

Appendix B

**SUBJECT: Wetland and Riparian Inventory: Methodology and Limitations
Birch Bay, Washington**

This memorandum provides the methodology utilized for refining the inventory of existing wetlands within the Birch Bay WMU¹ per Task #1 of the agreed upon scope of work between Parametrix/ ESA Adolfson and the Multi-agency Watershed Group (MAWG)². The wetland inventory qualitatively identifies wetland areas and evaluates the relative importance (function and value) of these wetlands using rapid assessment techniques, remote sensing, high-resolution aerial photos (Pictometry), and other available data sets, with limited field reconnaissance. The methodology used for a similar inventory of riparian areas within the Birch Bay watershed is also included within this memorandum.

The wetland identification and riparian data generated during the course of this study are saved in a .shp (ESRI) file format titled BB_WETLAND_ID.shp and BbayRiparianBuffers.shp, respectively. The data files have been made available to members of the MAWG as part of the requested deliverables under Task #1 of the aforementioned scope of work.

PURPOSE

The scope and intent of this work is to develop an integrated approach that incorporates methods used in watershed characterization to provide guidance for future land use planning efforts. The overall goals of the project are to:

- use watershed science-based strategies for guiding future development;
- outline comprehensive mitigation and restoration strategies to offset anticipated development impacts; and
- identify options for streamlining local development review.

More specifically, this project seeks to facilitate protection and restoration of ecosystem processes necessary for the long term functioning of marine, freshwater, and terrestrial systems in and adjacent to the Birch Bay watershed while achieving more effective and efficient decision making related to land use management at the local level.

BACKGROUND

As part of the SMP update process Whatcom County conducted a landscape-scale characterization of ecosystem processes using the methods developed by Stanley et al. (2005). The landscape characterization examined key

¹ For purposes of this task, the Pt. Whitehorn and the industrially zoned areas of the upper Terrell Creek drainage subbasins would be excluded. However, these areas are to be included in the overall characterization of ecosystem processes.

² The MAWG includes: the Washington Department of Ecology, the Puget Sound Action Team (PSAT), the U.S. Environmental Protection Agency (EPA), Washington Department of Fish and Wildlife (WDFW), National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (FWS), Washington Department of Community Trade and Economic Development (CTED), Cascade Land Conservancy, Washington Department of Transportation (WSDOT), and the Washington Association of Counties.

processes related to the movement of water, sediment, heat/light, LWD, and nutrients in each of the 26 identified watershed management units (WMUs) in the County. The characterization:

- Identified key processes within the landscape that shape and influence the health of aquatic systems including wetlands, streams, estuaries, and marine waters;
- Mapped areas on the landscape that are important to the operation and maintenance of these processes,
- Assessed how these processes have been altered by human activity, and
- Determined protection, restoration and management needs for each WMU, including Birch Bay, based on existing conditions.

This pilot project builds on this existing work by: 1) refining certain aspects of the characterization (e.g., improved wetland characterization); 2) numerically scoring two of the processes (water and nutrients) using new tools developed by Stanley et al. to depict (in conjunction with information on the other processes) the relative importance of each sub-watershed for water and denitrification processes; and 3) adding a metrics-based fish and wildlife assessment.

This pilot project is part of a larger effort by the MAWG to develop an integrated set of tools that use watershed science in a land use planning context. The Birch Bay watershed was chosen as the pilot case, because Whatcom County has been actively seeking opportunities to use watershed-based planning tools to streamline development review and improve natural resource management. As an example, Whatcom County’s Critical Area Ordinance (CAO) includes provisions that allow watershed plans to “substitute” for some critical area regulations and other land use restrictions. The CAO also includes detailed standards and procedures for mitigation banking based on and consistent with State banking standards.

WETLAND INVENTORY

Wetland Identification Methodology

On February 14, 2007 a subcommittee of the MAWG, several Whatcom County employees, and members of the ESA Adolphson team joined in a working meeting to discuss scope, methodological details, and provide training for “remote” wetland identification. During the course of this meeting the basic parameters for study were determined and the specific area of interest was identified.

Data Sources

Numerous data sources were used during this inventory refinement (Table 1). All of the sources provided pertinent information regarding wetland signatures, however the aerial imagery from different seasons proved to be the most useful for quickly identifying wetland signatures on a year-round basis. The LiDAR also proved to be beneficial by revealing landscape position and surface slopes of possible wetland locations. The NRCS data, although relatively course in scale, also guided decisions based on the permeability of surrounding soils.

The previous wetland surveys were also beneficial. These include the National Wetlands Inventory, NOAA Coastal Change Analysis remote sensing data, and a reconnaissance level wetlands inventory conducted by Jim Wiggins, Aquaterra Systems Inc. and Randall Perry, Department of Ecology in 2001. Most useful was the 2001 inventory by Ecology as it received ground truthing that the other datasets did not. These reference inventories provided a starting point for the stereophoto interpretation.

Table 1: Data Sources utilized for the identification of wetlands and riparian corridors.

Name	Date	Source	Description
LiDAR	Summer 2006	US Geological Survey	The LiDAR data presented in hillshade provided information on landscape position and relief

Stereo Photos	2001/2006	WA Department of Transportation (DOT)	The stereo photos provided aerial perspective of research area. The September 2006 photos did not cover the area south of Point Whitehorn, this area was supplanted by 2001 photos purchased from the DOT photo lab. The photos were not ortho-rectified or geo-referenced. Whatcom County printed stereopairs of the 2006 photos at 1:12000 scale. A stereoscope was used to pick up vegetation signatures that indicated a high likelihood wetland vegetation.
Ortho and Oblique imagery	Winter 2004	Pictometry International Inc.	Another source of aerial imagery for project area, taken in February of 2004. This provided a wet view of the landscape contrasting more recent dry season photos from DOT. High resolution (6 inch) oblique images provide a detailed look at hard to see areas on the summer aerial photos.
NRCS – Soil Data	2001	SSURGO soils NRCS	Provided general locations of soil composition and drainage classification
BB-Wetland	2001	Department of Ecology via Aquaterra Systems Inc.	Previous wetland survey that covered approximately 40% of the project area. Represented the most reliable wetland inventory due to levels of field reconnaissance
Whatcom County, Critical Area Ordinance Wetlands (WCC 16.16)	1997, updated 2006	National Wetlands Inventory, WA Department of Fish and Wildlife, NOAA National Landcover Dataset	Provided general locations of potential wetland areas. Primarily based on remote sensing from 1980s and 2000.
Historical Wetlands	2001	Gersib, R.	Based primarily on 1990s photos and soils

Wetland Identification Parameters

The wetland identification parameters described below were determined to provide an adequate level of site specific information to meet project goals and objectives while not moving beyond the limitations presented by the available data and the remote assessment methodology developed.

Wetland Class

The wetland classes are from the Hydrogeomorphic Method (HGM) for classifying wetlands (Brinson, 1993) as defined in the *Washington State Wetland Rating System for Western Washington* (2004). A score was given for both current class and potential class. Potential refers to the class the wetland may have been prior to disturbance, and what it could possibly be again.

Table 2: Wetland Classifications

1	Depressional
2	Riverine
3	Lake-Fringe
4	Slope
5	Flats
6	Freshwater Tidal
7	Estuarine
8	Upland*

*Only used in Potential category, typically referring to stock or stormwater ponds.

Special

The special category was recorded only if the wetland areas were identified as ecosystems of special concern, afforded higher regulatory restrictions than other wetland environments. The classes in the special category were a subset of the special wetland types as identified in the *Washington State Wetland Rating System for Western Washington* (2004).

Table 3: Special Wetland Categories

0	Not Special
1	Bog
2	Lagoon
3	Estuary

Vegetation Alteration

This category was subjectively determined based on the degree of observed vegetation alteration and degree of recovery. Based on regional characteristics, it was assumed in this analysis that the majority of the Birch Bay watershed had been extensively forested prior to Euro-American settlement in the immediate area and had been logged at least once since the settlement period. If the majority (>80%) of the identified wetland polygon was forested it was determined that the alteration of vegetation structure is low.

Table 4: Vegetation Alteration

1	Low (<20% altered)
2	Partial (20 – 80 % altered)
3	High (>80% altered)

Buffer Size

The values for this category were derived from the Veg_Alt, Hydro_Alt, and HGM_Now classes through a system of if, then statements described below. Buffer sizes were established as the minimum required buffer width for Class 1 and 2 wetlands (75-feet) and Class 3 and 4 wetlands (40-feet) (per the Whatcom County Critical Area Ordinance, WCC 16.16). Since it is challenging to classify wetlands using remote analysis, we generated a system for making conservative assumptions about buffer width as follows:

If Veg_Alt = 3 (High Alteration), then Buffer_Size = 2 (40-feet)

If Veg_Alt = 1 (Low Alteration), then Buffer_Size = 1 (75-feet)

If Veg_Alt = 2 and HGM_Now = 2 (riverine), 3 (lake fringe), or 7 (estuarine), then Buffer Size = 1 (75-feet)

If Veg_Alt = 2, HGM_Now = 1 (depressional), and Hydro_Alt = 1 (Low Alteration) or 2 (Moderate Alteration), then Buffer Size = 1 (75 feet)

If Veg_Alt = 2, HGM_Now = 1 (depressional), and Hydro_Alt = 3 (High Alteration), then Buffer Size = 2 (40 feet)

Hydrological Alteration

This category was subjectively determined based on the degree of observed hydrological alteration within the identified wetland polygon. The level of hydrological alteration was determined based on the degree to which water flow paths had been modified (e.g. drained and/or channelized into drainage ditches) or the presence of infrastructure such as roads was located within the identified wetland polygon. In some rare cases development (predominantly housing plots) was located within these wetland polygons and was included in the assumptions of hydrological alteration. If greater than 80% of the identified wetland polygon was determined to contain ‘natural’ surface hydrology conditions it was determined that the degree of hydrological alteration is low.

Table 5: Hydrological Alteration

1	Low (<20% altered)
2	Partial (20 – 80 % altered)
3	High (>80% altered)

Confidence Level

Confidence level was determined qualitatively based on several characteristics. The first was the number of data sources that confirmed the potential for wetland presence within the examined area. If only one source revealed this potential, then confidence level remained low. If more than one source identified wetland potential, then confidence level was considered either moderate or high depending on surrounding landscape and hydrological conditions. Our best professional judgment, supported by a QA/QC approach for validating wetland characteristics also played heavily into determining the degree of confidence for each identified wetland polygon.

Table 6: Confidence Level

1	Low
2	Moderate
3	High

Wetland Potential

This category was defined as the potential for an identified wetland polygon to expand. Closely related to hydrological alteration, wetland potential in this instance is synonymous with restoration potential. The binary (yes/no) category was qualitatively determined based on the degree and type of hydrological alteration within the identified wetland polygon. However, highway infrastructure and development were considered semi-permanent and decreased the potential for a wetland area to expand. In some instances, the identified wetland polygons appeared to cover the maximum amount of area possible based on surrounding landscape characteristics.

Table 7: Wetland Potential

1	Yes
2	No

Source

This category was filled in based on the number and type of sources used to identify the wetland polygon. The data sources are listed above.

Notes

This category was provided to supply anecdotal information about the identified wetland polygon that would not be captured by the other categories.

Field Check

This simple binary (yes/no) category was developed to record whether or not the identified wetland polygon was included in the limited field reconnaissance conducted to confirm site conditions.

Table 8: Field Check

1	Yes
2	No

Research Team

To maintain the integrity and consistency of the data collected and evaluation conducted, a 4-member team of wetland scientists and watershed ecologists from ESA Adolfson performed the study. Each member was trained in the methodology, understood the scope of available resources, and had been provided with an overview of the landscape conditions within the watershed. Teams of two worked systematically across the watershed applying the methodology. Team members cycled out periodically, allowing for all members of the larger team to work with one another in an effort to ensure consistency of data collection and evaluation.

Assumptions

During the course of this ‘remote’ wetland identification study several assumptions were made concerning the confidence of findings at varying scales and across land uses with differing types and densities of vegetative cover. These assumptions are listed below.

- Although no minimum size for identifying potential wetlands was clarified, visual wetland signatures in any area smaller than 1,000 to 3,000 square feet was difficult to discern, unless the area was open water.
- For consistency, open water, such as stock and stormwater ponds and lakes were digitized as wetland polygons. However, these areas were consistently not afforded the wetland potential parameter.
- Any identified wetland polygons that extended beyond the boundaries of the study area were included in their entirety.
- Linear ditches were often included in the delineation of the wetland polygon to provide visual cues to the general movement of water through a complex of wetland areas.
- Agricultural fields and full-canopied forests often displayed the most difficult visual cues to discern remotely, described in more detail below in the Limitations section. The extent of wetland polygons was limited in these landcover types to areas that could be visually discerned with at minimum low confidence, and were supported by landscape position and soil data.

Field Reconnaissance

On March 10, 2007 several ESA Adolfson wetland biologists and Whatcom County employee Peter Gill conducted field reconnaissance on more than 40% of the identified wetland polygons. The field reconnaissance

was a windshield survey that was performed using major roadways. Some limited site walks were performed, however, the overall intent was to observe conditions throughout the watershed. Approximately 10% of the identified polygons were altered by field reconnaissance findings.

The areas examined in the field represented the general land use and environmental conditions observed throughout the Birch Bay watershed. These conditions included active agricultural fields with subtle swale/depression complexes, second growth conifer forest, and alder forests. In general, the remotely identified boundaries were confirmed, however, there were some instances where the actual wetland observed in the field was either much smaller (e.g. the intersection of Semiahmoo and Shintaffer roads) or much larger (e.g. the intersection of Point Whitehorn and Grandview) than the polygons identified in the office. Remote identification was more successful in cleared areas than in areas with dense forest cover.

Limitations

Wetlands are not always easy to identify, much less categorize, when in the field. When using remote sensing techniques these environments become even more difficult to discern. The most limiting factor for such analysis is the quality of the data being examined. Even using high quality aerial imagery from different times of the year and LiDAR technology it was often difficult to discern wetland characteristics in areas of several landcover types. The most difficult areas to discern was forested landscapes. Canopy cover inhibits the analysis of surface conditions, and although the LiDAR technology provides a fairly accurate representation of the ground plane beneath the canopy, inconsistencies and errors in the data maintained a low confidence level. For forested areas, we relied heavily on previously collected information from a variety of previous wetland surveys conducted within the watershed.

Another landcover type from which it was difficult to discern wetland characteristics was active agricultural or pasturelands. Although, the ground plane is easily discernable using aerial imagery and many of the lands in these land use categories were either distinctly wetland or not, a lot of the areas showed marginal wetland conditions and thus became one of the focuses for field survey.

Although the use of this remote wetland identification methodology proved to be useful for identifying general locations and characteristics of wetland areas within a landscape context, it is near impossible to determine with any accuracy the extent of wetland conditions in these areas. Thus, the data generated from this study merely provides information regarding general wetland locations and characteristics within a landscape scale context. No empirical evaluations of wetland area can be developed from the information generated.

RIPARIAN INVENTORY

Riparian Area Characterization Methodology

Developed during the same February 14, 2007 meeting that defined the basic parameters for wetland identification; the riparian characterization was designed to be a coarse evaluation of riparian conditions within the Birch Bay watershed using remote sensing techniques and a rapid assessment methodology. The riparian assessment methodology was developed from the WDFW Draft Landscape PHS Riparian Metrics (Figure 1). These metrics provide a rating system for channel stability and stream habitat based on two primary characteristics within the riparian corridor: (1) the percentage of natural vegetation within the corridor, and (2) the number of riparian corridor breaks per mile of stream habitat.

Defining the Riparian Corridor

For the purposes of this study, the riparian corridors for each watercourse were determined by regulatory guidelines stipulated in the Whatcom County Critical Area Ordinance (WCC 16.16.720.H.3). According to the code, Type 1 streams regulated by the shoreline management program (Terrell Creek) require a 150 ft buffer, all rivers and streams that are salmon-bearing are afforded a 100-ft buffer from the ordinary high water mark of each

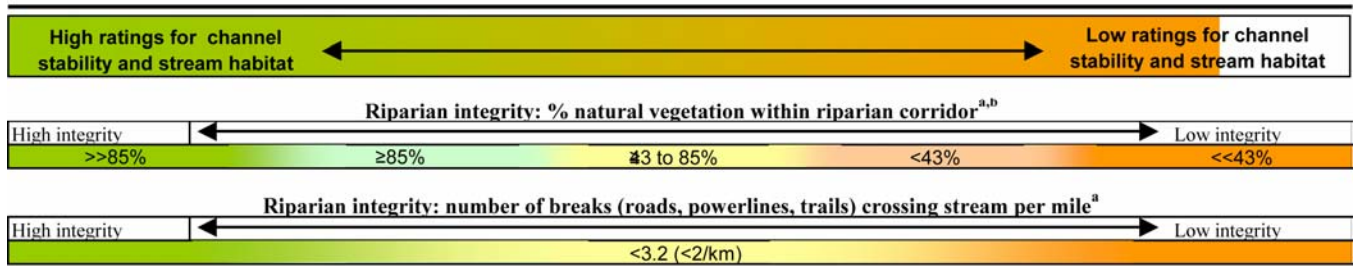
bank. Other watercourses such as non salmon-bearing streams and ditches are given a 50-foot buffer width. Lakes (under 20 acres) and ponds were also given a 50-foot riparian width in accordance with the WCC 16.16.

In an attempt to provide a more accurate assessment of riparian conditions, study reaches were broken at all tributary confluences. In some instances, in-line lakes were also used as study reach breaks. Although reaches were not of uniform length, breaking the reaches at tributary confluences represented the most logical course of action due to the short, dendritic patterns of the majority of streams in the Birch Bay watershed.

Data Sources

Whatcom County digitized the location of streams and lakes using 2004 Pictometry images and 2006 LiDAR data. The streams were broken into segments at confluences and buffer according to the Whatcom County Critical Areas Ordinance requirements. Using the buffers as riparian areas, ESA Adolphson used the same 2004 aerial photography to determine both percent of natural vegetation and corridor breaks for this inventory.

Figure 1: WDFW Draft Landscape PHS Riparian Metrics Summary Riparian Metrics



Riparian Evaluation Parameters

The riparian evaluation parameters were developed from the WDFW Draft Landscape PHS Riparian Metrics (Figure 1). These parameters were determined to provide an adequate level of site specific information to meet project goals and objectives while not moving beyond the limitations presented by the available data and the remote assessment methodology developed.

Crossings

Determined per stream or lake reach, the crossings were broken into three categorical headings: roads, utility lines, and other. More than 90% of the riparian breaks identified within the study area were roads with only a single utility line instance.

Natural Vegetation

This qualitatively determined category is based on the percent of canopy or shrub vegetation present within a study reach. The percentage for both the left and right banks was calculated independently. The percentage categories were based on those described in Figure 1.

Table 9: Riparian Vegetation Categories

1	<5%
2	5 – 44%
3	44 – 85%
4	85 – 95%
5	> 95%

Research Team

To maintain the integrity and consistency of the data collected and evaluation conducted, ESA Adolfson scientist Steve Winter collected all riparian data. Steve worked systematically through the water systems identifying and categorizing riparian characteristics based on the previously described parameters. QA/QC was conducted independently on all data collected.

Limitations

Similar to the limitations described in the wetland methodology, the most limiting factor for any remote sensing approach to landscape characterization is the quality of the data available. Although the aerial imagery used in this analysis was current (2004) and of high quality, discerning vegetation types using aerial imagery is difficult. This limitation resulted in data that merely provides information regarding the presence or absence of riparian vegetation. It does not provide any insight into the type or composition of vegetation present within the riparian corridor.

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