

South Lynden Watershed Improvement District
Agriculture-Watershed Characterization and Mapping Report
August 2016



Whatcom County Ag-Watershed Project



PROJECT PARTNERS



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Abbreviations used in this document

AU	Analysis Unit (for watershed characterization assessment) 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 are: 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 South Lynden 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 websites² or through the Ag-Watershed Project page.³ The results of the characterization and mapping have also been incorporated into an online story map 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 South Lynden 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 South Lynden Watershed Improvement District (see Figure 3) is located in the central lowland area of Whatcom County, adjacent to and in the floodplain of the main Nooksack River within WRIA 1. The area is predominantly agricultural, comprising mostly dairy farms and fields. The closest city, Lynden (pop. 12,900), borders the WID to the north. A significant proportion of the soils in the South Lynden WID have been classified by the USDA Natural Resources

Conservation Service as Prime or Prime if managed⁵ (see Prime Soils reference map).

The WID area encompasses 12,991 acres in total. The WID area includes portions of significant tributaries to the Nooksack River: Kamm Creek, Scott Ditch, and the northern part of the Wiser Lake/Cougar Creek watershed. These tributaries and other drainages are included in Water Resource Inventory Area 1 (WRIA 1).

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 # 5, Diking District #3 and Consolidated Drainage Improvement Districts #20 and #21 (see Special Districts reference map).

More information about the South Lynden WID can be found at their website www.southlyndenwid.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

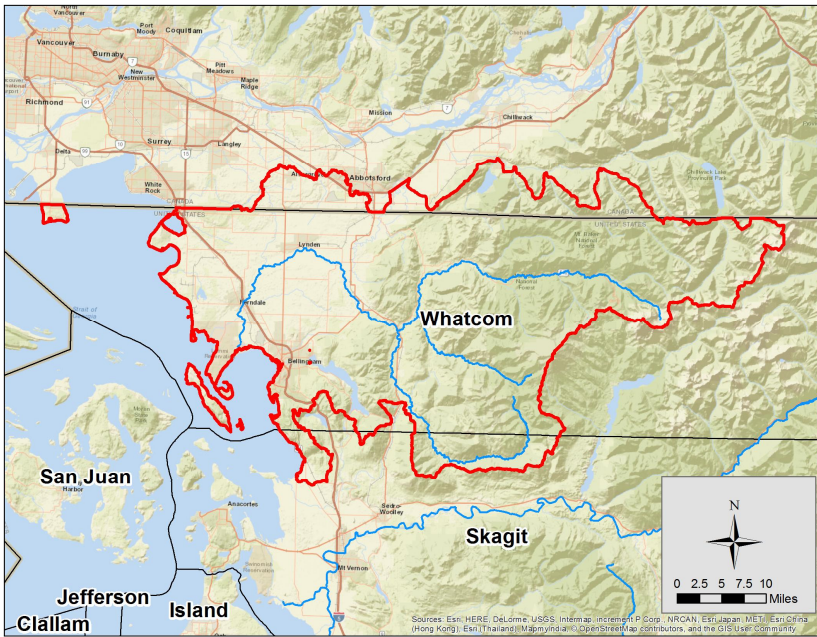


Figure 1. Regional map showing general location of Whatcom County and Water Resource Inventory Area 1

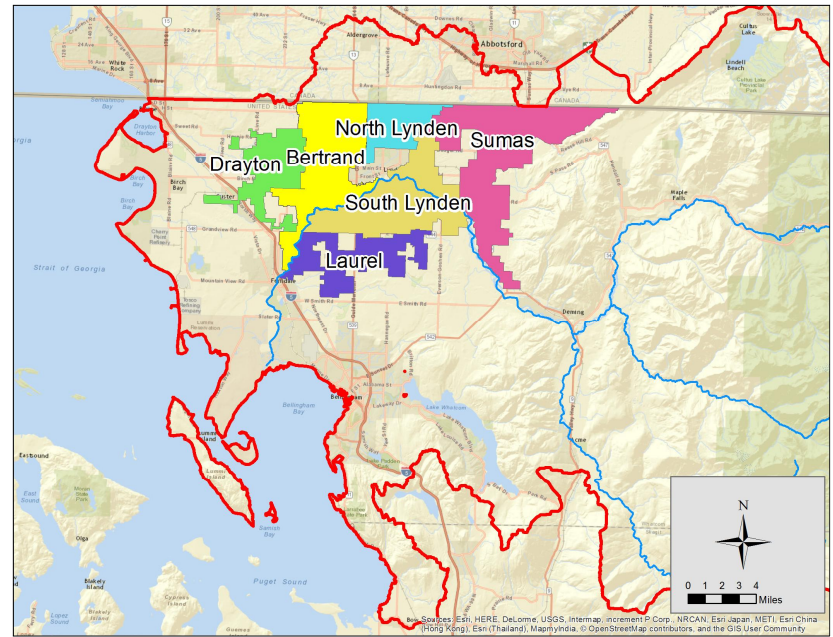


Figure 2. Map showing Water Resource Inventory Area 1 and the South Lynden Watershed Improvement District

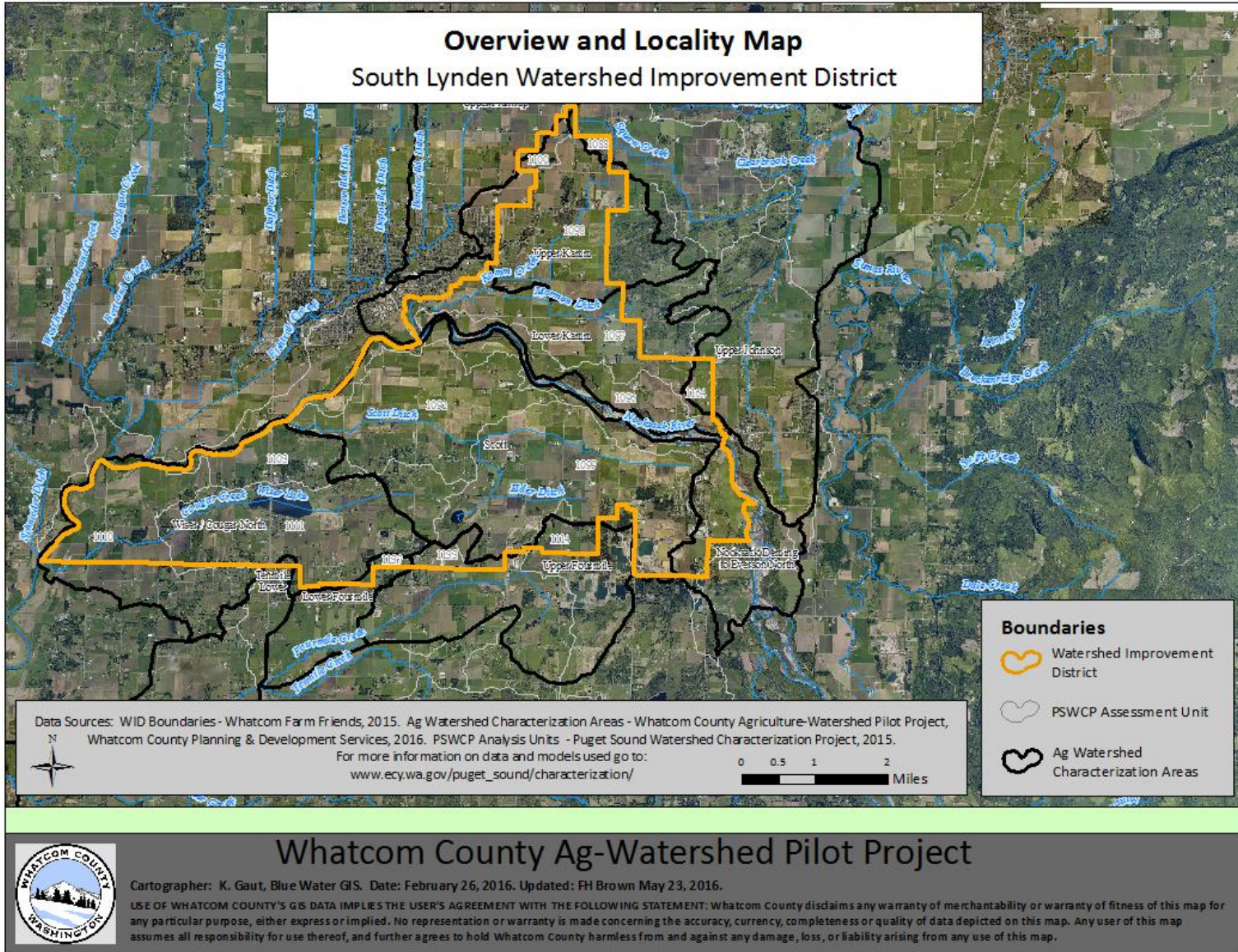


Figure 3. South Lynden WID overview and locality map

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 South Lynden 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.

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>

A work session was held with South Lynden 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 South Lynden 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 South Lynden WID, the information contained in the watershed reference maps (see section 6.2 of this report) was combined with the results of watershed characterization⁸ (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.

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 South Lynden 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 protection programs in Whatcom County, (ii) available GIS data contained in the agricultural reference maps (see section 6.1 of 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 agricultural characterization 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 South Lynden 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 South Lynden WID area. Check marks in Table 1 below indicate where a specific enhancement priority was identified during the characterization and mapping process. Detailed descriptions of each priority and the opportunities for enhancement through specific actions can be found in Table 3 and Table 5.

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

	Upper Kamm	Lower Kamm	Scott	Wiser Lake/Cougar Creek (north portion)	Upper Fourmile Creek (small northern portion)
Agricultural Enhancement Priority (See Table 3 for details)					
Prime agricultural soils	√	√	√	√	√
Water quality for crops and livestock	-	√ (nitrate)	-	-	-
Water quantity for agricultural activities	√	√	√	√	-
Agricultural drainage	√	-	-	-	-
Flood protection	√	√	√	-	-
Agricultural land base:					
Important agricultural land	√	√	√	√	√
Protection from development pressure	√	-	-	√	-
Other:					
Pollination for berry crops	√	-	-	-	-
Watershed Enhancement Priority (See Table 5 for details)					
Water Quality					
Nutrients, Ammonia-N	-	-	-	-	-
Bacteria	√	√	√	√	-
Temperature	-	-	-	-	-
Dissolved oxygen	√	√	√	√	-
Other:	√ (pH)	√ (pH)	-	-	-
Habitat					
Salmon spawning (documented, current)	√	-	-	-	-
Anadromous fish	√	√	√	√	√
Wildlife	√	√	√	√	√
Wetland	√	√	√	√	√
Water Flow Processes ⁹					
Delivery	√	√	√	-	√
Discharge	√	√	-	-	-
Recharge	√	√	√	-	√
Storage	√	√	√	√	-
Other	-	-	-	-	-

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

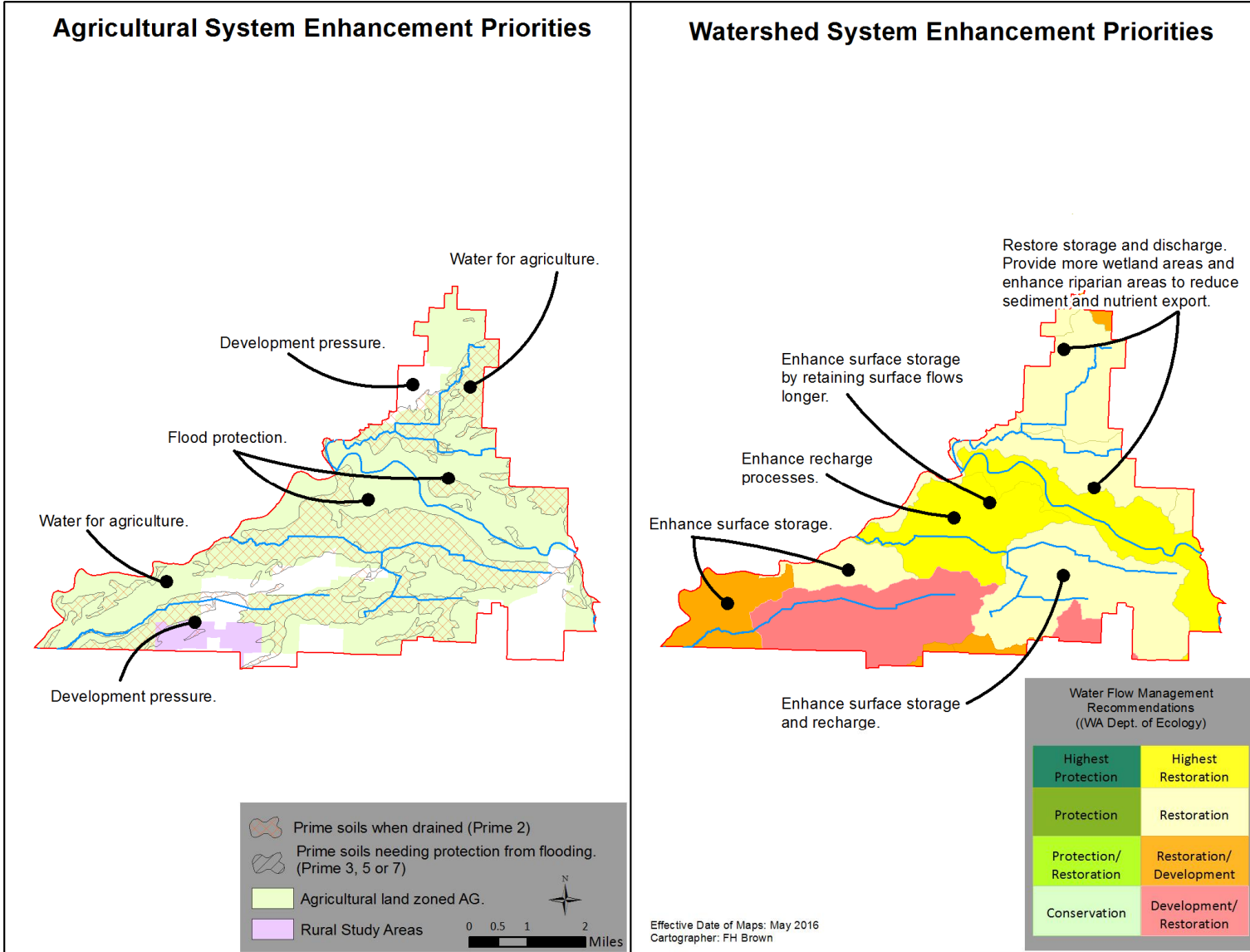


Figure 4. South Lynden WID: Summary maps of agricultural and watershed enhancement priorities

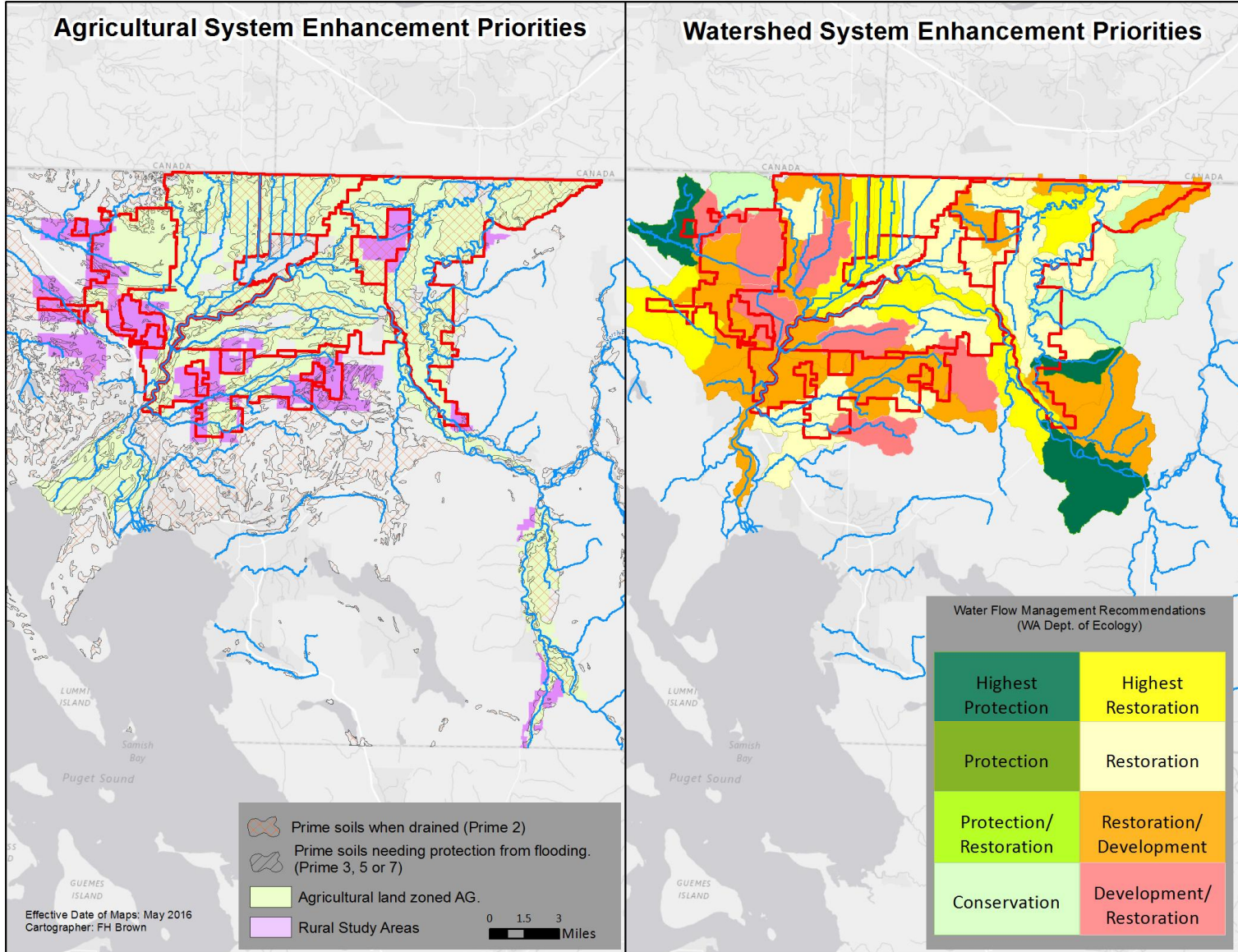


Figure 5. General agricultural and watershed enhancement priorities for the lowland areas of Whatcom County.

3.5 Possible future challenges and priorities

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

- Water Quality: Creeks and ditches are actively monitored for water quality parameters (dissolved oxygen, bacteria, nitrate, and fecal coliform) in this WID area. Groundwater quality (nitrates) is also a concern in large areas of the Sumas-Blaine Aquifer located within the WID area. Better understanding is needed on the connections between water quality and agricultural drainage.
- Drainage: The South Lynden WID area includes a high percentage of prime agricultural soils, some of which have been improved with drainage infrastructure. Improved understanding of best practices for regular drainage maintenance and cost-sharing is needed by co-managers: landowners, WIDs, local Drainage Districts, as well as local, state and federal public agencies.
- Water Quantity: Access to legal irrigation water is a key priority (60 new applications for water rights have been filed in the WID area). Kamm Ditch/Stickney Slough and Wisser Lake are closed year-round to further appropriations unless mitigated, and Wisser Lake Creek is closed to new withdrawals seasonally (from May 1 to October 31). Irrigation is needed to optimize forage production and to recover nutrient applications. Restrictions on irrigation from creeks, tributaries, and other surface water sources are in place until instream flow levels are met during critical periods for fish per the existing Nooksack Instream Flow Rule.¹¹ There is limited access to water rights in some areas of the WID, and major Group A public

suppliers do not have adequate water rights in suitable locations to meet projected future demand.¹²

- Flood Management: Parts of the WID area are within the 1:100-year flood zone and designated floodway for the Nooksack River. Diking infrastructure is in place to protect lands and transportation corridors from flood impacts. Improvements should address beaver management to reduce localized flooding. Flood management priorities in the South Lynden WID should be considered within ongoing larger local and regional river management and flood advisory strategies.

¹⁰ This section includes priorities identified by the South Lynden WID on their website <http://www.southlyndenwid.com/#!projects/c10d6> (last accessed 23 May 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 South Lynden 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; and
- 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 2012¹⁴ 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; and
- 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” (AWCSs), based on a combination of the WRIA 1 water management areas¹⁵ and the Puget Sound Watershed Characterization Project Assessment Units (see section 5 in this report for explanation of the assessment units). The AWCA’s 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 AWCA’s 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);

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

- 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).

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 Agricultural Priority Actions Map (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 South Lynden 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 ag 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 agricultural 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
<i>Prime agricultural soils</i>	>50% of the area is Prime farmland (any prime soils category 1-10 according to USDA definitions for prime farmland)	-
<i>Water quality for crops and livestock</i>	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 ag 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.
<i>Water quantity for agricultural activities</i>	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.
<i>Agricultural drainage</i>	>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 not currently a priority (if they do not, that does not necessarily mean that drainage is not needed in the areas, 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.
<i>Flood protection</i>	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.
<i>Agricultural land base:</i>		
• <i>Important agricultural land</i>	>50% of the area is any combination of AG zoned, Rural Study Area or PDR easement.	-
• <i>Protection from development pressure</i>	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.
<i>Other:</i>	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 South Lynden WID

NOTE: Possible actions include: Specific actions identified by WID Actions Map # location (e.g. SL9) and Assessment Units (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 Kamm Creek							
	Water quantity: Irrig., stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Upper Kamm (AU 1098) Notes from reference maps and other documents	10-25 new water rights applications in Upper Kamm – See Ag Priorities maps: Water Quantity. Water quantity priority	Sections of Kamm Creek and Unnamed Creek (trib to Kamm) in Upper Kamm are in category 5 ¹⁸ for DO and pH, and category 4a for bacteria. Iron (natural origin) found in most areas of Sumas aquifer in the Lynden-Everson- Nooksack-Sumas study area. ¹⁹	>50% of soils in Upper Kamm are Prime if Drained – see Ag Priorities maps: Drainage. Ag drainage priority CDID #20 is located within the Kamm Creek subbasin. ²⁰	The southern part of Upper Kamm is in designated floodway and the 1:100-year flood zone. <5% of the soils are prime if protected from flooding. – See Ag Priorities maps: Flooding. Ag flood protection priority	100% of soils are Prime. See Ag Priorities maps: Prime Soils. Ag prime soils priority >80% of land is in AG Zoning, RSA or PDR. See Ag Priorities maps: Ag Land Base. Ag land base priority Recent urban expansion in the west of this area (Lynden). ²¹ Potential residential development in the RSA to the east. See Ref. map: Potential development rights. Development pressure		
Upper Kamm (AU 1098) Combination of notes from work sessions in October 2012 and January 2016	Berry fields in north portion of watershed need water for irrigation. Water is not generally taken from ditches for agriculture. Groundwater sufficient but many new apps for water rights. Summer 2015: still had water but sand in well filters suggesting they were near bottom. Farmers on main Nooksack can find pumps dry when channels shift.	Iron in water is of natural origin. Water quality generally not an issue for crops & livestock use. DOE is sampling in the area around Kamm Rd where water pools and gets stagnant. Blueberry farmers often use sawdust for mulch rather than fully composted manure (too expensive & hard to obtain). Question: how much of the high fecal counts are caused by non-farm animals.	Generally no major drainage problems. Need to do ditch cleaning every few years. Some trees are falling in, especially on peat soils where ditch banks slough readily. TeVelde's road ditch (east end of Kamm Rd) flows in wrong direction. Blackberries are a problem upstream from the railroad. CREP and riparian plantings can make ditch maintenance difficult. Ice and windstorms break branches & clog ditches.	High water levels were lower this year (2016) but overtopping did occur in Nov-Dec 2015. This is a hazard for traffic and buses in the area. Issues around Kamm Rd: pooling of water as dike is sloped the wrong way. Question about possible runoff from new school construction in east Lynden, with reference to potential for increasing flooding problems on ag land. Beavers are not generally considered a problem in this area.	Pressure for development as Lynden expands eastwards into the City's new residential areas.	Rocky soils in upper area. Pollination needed for berry crops. Pest control needed (birds, bats & insects could provide some pest control).	-Opportunities for controlled drainage in the upper Kamm. -Investigate aquifer recharge potential here.(i) Kamm Springs provide good summer low flows. <u>Specific</u> (see ag actions map): -(SL9/27) AU1098: Drainage: Drainage not working (wrong gradient). -(SL13/28) AU 1096: Evaluate gravel removal on Nooksack R bars to reduce overtopping & Nov-Dec floods. -(SL10/29) Drainage: Ditches need cleaning every few years, trees falling in.

¹⁸ 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. 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 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)

²⁰ WCD (2014), *Agricultural Drainage for Drainage Districts*. <http://www.whatcomcd.org/ag-drainage-districts>

²¹ *Whatcom County Title 20 Zoning map* (2016) <http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15461>

3B. Agricultural Enhancement Priorities: Lower Kamm Creek							
	Water quantity: Irrig., stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Lower Kamm AU 1097 Notes from reference maps and other documents	1-10 new water rights applications in Lower Kamm. See Ag Priorities maps: Water Quantity and Reference map: Water rights points of diversion (map shows 4-5 applications). Water quantity priority	Sections of Kamm Creek and Stickney Slough (Mormon Ditch) in Lower Kamm are in category 5 for DO and pH, and category 4a for bacteria. ²² Nitrate contamination is reported in groundwater over large areas of the Sumas-Blaine Aquifer. ²³ Iron (natural origin) found in most areas of Sumas aquifer in the Lynden-Everson- Nooksack-Sumas study area. ²⁴	25-50% of the soils are Prime if drained. See Ag Priorities map: Drainage. CDID #20 is located within the Kamm Creek subbasin. ²⁵	Areas of Lower Kamm are in designated floodway and much of the land is in the 1:100-year flood zone. <5% of the soils are prime if protected from flooding. See Ag Priorities maps: Flooding Ag flood protection priority	93% of soils in Lower Kamm are Prime. See Ag Priorities maps: Prime Soils. Ag prime soils priority >80% of land in Lower Kamm is in Ag Zoning and RSA. See Ag Priorities maps: Ag Land Base. Ag land base priority.		
Lower Kamm AU 1097 Combination of notes from work sessions in October 2012 and January 2016	Generally no water quantity problems, but some new water right applications in south-east portion of Lower Kamm watershed.	AU1099: Iron in water is of natural origin. Doesn't impact farming generally. High nitrates could be a problem for potable water quality and possibly for livestock watering (not a general concern for farmers though). AU1098: Clay soils: potential for rapid runoff from forested areas containing fecal coliforms of wildlife origin. AU1097: Ditches not fenced, few hedgerows and filter strips in area. Ag water quality priority (nitrate)	Mostly dairy farming here. Most drainage issues in lower area all along Northwood Road to the hill. AU 1098: Drainage is fine for current farming, but would need better drainage if planted to blueberries. Where drainage is slow, sediment accumulates in ditches. AU 1097: Nooksack River backs up into Kamm Creek and reduces drainage Nov-Dec. Question about whether stormwater outlets from east Lynden affect drainage and flooding?	Flooding limits crop planting and harvesting. Flooding occurs regularly Nov-Dec. Flooding across Northwood Rd when Nooksack River floods. Water spills out of the Nooksack R by Everson in Nov-Dec. Flooding has increased lately: smaller floods now lead to overtopping of dikes. Flooding toward Noon Rd is a problem for milk truck access. AU1096: Flooding not too severe, but hazard for traffic & safety & can cause damage to dikes. AU1097: sediment buildup around Mormon Ditch causing flooding. AU1096: when Nooksack R overtops, sediment settles on fields, gets into ditches, can kill off pasture grass. Having grass wet for 1 day is ok; standing water for 3 days is not.	AU 1096, 1097: good for corn, pasture, berries. Most non-farming neighbors are from old farming families so there are not many complaints. Sometimes there are smell complaints.	Dike management opportunities. Habitat pressure vs fisheries seems no better after 10+ years of work.	Both upper and lower Kamm: (i) Could provide opportunities for aquifer recharge in this area, depending on net infiltration vs withdrawal. Area provides open space, but needs buffers from development. Provides cultural identity (farming). Get more hobby farmers involved in process of watershed management. Opportunities for culvert removal to improve fish habitat.(i) <u>Specific:</u> -Lower & set back levee, and deal with inundation? (i) -Control flood flow at Kale St to take pressure off milk truck crossings. (iv)

²² Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/Wq/303d/index.html>

²³ Ecology (2012) *Sumas-Blaine Aquifer Nitrate Contamination Summary*. Pub #12-03-026. <https://fortress.wa.gov/ecy/publications/documents/1203026.pdf>

²⁴ 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)

²⁵ WCD (2014), *Agricultural Drainage for Drainage Districts*. <http://www.whatcomcd.org/ag-drainage-districts>

3C. Agricultural Enhancement Priorities: Scott Ditch							
	Water quantity: Irrig., stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Scott Ditch Notes from reference maps and other documents	10-25 new water rights applications in Scott. See Ag Priorities maps: Water Quantity, and Reference map: Water rights points of diversion Water quantity priority	Sections of Scott Ditch in Scott are in category 5 for DO, and category 4a for bacteria. ²⁶ Iron (natural origin) found in most areas of Sumas aquifer in the Lynden-Everson-Nooksack-Sumas study area. ²⁷	25-50% of the soils are Prime if drained. See Ag Priorities map: Drainage. CDID #21 is located within the Scott Ditch sub-basin. ²⁸	The northern part of Scott Ditch area is in designated floodway and about half of the area is within the 1:100-year flood zone. Ag flood protection priority <5% of the soils are prime if protected from flooding, except for a small portion in the far south-east of this area. See Ag Priorities maps: Flooding	99% of soils in Scott Ditch are Prime. See Ag Priorities maps: Prime Soils. Ag prime soils priority >80% of land in Scott is in Ag Zoning or Rural Study Area. See Ag Priorities maps: Ag Land Base. Ag land base priority.		
Scott Ditch AU 1092 AU 1096 AU 1099 AU1095 (small portion) Notes from work session January 2016	Inadequate water supply in wells. Plenty of water in Nooksack River but some participants noted that actual water rights are an issue. Several active gravel pits in the WID area at southern border - question about how these affect water availability.	Iron in groundwater. Bacteria in surface water varies by season (high in winter).	Generally, the drainage is acceptable. Some areas have stormwater entering from neighboring developed land (not good if stormwater is sent into drainage ditches April to Nov as this competes with ag drainage functions. AU1096: Drainage at Theil Rd (Fountain Lake?) is lower than culvert by 4". Riparian planting along Scott Ditch and Elder Ditch impedes flow, but no other significant ditch district needs to be taken care of. Overtoppng of the levee at Polinder Road.	Diking District supervises dike maintenance, which is acceptable. Nooksack River backs up into Scott Ditch, which floods fields for longer time periods now: fields stay wet from Bylsma to Hannegan Rds. Need to check Scott channel grade from Bylsma Rd downstream. Evaluate need for floodgate or control structure at confluence of Scott Ditch & Nooksack. Sediment/gravel buildup in Nooksack River. Some CREP planting projects are creating flow issues west of Hannegan Rd/ (not specified). Significant 2015 flood overtopping along Nooksack R, water lies at corner of Nolte Rd. High floods now mean more water south of the Nooksack River at Noon Rd.	No general pressure for land conversion out of ag, but in AU1099, land development pressure along Mead Rd and Everson South, includes potential stormwater impacts on ag land.	Bank erosion at mouth of Scott Ditch.	Specific: (SL1/17) AU1099: Drainage - Gradient too low and poor drainage north of Elder Ditch. (SL2/18) AU1092: Drainage: County Ditch Maintenance needed. Road ditches blocked. Noxious weeds. (SL3/19) AU1099: Beaver activity in Scott Ditch needs management. (SL11/20) AU1099: Evaluate gravel removal /mining on Nooksack River bars to reduce back up in Scott Ditch. (SL4/21) AU1090 Drainage issues due to 0 elevation change in Elder Ditch along with beaver activity and planted riparian. (22) AU1092: Survey channel profile on lower Scott Ditch from Bylsma Rd downstream to mouth to assess potential reverse grade. (SL6/23) AU1092 Flood gate at mouth of Scott Ditch would prevent Nooksack River from backing up. (SL7/24) AU1090 Drainage - Remove noxious weeds (blackberry, nightshade and knot) in Scott Ditch at Bylsma Rd. (SL12/25) AU1096 Flood Protection - Dike on north side of Nooksack River needs replacement.

²⁶ Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/Wq/303d/index.html>

²⁷ 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)

²⁸ WCD (2014), *Agricultural Drainage for Drainage Districts*. <http://www.whatcomcd.org/ag-drainage-districts>

3D. Agricultural Enhancement Priorities: Wiser Lake/Cougar Creek (North)							
	Water quantity: Irrig., stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
<p>Wiser Lake/Cougar Creek North</p> <p>(northern part within the South Lynden WID)</p> <p>AU 1099 AU 1110 AU1111</p> <p>Notes from reference maps and other documents</p>	<p>>25 new water rights applications in this area (includes portion outside the WID). See Ag Priorities maps: Water Quantity and Reference map: Water rights points of diversion</p> <p>Water quantity priority</p>	<p>A section of Wiser Creek in Wiser Lake/Cougar Creek North is in category 5 for DO, and category 4a for bacteria.²⁹</p> <p>Iron (natural origin) found in most areas of Sumas aquifer in the Lynden-Everson-Nooksack-Sumas study area.³⁰</p>	<p>25-50% of the soils are Prime if drained. See Ag Priorities map: Drainage.</p> <p>DID #5 is located within the Cougar Creek sub-basin.³¹</p>	<p>A small area in the northern part of Wiser/Cougar North is in designated floodway and the 1:100-year flood zone.</p> <p><5% of the soils are prime if protected from flooding. See Ag Priorities maps: Flooding</p>	<p>94% of soils in Wiser Lake/Cougar Creek are Prime. See Ag Priorities maps: Prime Soils.</p> <p>Ag prime soils priority</p> <p>>80% of land in Wiser Lake/Cougar North is in Ag Zoning or Rural Study Area. See Ag Priorities maps: Ag Land Base.</p> <p>Ag land base priority.</p> <p>Rural Study Area present, and parcels with >2 potential dwelling units. See Reference map: Potential development rights.</p> <p>Development pressure</p>		
<p>Wiser Lake/Cougar Creek North</p> <p>Notes from work session January 2016</p>	<p>Good irrigation water availability.</p>	<p>Iron in some groundwater, but localized.</p>	<p>Outlet to Nooksack controlled by floodgate. Wet ground through the west end, east and west of Ritter Rd. Major drainage down Ritter Rd ditch for this area.</p>	<p>Adequate at present. Some concern about sediment build up in Nooksack River.</p>	<p>Development on Wiser Ridge, but not considered a problem at present.</p>		<p>Specific: (SL8/26) AU1111 Drainage: Maintenance needed on drainage line north of Pole Rd.</p>

²⁹ Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/Wq/303d/index.html>

³⁰ 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)

³¹ WCD (2014), *Agricultural Drainage for Drainage Districts*. <http://www.whatcomcd.org/ag-drainage-districts>

3E. Agricultural Enhancement Priorities: Upper Fourmile Creek (north portion within South Lynden WID)							
	Water quantity: Irrig., stock, processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
<p>Fourmile (northern part within S. Lynden WID: small portions of AU1114 and AU1133)</p> <p>Notes from reference maps and other documents</p>	<p><10 new water rights applications in Upper Fourmile (map shows 2 new applications in this area). See Ag Priorities maps: Water Quantity, and Reference map: Water rights points of diversion</p>	<p>None listed</p>	<p>25-50% of the soils are Prime if drained. See Ag Priorities map: Drainage.</p> <p>DD #3 is located within the Fourmile Creek sub-basin.³²</p>	<p><5% of the soils in Upper Fourmile Creek are prime if protected from flooding. – Whatcom Ag-Watershed Pilot Project, Ag Priorities: Flooding map</p>	<p>92% of soils in Upper Fourmile Creek are Prime. See Ag Priorities maps: Prime Soils. Ag prime soils priority</p> <p>>80% of land in Upper Fourmile Creek is in Ag Zoning or RSA. See Ag Priorities maps: Ag Land Base. Ag land base priority.</p> <p>No Rural Study Area in this part of the WID.</p>		
<p>Fourmile (northern part within South Lynden WID)</p>			<p>Peat soils in the area mean that trees planted along ditches are more likely to fall in over time.</p>	<p>River is probably higher than ditch on Nolte Rd. Flood flow overtops, drains to the Nolte Rd and is held back in the corner.</p>		<p>Lower levee would be unacceptable if flood flows in spring linger on fields as happened in 1990.</p>	

³² WCD (2014), *Agricultural Drainage for Drainage Districts*. <http://www.whatcomcd.org/ag-drainage-districts>

4.3 Agricultural priorities: Summary maps

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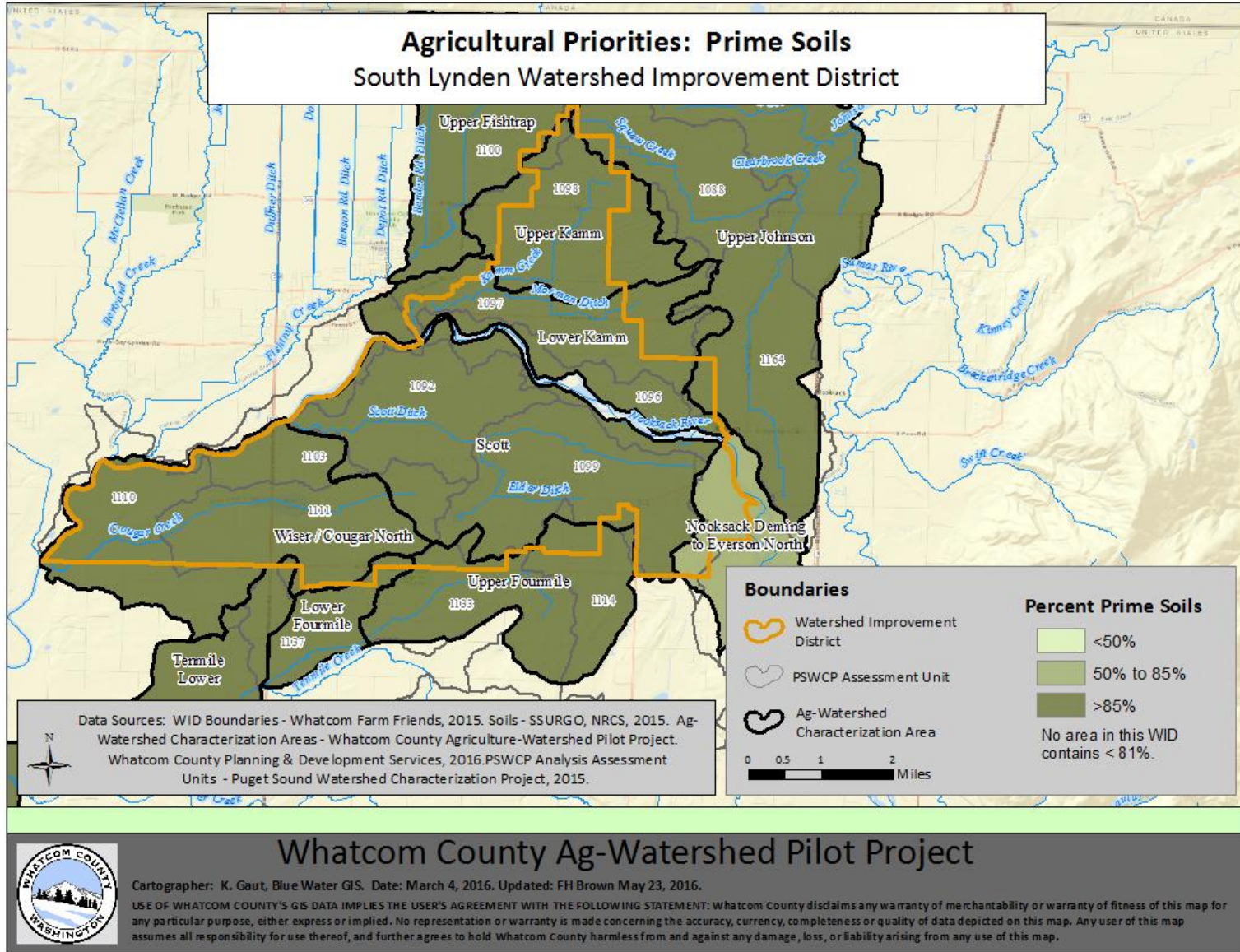


Figure 6. South Lynden WID agricultural priorities: Proportion of prime soils. Data from reference map of prime soils

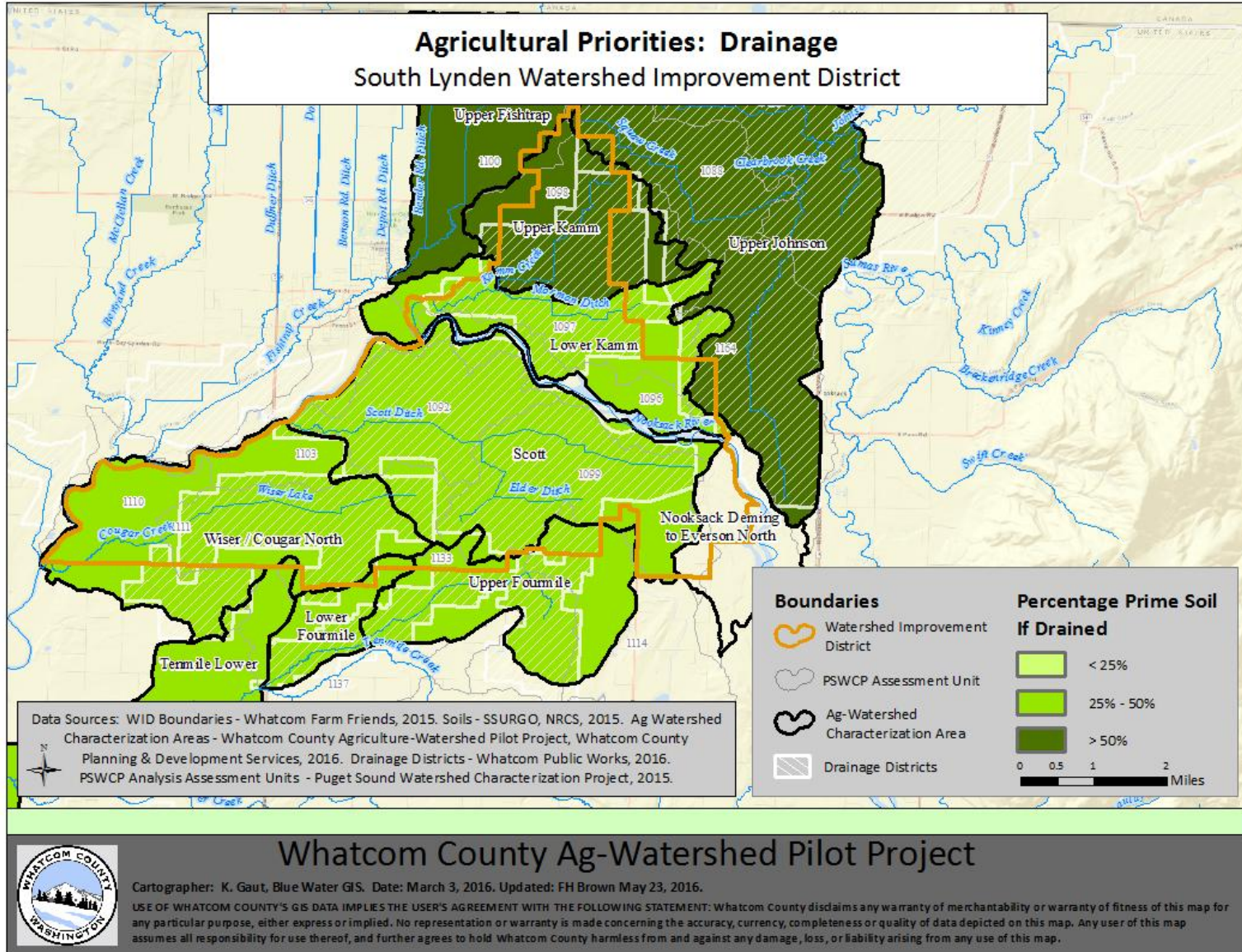


Figure 7. South Lynden WID agricultural priorities: Drainage of agricultural land. Data from reference maps of prime soils and special districts

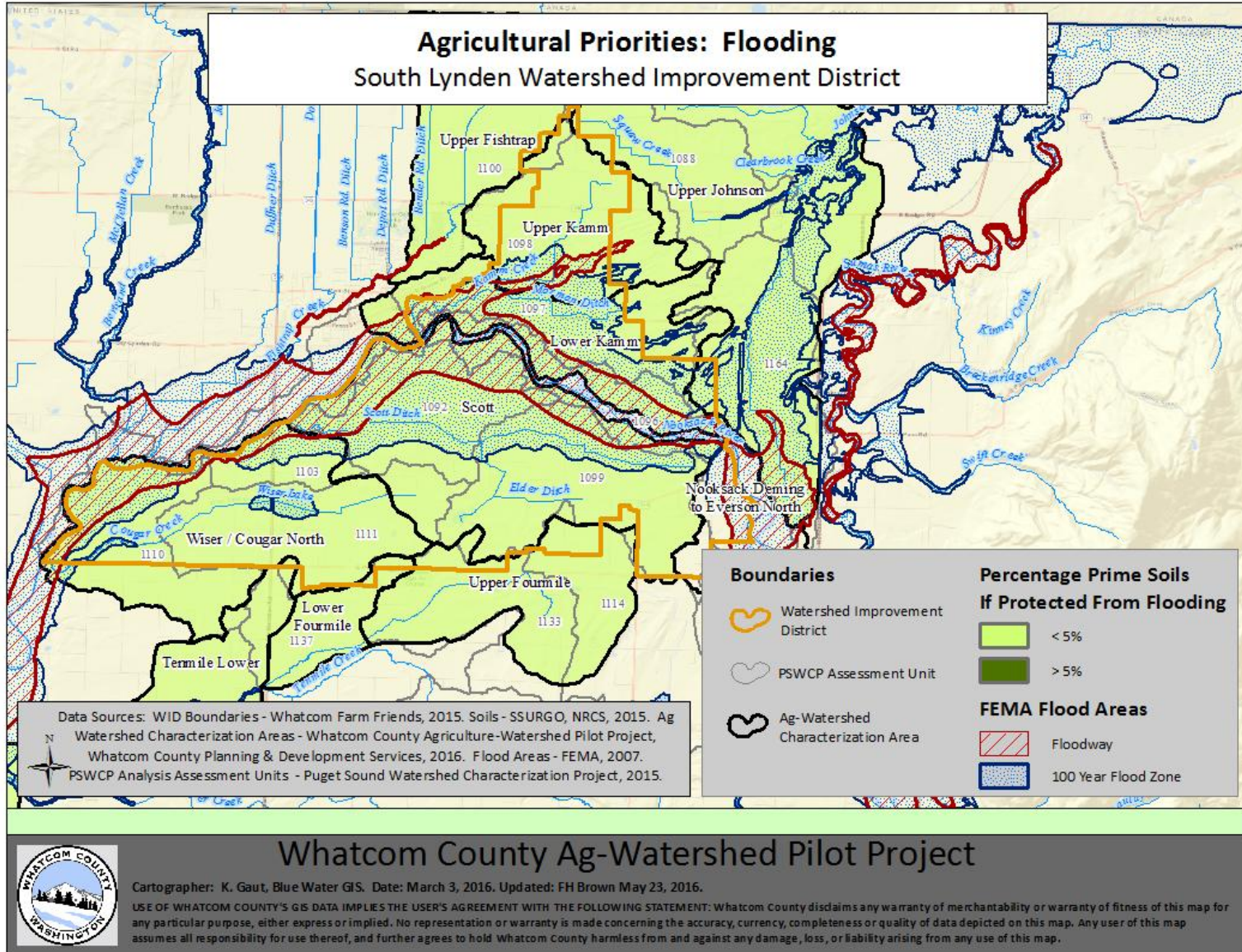


Figure 8. South Lynden WID agricultural priorities: Protection from flooding. Data from reference maps on prime soils and special districts

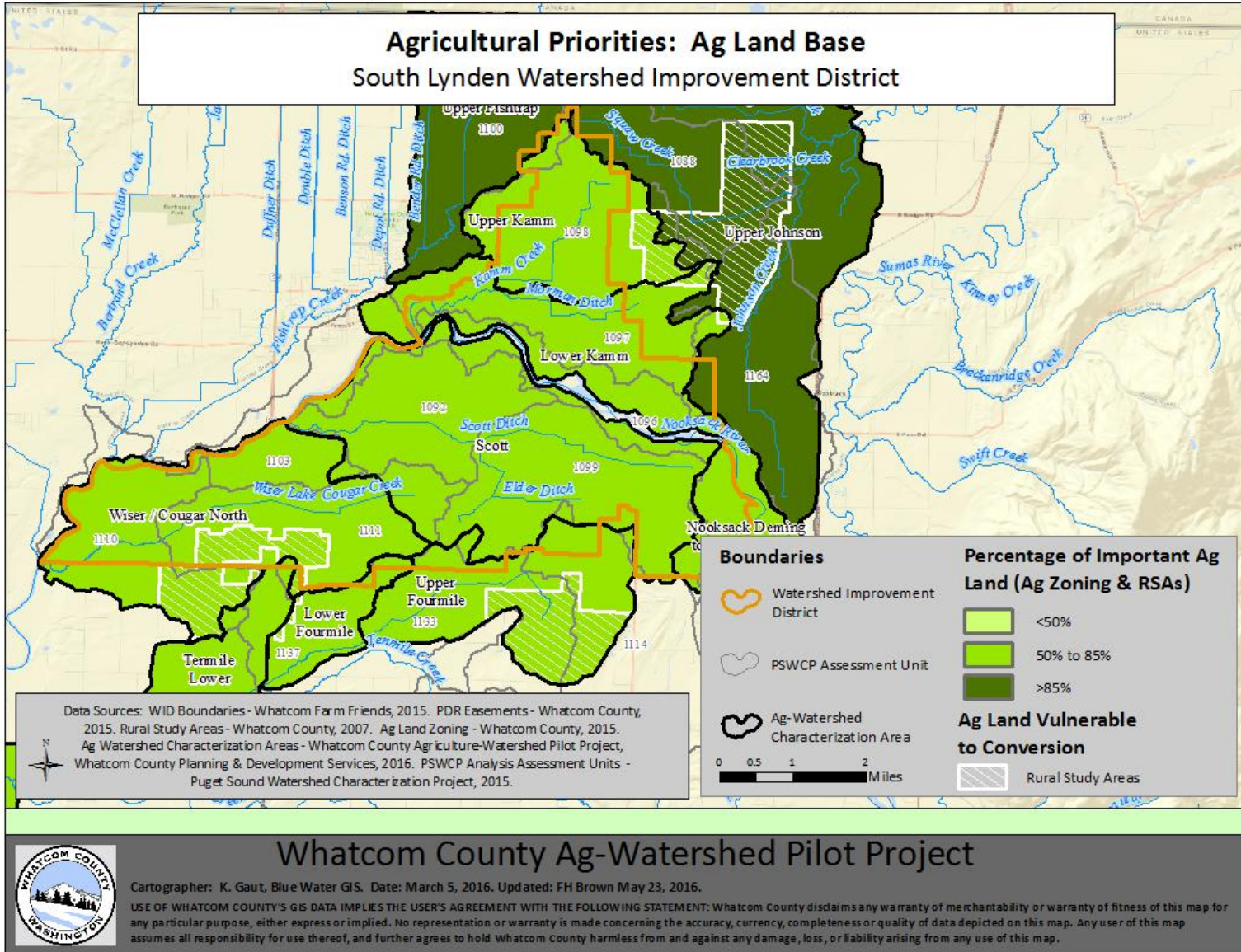


Figure 9. South Lynden WID agricultural priorities: Protection of the agricultural land base. Data from reference map of agricultural priority areas

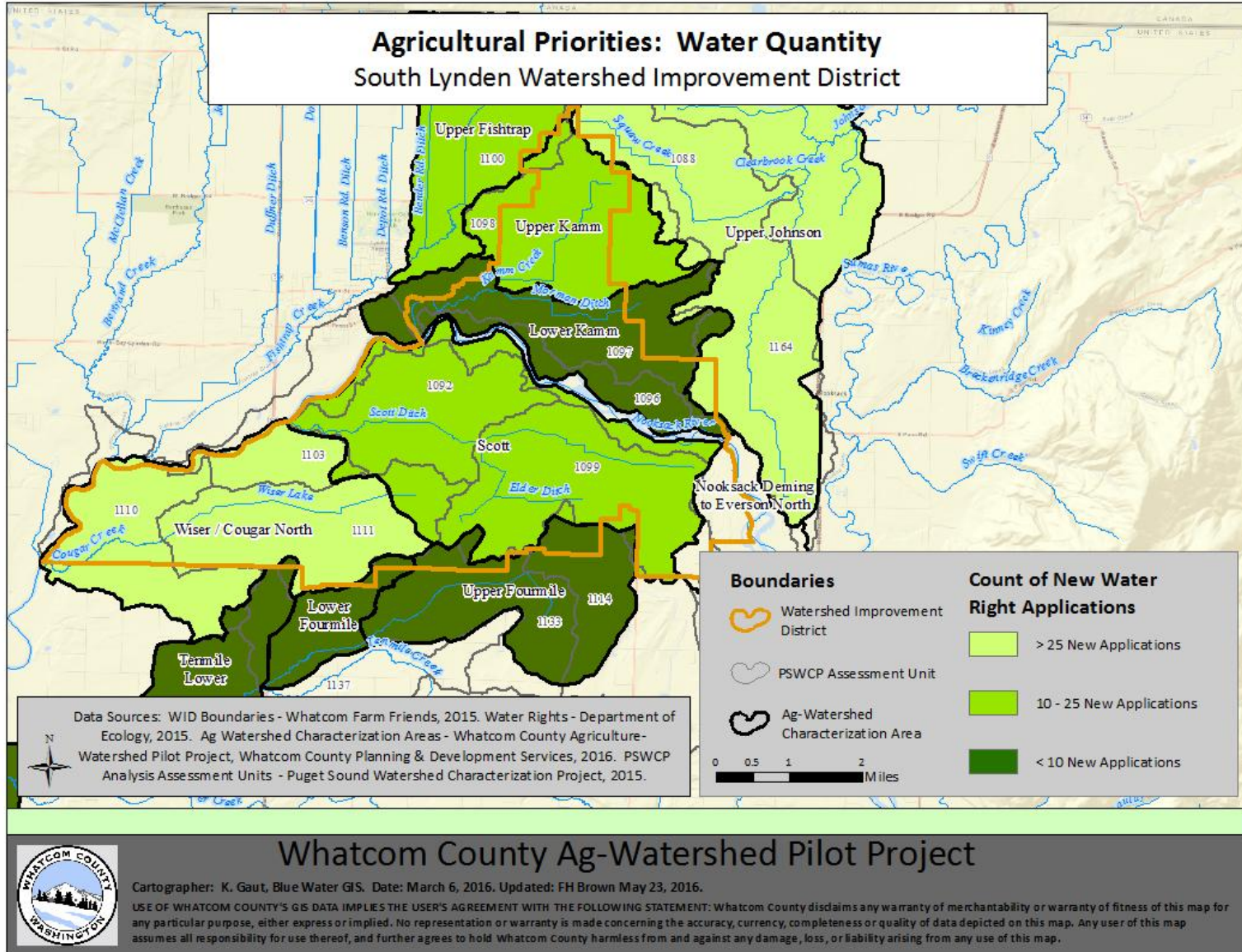


Figure 10. South Lynden WID agricultural priorities: Water for agricultural activities. Data from reference map on water right points of diversion

4.4 Agricultural priorities: Specific actions map

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

Action # on map	AU #	Priority	Notes
1	1099	Drainage	Gradient is too low. There is poor drainage north from Elder Ditch. Perhaps the culvert needs to be lowered?
2	1092	Drainage	County ditch maintenance needed. Road ditches blocked and noxious weeds in ditch.
3	1099	Drainage	Beaver activity in Scott Ditch needs management.
4	1099	Drainage	Drainage issues due to zero elevation change in Elder Ditch along with beaver activity and planting of riparian areas.
5	1092	Drainage	Survey channel profile on lower Scott Ditch from Bylsma Rd to mouth to assess grade.
6	1092	Drainage	Flood gate at mouth of Scott Ditch would prevent Nooksack backing up.
7	1092	Drainage	Remove noxious weeds (blackberries, nightshade and knot weed).
8	1111	Drainage	Maintenance needed on drainage tile line north of Pole Rd.
9	1098	Drainage	Drainage not working in this area. Drainage going the wrong way.
10	1098	Drainage	Ditch needs cleaning every few years. Remove trees falling into ditch.
11	1103	Flooding	Consider gravel removal to reduce back up in Scott Ditch.
12	1096	Flooding	Dike on north side of Nooksack River needs replacement.
13	1096	Flooding	Consider removing portions of gravel bars in Nooksack River to reduce backup of water.
14	1097	Drainage	Trees along the ditch at the east end of Timon Rd are falling in, impeding drainage at times.

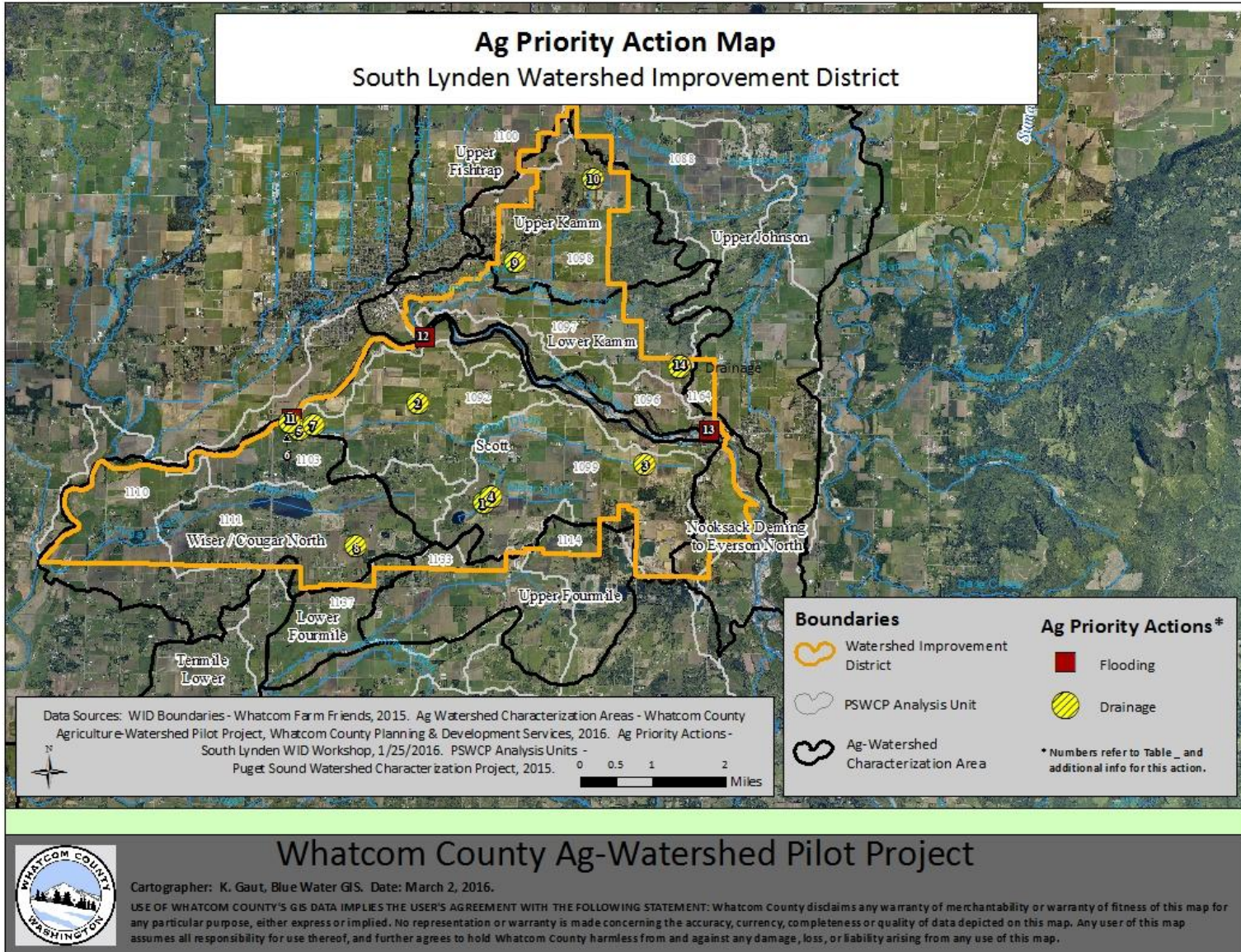


Figure 11. South Lynden WID map of specific actions for agricultural priorities. Information on this map is from the work session in 2016.

5 Watershed characterization and mapping for the South Lynden 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.³³

5.1.1 General approach

The watershed characterization assessment uses methods developed by the Puget Sound Watershed Characterization Project.³⁴ 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

³³ 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>

³⁴ See http://www.ecy.wa.gov/puget_sound/characterization/index.html

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 watershed characterization 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.

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 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).

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.

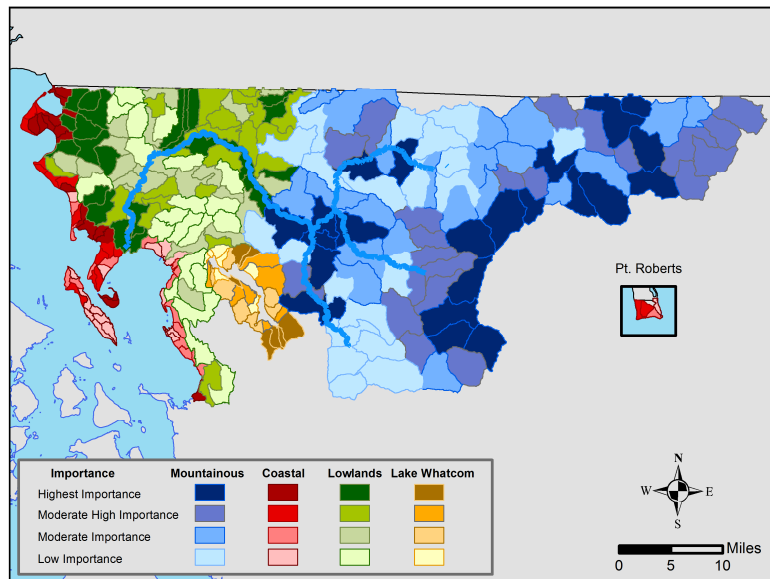


Figure. Overall Importance to water flow Processes: Results of Puget Sound Characterization assessment for WRIA 1 in the lowland landscape group. Darkest colored assessment units are considered highest *importance* relative to other assessment units in the same landscape group of WRIA 1.

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.

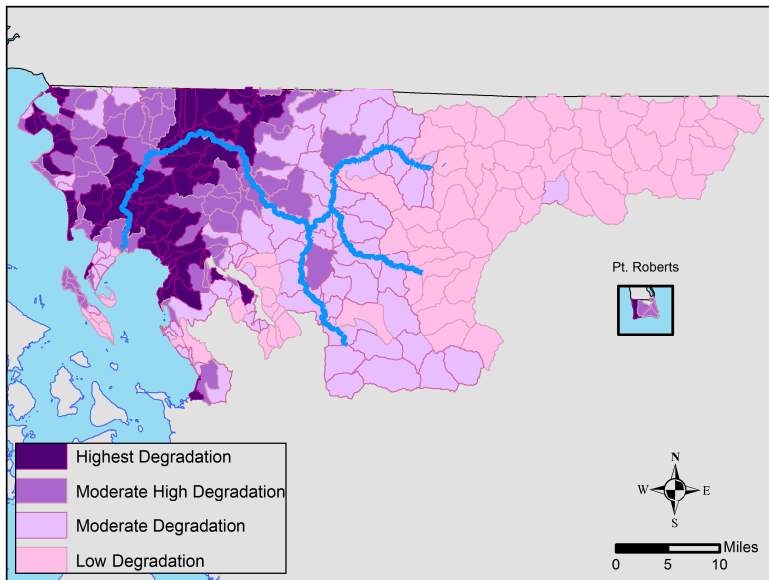


Figure. Overall degradation of water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA 1. Dark pink assessment units are considered to have the highest *degradation* relative to other assessment units in WRIA 1.

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.

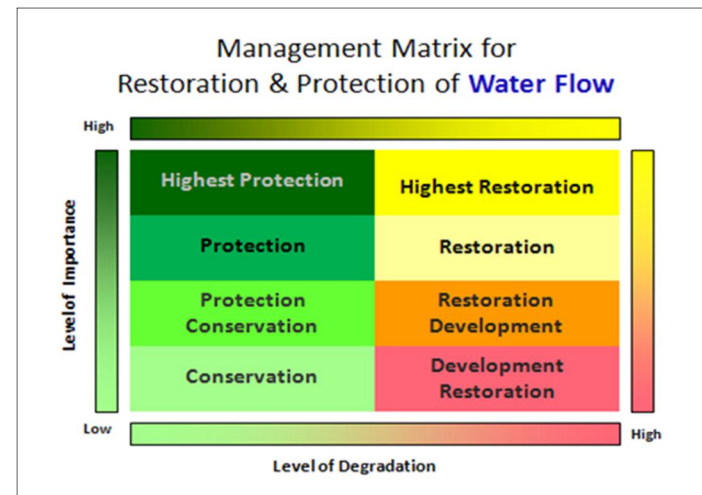


Figure. Management matrix for water flow, indicating relative priorities for restoration and protection of processes. By accounting for both the relative level of *importance* and the relative level of *degradation* of an Assessment Unit one can begin to prioritize which areas of a watershed to apply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

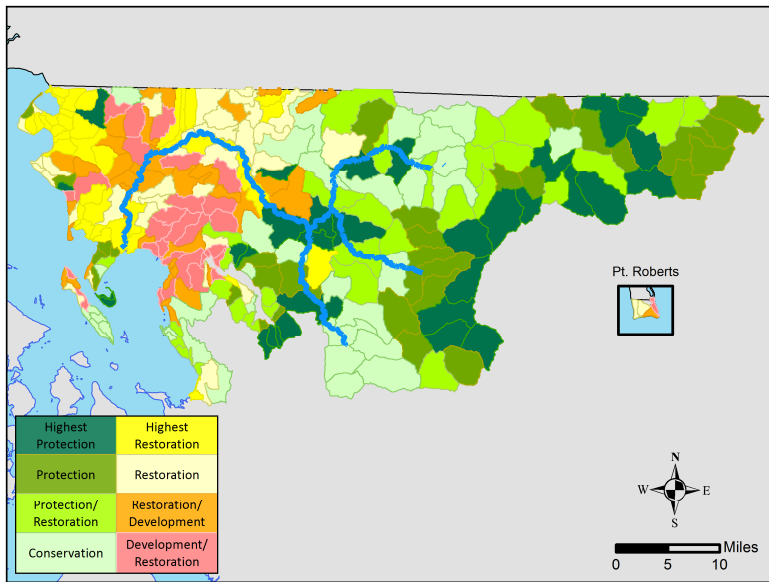


Figure. Overall priorities for restoration and protection of water flow processes in WRIA 1: Results of Puget Sound Watershed Characterization assessment

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 South Lynden WID

NOTE: Possible actions include: Specific actions identified by WID Actions Map # location and Assessment Units (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 Kamm Creek				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Upper Kamm Creek AU1098 (October 2012 results + 2016 updates)	Critical Habitat: Sandhill crane, trumpeter swan (1) and wetland (1) (see Watershed Reference map: Priority Species and Habitat)	Known presence of chum, coho, Chinook, and cutthroat. ³⁵ Current known and current presumed salmonid distribution in Kamm Creek in Upper Kamm – see Watershed Reference map: Fish Distribution and Fish Barriers.	Sections of Kamm Creek and Unnamed Creek (trib to Kamm) in Upper Kamm are in category 5 ³⁶ for dissolved oxygen (DO) and pH, and category 4a ³⁷ for bacteria.	<u>Results of PSWC water flow assessment:</u> An area of moderately high importance for recharge, delivery, discharge and surface storage processes. Overall water flow processes are highly degraded. <u>Summary:</u> Water flow processes are moderate-high importance and highly degraded. Mainstem is impaired for DO and bacteria which suggests a relationship to degraded storage (wetlands) and sediment (phosphorous & bacteria adsorption) processes. <u>Potential for Enhancement:</u> Investigate measures to restore storage and discharge. Improve sinks (wetlands, hydric soils) to mitigate nutrient export and retain sediment, and enhance riparian areas to reduce export into surface waters. Consider actions to improve riparian habitat and associated connectivity.
Upper Kamm Creek AU1098 (January 2016 work session notes)	Geese are present but no sandhill cranes have been observed in this area ³⁸ (comment by work session participant). WDFW staff will advise on the validity of this record – it is a migratory spot so cranes might not stay long in the area. ³⁹	Chinook and bull trout will forage in Kamm Creek. Not a lot of flow in the stream for fish in the Upper Kamm – more water below Badger Road.	Livestock farming is very limited north of Badger Road. Many waterbirds in this area - could potentially be contributing to high fecal bacteria concentrations in standing water.	Transfer of water rights in the watershed is being considered (location not indicated), intended to improve instream flows.

³⁵ Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

³⁶ 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)

³⁷ 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)

³⁸ Work session participant comment, 2016.

³⁹ Ingram, Joel (2016), WDFW. Pers. comm.

5B. Watershed Enhancement Priorities: Lower Kamm Creek				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
<p>Lower Kamm Creek AU1097</p> <p>(October 2012 results + 2016 updates)</p>	<p>Critical Habitat: Trumpeter swan (1) and wetland (1)</p> <p>Rare Plant: Soft-leaved willow⁴⁰</p> <p>(see Watershed Reference map: Priority Species and Habitat)</p>	<p>Known presence of chum, coho, Chinook, and cutthroat.⁴¹</p> <p>Documented coho presence.⁴²</p> <p>Current known and current presumed salmonid distribution in Kamm Creek in Upper Kamm – see Watershed Reference map: Fish Distribution and Fish Barriers.</p>	<p>Sections of Kamm Creek and Stickney Slough in Lower Kamm are in category 5 for DO and pH, and category 4a for bacteria.⁴³</p>	<p><u>Results of PSWC water flow assessment:</u></p> <p>An area of high importance for recharge and moderate high importance for delivery, discharge and surface storage processes. Overall water flow processes are highly degraded.</p> <p><u>Summary:</u></p> <p>Water flow processes are moderately important and highly degraded. Mainstem is impaired, DO and bacteria which suggest a relationship to degraded storage (wetlands) and sediment (phosphorous & bacteria adsorption) processes.</p> <p><u>Potential for Enhancement:</u></p> <p>Investigate measures to restore storage and discharge. Improve sinks (wetlands, hydric soils) to mitigate nutrient export and retain sediment, and enhance riparian areas to reduce export into surface waters.</p>
<p>Lower Kamm Creek AU1097</p> <p>(January 2016 work session notes)</p>	<p>Geese are present but no Sandhill Cranes have been observed in this area⁴⁴ (comment by work session participant). WDFW staff will advise on the validity of this record – it is a migratory spot so cranes might not stay long in the area.⁴⁵</p> <p>Beaver are active in the river (take corn from the fields).</p>	<p>Chinook and bull trout will forage in Kamm Creek.</p> <p>Kamm Creek has some good gravels (marked on map). Areas of higher gradient are better habitat.</p> <p>Mormon Ditch area is flat, not ideal for fish spawning habitat. – Participant comments from WID work session.</p>		<p>Opportunities for culvert removal to improve fish habitat. (i)</p>

⁴⁰ WA Department of Natural Resources (2015), *Washington Natural Heritage Program*. <http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html>

⁴¹ Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

⁴² WDFW *SalmonScape* <http://apps.wdfw.wa.gov/salmonscape/>

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

⁴⁴ Work session participant comment (2016).

⁴⁵ Ingram, Joel (2016), WDFW. Pers. comm.

5C. Watershed Enhancement Priorities: Scott Ditch				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Scott Ditch AU 1092 AU 1096 AU 1099 AU1095 (small portion) Notes from reference maps and other documents	Critical Habitat: Shorebird concentration, trumpeter swan, waterfowl concentrations and wetland. Rare Plant: soft-leaved willow ⁴⁶ (see Watershed Reference map: Priority Species and Habitat)	Coho and cutthroat. ⁴⁷ Documented coho presence. ⁴⁸ Tributaries to Scott Ditch have historic salmonid distribution and mainstem has current known salmonid distribution. (See Watershed Reference map: Fish Distribution and Fish Barriers.)	Sections of Scott Ditch are in category 5 for DO, and category 4a for bacteria. ⁴⁹	<u>Summary of PSWC water flow assessment:</u> An area of high importance for surface storage and recharge processes, and moderate to moderate-high importance for delivery and discharge processes. Overall water flow processes are highly degraded. <u>Potential for Enhancement:</u> Water quality listings for dissolved oxygen and bacteria. Investigate opportunities to increase surface storage and retain surface flows for longer in this area. Restoring some wetland habitat would help to increase surface storage. Protection and restoration of forest cover and riparian vegetation in this area would help to improve delivery processes.
Scott Ditch AU 1092 AU 1096 AU 1099 AU1095 (small portion) Notes from January 2016 work session	Noxious weeds are plugging the area where Hannegan Road crosses Scott Ditch.	Question was raised at the work session about whether Scott & Elder ditches were artificially constructed, leading to creation of fish habitat that was not historically present there. ⁵⁰		

⁴⁶ WA Department of Natural Resources (2015) *Washington Natural Heritage Program*. <http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html>

⁴⁷ Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

⁴⁸ WDFW *SalmonScape* <http://apps.wdfw.wa.gov/salmonscape/>

⁴⁹ Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/wq/303d/index.html>

⁵⁰ Older USGS maps and the historic map at the Ag Water Board website (ca. 1900) show a stream where Scott Ditch now enters the Nooksack River. See <http://www.agwaterboard.com/#!storymap/c1jc6>

5D. Watershed Enhancement Priorities: Wisser Lake / Cougar Creek (North portion)				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
<p>Wisser/ Cougar (north) AU1110, AU1111 and small portion of AU1103</p> <p>Notes from reference maps and other documents</p>	<p>Critical Habitat: Shorebird concentrations, trumpeter swan, waterfowl concentration and wetland.</p> <p>Rare Plant: Bristly sedge⁵¹</p> <p>(see Watershed Reference map: Priority Species and Habitat)</p>	<p>Char, Chinook, chum, coho, cutthroat, pink, sockeye, steelhead⁵²</p>	<p>Sections of Wisser Creek are in category 5 for DO, and category 4a for bacteria.⁵³</p> <p>A section of the main Nooksack River in AU1103 (west of Hannegan Rd) is in category 4a for bacteria and Unnamed Creek (trib to Nooksack River) in AU1103 is in category 5 for DO.⁵⁴</p>	<p><u>Summary of PSWC water flow assessment:</u> The areas in AU1110 and AU1103 are of moderately high to high importance for surface storage and delivery processes. Water flow processes are moderately to highly degraded, but overall this is an area of the WID that is of relatively lower importance for water flow processes.</p> <p><u>Potential for Enhancement:</u> Water quality listings for bacteria and dissolved oxygen. Investigate opportunities to increase surface storage and retain surface flows for longer in this area. Restoring some wetland habitat would help to increase surface storage. Protection and restoration of forest cover and riparian vegetation in this area would help to improve delivery processes.</p>
<p>Wisser/ Cougar (north) AU1110, AU1111 and small portion of AU1103</p> <p>Notes from January 2016 work session</p>			<p>Manure solids applied on berry fields with sawdust accumulate in runoff and are also moved by floodwater.</p>	

⁵¹ WA Department of Natural Resources (2015), *Washington Natural Heritage Program*. <http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html>

⁵² Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

⁵³ Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/wq/303d/index.html>

⁵⁴ 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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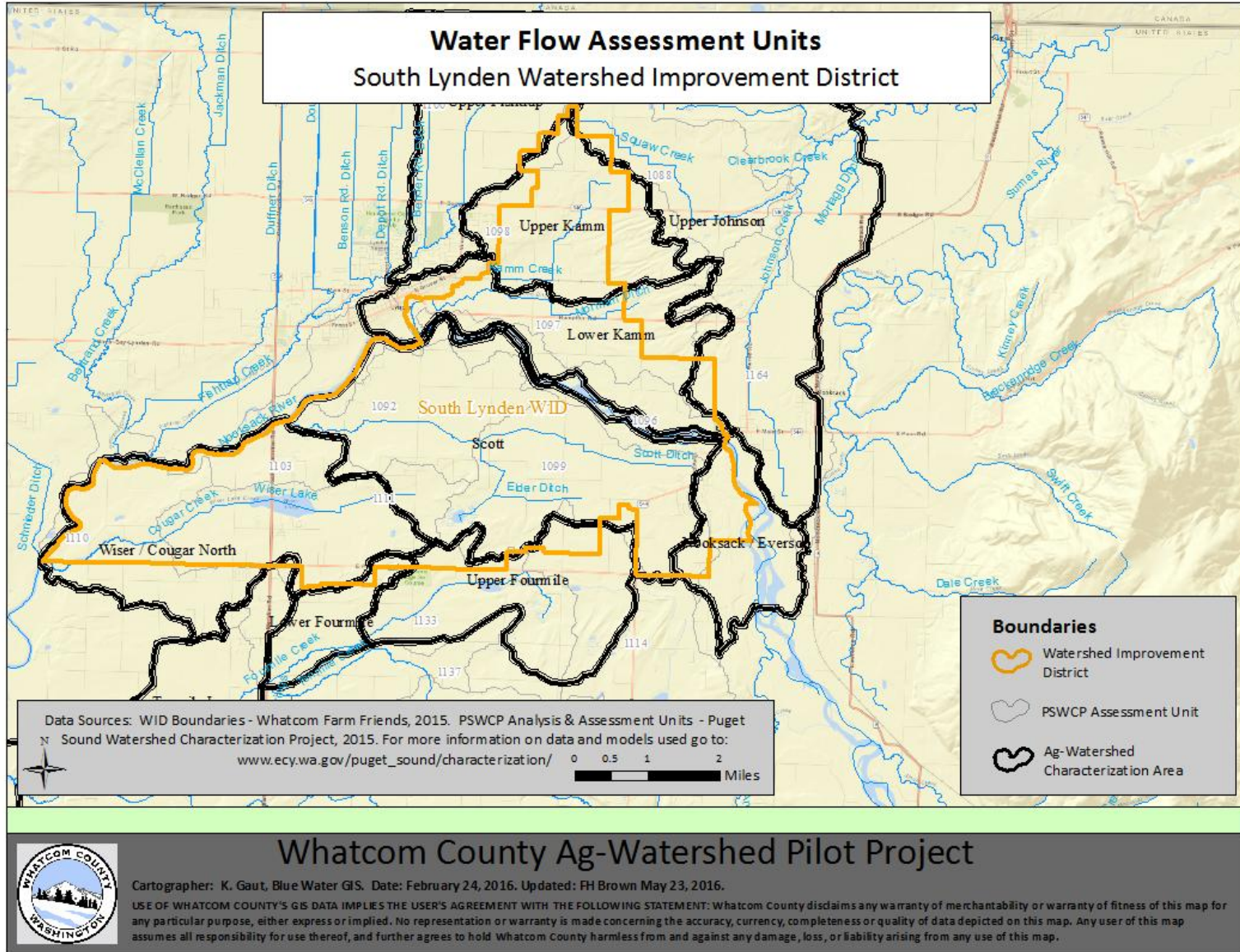


Figure 12. South Lynden WID: Water flow assessment units in relation to the WID area

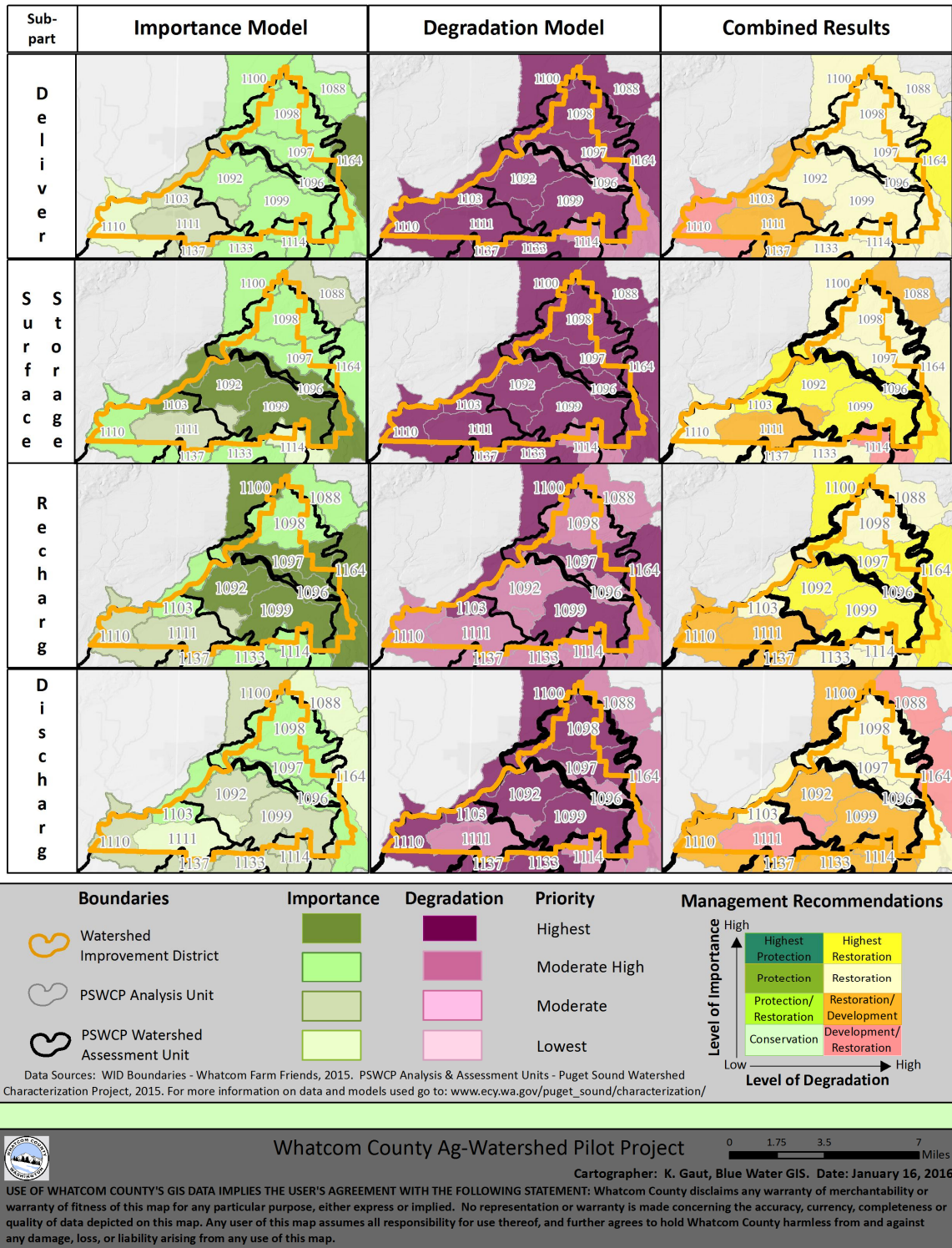


Figure 13. South Lynden WID: Water flow process assessment results

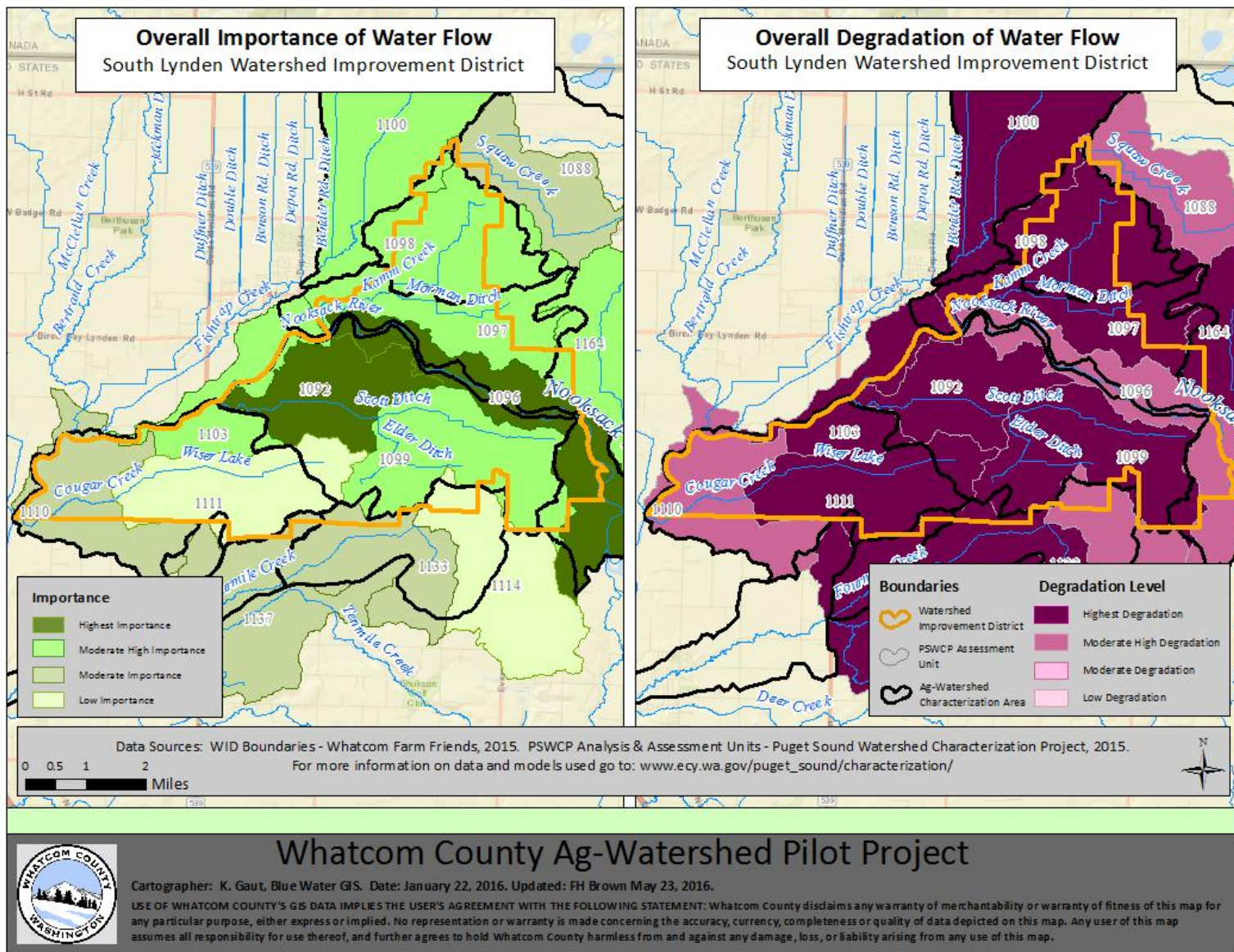


Figure 14. South Lynden WID: Overall importance and degradation of water flow processes

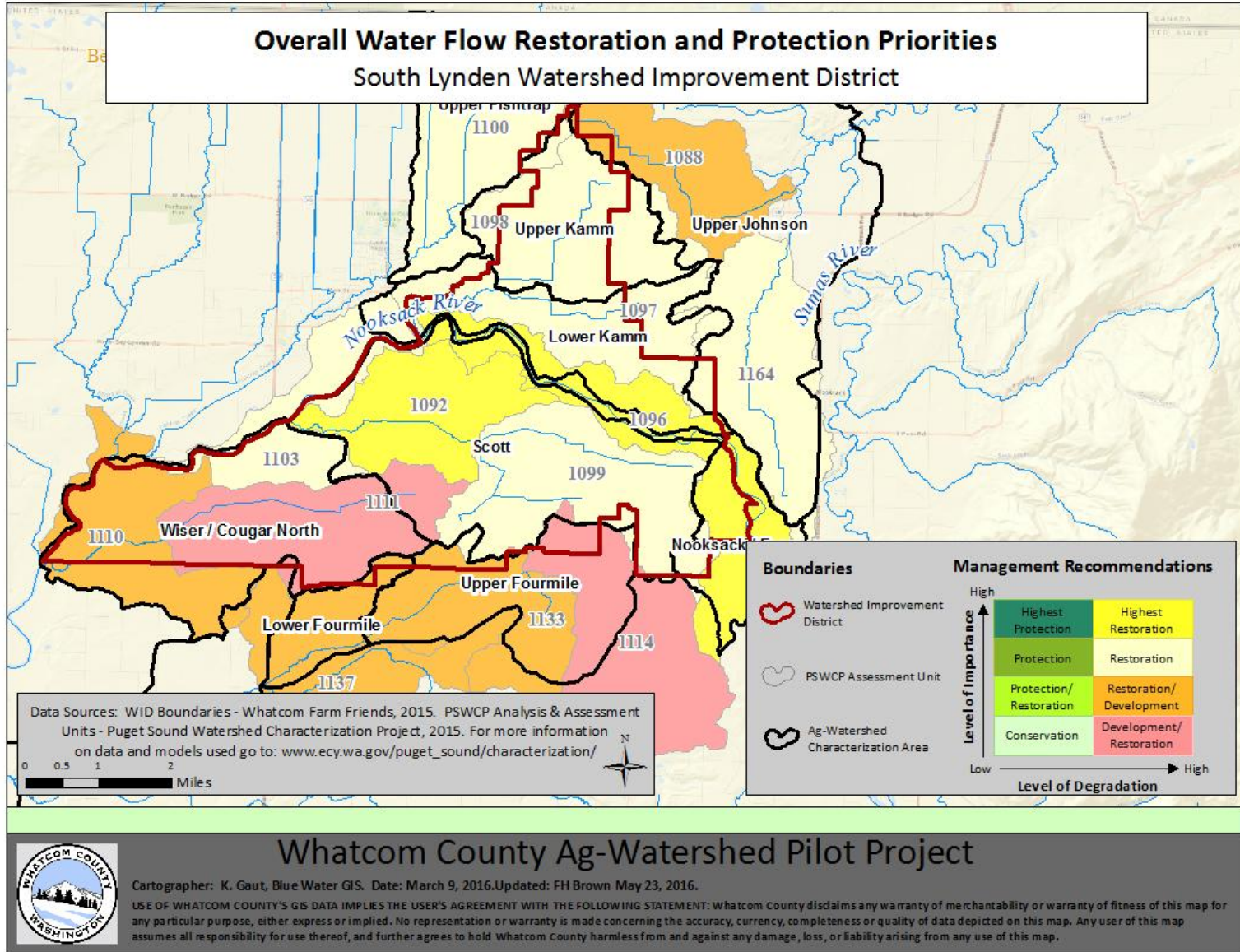


Figure 15. South Lynden WID: Overall water flow restoration and protection priorities

5.4 Watershed priorities: Specific actions map

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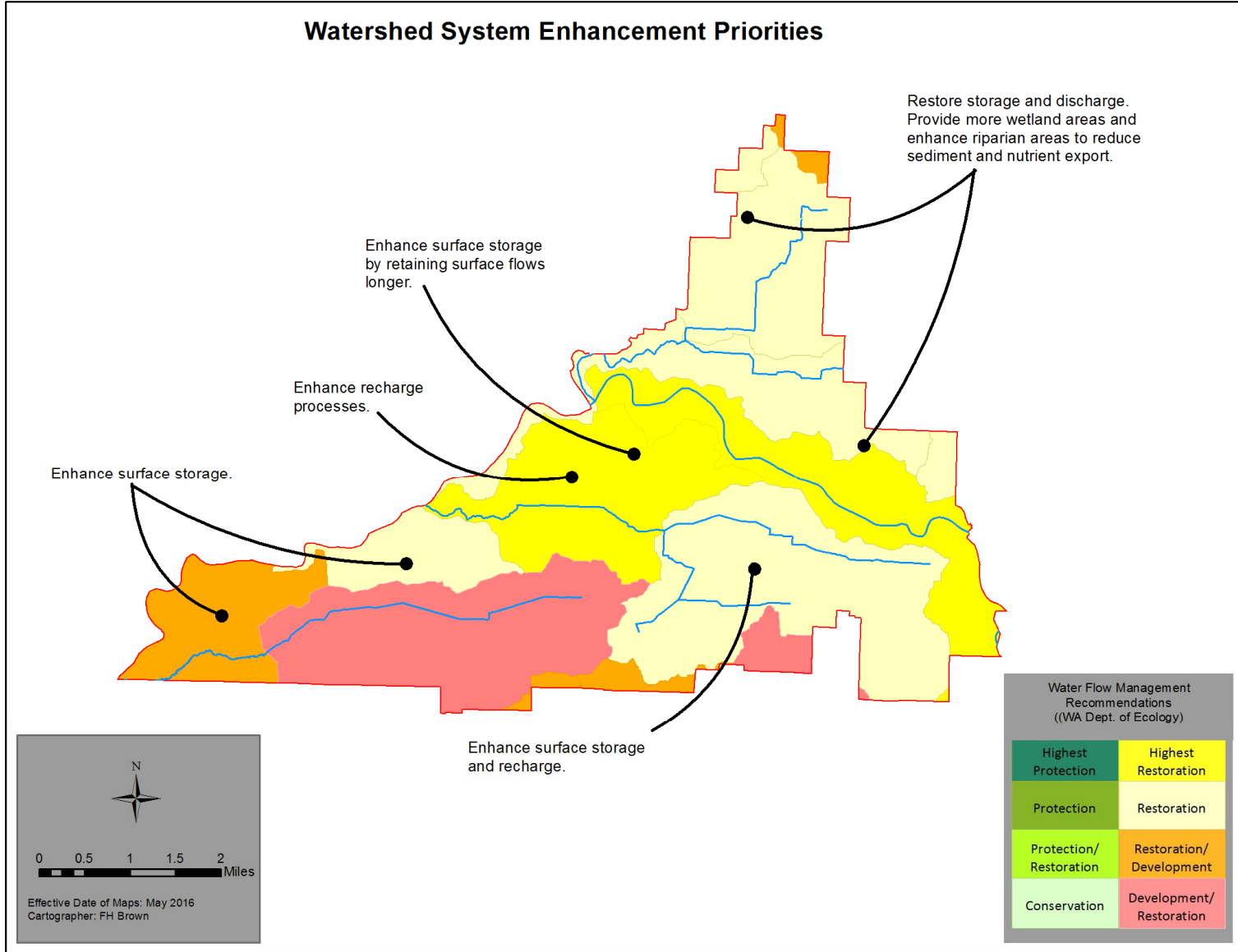


Figure 16. South Lynden WID: Summary watershed system enhancements and specific actions

6 Reference maps for the South Lynden Watershed Improvement District

6.1 Agriculture reference maps

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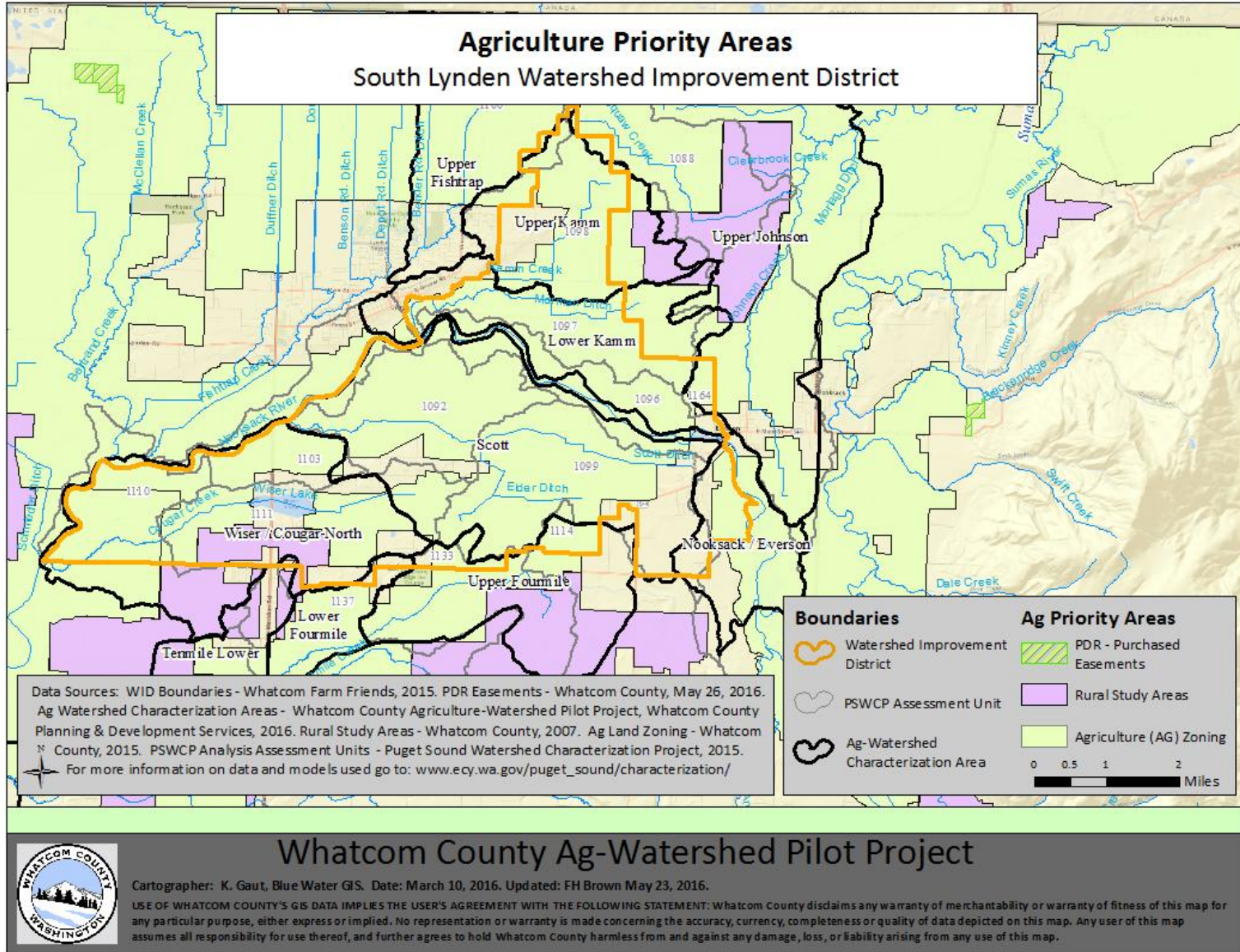


Figure 17. South Lynden WID Reference map: Agriculture priority areas

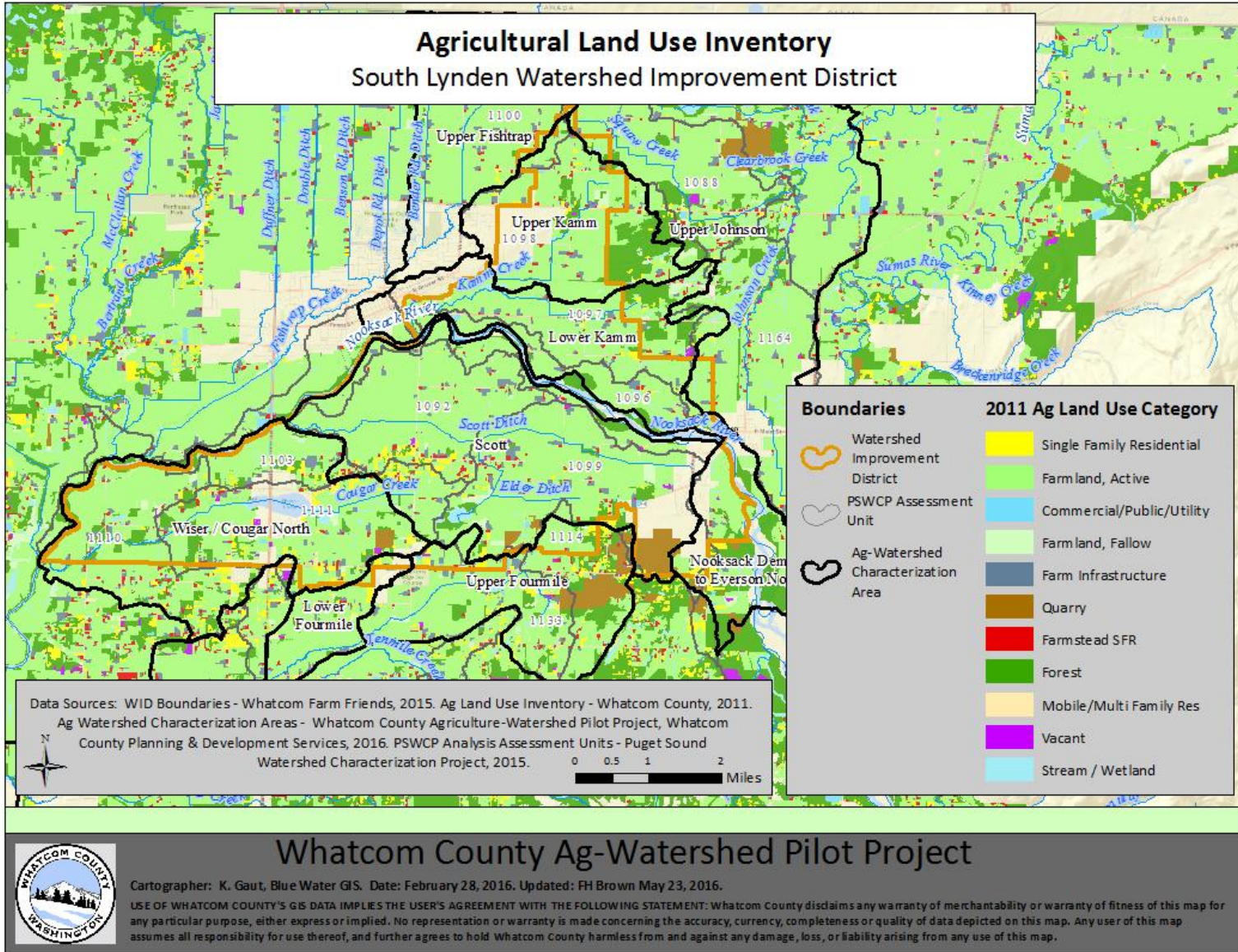


Figure 18. South Lynden WID Reference map: Agricultural land use inventory

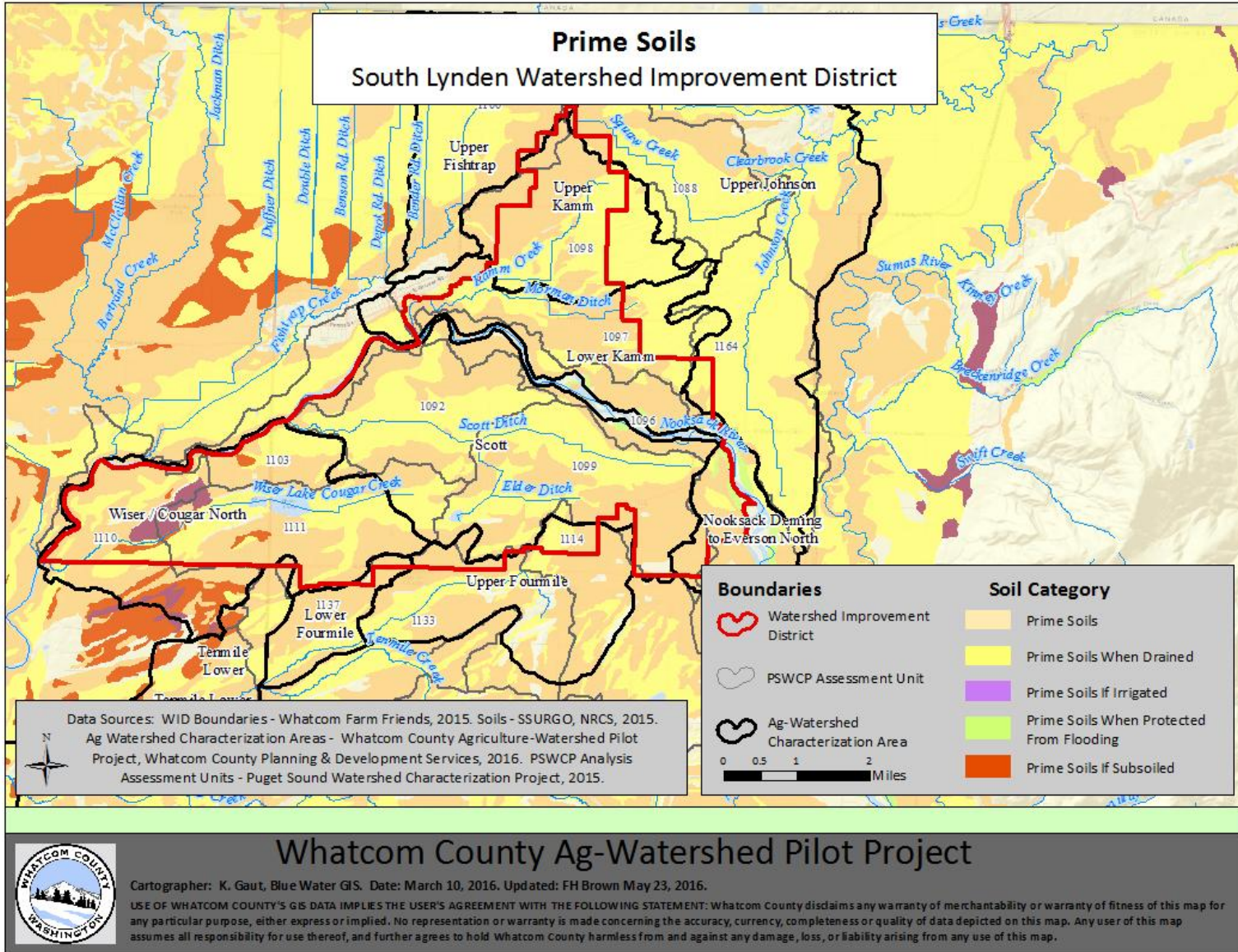


Figure 19. South Lynden WID Reference map: Prime soils

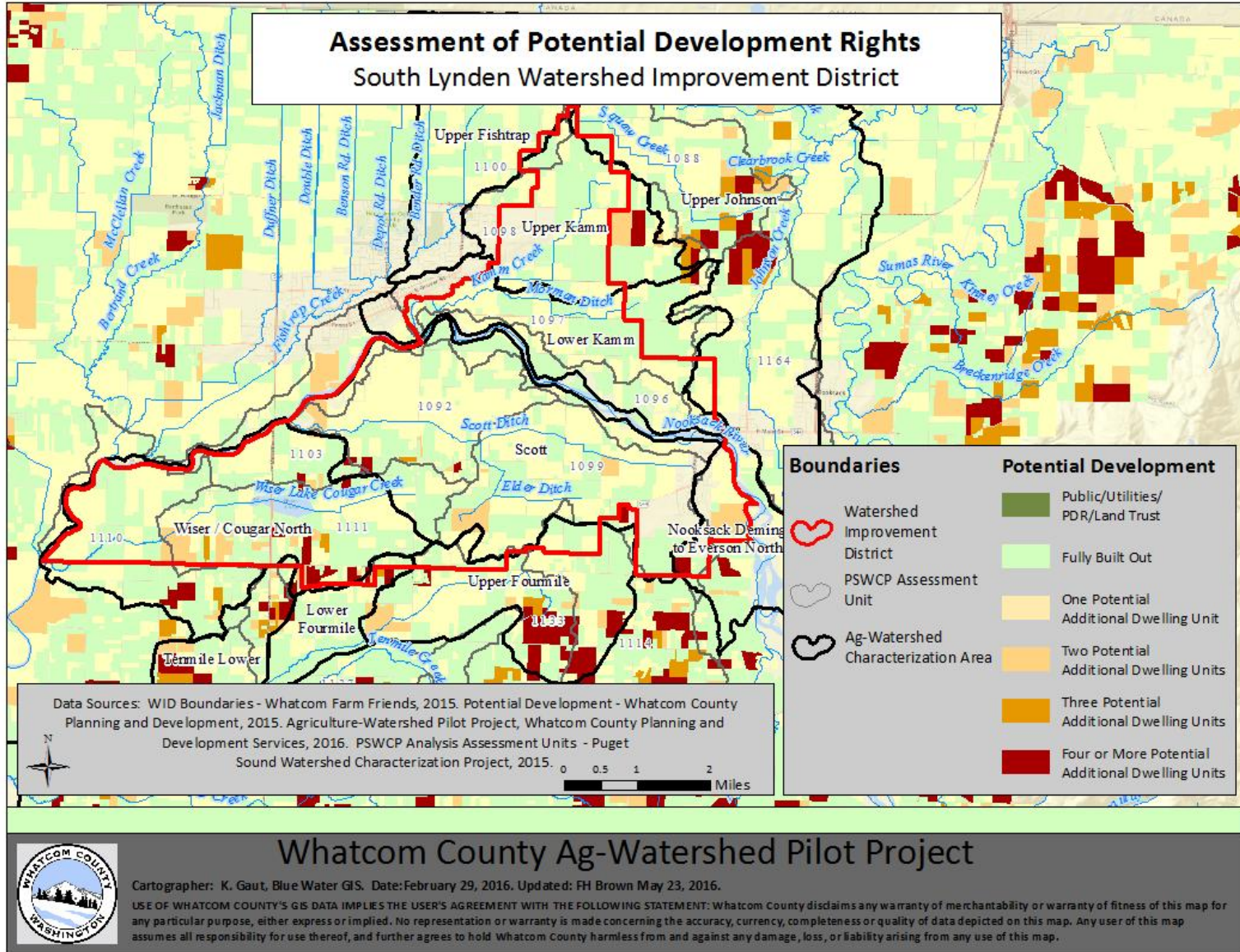
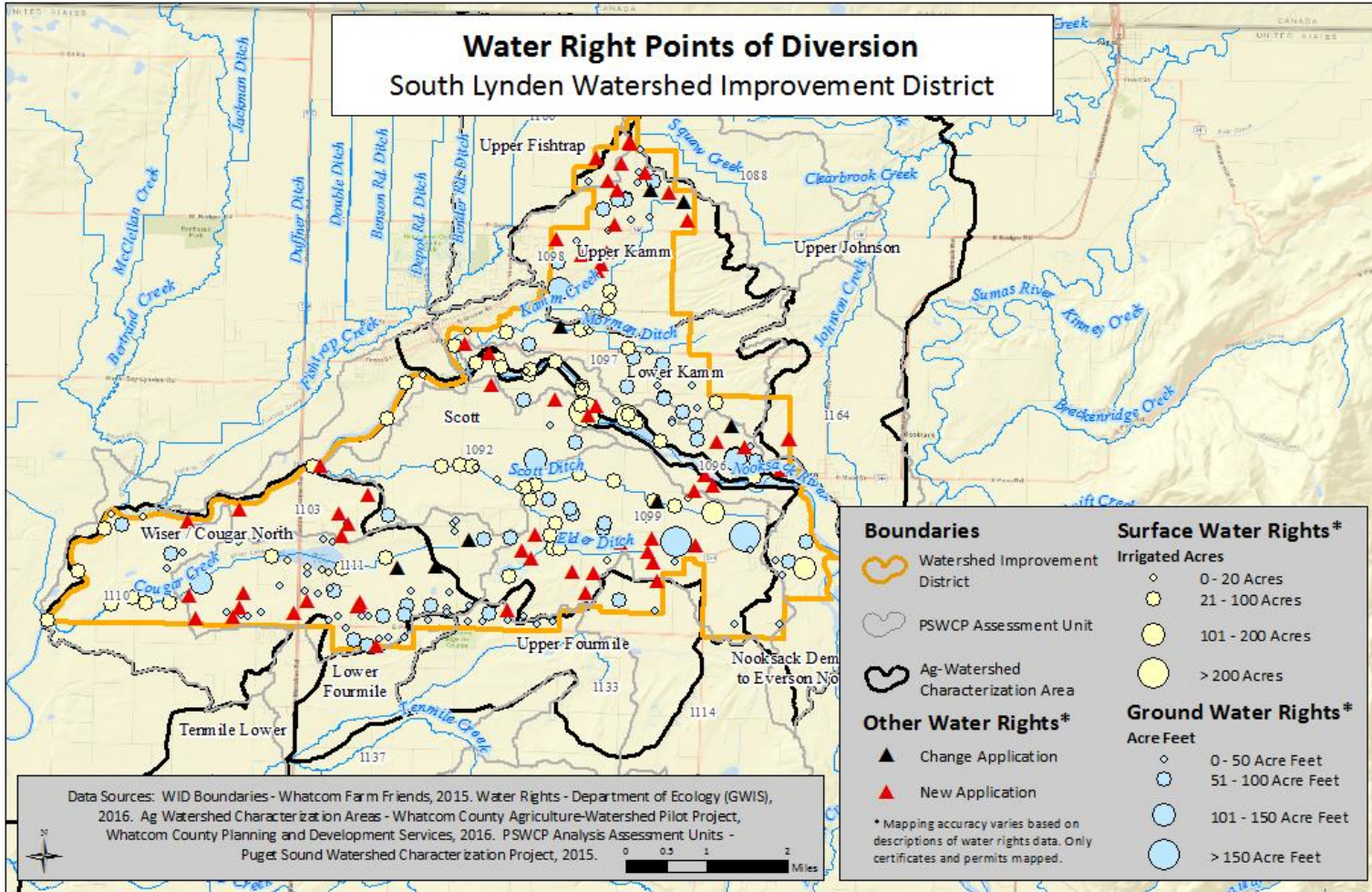


Figure 20. South Lynden WID Reference map: Assessment of potential development rights



Whatcom County Ag-Watershed Pilot Project

Cartographer: K. Gaut, Blue Water GIS. Date: February 28, 2016. Updated: FH Brown May 23, 2016.

USE OF WHATCOM COUNTY'S GIS DATA IMPLIES THE USER'S AGREEMENT WITH THE FOLLOWING STATEMENT: Whatcom County disclaims any warranty of merchantability or warranty of fitness of this map for any particular purpose, either express or implied. No representation or warranty is made concerning the accuracy, currency, completeness or quality of data depicted on this map. Any user of this map assumes all responsibility for use thereof, and further agrees to hold Whatcom County harmless from and against any damage, loss, or liability arising from any use of this map.

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

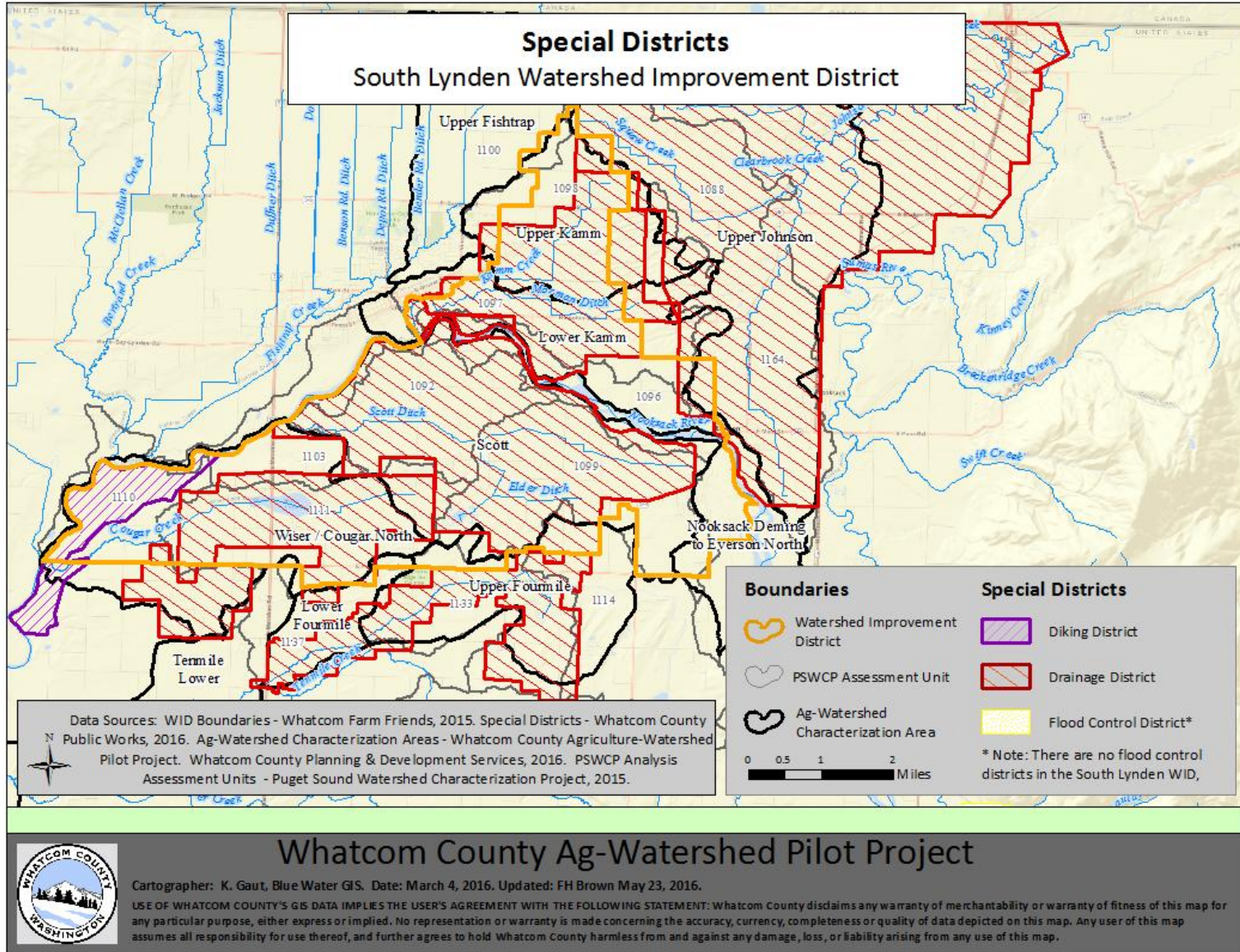


Figure 22. South Lynden WID Reference map: Special districts

6.2 Watershed reference maps

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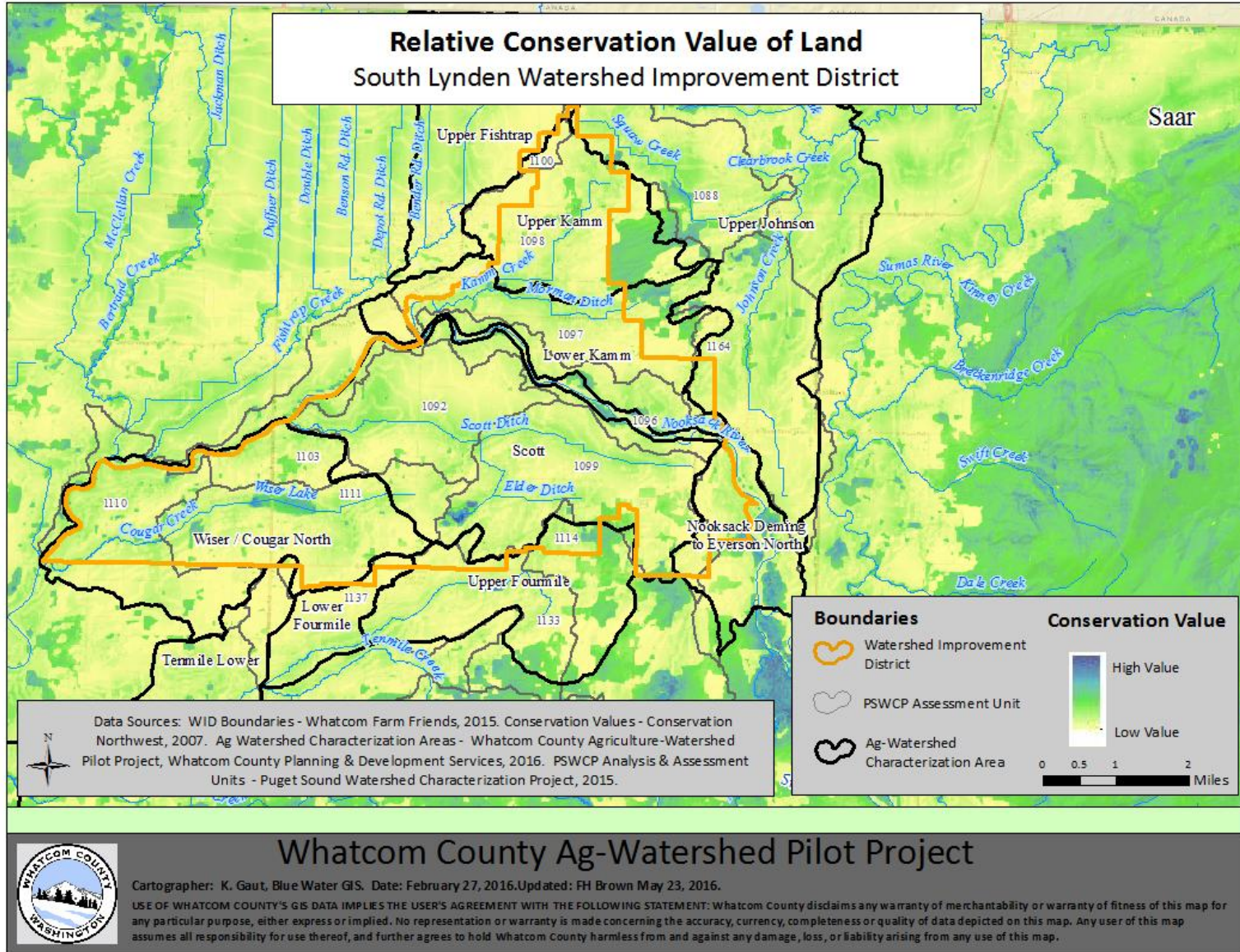


Figure 23. South Lynden WID Reference map: Relative conservation value of land

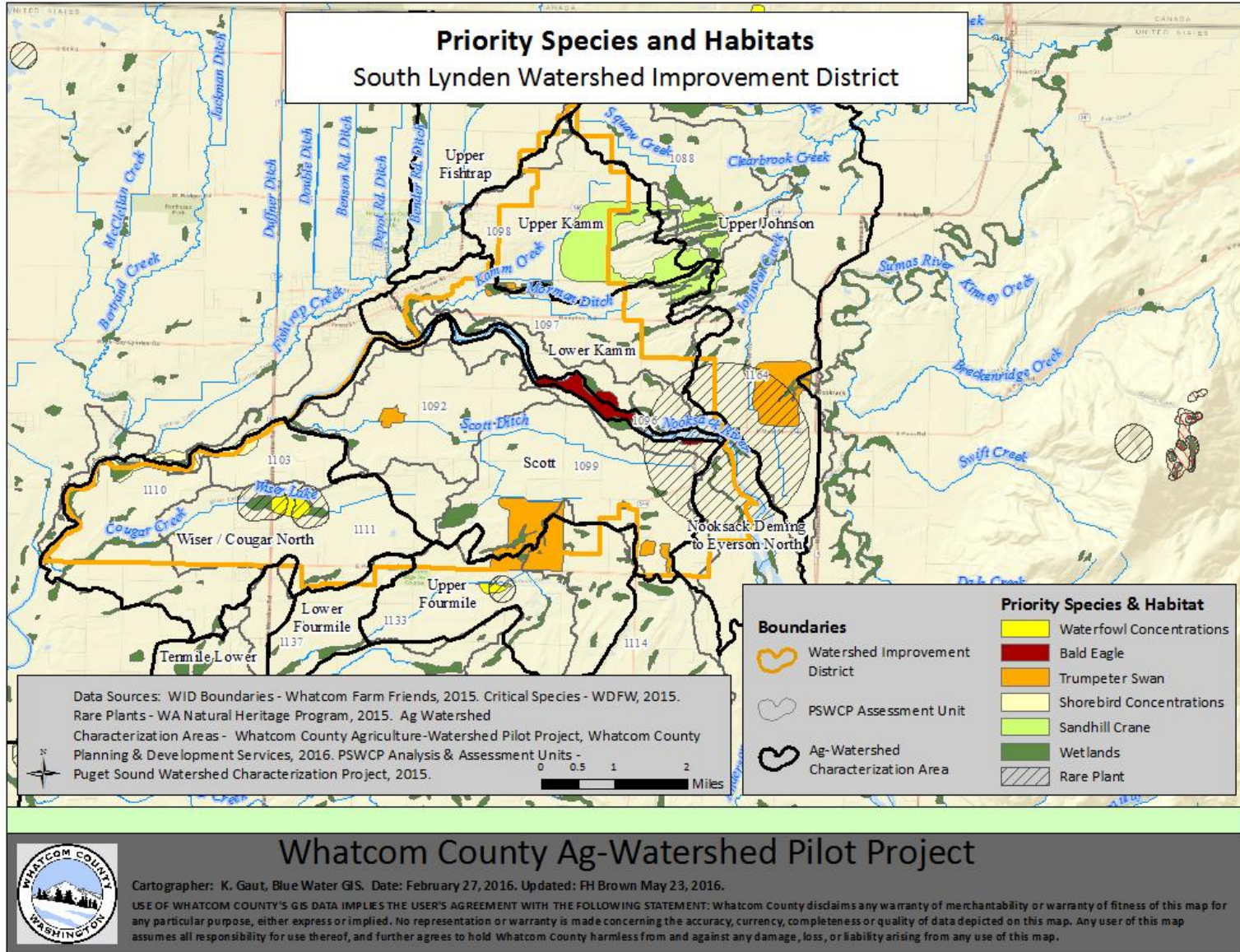


Figure 24. South Lynden WID Reference map: Priority species and habitat

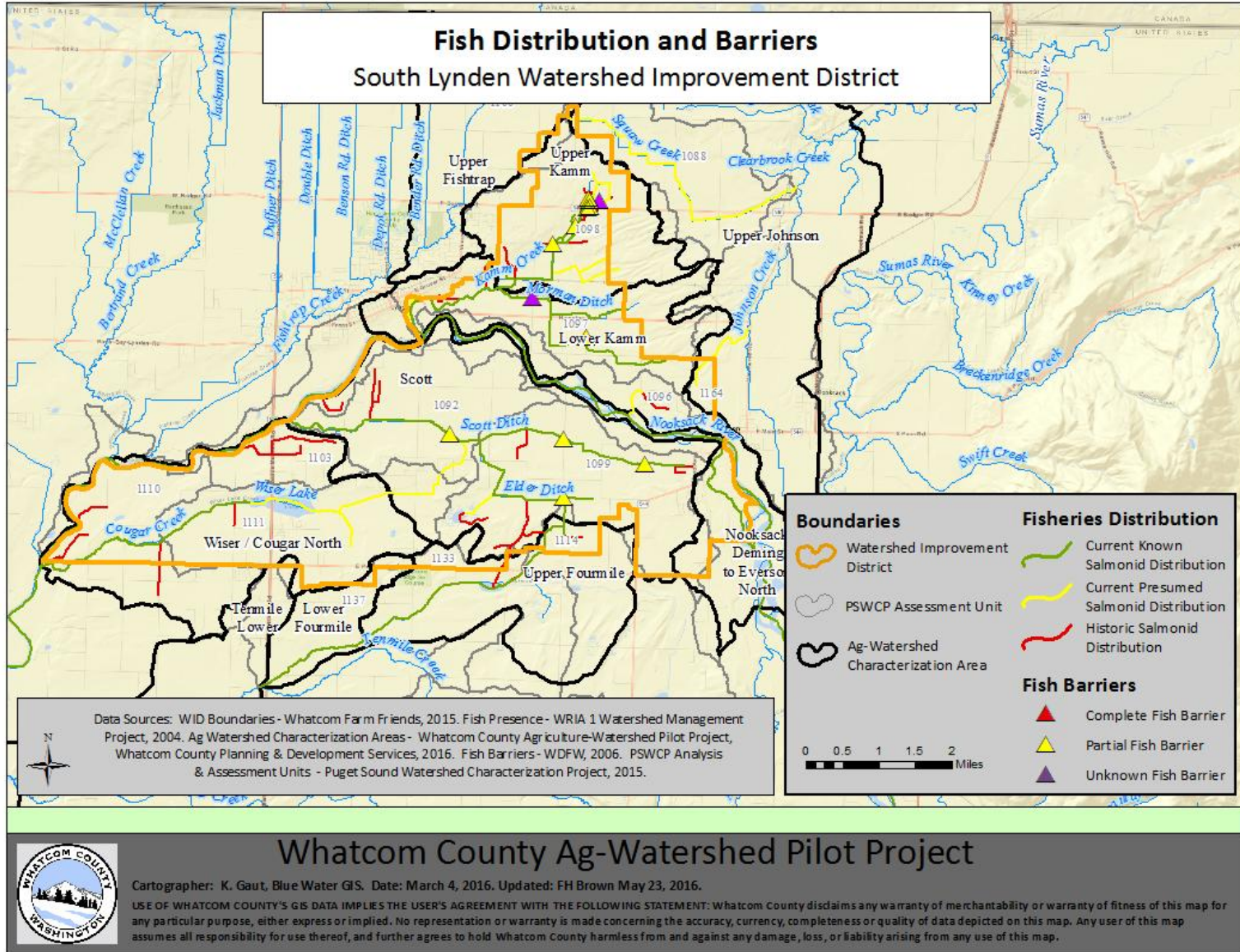


Figure 25. South Lynden WID Reference map: Fish distribution and fish barriers

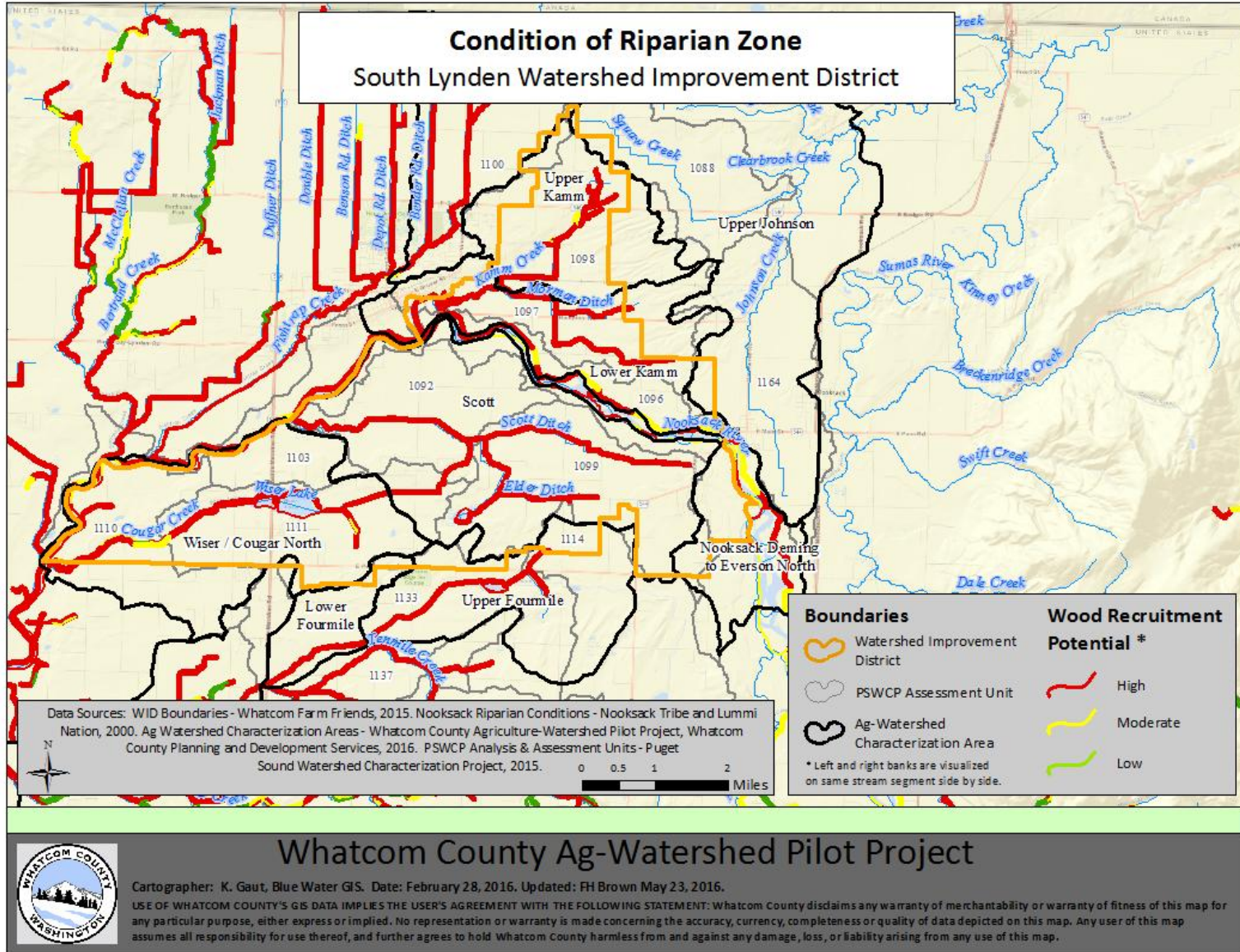


Figure 26. South Lynden WID Reference map: Condition of riparian zone

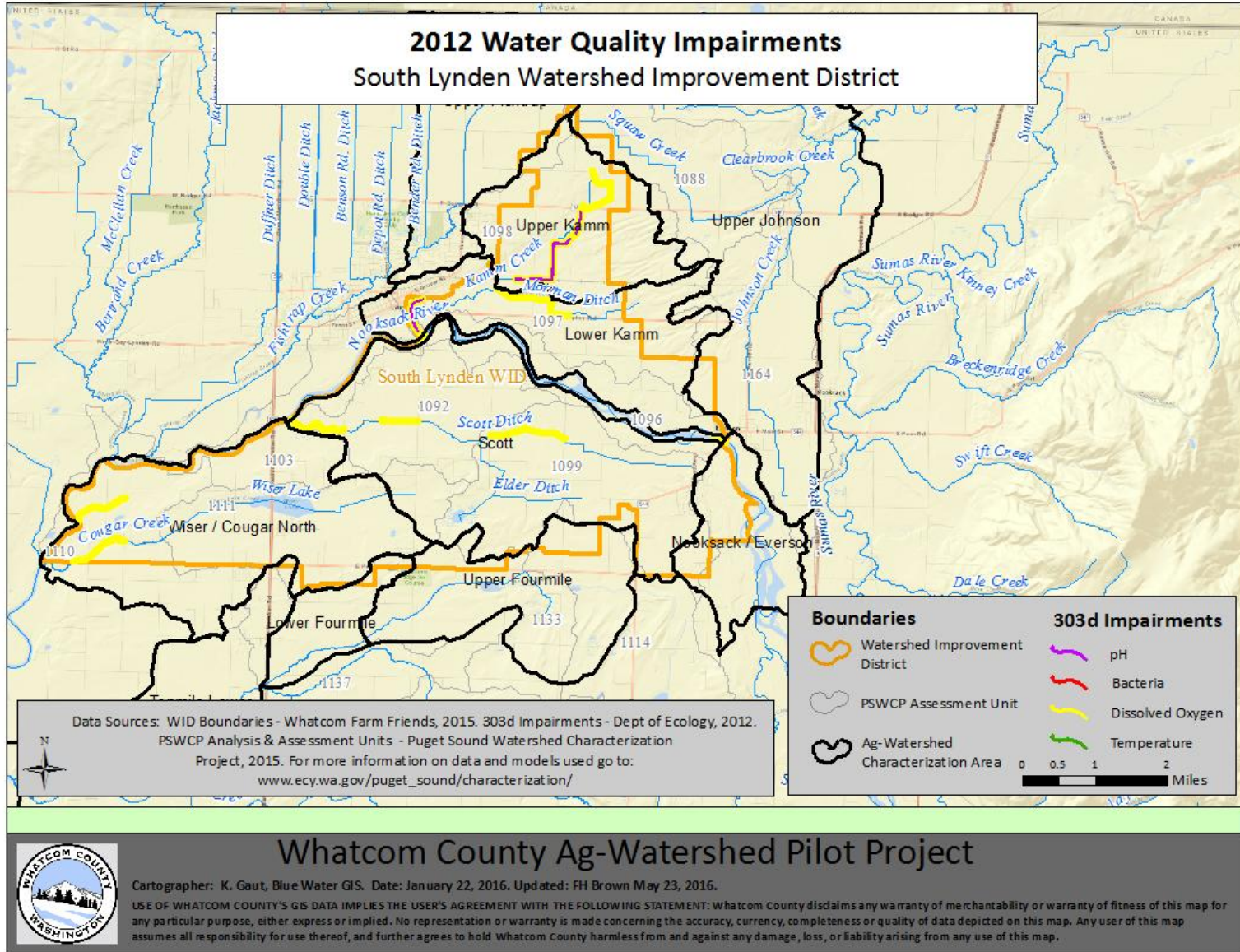
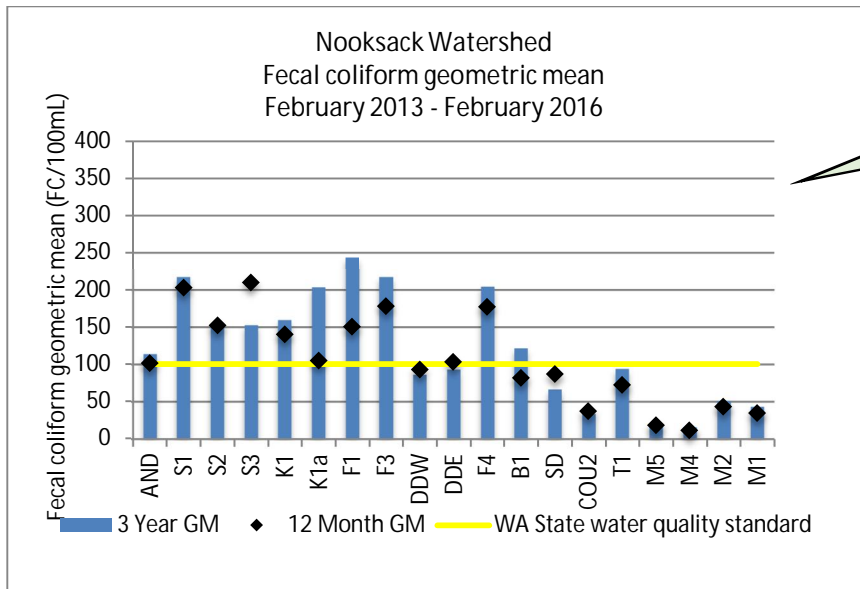
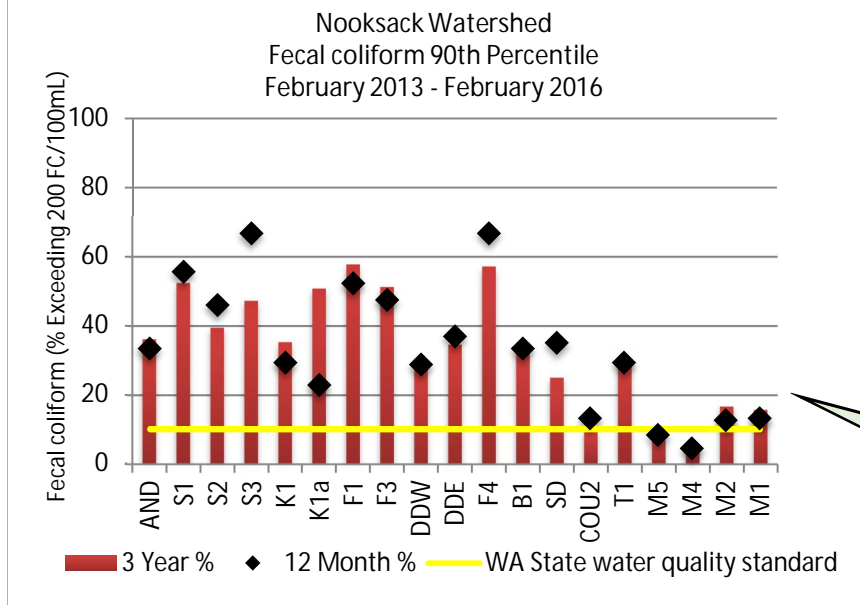
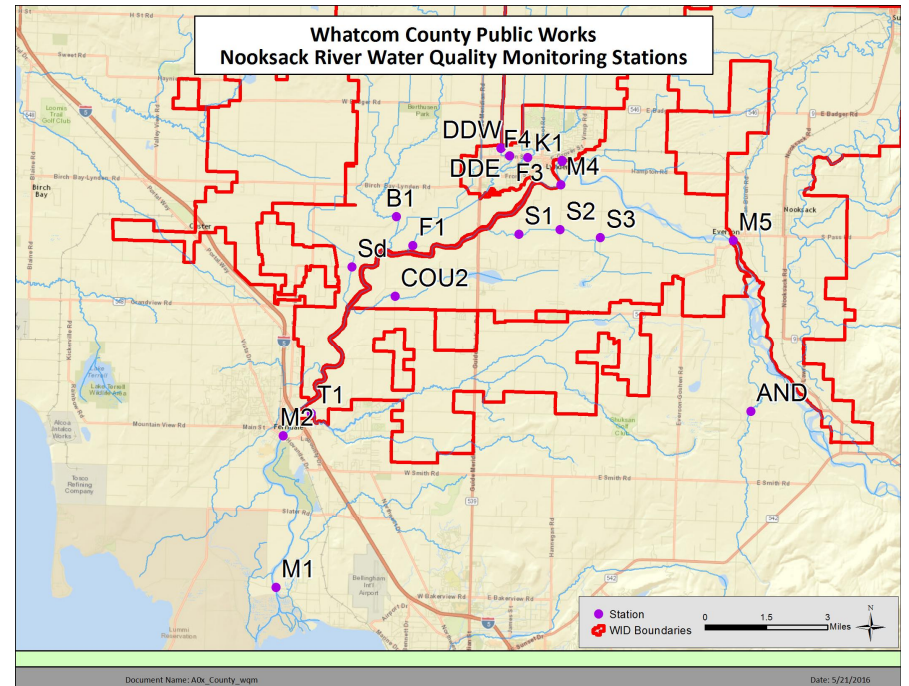


Figure 27. South Lynden WID Reference map: Water quality impairments (2012)



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.



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.

Figure 28. South Lynden WID Reference map: Routine water quality monitoring results. Data from Whatcom County Public Works

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Watershed Improvement District boundaries	Received from Ag Water Board, 2015. www.agwaterboard.com
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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.	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).
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 AWCA's reflect hydrological and agricultural characteristics in the landscape; are recognizable for WID members and are of a size that is practical for the WID's to utilize in their planning processes. Importantly, the AWCA's represent common areas within which to characterize and map both agricultural and watershed enhancement priorities.	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
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	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 South Lynden 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 South Lynden WID

July 2016

Prepared by Cheryl Lovato Niles & Heather MacKay

Whatcom County Ag-Watershed Project

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 South Lynden Watershed Improvement District (WID).

Sources for the following data types have been collated for the Kamm, Scott, Wiser/Cougar Creek, and Nooksack-Everson 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,
- Ground water measurements from 2000 to the present,
- Erosion and avulsion hazard in the Nooksack River channel migration zone,
- 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

Watershed/Area	Parameter	Source	Description	URL
Lower Kamm, Wiser/Cougar Lake, Scott, Nooksack Everson	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 [last accessed February 1, 2016] (see note below for information on how to download FC data)
Upper Kamm, Lower Kamm, Scott, Wiser Cougar North,	Fecal coliform	Conservation District	Watershed Health Assessment (November 2015)	http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results [last accessed February 1, 2016]
All (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 (only WSDA results shown as of 2/9/16). Data is available upon request from WSDA Dairy Nutrient Management group - Michael Isensee 360-961-7412	Map of preliminary source tracking results	http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results [last accessed February 1, 2016]

Accessing water quality data from routine monitoring sites: Figure 1 shows the locations of routine water quality monitoring sites that are within the S. Lynden 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 the table below.

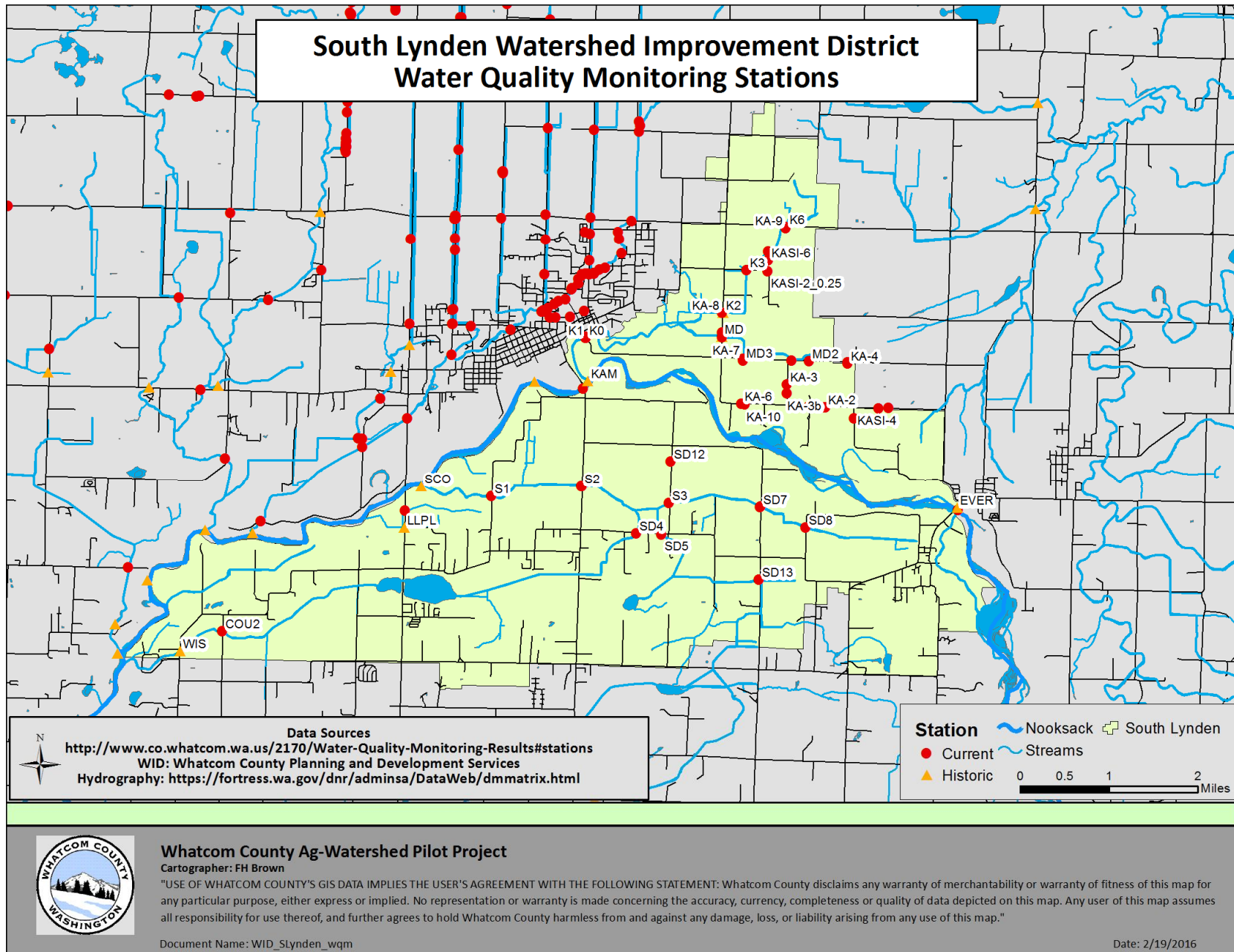


Figure 1: South Lynden WID: Routine water quality monitoring stations. See Tables 1 and 2 for more information.

Table 2: Where to find earlier water quality data from monitoring stations on Whatcom County Water Quality Monitoring Results for S. Lynden 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	Washington State Department of Agriculture	Nooksack Tribe
What	Data generally includes FC, pH, T, Conductivity, and DO. Occasionally flow and wetted width are recorded.	Focused on fecal coliform	Focused on fecal coliform	Fecal coliform, E.coli, T, pH, DO, Conductivity, Turbidity,
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.	Data is available upon request from WSDA Dairy Nutrient Management group - Michael Isensee 360-961-7412	Available by request
Details	You may request data for a watershed sub basin from Jessica Kirkpatrick, Steve Hood, or Chris Luerkens at 360-715-5200.	< http://www.co.whatcom.wa.us/2172/Resource-Library >	Station locations are shown on Whatcom County's map of routine monitoring sites but results are available on the Preliminary Source ID Results map (both maps at < http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results >) and by request – contact information above.	Jezra Belieau, Water Resources Specialist Nooksack Indian Tribe jbeaulieu@nooksack-nsn.gov
Station Names	IC147Lake LNSKWQ_S2 NWIC-K1 NWIC-K1* NWIC-K2 K3 KF LLPL NWIC-M4 NWIC-M4* NWIC-M5 NWIC-M5* NWIC-MD	M4 S1 S2 S3 COU2	KA-1 KA-10 KA-2 KA-2.5 KA-2UP KA-3 KA-3b KA-4 KA-4.1 KA-5 KA-6 KA-7 KA-8	SW09 SW15

Who	Department of Ecology	Whatcom County Public Works	Washington State Department of Agriculture	Nooksack Tribe
	MD2 MD3 NWIC-PNG NWIC-S1 NWIC-S1* NWIC-S2 NWIC-S3 SD3 SD4 SD5 SD7 SD8 NWIC-WIS NWIC-WIS*		KA-9 KA-H1 KASI-1 KASI-2_0.25 KASI-3 KASI-4 KASI-5 KASI-6 LLPL1 SD11 SD12 SD13	

Table 3: Streamflow

WID/Area	Watershed	Ongoing/ Completed	Station ID	Description	Lat	Long	Collected by	Source	URL
South Lynden	Wiser/Cougar North	Ongoing	12211500	Nooksack River near Lynden	485514	1222904	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	notes
South of South Lynden	Mainstem	FC, T, NH3, NO2 NO3, TPN, TPP, OP, DO, pH,	01A050	Nooksack River @Brennan	ongoing	Ecology	River & Stream Water Quality Monitoring	https://fortress.wa.gov/ecy/eap/riverwq/regions/state.asp [last accessed October 1, 2015]	Oxygen is monitored "continuously" - 15 to 30 minute intervals

Table 5: Additional streamflow reports

WID/Area	Title	Published	URL
Bertrand, N. Lynden, S. Lynden, Laurel	USGS Estimating low-flow frequency statistics and hydrologic analysis of selected stream-flow gaging stations, Nooksack River basin, report 2009-5170	USGS Scientific Investigations Report, 2009.	http://wria1project.whatcomcounty.org/uploads/PDF/WaterQN/2009_USGS%20Report%20for%20Selected%20WRIA%201%20Gage%20Stations.pdf

Table 6: 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 7: 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 8: 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.
all	all	Well location, use, depth, installation date, open interval	Wells with Sufficient Information to Compute Hydraulic Conductivities, Downloaded from the USGS	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

WID/ Area	Water- shed	Parameter	Title of Table/Source	Station ID	Source	URL	Notes
			National Water Information System (NWIS)				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.
South Lynden	Upper Kamm, Lower Kamm,	Hydraulic conductivity	Summary Information for Aquifer Tests in the WRIA 1 Study Area	Lynden, Everson, Pole Road	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 9: Additional reports on groundwater

Area	Title	Published	Authors	URL
all	Nitrate Contamination in the Sumas-Blaine Aquifer, Whatcom County, Washington	Publication No. 11-03-027, May 2011	Melanie Redding L. Hg., Barbara Carey L. Hg., and Kirk Sinclair L. Hg., 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, L. Hg.	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 10: 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 Report 98-4195, 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

WID/ Area	Parameter	Title	Last modified	Source	URL	Notes
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: Data 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 11: 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 12: Land use/Land cover

WID/Area	Watershed	Parameter	Document	URL	Notes
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]	
S.	Kamm	Ag land use classes	Land Uses and Vegetative Cover in focus area (figure 10) from Agriculture-Watershed Characterization and Mapping Report. 2013. Whatcom County Ag-Watershed Project report.	https://sites.google.com/site/wcwatershedag/ [last accessed March 1, 2016]	Source: WC-Planning and Development Services, 2013
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	
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 13: Land use/Land cover map and charts from Lower Nooksack Water Budget Overview
Report includes Kamm, Scott, Wiser Lake/Cougar Creek

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 14: Land use/Land cover electronic data from Lower Nooksack Water Budget Overview
Report includes Kamm, Scott, Wiser Lake/Cougar Creek

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 15: 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
Lower Kamm or Upper Kamm?	Kamm	RM 2.2-3.2	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.
Lower Fishtrap and/or Lower Kamm	Fishtrap Creek Lower	RM 3.0-4.1	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 16: WDFW spawner surveys

Watershed/ WID	Parameter	Creek	Station location	Frequency	Date	Collected by	Source
Upper or lower Kamm? (South Lynden)	salmon (coho pink, chinook, chum): live, dead, and redds	Kamm Cr	RM 0	once each year		WDFW and NSEA field crews	WDFW Tasha Geiger Nooksack River Stock Assessment 360-305-2023 Natasha.geiger@dfw.wa.go v
Upper or lower Kamm? (South Lynden)	Steelhead: live, dead, and redds	Kamm Cr	several sites		2009 - 2010	WDFW and NSEA field crews	WDFW Tasha Geiger Nooksack River Stock Assessment 360-305-2023 Natasha.geiger@dfw.wa.go v
Scott, Wiser Lake/Cougar Creek	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.go v

Table 17: 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/r efdesk/herp/herpmain.html [last accessed October 1, 2015]	DNR
Washington State	Washington Nature Mapping Program – wildlife distribution maps		unknown	unknown	http://naturemappingfoundatio n.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/d efault.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/progra ms/wq/plants/weeds/index.htm l [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/Do cumentCenter/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%20 Aquatic%20Invasive%20Species %20Report%202010.pdf [last accessed October 1, 2015]	UW Forest Service and Bureau of Land Management

Table 18: Additional habitat/wildlife documents

Watershed/area	Parameter	Document
Does not include Dakota, California, or Sumas River watersheds	Riparian function	Coe, T. 2001. Nooksack River Watershed Riparian Function Assessment. Nooksack Indian Tribe Natural Resources Department. < http://salmon.wria1.org/resources/documents > [last accessed January 4, 2016]
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.
Kamm Creek watersheds	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 19: 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
Kamm	Fish Presence	Fish Presence map (figure 7) from Agriculture Watershed Characterization and Mapping Report	< https://sites.google.com/site/wcwatershedag/ > [last accessed February 24, 2016]	Data source listed as Fish Habitat Technical Team, 2003
Kamm	Salmonid Streams	Fish presence in the Lynden North Watershed management unit (figure 14) from Agriculture Watershed Characterization and Mapping Report	< https://sites.google.com/site/wcwatershedag/ > [last accessed February 24, 2016]	Source: WRIA 1, NWIFC, WCD, WCC
Kamm	Riparian wood recruitment potential	Condition of Riparian zone in the Study Area (figure 15) from Agriculture Watershed Characterization and Mapping Report	< https://sites.google.com/site/wcwatershedag/ > [last accessed February 24, 2016]	Source: Whatcom County Shoreline Characterization and Inventory Report 2006
Kamm	Priority Habitat and Species	Priority Habitat and Species (figure 9) from Agriculture Watershed Characterization and Mapping Report	< https://sites.google.com/site/wcwatershedag/ > [last accessed February 24, 2016]	Source listed as Whatcom County Critical Areas maps
Kamm	Wildlife Habitat	Western Whatcom County Wildlife Habitat Assessment and Significant Biological Areas Map (figure 6) from Agriculture Watershed Characterization and Mapping Report	< https://sites.google.com/site/wcwatershedag/ > [last accessed February 24, 2016]	Washington Department of Fish and Wildlife
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

Watershed/ Area	Parameter	Document/Website	URL	Source
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
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 <i>Federal Register</i> notices (see links below), are the definitive sources for determining critical habitat boundaries. Map and <i>Federal Register</i> 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

Watershed/ Area	Parameter	Document/Website	URL	Source
Puget Sound Region	Wetlands	National Wetlands Inventory, data and maps	http://www.fws.gov/wetlands/ [last accessed February 1, 2016]	US FWS

Table 20: 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 21: 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 South Lynden Watershed Improvement District

1. Overview of South Lynden WID characterization and mapping work

South Lynden Watershed Improvement District (South Lynden WID) hosted a work session with the ag-watershed project team to prepare agricultural-watershed characterization and mapping work products for use in the South Lynden 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 South Lynden 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).

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

2. South Lynden WID work session

The January 25, 2016 work session participants included South Lynden 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 South Lynden WID area and instruction on the method used for the characterization and mapping activities.

Background information provided at the work session:

- January 25, 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 South Lynden WID*" website excerpt describing the WID boundary locations and list of WID priorities for agriculture and watershed services.

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 South Lynden 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).

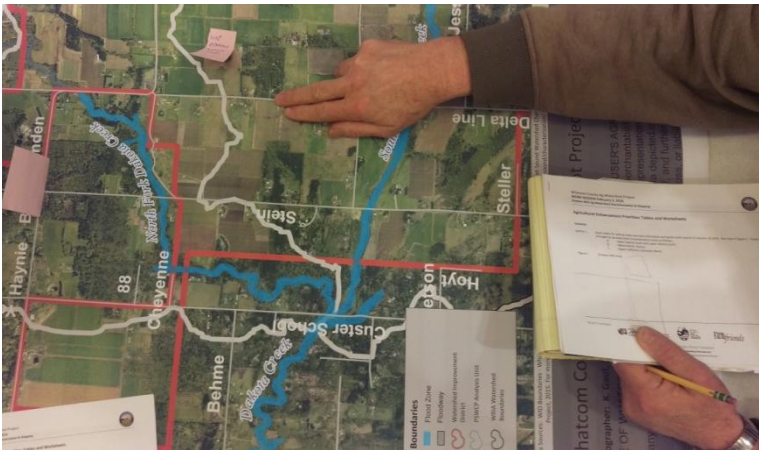


Figure 1. 2016 WID Work session table-top materials.

Work session materials:

- South Lynden WID large-scale locality maps for table-top discussion and note-taking purposes.
- South Lynden WID Agricultural Enhancement Priorities: Tables & Worksheets.
- South Lynden WID Watershed Enhancement Priorities: Tables & Worksheets.
- South Lynden 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 & South Lynden 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 South Lynden 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 South Lynden 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 South Lynden WID work session invitees and attending participants*.

Table 1. South Lynden WID work session invitees and participants.

WID Invitees & Participants*	WID Area	Ag Type
Hans Wolfisberg	Nooksack Everson	Dairy
Harold Van Berkum	Nooksack Everson	Dairy
Jag Almawala	Nooksack Everson	Berry
Ron Bronsema	Nooksack Everson	Dairy
Sherm Polinder*	Scott	Dairy
Dusty Williams	Nooksack Everson	Crop
Roger Hawley	Wiser Cougar	Potato
Jake De Hoog*	Scott	Cattle
Raj Bathe	Nooksack Everson	Berry
Dan Noteboom*	Scott	Dairy
Jason VanderVeen	Nooksack Everson	Dairy
Todd Kelsey	Scott	Cattle
Rob Dhaliwal*	Scott	Berry
Derek Gavette*	Nooksack Everson	Crop
Landon Van Dyke*	Scott	Dairy/Berry
Rod Vande Hoef*	Upper Kamm	Dairy
Jeff De Jong*	Scott	Dairy
Grant Van Dyke*	Scott	Dairy
Rolf Haugen*	Nooksack Everson	Berry
Ed Blok*	Scott	Dairy
WID Guests	Expertise	Agency
Karin Beringer*	Ag land priorities, enhancements	Ag Land
Chris Elder		Program,
Mark Personius*		WCPDS
Paula Harris	Flood, drainage enhancements	Flood,
Gary Stoyka		WCPW
Joel Ingram	Fish & wildlife habitat enhancements	WA Dept. of Fish & Wildlife
Frank Corey*	Riparian priorities, enhancements, CREP, water quality	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 - South Lynden WID Board reviewed project scope of work (SOW) and proposed Memorandum of Understanding (MOU) with Whatcom County Planning and Development Services.

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

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

May-June 2016 - South Lynden WID Board reviewed and confirmed the final South Lynden WID Agriculture-Watershed Characterization and Mapping Report.

4. Record of documents

The South Lynden 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 South Lynden 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 South Lynden WID work session invitation and RSVP tracking list.
- January 25, 2016 South Lynden WID Work Session Agenda.

Information materials provided for preliminary review included:

Tables

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

Maps

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

Table 2. Excerpt: Ag-Watershed Project Agricultural Analysis Method²

<i>Priority What?</i>	<i>Where?</i>	<i>Related Background Info.</i>
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

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1 Methodology

The description of the watershed characterization methodology has been adapted from that provided in the Appendix to the pilot agriculture-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-

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

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.

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.

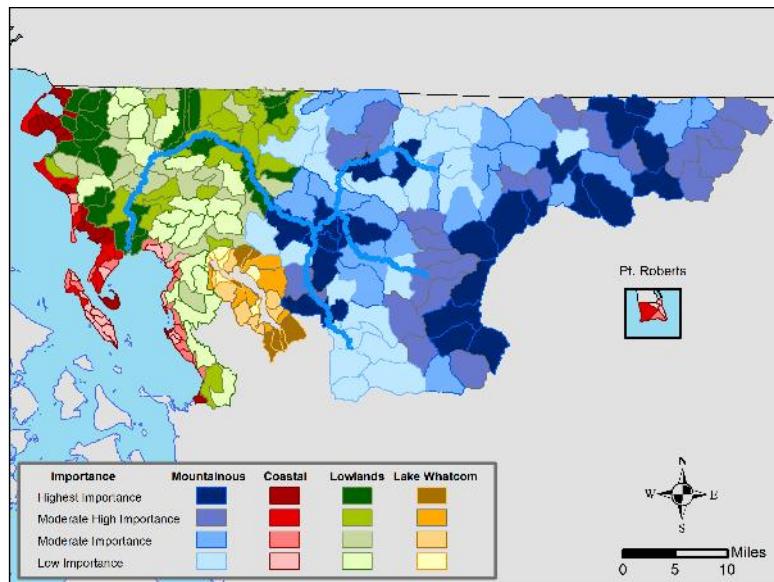


Figure. Overall importance to water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA 1. Darkest colored assessment units are considered highest *importance* relative to other assessment units in the same landscape group of WRIA 1.

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.

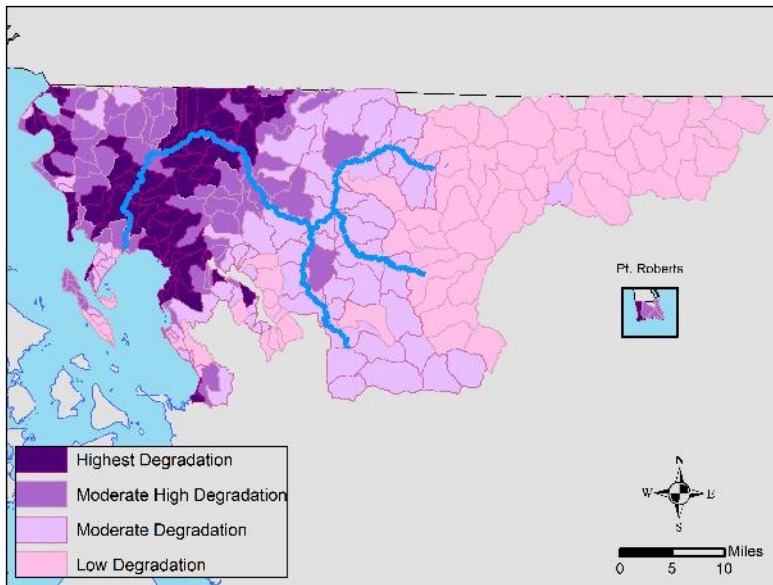


Figure. Overall degradation of water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA1. Dark pink assessment units are considered to have the highest *degradation* relative to other assessment units in WRIA1.

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.

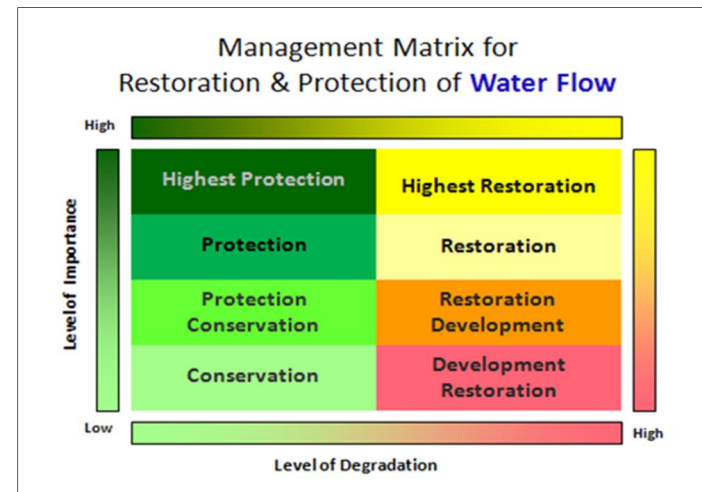


Figure: Management Matrix for Water Flow, indicating relative priorities for restoration and protection of processes. By accounting for both the relative level of *importance* and the relative level of *degradation* of an Assessment Unit one can begin to prioritize which areas of a watershed to apply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

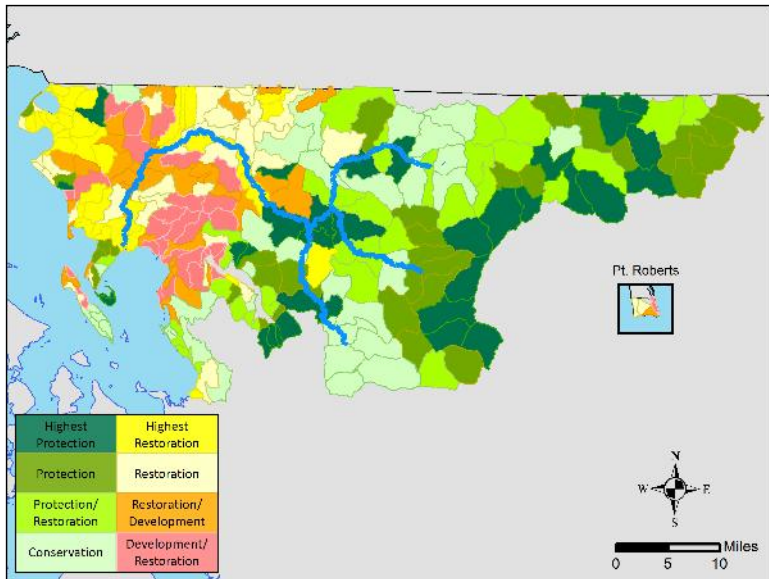


Figure. Overall priorities for restoration and protection of water flow processes in WRIA 1: Results of Puget Sound Watershed Characterization assessment.

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

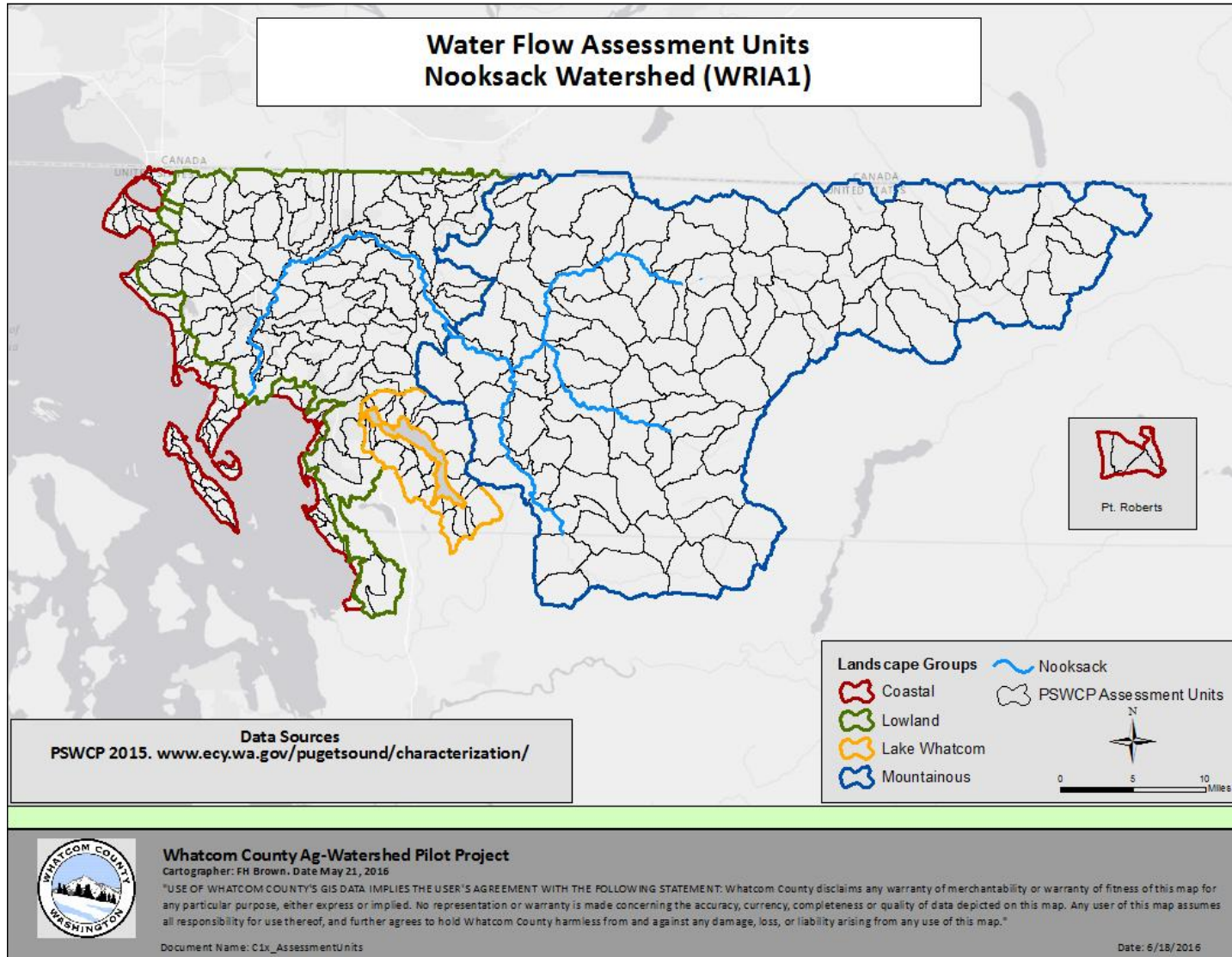


Figure 1. Water flow assessment units used in the Puget Sound Watershed Characterization.

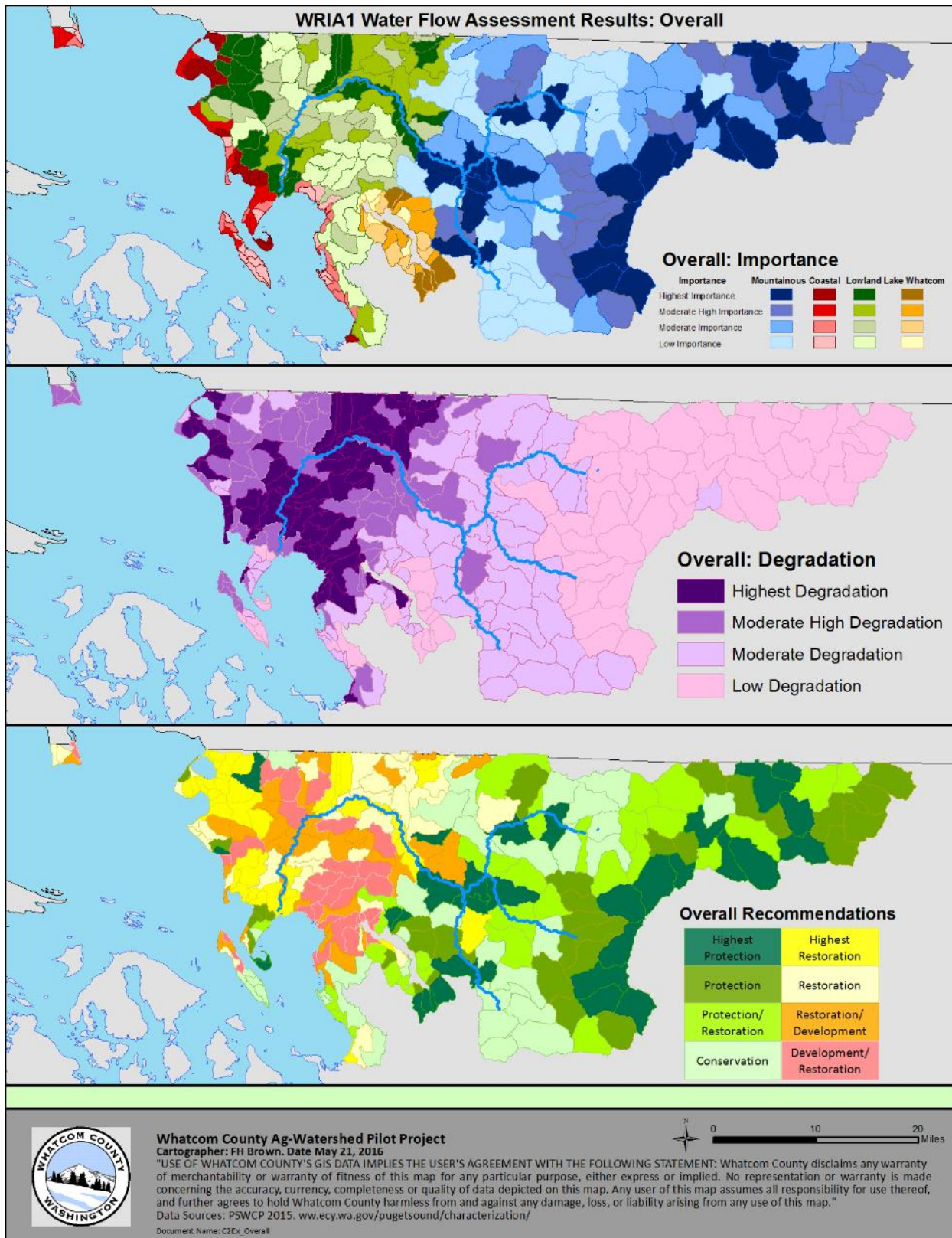


Figure 2. Overall water flow assessment results for WRIA1.

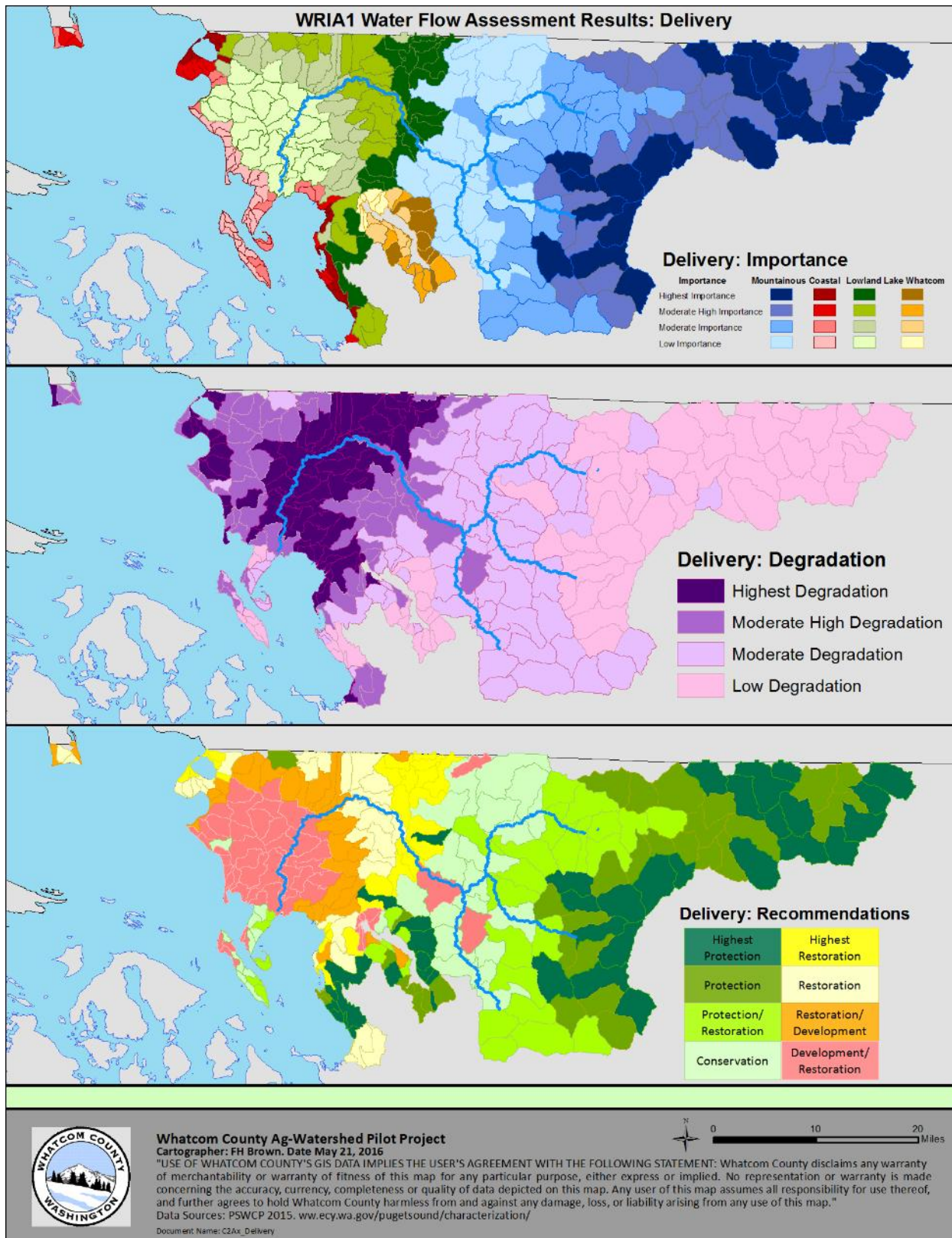


Figure 3. Delivery processes: Assessment results for WRIA1.

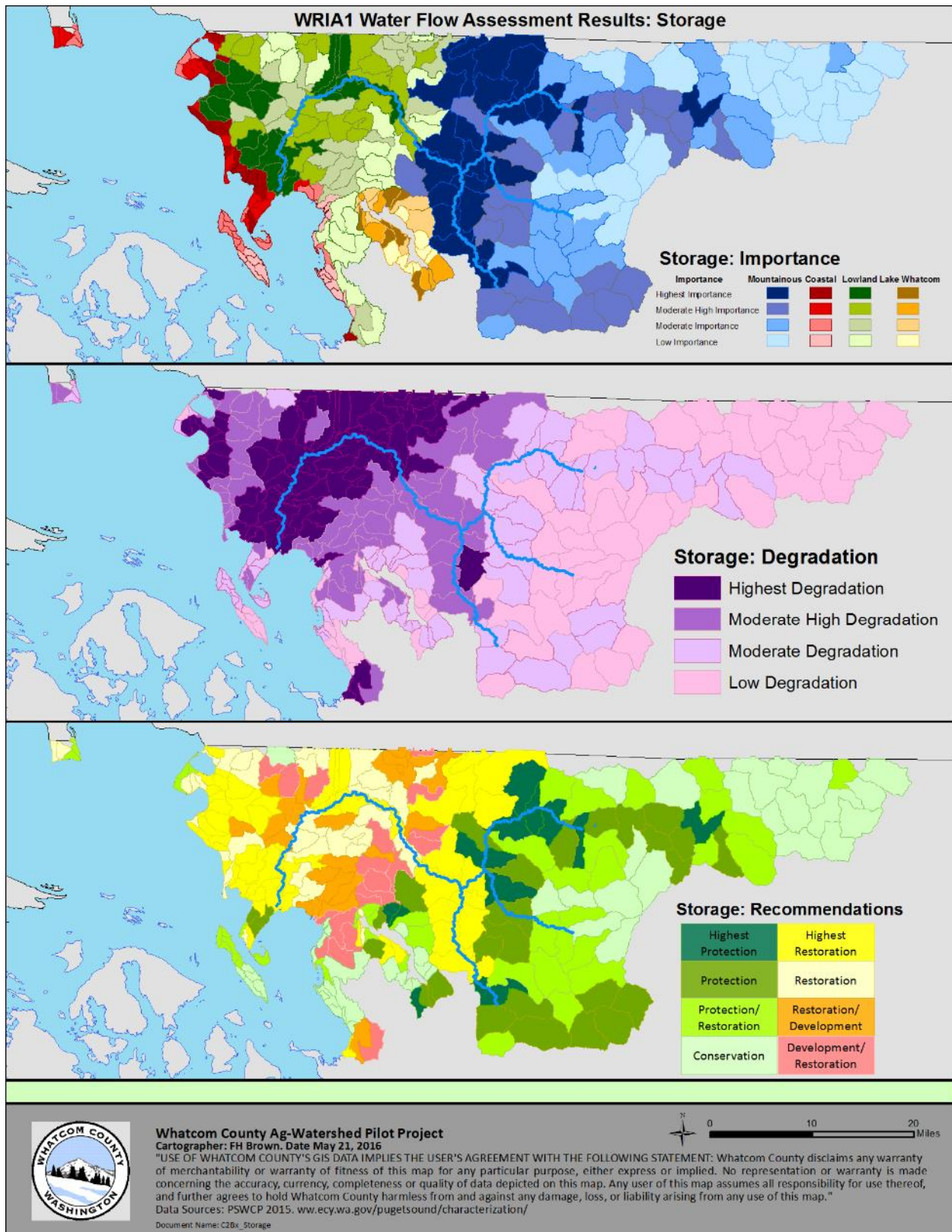


Figure 4. Storage processes: Assessment results for WRIA1.

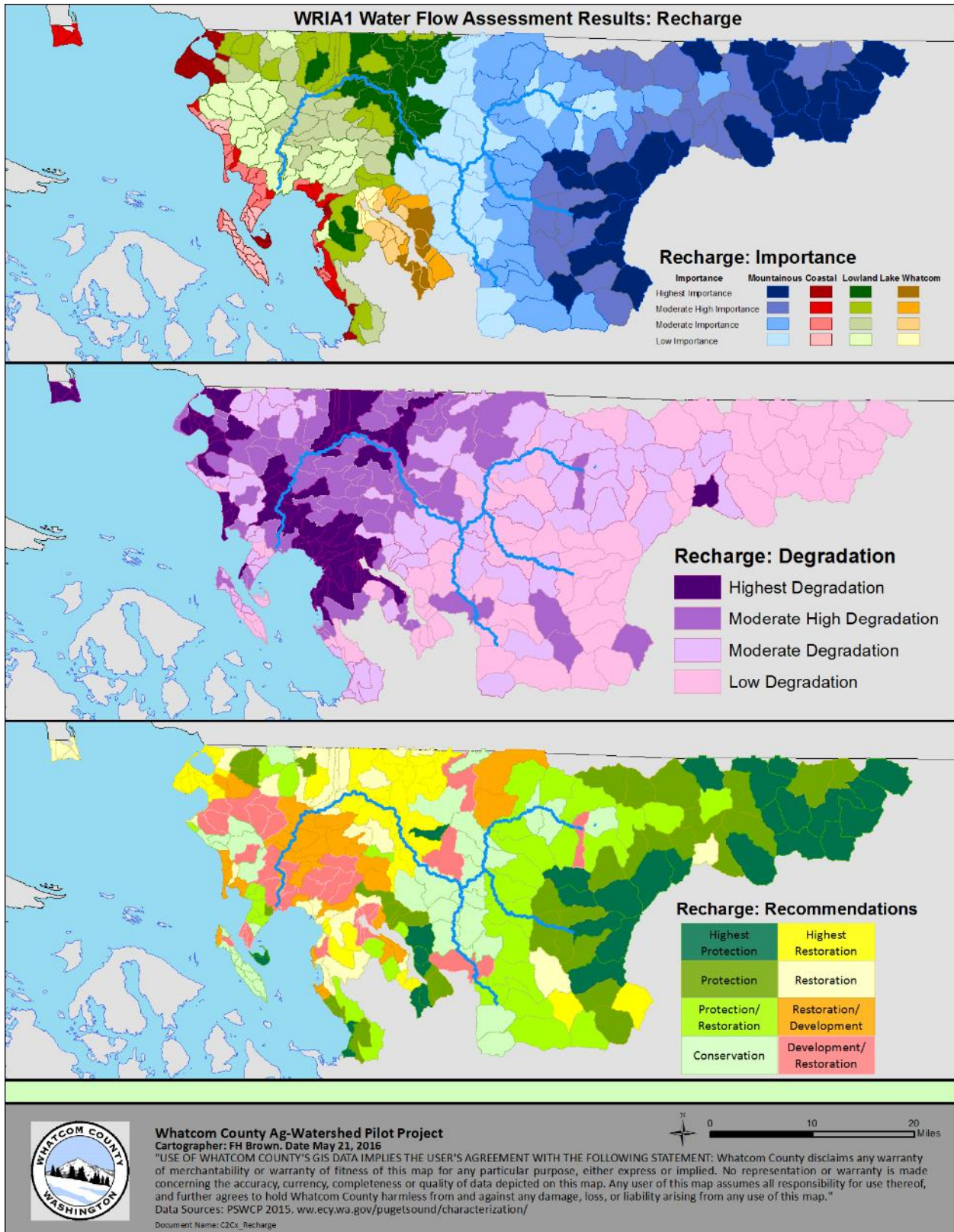


Figure 5. Recharge processes: Assessment results for WRIA1.

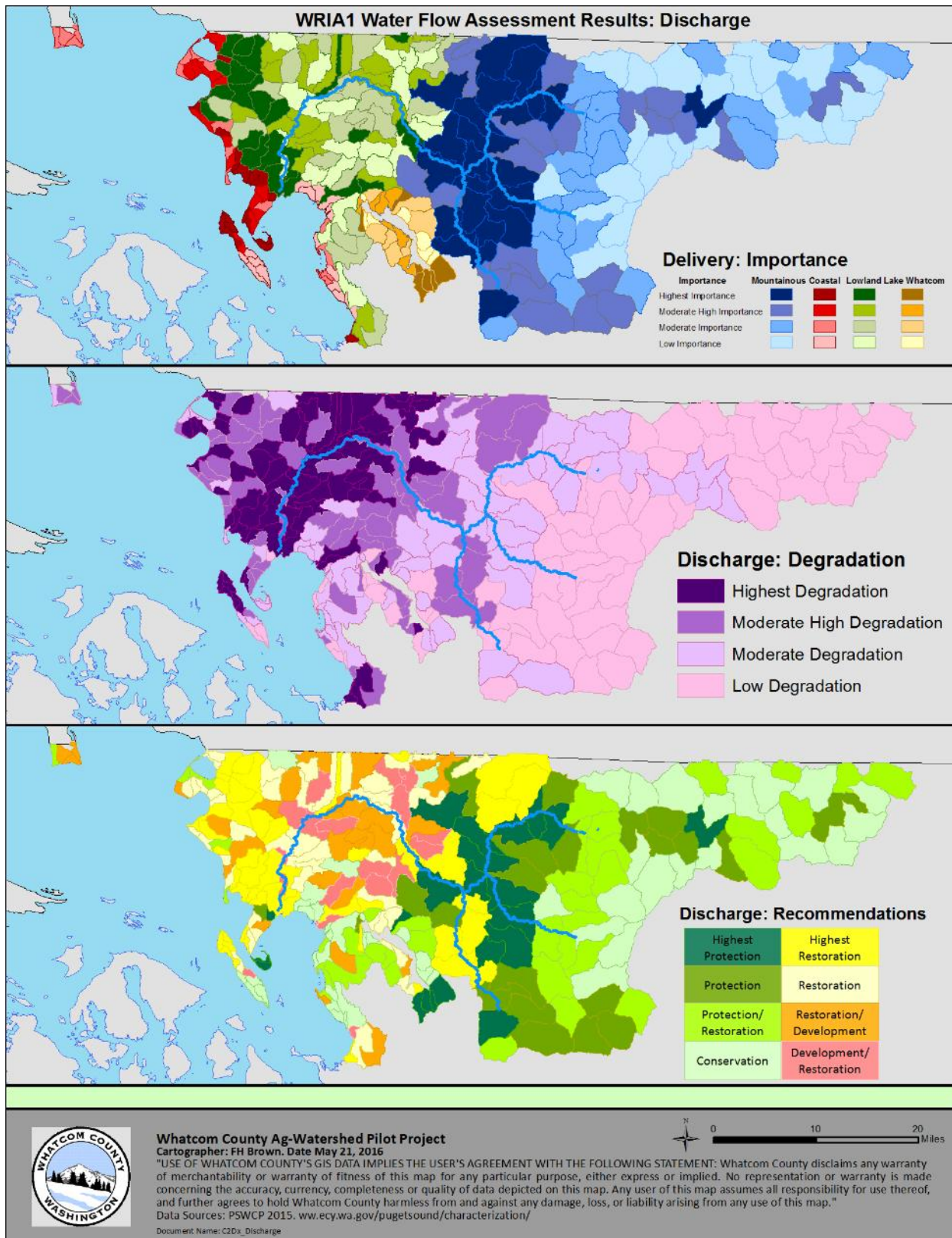


Figure 6. Discharge processes: Assessment results for WRIA1.

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.

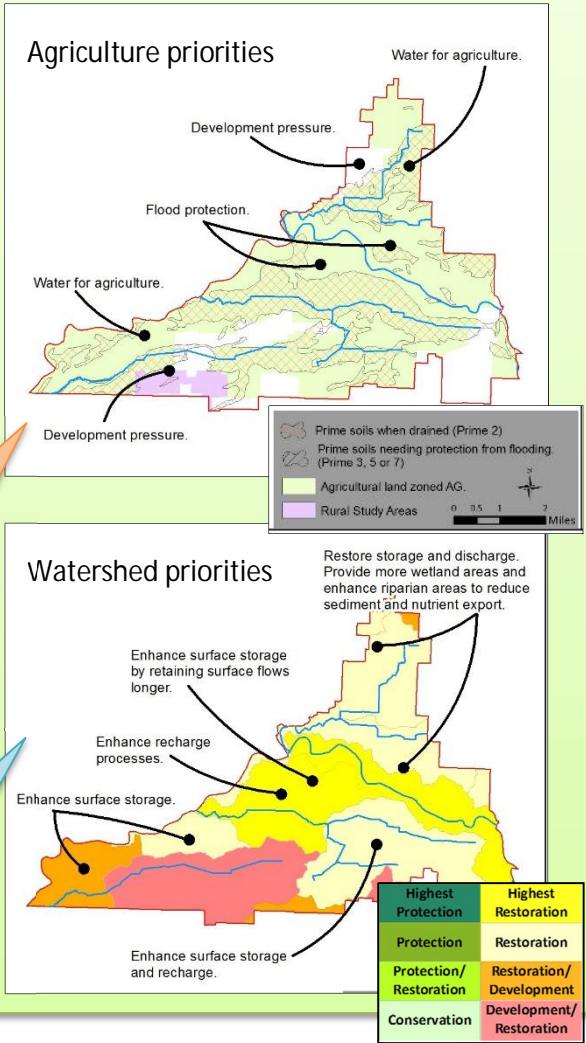


Working agricultural lands. Needs and enhancement priorities:

- 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)



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

