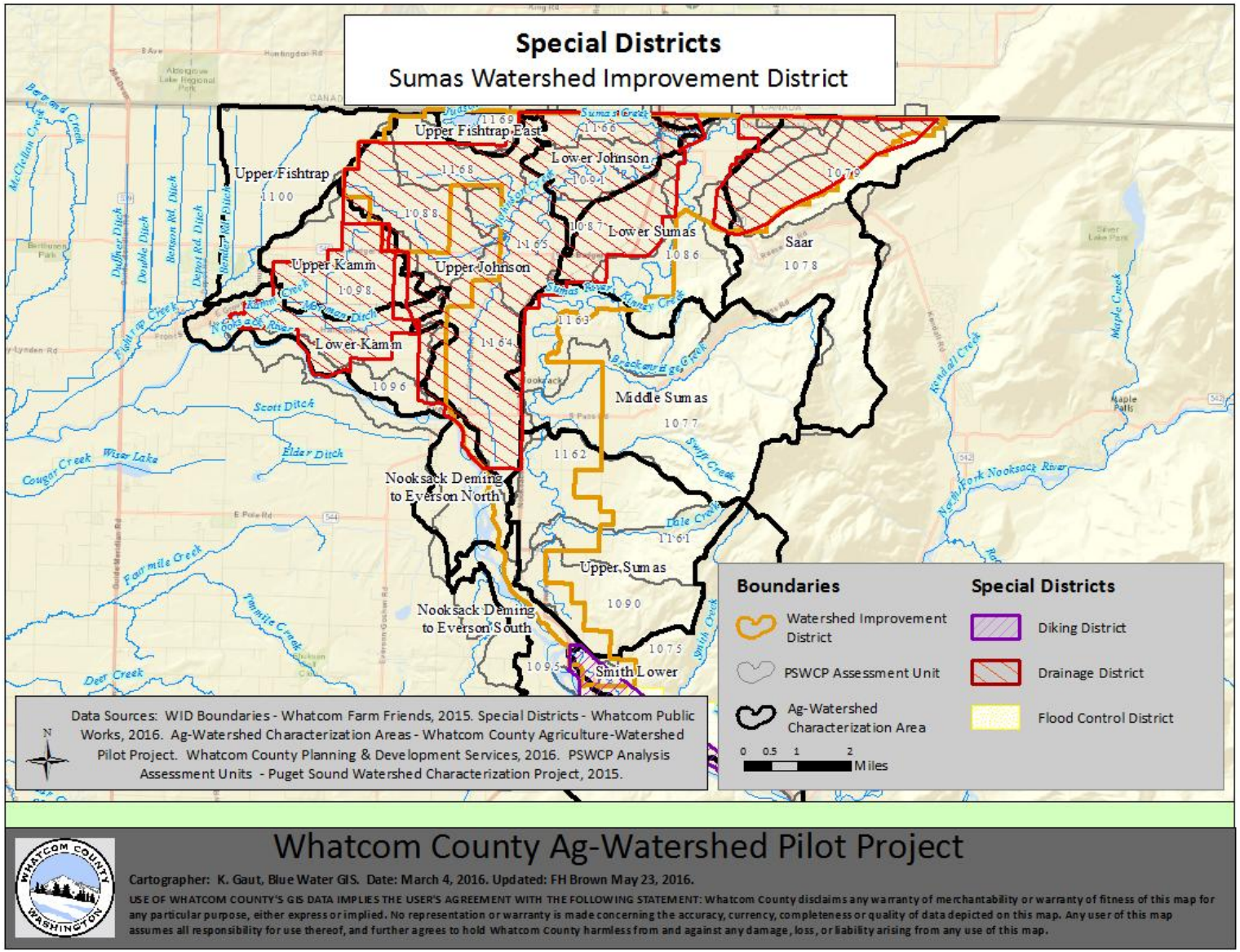

Figure 22. Sumas WID Reference map: Special districts

6.2 Watershed reference maps

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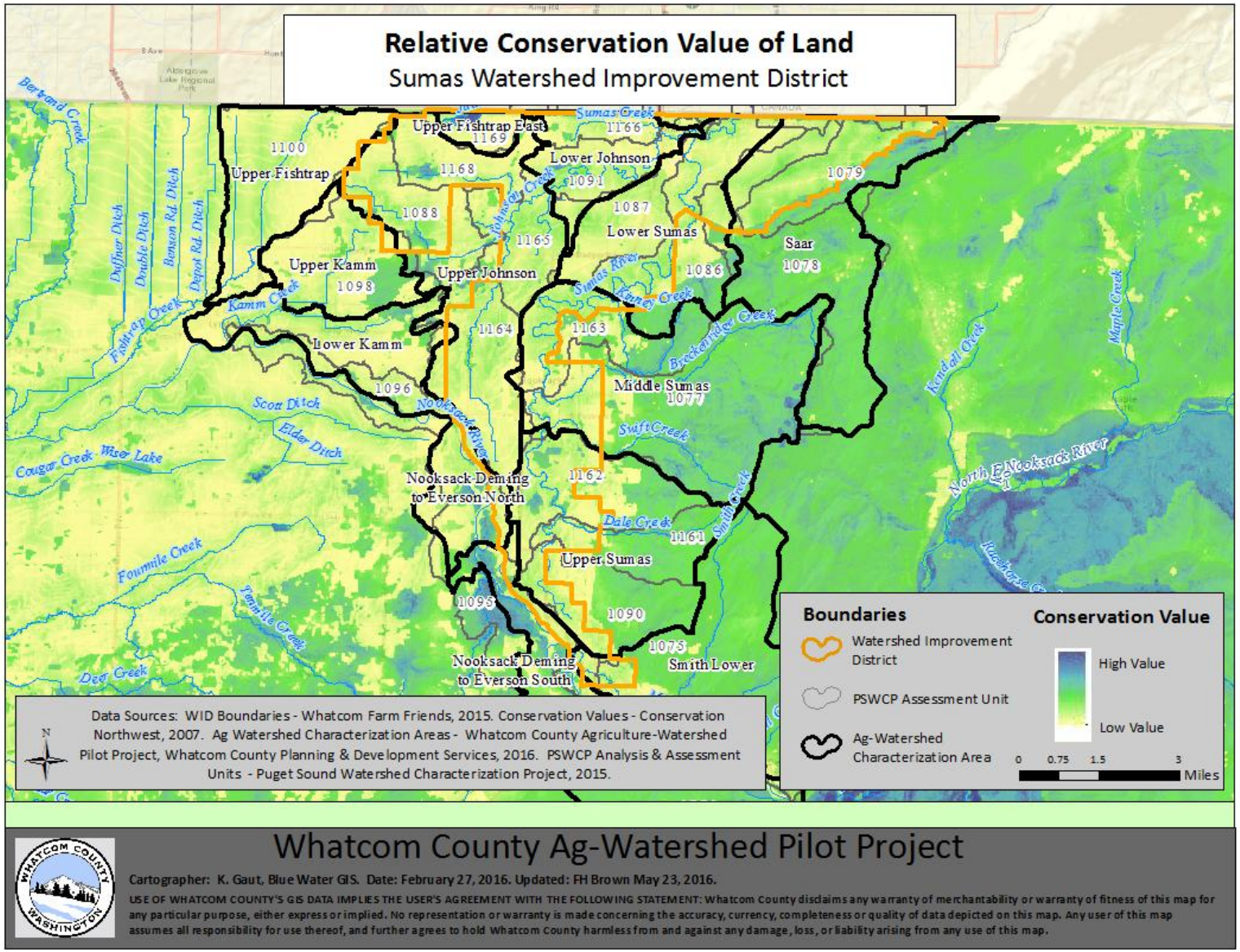


Figure 23. Sumas WID Reference map: Relative conservation value of land

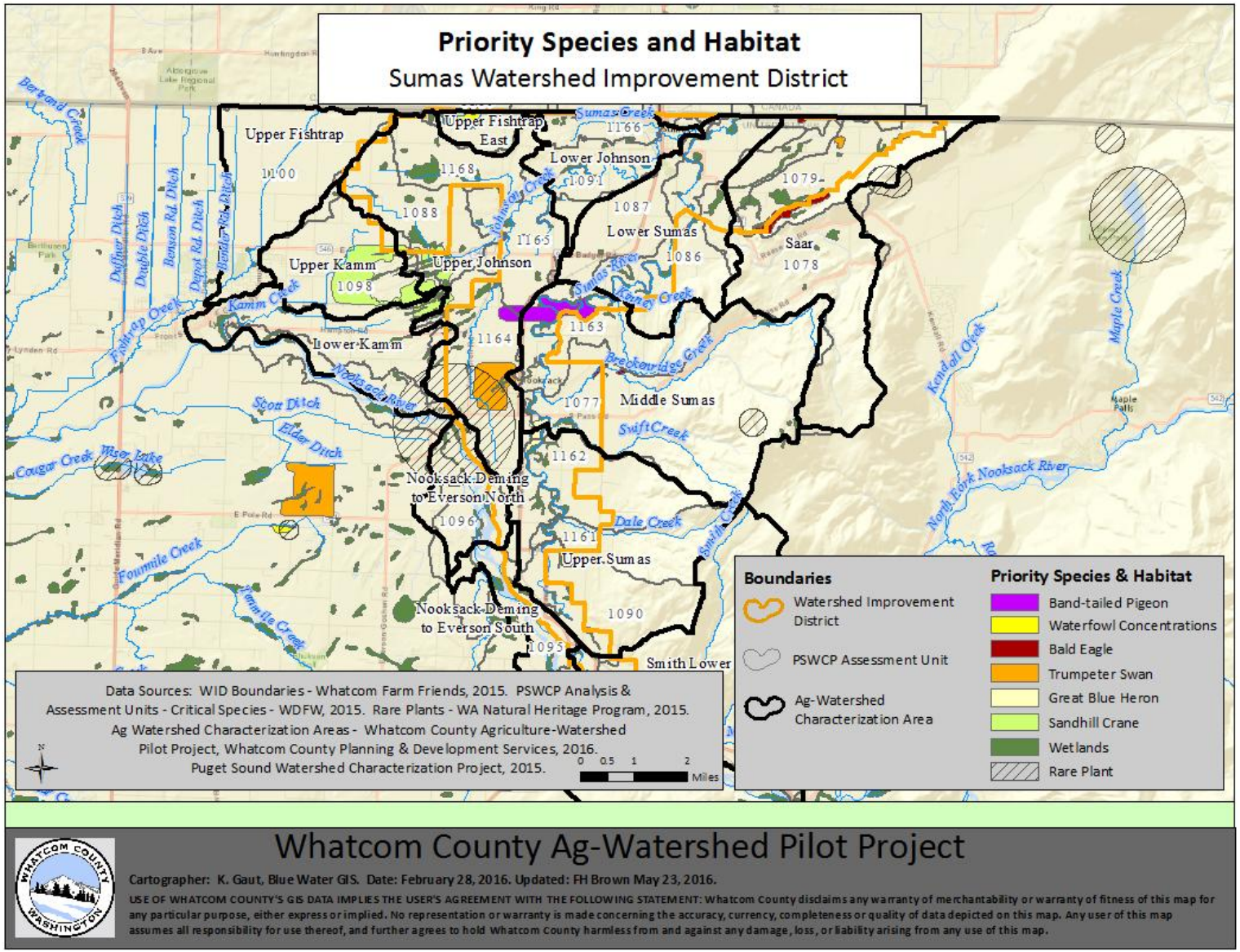


Figure 24. Sumas WID Reference map: Priority species and habitat

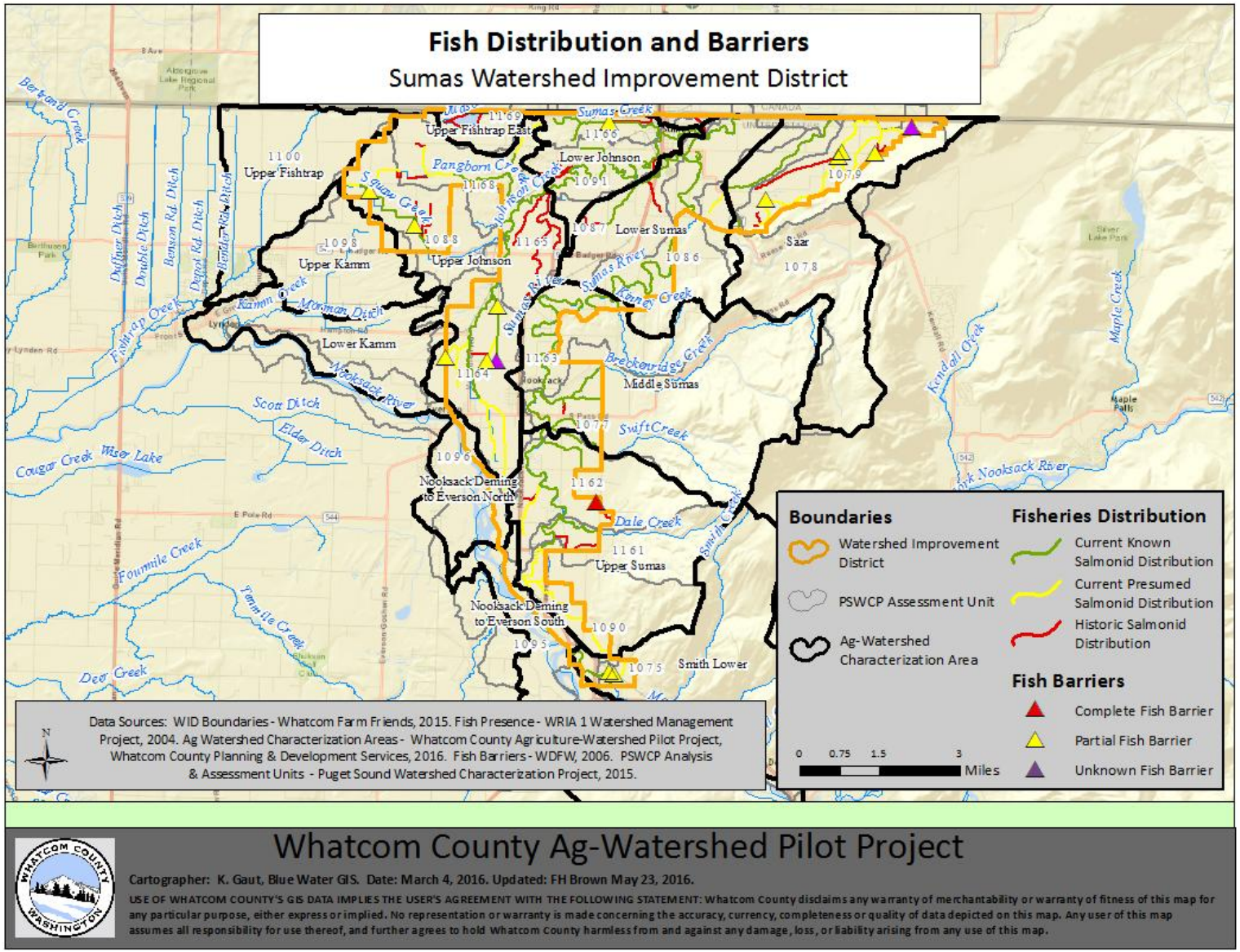


Figure 25. Sumas WID Reference map: Fish distribution and fish barriers

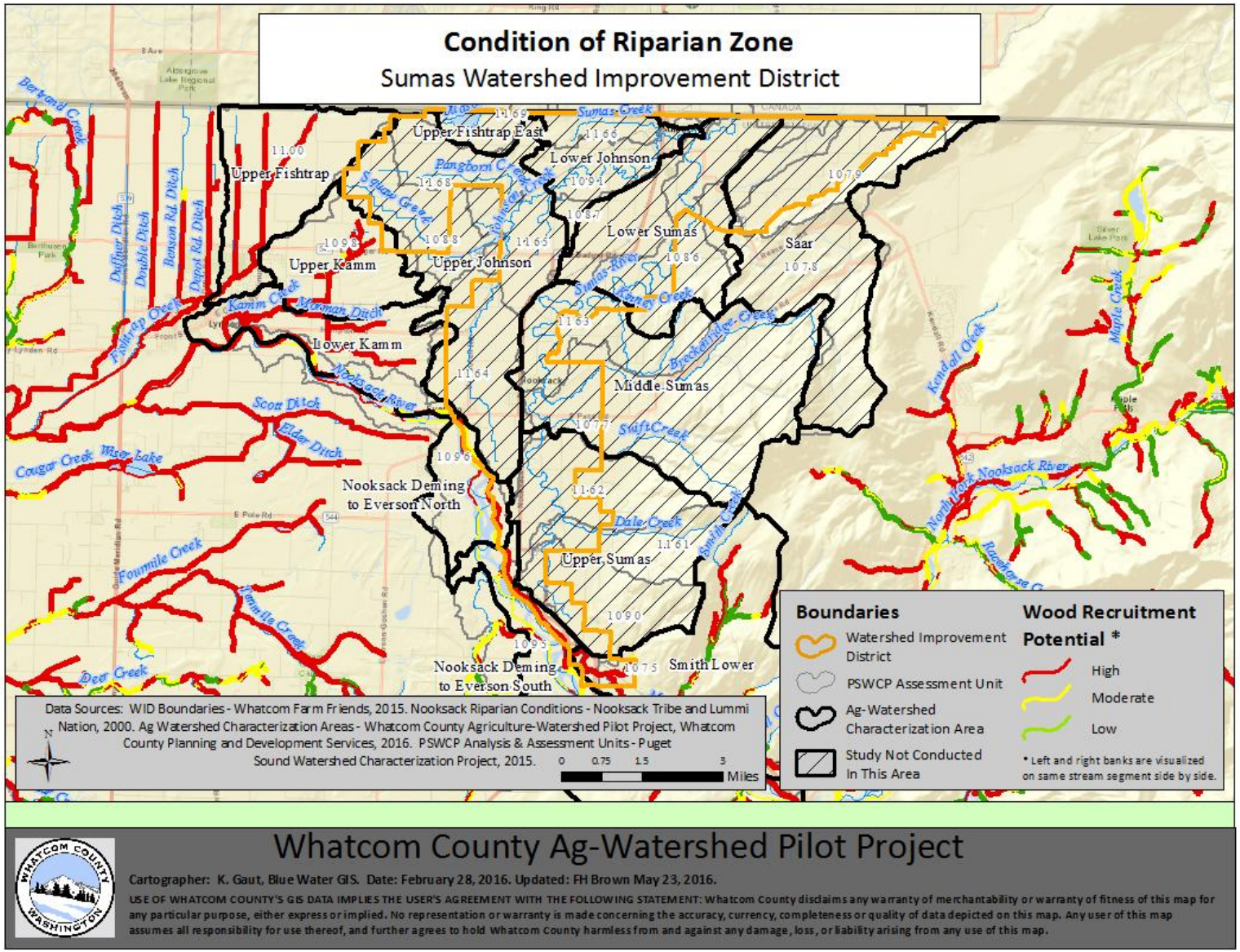


Figure 26. Sumas WID Reference map: Condition of riparian zone

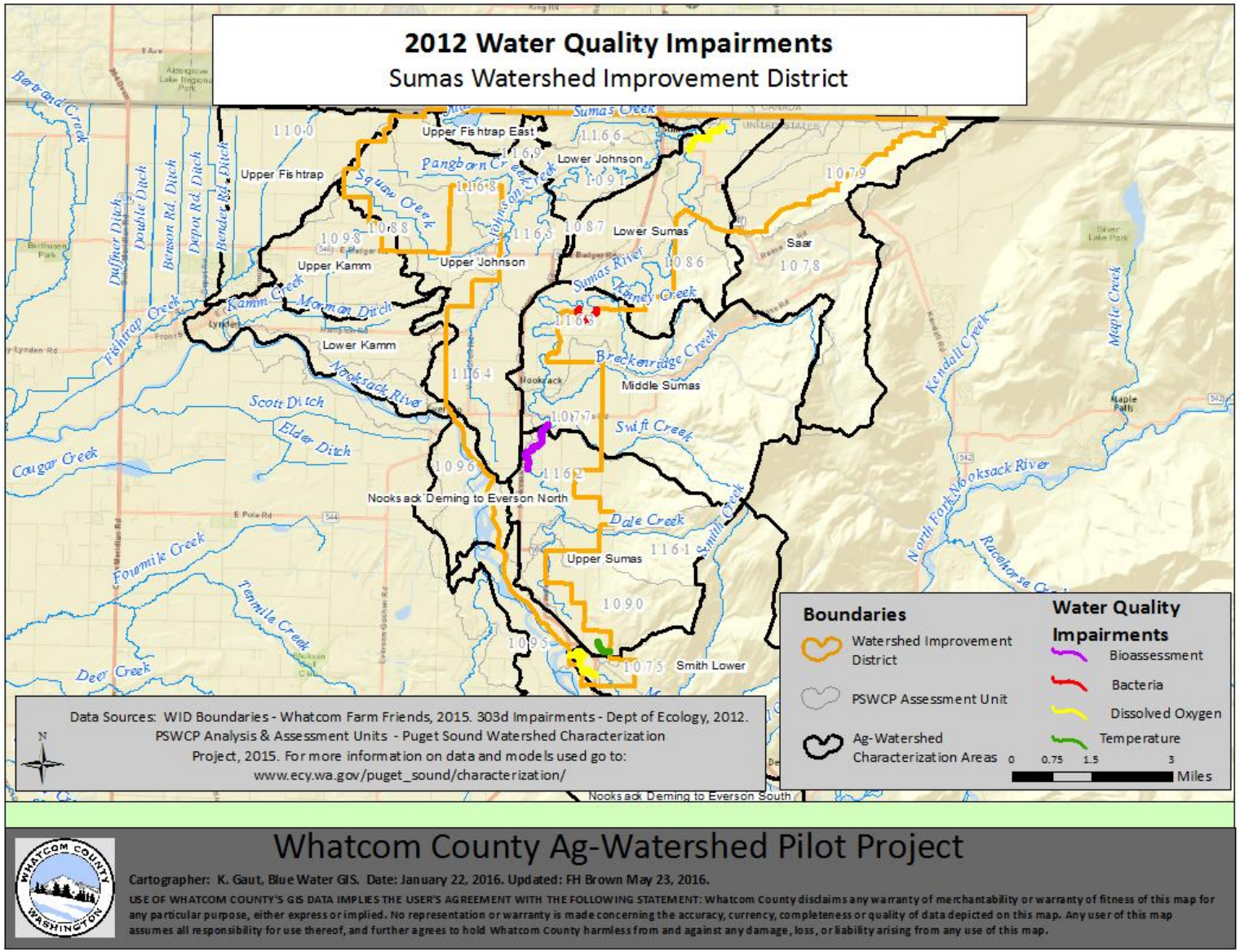
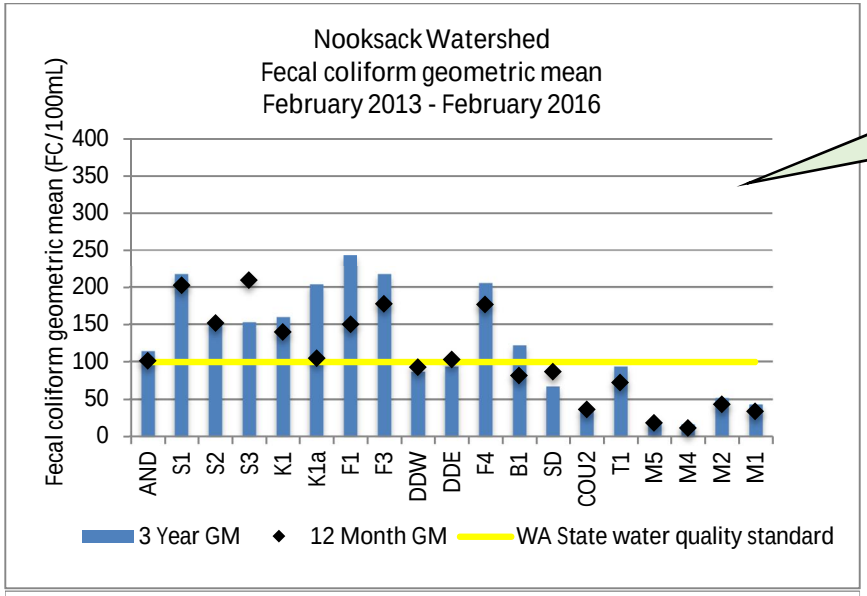
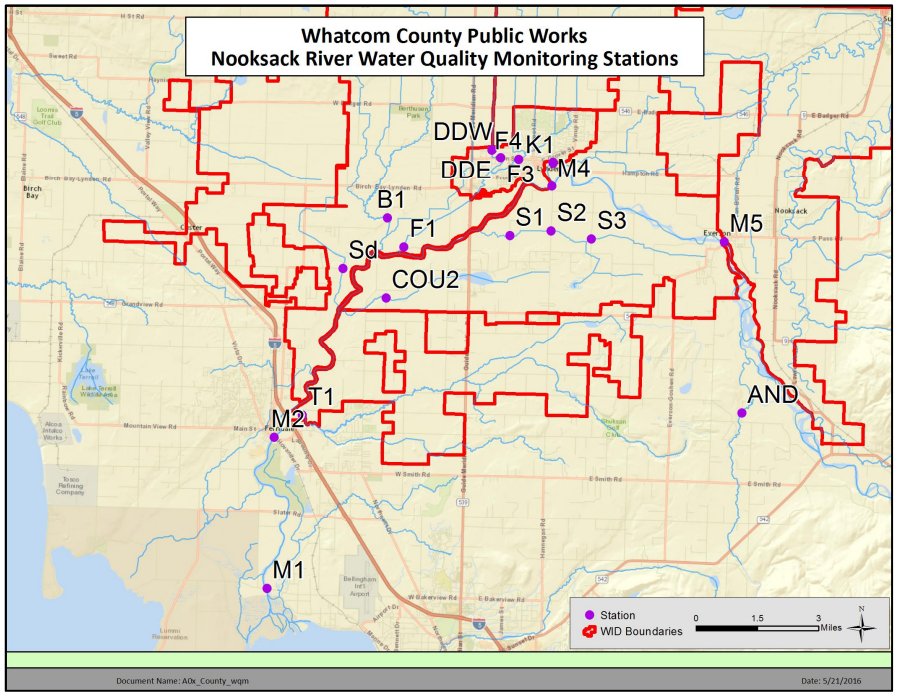
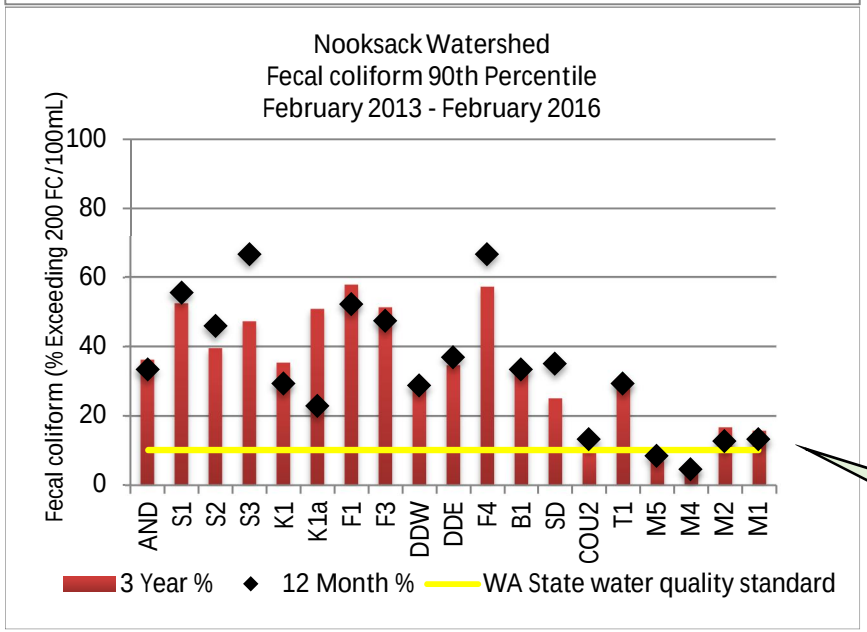


Figure 27. Sumas WID Reference map: Water quality impairments (2012)



This graph illustrates fecal coliform geometric means at routine stations. A black dot located above the blue bar indicates that bacteria levels have been increasing in the past twelve months at that site. Data from Whatcom County Public Works.





This graph illustrates the percent of samples exceeding 200 FC/100mL at routine monitoring stations. A black dot above the red bar indicates that bacteria levels have been increasing in the past twelve months at that site. Data from Whatcom County Public Works.

Figure 28. Sumas WID: Routine water quality monitoring results. Data from Whatcom County Public Works

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GIS data sources

Agricultural Conservation Easements	Whatcom County Planning & Development Services. http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/10821 Most recent update received from Chris Elder 2 May 2016.
Agricultural land use inventory	Whatcom County Planning & Development Services, 2011. Received from Sarah Watts December 2015.
Agricultural Priority Actions	Generated at WID work sessions in January-February 2016.
Ag-Watershed Characterization Areas	Generated for the Whatcom County Agriculture-Watershed Pilot Project, January 2016.
Cropland	Cropland Data Layers, United States Department of Agriculture, National Agricultural Statistics Service, 2015. http://nassgeodata.gmu.edu/CropScape/
Fish Barriers	Washington Department of Fish & Wildlife, 2006 http://wdfw.wa.gov/conservation/habitat/fish_passage/data_maps.html
Fish Presence	Fish Habitat Technical Team, WRIA 1 Watershed Management Project, 2004. Received from Sarah Watts, Whatcom County Planning & Development Services, December 2015.
Floodzones, floodways & Levees	FEMA, 2007. Latest received from Chris Elder, Whatcom County Planning & Development Services, 22 February 2016.
Hydrography	Washington State Department of Natural Resources. https://fortress.wa.gov/dnr/adminsa/DataWeb/dmmatrix.html
Riparian Conditions	Nooksack Indian Tribe, 2001. Nooksack River Watershed Riparian Function Assessment. Data received from Treva Coe, January 2016.
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Rare Plants	Washington Natural Heritage Program, 2015. Washington Department of Natural Resources, 2015. http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html

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Special Districts boundaries	Whatcom County Public Works, 2016. Received from Travis Bouma 7 March 2016.
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Water Quality Monitoring Stations	Whatcom County Department of Public Works. http://www.co.whatcom.wa.us/2170/Water-Quality-Monitoring-Results#stations
Water Resource Inventory Area 1 (WRIA1) boundary	Whatcom County Planning & Development Services, 2015.
Water Rights	Washington Department of Ecology, Geographic Water-right Information System (GWIS) 2016. http://www.ecy.wa.gov/2016Water.html
Watershed characterization	Landscape groups, water flow assessment results from the Puget Sound Watershed Characterization Project http://www.ecy.wa.gov/puget_sound/characterization/index.html (Last accessed April 2016)
Watershed Improvement District boundaries	Received from Ag Water Board, 2015. www.agwaterboard.com
Whatcom County Tax Parcels	Dated October 6, 2015. Received from Sarah Watts, Whatcom County Planning & Development Services.
Zoning	Whatcom County Title 20 Zoning, Whatcom County Planning & Development Services. http://www.whatcomcounty.us/716/Data/

8 Glossary of key terms used in this report

Agricultural enhancement [protection]	Agricultural enhancement entails maintaining the land base, soil, water, air, plants, animals, production capacity and natural infrastructure necessary to keep farmers farming over the long term as land uses and economic situations change over time. Thus "agricultural enhancement" and "agricultural protection" include but are not limited to agricultural land protection alone.
Agriculture-Watershed Characterization Area (AWCA)	Each WID area has been divided into several smaller "Agriculture-Watershed Characterization Areas", based on a combination of the WRIA 1 water management areas and the PSWC Project Assessment Units. The AWCAs reflect hydrological and agricultural characteristics in the landscape; are recognizable for WID members and are of a size that is practical for the WIDs to utilize in their planning processes. Importantly, the AWCAs represent common areas within which to characterize and map both agricultural and watershed enhancement priorities.
Assessment Unit (AU)	The assessment units (AUs) used in the Puget Sound Watershed Characterization (PSWC) represent the minimum spatial scale over which the characterization results are meaningful. The AUs were derived from reach-scale catchments delineated by the Salmon and Steelhead Habitat Inventory and Assessment Program (SSHIAP; NWIFC 2009). The SSHIAP catchments were aggregated into larger units with a mean size 4.7 square miles. See: Stanley et al. (2011) https://fortress.wa.gov/ecy/publications/documents/1106016.pdf Wilhere et al. (2013) ftp://www.ecy.wa.gov/gis_a/inlandWaters/ps_project/Docs/Watershed_Characterization_WDFW_Report_Final_Dec2013.pdf
Landscape Group	A group of AU's within the analysis area that each have similar environmental characteristics, such as precipitation, landform, and/or geology. In the current version of the Characterization models, landscape groups are identified strictly on geographical position (coastal, lowland, and mountain, plus a subset of lowland assessment units that drain to one of four large lakes).
Watershed characterization	Watershed 'characterization' is a set of water and habitat assessments that compare areas within a watershed for restoration and protection value. It is a coarse-scale tool that supports decisions regarding where on the landscape should efforts be focused first, and what types of actions are most appropriate to that place. See http://www.ecy.wa.gov/puget_sound/characterization/index.html
Watershed enhancement	Watershed enhancement actions are those actions which improve the ability of the watershed to provide its natural benefits and services to communities. Watershed enhancement includes the idea of "repairing" major landscape processes related to hydrology and ecosystems, in order to maintain, protect or improve the delivery of watershed services.
Water Resource Inventory Area	Water Resource Inventory Area (WRIA): Administrative watershed boundaries designated by the State of Washington's natural resource agencies.

Appendices

Appendix A: Data sources for the Sumas Watershed Improvement District

Appendix B: WID work session information

Appendix C: Water flow assessment results for Water Resource Inventory Area 1

Appendix D: Fact sheet 5 (Planning, designing and implementing beneficial actions for agricultural & watershed enhancement)

Appendix A: Sources of Available Data for Sumas WID
July 2016

Prepared by Cheryl Lovato Niles & Heather MacKay

Purpose of this document

The purpose of this document is to collate relevant sources of data, particularly sources for data sets generated through longer-term routine monitoring programs. These data sets are potentially useful for field and desk work in the Sumas Watershed Improvement District (WID).

Sources for the following data types have been collated for the Johnson, Sumas, Saar, Smith, Nooksack Deming, and Nooksack South Watersheds:

- Water quality measures (fecal coliform, temperature, dissolved oxygen, turbidity, nitrogen, and phosphorous) from 2000 to the present,
- Hydrography,
- Stream flow from 2000 to the present,
- Erosion and avulsion hazard in the Nooksack River channel migration zone,
- Ground water measurements from 2000 to the present,
- Water rights,
- Fish presence and habitat evaluations from 1990 to the present,
- Salmon and steelhead population boundaries,
- Aquatic nuisance species,
- Instream and streambank vegetation from 1990 to the present,
- Land use and land cover from 2000 to the present,
- Wildlife, and
- Soils.

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Table 1: Fecal coliform monitoring maps and reports for Sumas WID area

Watershed/Area	Parameter	Source	Description	URL
Nooksack Deming	Fecal coliform	Whatcom County	Map of routine monitoring sites and reports of sampling results updated monthly	http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results (see note below for information on how to download FC data)
Nooksack Deming	Fecal coliform	Conservation District	Watershed Health Assessment (November 2015)	http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results
Whatcom County (Department of Agriculture tests numerous stations routinely and also in response to high FC counts – station locations vary)	Fecal coliform	Washington State Departments of Agriculture and Ecology. WSDA data is available upon request from WSDA Dairy Nutrient Management group - Michael Isensee 360-961-7412	Map of recent preliminary source tracking results	http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results

Accessing water quality data from routine monitoring sites: Figure 1 shows the locations of routine water quality monitoring sites that are within the Sumas Watershed Improvement District.

Whatcom County, the Tribes, Washington State Department of Ecology, and Washington Department of Agriculture coordinate their water quality monitoring efforts. To see the most recent couple of months of data from the map of routine water quality monitoring online at the County's website http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results, open the map at <http://wacds.maps.arcgis.com/apps/webappviewer/index.html?id=71fa677503c949c8847066178a531099>, and click on the layers symbol in the upper right hand corner. This opens a box titled Layer List. Select the box to the left of "Preliminary WQ Data Results (All)", and then click on the arrow to the right to open up the drop down menu. Select "Open Attribute Table". A detailed table will open up. Under "Options" in the upper left corner of the table, you can choose to export the data and it will automatically populate an Excel spreadsheet. The purple dots indicate station locations; the blue squares indicate that there is data associated with that station in this system. To find earlier data see Table 2 below.

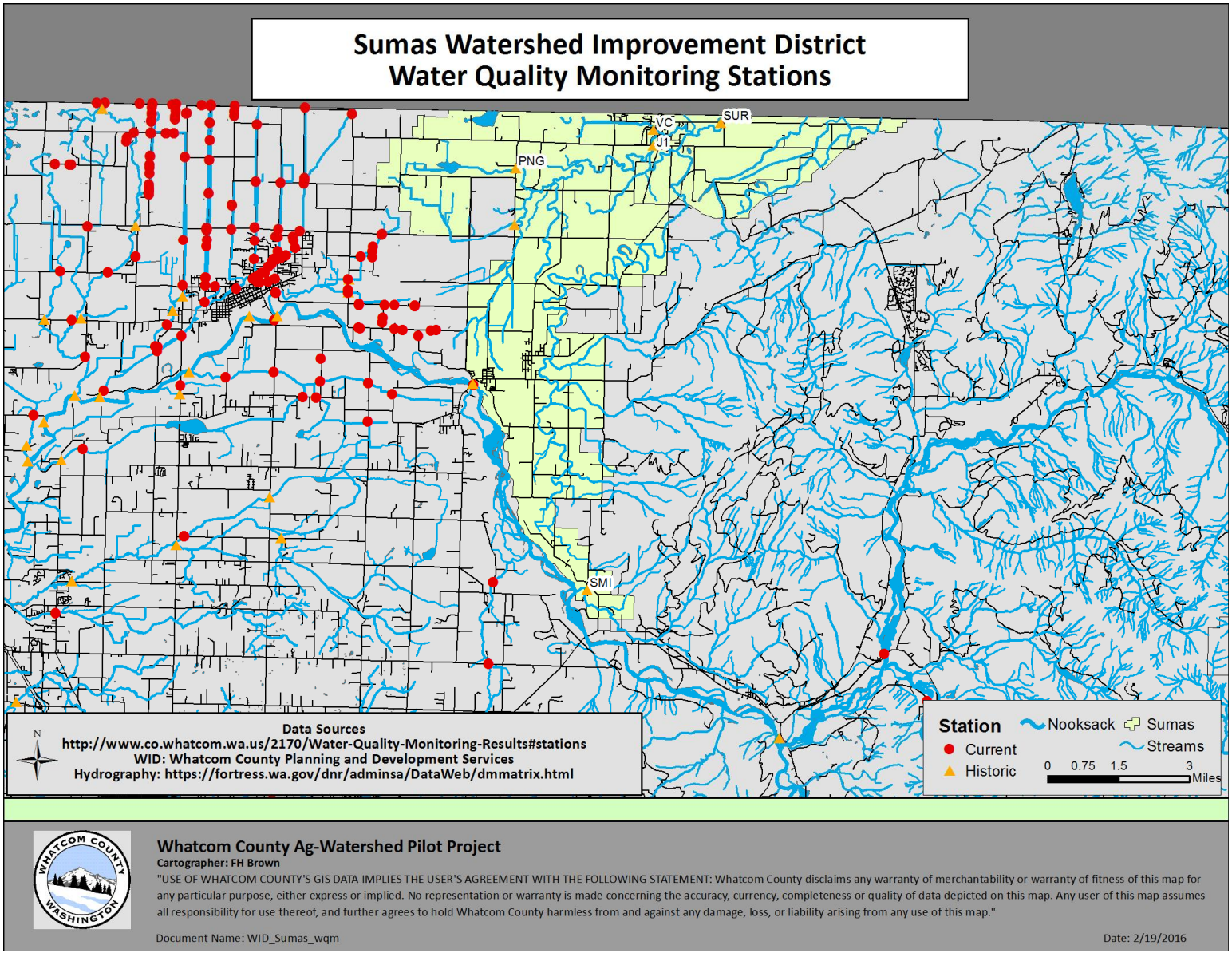

Figure 1: Sumas WID: Routine water quality monitoring stations. See Tables 1 and 2 for more information.

Table 2: Where to find earlier water quality data from monitoring stations in Whatcom County: Water Quality Monitoring Results for Sumas WID area. *Data for the County Health Department is not included here because their monitoring focuses entirely on marine water. Earlier Washington Department of Agriculture data is available by request. See table 1 for contact information.*

Who	Department of Ecology	Whatcom County Public Works
What	Data generally includes FC, pH, T, Conductivity, and DO. Occasionally flow and wetted width are recorded.	Focused on fecal coliform
How	You may request the data from the Department of Ecology Bellingham Field office. Details below.	Annual reports for 2011 through 2013 are available online at url below.
Details	You may request data for a watershed subbasin from Jessica Kirkpatrick, Steve Hood, or Chris Luerkens at 360-715-5200.	<http://www.co.whatcom.wa.us/2172/Resource-Library>
Station Names	AND 01D080 NWIC-J1 NWIC-SMI NWIC-SQ NWIC-SUR PNG VC	AND

Table 3: Streamflow

WID/Area	Watershed	Ongoing/ Completed	Station ID	Description	Lat	Long	Collected by	Source	URL
Sumas	Johnson	Ongoing	12214500	Sumas River near Sumas	485830	1221500	USGS	USGS "Summary Information for Continuous Streamflow Gages in and near the WRIA 1 Study Area"	http://wa.water.usgs.gov/projects/wria01/sw.htm [last accessed October 1, 2015]
Sumas	Lower Johnson	Ongoing	12215100	Sumas River near Huntington, BC	490009	1221350	USGS, and Env. Canada	USGS "Summary Information for Continuous Streamflow Gages in and near the WRIA 1 Study Area"	http://wa.water.usgs.gov/projects/wria01/sw.htm [last accessed October 1, 2015]
Sumas	Saar	Ongoing	12215500	Saar Creek near Sumas	485935	1221235	USGS	USGS "Summary Information for Continuous Streamflow Gages in and near the WRIA 1 Study Area"	http://wa.water.usgs.gov/projects/wria01/sw.htm [last accessed October 1, 2015]

Table 4: Streamflow plus additional measures

WID/Area	Watershed	Additn'l parameters	Station ID	Station location	Ongoing/ Completed	Collected by	Source	URL
Sumas	Lower Johnson	T, Pressure, cond., DO, pH, also available	12215000	Johnson Creek at Sumas	ongoing	USGS	USGS Washington Water Science Center	http://maps.waterdata.usgs.gov/mapper/index.html
Sumas	Lower Johnson	Unknown	12214895	Johnson Creek below Bone Creek at Sumas	unknown	USGS	USGS Washington Water Science Center	No data online for this site. Email inquiries using form linked at <http://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=12214895>

Table 5: Hydrography

Area	Parameter	Source	URL
US	Hydrography	USGS. The National Map, Hydrography	http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd [last accessed September 30, 2015]

Table 6: Erosion and avulsion in Nooksack River channel migration zone

Area	Parameter	Document Title	Author	Date	URL
Sumas, S. Lynden, N. Lynden, Bertrand, Laurel	Erosion and Avulsion	Erosion and Avulsion Hazard Mapping and Methodologies for use in the Nooksack River Channel Migration Zone Mapping	Paul Pittman, LEG Whatcom County Public Works and Peter Gill, Whatcom County Planning and Development Services,	2009	http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15492 [last accessed February 29, 2016]

Table 7: Groundwater Data

WID/ Area	Water-shed	Parameter	Title of Table/Source	Station ID	Source	URL	Notes
all	all	Well location, use, depth, installation date, open interval	Summary Information for Wells in the WRIA 1 Study Area	1297 wells listed. Latitude and Longitude provided for all.	USGS	http://wa.water.usgs.gov/projects/wria01/data/well_info.htm via http://wa.water.usgs.gov/projects/wria01/gw.htm [both last accessed October 1, 2015]	This table contains data for all wells in the WRIA 1 study area that were in the USGS database as of December 14, 1999. There are many wells in the WRIA 1 study area that are not in the database. Additional information regarding wells in this table can be obtained by contacting Luis Fuste, the Information Officer of the USGS Washington Water Science Center of the USGS, at (253) 428-3600 x2653. Information in this table may overlap with information in the database of the Whatcom County Health and Human Services Department See Summary Information for Whatcom County Health and Human Services Department Wells in the WRIA 1 Study Area).
all	all	Well location, use, depth, installation date, open interval	Summary Information for Wells in the WRIA 1 Study Area, Downloaded from the Whatcom County Health and Human Services Department Database	Numerous wells listed. Township, range, section, and quarter section listed for all.	Whatcom County Health and Human Services	http://wa.water.usgs.gov/projects/wria01/data/tableGW2.htm [last accessed October 1, 2015]	This table contains selected data for all wells in the WRIA 1 study area that were in the Whatcom County Health and Human Services Department database as of January 7, 2000. There are many wells in the WRIA 1 study area that are not in the database. Additional information regarding wells in this table can be obtained by contacting Anne Marie Karlberg at the Whatcom County Health and Human Services Department, at (360) 738-2504 x50819. Information in this table may overlap with information in the database of the USGS (see Summary Information for Wells in the WRIA 1 Area, Downloaded from the USGS National Water Information System). Disclaimer: The locations of these wells have not been field checked. Construction information was gathered from driller's logs and may contain errors.

WID/ Area	Water-shed	Parameter	Title of Table/Source	Station ID	Source	URL	Notes
all	all	Well location, use, depth, installation date, open interval	Wells with Sufficient Information to Compute Hydraulic Conductivities, Downloaded from the USGS National Water Information System (NWIS)	Numerous wells listed. Lat. and long. listed for all.	USGS	http://wa.water.usgs.gov/projects/wria01/data/tableGW4.htm [last accessed October 1, 2015]	All information in this table is provisional and subject to revision. The data in the database were collected and entered for a wide variety of projects and purposes over a long period of time and the resulting dataset varies in quality and detail. Although many wells have accurate information (especially those checked and used in recent studies), some problems are known to exist for older entries. Examples of known problems include, but are not limited to, inaccurate well locations, old information regarding the primary use of the well, incorrect installation dates, and erroneous labeling of well locations as having been field-checked. No checks were performed to assure consistency between the latitude and longitude of a well and its assigned local name
all	all	Water level below surface, date of measurement, method	Historical Ground-Water Levels in the WRIA 1 Study Area	Numerous wells listed. USGS ID is lat long.	USGS	http://wa.water.usgs.gov/projects/wria01/data/water_levels.htm [last accessed October 1, 2015]	Table contains historical water-level information for wells in the WRIA 1 study area that were in the USGS National Water Information System (NWIS) on December 14, 1999, and for which water-level information was available. Additional information regarding wells in this table can be obtained by contacting Luis Fuste, the Information Officer of the USGS Washington Water Science Center of the USGS, at (253) 428-3600 x2653.

WID/ Area	Water-shed	Parameter	Title of Table/Source	Station ID	Source	URL	Notes
Sumas	Lower Johnson, Lower Sumas	Hydraulic conductivity	Summary Information for Aquifer Tests in the WRIA 1 Study Area	Sumas	USGS, Ecology, Cascades Env. Services and Water Resources Cons. Team	http://wa.water.usgs.gov/projects/wria01/gw.htm [last accessed October 1, 2015]	The published source of the data may be found by cross-referencing the code in the column labeled "Catalogue Number" with information in a Microsoft Access* database developed by Greenberg and others (1996) and expanded by the USGS as part of the current (January, 2000) study.

Table 8: Additional reports on groundwater

Watershed	Title	Published	Authors	URL
all	Nitrate Contamination in the Sumas-Blaine Aquifer, Whatcom County, Washington	Publication No. 11-03-027, May 2011	Melanie Redding, Barbara Carey and Kirk Sinclair Washington State Department of Ecology	https://fortress.wa.gov/ecy/publications/documents/1103027.pdf [last accessed February 1, 2016]
all	Sumas-Blaine Aquifer Nitrate Contamination Summary	Department of Ecology Pub. No. 12-03-026, June 2012	Barbara Carey	www.ecy.wa.gov/biblio/1203026.html [last accessed February 1, 2016]
all	Hydrogeology, ground water quality, and sources of nitrate in lowland glacial aquifers of Whatcom County, Washington, and British Columbia, Canada	US Geological Survey Water-Resources Investigations Report 98-4195. 1999. 251 pages, 5 plates.	Cox, S. E., and S. C. Kahle	
WRIA1	WRIA 1 Groundwater Data Assessment: Overview. In Bandaragoda, C., C. Lindsay, J. Greenberg, and M. Dumas, editors. WRIA 1 Groundwater Data Assessment	Whatcom County PUD #1, Whatcom County, WA. WRIA 1 Joint Board, 2013.	Lindsay, C. and C. Bandaragoda	http://wria1project.whatcomcounty.org/ [last accessed 2/1/16]

Table 9: Groundwater maps

WID/ Area	Parameter	Title	Last modified	Source	URL	Notes
all	Ground-water movement	Generalized Pattern of Ground -Water Movement for the Puget Sound Aquifer System in the WRIA 1 Study Area	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW2.pdf [last accessed October 1, 2015]	Modified from Vaccaro, J.J., Hasen, A.J. and Jones, M.A., 1998. Hydrogeologic Framework of the Puget Sound Aquifer System, Washington and British Columbia; US Geological Survey Professional Paper 1424-D.
all	Selected well locations	Locations of Selected Wells in the WRIA 1 Study Area by Primary Water Use	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW4.pdf [last accessed October 1, 2015]	USGS National Water Information System (NWIS), downloaded December 14, 1999. Not all well locations have been verified and therefore they may plot in the wrong locations.
all	Ground-water levels	Water-Level Contours in the Uppermost Aquifer of the Lynden-Everson-Nooksack-Sumas (LENS) Study Area	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW3.pdf [last accessed October 1, 2015]	From: Cox, S.E., and Kahle, S.C., 1999, Hydrogeology, Ground-Water Quality, and Sources of Nitrate in Lowland Glacial Aquifers of Whatcom County, Washington, and British Columbia, Canada: U.S. Geological Survey Water-Resources Investigations Report98-4195, 5 plates, 251 p.
all	Aquifer tests	Approximate Locations of Aquifer Tests in the WRIA 1 Study Area	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW5.pdf [last accessed October 1, 2015]	From: Various Hydrogeologic Studies in the WRIA 1 Study Area
all	Selected well locations	Locations of Selected Wells in the WRIA 1 Study Area with Sufficient Information to Compute Hydraulic Conductivities	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW6.pdf [last accessed October 1, 2015]	From: USGS National Water Information System (NWIS), downloaded December 14, 1999. Not all well locations have been verified, therefore they may plot in the wrong locations.
all	Selected well locations	Locations of Selected Wells in the WRIA 1 Study Area with Five or More Historical Water Levels	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW7.pdf [last accessed October 1, 2015]	From: USGS National Water Information System (NWIS), downloaded December 14, 1999. Not all well locations have been verified and therefore they may plot in the wrong locations

all	Soil types	Distribution of Soil Map Units in the WRIA 1 Study Area	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW8.pdf [last accessed October 1, 2015]	From: U.S. Department of Agriculture, 1994, State Soil Geographic (STATSGO) Data Base: Date use information, Soil Conservation Service, National Cartography and GIS Center, Fort Worth, Texas, accessed January 28, 2000, at URL http://www.ftw.nrcs.usda.gov/stat_data.html. Note: The soil information for this map was Natural Resources Conservation Service 1994 STATSGO data. STATSGO was compiled at 1:250,000 and designed to be used primarily for regional, multi-state, state, and river-basin resource planning, management, and monitoring.
all	Soil permeability	Soil Permeability in Parts of the WRIA 1 Study Area	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW9.pdf [last accessed October 1, 2015]	Modified from: U.S. Department of Agriculture-Soil Conservation Service, 1992, Soil Survey of Whatcom County Area, Washington, 54 sheets, 481 p.

Table 10: Water rights

Area	Parameter	Title	Source	URL	Notes
all	Quantity, place of use, source, purpose, all documents associated with water rights, and well logs	Water Resources Explorer	Washington State Department of Ecology	http://www.ecy.wa.gov/programs/wr/info/webmap.html [last accessed October 1, 2015]	You can search with an interactive map, or using information such as address, township and range, or latitude and longitude.
all	Water rights	WRIA 1 Water Rights Atlas, 2003	Public Utility District No. 1	http://wria1project.whatcomcounty.org/Resource-Library/Studies-And-Reports/Water-Rights/65.aspx [last accessed February 1, 2016]	

Table 11: Land use/Land cover

WID/Area	Watershed	Parameter	Document	URL
Whatcom County		Agricultural Land Cover Analysis	Whatcom County Agricultural Land Cover Analysis version 2.3. 2013. Whatcom County Planning and Development Services	http://www.whatcomcounty.us/documentcenter/view/3989 [last accessed October 1, 2015]
Whatcom County		Critical Areas Ordinance Maps	Whatcom County's Critical Areas (CAO) are environmentally sensitive natural resources that have been designated for protection and management in accordance with the requirements of the Growth Management Act.	http://www.whatcomcounty.us/811/County-Wide-Critical-Area-Ordinance-Maps [last accessed February 26, 2016]
Whatcom County		Land Cover Change	WDFW High Resolution Change Detection Project; Whatcom County: Land Cover Change by Sub-Basin	http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15805 [last accessed February 26, 2016]

Table 12: Land use/Land cover map and charts from Lower Nooksack Water Budget Overview -*Report includes Smith, Nooksack South, and Nooksack Deming) areas*

From: Bandaragoda, C., J. Greenberg, M. Dumas and P. Gill. (2012). Lower Nooksack Water Budget (Chapter 5, Land Cover). Whatcom County, WA: WRIA 1 Joint Board. Retrieved from http://wria1project.whatcomcounty.org/ [last accessed October 1, 2015]	Figure
WRIA 1 map of existing land cover	Figure 1
WRIA 1 map of historic land cover classes, produced by Utah State University (Winkelaar 2004).	Figure 2
Areal distribution of existing and historical land cover classes in the Lower Nooksack watershed (top) and the Nooksack Forks watershed (bottom).	Figure 7
Final land cover classification, original data source class, and Lower Nooksack Water Budget land cover parameters.	Table 1
Crop types in the Lower Nooksack Subbasin.	Table 2

Table 13: Land use/Land cover electronic data from Lower Nooksack Water Budget Overview – *Report includes Smith, Nooksack South, Nooksack Deming areas*

From: Bandaragoda, C., J. Greenberg, M. Dumas and P. Gill. (2012). Lower Nooksack Water Budget (Chapter 5, Land Cover). Whatcom County, WA: WRIA 1 Joint Board. Retrieved from http://wria1project.whatcomcounty.org/ [last accessed October 1, 2015].	Title
Tables of crop type summarized by the 16 drainages of the Lower Nooksack Subbasin	Appendix Chap5A_LN_AgLandUse.pdf
Classes and descriptions of original NOAA CCAP dataset	Appendix Chap5B_LandCoverClass.pdf
Classes and descriptions of original Whatcom County Agricultural Land Cover Analysis	Appendix Chap5C_WhatcomCountyLandCover.pdf
GIS data, Whatcom County Agricultural Land Cover Analysis	Agrural-use-pds2011.shp
Parameter grids (ascii files) and Excel spreadsheets of parameter values by land cover class	Land Cover Model Parameter Lookup Tables (Folder: Ascii grids/ see lulc_existing.xls and lulc_historic.xls
Matlabcode to convert raster, lookup tables, and shapefile data to area averaged parameter values	Topnet-WM Preprocessing Program files
ArcGIS 10 Files Geodatabase Raster Grids 30 Meter Pixel resolution; Metadata xml	wria1_lulc_water_budget.gdb, 1. Existing Land Cover GIS data (<Lulc_exist>) 2. Historical Land Cover GIS data (<Lulc_hist>)
Lower Nooksack Subbasin Land cover tables and charts from GIS data	Lulc_charts_lowerNookonly.xlsx
WRIA 1 Land cover codes, tables, and charts from GIS data	Lulc_charts_wria1.xlsx

Table 14: NSEA spawner surveys

NSEA has spawner survey reports from 1998 to the present. This table includes every relevant reach surveyed since 2005. Some reaches were not surveyed every year.

Watershed	Creek	Station Location	Collected by	Source	Notes
Smith Creek	Smith Creek	RM 2.5-3.5	trained NSEA staff and volunteers	Nooksack Salmon Enhancement Spawning Grounds data and reports. http://www.n-sea.org/archived-publications [last accessed Feb 1, 2016]	Live salmon, carcasses and redds are recorded. The reports include brief descriptions of the reach. The monitored reaches have changed somewhat over time.
Smith Creek	Macaulay Creek, lower	RM 0.5-1.0	trained NSEA staff and volunteers	Nooksack Salmon Enhancement Spawning Grounds data and reports. http://www.n-sea.org/archived-publications [last accessed Feb 1, 2016]	Live salmon, carcasses and redds are recorded. The reports include brief descriptions of the reach. The monitored reaches have changed somewhat over time.
Smith Creek	Macaulay Creek, upper	RM 1.0-1.5	trained NSEA staff and volunteers	Nooksack Salmon Enhancement Spawning Grounds data and reports. http://www.n-sea.org/archived-publications [last accessed Feb 1, 2016]	Live salmon, carcasses and redds are recorded. The reports include brief descriptions of the reach. The monitored reaches have changed somewhat over time.
Smith Creek	Mitchell Creek	RM 0.3-1.0	trained NSEA staff and volunteers	Nooksack Salmon Enhancement Spawning Grounds data and reports. http://www.n-sea.org/archived-publications [last accessed Feb 1, 2016]	Live salmon, carcasses and redds are recorded. The reports include brief descriptions of the reach. The monitored reaches have changed somewhat over time.

Table 15: WDFW spawner surveys

WID/Area	Parameter	Creek	Station location	Frequency	Date	Collected by	Source
California Cr, Dakota Cr, Scott, Schneider, Wiser Lake/Cougar Creek Sumas River, Saar, Fourmile and Ten Mile Creeks	Limited field data from a one year survey to assess adult Steelhead spawning habitat: Steelhead redds or suitable gravel for Steelhead spawning.	Specifics are available upon request	Specifics are available upon request	One-time	2009	WDFW and NSEA field crews	WDFW Tasha Geiger Nooksack River Stock Assessment 360-305-2023 Natasha.geiger@dfw.wa.gov

Table 16: Aquatic nuisance species

Area	Title - Parameter	Notes	Frequency	Date		Source
Washington State	Aquatic invasive species	Description of aquatic nuisance species with distribution maps. Organized by organism.	ongoing		http://wdfw.wa.gov/ais [last accessed October 1, 2015]	WDFW
Washington State	Washington Herp Atlas		unknown	Maps updated 2013	http://www1.dnr.wa.gov/nhp/refdesk/herp/herpmain.html [last accessed October 1, 2015]	DNR
Washington State	Washington Nature Mapping Program – wildlife distribution maps		unknown	unknown	http://naturemappingfoundation.org/natmap/maps/ [last accessed October 1, 2015]	NatureMapping Program
US	USGS NAS – Nonindigenous Aquatic Species – presence and distribution	Searchable database/maps of nonindigenous aquatic species sightings organized by group, i.e. amphibians, fish, mammals.	unknown	Date of info varies	http://nas.er.usgs.gov/queries/default.aspx [last accessed October 1, 2015]	USGS
Washington State	Washington Department of Ecology Environmental Assessment Aquatic Plant Monitoring	Description of aquatic nuisance plants with distribution maps, searchable survey results by county, lake, or plant name, and downloadable survey data.	ongoing	Date of info varies	http://www.ecy.wa.gov/programs/wq/plants/weeds/index.html [last accessed October 1, 2015]	WA Department of Ecology
Whatcom County	Whatcom County Noxious Weeds webpages	Distribution map of some noxious weeds. Field guides and information about noxious weeds.	unknown	Map date is 2008. Website date is 2007. Other material is undated.	http://www.whatcomcounty.us/DocumentCenter/View/2506 [last accessed October 1, 2015]	Whatcom County
Pacific Northwest	Aquatic and Riparian Effectiveness Monitoring Program Invasive Species Report	Description of monitoring program and presence of invasive species in surveyed areas.	2010	2011	http://www.reo.gov/monitoring/reports/watershed/AREMP%20Aquatic%20Invasive%20Species%20Report%202010.pdf [last accessed October 1, 2015]	UW Forest Service and Bureau of Land Management

Table 17: Additional habitat/wildlife documents

Watershed/area	Parameter	Document
Relevant to all WID areas	Fish barriers	Whatcom County Public Works, 2006. Whatcom County Fish Passage Barrier Inventory Final Report - IAC Project Number: 01-1258 N. January, 2006. <http://salmon.wria1.org/resources/documents> [last accessed January 4, 2016]
WRIA 1	Fish habitat	Smith, C.J. 2002. Salmon and steelhead habitat limiting factors in WRIA 1, the Nooksack basin. Washington State Conservation Commission, Lacey, Washington. 325 pp.
Middle and Lower Sumas watersheds, Smith watershed, Nooksack South, Nooksack Deming	2013 Data Integration of WRIA 1 Hydraulic, Fish Habitat, and Hydrology Models	Bandaragoda, C. Joanne Greenberg, and Mary Dumas (2013). Data integration of WRIA 1 Hydraulic, Fish Habitat, and Hydrology Models. 134 pp. Nooksack Indian Tribe, Whatcom County, WA. WRIA 1 Joint Board. Retrieved [Date], from http://wria1project.whatcomcounty.org/ [last accessed February 1, 2016]
Nooksack	Fish presence	Nooksack Tribe, 2004. Referenced in North Lynden Watershed Improvement District Management Plan for Drainage, flooding, Irrigation and Fish Issues, 2009. Bibliography entry is unclear.
WRIA 1	Fish presence	Anchor Environmental, LLC. 2003. Fish periodicity in WRIA 1. Prepared for City of Bellingham Public Works Department. Seattle, Washington. 43 pp+ Appendices
Whatcom County	Biodiversity	Nelson, R., 2007. Mapping Biodiversity in Whatcom County: Data and Methods. Submitted to the Whatcom Legacy Project, August 2007. <http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15493> [last accessed February 29, 2016}
Whatcom County	Wildlife	Eissinger, A., 1994. Significant Wildlife Areas. (Available through the public library)

Table 18: Additional habitat/wildlife maps and databases

Watershed/ Area	Parameter	Document/Website	URL	Source
Whatcom County	Fish Presence Char, Chinook, Chum, Coho, Cutthroat, Pink, Steelhead, Bull Trout/Dolly Varden	Maps: Fish Presence by species available on Whatcom County Critical Areas Ordinance Maps page	<http://www.co.whatcom.wa.us/811/County-Wide-Critical-Area-Ordinance-Maps> [last accessed February 24, 2016]	Whatcom County
Whatcom County	Wildlife	The Whatcom County mappings were completed in 2007, as part of a project to characterize ecosystem processes and wildlife habitat in the Birch Bay Watershed.	http://wdfw.wa.gov/conservation/habitat/planning/lha/whatcom.html [last accessed February 1, 2016]	Washington Department of Ecology and Washington Department of Fish and Wildlife
Washington State	Priority Habitats and Species on the Web	PHS on the Web is a Washington Department of Fish and Wildlife web-based, interactive map for citizens, landowners, cities and counties, tribal governments, other agencies, developers, conservation groups, and interested parties to find basic information about the known location of Priority Habitats and Species (PHS) in Washington State.	http://wdfw.wa.gov/mapping/phs/ [last accessed October 1, 2015]	Washington Department of Fish and Wildlife
Washington State	Salmon distribution, status, and habitats	SalmonScape is an interactive mapping application designed to display and report a wide range of data related to salmon distribution, status, and habitats. The data sources used by SalmonScape include stream specific fish and habitat data, and information about stock status and recovery evaluations.	<http://apps.wdfw.wa.gov/salmonscape/> [last accessed October 1, 2015]	Washington Department of Fish and Wildlife
West Coast	Salmon	Maps of salmon and steelhead population boundaries	<http://www.westcoast.fisheries.noaa.gov/maps_data/maps_and_gis_data.html> [last accessed October 1, 2015]	NOAA Fisheries, West Coast Region
Whatcom County	Marine species and Habitats	Whatcom County Marine Resources maps of marine species and habitats	http://www.mrc.whatcomcounty.org/library [last accessed October 1, 2015]	Whatcom County Marine Resources Committee Library

Watershed/ Area	Parameter	Document/Website	URL	Source
US	Critical habitat maps for marine and anadromous fishes	Website links to data and maps. The critical habitat maps provided here are for illustrative purposes only. Textual descriptions of critical habitats, which are provided in the associated *Federal Register* notices (see links below), are the definitive sources for determining critical habitat boundaries. Map and *Federal Register* notice links are PDF files.	http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm [last accessed January 21, 2016]	NMFS NOAA
US	Threatened and Endangered Species	Environmental Conservation Online System, data and maps.	http://ecos.fws.gov/ecp/ [last accessed February 18, 2016]	US FWS
Washington State	Rare plants, animals, ecological communities	Reference Desk of the Washington Natural Heritage Program. Includes searchable databases	http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html [last accessed October 1, 2015]	Washington State Department of Natural Resources
Puget Sound Region	Wetlands	National Wetlands Inventory, data and maps	http://www.fws.gov/wetlands/ [last accessed February 1, 2016]	US FWS

Table 19: Soils

WID/Area	Parameter	Document	URL	Source
National	Soils	Web Soil Survey	<http://websoilsurvey.nrcs.usda.gov/app/> last accessed October 1, 2015	USDA Natural Resource Conservation Service

Table 20: WRIA 1 materials online - *In addition to the WRIA 1 materials included in this memo, there are many additional resources available on the WRIA1 Resource Library webpages*

Watersheds	Type of Resource	Topics or Titles	URL
all	Studies	Water rights, Water Quantity, Water Quality, and Habitat and Instream Flow; The 2010 State of the Watershed Report, 2013 WRIA Groundwater Data Assessment, 2013 Data Integration of WRIA 1 Hydraulic, Fish Habitat and Hydrology Models, The Whatcom County Coordinated Water System Plan (2000), and 2005 Numerical Groundwater Flow Model of the Abbotsford-Sumas Aquifer	<http://wria1project.whatcomcounty.org/Resource-Library/8.aspx> [last accessed February 1, 2016]
all	Maps	WRIA 1 Watersheds Map V3 Historic Land Cover Map - USU Existing Land Cover Future Land Cover – USGS Impervious Surfaces – NOAA Population Density – WA DOE Approximate Depth to Water Combined Hydrology Mechanisms, Draft – 11 Precipitation – PRISM Surface Water Storage Alterations Water Right Watershed Status Long Term Monitoring Adopted Map, and Interactive WRIA Monitoring Stations.	<http://wria1project.whatcomcounty.org/Resource-Library/Maps/38.aspx> [last accessed February 1, 2016]

Appendix B: WID Work session information
Sumas Watershed Improvement District

1. Overview of Sumas WID characterization and mapping work

Sumas Watershed Improvement District (Sumas WID) hosted a work session with the ag-watershed project team to prepare agricultural-watershed characterization and mapping work products for use in the Sumas WID's ongoing comprehensive planning. Some of the final work products will also be used as part of the Ag-Watershed Project final report to the Whatcom County Planning & Development Services (WCPDS) Agriculture Program and to the Washington Department of Commerce.[1]

This appendix provides documentation of the January 2016 WID work session, a summary of materials used to gather and document input both before and after the work session, and a list of participants engaged in developing and reviewing the agricultural-watershed characterization and mapping work.

The Sumas WID Board reviewed and approved:

- the scope of work for Task 6 (extended ag-watershed characterization and mapping: December 2015),
- draft characterization tables from the work session and preliminary draft maps (February-March 2016),
- the draft summary report documenting methods and results (April-May 2016), and
- the full draft report on the WID characterization and mapping (this document: May-June 2016).

2. Sumas WID work session

The January 26, 2016 work session participants included Sumas WID members and guests who contributed local knowledge and expertise to identify agriculture and watershed priorities and enhancement opportunities within in the WID area.

Participants were introduced to a structured process to identify specific characteristics of the agricultural and watershed systems and locate these on maps of the WID area. Small groups of participants then worked together to identify, characterize and locate agricultural system characteristics and enhancement opportunities in the WID area.

The January 2016 work session orientation included an overview of the Sumas WID area and instruction on the method used for the characterization and mapping activities.

Background information provided at the work session included:

- January 26, 2016 Agenda and work session overview.
- Summary of the Agricultural Analysis Method, included in an excerpt from the 2013 Ag-Watershed Characterization & Mapping Report.
- Fact sheet #2 "Identifying Opportunities to Strengthen Agriculture & Watershed Systems in Whatcom County."
- "*About the Sumas WID*" website excerpt describing the WID boundary locations and list of WID priorities for agriculture and watershed services.

[1] The Ag-Watershed Project is a research and development project funded by a National Estuary Program Watershed Protection and Restoration Grant (June 2012 to June 2016) to Whatcom County Planning & Development Services, administered by the Washington Department of Commerce. Project partners include: Whatcom Farm Friends–Community Education, Whatcom Conservation District, and Washington State Department of Fish & Wildlife. Project fact sheets and links to all previous work, including technical reports and reference documents can be found at http://whatcomcounty.us/2260/Agricultural-Watershed-Pilot-Project

Reference information provided at the work session:

Prior to the WID work session, the Ag-Watershed Project team compiled information from existing planning and reference documents describing agricultural and watershed systems and enhancement priorities in the Sumas WID area. Background maps and materials were prepared for use in table-top mapping activities (see complete list of work session maps and supporting materials below).

Figure 1. 2016 WID Work session table-top materials.

Work session materials:

- Sumas WID large-scale locality maps for table-top discussion and note-taking purposes.
- Sumas WID Agricultural Enhancement Priorities: Tables & Worksheets.
- Sumas WID Watershed Enhancement Priorities: Tables & Worksheets.
- Sumas WID Background Maps featuring Water Flow Assessments:
  - Water Flow Assessment Unit (AU) map.
  - Water Flow Characterization Results (All) from Puget Sound Watershed Characterization Project (PSWCP) 2015 management recommendations.
  - Importance and Degradation of Water Flow from PSWCP 2015 analysis.
  - Overall Water Flow Restoration & Protection Management Recommendations from PSWCP 2015 analysis.

Reference maps provided at the work session:

- Overview and Locality Map: Preliminary showing PSWCP 2015 Area Units & Sumas WID sub-area names, locations.
- Agricultural Priority Areas: Preliminary Draft from Whatcom County Planning & Development Services (WCPDS), 2015 Purchase of Development Rights (PDR) Easements.
- Agriculture Priority Areas and Zoning from WCPDS, 2015.
- Actively Farmed Land from WCPDS, 2015.
- Fish Presence from WRIA 1 Watershed Management Project, 2004.
- Relative Conservation Value of Land from Conservation Northwest, 2007.
- Agricultural Land Use Classes from WCPDS, 2011.
- Priority Habitats and Species from WA Department of Fish & Wildlife 2014 and WA Natural Heritage Program, 2015.
- Prime Soils from SSURGO, NRCS, 2015.
- Water Rights: Points of Diversion from WA Department of Ecology, 2016.
- Condition of Riparian Zone from Nooksack Tribe and Lummi Nation Nooksack Riparian Conditions, 2000.
- Potential Development Rights from WCPDS, 2015.
- 303d Water Quality Impairments (2012) from WA Department of Ecology.
- Watershed health assessment results from Whatcom Conservation District, 2015.

Figure 2. Laurel WID 2016 work Session in action.

Work session participants:

The objective of the January 2016 Sumas WID work session was to gather input on agricultural system characteristics and enhancement opportunities from a representative mix of agricultural producers and landowners, with the goal of 51% of participants who are active farmers and/or landowners and Sumas WID members.

The WID Board invited a mix of participants considering: (i) location within the WID sub-basins; (ii) type of agricultural operation; (iii) size of agricultural operation; and (iv) parcel size. The WID Board identified additional guests to assist with and advise the work session participants, to provide additional technical inputs at the work sessions, and to review work products for accuracy. See Table 1 for a summary of Sumas WID work session invitees and attending participants*.

Table 1. Sumas WID Work Session Invitees and Participants.

WID Invitees (participants*)	WID Area	Ag Type
Jag Alamwala		Berry
Raj Bathe *	Lower Johnson	Berry
Scott Bedlington	Lower Sumas	Potato
Keith Boon	Saar	Turf
Ed Bosscher	Upper Sumas	Dairy
Pete Dykstra	Upper Johnson	Mixed
Andy Enfield	Upper Johnson	Berry
Kevin Gill *	Lower Johnson	Berry
David Haggith		Dairy
Jim Heeringa	Lower Johnson	Dairy
Mike Horat	Saar	Cattle
Terry Lenssen	Uppe\r Johnson	Dairy
Ralph Minaker *	Upper Johnson	Berry
Rod Perry *	Upper Johnson	Dairy
Brad Rader	Upper Johnson	Berry
Tom Thornton *	Upper Sumas	Crop
John Vander Veen		
Jerry Van Dellen *	Nooksack South	Dairy
Bill Visser	Lower Johnson	Dairy
Marv Vreugdenhil *	Saar	Dairy
WID Guests	**Expertise**	**Agency**
Karin Beringer *	Ag land enhancements, priorities	Ag Land Program, WCPDS
Chris Elder *		WCPDS
Mark Personius		WCPDS
Paula Harris	Flood, drainage enhancements, priorities	WCPW Flood
Erica Douglas	Water quality enhancements, priorities	WCPW, Water Quality
Joel Ingram	Fish & wildlife habitat enhancements, priorities	WA Dept. of Fish & Wildlife
Frank Corey *	Riparian Enhancements, CREP, water quality priorities	Whatcom Conservation District

3. Record of meetings

During WID Board meetings, WID Commissioners reviewed the proposed scope of the ag-watershed characterization and mapping work products, the draft work session materials, and preliminary draft work products prior to the completion of the final project deliverables. Meetings included:

December 8, 2015 - Sumas WID Board reviewed project scope of work (SOW) and proposed Memorandum of Understanding (MOU) with Whatcom County Planning and Development Services.

January 12, 2016 - Sumas WID Board reviewed and approved proposed SOW, MOU, and work session agenda and invitees.

March 8, 2016 - Sumas WID Board reviewed summary of work session input and preliminary draft report contents.

June 2016 - Sumas WID Board reviewed and confirmed the Sumas WID Agriculture-Watershed Characterization and Mapping Report.

4. Record of documents

The Sumas WID Board worked with Ag-Watershed Project staff to conduct work session outreach and proceedings. This record of documents includes administrative documents used to guide the project work and documentation of Ag-Watershed Project team and participant contributions to the final work products and analysis (maps, tables and summary report).

Administrative materials included:

- December 2015 SOW for Sumas WID agricultural and watershed characterization and mapping project (see Table 2 on page 4 with excerpt on the Agricultural Analysis Method).
- December 2015 draft MOU with WCPDS.
- January 2016 Sumas WID work session invitation and RSVP tracking list.
- January 26, 2016 Sumas WID Work Session Agenda.

Information materials provided for preliminary review included:

Tables

- Table 1. Summary of results of ag-watershed characterization mapping for the Sumas WID.
- Table 2. Agricultural characterization tables for Sumas WID characterization mapping for the Sumas WID.
- Table 3. Key actions on agricultural priorities specific actions map.
- Table 4. Watershed characterization tables for the Sumas WID.

Maps

- Sumas WID overview and locality.
- Sumas WID agricultural priorities: Proportion of prime soils. Data from reference map of prime soils.
- Sumas WID agricultural priorities: Drainage of agricultural land. Data from reference maps of prime soils and special districts.
- Sumas WID agricultural priorities: Protection of agricultural land from flooding. Data from reference maps of prime soils and special districts plus WCPDS GIS data on FEMA flood areas.
- Sumas WID agricultural priorities: Protection of the agricultural land base. Data from reference map of agriculture priority areas.
- Sumas WID agricultural priorities: Water for agricultural activities. Data from reference map on water right points of diversion.
- Sumas WID map of specific actions for agricultural priorities (generated at January 2016 work session).
- Sumas WID: Overall water flow restoration & protection priorities.
- Sumas WID: Water flow assessment units in relation to WID area.
- Sumas WID: Water flow process assessment results.
- Sumas WID: Overall water flow restoration & protection priorities.

Table 2. Excerpt: Ag-Watershed Project Agricultural Analysis Method[2]

Priority - What?	*Where?*	*Related Background Info.*
Soils	Primary, secondary, tertiary soils for all crop types and rotations. Selection Criteria: Prime Agricultural soils are present in the watershed.	Map: Ag Priority Areas Map: Ag Land Use Map: Prime soils
Water Quantity	Water for irrigation, livestock and agricultural processing. Selection Criteria: One or more applications for new water rights are present, and identified in the Ag Mapping Workshop.	Map: Water Rights
Land Drainage	Includes timing of field drainage for agricultural crops and storage opportunities. Selection Criteria: Over 50% of area contains Prime Ag soils only if drained, or identified in the Ag Mapping Workshop.	Map: Prime soils
Flood Protection	Relief from high flashy flows and sustained flooding events. Selection Criteria: Contains prime Ag soils only if protected from flooding, or identified in the Ag Mapping Workshop.	Map: Ag Land Use Map: Prime soils
Protection of the Ag Land Base	Use of purchase or transfer of unrealized development rights in order to protect working ag land from conversion pressures. Selection Criteria: over 50% the area includes any combination of land zoned Agriculture, "Rural Study Area", or in PDR easements.	Map: Ag Priority Areas Map: Ag Land Use Map: Potential Development Rights

[2] Agricultural Analysis Method from the Agriculture-Watershed Characterization & Mapping Report combines information on existing agricultural protection programs, local knowledge and available GIS data. See: Gill P (2013). *Agriculture-Watershed Characterization and Mapping Report for the North Lynden watersheds*. Prepared for the Whatcom County Agriculture-Watershed Pilot Project, Whatcom County Planning & Development Services, Bellingham. http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project

Appendix C: Water Flow Assessment Results for Water Resource Inventory Area 1

Contents

List of Figures

1 Methodology

The description of the watershed characterization methodology has been adapted from that provided in the Appendix to the pilot ag-watershed characterization and mapping report.[1]

1.1 General approach

The watershed characterization assessment uses methods developed by the Puget Sound Watershed Characterization Project.[2] The results of the watershed characterization assessment are intended to assist the WIDs in identifying high priority opportunities for watershed enhancement projects on agricultural land in the lowland areas of Whatcom County, with a focus in areas where watershed and agricultural priorities could be mutually reinforcing.

The *Puget Sound Watershed Characterization (PSWC)* is a set of water and habitat assessments that compare areas within a watershed for relative restoration and protection value. It is a coarse-scale decision-support tool that provides information for regional, county, and watershed-based planning. The information it provides allows local and regional governments, as well as NGOs, to base their land use decisions on a systematic analytic framework. It prioritizes specific geographic areas for protection, restoration, and conservation of our region's natural resources, and identifies where best to focus new development. Application of this method should result in future land-use patterns that protect the health of terrestrial and aquatic resources while directing limited financial resources to the highest priority areas for restoration and protection.

The objective of the PSWC assessment is to "characterize" the watershed in a way that helps to identify priority enhancement opportunities. The relative comparison of assessment units (AUs) for water flow processes across the lowland watersheds allows for a coarse-level snapshot of which areas are relatively important or degraded for water flow. From this snapshot we suggest possible enhancement actions that could contribute to improving or protecting water flow processes at the AU scale. Actual site location of those actions within an assessment unit would require different analyses not described here.

The assessment results in this document address the following primary questions for the Whatcom County lowland watersheds:
(1) *Where on the landscape* should management efforts be focused first to benefit water flow processes in the watersheds that are part of the Watershed Improvement District?
(2) *What types of activities and actions* are most appropriate to that place based on the assessment results?

The assessment results therefore address both the "where" and the "what" to focus on, in terms of water flow processes. This integrated approach offers a systematic framework for identifying more important areas within the lowland watersheds and those which are more degraded for water flow processes and water quality, with the intent of identifying areas that offer the most potential for enhancement.

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[1] Hume C & Stanley S (2013). *Summary of Water Flow Assessment Results for Bertrand, Fishtrap and Kamm Watersheds.* Appendix A in Gill P (2013). *Agriculture-Watershed Characterization and Mapping Report for the North Lynden watersheds.* Prepared for the Whatcom County Agriculture-Watershed Pilot Project by the Washington Department of Ecology Shorelands and Environmental Assistance Program. http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project

[2] See http://www.ecy.wa.gov/puget_sound/characterization/index.html

1.2 Limitations

Care should be taken to use the Puget Sound Watershed Characterization as intended. It is a coarse-scale assessment and is not intended for site-specific application or decision-making at the site scale. Finer scale data, local information and technical expertise is needed for those decisions. In addition:

- The Puget Sound Watershed Characterization is for planning purposes only. This does not affect or alter existing land use/environmental regulations although it may be used to help inform future land use and regulatory decisions.
- For the water flow assessment, the rankings for any single AU are relative only to other AUs in the area of analysis. This means it is only appropriate to compare the Watershed Improvement District (WID) results with results in other AUs in the lowland area of WRIA 1.
- Results at the AU scale represent land-use planning-level information. At the project- or site scale, each AU will have a combination of on-the-ground challenges and opportunities. Just because an AU is rated as a low priority for restoration does not mean there are no suitable restoration sites or opportunities in that AU. Similarly, not every site in an AU that is a high priority for restoration will be suitable for restoration.
- The assessments are landscape-scale and consequently do not address site-specific issues. These are best addressed through finer-scale studies, which will remain essential to the success of local conservation efforts. When developing site-level plans, the WID should evaluate the need for finer-scale information and collect it where needed.
- The watershed characterization assessment is not intended to address compliance with state or federal water quality law, nor describe the actions necessary to achieve compliance with those laws. It is a violation of state law when activities are shown to cause or have the substantial potential to cause nonpoint source pollution. If the reader has questions about the water quality laws, they can contact Whatcom County Public Works or the WA Department of Ecology for additional information.

1.3 Fundamental Concepts of Watershed Characterization

Watershed processes are defined as the dynamic physical and chemical interactions that form and maintain the landscape and ecosystems on a geographic scale of watershed to basins. This includes the movement of water, sediment, nutrients, pathogens, chemicals and wood. Watershed processes are controlled and influenced by natural attributes and human actions. Natural controls on watershed processes include physical attributes of the ecosystem such as geomorphology, geology, and soils. Many human actions influence watershed processes. For example, timber harvest may reduce the amount of wood entering streams. Shoreline armoring can reduce sediment input from bluffs and alter the erosion, movement, and deposition of sediments along beaches. Urban development can increase the amount and amplitude of stormwater runoff. Watershed characterization attempts to model these watershed processes such that areas of the landscape can be identified which are relatively more important (presence of natural controls) or degraded (due to human impacts).

1.4 Understanding the Water Flow Assessment results

The Water Flow Assessment uses two models to compare the *importance* and *degradation* of water flow processes in a watershed. Together, they identify areas that are relatively more suitable for protection or restoration of water flow processes. Each model provides a ranking from low to high for how important and how degraded each assessment unit is *relative* to the other units in the watershed.

Water Flow importance

The *importance* model evaluates the watershed in its "unaltered" state. This model combines the delivery, surface storage, recharge, and discharge components to compare the relative *importance* of assessment units in maintaining overall water flow processes in a non-degraded setting. When precipitation is "delivered" as either rain or snow, there are physical features that control the surface and subsurface movement of that precipitation within an assessment unit. These physical features include land cover, storage areas such as wetlands and floodplains, areas of higher infiltration and recharge, and areas that discharge groundwater. These areas are considered "important" to the overall water flow processes.

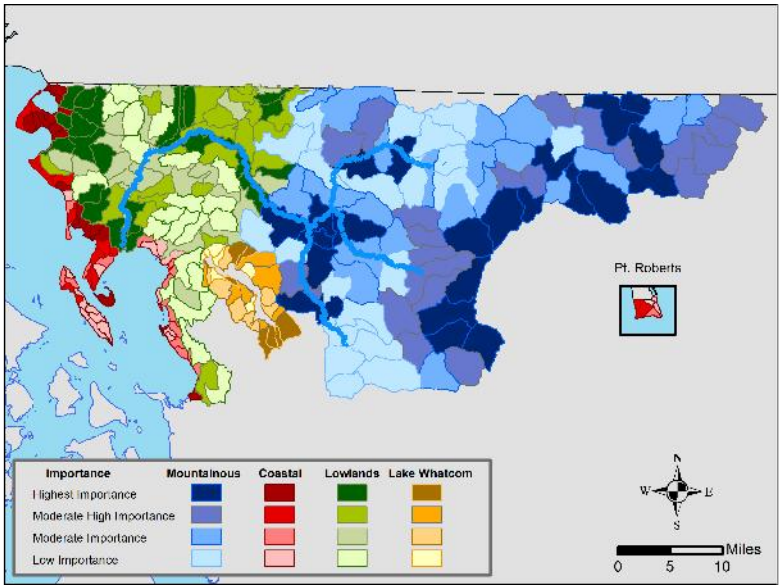


Figure. Overall importance to water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA 1. Darkest colored assessment units are considered highest *importance* relative to other assessment units in the same landscape group of WRIA 1.

In the figure to the left, each landscape group is displayed in a different color gradient (i.e. blue, green, red or tan), which allows for direct comparison within the extent of that landscape group only. Dark green assessment units would be considered *highly important* for overall water flow processes *only* within the lowland area of WRIA 1, and are not comparable to AUs outside of that extent. However, this does allow one to determine which AUs throughout the lowland areas of WRIA 1 are *relatively more important* than others in that same extent.

Water flow degradation

In the water flow *degradation* model the watershed is evaluated in its "altered" state to consider the impact of human actions on water flow processes. The *degradation* model calculates the degree of alteration to those controls that regulate the delivery, movement and loss of water, such as forest clearing and impervious surfaces. This model combines the delivery, surface storage, recharge, and discharge components to compare the relative *degradation* to overall water flow processes in assessment units. Degradation to these processes generally accelerates the movement of surface flows downstream. This accelerated delivery increases downstream flooding and erosion and subsequently degrades aquatic habitat over time.

The figure below displays the results of the *degradation* to water flow processes for all of WRIA 1. Since degradation is not controlled by landscape, we compare assessment units within the entire extent of the WRIA. A dark pink unit along the coast is comparable in level of degradation to a unit in the lowland area.

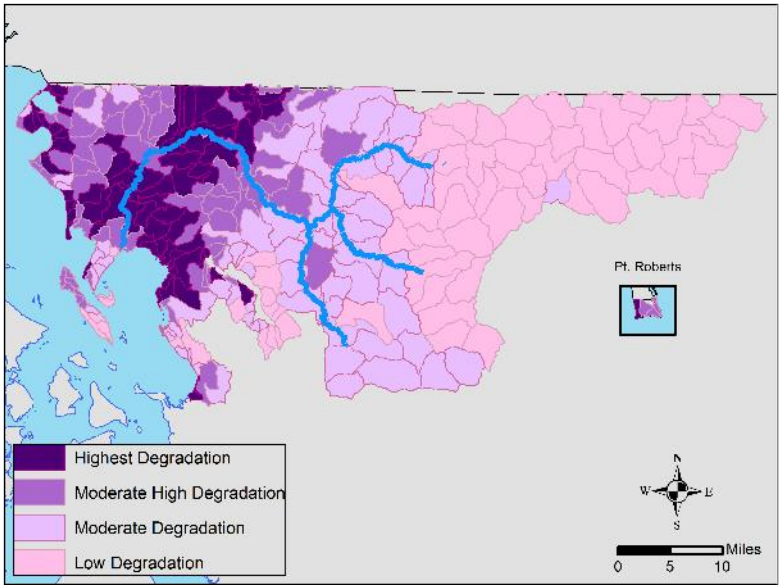


Figure. Overall degradation of water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA1. Dark pink assessment units are considered to have the highest *degradation* relative to other assessment units in WRIA1.

Management matrix for water flow

Combining the results of the *importance* and *degradation* models yields a simple categorical matrix that planners can use, along with other science-based information, to inform land management strategies and actions. At its simplest, this management matrix conveys which areas are relatively important and/or degraded, and what actions might be most appropriate there:

Highly important – low degradation = protect
Highly important – high degradation = restore
Low importance – low degradation = conserve
Low importance – high degradation = develop

The Puget Sound Watershed Characterization project generally prioritizes restoration or enhancement actions in watersheds which are both highly important and are relatively more degraded for watershed processes (yellow boxes in the Management Matrix Figure below). This does not mean that there are not important areas or necessary restoration actions in assessment units that are not highly important and highly degraded. Rather, given limited funding these might be the first places to focus on in order to increase the likelihood of improving watershed processes.

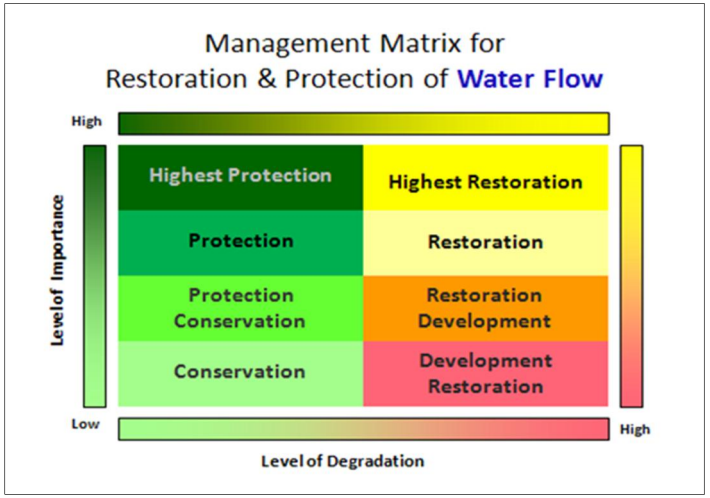


Figure: Management Matrix for Water Flow, indicating relative priorities for restoration and protection of processes
By accounting for both the relative level of *importance* and the relative level of *degradation* of an Assessment Unit one can begin to prioritize which areas of a watershed to apply management strategies which protect water flow processes, and which areas to prioritize restoration of water flow processes.

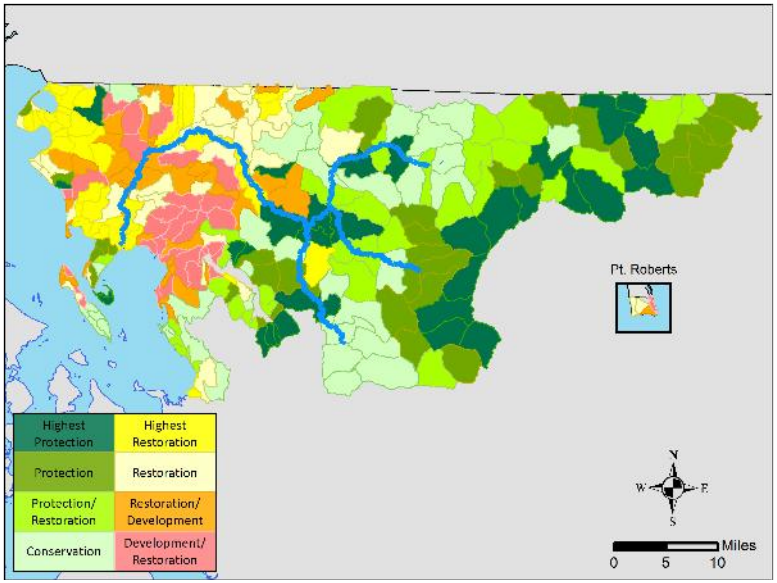


Figure. Overall priorities for restoration and protection of water flow processes in WRIA 1: Results of Puget Sound Watershed Characterization assessment.

2 Using the results of the water flow assessment

For water flow process enhancement or restoration, actions should be directed towards reducing the degradation to controls that regulate the delivery and movement of water through the watershed. These controls include forest cover, areas of surface storage, areas of permeable deposits, areas of slope wetlands and areas of floodplains with permeable deposits.

The terms "restoration" and "protection" as used in this document do not mean a return to historic land cover conditions or retaining 100% forested land cover. Restoration and protection actions should be done in a manner that recognizes and works within the constraints of the existing land use activities. For example, restoration in agricultural areas could mean consideration of measures that enhance a critical portion of water flow processes such as surface storage. This could involve the retention of water on fields for a longer period to avoid harmful peak flows within streams during the winter months. Restoration and protection measures are, therefore, always proposed here in the context of both the landscape setting and the current land use activities.

There are actions which can offer mutual benefits to both water flow and water quality. For example, there are some areas where wetland restoration or enhancement to surface storage processes could provide some improvements for both. Enhancement actions for water flow processes may have additional benefits to other watershed processes and functions particularly in the area of riparian habitat and structure which are critical to salmonid habitats throughout the Whatcom County lowland watersheds.

3 Water flow assessment results for WRIA1

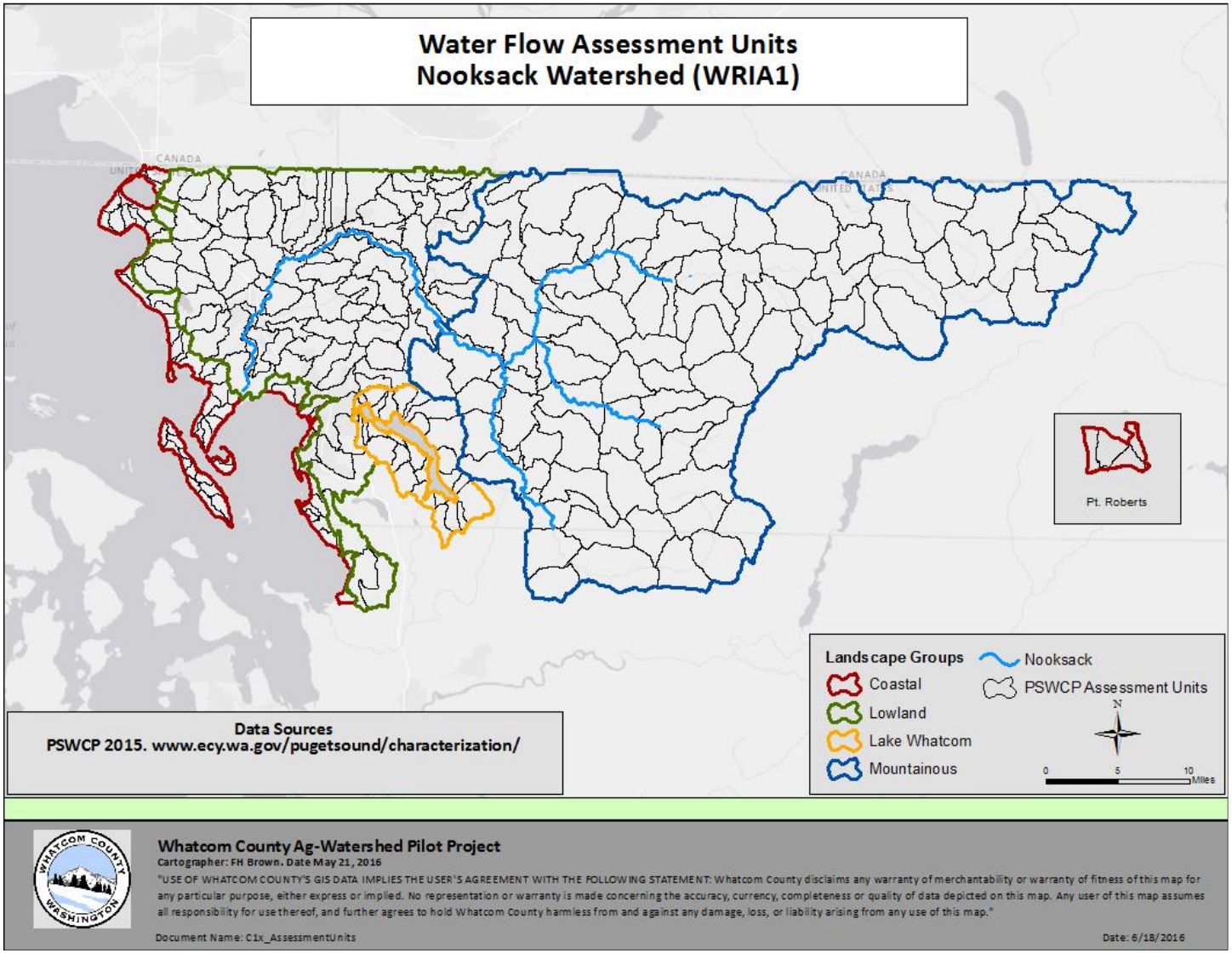


Figure 1. Water flow assessment units used in the Puget Sound Watershed Characterization.

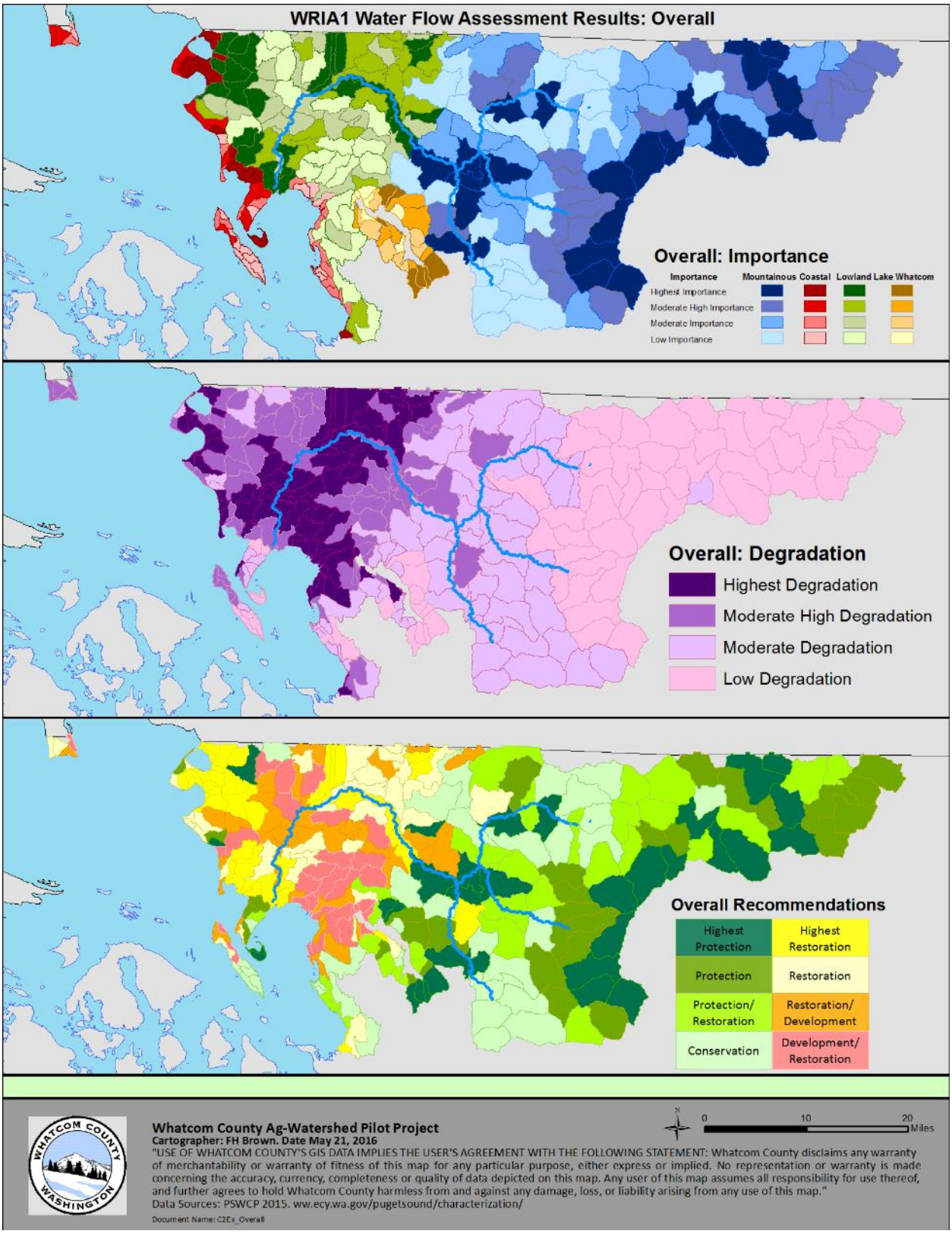


Figure 2. Overall water flow assessment results for WRIA1.

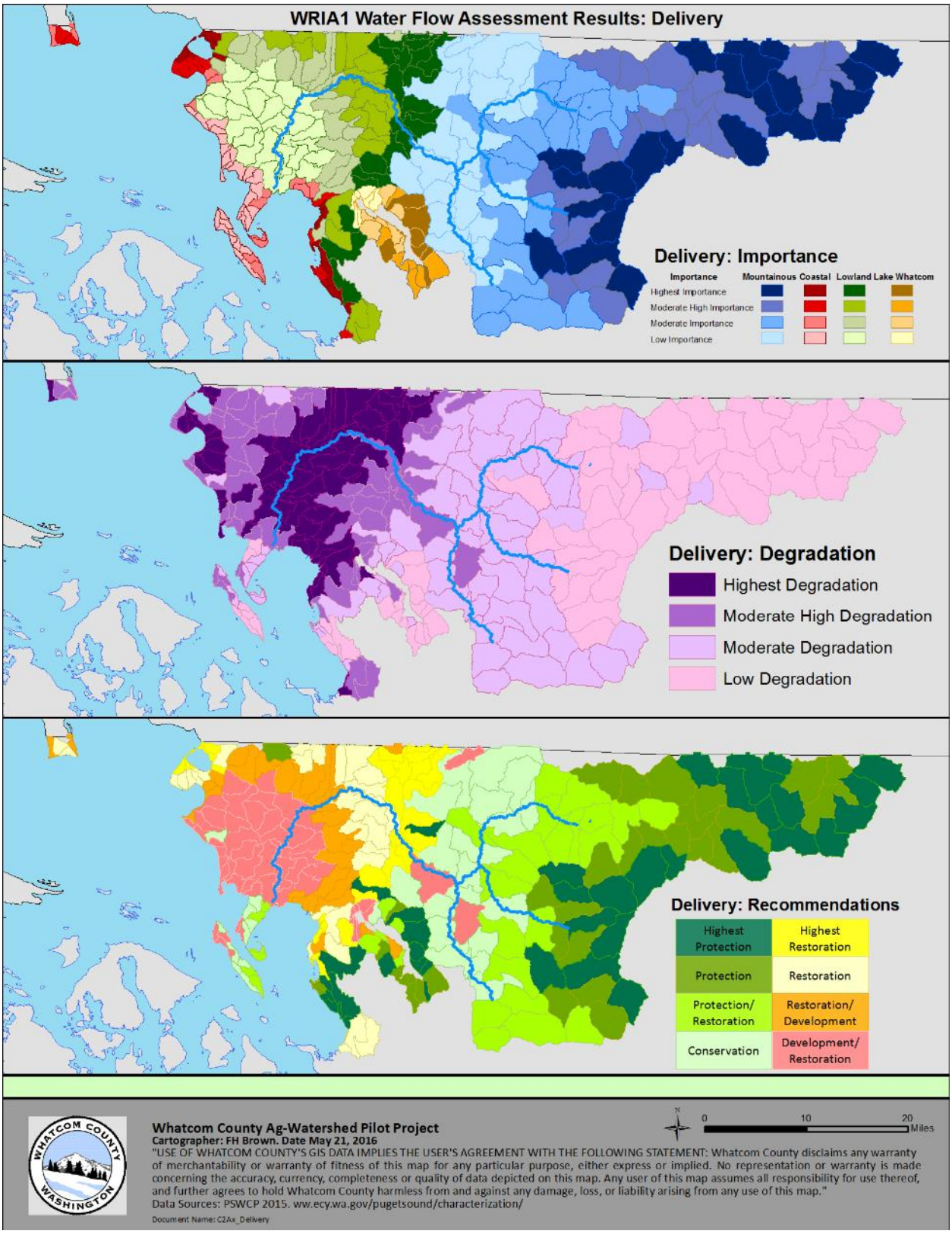


Figure 3. Delivery processes: Assessment results for WRIA1.

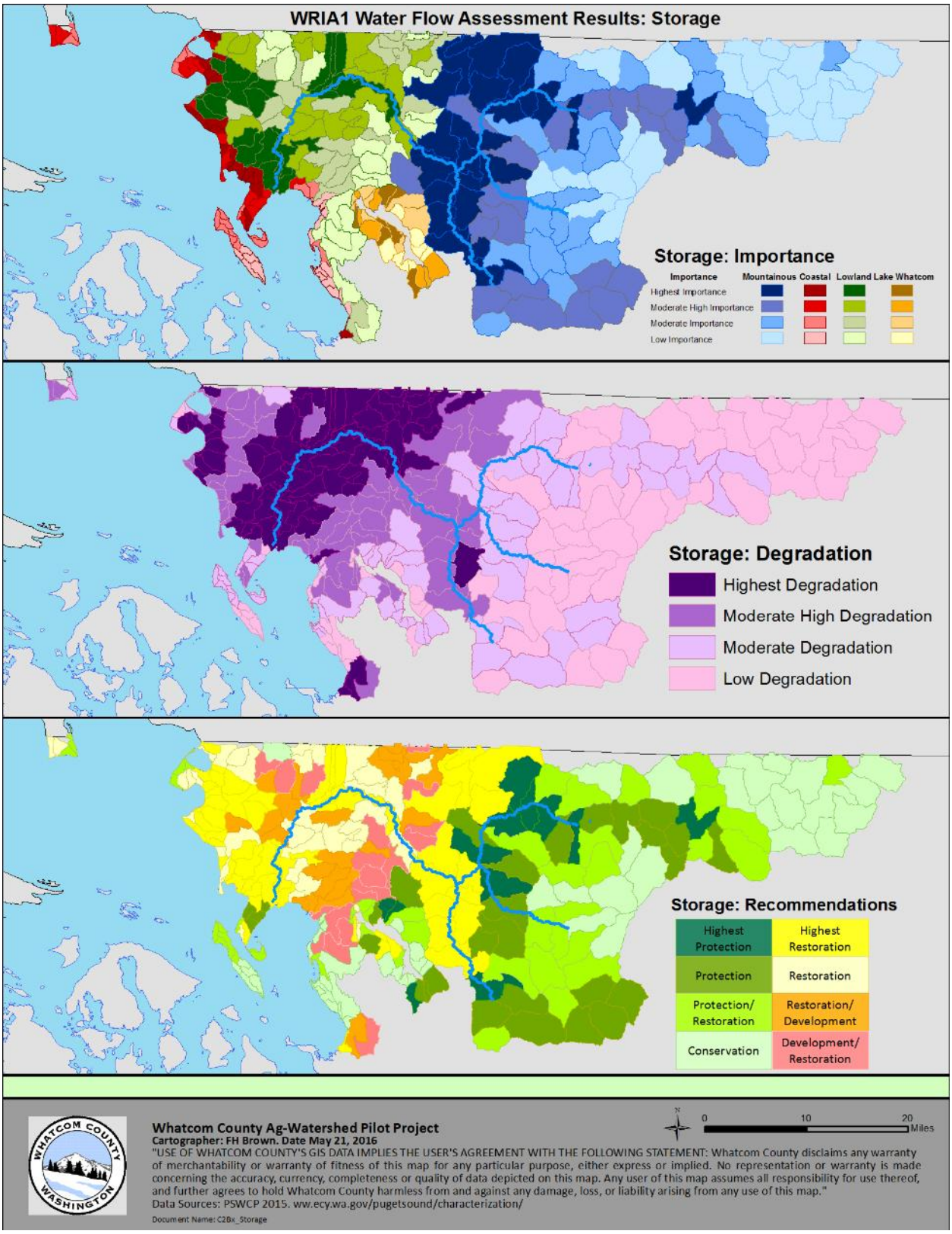


Figure 4. Storage processes: Assessment results for WRIA1.

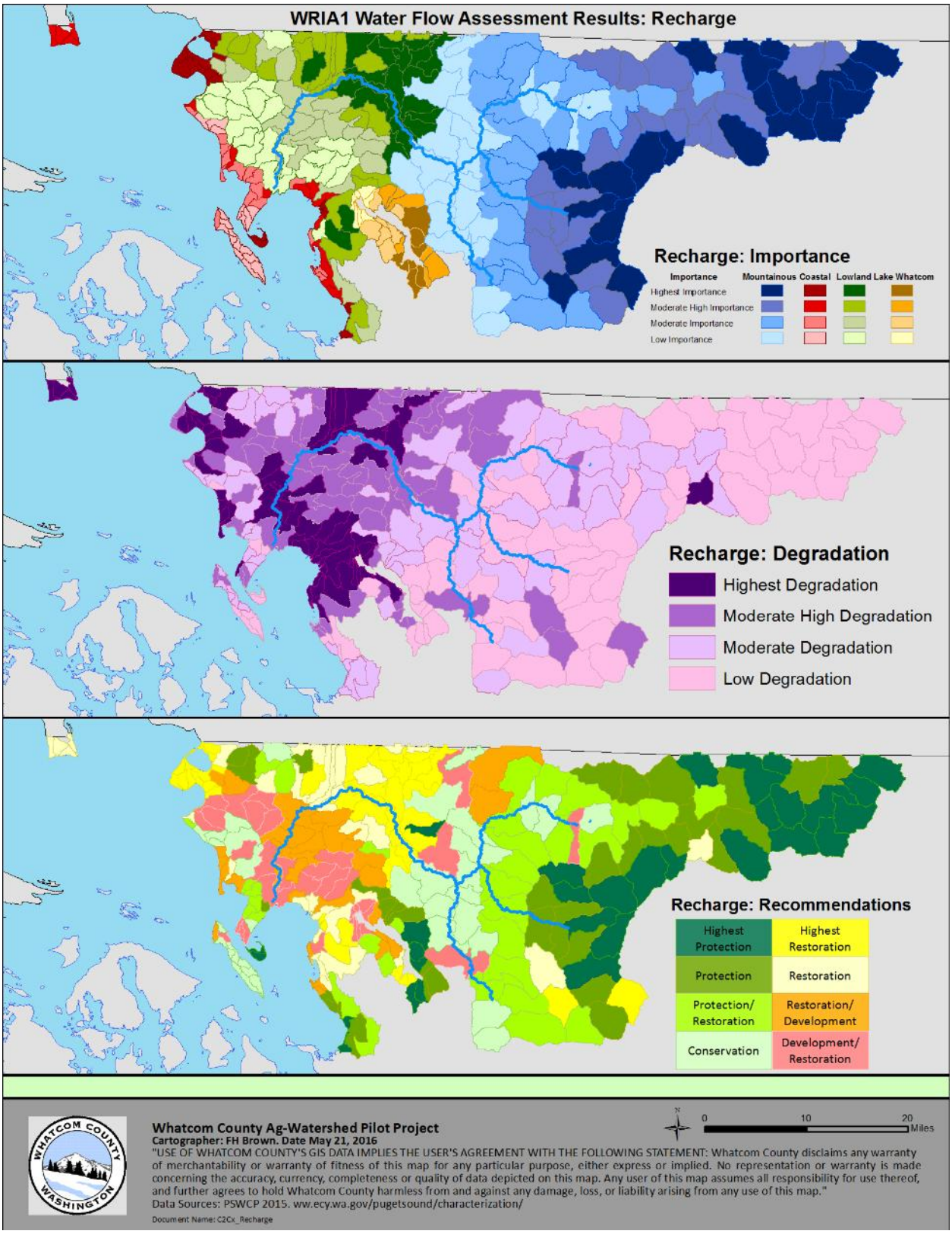


Figure 5. Recharge processes: Assessment results for WRIA1.

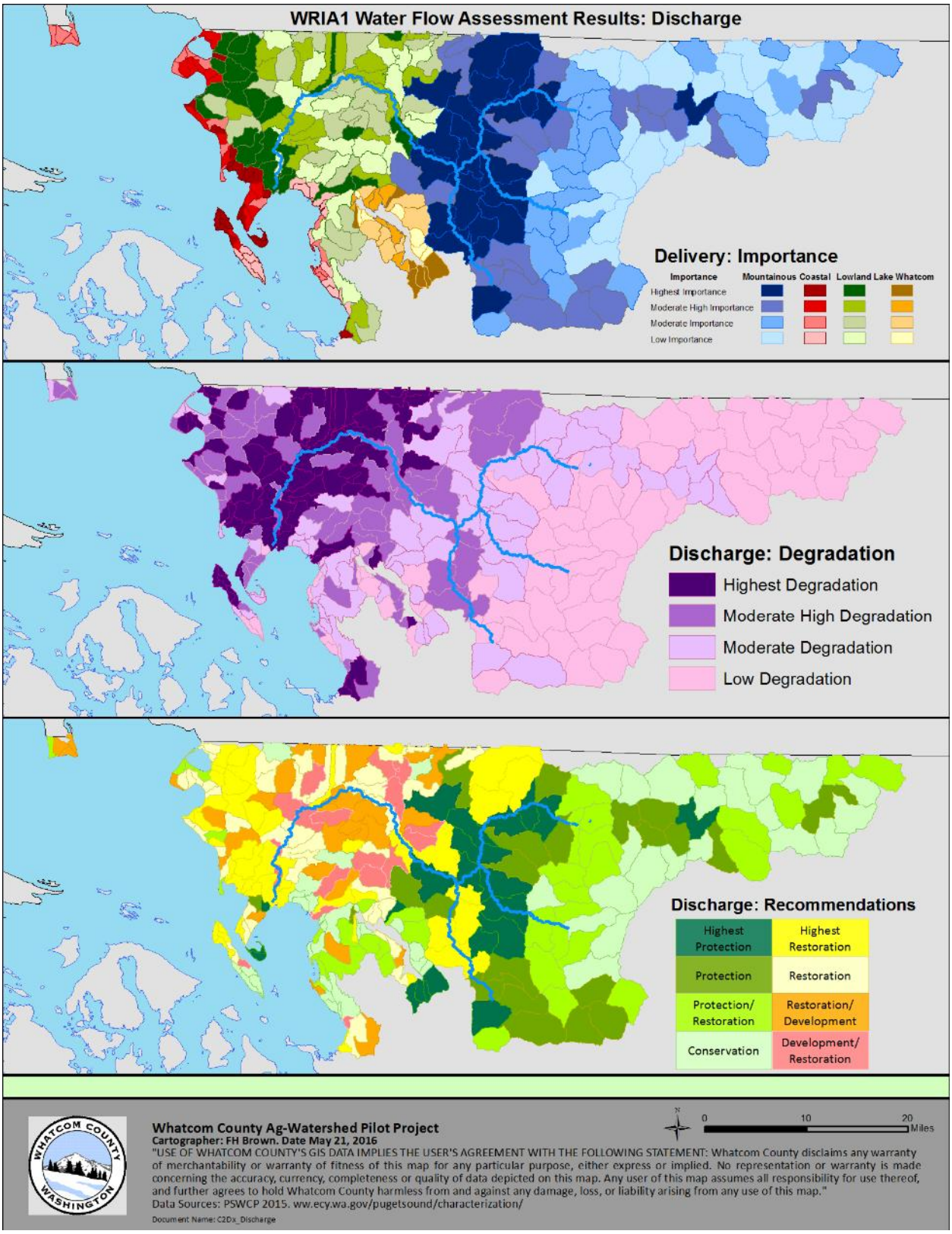


Figure 6. Discharge processes: Assessment results for WRIA1.

Appendix D. Ag-Watershed Project Fact Sheet #5:
Planning, designing and implementing beneficial actions for agricultural & watershed enhancement

Whatcom County Ag-Watershed Project Fact Sheet #5

Planning, designing and implementing beneficial actions for agricultural & watershed enhancement

The Whatcom County Agriculture-Watershed Pilot Project (the "Ag-Watershed Project") has examined ways to reward beneficial actions by farmers and landowners who voluntarily go beyond existing regulation to maintain, restore or enhance large-scale watershed processes, while also strengthening agriculture in Whatcom County (see Fact Sheet #1).

Agricultural landowners and farmers have worked with the Project Partners (Whatcom County, Whatcom Conservation District, Whatcom Farm Friends and Washington Department of Fish & Wildlife) to test ways to better integrate agriculture and watershed planning and to design, select and implement effective local enhancement projects.

The project has used pilot studies on agricultural land in Whatcom County to test

- planning tools to identify high-priority, high-value opportunities to take actions for agricultural and watershed enhancement and/or protection,
- scientific measurement tools that connect specific beneficial actions on working farmland to measurable outcomes for agriculture and watersheds, and
- administrative tools to verify, track and account for the benefits of these actions over time.

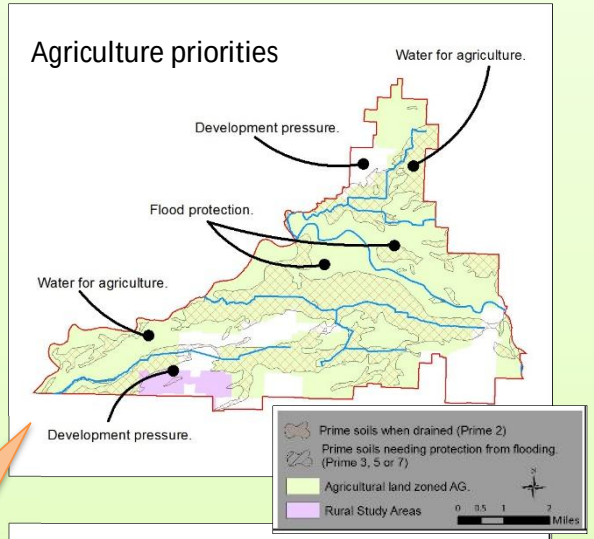
Fact sheet #5 shows how Agriculture-Watershed Characterization and Mapping can be used as a planning tool to:

- integrate local agricultural priorities into routine planning for consideration alongside adopted watershed priorities in Whatcom County and the Puget Sound region, and
- design local projects on a single farm or group of farms that help to achieve both agricultural and watershed enhancement priorities.

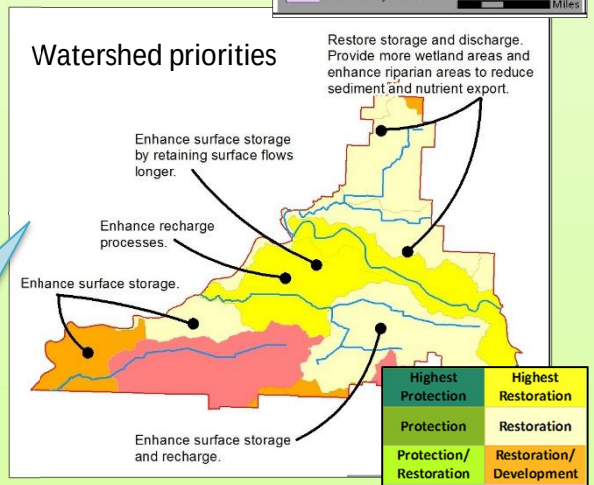
STEP1: CHARACTERIZE AND MAP AGRICULTURAL AND WATERSHED ENHANCEMENT PRIORITIES

The characterization and mapping process combines information from current agriculture and watershed plans with existing spatial data, field experience and farmers' local knowledge to identify agricultural priorities and needs in the area alongside watershed priorities and needs, as shown below in the example maps for a Watershed Improvement District. (See Fact Sheet #2 for more detailed information on the characterization and mapping process.)

Farmers, planners and landowners identify, characterize & map enhancement priorities, using local field knowledge, existing data and reference maps.



Working agricultural lands. Needs and enhancement priorities:
- Water quantity for out of stream uses
- Water quality for agricultural use
- Drainage of fields
- Flood protection
- Protection of agricultural land base and soils
- Pollination



Watershed systems. Protection, restoration and enhancement priorities:
- Water quality
- Habitat (riparian, instream, fish, wildlife, wetlands)
- Water quantity
- Water flow processes (recharge, discharge, surface water storage, water delivery)

See Ag-Watershed Project website http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project for Fact Sheets 1-5 and links to the Watershed Characterization and Mapping Reports for the Watershed Improvement Districts

STEP 2: IDENTIFY PLACES WHERE AGRICULTURAL AND WATERSHED PRIORITIES COINCIDE

In some locations, agricultural and watershed priorities may be in competition; in other locations they may be complementary. Ideally, projects should enhance watershed processes while also strengthening agriculture. Sometimes, however, acceptable tradeoffs must be found between agricultural and watershed priorities. Mapping these priorities concurrently allows farmers and planners to identify the places in the landscape that offer opportunities to address both watershed and agricultural needs most efficiently and effectively.

STEP 3: SELECT SPECIFIC ACTIONS FOR AGRICULTURAL AND WATERSHED ENHANCEMENT

Watershed Improvement Districts (WIDs) and other special districts, planners and landowners can use the maps and characterization reports to determine which agricultural enhancements or conservation actions might be most appropriate at a site, given current regulation. Scientific measurement tools (metrics) allow planners and WIDs to develop potential scenarios for optimizing agricultural and watershed enhancements before pursuing project design, verification and implementation (see Fact Sheet #3).

STEP 4: INTEGRATE ACTIONS INTO WATERSHED & LAND USE PLANS AND INVESTMENT STRATEGIES

Priority actions and projects can be integrated into farmers' business plans, ongoing WID planning, land and watershed management efforts and funding programs (see Fact Sheet #4). Tracking progress against longer-term goals helps to quantify the benefits of investing in actions for watershed and agricultural enhancement on working farmland.

AG-WATERSHED PROJECT PILOTS & CASE STUDIES: EXAMPLES OF BENEFICIAL ACTIONS & PROJECTS

Pilot 1 (single landowner)
Proposed enhancement: Avoided conversion of wetland habitat resulting from beaver activity in the headwaters of an important salmon bearing stream, on a site that could be returned to active farming at the end of the Conservation Reserve Enhancement Program (CREP) lease.
Agricultural benefits: diversification of revenue from payment for permanent wetland conservation easement on marginal farmland.
Watershed benefits: wetland habitat and surface water storage capacity in the upper watershed are permanently protected.

Pilot 2 (multiple landowners):
Improve flood protection and field drainage for low-lying farmland, while concurrently increasing stream width and channel complexity, improving stream-floodplain connectivity and restoring riparian vegetation in a highly channelized reach.
Agricultural benefits: improved flood protection and drainage for fields on prime farmland [proposed project design addresses faster removal of flood waters from fields & improved efficiency of drainage ditches].
Watershed benefits: stream function and habitat condition in the reach are enhanced in exchange for a small amount of agricultural land taken out of production to accommodate channel widening.

Case study (land use planning): Measuring the potential agricultural benefits of different land use options. The demonstration site is an undeveloped property located in the Nooksack basin lowlands, within the floodway. Soils are mostly agricultural, but prone to flooding. Surrounding land use is mixed urban and agricultural.
Future option 1 (agricultural use)
-- Entire site actively farmed, except for creek buffer
-- Permanent Agricultural Conservation Easement protects
land for farming
-- Maintain soil drainage for fields
Future option 2 (mixed use)
-- NE portion actively farmed, SW portion converted to recreation/open space
-- Watershed enhancement along creek & floodway