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

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Abbreviations used in this document

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

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

1 Introduction

1.1 Background and purpose of agriculture-watershed characterization and mapping

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

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

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

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

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

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

The agriculture-watershed characterization maps and tables combine existing spatial data with field experience and farmers' local knowledge to identify agricultural priorities and needs in the 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 - those beneficial actions that go beyond existing regulation to maintain, repair or protect large-scale watershed processes, while also strengthening agriculture in Whatcom County.

The Ag-Watershed Project is a research and development project funded by a National Estuary Program Watershed Protection and Restoration Grant (June 2012 to June 2016) to Whatcom County Planning & Development Services, administered by the Washington Department of Commerce. Project partners include: Whatcom Farm Friends–Community Education, Whatcom Conservation District and Washington 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 North 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 websites[2] or through the Ag-Watershed Project page.[3] The results of the characterization and mapping have also been incorporated into an online story map that can be accessed at http://arcg.is/29MYdYu.[4]

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[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 North 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 Figures 1 and 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 North Lynden Watershed Improvement District (see Figure 3) is located in the northern central lowland area of Whatcom County, within WRIA 1. The closest city, Lynden (pop. 12,900), is located immediately south of the WID area. Land use in the WID area is predominantly agricultural. Agriculture includes a mix of dairies, dairy corn, dairy hay, berry crops, and vegetable crops. A significant proportion of the soils in the North Lynden WID have been classified by the USDA Natural Resources Conservation Service as Prime or Prime if managed[5] (see Prime Soils reference map in Figure 21).

The North Lynden WID area encompasses 5,931 acres in total. The WID area includes the US portions of the upper and middle Fishtrap Creek drainages, which originate in Canada. Flow through Fishtrap Creek is generally north to south, entering the mainstem of the Nooksack River just south of Lynden. The US portion of Fishtrap Creek is included in Water Resource Inventory Area 1 (WRIA 1).

More information about the North Lynden WID can be found at their website http://www.northlyndenwid.com/

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

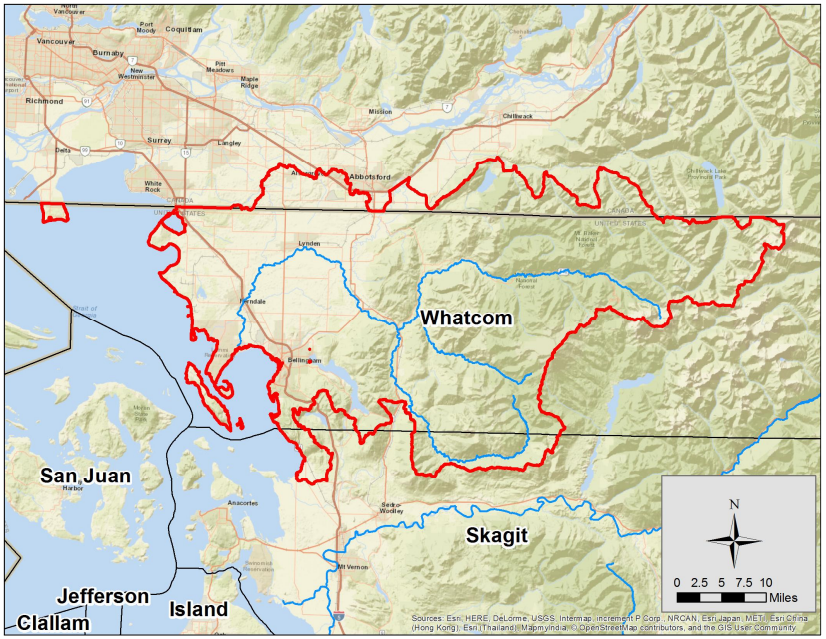

Figure 1. Regional map showing general location of Whatcom County and Water Resource Inventory Area 1 (red boundary)

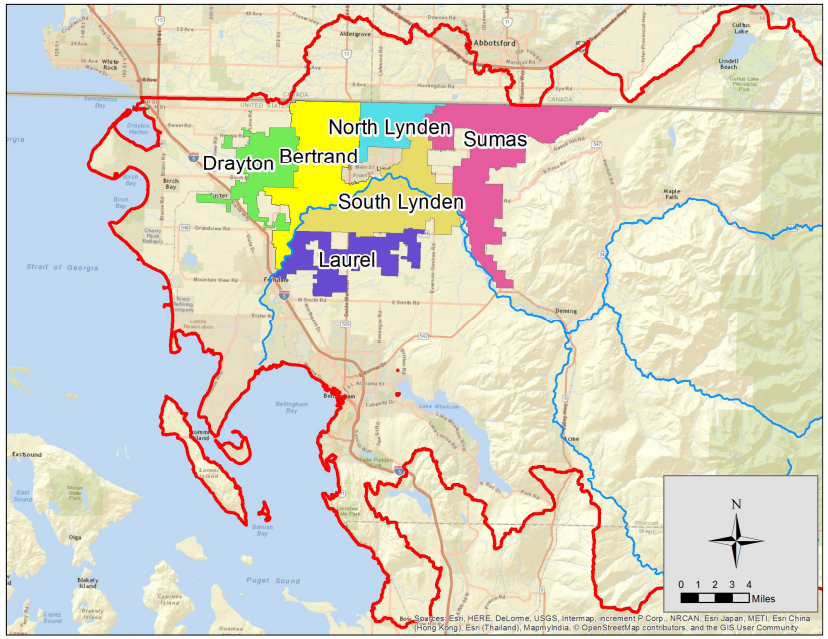

Figure 2. Map showing Water Resource Inventory Area 1 and the North Lynden Watershed Improvement District

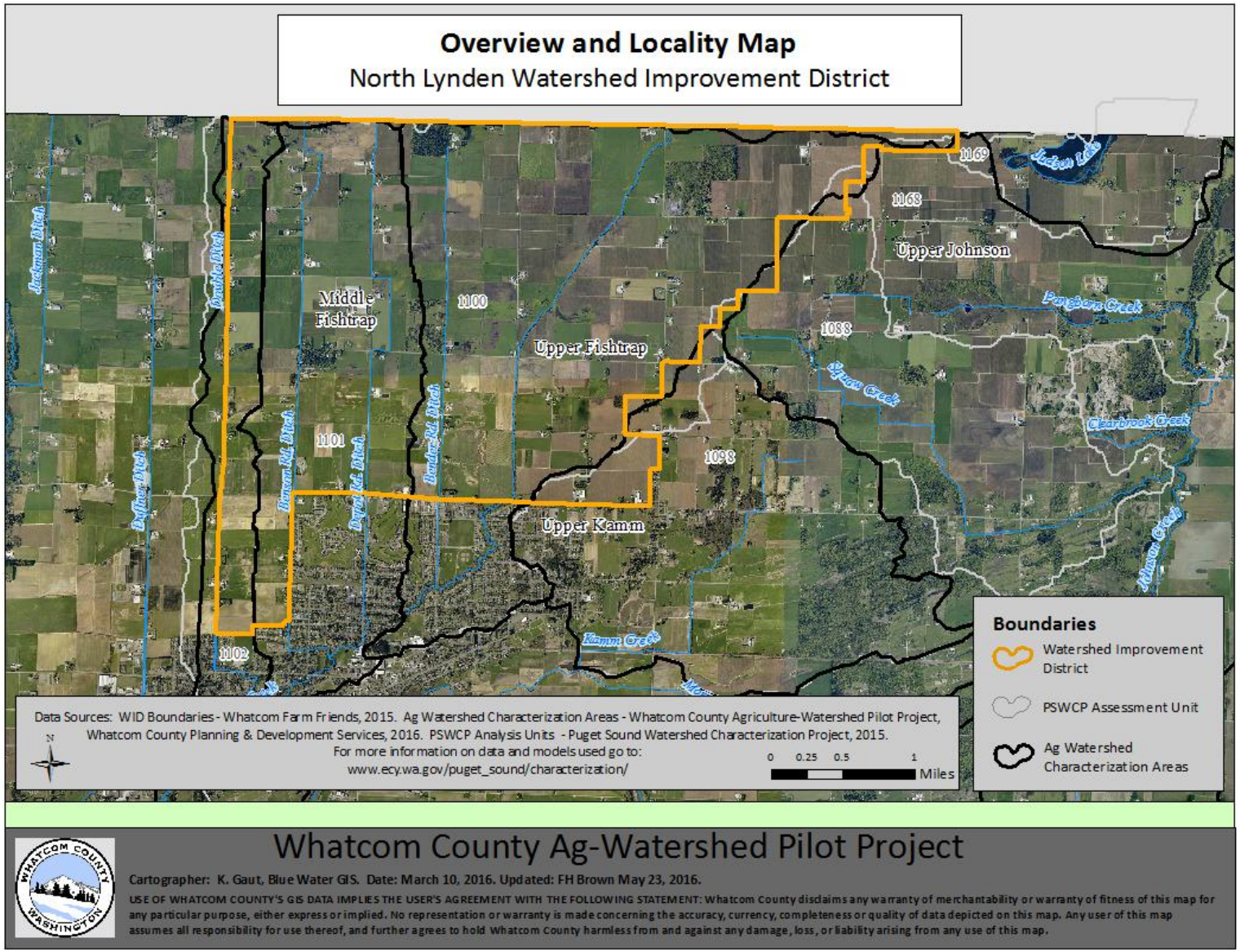

Figure 3. North Lynden WID: Overview and locality map

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 in January 2016 and has been incorporated into this agriculture-watershed characterization report for the North Lynden Watershed Improvement District.

3.2 Brief description: Methodology used for the 2016 WID characterization and mapping

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

A work session was held with landowners, WID members and technical staff of local agencies in October 2012, 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.

The results of the 2012 work session were reviewed with the WID board in January 2016, and the agricultural and watershed enhancement tables and maps were updated where necessary.

3.2.1 Watershed analysis

The results of the watershed characterization and mapping for the North 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 North Lynden WID, the information contained in the watershed reference maps (see section 5.1 of this report) was combined with the results of watershed characterization[8] (water flow assessments for WRIA 1, provided by the Department of Ecology in a series of maps showing the areas which are most in need of either restoration or protection of larger-scale water flow processes). The work session participants reviewed this information, provided additional local field knowledge

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

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

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

on site-specific watershed priorities, and identified potential actions or projects that could help to achieve watershed priorities.

A more detailed description of the methodology is provided in section 5.1 of this report.

3.2.2 Agricultural analysis

The results of the agricultural characterization and mapping for the North 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 2012 work session and by WID commissioners in 2016.

At the 2012 work session, participants assisted the project team to collate and evaluate information on agricultural system needs and priorities in the WID area, and to locate the different agricultural system needs and priorities on base maps of the WID area.

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

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

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

The characterization maps and tables should 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 North 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 North Lynden WID area. Check marks in Table 1 below indicate where a specific enhancement priority was identified during the characterization and mapping process, and the source of the data or information on that priority where appropriate. Detailed descriptions of each priority and the opportunities for enhancement through specific actions can be found in Table 3 and Table 4.

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

Agriculture-Watershed Characterization Area:	Upper Fishtrap	Middle Fishtrap	Lower Fishtrap (excluding floodplain south of Lynden)
Agricultural Enhancement Priority (See Table 3 for details)			
Prime agricultural soils	ü	ü	ü
Water quality for crops and livestock	-	-	-
Water quantity for agricultural activities	ü	-	-
Agricultural drainage	ü	ü	ü
Flood protection	ü	ü	ü
Agricultural land base:			
Important agricultural land	ü	ü	ü
Protection from development pressure	ü	ü	ü
Other:	-	-	-
Watershed Enhancement Priority (See Table 5 for details)			
Water Quality			
Nutrients, Ammonia-N	-	-	-
Bacteria	ü	ü	ü
Temperature	-	-	-
Dissolved oxygen	ü	ü	ü
Other:			ü (pesticides)
Habitat			
Salmon spawning (documented, current)	ü	-	ü
Anadromous fish	ü	ü	ü
Wildlife	ü	ü	ü
Wetland	ü	ü	ü
Water Flow Processes[9]			
Delivery	ü	ü	-
Discharge	-	ü	ü
Recharge	ü	ü	ü
Storage	ü	ü	ü
Other			

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

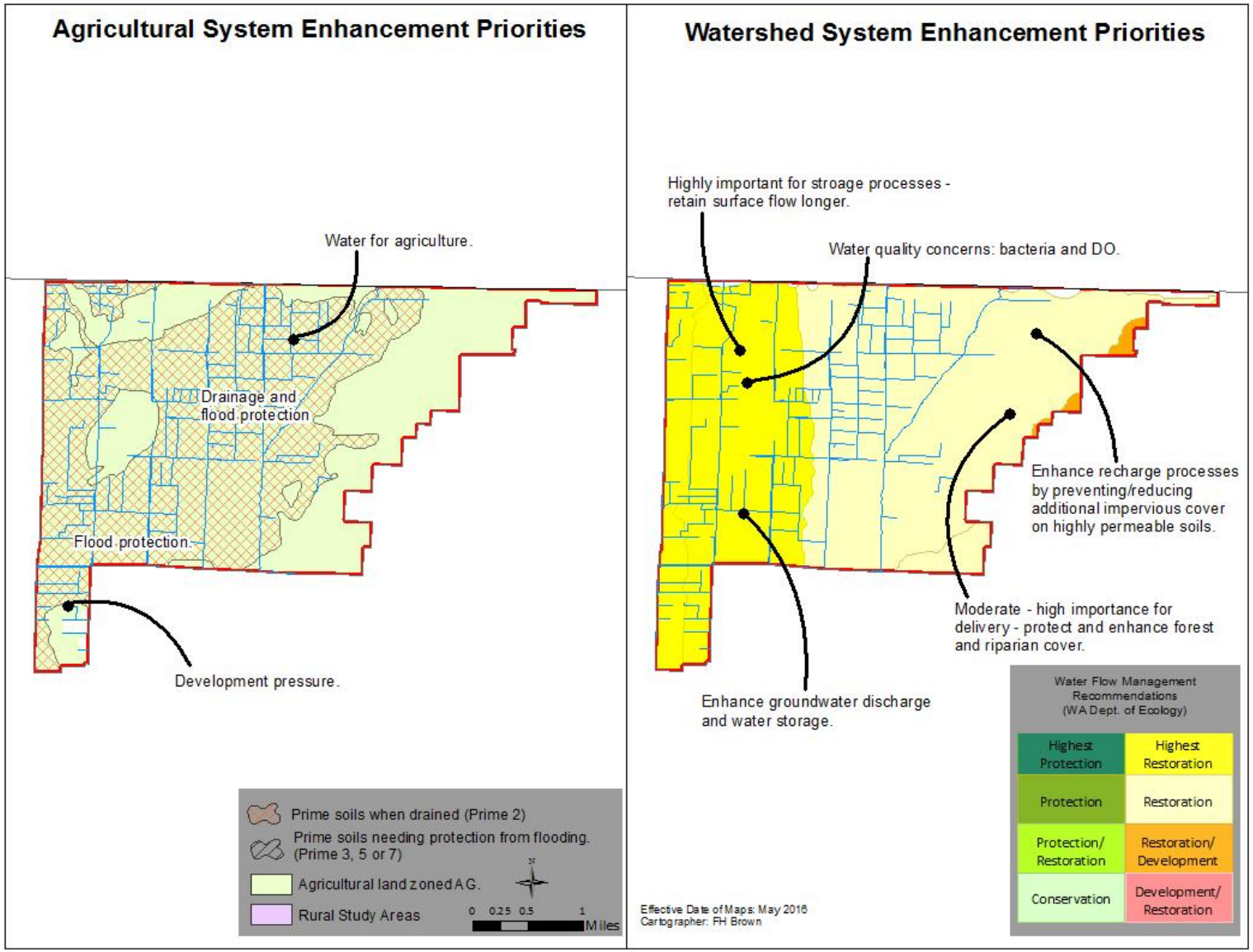

Figure 4. North Lynden WID: Summary maps of agricultural and watershed enhancement priorities

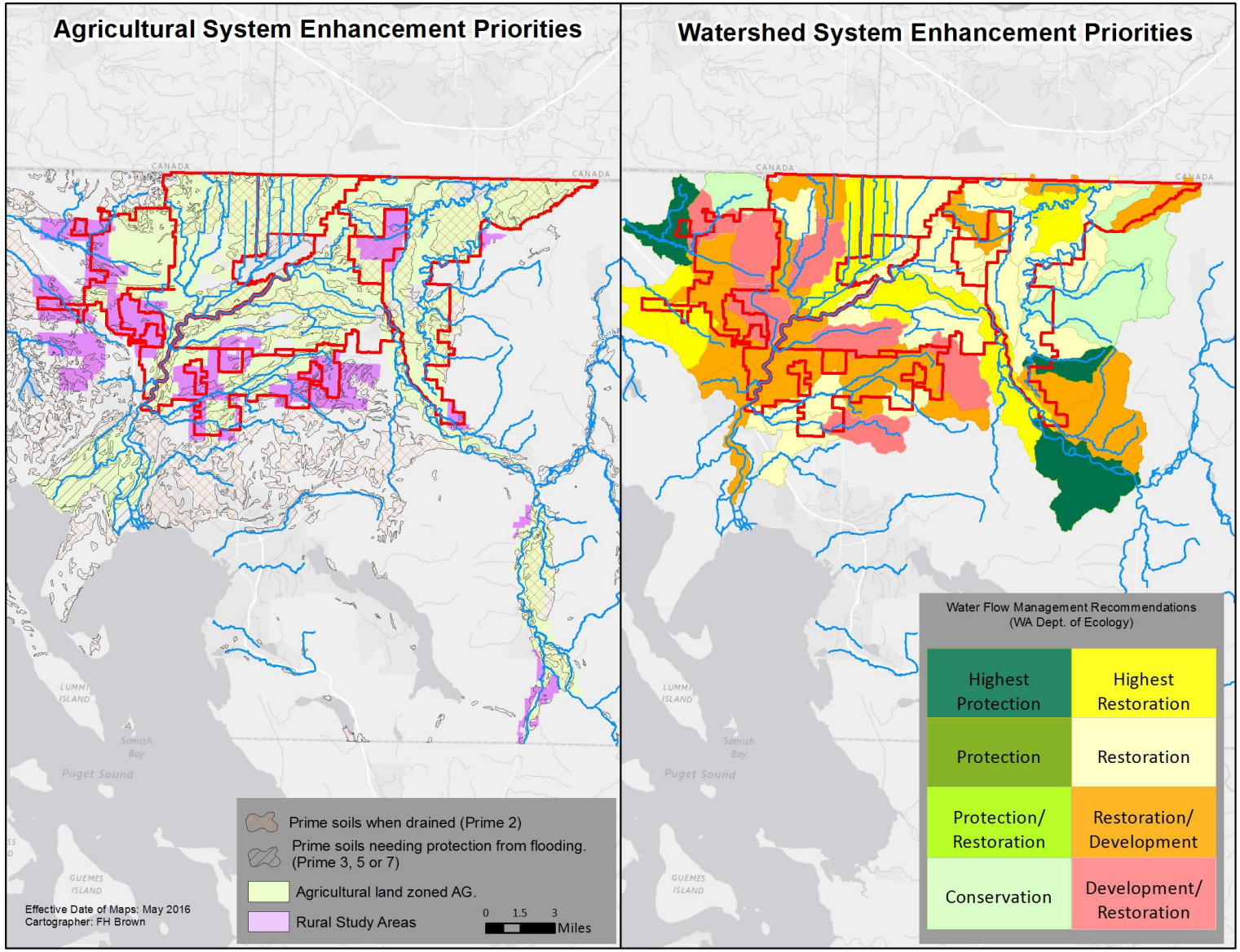

Figure 5. General agricultural and watershed enhancement priorities for the lowland areas of Whatcom County

3.5 Possible future challenges and priorities

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

- Water quantity: Access to legal irrigation water is a key priority (23 applications for new water rights have been filed in the North Lynden WID area). Fishtrap Creek is closed year round to further appropriations unless mitigated.[10] 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] The Delta Water Association, a Group A public water supplier which occupies most of the of the WID, is currently exceeding their water right limits, but south of the WID and in some small sections within the WID there are more water rights than current and future projected water demand. [12]

- Protection of agricultural land from development pressure: The North Lynden WID is located on prime farmland soils. The land in the WID area is zoned Agriculture (AG) except for the portion between Double Ditch Road and Bender Road which is in the City of Lynden's Urban Growth Area. A number of parcels have the potential for one additional dwelling unit and are smaller than the minimum lot size of 40 acres for the AG zone.

- Water quality: Elevated fecal bacteria and low dissolved oxygen levels have been recorded in surface waters throughout the WID. Potential sources of fecal bacteria include failing septic systems, livestock manure, waste from domestic pets and wildlife.[13] Widespread nitrate contamination in the Sumas Blaine aquifer which underlays the WID area is cited as a concern for agriculture in all three sub-basins.

- Drainage & flood management: Drainage and flood protection are priorities in all three sub-basins within the WID. Maintaining the effectiveness of drainage ditches is important for drainage, flooding, and water quality.

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

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

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

[13] A Rocha, City of Lynden, Lummi Natural Resources, Nooksack Tribe Natural Resources, Nooksack Salmon Enhancement Association, North Lynden WID, WA Fish and Wildlife, WA Department of Ecology, Whatcom Conservation District, 2012. *Fishtrap Creek State of the Watershed Report.* < http://arocha.us/wp-content/uploads/2012/05/Fishtrap-Creek.pdf> [last accessed June 3, 2016]

4 Agricultural characterization & mapping for the North 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,[14] 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.

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

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

A viable agricultural system relies on three kinds of infrastructure:

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

The agricultural characterization has been focused on those aspects of agricultural infrastructure that are considered to be priorities for maintaining a viable agricultural industry in Whatcom County, and that are suited to mapping. These general priorities were initially identified in the pilot agricultural characterization and mapping workshop held in Lynden in October 2012[15] 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;

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

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

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

Step 1: Delineation of Agriculture-Watershed Characterization Areas. The WID area was divided into several smaller "Agriculture-Watershed Characterization Areas" (AWCAs), based on a combination of the WRIA 1 water management areas[16] and the Puget Sound Watershed Characterization Project Assessment units (see section 5 in this report for explanation of the assessment units). The AWCAs reflect hydrological and agricultural characteristics in the landscape, are recognizable for WID members, and are of a size that is practical for the WIDs to utilize in their planning processes. Importantly, the AWCAs represent common areas within which to characterize and map both agricultural and watershed enhancement priorities.

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

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

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

- Agriculture priority areas identified in the County's Agriculture program as important agricultural land,[17] 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,[18] 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] Surface Water Delineation Boundaries in WRIA 1 (November 2002). http://wria1project.whatcomcounty.org/uploads/PDF/Maps/WRIA%201%20Watersheds%20&%20Streams%20V3_draftscreen.pdf

[17] *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

[18] 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. Work session. The work session in October 2012 included 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 Summary 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 North 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 agricultural priority, then add this in yellow highlight to the detailed agricultural characterization tables, and put a check mark in the summary table of agricultural and watershed enhancement priorities (Table 1).		
2. Modifiers: Refer to the work session participants' comments for this area to see whether their comments might modify the indicator of priority or would support a priority being added to the table, as explained below. Modify the agricultural priority indicators in summary Table 1 and detailed Table 3 as needed.		
3. Specific actions/opportunities: If the participants recommended specific actions to address priority needs, then record these in the "possible actions" column in the detailed agriculture characterization tables. Specific actions that can be tied to a specific location should be placed on the agricultural priority actions map. Specific actions that are more general can be listed in the possible actions column of the detailed agricultural characterization tables.		
Priority	Criteria for indicating priority	Modifiers
Prime agricultural soils	>50% of the area is Prime farmland (any prime soils category 1-10 according to USDA definitions for prime farmland)	-
Water quality for crops and livestock	Note WA Dept. of Ecology water quality impairments in category 5, 4a or 4b where these might affect use of the water for agricultural activities.	If work session participants noted a specific water quality issue that could affect the use of water for agricultural purposes (e.g. iron causes blockage of irrigation pipes; nitrate can be a problem for livestock), then indicate as "priority for agriculture" and crosscheck with reference documents or reference maps to substantiate if possible.
Water quantity for agricultural activities	More than 1 new application for water right in the area.	Refer to participants' comments and reference maps. If number of new applications is <3 and participants stated, with supporting evidence, that water quantity for agriculture is currently sufficient, then the priority indicator can be removed.
Agricultural drainage	>50% of the area contains Prime 2 soils (Prime if drained) Note presence of drainage district – not a modifier but indicates that drainage needs ongoing maintenance to remain effective.	Refer to participants' comments to see whether they consider drainage to be a priority (if they do not, that does not necessarily mean that drainage is not needed in the area, but probably means that if drainage infrastructure is present then it is adequately maintained). If specific actions were recommended at specific locations, then add those to the actions column.
Flood protection	Contains >5% soils that are Prime if protected from flooding, OR Contains 1 in 100-year flood area, OR Contains floodway	If only a small portion of the area contains one of the 3 criteria at left, then refer to participants' comments and if they did not consider flood protection to be a general need for the area, then the priority indicator can be removed.
Agricultural land base: · *Important agricultural land*	>50% of the area is any combination of AG zoned, Rural Study Area or PDR easement.	-
· *Protection from development pressure*	Reference maps: If a Rural Study Area is present (see ag priority areas reference map), OR If the area contains parcels with more than 2 potential additional dwelling units (development rights reference map)	Refer to participants' comments to see if they are experiencing residential-ag conflicts or pressure for conversion of agricultural land in the area and consider this to be a priority.
Other:	Refer to participants' comments. Crosscheck with reference documents or reference maps to substantiate if possible.	-

4.2 Agricultural characterization tables

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Table 3. Agriculture characterization tables for the North Lynden WID

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

3A. Agricultural Enhancement Priorities: Upper Fishtrap Creek							
	Water quantity: Irrigation, stock and processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Upper Fishtrap Creek AU1100 Notes from reference maps and other documents	10-25 new applications for water rights in Upper Fishtrap. See Ag Priorities: Water Quantity map Ag water quantity priority	Sections of Fishtrap Creek and Bender Ditch in Upper Fishtrap are in category 5[19] for DO, and category 4a[20] for bacteria.[21] Nitrate contamination is reported in groundwater over large areas of the Sumas-Blaine Aquifer.[22] Periodic high concentrations of fecal coliform have been measured in water flowing south at border sites.[23]	>50% of soil in Upper Fishtrap is prime if drained. See Ag Priorities: Drainage map. Ag drainage priority The North Lynden WID is located within the Fishtrap and Double Ditch sub-basins, and manages drainage in that area.[24]	<5% of soil is prime if protected from flooding. A section of Fishtrap Creek within Lynden is in floodway but is outside the WID. See Ag Priorities: Flooding map. Ag flood protection priority	88% of land in Upper Fishtrap is in AG Zoning. See Ag Priorities: Ag Land Base map. Ag land base priority 98% of soils are Prime in Upper Fishtrap. See Ag Priorities: Prime Soils map Prime soils priority Land is somewhat parcelized near Lynden.		
Upper Fishtrap Creek AU1100 Notes from work session in October 2012, updated January 2016	Agricultural water availability is limited by water rights	E.coli/fecal coliforms in surface water Nitrate in groundwater is an issue. Swampy area on Canadian side of the border – questions about whether this is potentially a source of fecal coliforms.	Tile drains control drainage of berry fields.	Flooding is a high priority issue here. Fishtrap Creek backs up and floods either side of the stream. More berries are being grown here, so tolerance for flooding is decreased although berry fields are generally well-drained. >6 days winter flooding is problematic between Guide Meridian & Northwood Rd. >3 days flooding between April-September is problematic from Guide Meridian to Northwood Rd..	Development pressure, since this area is just north of Lynden. Potential conflicts with residential areas due to spraying. Protection from development pressure is an ag priority		Opportunities for denitrification, sub-irrigation. (i) Possibility for placing weirs in Assink Rd ditch to store water for summer use, but only if drainage is not affected.(ii)

[19] 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)

[20] 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)

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

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

[23] Whatcom County, 2015. *Whatcom Clean Water Program Quarterly Report, April 1 – June 30, 2015.*

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

3B. Agricultural Enhancement Priorities: Middle Fishtrap Creek							
	Water quantity: Irrigation, stock and processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Middle Fishtrap Creek AU1101 Notes from reference maps and other documents	<10 new applications for water rights in Middle Fishtrap (map shows 6 new applications). See Ag Priorities: Water Quantity map	Sections of Depot Rd Ditch, Benson Rd Ditch, and Fishtrap Creek in Middle Fishtrap are in category 5 for DO, and category 4a for bacteria.[25] Nitrate contamination is reported in groundwater over large areas of the Sumas-Blaine Aquifer.[26]	>50% of soil in Middle Fishtrap is prime if drained. See Ag Priorities: Drainage map. Ag drainage priority The North Lynden WID is located within the Fishtrap and Double Ditch sub-basins, and manages drainage in that area.[27]	<5% of soil is prime if protected from flooding. A section of Fishtrap Creek within Lynden is in floodway but is outside the WID. See Ag Priorities: Flooding map.	66% of land in Middle Fishtrap Middle is in AG Zoning. See, Ag Priorities: Ag Land Base map. Ag land base priority 93% of soils in Middle Fishtrap are Prime. See Ag Priorities: Prime Soils map Prime soils priority City of Lynden UGA extends to Double Ditch Rd. See Ag reference map: Agriculture Priority Areas. Protection from development pressure is an ag priority		
Middle Fishtrap Creek AU1101 Notes from work session in October 2012, updated January 2016	Not currently limited by water rights.	E.coli/fecal coliforms in surface water. Nitrate in groundwater.		Flood drainage backs up at Double Ditch & Badger rds. Ag flood protection priority Pepin Creek rerouting project should relieve some of the flooding problems in this area.	More berries, less dairy now. Commercial Ag right up to Badger Road. High potential for ag-residential conflict without a buffer. New plats in this area and new city park, but Right to Farm ordinance applies. UGA & UGA Reserve: in the near future this ag land will be converted to urban.		

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

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

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

3C. Ag Enhancement Priorities: Lower Fishtrap Creek (north of Main Street)							
	Water quantity: Irrigation, stock and processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Lower Fishtrap Creek AU1102 Notes from reference maps and other documents	<10 new applications for water rights in Lower Fishtrap (map shows 4 new applications in WID area). See Ag Priorities: Water Quantity map	Sections of Double Ditch Drain in Fishtrap Lower are in category 5 for DO, and category 4a for bacteria.[28] Nitrate contamination is reported in groundwater over large areas of the Sumas-Blaine Aquifer.[29]	>50% of soil in Fishtrap Lower is prime if drained. See Ag Priorities: Drainage map. Ag drainage priority The North Lynden WID is located within the Fishtrap and Double Ditch sub-basins, and manages drainage in that area.[30]	<5% of soil is prime if protected from flooding. A section of Fishtrap Creek within Lynden is in floodway but is outside the WID. See Ag Priorities: Flooding map.	70% of land in Lower Fishtrap is in AG Zoning. See Ag Priorities: Ag Land Base map. Ag land base priority. 90% of soils in Lower Fishtrap are Prime. See Ag Priorities: Prime Soils map Prime soils priority City of Lynden UGA extends to Double Ditch Rd. See Ag reference map: Agriculture Priority Areas. Protection from development pressure is an ag priority		
Lower Fishtrap Creek AU1102 Notes from work session in October 2012, updated January 2016	Not currently limited by water rights.	E.coli/fecal coliforms in surface water. Nitrate in groundwater.		Flood drainage backs up at Double Ditch & Badger rds. Ag flood protection priority Pepin Creek rerouting project should relieve some of the flooding problems in this area.	Fewer cows & dairy, some increase in berries. This area is shifting from ag to urban growth and conversion of land for the Pepin Creek reroute.		

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

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

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

4.3 Agricultural priorities: Summary maps

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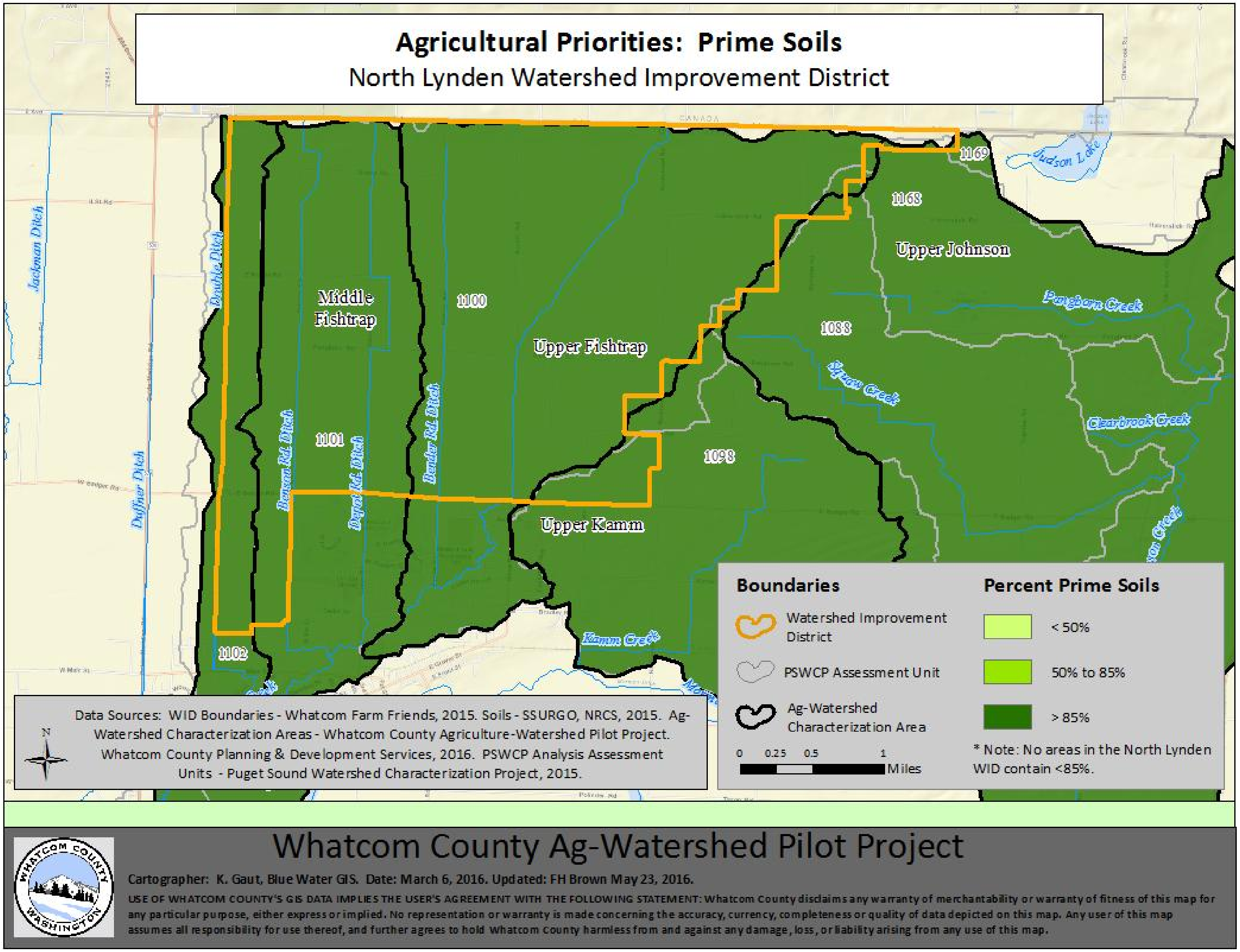

Figure 6. North Lynden WID agricultural priorities: Proportion of prime soils. Data from reference map of prime soils

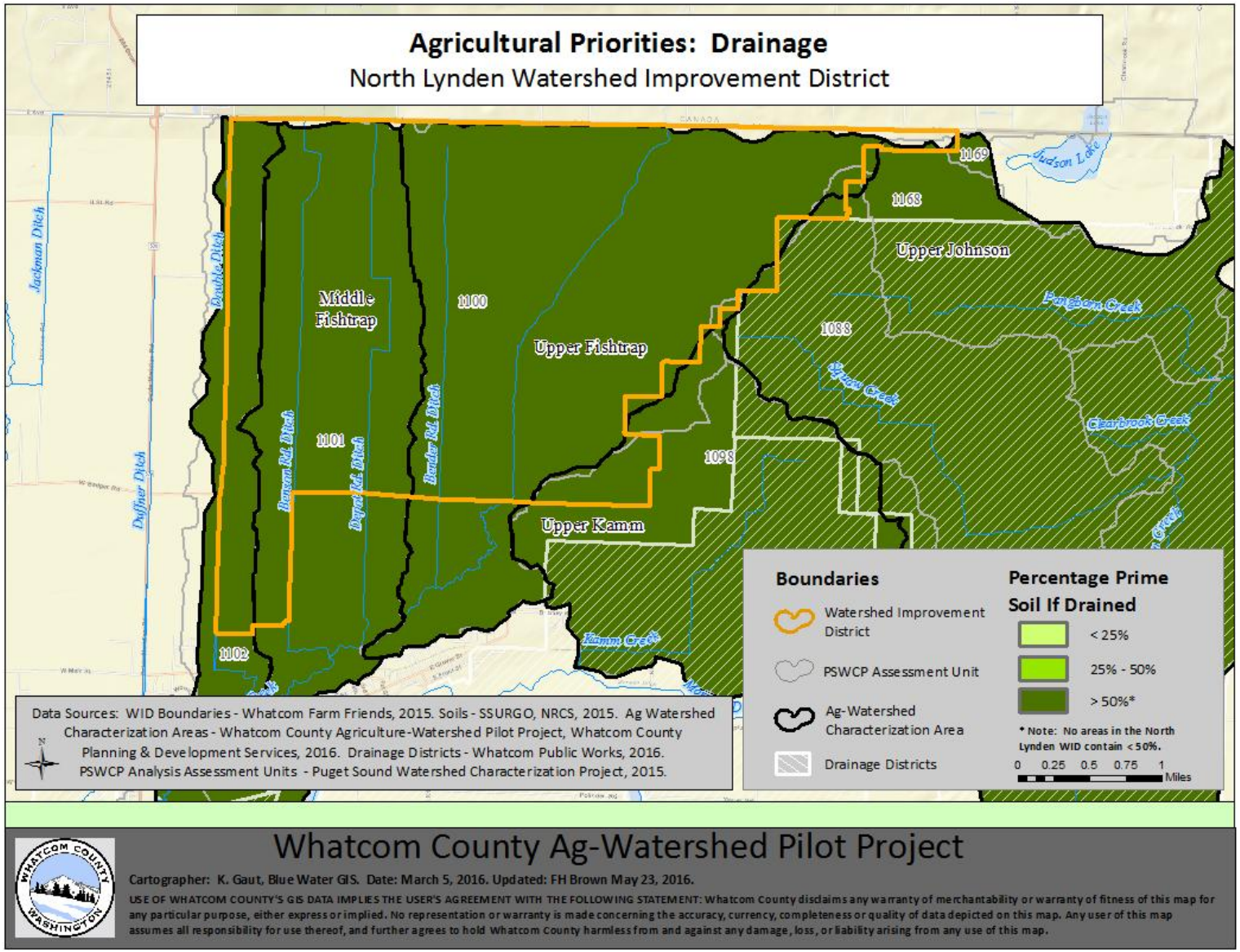

Figure 7. North Lynden WID agricultural priorities: Drainage of agricultural land. Data from reference maps of prime soils and special districts

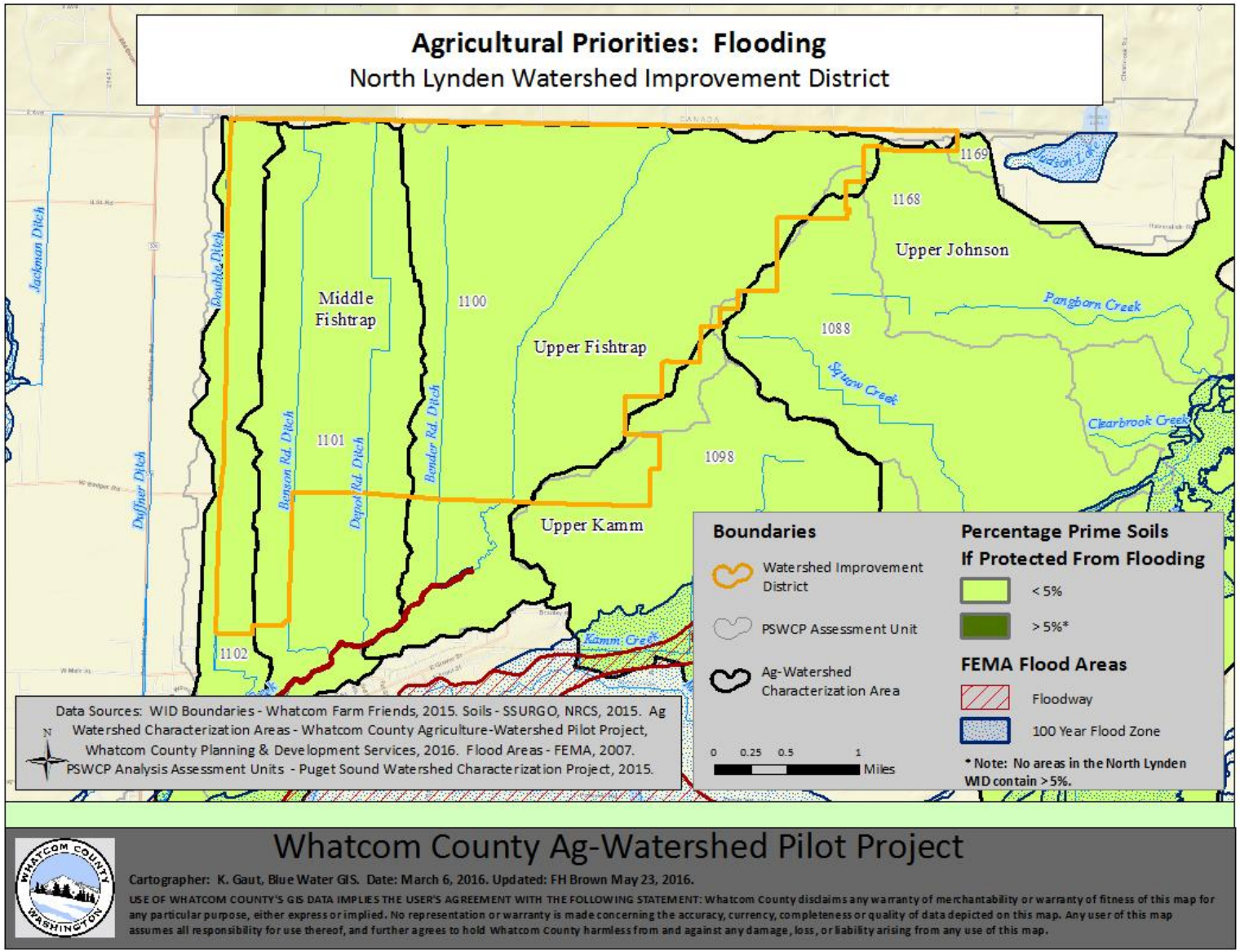

Figure 8. North Lynden WID agricultural priorities: Protection from flooding. Data from reference maps on prime soils and special districts

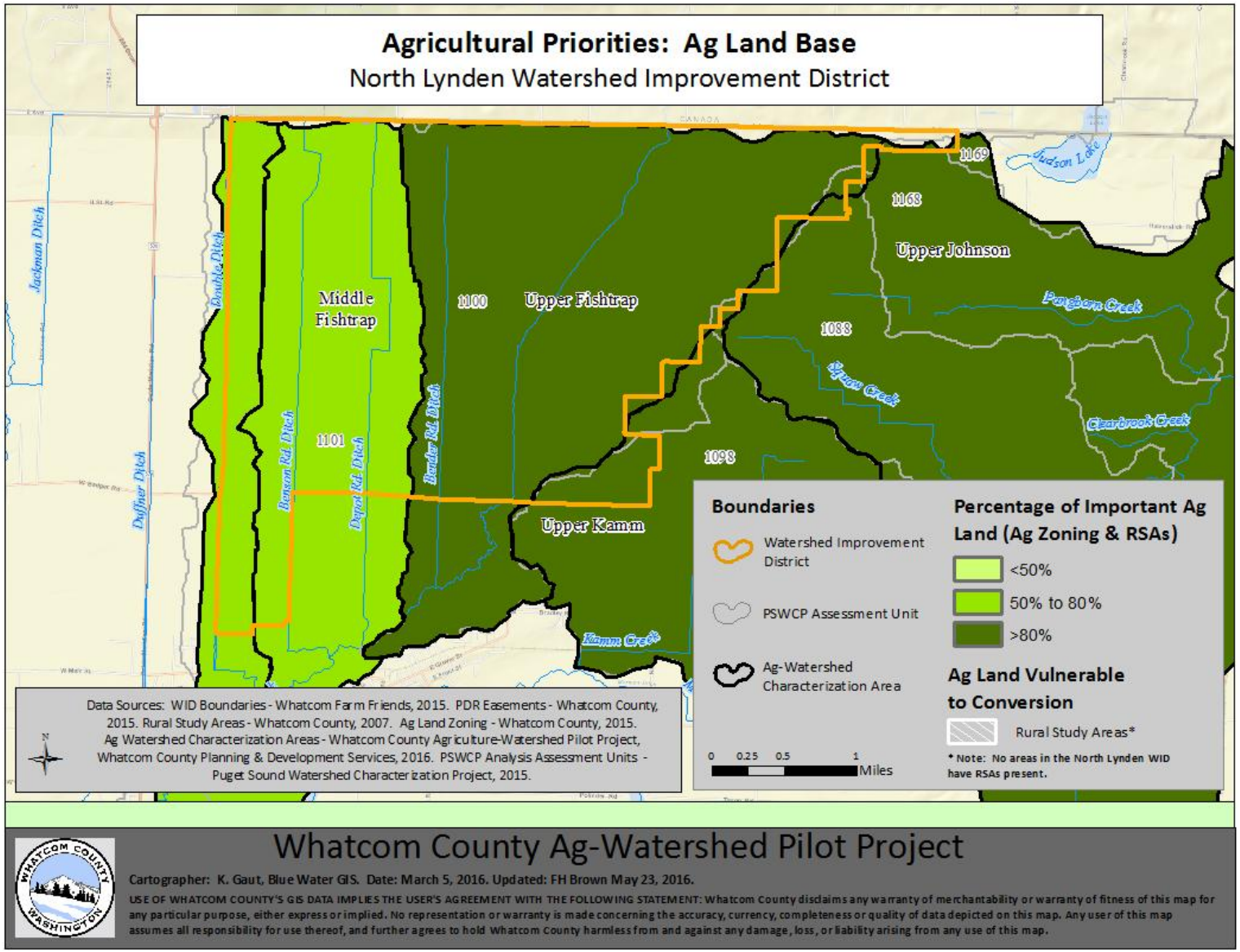

Figure 9. North Lynden WID agricultural priorities: Protection of the agricultural land base. Data from reference map of agricultural priority areas

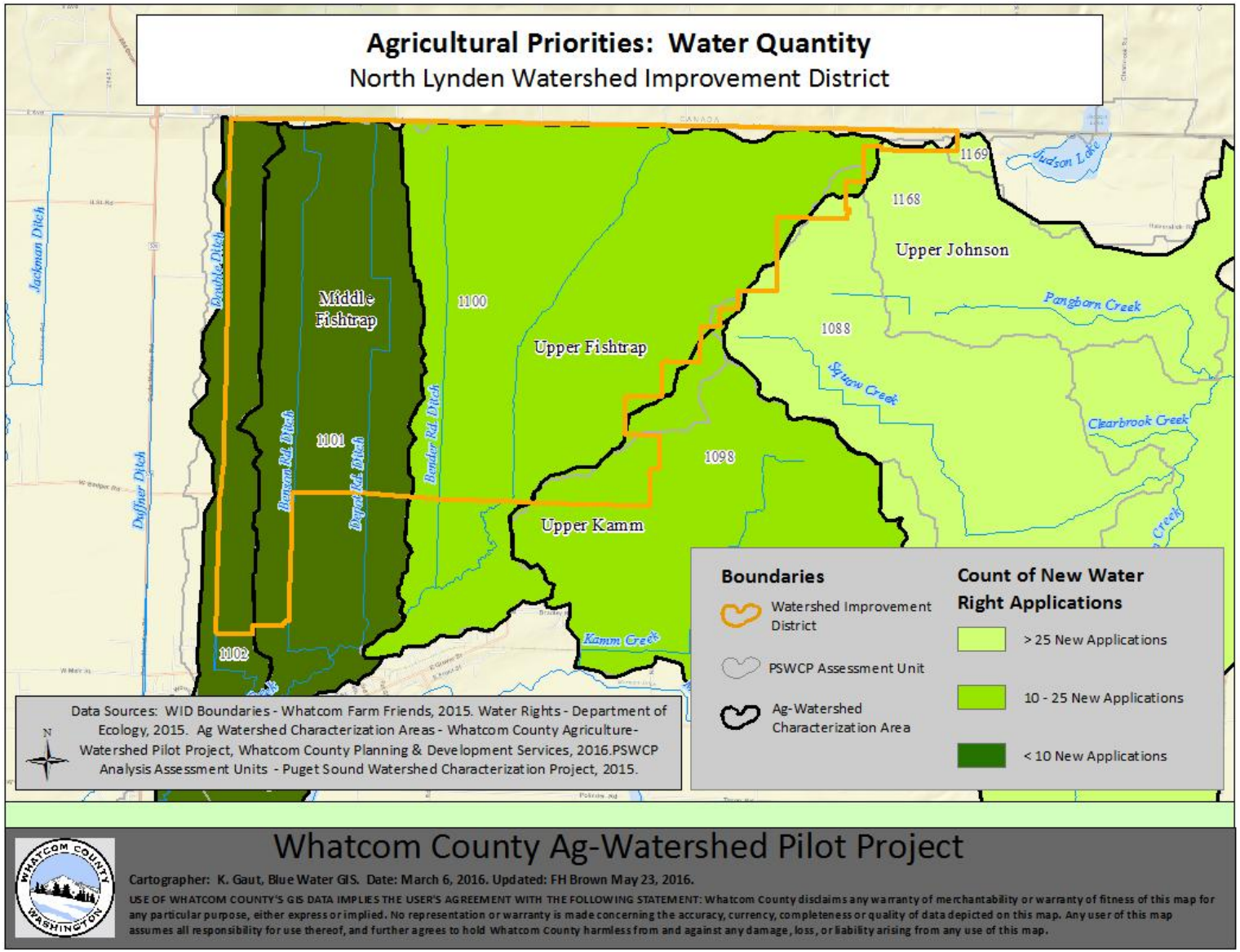

Figure 10. North Lynden WID agricultural priorities: Water for agricultural activities. Data from reference map on water right points of diversion

4.4 Agricultural priorities: Specific actions map

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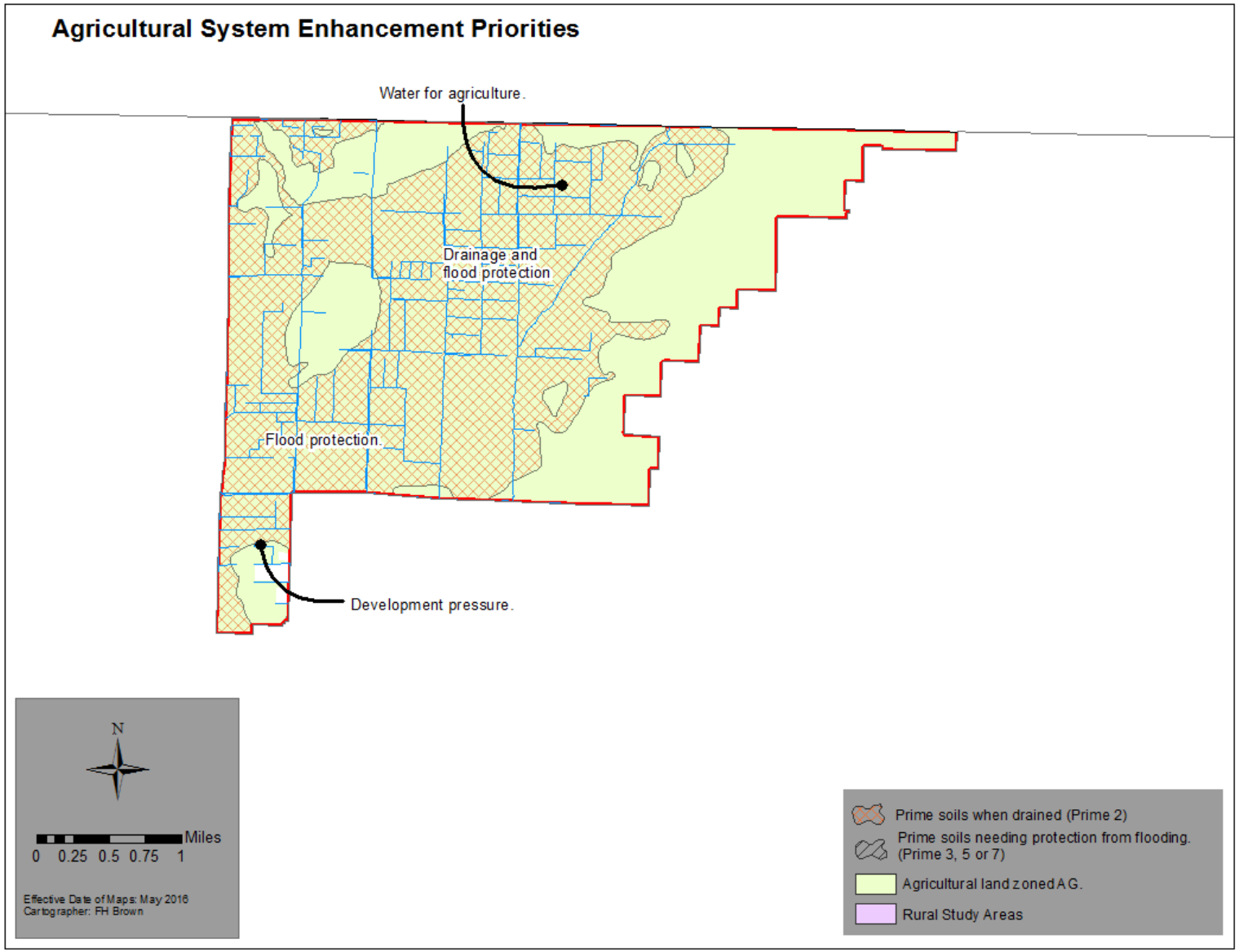

Figure 11. North Lynden WID: Summary map of agricultural priorities

5 Watershed characterization and mapping for the North 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.[31]

5.1.1 General approach

The watershed characterization assessment uses methods developed by the Puget Sound Watershed Characterization Project.[32] The results of the watershed characterization assessment are intended to assist the WIDs in identifying high priority opportunities for watershed enhancement projects on agricultural land in the lowland areas of Whatcom County, with a focus in areas where watershed and agricultural priorities could be mutually reinforcing.

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

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

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

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

[31] 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

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

5.1.2 Limitations

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

- The Puget Sound Watershed Characterization is for planning purposes only. This does not affect or alter existing land use/environmental regulations although it may be used to help inform future land use and regulatory decisions.
- For the water flow assessment, the rankings for any single AU are relative only to other AUs in the area of analysis. This means it is only appropriate to compare the WID results with results in other AUs in the lowland area of WRIA 1.
- Results at the AU scale represent land-use planning-level information. At the project- or site scale, each AU will have a combination of on-the-ground challenges and opportunities. Just because an AU is rated as a low priority for restoration does not mean there are no suitable restoration sites or opportunities in that AU. Similarly, not every site in an AU that is a high priority for restoration will be suitable for restoration.
- The assessments are landscape-scale and consequently do not address site-specific issues. These are best addressed through finer-scale studies, which will remain essential to the success of local conservation efforts. When developing site-level plans, the WID should evaluate the need for finer-scale information and collect it where needed.

The watershed characterization assessment is not intended to address compliance with state or federal water quality law, nor describe the actions necessary to achieve compliance with those laws. It is a violation of state law when activities are shown to cause or have the substantial potential to cause nonpoint source pollution. If the reader has questions about the water quality laws, they can contact Whatcom County Public Works or the WA Department of Ecology for additional information.

5.1.3 Fundamental concepts of watershed characterization

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

5.1.4 Understanding the water flow assessment results

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

Water flow importance

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

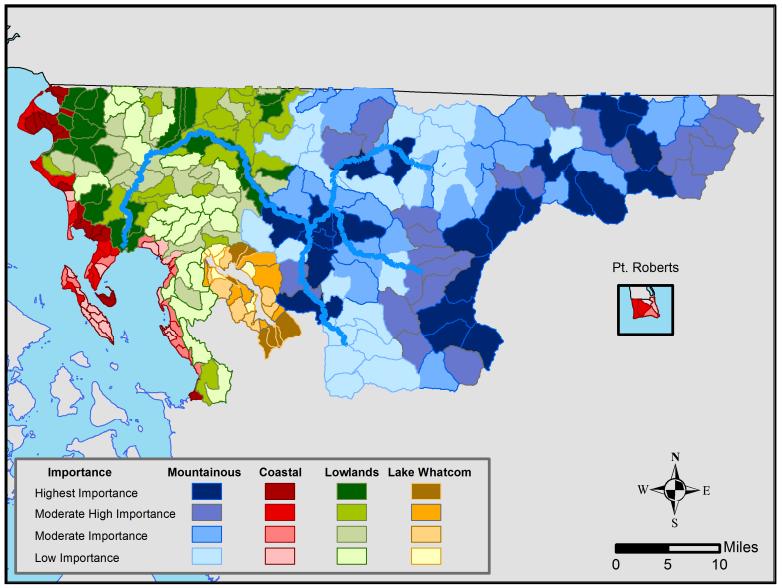

Figure. Overall importance to water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA 1. Darkest colored assessment units are considered highest *importance* relative to other assessment units in the same landscape group of WRIA 1.

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

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

Water flow degradation

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

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

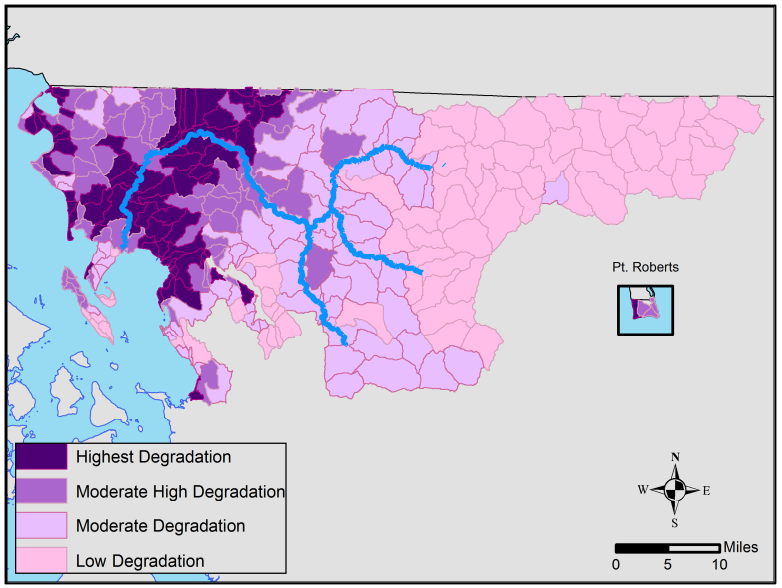

Figure. Overall degradation of water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA 1. Dark pink assessment units are considered to have the highest *degradation* relative to other assessment units in WRIA 1.

Management matrix for water flow

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

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

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

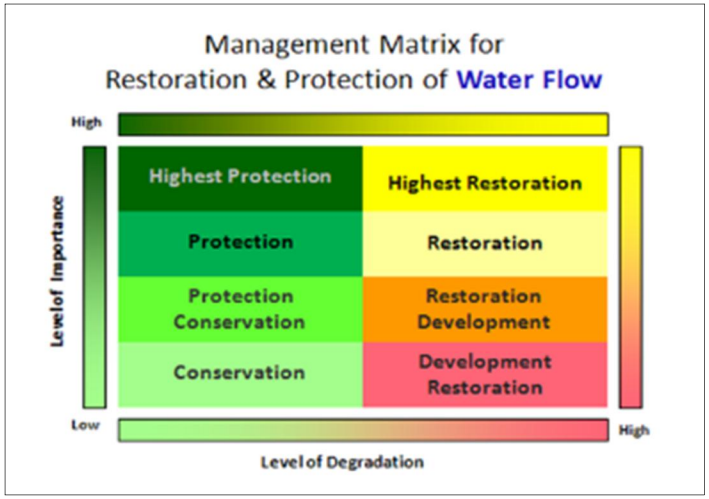

Figure. Management matrix for water flow, indicating relative priorities for restoration and protection of processes

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

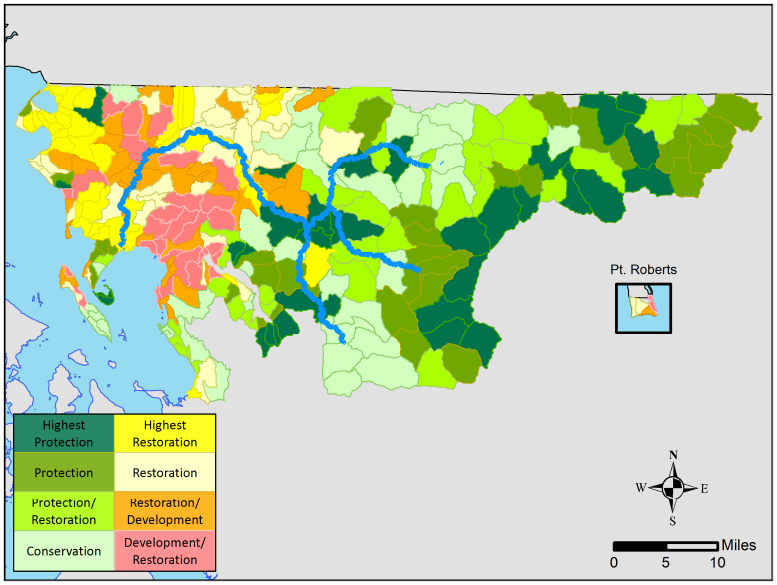

Figure. Overall priorities for restoration and protection of water flow processes in WRIA 1: Results of Puget Sound Watershed Characterization assessment.

5.1.5 Using the results of the water flow assessment

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

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

There are actions which can offer mutual benefits to both water flow and water quality. For example, there are some areas where wetland restoration or enhancement to surface storage processes could provide some improvements for both. The potential enhancement actions suggested in Table 4 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 4. Watershed characterization tables for the North Lynden WID

4A. Watershed Enhancement Priorities: Upper Fishtrap				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Upper Fishtrap AU1100 & small portion of AU1098 (October 2012 results + 2016 updates)	Critical Habitat: Bald Eagle, wetland Bald eagle nesting areas (See reference map: Priority Habitats & Species) Low relative conservation value (See reference map: Conservation values) Low wildlife habitat suitability (WDFW, 2007)[33]	Chinook spawning on Double ditch and on east fork of Fishtrap, also chum, coho, pink, bull trout, steelhead[34] Sea-run cutthroat, and resident trout (Review Committee, NSEA) Low summer flows reported in the Canadian portion of the Fishtrap watershed (~1cfs).	Sections of Fishtrap Creek and Bender Ditch in Upper Fishtrap are in category 5[35] for DO, and category 4a[36] for bacteria.[37]	Results of PSWC water flow assessment: Due to the presence of extensive hydric soils and low gradient, this area is moderate-high to high importance for surface storage and recharge; moderate to high for discharge processes. All water flow processes are highly degraded as indicated by loss of wetlands, and alteration of recharge and discharge processes. Summary: This area is highly important to water flow processes and also highly degraded. Draining, filling and dredging of wetland and stream habitat have impacted storage and discharge processes particularly. Several tributaries are impaired for DO and Bacteria which suggest a relationship to impaired storage (wetlands), sediment (phosphorous & bacteria adsorption) and nitrogen processes (degradation of denitrification areas (e.g. saturated soils and wetlands). ESA listed species are present. Potential for Enhancement: Investigate measures to restore storage, and discharge processes. Focus on source control for water quality impairments. Improve riparian habitat and associated connectivity.

[33] WDFW (2007). *Western Whatcom County Wildlife Habitat Assessment and Significant Biological Areas.* Cited in Gill (2013). Not seen in the original.

[34] Fish Habitat Technical Team (2003). *Fish Presence- WRIA 1 Salmonid Distribution*. Retrieved 2012, from WRIA 1 Salmon Recovery: http://whatcomsalmon.whatcomcounty.org/maps-fishpresence-chum.html

[35] 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)

[36] 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)

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

4B. Watershed Enhancement Priorities: Middle Fishtrap				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Upper Fishtrap AU1101 (October 2012 results + 2016 updates)	Critical Habitat: Bald Eagle, wetland Low relative conservation value (See reference map: Conservation values) Low wildlife habitat suitability (WDFW, 2007)[38]	Fishtrap mainstem contains fall Chinook, chum, coho, steelhead, cutthroat trout, lamprey, stickleback, Salish sucker, and Nooksack dace. Older maps show spawning and rearing for Chinook[39] but spawning is not shown as currently documented in the tributaries (Bender, Depot & Benson Rd ditches) in the WDFW SalmonScape maps. Partial fish barrier may still exist within City of Lynden.	Fecal coliform levels exceed state water quality standards in Fishtrap Creek at Main Street (station F4)[40] Temperature is a concern downstream (category 5 at Flynn Road)[41] but no listing within the WID area of the watershed. Sections of Depot Rd Ditch, Benson Rd Ditch, and Fishtrap Creek in Middle Fishtrap are in category 5 for DO, and category 4a for bacteria.[42]	Results of PSWC water flow assessment: An area of high importance for surface storage and moderately high importance for all other flow processes. Overall water flow processes are highly degraded. Summary: This area is highly important to water flow processes and also highly degraded. Draining, filling and dredging of wetland and stream habitat have impacted storage and discharge processes particularly. Several tributaries are impaired for DO and Bacteria which suggest a relationship to impaired storage (wetlands), sediment (phosphorous & bacteria adsorption) and nitrogen processes (degradation of denitrification areas (e.g. saturated soils and wetlands)). ESA listed species are present. Potential for Enhancement: Investigate measures to restore storage (wetlands), and discharge, processes. Focus on source control for water quality impairments. Wetlands should be restored.

[38] WDFW (2007). *Western Whatcom County Wildlife Habitat Assessment and Significant Biological Areas.* Cited in Gill (2013). Not seen in the original.
[39] Watts S. (1994). *Fish and Wildlife Habitat Atlas of Whatcom County*. Whatcom County Planning & Development Services.
[40] Whatcom County, 2016. *Nooksack River Watershed Water Quality Status, Fecal Coliform Bacteria March 2016.* http://www.whatcomcounty.us/DocumentCenter/View/16735 [last accessed May 10, 2016]
[41] Ecology, 2012. *Water Quality Assessment for Washington.* <http://www.ecy.wa.gov/programs/Wq/303d/index.html>
[42] Ecology, 2012. *Water Quality Assessment for Washington.* <http://www.ecy.wa.gov/programs/Wq/303d/index.html>

4C. Watershed Enhancement Priorities: Lower Fishtrap (north of Main Street)				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Lower Fishtrap (north of Main Street) AU1102 (October 2012 results + 2016 updates)	Critical Habitat: Bald Eagle, wetland Wildlife Atlas identifies swan and waterfowl habitat in floodplain, and concentration area for shorebirds and Eagle nesting areas at confluence with the Nooksack River.[43] Low relative conservation value (See reference map: Conservation values) Low wildlife habitat suitability (WDFW, 2007)[44]	Chinook rearing and spawning is best in the BC portion of Double Ditch. Documented Fall Chinook and winter steelhead spawning in lower Fishtrap AWCA[45] Fishtrap mainstem contains fall Chinook, chum, coho, steelhead, cutthroat trout, lamprey, stickleback, Salish sucker, and Nooksack dace.	Fecal coliform levels exceed state water quality standards in Double Ditch (stations DDW, DDE, & F3)[46] Pesticide contamination including DDE, Alpha-BHC, Chlorpyrifos, Deldrin, Gamma-bhc (Lindane), and Parathion.[47] Sections of Double Ditch Drain in Fishtrap Lower are in category 5 for DO, and category 4a for bacteria.[48] Temperature is a concern downstream (category 5 at Flynn Road)[49] but no listing within the WID area of the watershed.	<u>Results of PSWC water flow assessment</u>: Area is of high importance for overall water flow processes- relative to other areas of lowland WRIA. Due to the presence of extensive hydric soils and low gradient, this area is of high importance for storage; moderate to high for discharge and recharge processes. Overall Water Flow processes are highly degraded as indicated by loss of wetlands, and high relative alteration of all components <u>Summary:</u> This area is highly important to water flow processes and also highly degraded. Draining, filling and dredging of wetland and stream habitat have impacted storage and discharge processes particularly. Several tributaries are impaired for DO and Bacteria. ESA listed species are present. <u>Potential for Enhancement</u>: Investigate measures to restore storage (wetlands) and discharge areas. Focus on source control and delivery reduction for water quality impairments. Improve riparian habitat (buffers) to address temperature impairments.

[43] Watts S. (1994). *Fish and Wildlife Habitat Atlas of Whatcom County*. Whatcom County Planning & Development Services.
[44] WDFW (2007). *Western Whatcom County Wildlife Habitat Assessment and Significant Biological Areas.* Cited in Gill (2013). Not seen in the original.
[45] WDFW, n.d. SalmonScape [interactive webmap] <http://apps.wdfw.wa.gov/salmonscape/> [last accessed May 04, 2016]
[46] Whatcom County, 2016. *Nooksack River Watershed Water Quality Status, Fecal Coliform Bacteria March 2016.* http://www.whatcomcounty.us/DocumentCenter/View/16735 [last accessed May 10, 2016]
[47] NW Washington A Rocha, 2012. *Fishtrap Creek State of the Watershed Report.* WA ECY and NSEA. < http://arocha.us/wp-content/uploads/2012/05/Fishtrap-Creek.pdf> [last accessed May 10, 2016]
[48] Ecology, 2012. *Water Quality Assessment for Washington.* <http://www.ecy.wa.gov/programs/Wq/303d/index.html>
[49] 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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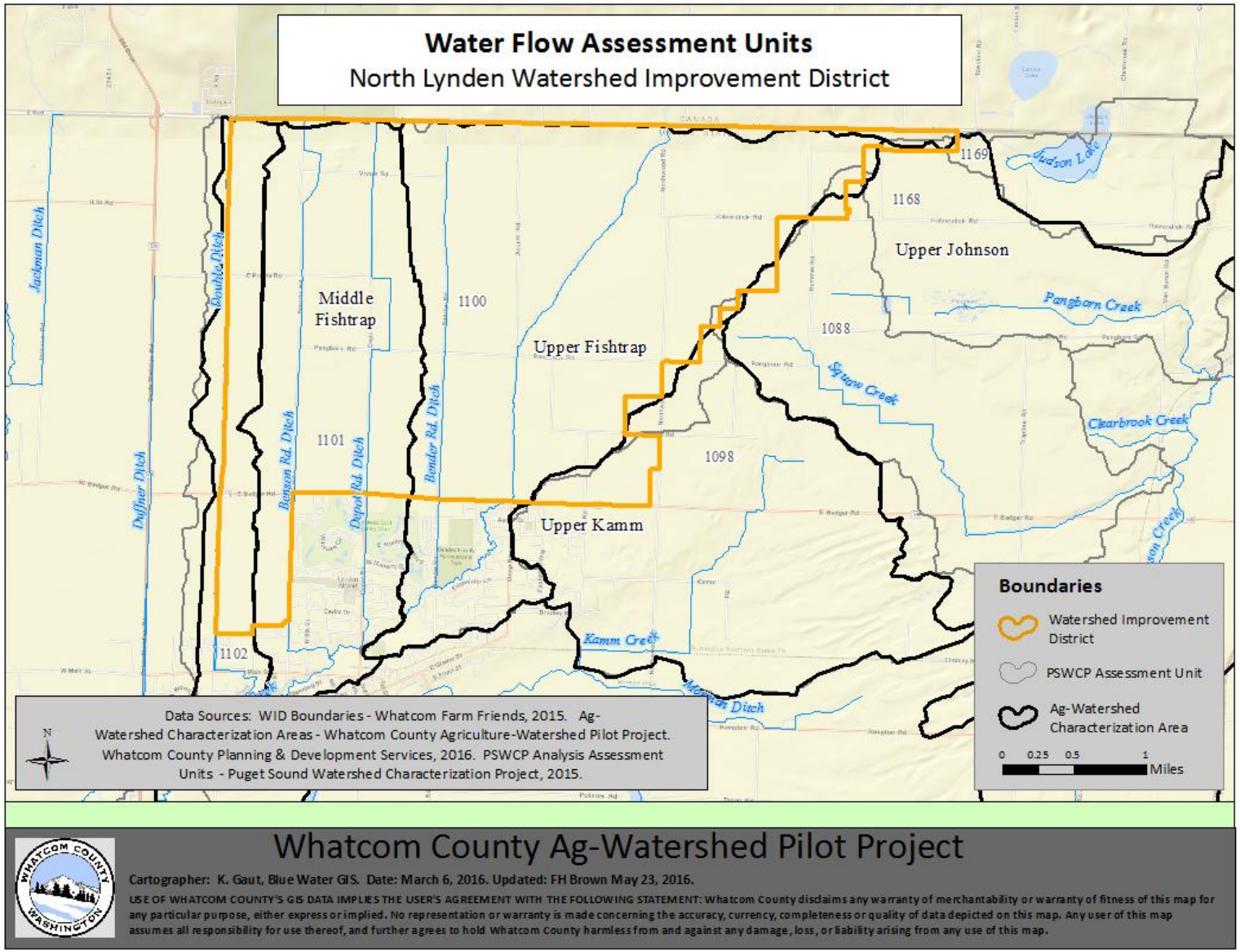

Figure 12. North Lynden WID: Water flow assessment units in relation to the WID area

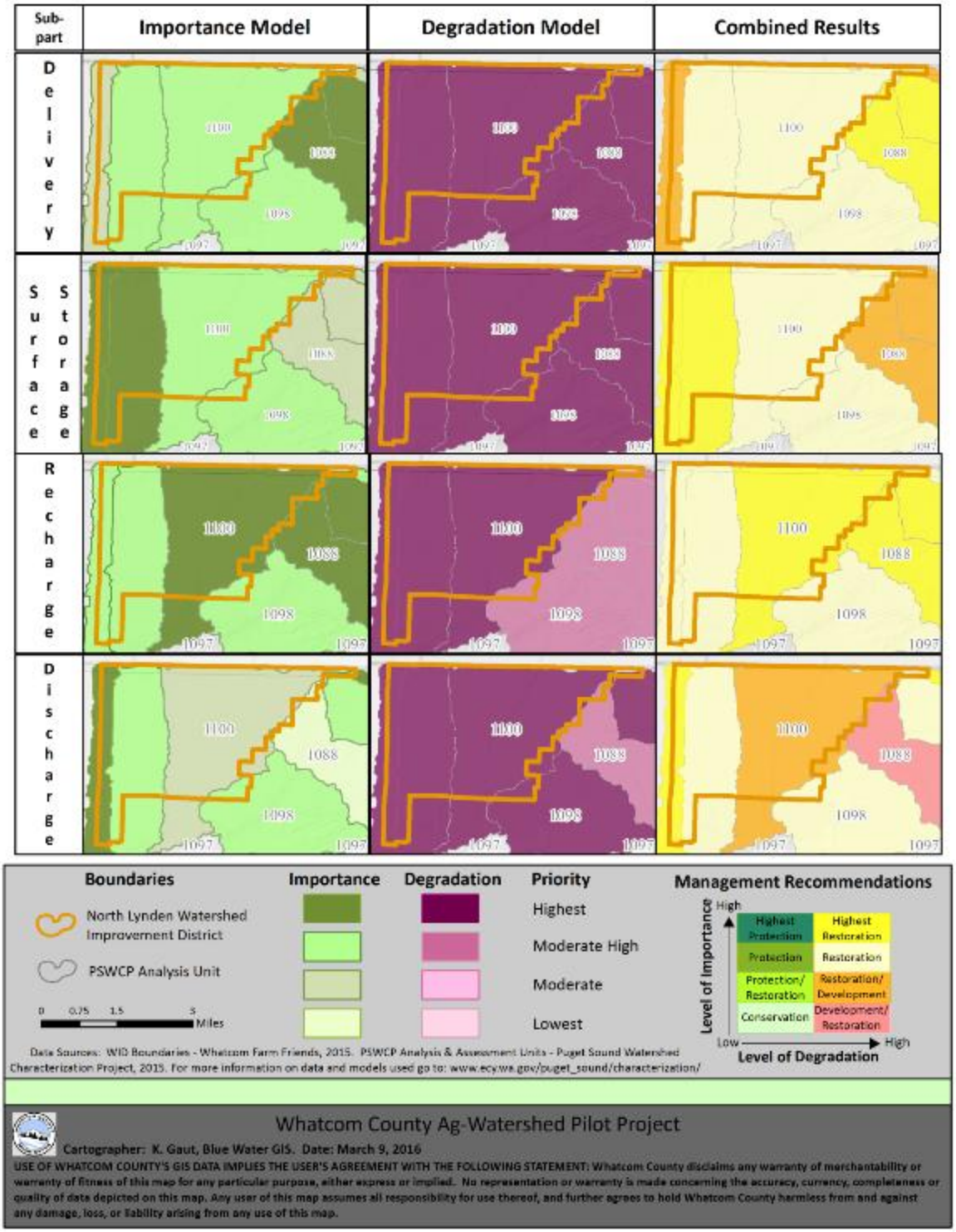

Figure 13. North Lynden WID: Water flow process assessment results

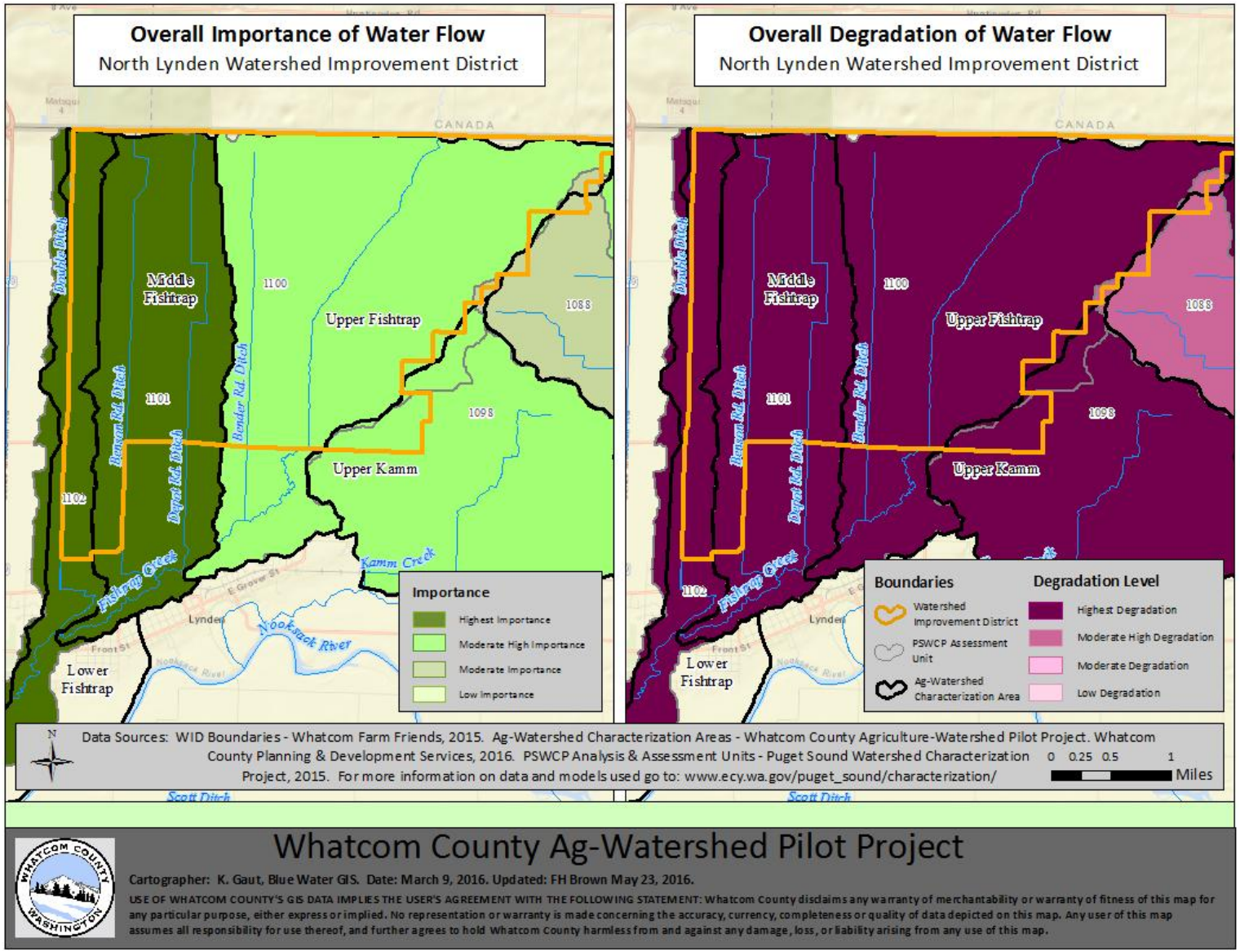

Figure 14. North Lynden WID: Overall importance and degradation of water flow processes

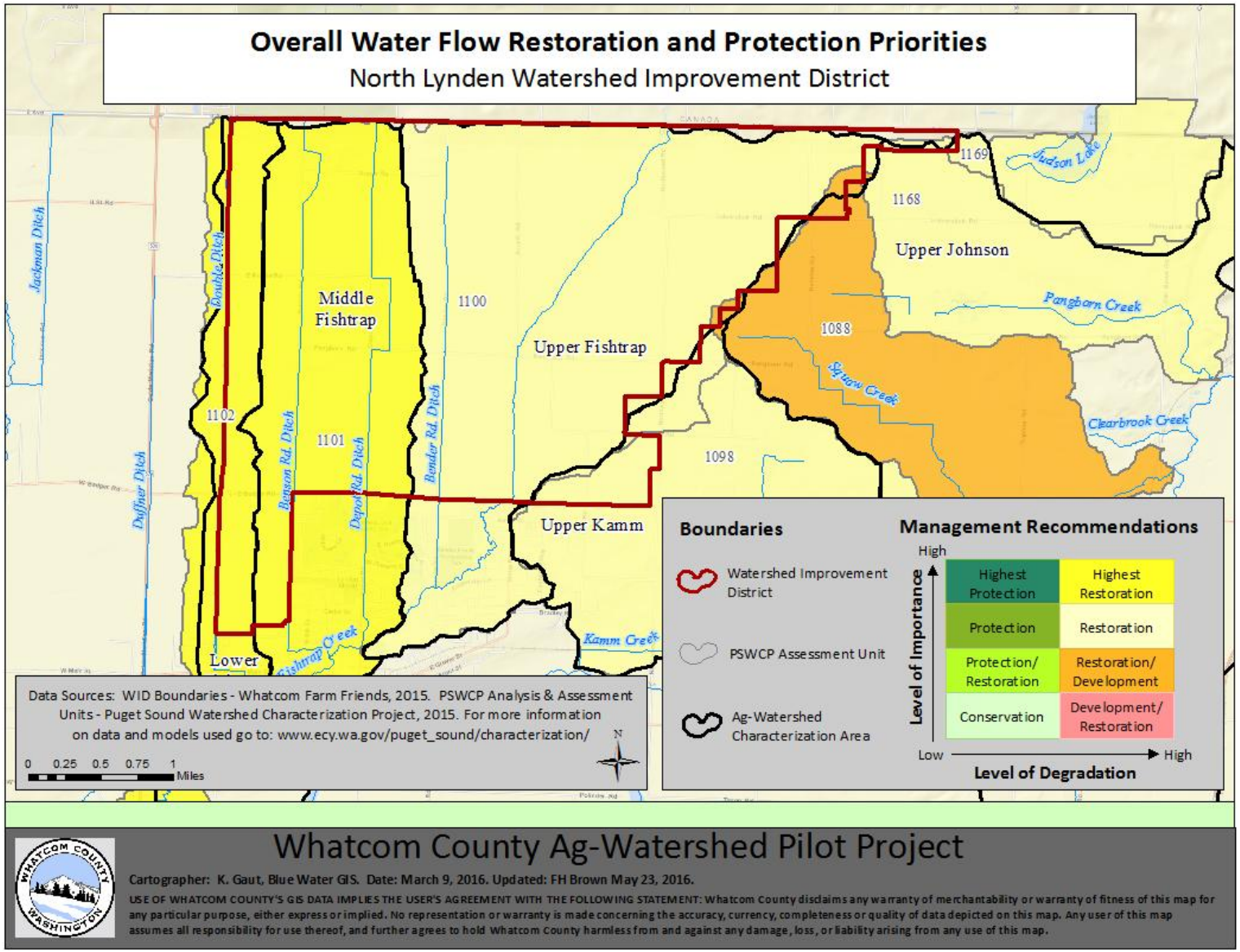

Figure 15. North Lynden WID: Overall water flow restoration and protection priorities

5.4 Watershed priorities: Specific actions map.

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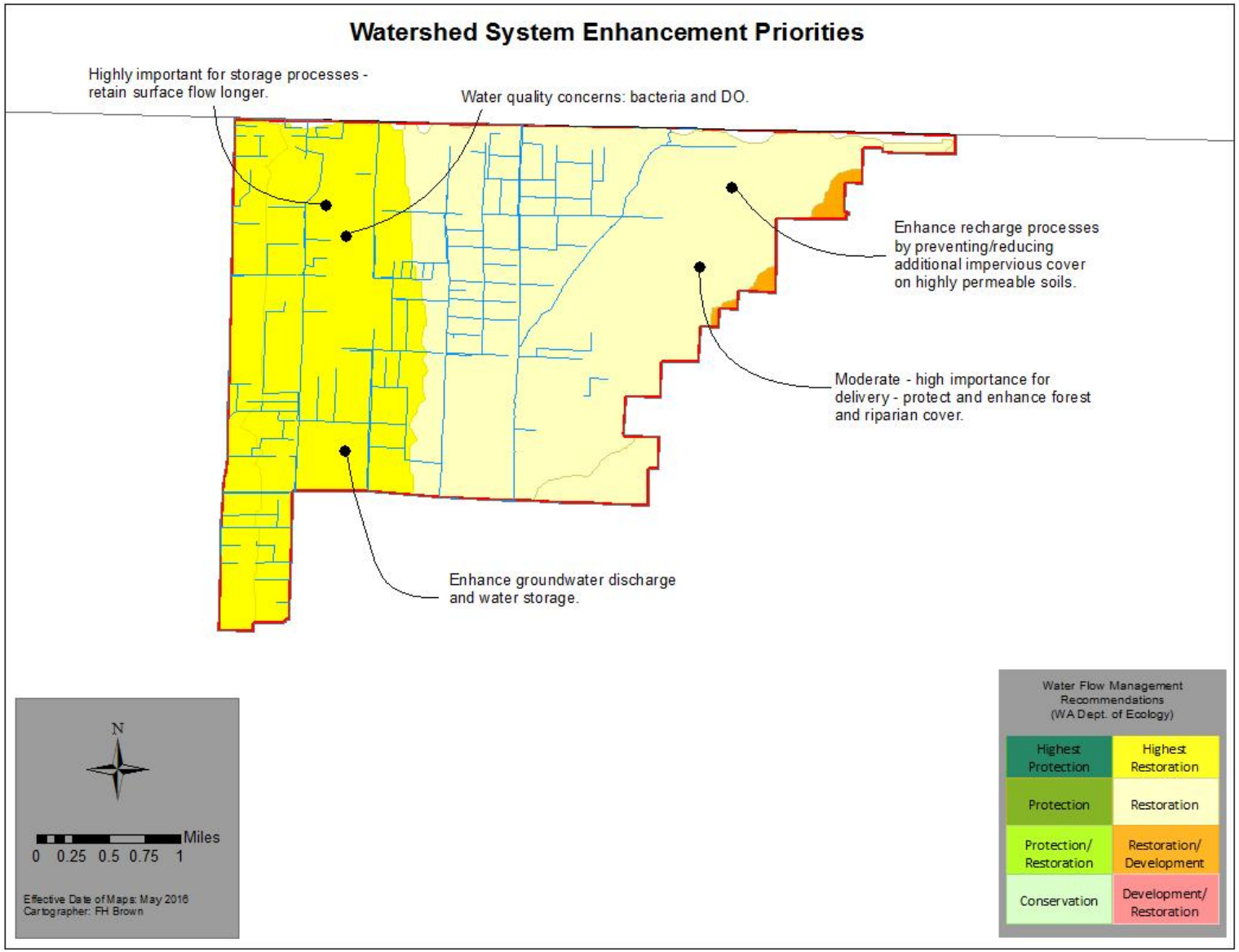

Figure 16. North Lynden WID: Summary watershed system enhancement priorities and specific actions

6 Reference maps for the North Lynden Watershed Improvement District

6.1 Agriculture reference maps

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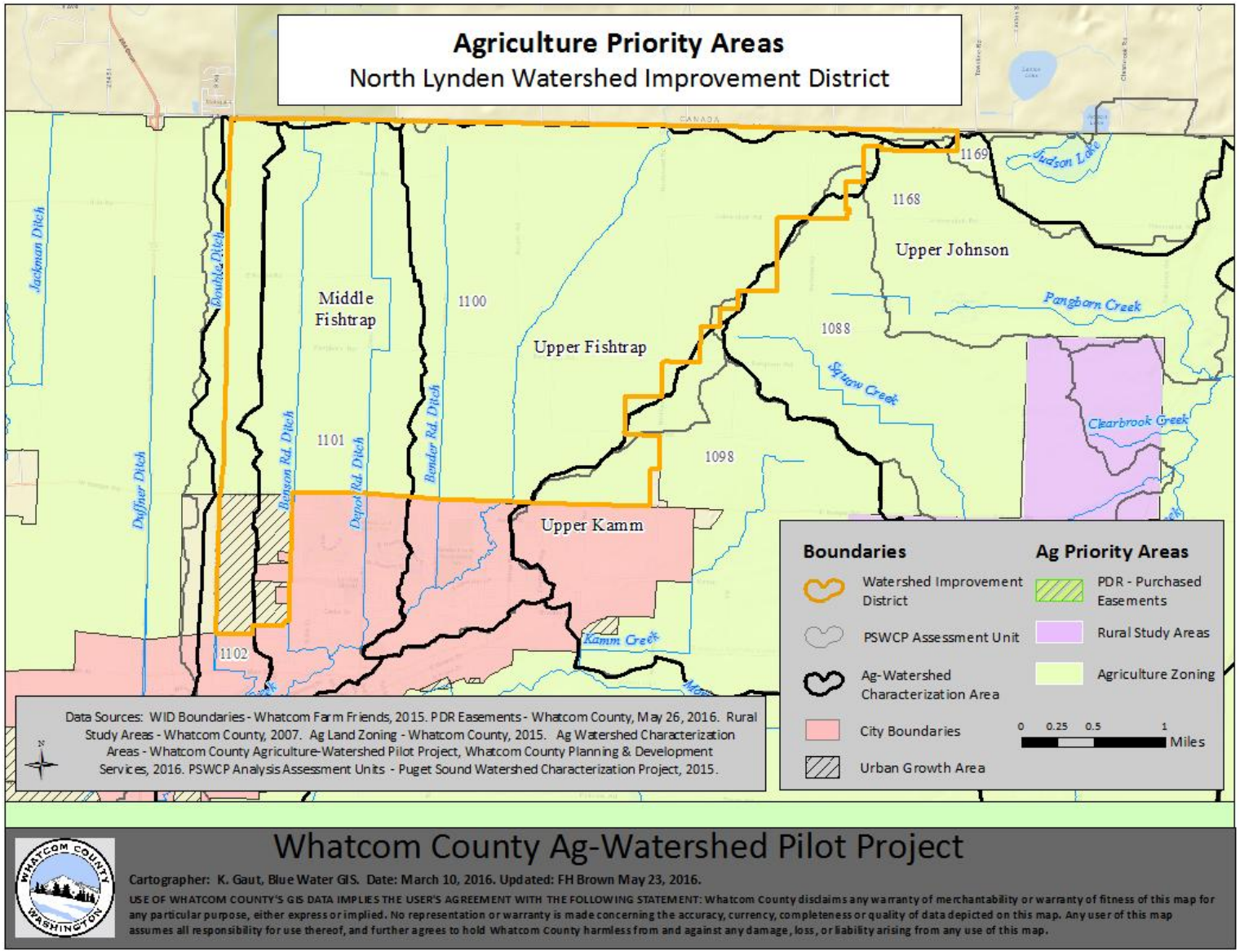

Figure 17. North Lynden WID Reference map: Agriculture priority areas

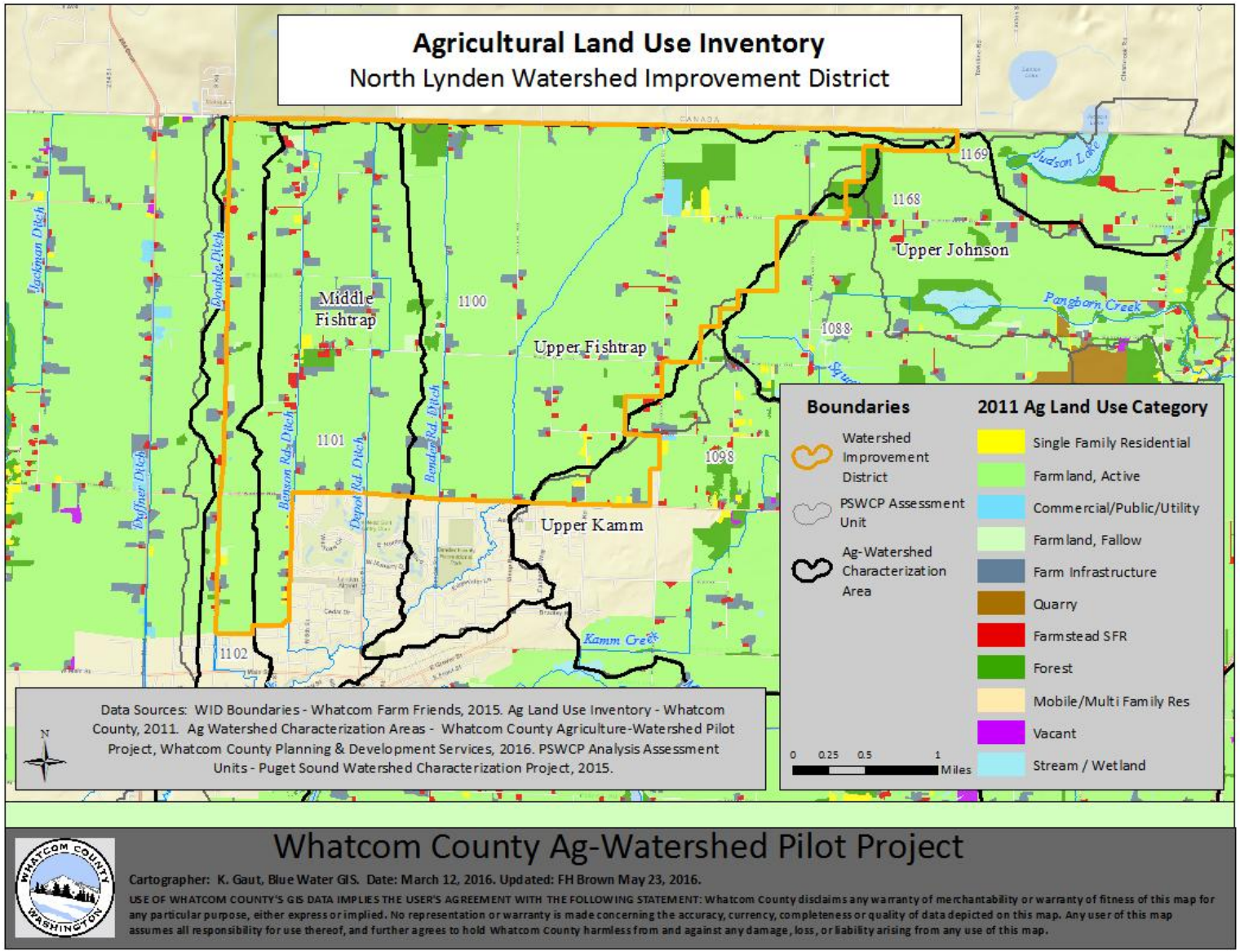

Figure 18. North Lynden WID Reference map: Agricultural land use inventory

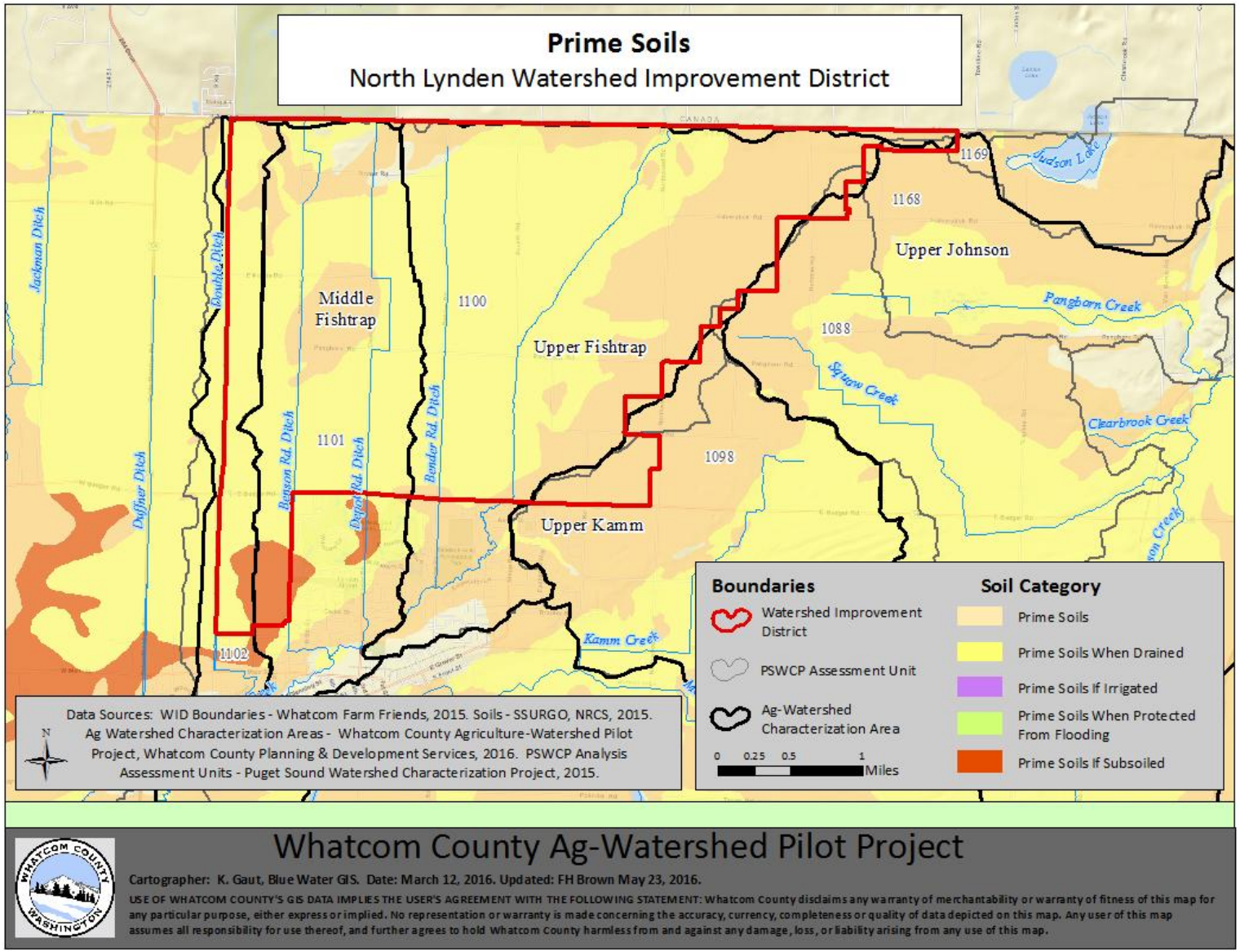

Figure 19. North Lynden WID Reference map: Prime soils

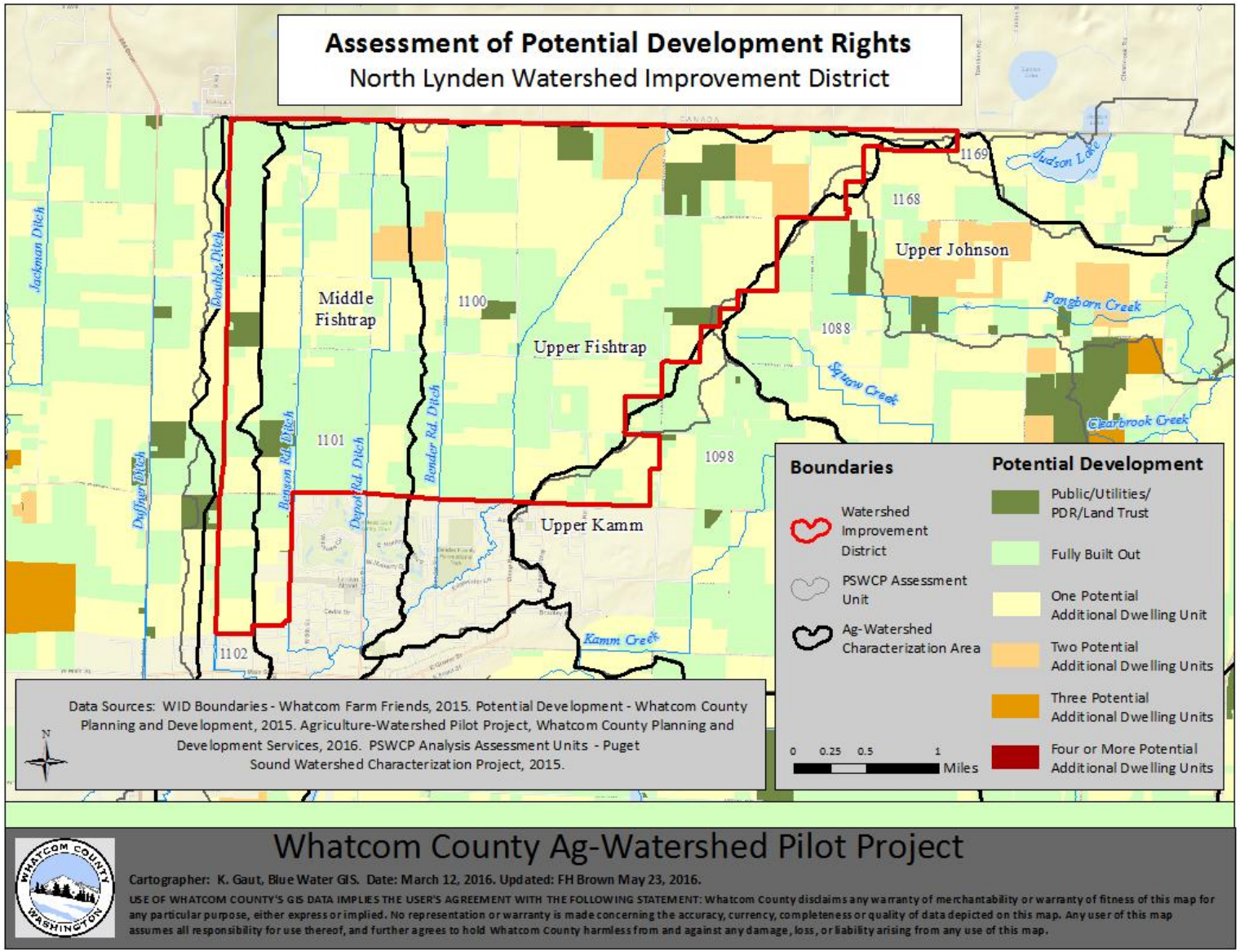

Figure 20. North Lynden WID Reference map: Assessment of potential development rights

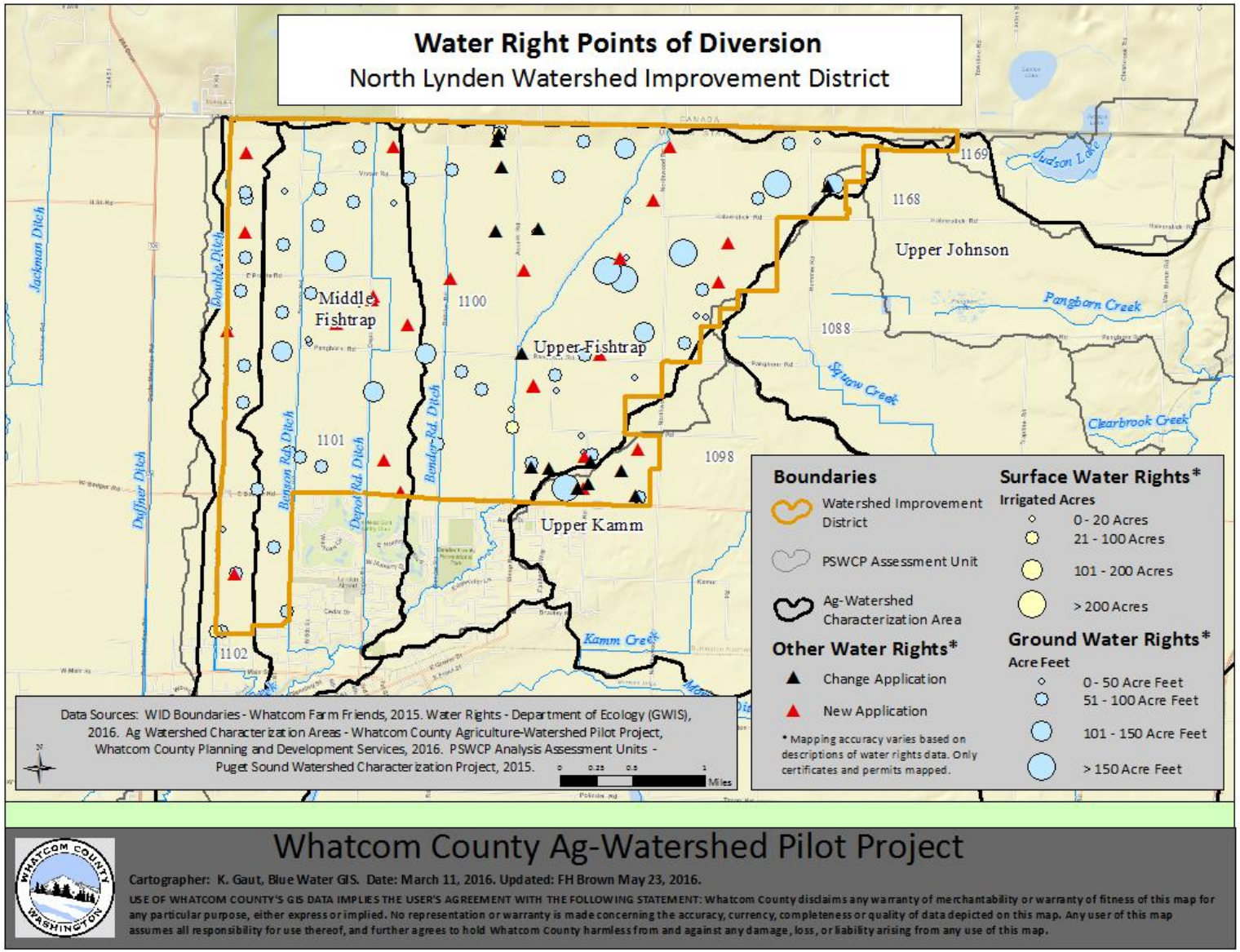

Figure 21. North Lynden WID Reference map: Water right points of diversion

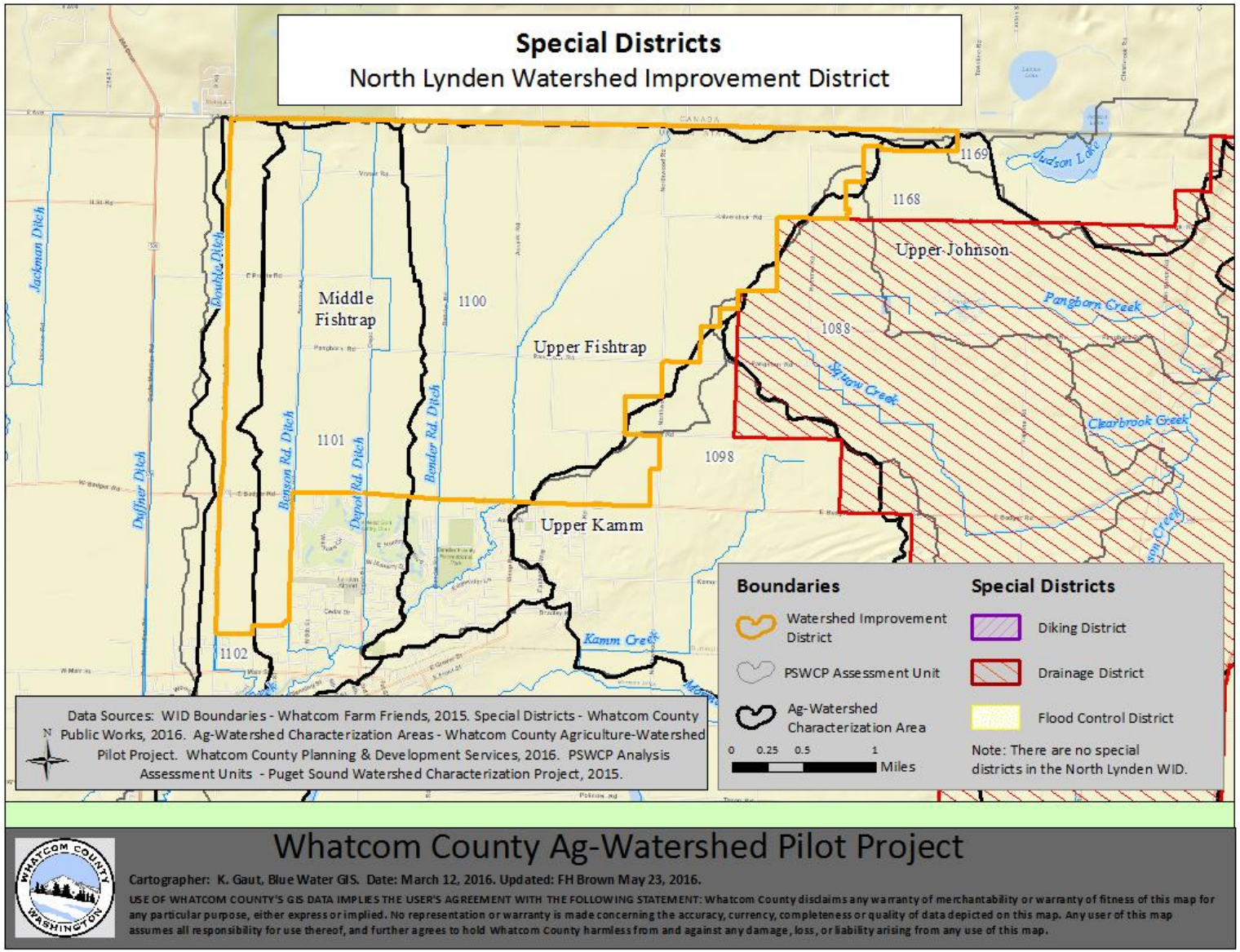

Figure 22. North Lynden WID Reference map: Special districts

6.2 Watershed reference maps

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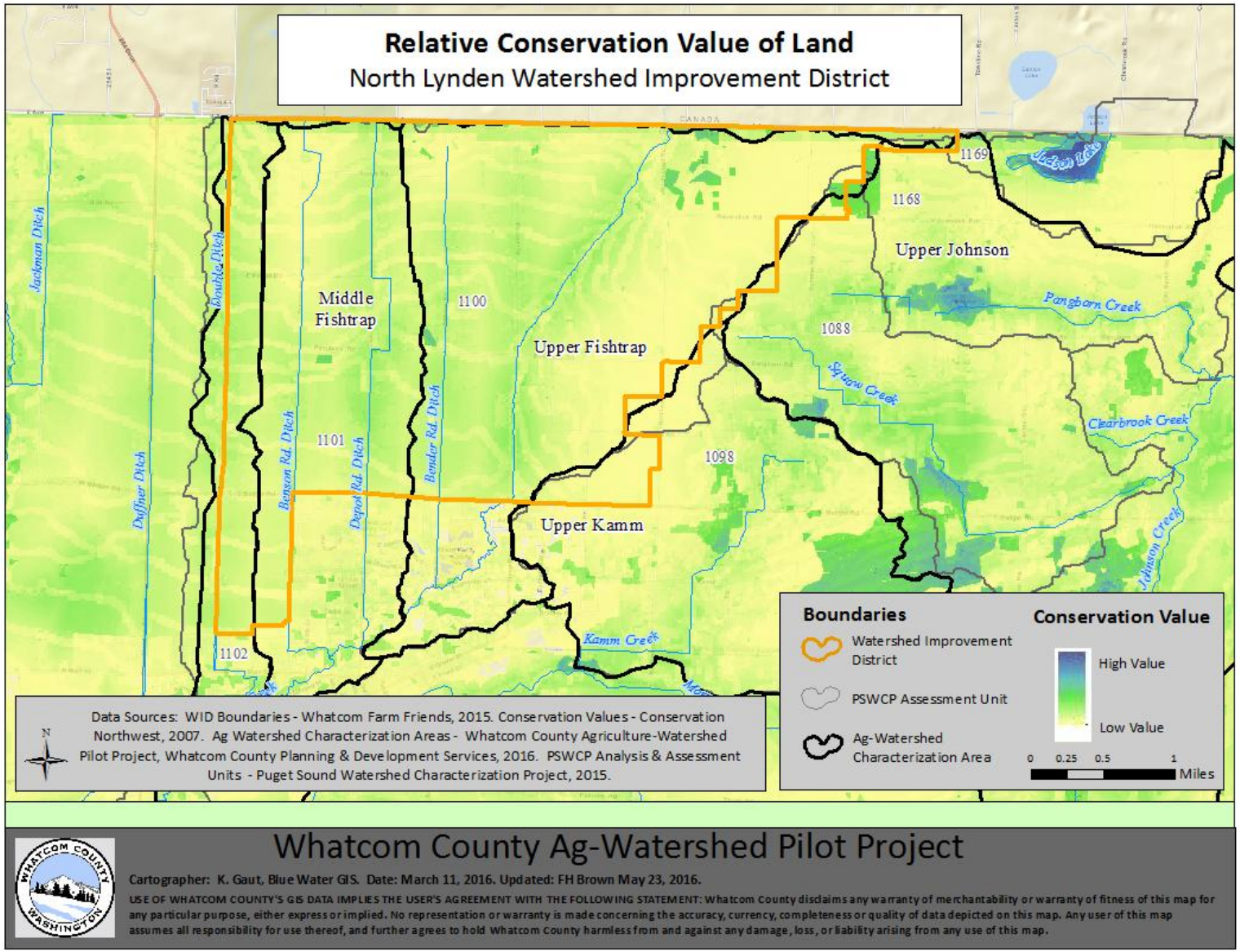


Figure 24. North Lynden WID Reference map: Relative conservation value of land

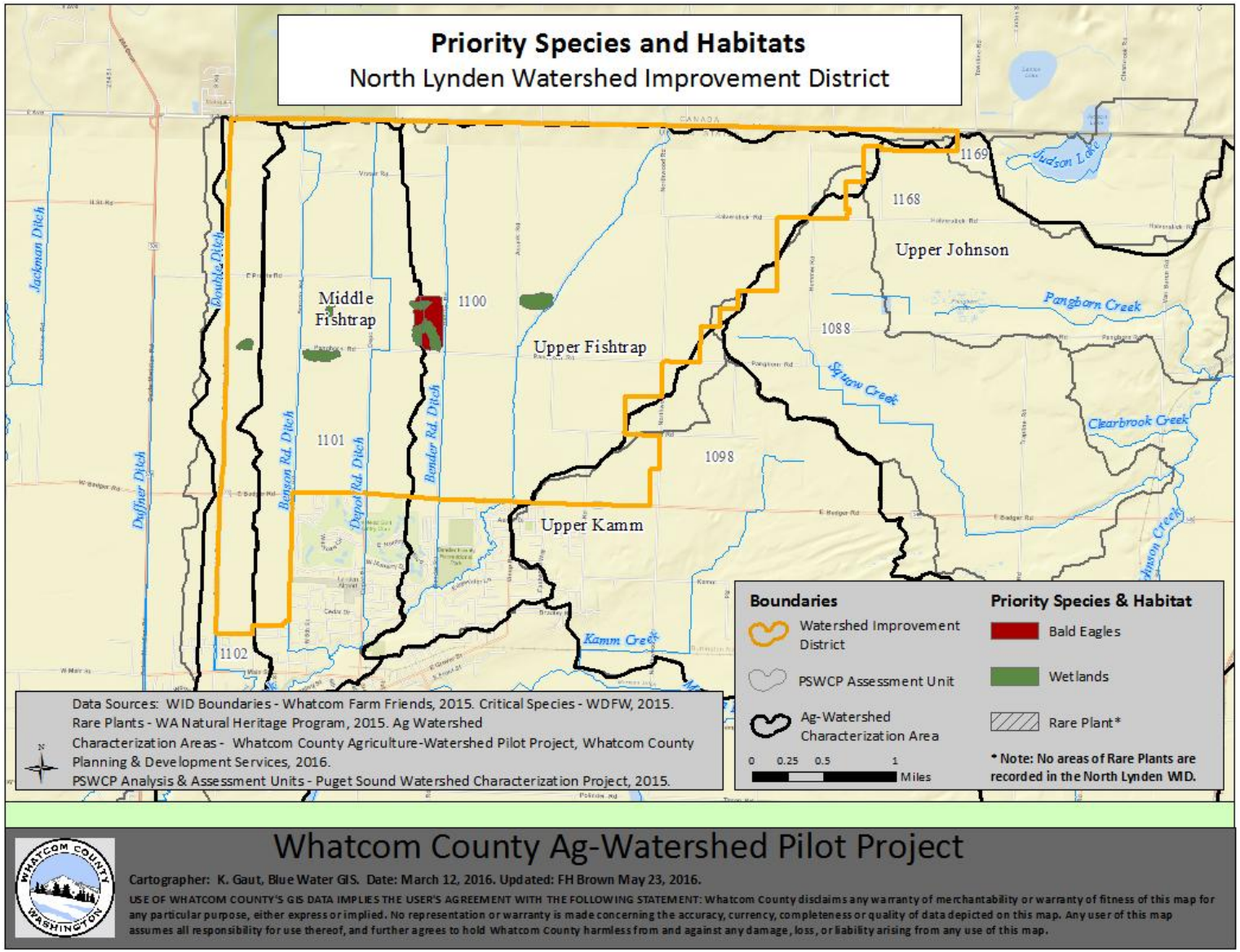


Figure 25. North Lynden WID Reference map: Priority species and habitat

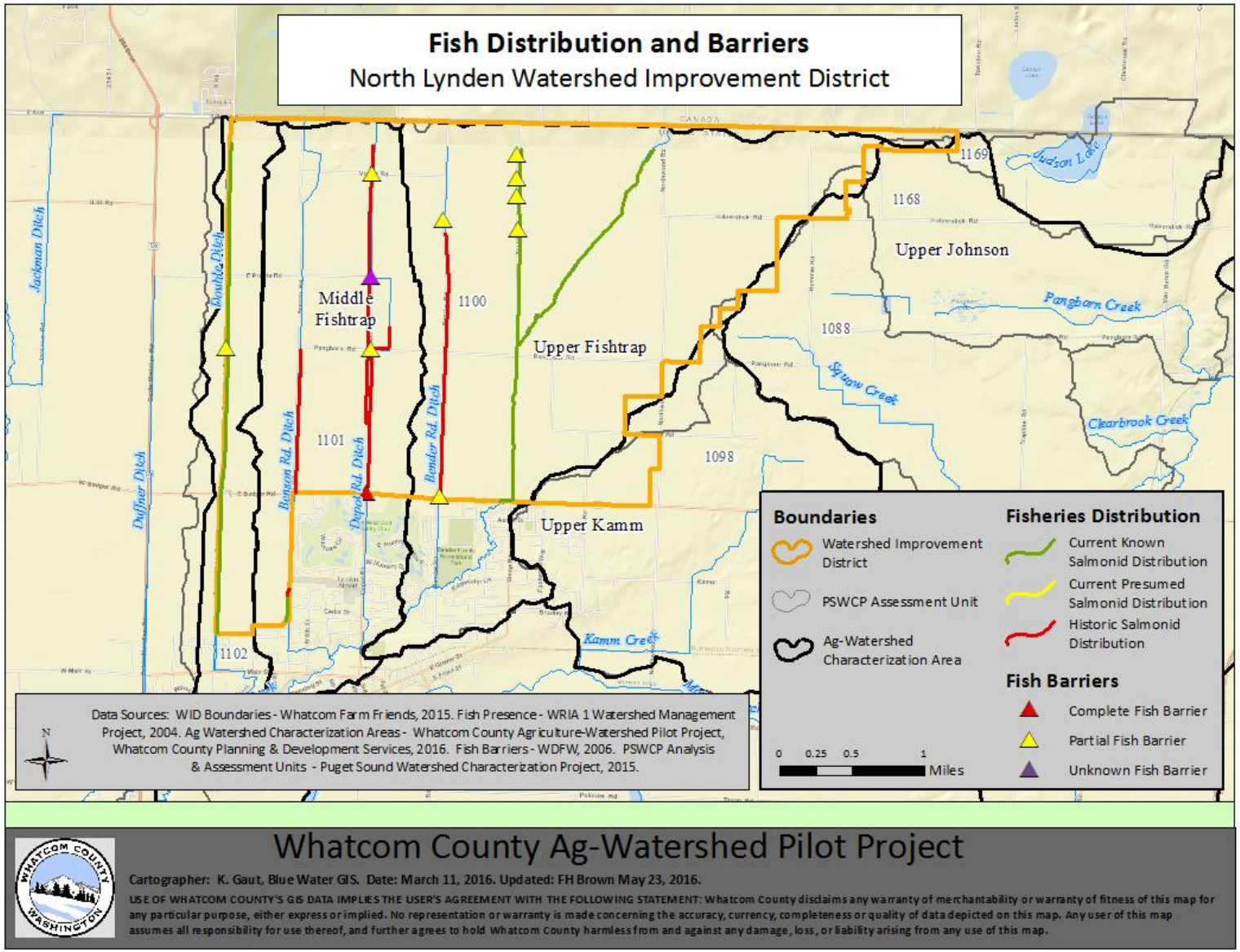


Figure 26. North Lynden WID Reference map: Fish distribution and fish barriers

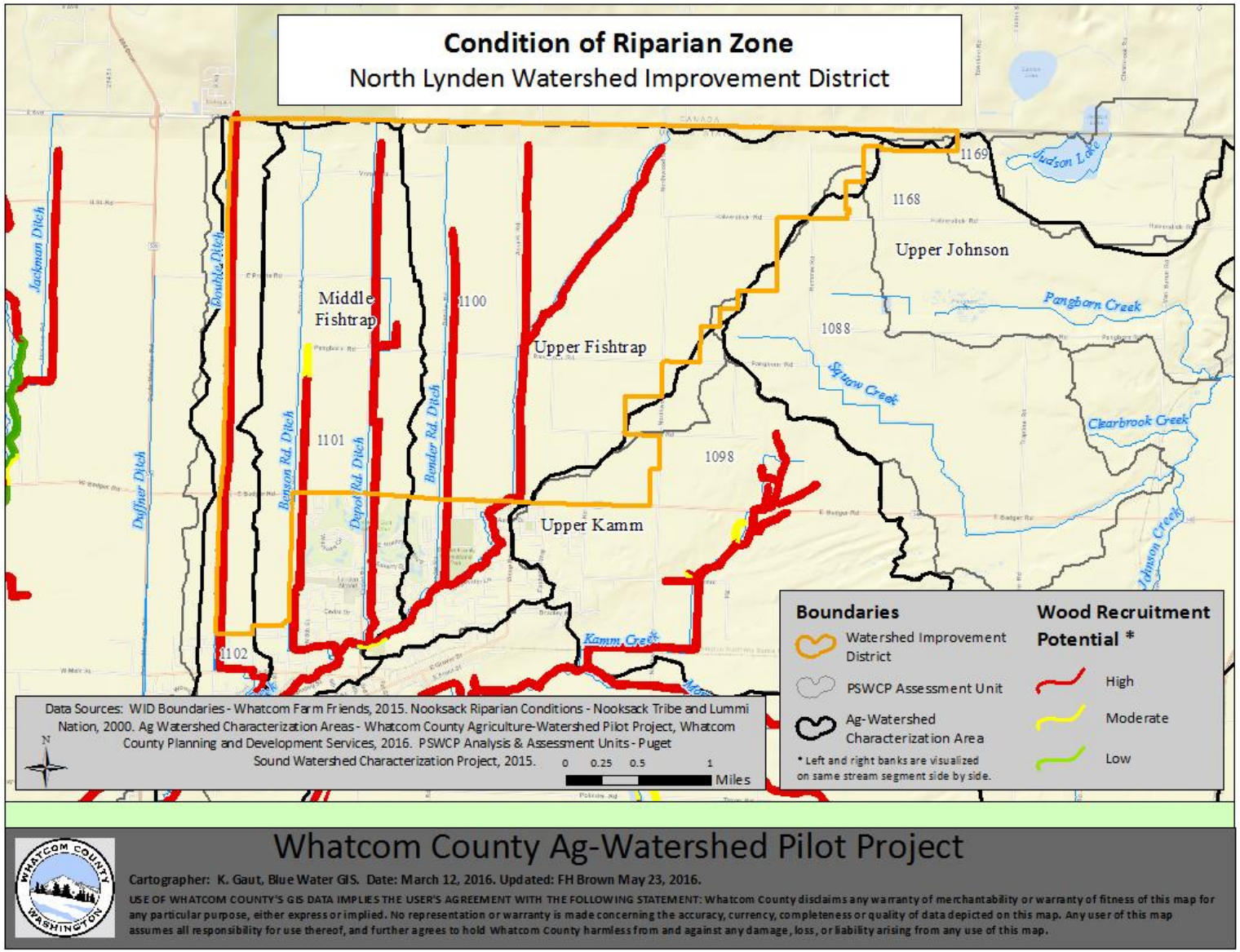


Figure 27. North Lynden WID Reference map: Condition of riparian zone

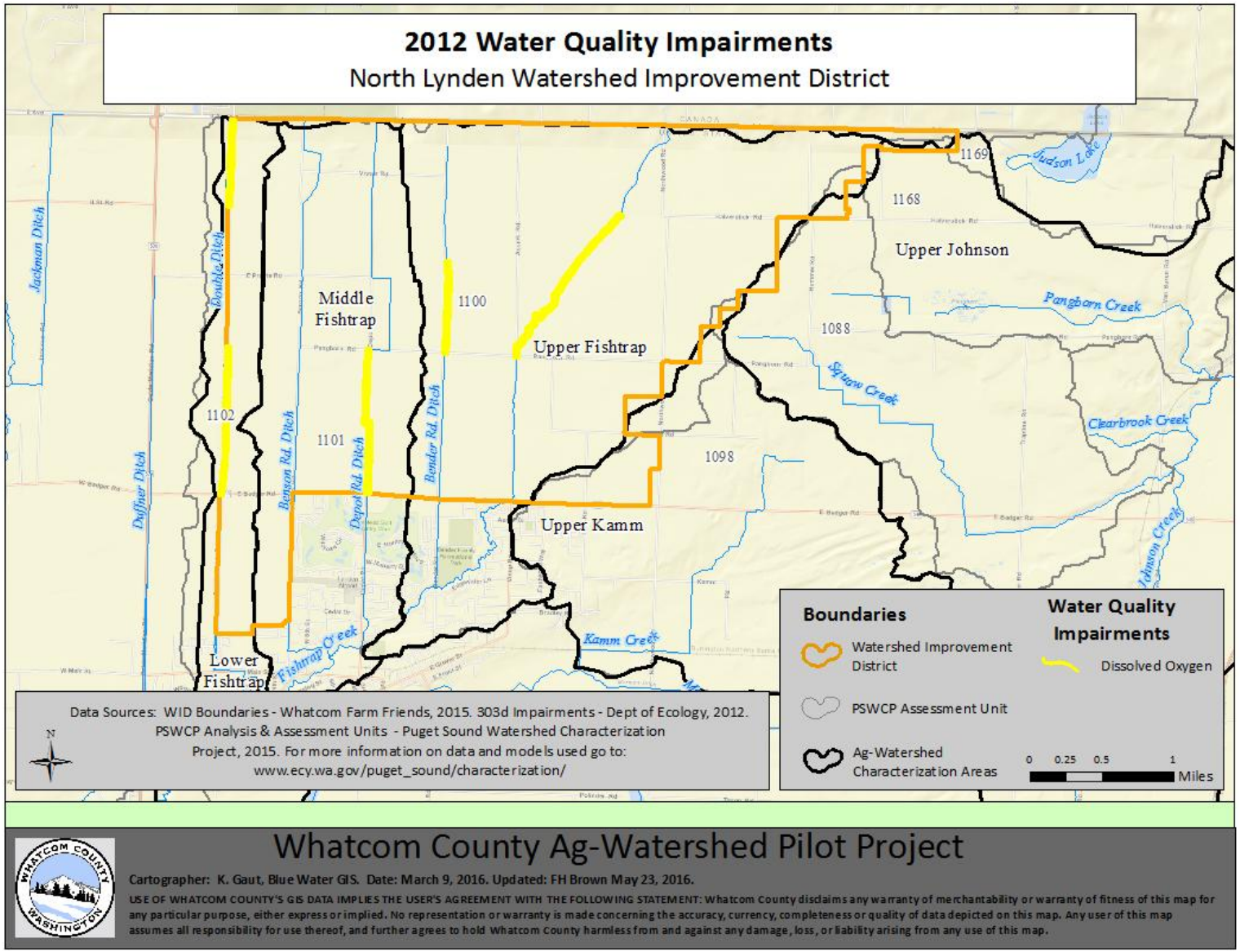
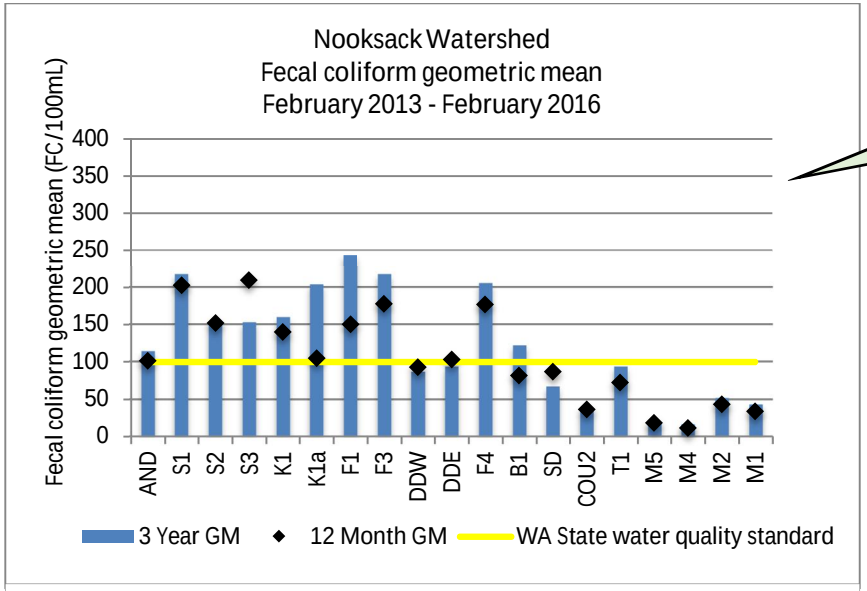
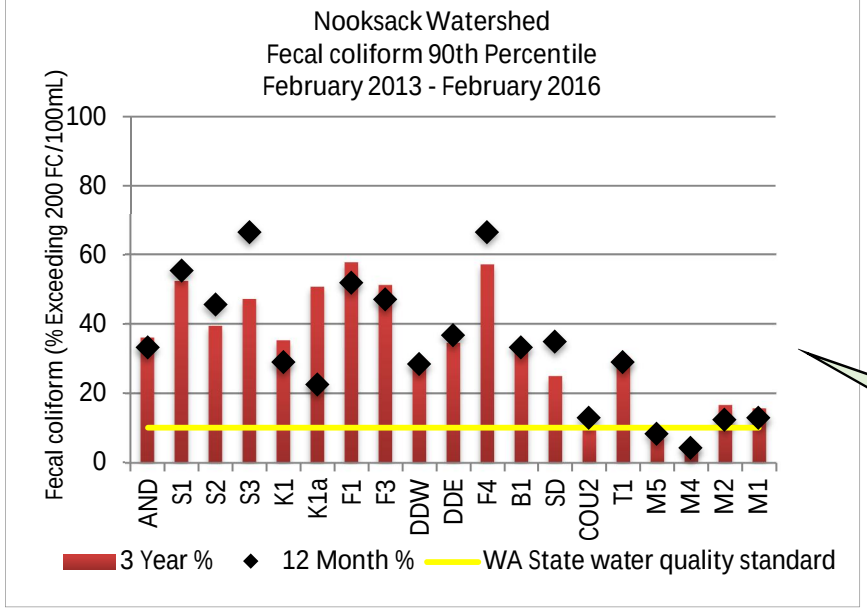
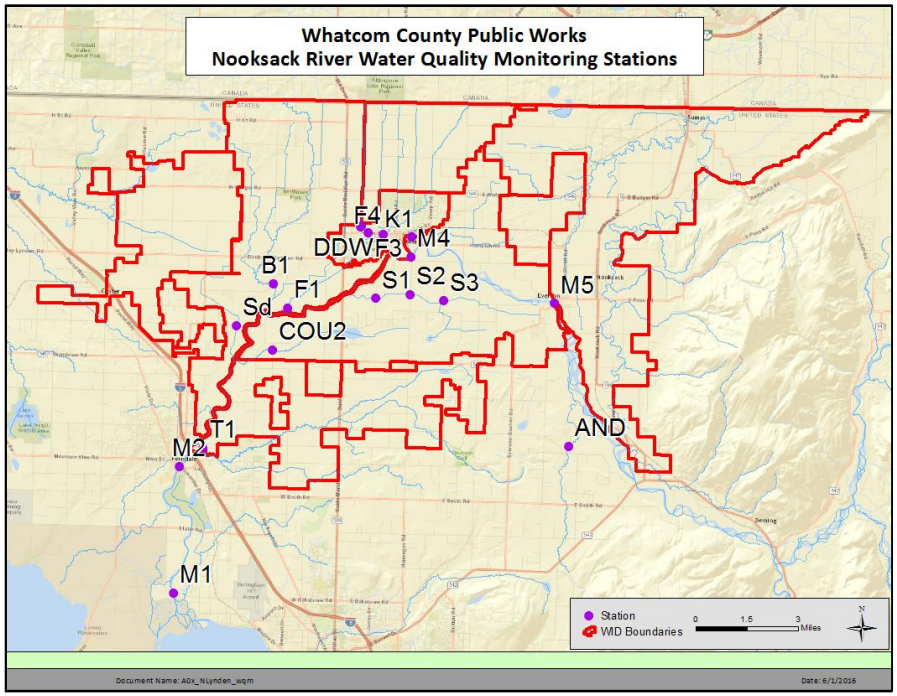


Figure 28. North Lynden WID Reference map: Water quality impairments (2012)



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. Data from Whatcom County Public Works.





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

Figure 29. North Lynden WID Reference map: Routine water quality monitoring results. Data from Whatcom County Public Works

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GIS data sources

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

Relative Conservation Values	Data received from Sarah Watts, Whatcom County Planning & Development Services, January 2016. Source: Nelson, R (2007) *Mapping Biodiversity in Whatcom County: Data and Methods*. Prepared for the Whatcom Legacy Project, 2007. http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15493 (Last accessed 25 September 2016)
Rural Study Areas	Whatcom County Planning & Development Services. Received from Sarah Watts, December 2015.
Special Districts boundaries	Whatcom County Public Works, 2016. Received from Travis Bouma 7 March 2016.
Water Quality Impairments	Washington Department of Ecology, 2012. *Water Quality Assessment for Washington*. http://www.ecy.wa.gov/programs/Wq/303d/index.html
Water Quality Monitoring Stations	Whatcom County Department of Public Works. http://www.co.whatcom.wa.us/2170/Water-Quality-Monitoring-Results#stations
Water Resource Inventory Area 1 (WRIA1) boundary	Whatcom County Planning & Development Services, 2015.
Water Rights	Washington Department of Ecology, Geographic Water-right Information System (GWIS) 2016. http://www.ecy.wa.gov/2016Water.html
Watershed characterization	Landscape groups, water flow assessment results from the Puget Sound Watershed Characterization Project http://www.ecy.wa.gov/puget_sound/characterization/index.html (Last accessed April 2016)
Watershed Improvement District boundaries	Received from Ag Water Board, 2015. www.agwaterboard.com
Whatcom County Tax Parcels	Dated October 6, 2015. Received from Sarah Watts, Whatcom County Planning & Development Services.
Zoning	Whatcom County Title 20 Zoning, Whatcom County Planning & Development Services. http://www.whatcomcounty.us/716/Data/

8 Glossary of key terms used in this report

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

Appendices

Appendix A: Data sources for the North 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 North Lynden WID
July 2016

Prepared by Cheryl Lovato Niles & Heather MacKay

Purpose of this document

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

Sources for the following data types have been collated for the Middle and Upper Fishtrap 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.

The following reports contain a range of information types including agricultural land use, crop types, fish presence, and hydrology.

- *Management Plan for Drainage, Flooding, Irrigation and Fish Issues.* North Lynden Watershed Improvement District, 2009. Final report prepared for the North Lynden Watershed Improvement District commissioners on the status of water resources in the WID boundary area, key issues to address, and strategic approaches to advancing priority issues. [planning report] https://www.piersystem.com/go/doctype/2012/35793/NLWID-Watershed-Report-Chapterized-Sections [last accessed September 30, 2015]
- *Drainage and Fish Habitat Management Guide*, North Lynden Watershed Improvement District, Feb. 2010. [planning report] www.whatcomcd.org/sites/default/files/ag_drainage/dmps/North%20Lynden%20WID%20Draft%20Drainage%20Mgt%20Guide.pdf [last accessed October 21, 2015]

Table of Contents

Table 1: Fecal coliform monitoring maps and reports

Area	Watershed	Parameter	Source	Description	URL
North Lynden	Middle Fishtrap	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)
North Lynden	Middle and Upper Fishtrap	Fecal coliform	Conservation District	Watershed Health Assessment (November 2015)	http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results [last accessed February 1, 2016]
all	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 N. 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.

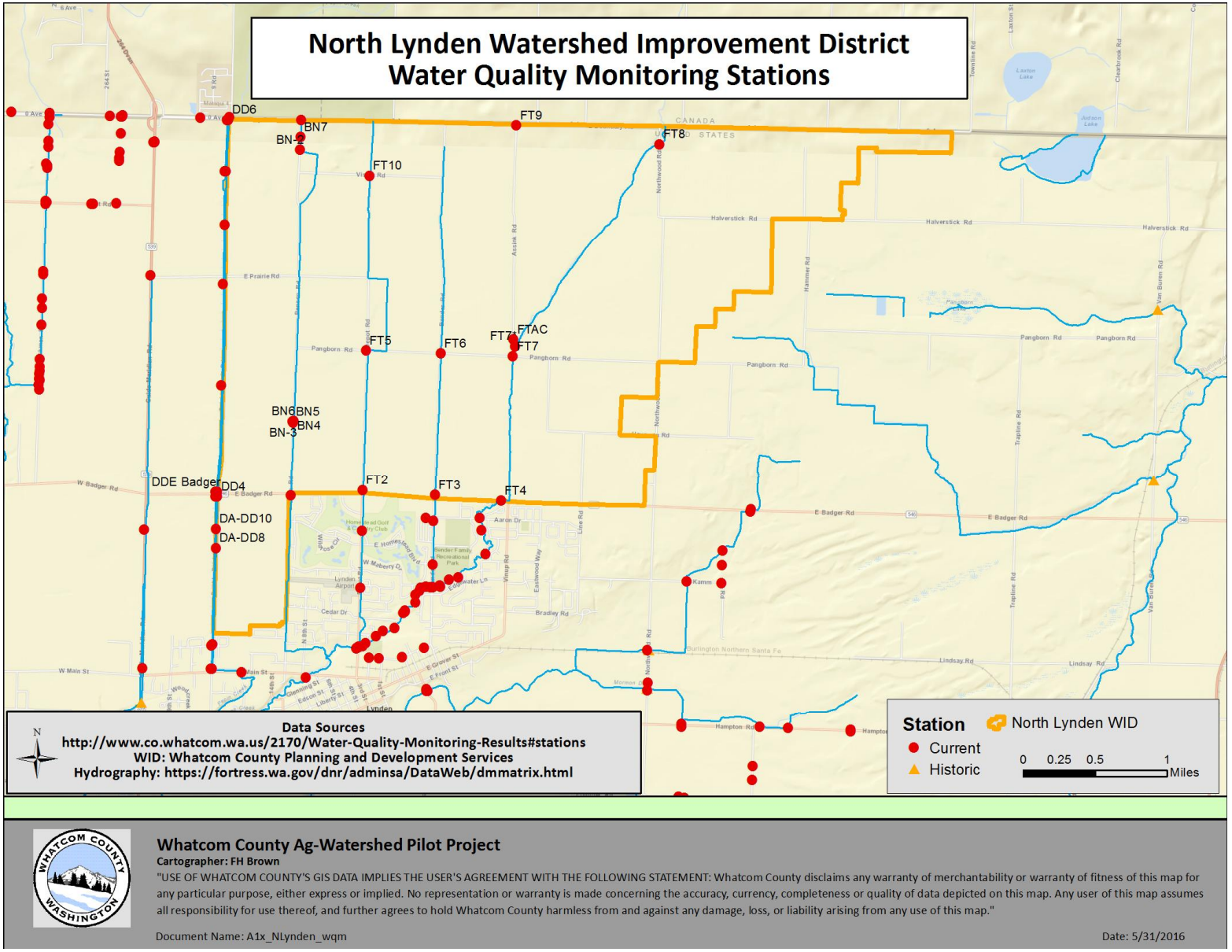

Figure 1: North Lynden WID: Routine water quality monitoring stations. See Tables 1 and 2 for more information.

Table 2: Where to find earlier water quality data from monitoring stations on Whatcom County Water Quality Monitoring Results for N. 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	Nooksack Tribe	City of Lynden	WSDA
What	Data generally includes FC, pH, T, Conductivity, and DO. Occasionally flow and wetted width are recorded.	Focused on fecal coliform	Fecal coliform, E.coli, T, pH, DO, Conductivity, Turbidity,	Focused on fecal coliform. Sampling is done in collaboration with Whatcom County Public Works.	Focused on fecal coliform
How	You may request the data from the Department of Ecology Bellingham Field office. Details below.	Annual reports for 2011 through 2013 are available online at URL below.	Available by request	Current and archived Whatcom County reports are available at urls below. Periodic "Fishtrap Watershed Water Quality Status" reports are distributed via email. Contact Whatcom County Public Works to request the most recent status report. 360-778-6200	Data is available upon request from WSDA Dairy Nutrient Management group - Michael Isensee 360-961-7412
Details	You may request data for a watershed subbasin from Jessica Kirkpatrick, Steve Hood, or Chris Luerkens at 360-715-5200.	<http://www.co.whatcom.wa.us/2172/Resource-Library>	Jezra Beaulieu, Water Resources Specialist Nooksack Indian Tribe jbeaulieu@nooksack-nsn.gov	Current Whatcom County report for Nooksack watershed: http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results Archived Whatcom County reports: http://www.co.whatcom.wa.us/2172/Resource-Library	Station locations are shown on Whatcom County's map of routine monitoring sites. Results are available there, 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.

Who	Department of Ecology	Whatcom County Public Works	Nooksack Tribe	City of Lynden	WSDA
Station Names	DD1 DD2 DD3, DA-DD11 DD4, DA-DD12 F3 F4 FT1 FT2 FT3 FT4 FT5 FT6 FT7 FT8, SW11 DD5, DA-DD5 DD6, DA-DD6	DDE Badger DDW Badger F3a FT10 FT7* FT9 FTAC F3 F4 FT1 FT2 FT3 FT4 FT7 FT8, SW-11 DDE DDW F5 F5a, F5* F6 F7, F6a	SW-11 SW-12	Numerous	F6b, F6-Main F6of, F6-Culvert DD5, DA-DD5 DD6, DA-DD6, DDE DDW BN-1 BN-2 BN-3 BN4 BN5 BN6 BN7 DA-DD1 DA-DD2 DA-DD3 DA-DD4 DA-DD9 DD-CA1 F5-Down F5-Up

Table 3: Temperature monitoring from Nooksack Tribe

WID/Area	Watershed	Ongoing/ completed	Station ID	Description	Lat	Long	Collected by	Source
North Lynden	Upper Fishtrap	completed	08FT01	Fishtrap Creek @ Assink Road	48.9798666	122.4291833	Nooksack Indian Tribe	NNR Office, 2009 data in STORET; currently working on uploading the remaining data to EPA STORET http://www.epa.gov/storet/ [URL last accessed September 30, 2015]
North Lynden	Upper Fishtrap	completed	08FT03	Fishtrap Creek @ Bender Road	48.95601666	-122.438333	Nooksack Indian Tribe	NNR Office, 2009 data in STORET; currently working on uploading the remaining data to EPA STORET http://www.epa.gov/storet/ [URL last accessed September 30, 2015]

Table 4: Streamflow

WID/Area	Watershed	Ongoing/ Completed	Station ID	Description	Lat	Long	Collected by	Source	URL
North Lynden	Upper Fishtrap	Ongoing	08MH153	Fishtrap Creek at International Boundary	490010	1222422	Env. Canada	USGS "Summary Information for Continuous Streamflow Gages in and near the WRIA 1 Study Area"	http://wa.water.usgs.gov/projects/wria01/sw.htm [last accessed October 1, 2015]
North Lynden	Upper Fishtrap	Ongoing	12212000	Fishtrap Creek at Lynden	485752	1222550	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 5: Streamflow plus additional measures

WID/Area	Watershed	Additn'l parameters	Station ID	Station location	Ongoing/ Completed	Collected by	Source	URL
North Lynden	Upper Fishtrap	Many including: T, pressure, cond., DO, pH, biomass, nutrients, chemicals,	12212001	Fishtrap Creek at Aaron Rd, Near Lynden WA	ongoing	USGS	USGS Washington Water Science Center	http://maps.waterdata.usgs.gov/mapper/index.html

Table 6: Additional streamflow reports

Watershed	Title	Published	URL
Fishtrap Creek	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 7: 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 8: Erosion and avulsion in Nooksack River channel migration zone

Area	Parameter	Document Title	Author	Date	URL
N. Lynden,	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 9: 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 installation dates, and erroneous labeling of well locations as

WID/ Area	Water-shed	Parameter	Title of Table/Source	Station ID	Source	URL	Notes
			National Water Information System (NWIS)				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 measure-ment, 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.
North Lynden	Upper Fishtrap	Hydraulic conductivity	Summary Information for Aquifer Tests in the WRIA 1 Study Area	Lynden, Everson, Pole Road (South Lynden area)	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 10: Additional reports on groundwater

Watershed	Title	Published	Authors	URL
all	Nitrate Contamination in the Sumas-Blaine Aquifer, Whatcom County, Washington	Publication No. 11-03-027, May 2011	Melanie Redding 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 11: Groundwater maps

WID/ Area	Parameter	Title	Last modified	Source	URL	Notes
all	Ground-water movement	Generalized Pattern of Ground -Water Movement for the Puget Sound Aquifer System in the WRIA 1 Study Area	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW2.pdf [last accessed October 1, 2015]	Modified from Vaccaro, J.J., Hasen, A.J. and Jones, M.A., 1998. Hydrogeologic Framework of the Puget Sound Aquifer System, Washington and British Columbia; US Geological Survey Professional Paper 1424-D.
all	Selected well locations	Locations of Selected Wells in the WRIA 1 Study Area by Primary Water Use	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW4.pdf [last accessed October 1, 2015]	USGS National Water Information System (NWIS), downloaded December 14, 1999. Not all well locations have been verified and therefore they may plot in the wrong locations.

all	Ground-water levels	Water-Level Contours in the Uppermost Aquifer of the Lynden-Everson-Nooksack-Sumas (LENS) Study Area	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW3.pdf [last accessed October 1, 2015]	From: Cox, S.E., and Kahle, S.C., 1999, Hydrogeology, Ground-Water Quality, and Sources of Nitrate in Lowland Glacial Aquifers of Whatcom County, Washington, and British Columbia, Canada: U.S. Geological Survey Water-Resources Investigations Report98-4195, 5 plates, 251 p.
all	Aquifer tests	Approximate Locations of Aquifer Tests in the WRIA 1 Study Area	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW5.pdf [last accessed October 1, 2015]	From: Various Hydrogeologic Studies in the WRIA 1 Study Area
all	Selected well locations	Locations of Selected Wells in the WRIA 1 Study Area with Sufficient Information to Compute Hydraulic Conductivities	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW6.pdf [last accessed October 1, 2015]	From: USGS National Water Information System (NWIS), downloaded December 14, 1999. Not all well locations have been verified, therefore they may plot in the wrong locations.
all	Selected well locations	Locations of Selected Wells in the WRIA 1 Study Area with Five or More Historical Water Levels	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW7.pdf [last accessed October 1, 2015]	From: USGS National Water Information System (NWIS), downloaded December 14, 1999. Not all well locations have been verified and therefore they may plot in the wrong locations
all	Soil types	Distribution of Soil Map Units in the WRIA 1 Study Area	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW8.pdf [last accessed October 1, 2015]	From: U.S. Department of Agriculture, 1994, State Soil Geographic (STATSGO) Data Base: Date use information, Soil Conservation Service, National Cartography and GIS Center, Fort Worth, Texas, accessed January 28, 2000, at URL http://www.ftw.nrcs.usda.gov/stat_data.html. Note: The soil information for this map was Natural Resources Conservation Service 1994 STATSGO data. STATSGO was compiled at 1:250,000 and designed to be used primarily for regional, multi-state, state, and river-basin resource planning, management, and monitoring.
all	Soil permeability	Soil Permeability in Parts of the WRIA 1 Study Area	2000	USGS	http://wa.water.usgs.gov/projects/wria01/maps/mapGW9.pdf [last accessed October 1, 2015]	Modified from: U.S. Department of Agriculture-Soil Conservation Service, 1992, Soil Survey of Whatcom County Area, Washington, 54 sheets, 481 p.

Table 12: 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 13: Land use/Land cover

WID/Area	Watershed	Parameter	Document	URL	Notes
N. Lynden	Canadian Fishtrap	Impervious Area	Koole, S. 2005. An Analysis of the Land Use Patterns and the Overall Health of the Canadian Portion of the Bertrand and Fishtrap Creek Watersheds. Envs Thesis Paper. Prof. Karen Steensma, Advisor.		Referenced in North Lynden WID Mgmt Plan, 2009
N. Lynden	Canadian Fishtrap	Land use US/Canadian	Koole, S.R. and K.M.M. Steensma. (2007) Land use in the Canadian portions of two transboundary watersheds, Bertrand Creek and Fishtrap Creek. Vancouver, BC: Proceedings of the 2007 Georgia Basin Puget Sound Research Conference		Referenced in North Lynden WID Mgmt Plan, 2009
N. Lynden	Fishtrap Creek - Canadian and US	land use map US and Canadian	Bandaragoda, C., Greenberg, J. (2009) Fishtrap Creek Hydrologic Model Update and Assessment, Final Report, Appended to North Lynden WID Mgmt Plan, 2009		
N. Lynden	Fishtrap US	Pop. size US/Canadian size elevation Irrigated acreage	North Lynden WID, 2009. Management Plan for Drainage, Flooding, Irrigation and Fish Issues	https://www.piersystem.com/external/content/document/2012/297519/1/TOC,%20Acknowledgements,%20Executive%20Summary.pdf [last accessed October 1, 2015]	
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]	
N. Lynden,	Fishtrap	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	http://www.whatcomcounty.us/811/County-Wide-Critical-Area-Ordinance-Maps [last accessed February 26, 2016]	

WID/Area	Watershed	Parameter	Document	URL	Notes
			requirements of the Growth Management Act.		
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 14: Land use/Land cover map and charts from Lower Nooksack Water Budget Overview – *report includes Fishtrap watershed*

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 15: Land use/Land cover electronic data from Lower Nooksack Water Budget Overview – *report includes Fishtrap watershed*

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 16: 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
Middle Fishtrap	Fishtrap lower	RM 4.9-5.7, close to Depot Road bridge	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	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.
Upper Fishtrap	Fishtrap Creek Upper	RM 8.8-9.2	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.

Table 17: WDFW spawner surveys

Watershed	Parameter	Creek	Station location	Frequency	Date	Collected by	Source
Fishtrap	salmon (coho pink, chinook, chum): live, dead, and redds	Fishtrap Cr	RM 3.0 and 8.5	annually	2005 and 2007	WDFW and NSEA field crews	WDFW Tasha Geiger Nooksack River Stock Assessment 360-305-2023 Natasha.geiger@dfw.wa.gov
Fishtrap	Steelhead: live, dead, and redds	Fishtrap Cr	numerous sites	every two weeks to every month in spring	2008 - 2012	WDFW and NSEA field crews	WDFW Tasha Geiger Nooksack River Stock Assessment 360-305-2023 Natasha.geiger@dfw.wa.gov

Table 18: Aquatic nuisance species

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

Table 19: 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]
Whatcom County	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.
Fishtrap	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]
Fishtrap	Fish presence	Pearson, M. P., 2004. The Ecology, Status, and recovery prospects of the Nooksack Dace (Rhinichthys cataractae) and the Salish Sucker (Catostomus sp) in Canada. The University of British Columbia, July 2004.
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
Fishtrap	Juvenile salmonids (salmon, steelhead, trout)	This data was collected by Bob Vadas (WDFW) and is not an official report but it does speak to juvenile population numbers found in Bertrand Cr, Fishtrap Cr and Deer Cr sampling locations where also sampled for comparison. This data has not been fully analyzed at this time and should only be used as an initial look into juvenile populations. Sampling was conducted from 2006-2010.
Numerous watercourses in Fishtrap watershed	Vegetation, habitat, fish use	North Lynden Watershed Improvement District, 2009. Management Plan for Drainage, Flooding, Irrigation, and Fish Issues

Watershed/area	Parameter	Document
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 20: 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
Fishtrap,	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
Fishtrap	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
Fishtrap	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
Fishtrap	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
Fishtrap	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
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	http://wdfw.wa.gov/mapping/phs/ [last accessed October 1, 2015]	Washington Department of Fish and Wildlife

Watershed/ Area	Parameter	Document/Website	URL	Source
		agencies, developers, conservation groups, and interested parties to find basic information about the known location of Priority Habitats and Species (PHS) in Washington State.		
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 *Federal Register* notices (see links below), are the definitive sources for determining critical habitat boundaries. Map and *Federal Register* notice links are PDF files.	http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm [last accessed January 21, 2016]	NMFS NOAA
US	Threatened and Endangered Species	Environmental Conservation Online System, data and maps.	http://ecos.fws.gov/ecp/ [last accessed February 18, 2016]	US FWS
Washington State	Rare plants, animals, ecological communities	Reference Desk of the Washington Natural Heritage Program. Includes searchable databases	http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html [last accessed October 1, 2015]	Washington State Department of Natural Resources
Puget Sound Region	Wetlands	National Wetlands Inventory, data and maps	http://www.fws.gov/wetlands/ [last accessed February 1, 2016]	US FWS

Table 21: Soils

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

Table 22: 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
North Lynden Watershed Improvement District

1. Overview of North Lynden WID characterization and mapping work

North Lynden Watershed Improvement District (North Lynden WID) worked with the Ag-Watershed Project team to prepare agricultural-watershed characterization and mapping work products for use in the North 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 Land Program and the project funder, Washington Department of Commerce.[1]

The North Lynden WID Board:

- Reviewed and approved the scope of work for Task 6 (extended agriculture-watershed characterization and mapping: December 2015),
- Reviewed and updated the agriculture and watershed characterization tables from the October 2012 work session (January 2016), and
- Reviewed and confirmed the online version of the full draft report on the WID characterization and mapping.

[1] The Whatcom County Agriculture-Watershed Pilot Project (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 State Department of Commerce. Project partners include: Whatcom Farm Friends–Community Education, Whatcom Conservation District, and Washington State Department of Fish & Wildlife. Project fact sheets and links to all previous work, including technical reports and reference documents can be found at http://whatcomcounty.us/2260/Agricultural-Watershed-Pilot-Project

2. North Lynden work session (October 2012)

The October 2012 work session participants included farmers and landowners from the North Lynden focus area (Bertrand, Fishtrap and Kamm watersheds), project team members and agency staff who contributed local knowledge and expertise to identify agriculture and watershed priorities and enhancement opportunities in the 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 area. Small groups of participants then worked together to identify, characterize and locate agricultural system characteristics and enhancement opportunities in the WID area.

3. Record of meetings and discussions

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 15, 2015 - North Lynden WID Board reviewed project scope of work (SOW) and proposed Memorandum of Understanding (MOU) with Whatcom County Planning and Development Services.

January 19, 2016 - North Lynden WID Board reviewed and updated the agriculture and watershed characterization tables from the October 2012 workshop,[2] and the maps contained in the 2013 report.[3]

[2] Whatcom County Agriculture-Watershed Pilot Project (2012). *Agricultural services workshop summary notes.* Lynden, October 31, 2012.

[3] 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

June-July 2016 - North Lynden WID Board reviewed and confirmed the online version of the North Lynden WID Agriculture-Watershed Characterization and Mapping Report.

4. Record of documents

The North 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 North 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.

Information materials provided for preliminary review included:

- Table 2. Agricultural characterization tables for North Lynden area (Fishtrap Creek)
- Table 4. Watershed characterization tables for the North Lynden area (Fishtrap Creek)
- Summary notes from the 2012 work session[2]
- 2013 Agriculture-watershed characterization & mapping report[3]

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

Contents

List of Figures

1 Methodology

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

1.1 General approach

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

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

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

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

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

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

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

1.2 Limitations

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

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

1.3 Fundamental Concepts of Watershed Characterization

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

1.4 Understanding the Water Flow Assessment results

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

Water Flow importance

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

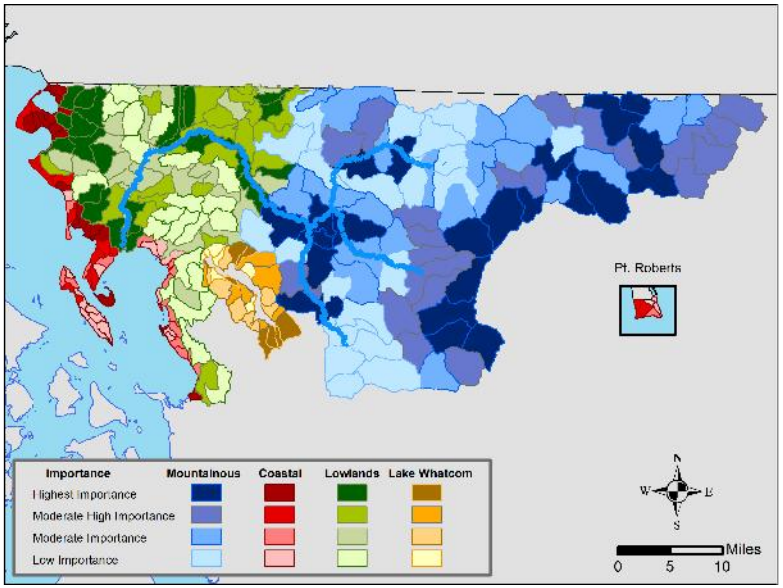


Figure. Overall importance to water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA 1. Darkest colored assessment units are considered highest *importance* relative to other assessment units in the same landscape group of WRIA 1.

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

Water flow degradation

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

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

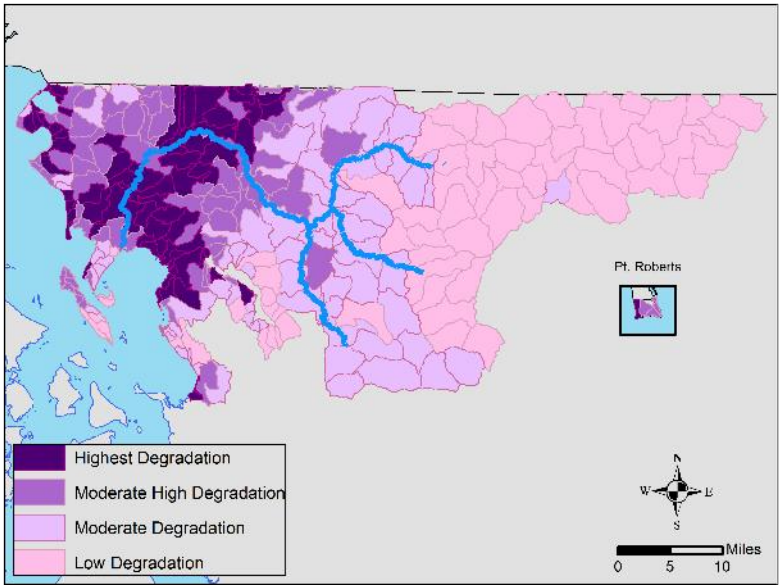


Figure. Overall degradation of water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA1. Dark pink assessment units are considered to have the highest *degradation* relative to other assessment units in WRIA1.

Management matrix for water flow

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

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

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

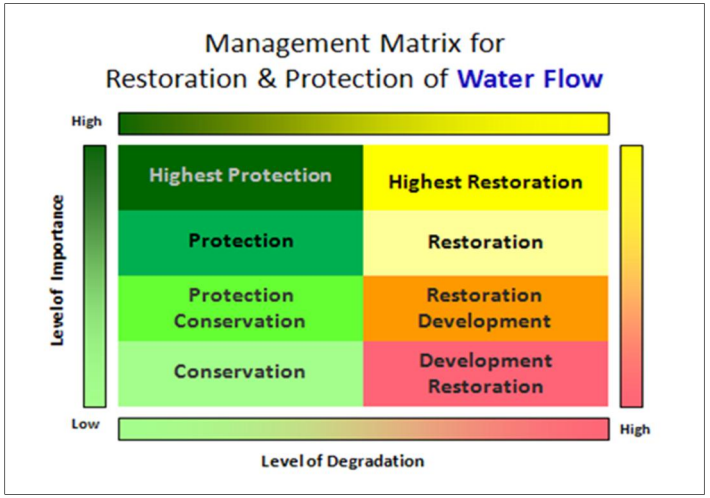


Figure: Management Matrix for Water Flow, indicating relative priorities for restoration and protection of processes

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

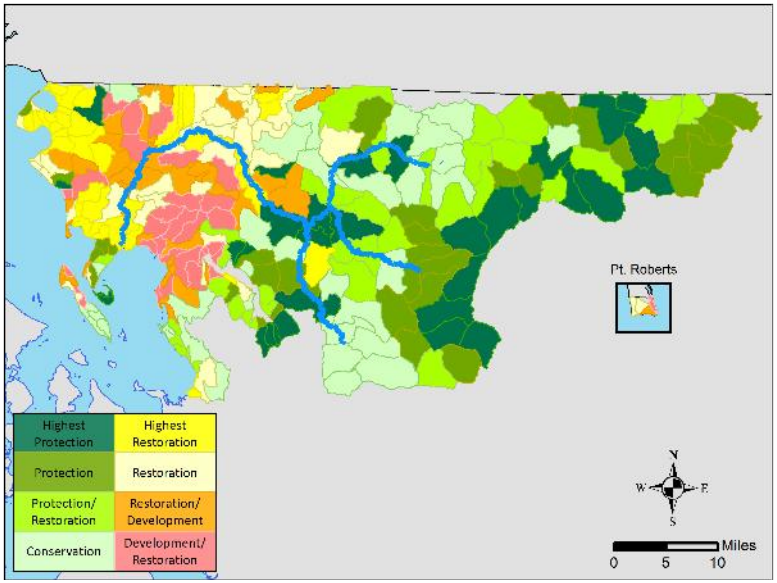


Figure. Overall priorities for restoration and protection of water flow processes in WRIA 1: Results of Puget Sound Watershed Characterization assessment.

2 Using the results of the water flow assessment

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

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

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

3 Water flow assessment results for WRIA1

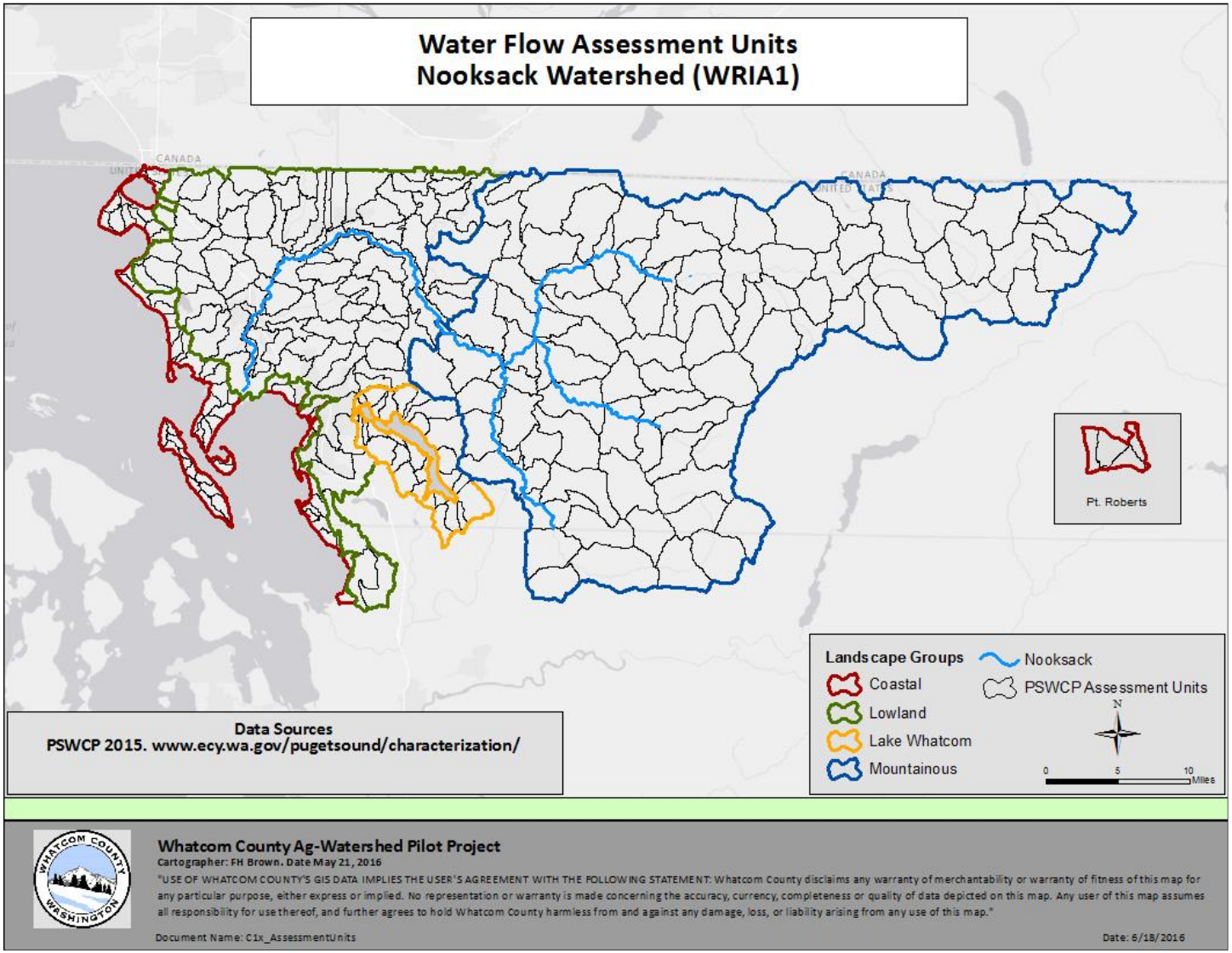


Figure 1. Water flow assessment units used in the Puget Sound Watershed Characterization.

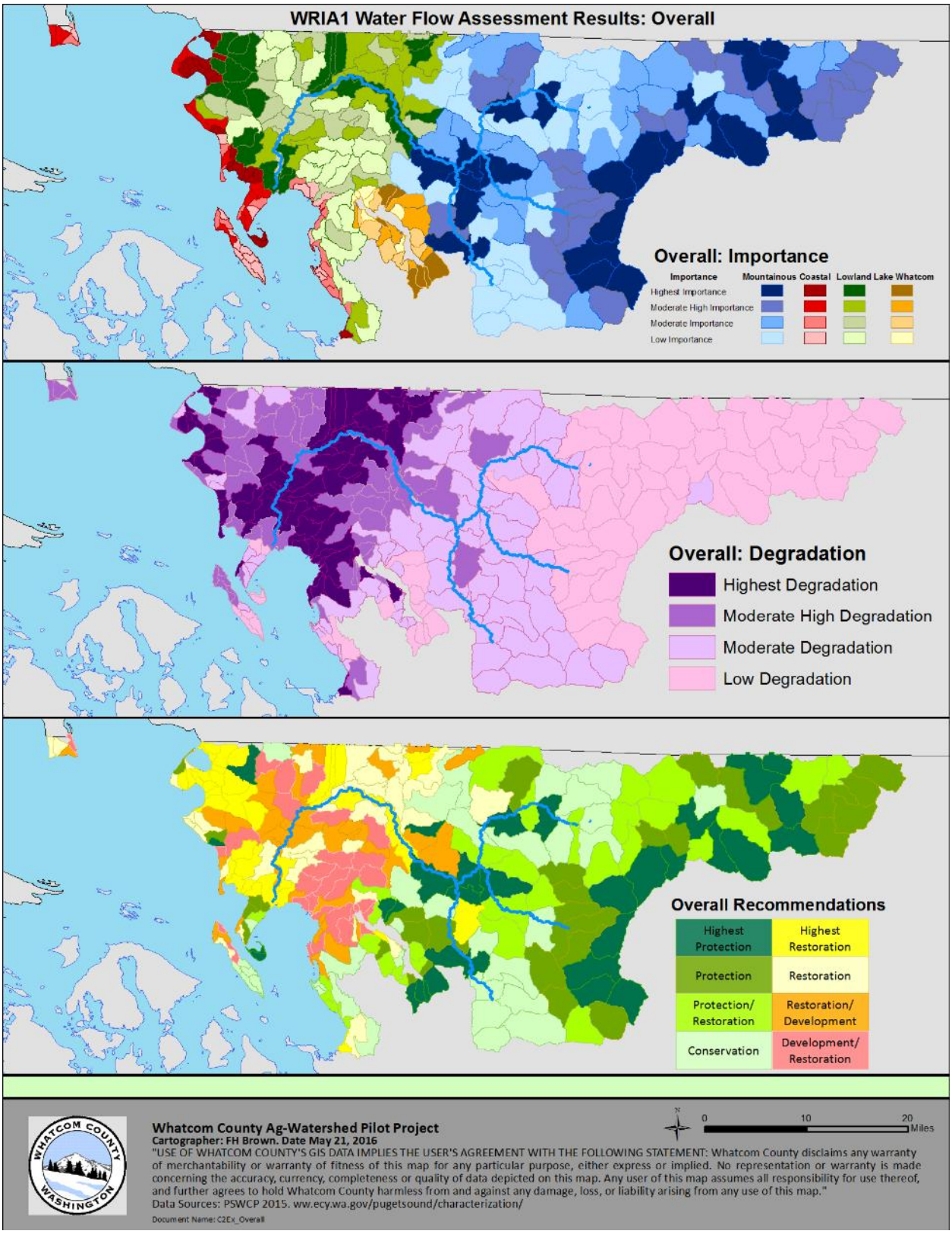


Figure 2. Overall water flow assessment results for WRIA1.

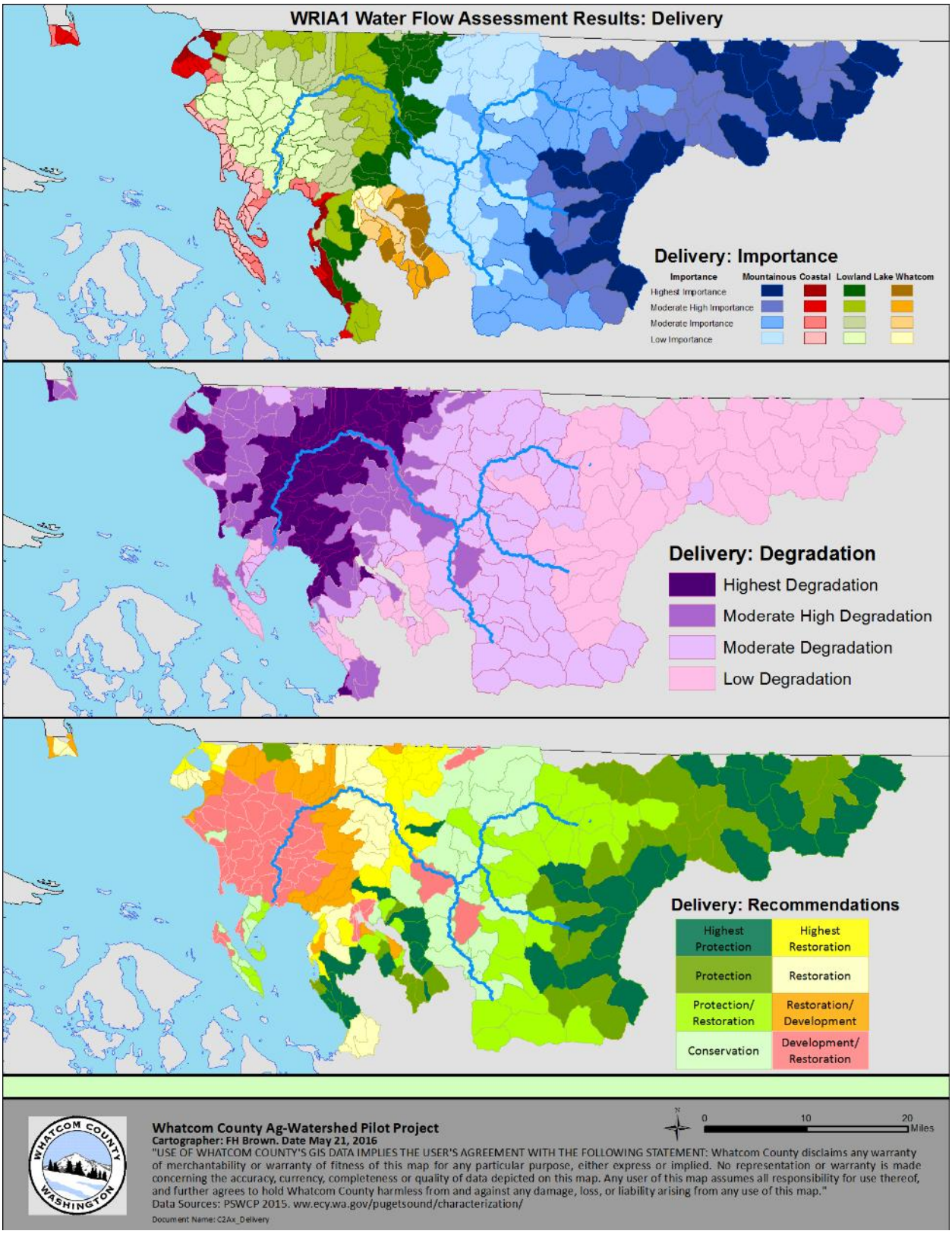


Figure 3. Delivery processes: Assessment results for WRIA1.

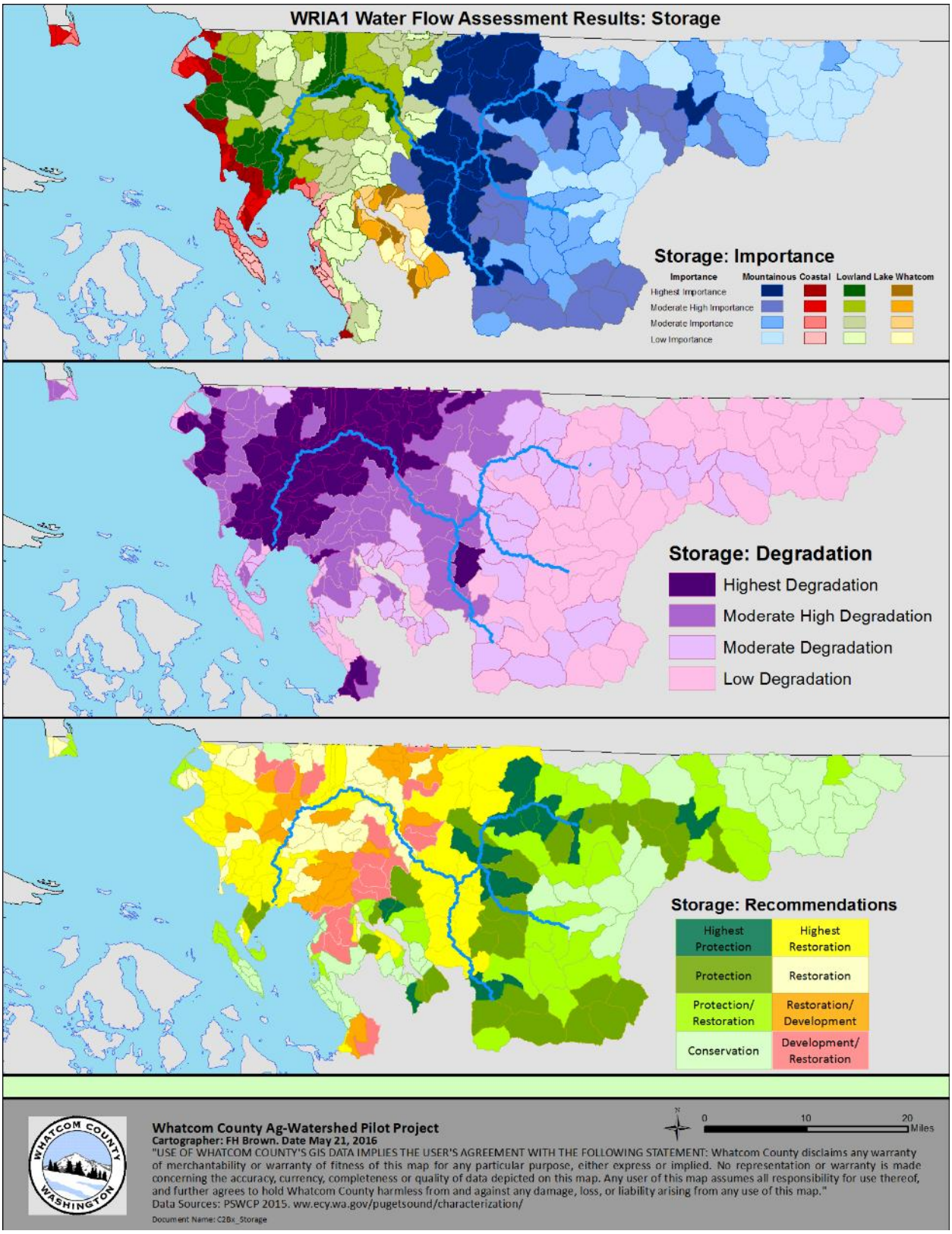


Figure 4. Storage processes: Assessment results for WRIA1.

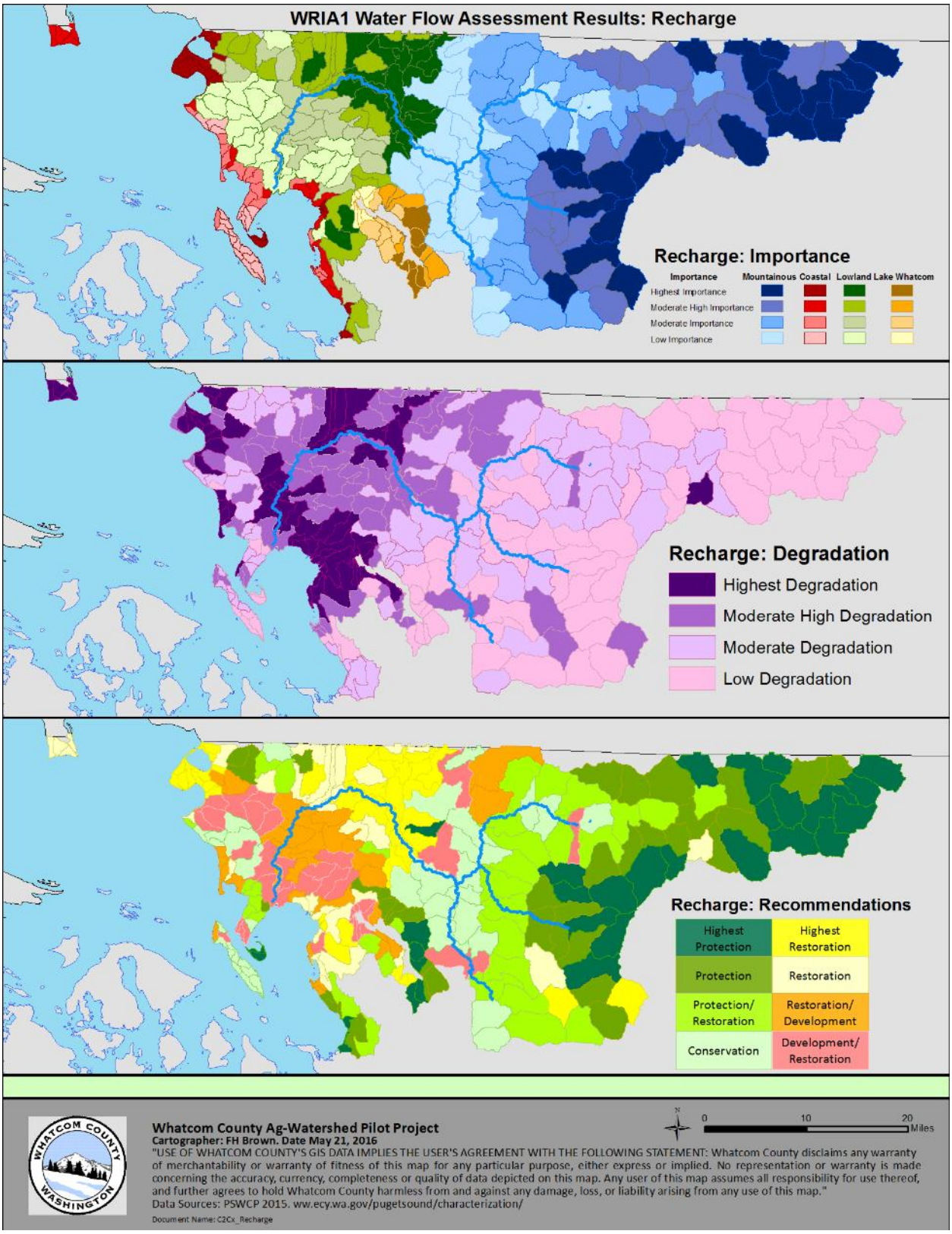


Figure 5. Recharge processes: Assessment results for WRIA1.

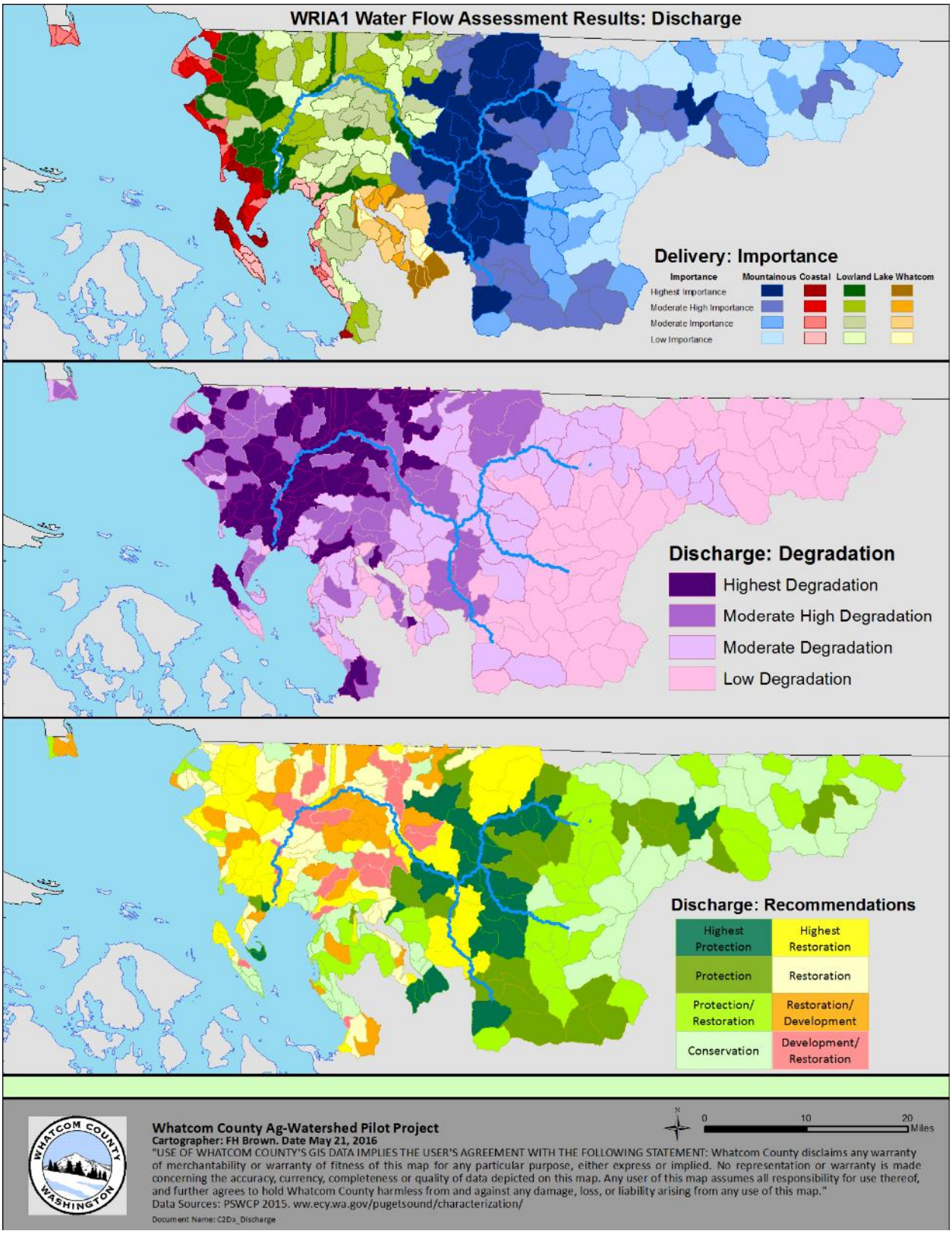


Figure 6. Discharge processes: Assessment results for WRIA1.

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

Whatcom County Ag-Watershed Project Fact Sheet #5

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

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

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

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

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

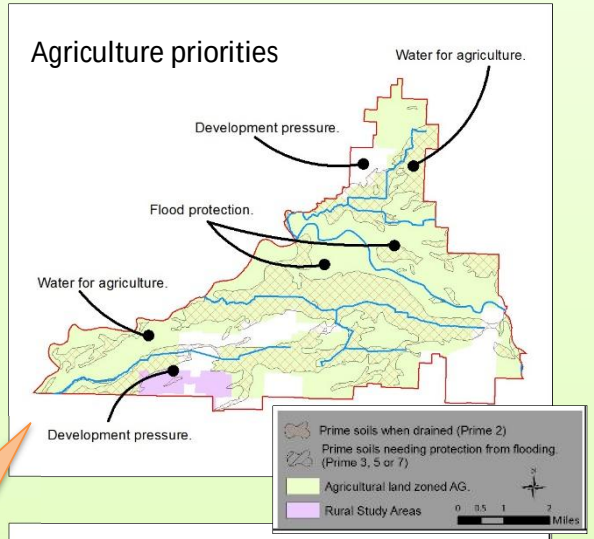
Fact sheet #5 shows how Agriculture-Watershed Characterization and Mapping can be used as a planning tool to:

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

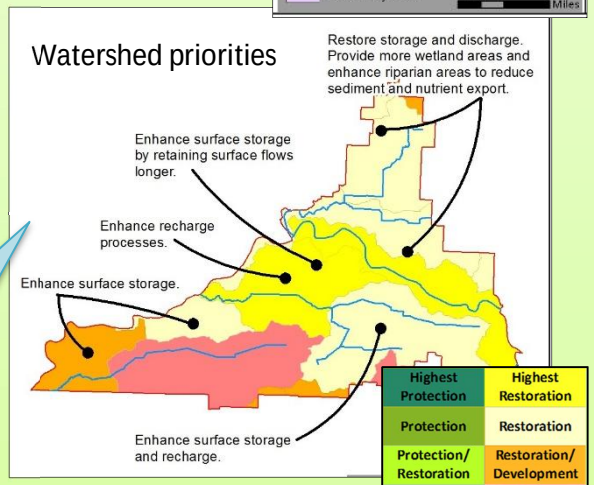
STEP1: CHARACTERIZE AND MAP AGRICULTURAL AND WATERSHED ENHANCEMENT PRIORITIES

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

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



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



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

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

STEP 2: IDENTIFY PLACES WHERE AGRICULTURAL AND WATERSHED PRIORITIES COINCIDE

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

STEP 3: SELECT SPECIFIC ACTIONS FOR AGRICULTURAL AND WATERSHED ENHANCEMENT

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

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

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

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

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

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

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