Riparian Habitat Prioritization: Tillamook Lowlands

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Summary

A preliminary prioritization of riparian habitats in the Tillamook lowlands was conducted. Riparian areas were prioritized separately for protection and for restoration. Ranking was based on wildlife habitat functions, and did not address flood management or water quality functions of riparian areas. (Ranking did not address instream characteristics such as substrate, instream structure, or bank erosion.) A protocol for site prioritization was developed, using the following criteria: riparian vegetation, adjacent wetlands, representation of historic plant communities, presence of tidal channels, and landscape position/sinuosity. A site ranking developed by Simenstad *et al* (1999) was incorporated into the flowchart for a subset of diked estuarine wetland sites. Flowcharts were used to separate sites into eight ranking groups: four groups for protection (top, high, medium, low), and the same four for restoration. Reaches ranked in the top three groups were marked on mylar overlays over 1:24k digital orthophotos (digital ortho-quarterquads). Each ranked reach was labeled with a code that shows the flowchart endpoint corresponding to that site, to clarify the decision-making process.

Data used in the ranking procedure included aerial photographs, digital orthophotos, wetland and riparian inventory maps, a historic vegetation map, the Estuary Plan Book, GIS layers acquired from the Tillamook Bay National Estuary Program, USGS quad maps, soil survey data, and other publicly-available maps and technical documents. Wetland and riparian inventory resources included the National Wetland Inventory, the City of Tillamook Local Wetland Inventory (Wilson *et al*, 1997), and the City of Tillamook Riparian Inventory (Brophy, 1999b).

Due to the scope of work and the nature of data sources, this prioritization should be considered preliminary. Results of other research should be combined with this prioritization to further refine priorities. Field work, landowner contact, and other local knowledge should be used to verify riparian characteristics and conditions before site-specific protection and restoration plans are developed.

Methods

Applicability of method to other locations

The method used to prioritize riparian reaches in the study area was developed specifically for the Tillamook lowlands. Because the ranking criteria are tailored to the Tillamook lowlands, the method is not appropriate for use in other locations.

Base map

<u>Study area</u>

The study area consisted of the area shown in printouts of three digital quarter-quads (DOQQs) obtained from the USFWS. Quarter-quad numbers were 45123d7NE (Tillamook 7.5' quad, NE quarter), 45123d7NW (Tillamook 7.5' quad, NW quarter), and 45123d8NE (Netarts 7.5' quad, NE quarter). Prioritization criteria were applied only to valley bottomlands under approximately 120 ft elevation. Reaches within the wooded foothills of the Coast Range were not prioritized.

Streams layer

The "lstreams" and "lrivers" layers from the TBNEP GIS were used as the base map for prioritizing reaches. A few reaches that are not shown on these layers were drawn on the mylar overlays. This was only done for high priority reaches, some major tidal channels, and areas of particular interest, for instance, the floodway that connects Dougherty Slough to the Wilson River. The channel location for these added reaches is approximate where woody vegetation obscured the channel position.

Many tidal channels and ditched former tidal channels are not shown on the "lstreams" or "lrivers" layers. In the westernmost (least disturbed) portion of the tidal zone, tidal channels are complex and interconnecting. In these areas, protection and restoration should be approached from an "area" perspective rather than a "reach" perspective (see **Restoration methods: Hydrology and channel structure: Tidal sites** below).

Adjacent wetlands

Locations of wetlands were obtained from NWI maps, the Tillamook Local Wetland Inventory, and the Estuary Plan Book mapping of estuarine habitats. Reaches where the adjacent wetland consisted solely of a farm pond were not assigned high priority, even though farm ponds are shown on the NWI (usually classified PUBH). Although the NWI is fairly accurate within the Tillamook UGB (based on field work during the Tillamook LWI, Wilson *et al*, 1997), actual locations of wetlands may differ from what is shown on the NWI maps. Prioritization of riparian reaches should be adjusted to correspond to actual wetland locations wherever that information is available.

Site prioritization

General approach and riparian functions

This riparian prioritization focused on wildlife habitat. Examples of riparian characteristics that relate to wildlife habitat include the type and extent of riparian vegetation, the presence of adjacent wetlands and other water resources, the extent of development (e.g., urbanization) in the riparian area, and the nature of the channel (natural and meandering *versus* ditched and channelized) (Pacific Habitat Services, Inc., 1998). Due to the nature of data sources, this study did not address instream habitat characteristics such as substrate, large woody debris, and bank erosion.

Riparian reaches were ranked in groups ("top", "high", "medium", and "low") for protection, and separately for restoration. [A "reach" is a section of a stream or river that shows relatively homogeneous characteristics for the criteria considered in this study.] Reaches that ranked "top", "high" or "medium" were marked on mylar overlays over digital ortho-quarterquads obtained from USFWS.

Riparian vegetation can be woody (trees or shrubs) or non-woody (herbaceous vegetation only). Woody vegetation can be distinguished from herbaceous vegetation in airphotos, so it was a useful criterion for this study. Woody vegetation provides many layers of habitat for a variety of wildlife species, and provides shelter to buffer riparian areas from disturbance, noise, and pollution. Woody vegetation can overhang the stream channel, providing shade that helps keep water temperatures cool enough for survival and growth of anadromous fish. Many other functions are served by woody vegetation, such as flood control, soil erosion control, and soil structure improvement; these functions were not directly addressed in this study. **Riparian areas with a strip of woody vegetation more than 100 feet wide were prioritized.**

Some woody riparian areas are particularly valuable. Tidal forests are a rare plant community in the study area and throughout Oregon, and offer unique wildlife habitat not found in nontidal woodlands. **Tidal forests were assigned top priority for protection.**

Wetlands adjacent to riparian areas provide diverse habitat for many types of wildlife, and if connected to the stream channel, wetlands can also provide habitat for anadromous fish (such as resting and foraging areas during high flow). Adjacent wetlands also provide many important flood management and water quality functions, which were not directly addressed in this study. **Riparian areas with adjacent wetlands were prioritized.**

Development (buildings, parking lots, roads) in the riparian area affects wildlife by reducing habitat, and can disturb wildlife because of increased artificial light, noise and pollution. For this study, development and width of woody riparian vegetation were inversely related to each other (areas that were developed generally did not have intact woody riparian vegetation), so development was not evaluated separately from width of woody vegetation.

Today, most of the streams in the Tillamook lowlands (other than the main rivers) have been ditched and channelized. However, **portions of Dougherty Slough and Hoquarton Slough were prioritized because they retain to a large extent their natural channel morphology (sinuosity), and because of their unique landscape position.**

Other riparian characteristics (such as presence of large woody debris, and perennial versus intermittent water flow) are important in determining wildlife habitat value, but they could not be evaluated in this study (see **Limitations of this study** below).

<u>Ranking criteria</u>

The flowcharts attached to this report (Appendix 1) show the criteria used to separate riparian reaches into priority ranking groups. Criteria used are:

Tidal and nontidal sites:

- Tidal/potentially tidal? (see **Tidal zone** below): **Y/N**
- Adjacent wetland? (from NWI and LWI): (see **Adjacent wetlands** below). **Y/N**

Nontidal sites only:

- Width of wooded riparian corridor? (see **Wooded riparian corridor** below). Used only for nontidal sites, and upland sites in the tidal zone. Measured on one side of the channel. **>100 ft / 100-200 ft / >200 ft**

- In Dougherty/Hoquarton natural channel zone? (see **Landscape position/Sinuosity** below): **Y/N**

Tidal sites only:
- Undiked, undisturbed tidal wetland habitat with intact tidal channels? (see **Identification of undiked tidal wetland habitat** below): **Y/N**
- Tidal forest? **Y/N** (see **Identification of tidal forest** below)
- Has scattered mature spruce? **Y/N** (see **Identification of tidal forest** below)
- Ranked in breach dike study? (see **Other reports** below): **Y/N**
- If ranked in breach dike study, ranking (see **Other reports** below) **1-6 / 7-11 / 12-15**
- If not ranked in breach dike study, are remnant channels visible? (see **Remnant channels** below): **Y/N**

<u>Reach coding</u>

Each reach is marked with a color and pattern that indicates its priority rank. Each end of a marked reach has a green terminator ( or ). Rankings and associated patterns are:

"P: Top" is top priority for protection: color is green, pattern is: 

"P: High" is high priority for protection: color is green, pattern is: 

"P: Medium" is medium priority for protection: color is green, pattern is: 

"R: Top" is top priority for restoration: color is red, pattern is: 

"R: High" is high priority for restoration: color is red, pattern is: 

"R: Med" is medium priority for restoration: color is red, pattern is: 

Reaches in the "lstreams" and "lrivers" layer that were ranked low priority for both protection and restoration were not marked on the mylar. However, protection of existing riparian vegetation, and restoration of native woody vegetation along these reaches is still highly recommended (see **Recommendations: Protection** below).

Each reach also has an endpoint code showing where that reach came out in the flowchart. This code (for example, "T9B") allows the user to determine the decision process that led to the priority ranking. Codes starting with "T" indicate reaches in the tidal zone; endpoint codes starting with "N" indicate nontidal sites. Some sites with endpoint codes starting with "N" are located in the defined tidal zone (see **Tidal zone** below), but lack adjacent wetlands and so were rated using the nontidal flowchart.

<u>Tidal zone</u>

Because riparian characteristics differ between tidal and non-tidal sites, two different methods were required to rank riparian reaches within the study area. For example, woody vegetation was historically found along most nontidal riverbanks and streambanks in the Tillamook lowlands (Coulton *et al*, 1996a). Woody vegetation is now largely gone from streambanks and riverbanks in the Tillamook lowlands, so riparian reaches that still have some woody vegetation were ranked high for protection. However, in tidal areas, woody vegetation is not always expected. Some tidal sites were once forested (see **Identification of tidal forest** below), but in the areas most strongly affected by tides, tidal marsh was and still is the predominant plant community. Tidal marsh is dominated by herbaceous plants and generally has no trees or shrubs. Riparian reaches thus have to be ranked differently for areas that are (or once were) tidal marsh, compared to areas that were once wooded.

Ranking tidal (or potentially) and non-tidal sites differently requires drawing a boundary between these two types of habitats. However, determination of the current and historic extent of tidally-influenced habitats in the Tillamook Valley is difficult. For the purposes of this study, the following simplifying assumption was made: tidal (or potentially tidal) habitats extend upstream only to the furthest-upstream tidal habitats shown on either the NWI or the EPB (Estuary Plan Book) mapping, or to the maximum extent of Coquille soils (which form under tidal influence), whichever is further upstream. The reasoning behind this assumption is described in **Discussion: Extent of tidal (and potentially tidal) habitats** below.

If indeed these areas were tidally-influenced in the past, it might be possible to restore them to tidal habitats by re-introducing tidal flow. However, on-the-ground field work, including elevation survey work and water level measurements, would be necessary to verify this possibility.

We recognize that many areas within the tidal zone were never tidal marsh or tidal forest. Uplands with no tidal influence did and still do exist within the tidal zone. The lack of tidal influence in these areas is recognized in the prioritization scheme through the "adjacent wetland" criterion (T2 in the flowcharts). Because of this criterion, uplands within the tidal zone are prioritized using the nontidal flowchart, starting at criterion T3B.

Adjacent wetlands

Compared to their historic abundance, freshwater wetlands are now rare in the Tillamook lowlands. Larry Reigel of the US Fish and Wildlife Service (L. Reigel, personal communication, 1999) conducted a GIS analysis of current acreage of wetland types compared to their historic extent (Coulton *et al*, 1996a). This analysis shows that only 3.9% of freshwater emergent wetlands remain ("grassy swamp" on the historic vegetation map), and only 9.6% of freshwater forested or scrub-shrub wetland ("brush or wooded swamp").

Riparian areas with adjacent wetlands were prioritized not only because those wetlands are now uncommon in the study area, but also because wetlands provide so many functions for wildlife habitat, flood control and water quality. Sites were assigned high priority if the National Wetland Inventory (NWI) maps showed wetlands (other than riverine wetlands) immediately adjacent to the reach. To receive priority, the wetlands needed to extend more than 50 feet beyond apparent top-of-bank as seen in airphotos (and thus needed to have a total width of more than 100 feet). Many reaches had very thin strips of wetland marked along the stream channel; these were generally less than 50 feet wide and often consisted of a single row of trees or scattered individual trees. These reaches were not prioritized, nor were reaches that had palustrine wetland shown **in the channel** only.

The NWI showed good accuracy in the Tillamook Local Wetland Inventory (LWI) study area (Wilson *et al*, 1997); all major wetlands located during the LWI along streams and rivers were on the NWI (although most were larger than shown on the NWI). The NWI failed to show some isolated (non-riparian) wetlands, but that omission does not affect this report. Because of its accuracy within the LWI study area, the NWI was considered an adequate basis for prioritizing riparian areas with adjacent wetlands.

<u>Wooded riparian corridor</u>

The width of the wooded riparian corridor was measured on the digital ortho-quarterquads obtained from USFWS (approximate scale 1" = 1200 ft).

<u>Prioritization of tidal marsh</u>

Of all the historic vegetation communities that were once found in the Tillamook lowlands, tidal marsh is the most common today: 35.3% of the original acreage of "grassy tidal marsh" remains (Larry Reigel, USFWS, personal communication 1999). However, this figure includes both high and low tidal marsh, because the methods used to create the historic vegetation map (Coulton *et al*, 1996a) didn't allow separation of high and low marsh.

High marsh is a very different environment from low tidal marsh, and offers different habitat for salmonids. Because it is located in brackish-to-freshwater areas, high marsh offers opportunities for osmotic transition, as well as a highly productive foraging environment (NOAA, 1990) and deep channels for predator avoidance (Lebovitz, 1992).

Most high marsh in Oregon has been converted to pasture and/or hay production (Jefferson, 1975). By contrast, low marsh is probably unlikely to be converted to agricultural use because tidal influence is too strong, and elevation is too low. Therefore, the proportion of the original **high marsh** remaining in the estuary may be much lower than the 35.3 % determined by GIS analysis of historic versus current lowland habitats (see **Methods: Adjacent wetlands** above). For this reason, protection of remaining tidal marsh is recommended. Low marsh is prioritized for protection as well as high marsh; low marsh may over time convert to high marsh through sediment accretion (Jefferson, 1975). In addition, diked tidal marsh is prioritized for restoration, because much of the diked former tidal marsh will eventually restore to high marsh -- though the process may take decades (Frenkel and Morlan, 1991).

Identification of undiked tidal wetland habitat

Airphotos were used to determine whether a site within the tidal zone was diked (or otherwise disturbed) or undiked. Disturbance of tidal wetland sites was generally visible in aerial photographs, either directly (visible ditching, diking, tidegates, etc.) or indirectly as a change in the appearance of vegetation compared to undisturbed areas.

Remnant channels

Alteration of natural tidal channels is usually visible in airphotos of diked sites: the natural, meandering channels gradually degrade over time and become less distinct, and eventually disappear altogether, usually replaced by straight drainage ditches. In some areas, tillage obscures former tidal channels (see **Discussion: Extent of tidal / potentially tidal habitats** below). If remnant tidal channels are still visible in current airphotos of a site, that site offers better opportunities for restoration. This is because the remnant channels may be able to carry restored tidal flow into the site in a natural fashion, or alternatively, they may provide guidelines for excavation work to channel reintroduced tidal flow. Also, sites with visible remnant channels may have been altered more recently than sites with no remnant channels. More recently altered sites may still have more of the original vegetation (in the seed bank, if not aboveground), and may have undergone less subsidence compared to sites altered long ago. Subsidence can greatly alter the path of restoration for tidal wetlands (Frenkel and Morlan, 1991).

Identification of tidal forest

Tidal forest was once found in large areas of the Columbia River Estuary, and also in other Oregon estuaries. Today, tidal spruce swamp is a rare plant community in Oregon (Jefferson, 1975; Thomas, 1999). Most of the tidal forest in Oregon was probably the type also known as tidal spruce swamp or tideland spruce meadow, because the dominant tree is generally Sitka spruce, *Picea sitchensis* (Jefferson, 1975).

Tidal forest is still found in very limited areas of the Tillamook lowlands. The largest remaining area is the forest surrounding Hoquarton Slough within the Urban Growth Boundary of the City of Tillamook (Wilson *et al*, 1997, and Brophy, 1999b). Other areas are found in upper Squeedunk Slough, and near the mouth of Hall Slough. All of these areas are assigned a high priority for protection.

Once the spruce trees are gone, it can be difficult to determine which areas once had tidal forest as opposed to tidal marsh. The historic vegetation map may not depict the complete extent of tidal forest, because it does not show the eastern portion of the Hoquarton Slough forest as tidally-influenced forest, even though the soils in that area are Coquille soils (formed under tidal influence). For the purposes of this study, if a riparian area was located in the tidal zone, had adjacent wetland, and had numerous scattered mature spruce, it was assumed to have once been tidal forest, and was assigned top priority for both protection of existing vegetation, and restoration of the full riparian plant community.

Landscape position and sinuosity

Many streams in the Tillamook lowlands have been straightened and channelized in order to drain the land and provide good pasture and farmland. Once a stream has been ditched and straightened, land use and ownership patterns make it nearly impossible to re-establish a meandering channel across a large area. Therefore, this study prioritized the only two substantial drainages (other than the mainstem rivers) in the study area that still retain their meandering channels to a large extent. These drainages were the portion of Dougherty Slough downstream of its floodway connection to the Wilson River, and Hoquarton Slough downstream of the section line between sections 19 and 20.

In addition to their meandering channels, Hoquarton Slough and Dougherty Slough provide habitat for anadromous fish (David Nusum, ODFW, personal communication, 1999). Additional value comes from their landscape position. These sloughs are located in areas of major flood concern, and they extend far enough up the valley that they provide extensive opportunities for hydrologic restoration. Furthermore, Dougherty Slough has been subject to overwash from the Wilson River during flood events, and because of this periodic disturbance, land use is less intensive in areas immediately adjacent to the Slough (except near Highway 101). Therefore, the potential for restoration of riparian vegetation in areas immediately adjacent to Dougherty Slough may be high.

Some reaches prioritized for both restoration and protection

In cases where woody riparian vegetation was between 100 and 200 feet wide (endpoints N5B and N7A), the reach was ranked for both protection and restoration. This is also the case for tidal sites with scattered mature spruce (endpoint T8A). As a first priority, protection of the existing woody vegetation is recommended. Beyond protection, restoration activity should involve plantings to extend the woody riparian corridor to a width of 200 feet, or some other appropriate width as determined during development of a site-specific action plan. Restoration might involve other activities as well (see **Restoration methods** below).

In general, even when a reach is prioritized for protection, it can benefit from active restoration as well. Few riparian areas in the Tillamook lowlands are completely undisturbed. For example, forests along Hoquarton Slough, upper Squeedunk Slough, and near the mouth of Hall Slough are tidally-influenced to some extent, based on the underlying soil type (Coquille) and the Estuary Plan Book mapping. However, hydrologic disruption due to human activities may have reduced tidal influence. Examples of hydrologic disturbance here include ditching along the edges of the forests, dredging of channels in the past (possibly with sidecasting of dredged material in the forest margin), and possible overall changes in water levels due to area-wide land use changes that alter drainage patterns. Field work to determine tidal influence would be useful; restoration of tidal flow into areas of the forest could help re-establish the original hydrologic environment.

Right and left streambanks

On nonmajor drainages in the study area (all drainages other than the Trask River, Wilson River, and Tillamook River), where a reach met criteria for prioritization, both left and right banks were generally marked with the same priority ranking. In these cases, restoration or protection (as appropriate) should be applied to both banks if at all possible. Restoration (or protection) on one bank is preferable to no restoration or protection; but functional integrity of in-stream and riparian habitat is best achieved through action on both banks.

In many cases, only one bank has woody vegetation. In some of these cases (where field work, e.g. Brophy, 1999b, provided more detailed data), the two banks are marked separately. Where detailed data were lacking (often, where the exact location of the channel could not be determined from aerial photos), the two banks are marked the same. Separate requirements for each bank should become apparent during development of site-specific action plans.

For major rivers, right and left banks were marked and prioritized separately. However, if protection or restoration action can be applied to both banks, effectiveness of that action will be increased.

Other reports

Simenstad *et al* (1999) conducted an assessment of potential dike-breach restoration sites in Tillamook Bay. The results were incorporated into the current study, as a means of distinguishing between the dike-breach study sites. The Tillamook Bay National Estuary Program (TBNEP, 1999) prepared a set of criteria for prioritizing floodplain and lowland sites; some of the criteria included: habitat connectivity; high quality instream or riparian habitat; riparian trees; and multiple benefits for habitat, water quality, erosion, and flood protection. These criteria were used to help establish the ranking protocol for this study.

Discussion

Limitations of this study

Further refinement of prioritization

This is a **preliminary site prioritization**. It is based on remote data sources (airphotos, published maps, GIS layers). Even though these remote data sources were interpreted using knowledge gained through local, on-the-ground experience, there may be inaccuracies in the data sources that produced the priority rankings. **Field work to verify riparian conditions is required before site selection is finalized and before site-specific action plans are developed.** In addition, local knowledge and results of other research (which could not be located and included in a study of this scope) should be considered before finalizing site selection and action plans. It is important to emphasize that **landowner involvement is an essential to site selection and action plan**

development. Protection and restoration will be successful only with the active, informed involvement of the landowner.

There may be cases where a reach is ranked high for restoration, even though it does not appear to offer much chance of success. An example would be a channelized drainage in an intensively used farm area, which has an adjacent wetland but no woody vegetation. Such a reach met the criteria for a high ranking, but might be eliminated during the process of site selection due to the currently intensive land use. The site selection process, and on-site field visits to verify riparian conditions, will offer opportunities for further such refinement of prioritizations.

<u>Riparian characteristics not considered</u>

Many riparian characteristics that strongly affect fish and other wildlife habitat (for example, bank erosion, riprap, presence of large woody debris, fill activity in floodplains, and undersized culverts) were not considered in this study, due to the limited scope of the study and the limitations of the data sources (airphotos, certain published maps, and GIS data). These factors warrant further investigation. We highly recommend expansion of Aquatic Habitat Inventory-type work (Moore et al, 1997) to cover all drainages in the study area.

<u>Other possible prioritization criteria</u>

This study did NOT attempt to prioritize riparian areas based on flood management or water quality functions, but instead focused on wildlife habitat. Areas of high wildlife habitat values were prioritized for protection, and areas that offer good opportunities for restoration of high-quality wildlife habitat were prioritized for restoration. Other approaches to prioritization should be used in combination with the approach used in this study. For example, it may be possible to reduce economic damage from flooding by changing the allowable land uses in frequently flooded areas (land use policy), and by setting back levees or constructing floodplain terraces and multistage river channels (hydrologic restoration) (TBNEP, 1998). If land use, hydrologic restoration, or other strategies are developed for a particular river reach, riparian habitat restoration along that same reach should be prioritized as well.

<u>Other reports</u>

A great deal of research has been conducted in the Tillamook Bay area, much of it associated with the Tillamook Bay National Estuary Program. The scope of work for this study did not include literature research on other studies in the area, and therefore did not generally consider the results of those studies. Results from Brophy (199b), Simenstad *et al* (1999) and TBNEP (1999) were incorporated into this study, but other prioritization schemes for the area may exist. Before making choices on riparian areas protection and restoration, other studies and ranking schemes should be considered in combination with the prioritization provided in this report.

The next step: site selection and action plans

Landowner involvement

Successful resource protection will occur only with active, informed landowner involvement, and with public support and understanding of restoration goals and processes. As mentioned in **Restoration methods** below, landowner involvement is essential from the very beginning of the site selection and site planning process.

Connectivity

The effectiveness of restoration efforts can be greatly increased by concentrating restoration efforts along a subset of drainages, chosen for their relatively high chances of successful restoration. In this way, restoration sites are well-connected to each other. For example, if restoration efforts were focused on just two streams, and 75% of the length of each of those two streams was restored to good condition, both of those streams might then provide acceptable habitat for sensitive species like salmonids. By contrast, if the same restoration effort were dispersed across ten streams, with only 10% of each stream's length being restored, conditions in any single drainage might not improve enough to provide tolerable habitat. This reasoning supports the prioritization of long, contiguous sections of Dougherty and Hoquarton Sloughs.

Similarly, restoration of tidal sites will be more effective if blocked cross-connections between sloughs are re-established. This allows wildlife to move between sites as conditions change. Originally, tidal channels in the lower tidal area formed a complex network, carrying tidal flow not only in and out of the bay, but laterally between adjacent sites that are now diked off from each other. If tidal flow is re-established within adjacent diked sites, effectiveness of the restoration might be greatly improved by also connecting the sites to each other (if such connection originally existed).

Existing regulatory protection

Although as a group, undiked tidal marsh sites are ranked high for protection, existing regulatory protection of these sites (through estuarine zoning, wetlands fill/removal laws, etc.) may be adequate. Existing protection should be considered during the site selection process (see also **Discussion: Further refinement of prioritization** above).

Recommendations for site-specific action plans

Protection

Area to be protected

Protection of existing riparian vegetation along all reaches, and restoration of woody vegetation where it is absent, are a high priority throughout the study area. This is equally true for reaches that are categorized as "low priority" for protection and restoration. In the Tillamook lowlands, riparian fencing (along with provision of off-channel water sources) can be an excellent strategy for protecting existing riparian vegetation, and restoring woody riparian vegetation. Riparian fencing works well in combination with other restoration techniques like riparian plantings; levee setbacks; floodplain terrace construction and creation of vegetated benches; creation of off-channel fish habitat; and wetland restoration. Riparian fencing programs are ongoing in the study area (for example, through the Soil and Water Conservation District), and continuation and expansion of those programs is highly recommended.

Areas that were assigned a high priority for protection in this study have relatively wide riparian corridors with natural vegetation -- forest, shrubby vegetation, freshwater wetland, or tidal marsh. Protection, in these cases, refers to protection of that natural vegetated area, the width of which can be estimated from airphotos (the width should be confirmed through on-site field work). The exact area to be protected in these priority areas will need to be negotiated between landowners, natural resource agencies, and other interested parties, and will depend partly on the strategy for protection. Given the small acreages of woody riparian vegetation left in the study area, protection of as much of the natural vegetation as possible is recommended.

Mechanisms for protection

Protection of the riparian area should focus first on protecting existing riparian vegetation. Protection also needs to include active management (for instance, monitoring the condition of the site, and removing invasive exotic species). Mechanisms for protection might include conservation easements, deed restrictions, donation to land trusts or local conservation organizations, and management agreements with resource agencies. The Oregon Wetlands Conservation Guide (OWCA, 199x) provides an overview of possible mechanisms, many of which are applicable to riparian areas as well as to wetlands.

<u>Restoration methods</u>

This study does not prescribe specific restoration methods; not all restoration methods are described here. Action plans for individual sites must be based on field work to establish conditions at each site, and must be developed in cooperation with each individual landowner and with technical advisors. Landowner involvement is essential from the very beginning of the site selection and site planning process (see **Landowner involvement** above). Regardless of priority rankings, landowner interest and willingness are needed before any site protection or restoration action can occur.

Vegetation

Probably the most important step in restoring nontidal riparian areas consists of planting and maintaining native woody vegetation along the stream channel. Plantings should be closely modeled after vegetation at nearby, undisturbed reference areas, and should consist of species native to the Tillamook Valley Lowlands. Reference areas should be chosen which match the topographic, hydrologic and soil conditions at the restoration site as closely as possible.

In areas to be restored to tidal marsh, plantings may not be needed if propagules of native marsh species are available nearby (Frenkel and Morlan, 1991). Propagules are probably available if undisturbed tidal marsh is found near the restoration site. If this is true, restoration of tidal flow will generally result in re-establishment of tidal marsh plant communities without plantings.

Strategies for restoring riparian vegetation within the zone of tidal influence, but where salinities are very low (slightly brackish and freshwater tidal systems) may differ from strategies for salt marsh. Many miles of streams in the Tillamook lowlands fall into the brackish/freshwater tidal zone, since tidal influence probably extends at least 2 to 5 miles up the major rivers (see **Discussion: Extent of tidally-influenced habitats** below). Brackish and freshwater tidal systems in the Tillamook lowlands may have originally been forested (with Sitka spruce prominent among tree species), or herbaceous. Native woody plantings suited to nontidal freshwater systems may be advisable in these restoration sites, particularly on streambanks. Sitka spruce should be prominent among woody plantings for these sites, since it is reported from freshwater tidal forests (Jefferson, 1975). Propagules of native herbaceous dominants of freshwater tidal systems may be lacking near many of the potential freshwater tidal restoration sites in this study, so plantings of herbaceous species may also be necessary. Dominant herbaceous species in brackish and freshwater tidal habitats include tufted hairgrass (*Deschampsia cespitosa*), Baltic rush (*Juncus balticus*), Pacific silverweed (*Potentilla pacifica*), bentgrasses (*Agrostis alba* sspp.), and slough sedge (*Carex obnupta*) (Frenkel and Eilers, 1976). Commercial seed sources exist for these species.

Hydrology and channel structure: nontidal sites

Some of the many methods of non-tidal riparian restoration (other than plantings) include levee setbacks; floodplain terrace restoration; culvert upgrades; removal of fill material from adjacent wetlands; excavation of backwater wetlands, resting pools, alcoves and other fish habitat; and placement of large woody debris (Coulton *et al*, 1996b).

Hydrology and channel structure: tidal sites

For tidal sites, restoration options include dike breaching, dike removal, or dike setbacks; tidegate removal or tidegate modification to allow fish passage (Charland, 1998); ditch filling and tidal channel restoration; and culvert upgrades (where culverts restrict tidal flow). Tidegate removal not only allows restoration of tidal marsh and tidal forest, but also allows restoration of tidal flow to in-stream habitat outside the range of tidally-influenced vegetation communities (see "**Extent of tidally-influenced habitats** below). Brophy (1999a) provides a brief discussion of potential tidal wetland restoration techniques.

In non-tidal portions of the study area, a common approach to riparian restoration focuses on a linear section of drainage and its environs. By contrast, in the tidal zone, an "area" approach works better. Dike removal or dike breaching often restores tidal flow to a broad area, not just to a linear section of a channel.

A good resource for making priority decisions in the tidal wetland zone is Simenstad *et al* (1999), a demonstration project ranking potential dike-breach restoration sites in Tillamook Bay. The priority rankings from Simenstad *et al* were incorporated into the current study, but we recommend going directly to the original study for detailed information on site ranking. Some high priority restoration sites are not included in Simenstad *et al*; these were prioritized using the methods described in **Methods** above, and are so marked on the mylar overlay.

<u>Protection combined with restoration</u>

Once protection is in place, further enhancement of riparian functions should be considered. For instance, even if riparian vegetation is protected, in-stream conditions may not be suitable for salmonid habitat. Terrace construction, improvement of hydrologic connections to adjacent wetlands, and other hydrologic restoration methods might be implemented to enhance riparian functions (see **Restoration methods: Hydrology and channel structure** above). Another example is Hoquarton Slough, where riparian forest is intact, but hydrologic disturbances exist (e.g., the ditch along the south edge of the forest on the south bank of Hoquarton Slough west of Tillamook). Not all such disturbances could be detected in this study, so on-site field work is needed to complete site action plans (see **Further refinement of prioritization** above).

Data sources and needs

<u>Extent of tidally-influenced habitats</u>

Tidal marsh and tidal forest (together referred to as "tidal wetlands") are valuable habitats that are important to many wildlife species, including anadromous salmonids (NOAA, 1990). For anadromous fish, tidal marsh and tidal forest are particularly important because they provide an osmotic transition zone, an extremely productive foraging environment, and overhanging banks and subterranean tidal channels that help juvenile fish avoid predators. In the case of tidal forest, these features are enhanced by the presence of trees that provide excellent shading, physical shelter, and large woody debris. For this reason, tidal wetlands and former tidal wetlands have been prioritized (for protection and restoration, respectively) in this study. However, lowland habitats (including tidal marsh and tidal forest) were diked and farmed very early in the history of the Tillamook lowlands. Therefore, the remnant tidal channels that could normally be used to identify areas of former tidal marsh or tidal forest are no longer visible.

Coulton *et al* (1996a) prepared a map of historic vegetation of the Tillamook Valley area; this map provides excellent information on the plant communities that are today largely gone from the valley. The outer limit of tidally-influenced habitats shown on the historic vegetation map are relatively close to Tillamook Bay. On the Tillamook River, the historic vegetation mapping shows the limit of tidally-influenced forest at about River Mile 2.5, but the NWI shows tidal marsh extending past River Mile 3. The Estuary Plan Book shows diked tidal marsh extending all the way to the SE limits of its mapping, about a mile farther east than the limit of tidally-influenced habitats on the historic vegetation map. For comparison, in the Yaquina and Alsea basins, the Estuary Plan Book mapping stops well short of the full extent of freshwater tidal habitats (Brophy, 1999a).

The SCS soil survey of the Tillamook area provides further evidence that tidal habitats once extended farther than shown on the EPB mapping or the Tillamook historic vegetation mapping. Coquille soils are found beyond River Mile 5 on the Tillamook (SCS, 1964), 2.5 miles past the limit of tidal forest shown on the historic vegetation mapping. Coquille soils were formed in tide-influenced flood plains (SCS, 1964; NRCS, no date given). Coquille soils also underlie the entire forested wetland along Hoquarton Slough; Hoquarton Slough itself is strongly tidal as it flows through this forested area (Brophy, 1999b).

Locations of tidegates in the valley (Charland, 1997) also suggest that tidal influence extends (or once extended) upriver past EPB tidal habitat mapping. Holden Creek is tidegated (David Nusum, ODFW Tillamook, personal communication, 1999), although it flows into the Trask about a mile upstream of the outer limit of tidal forest shown on the historic vegetation map. Tidegates (Charland, 1998) and sinuous channels that appear to be remnant tidal channels are found as far south as River Mile 5 on the Tillamook River, for instance at Anderson Creek. Of course, locations of tidegates do not necessarily indicate locations of tidally-influenced habitats. For example, tidal wetlands would not be found as far upriver as the head of tide, since tidal energy that far upstream would be inadequate to create the tidal channels that penetrate riparian habitats to create tidal wetlands.

Because of the uncertainty over the original extent of tidal wetland habitats, this study made the simplifying assumption that the tidal zone (which contains tidal or potentially tidal habitats) extends upstream only to the furthest-upstream tidal wetland habitats shown on either the NWI or the EPB mapping, or to the maximum extent of Coquille soils (whichever is further upstream). Despite this assumption, we recognize that many areas within the tidal zone were never tidal marsh or tidal forest. Uplands with no tidal influence did and still do exist within the zone. The lack of tidal influence in these areas is recognized in the prioritization scheme through the "adjacent wetland" criterion (T2 in the flowcharts). Because of this criterion, uplands within the tidal zone are prioritized using the nontidal flowchart, starting at criterion T3B.

Historic versus current wetland presence

In the tidal zone, the EPB shows many areas of drained tidal marsh (2.5D, 2.5.12D, 2.5.13D). Many of these are shown as upland on the NWI maps, though the NWI does show some drained tidal marsh as PEMCh or PEMCd (diked/impounded or partially drained-diked). Outside the tidal zone, wetlands that were drained decades ago are not shown on the NWI map (drained areas are no longer wetland, so the NWI does not map them). The historic vegetation map prepared by Coulton et al (1996a) is coarse scale, but still indicates that there were originally very large areas of wetland in the valley. Most of these former wetlands were drained for agriculture in the past, and today only 3 to 10% of the original wetland area remains (see **Methods: Adjacent wetlands** above). Therefore, determination of areas that could possibly be restored to riparian wetland habitat is difficult. Water table monitoring and fine-resolution topographic surveys could help determine appropriate areas for such restoration (see **Data needs** below).

Water table monitoring and topographic survey

Water table measurements (taken at multiple locations and over a period of years) and information on frequency of flooding would help determine which areas could be restored to side channel, alcove, or backwater wetland environments. Topographic survey data would also be important be a very important tool, particularly determination of location of dikes and levees, and determination of degree of downcutting of drainage channels. (Note: the dikes layer in the TBNEP does not show all dikes.)

Salinity measurements

Comprehensive data on salinity in the water bodies of the Tillamook lowlands would be a useful addition to any comprehensive water quality monitoring program. Monitoring salinity at potential restoration sites through different seasons and at different points in the tidal cycle would help predict the outcome of restoration.

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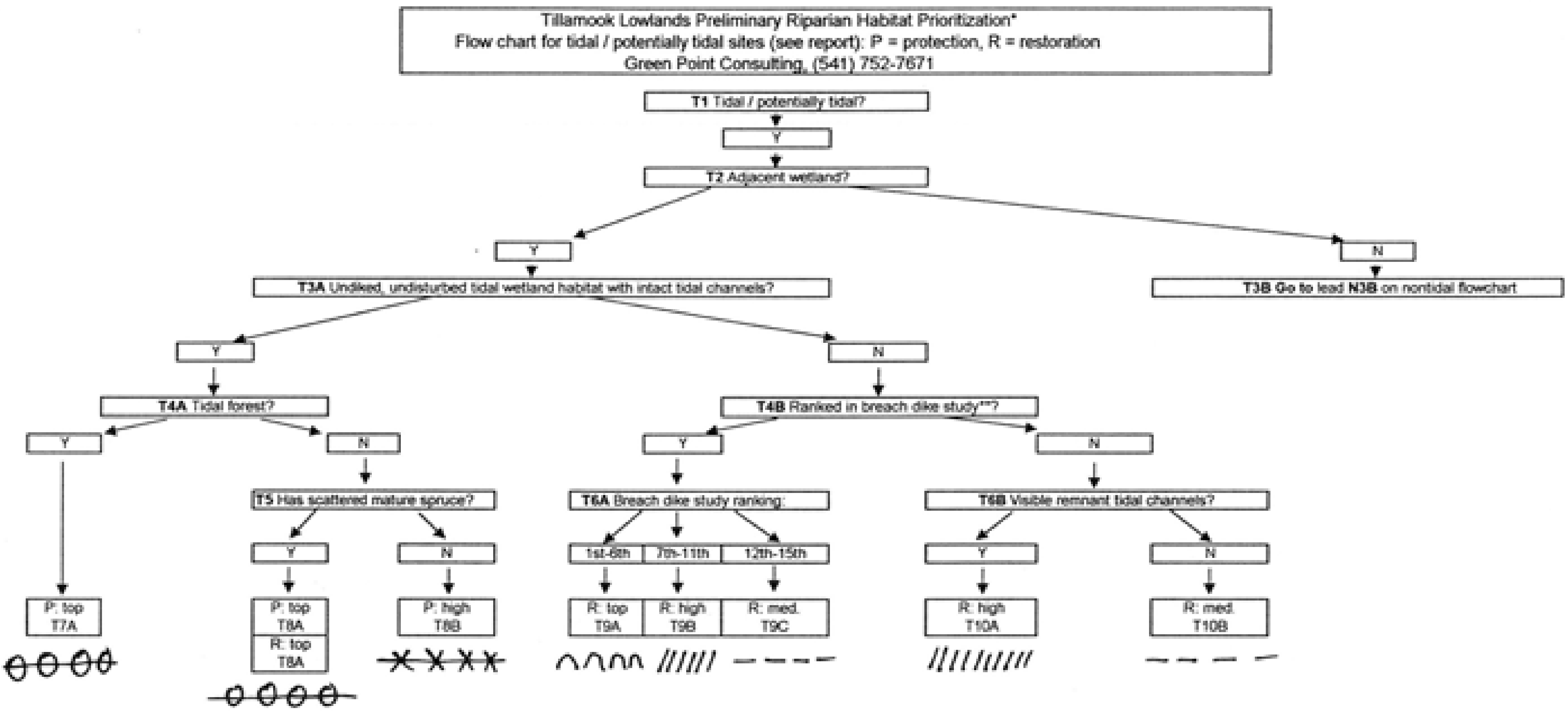
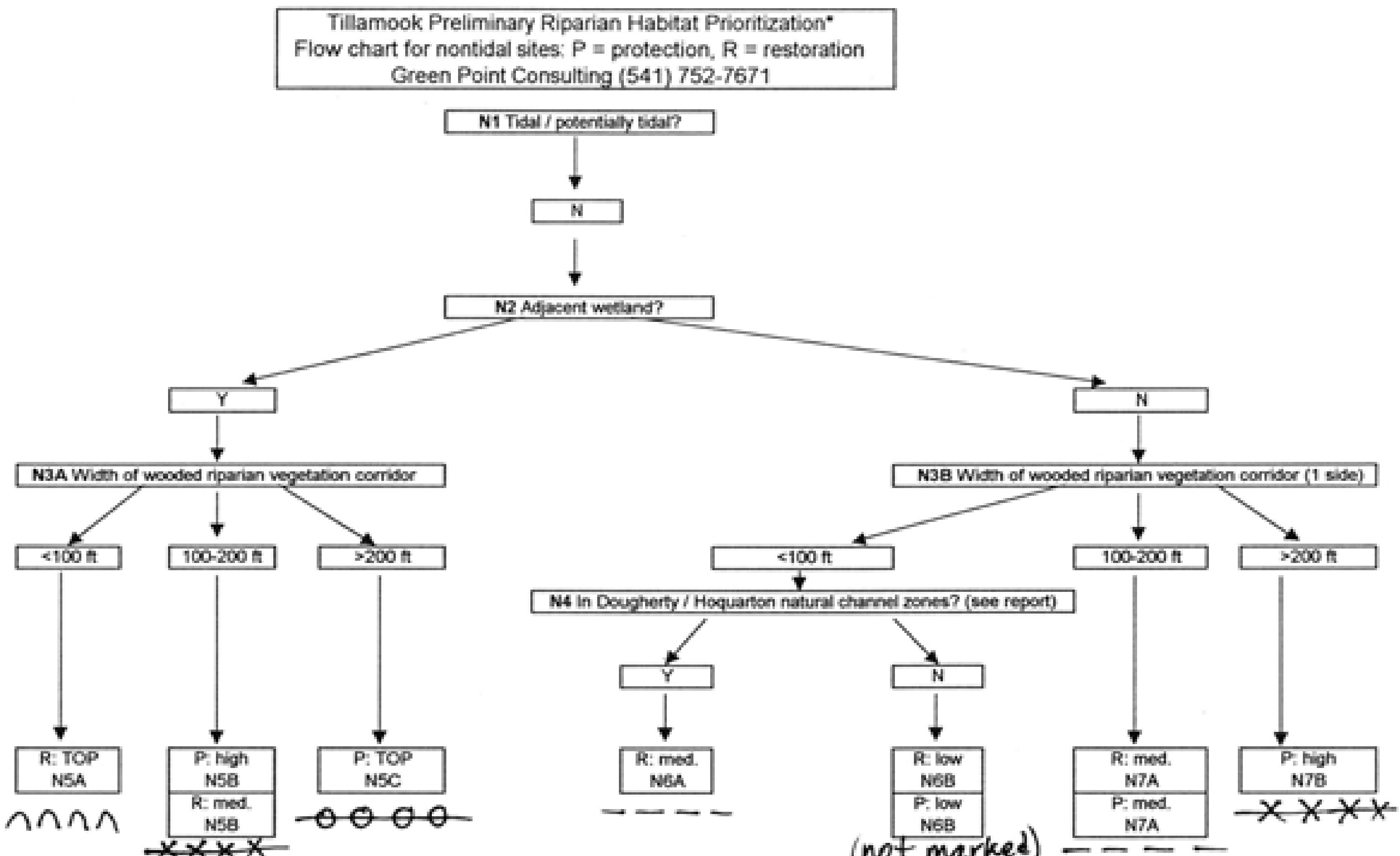
Appendix 1. Flowcharts for site prioritization



* Flow chart illustrates decision process for **preliminary** riparian habitat prioritization. This prioritization must be used in conjunction with other studies in the Tillamook lowlands. Riparian characteristics and conditions must be verified through landowner contact and on-site field work. All restoration and protection projects require landowner interest and involvement.

**"Breach dike study" refers to Simenstad, S., B.E. Feist, K. Bierly, J. Morlan, and P.B. Williams. 1999 (draft). Assessment of potential dike-breach restoration of estuarine wetlands in Tillamook Bay, Oregon. Technical Report to Tillamook Bay National Estuary Project.



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Appendix 2. Mapping

Please note: The map provided here is intended only to provide an illustration of the type of mapping produced during this project. It is not intended for use outside the context of development of the IRMS. Original mapping was in color and consisted of mylar overlays over digital ortho-quarter-quad printouts. Anyone interested in using this map should contact Philip Williams Associates for access to the original mapping. *Suggested viewing technique for map: use magnifier (zoom) tool in Adobe Acrobat Reader to zoom in.*